SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING SUMMARY

May 5, 1999

DREDGED MATERIAL MANAGEMENT PROGRAM

EPA

US Army Corps of Engineers
Seattle District

WASHINGTON STATE DEPARTMENT OF ECOLOGY

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Jennifer M. Belcher - Commissioner of Public Lands

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[1] A title description listing all overheads presented at the SMARM are provided in the text, but are not included in this summary document. A copy of all overheads presented are on file at the Dredged Material Management Office.

LIST OF ACRONYMS

AET	Apparent Effects Thresholds
BT	Bioaccumulation trigger
CAD	Confined aquatic disposal
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSMP	Cooperative Sediment Management Program
CSL	Cleanup Screening Level
DAIS	Dredged Analysis Information System
DDT	Dichlorodiphenyltrichloroethane
DMMP	Dredged Material Management Progam
DMMU	Dredged Material Management Units
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
GC/MS	Gas chromatograph/mass spectrometery
GC/ECD	Gas chromatograph/electron capture device
HDPE	High density polyethylene
IUPAC	International Union of Pure and Applied Chemistry
MTCA	Model Toxics Control Act
MUDS	Multi-User Confined Disposal Site
MUST	Multi-User Sediment Treatment
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NS&T	National Status & Trends
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PSAMP	Puget Sound Ambient Monitoring Program
PSDDA	Puget Sound Dredged Disposal Analysis
RI/FS	Remedial Investigation/Feasibility Study
SEPA	State Environmental Policy Act
SEDQUAL	Ecology's Sediment Quality Database
SMARM	Sediment Management Annual Review Meeting
SMS	Sediment Management Standards
SVPS	Sediment Vertical Profile System
TBT	Tributyltin
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total organic carbon
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WES	Waterways Experimental Station
WPPA	Washington Public Ports Association
Y2K	Year 2000

SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING
MINUTES

The Cooperative Sediment Management Program (CSMP) held its annual review of dredging/disposal and sediment management issues on May 5, 1999. This Sediment Management Annual Review Meeting (SMARM) was hosted by the Washington Department of Ecology (Ecology) at the Main Auditorium of Ecology's Headquarters in Lacey, Washington. The SMARM encompassed both the Dredged Material Management Program (DMMP) annual review meeting and Ecology's Sediment Management Standards (SMS) annual review process. The DMMP is an interagency cooperative program for dredged material management that began with the Puget Sound Dredged Disposal Analysis Program (PSDDA) and has expanded to other regions of Washington State. The DMMP agencies include the U.S. Army Corps of Engineers (USACE), Seattle District; U.S. Environmental Protection Agency (EPA), Region 10; the Washington Department of Natural Resources (DNR); and Ecology. The meeting agenda is provided as Attachment 1, and Attachment 2 is the list of attendees.

MORNING SESSION

Introduction and Overview

1. Brian Applebury, Chief, Operations Division, USACE, Seattle District gave opening remarks and introduced Tom Fitzimmons, Director, Department of Ecology. The panel of agency representatives included David Kendall, USACE; John Malek, EPA; Mike Palko, DNR; and Jim Pendowski, Ecology.

2. Tom Fitzimmons welcomed everyone to the 11th annual review meeting. He stated that in preparation for this meeting, he compared the status of sediment management at the beginning of the decade to its current status. Washington State has made tremendous progress in sediment management over the past decade, and there have been a number of ground-breaking activities in sediment science and management. As he understood it, prior to the past 11 years, there were neither sediment standards nor any integrated programs that were designed to address contaminated sediments.

Mr. Fitzimmons stated that virtually every urban bay or harbor in the United States has an area that could qualify as a Superfund site, and there is no shortage of environmentally stressed industrial and commercial lands in our communities. Many sites that have contaminated sediments include both historic and ongoing contamination. Some areas have been marginalized or written off by the communities surrounding them. The focus of sediment management work should be to integrate or reconnect these sites back to the economic, cultural, and community vision and energy that exists surrounding them (e.g., cleaning up the sites). There are at least 50 sites in Washington State, primarily within the Puget Sound region, that encompass several thousand acres of contaminated marine sediments. About half the population within Washington

State lives within 50 miles of Puget Sound and its shorelines. Therefore, coastal ecosystems are increasingly at risk. These areas have high recreational and economic value. Because of the importance of these estuaries and shorelines, the general public has become more involved and opinionated in sediment management and cleanup. In this state, there exists a nice environment in which to live combined with pollution, traffic, and noise problems.

Mr. Fitzimmons urged everyone to broaden their view of the environment to include the entire surrounding community, rather than in compartments or segments. For example, environmental concerns, landuse development, and traffic congestion have been dealt with by specific agencies. He felt rather than deal with issues in this kind of segmented way, there should be a more integrated and holistic approach. Shoreline management and cleanup activities should not be approached from a purely scientific way or purely from an agency perspective, but from a combination of concerns. He asked everyone to also look at sediment management from a perspective of what it means to the vitality of the community (e.g., economically). He thought the Bellingham Bay Pilot Study was a good example of how sediment management could be integrated with the vitality of the community.

Mr. Fitzimmons mentioned that the legislature in Washington State is becoming more aware of the significance of this issue. Until recently the legislature has seen sediment management as a localized, site-specific, cleanup activity similar to a spill or toxic waste site. As a result of the past legislation, legislators recognize the importance of integrating the science of sediment management, cleanup, and long-term planning with the integrity of the shoreline and economic vitality of the communities surrounding the contaminated sites. House bill 1448 captured the sense of importance of this issue and the need to get results within these communities not in many years to come, but within a reasonable amount of time. The most severely contaminated sites (hot spots) must be of primary focus, and cleaned up expeditiously. Risks to human health must be significantly reduced. He felt that the hope of the community is to have the energy and engine to get work done in a timely manner, and on the heels of cleanup.

For the next decade, Mr. Fitzimmons thought the programs should build on achievements that have been made, and that attention should be paid to increasing public access to shoreline areas and better connecting citizens with the aquatic environment. He felt the effort and costs to clean up a site should be made public knowledge. His hope was that once people know what happened to these sites, and what it took to clean them up, they would not let the sites become contaminated again and would not let other areas become contaminated. Good work has been accomplished, although funding and commitment will only come from the community and other sources if more tangible results are accomplished in these aquatic environments in the next 10 years. He urged the agencies and attendees to keep pollution prevention in the forefront. In order to make sure sediment management moves in this direction, the sediment management programs should be better integrated both economically and socially to try to meet the specific community's needs; the work needs to be accomplished within the next 10 years, and the work should focus on preventing further problems from occurring. He closed by saying that great accomplishments have been made in the past 10 years with respect to the science involved and developing sediment management criteria, and asked that this be built upon.

3. Brian Applebury agreed that the challenges of the future are great. He then discussed the meeting objectives and the purpose of the SMARM. The meeting was designed to obtain public input on proposed changes to the DMMP management plans presented in issue and clarification papers, to discuss disposal site management actions and changes, present public issues papers, and to receive comments and discuss the status of ongoing actions of DMMP and SMS groups. He summarized the meeting agenda which included DMMP and SMS group overviews, DMMP and CSMP issue papers and status reports, public issue papers, a tributyltin (TBT) issues subsession, and an opportunity to comment on clarification papers and status reports not presented at the SMARM. He indicated that all written comments on the SMARM proceedings must be submitted to the DMMP agencies by May 26, 1999 for consideration, and that written comments should be submitted for the SMS annual review for consideration by June 2, 1999.

Ovrhd 1-1.	1999 Sediment Management Annual Review Meeting
Ovrhd 1-2.	SMARM Jointly Sponsored by the Dredged Material Management Program and the SMS Group
Ovrhd 1-3.	Meeting Objectives and Purpose
Ovrhd 1-4.	Dredged Material Management Program Overview
Ovrhd 1-5.	SMS Group Overview
Ovrhd 1-6.	DMMP/CSMP Issue Paper and Status Report
Ovrhd 1-7.	Public Issue Paper(s)
Ovrhd 1-8.	TBT Issues Subsession
Ovrhd 1-9.	Papers (not presented)
Ovrhd 1-10.	Summary and Closing
Ovrhd 1-11.	SMS Issues Summary

DMMP Dredging/Disposal Overview

4. David Kendall, USACE, summarized the DMMP accomplishments since the 1998 SMARM. Accomplishments included a) awarding Battelle, NW a contract to evaluate the sensitivity of the amphipod *Leptocheirus* to TBT relative to various endpoints, b) updating the Dredged Analysis Information System (DAIS) to make it Y2K compliant and Windows compatible, c) finalizing the Columbia River Dredged Material Manual, d) releasing the public review draft Environmental Impact Statement (EIS) for the Puget Sound Confined Disposal Site Study, and e) issuing interim TBT guidance. The Bellingham Bay Pilot Study would be issuing its draft State Environmental Policy Act (SEPA) EIS in June 1999. He then gave an overview of the DMMP project testing activities. This included a discussion of the dredging year 1999 projects in Puget Sound, Grays Harbor, Willapa Bay, and the Columbia River; the number of Dredged Material Management Units (DMMUs) tested and the volume of material dredged; the amount of suitable and unsuitable material; the bioassay hits; and testing summaries for specific analytes including polychlorinated biphenyls (PCBs), total dichlorodiphenyltrichloroethane (DDT), mercury, and the TBT ion in porewater. He noted that for the bioassay tests, in DY 98/99 there were no single-hit results for the amphipod test, and only 4% of the amphipod test samples had two-hits. There were considerably more sediment larval test hits (47% of the DMMUs had two-hit failures). Prior to this (e.g., DY 96/97) the hits were more evenly distributed among the different bioassays. He noted that PCBs had the most bioaccumulation

trigger exceedances, 21% of the DMMUs had mercury screening level exceedances, the TBT ion in porewater exceeded the bioaccumuation trigger in a number of East Waterway sediments, and there were some DDT exceedances in which the detection limit exceeded the screening level.

Ovrhd 2-1.	DMMP Program Accomplishments
Ovrhd 2-2.	DMMP Program Accomplishments (cont'd)
Ovrhd 2-3.	DMMP Program Accomplishments (cont'd)
Ovrhd 2-4.	Overview of DMMP Project Testing Activities
Ovrhd 2-5.	Dredging Year 1999 Projects
Ovrhd 2-6.	Dredging Year 1999 Projects: Suitable/Unsuitable Material
Ovrhd 2-7.	Completed Testing Outcome Summaries
Ovrhd 2-8.	DY98/99 Bioassay Hits
Ovrhd 2-9.	DY96/97 Bioassay Hits
Ovrhd 2-10.	DY98/99 Testing Summary – PCBs
Ovrhd 2-11.	DY98/99 Testing Summary – Total DDT
Ovrhd 2-12.	DY98/99 Testing Summary – Mercury
Ovrhd 2-13.	DY98/99 Testing Summary – TBT ion in porewater
Ovrhd 2-14.	Dredging Year 1999 Projects – Puget Sound
Ovrhd 2-15.	Dredging Year 1999 Projects – Grays Harbor/Willapa Bay
Ovrhd 2-16.	Dredging Year 1999 Projects – Columbia River

5. Ted Benson, DNR, gave an overview of the PSDDA disposal site monitoring and management activities. He indicated that the new monitoring contractor would be determined within a few weeks of the SMARM. The contract work would include one or more tiered-full monitoring events (Port Gardner, Commencement Bay, and possibly Anderson/Ketron), a crab productivity study in Bellingham Bay, and a compilation of changes to the monitoring program. He briefly discussed the contract with Battelle Marine Science Laboratory to evaluate the sensitivity of *Leptocheirus* to TBT relative to acute, chronic, and reproductive endpoints.

Mr. Benson then reviewed the result of the 1998 physical monitoring that was conducted at the Commencement Bay PSDDA disposal site. The physical monitoring involved sediment vertical profile system (SVPS) monitoring at locations at and surrounding the disposal site. The survey found that dredged material was present outside of the site perimeter to the northwest of the site. This material (fine sands) was similar to that found at the dredging site. To the southwest and southeast of the disposal site, there were relic sands that were present prior to the site's designation. The agencies were looking into explanations as to why material was detected offsite: was the material moving offsite, or was material disposed offsite? Some of the information the agencies would be exploring included Coast Guard authorized disposal data, and data on currents present at the site.

He closed his discussion with information concerning DNR use authorization processing. He indicated that it takes a minimum of 5 working days for processing, which begins after receipt of a complete application. Amendments usually require 3 working days after receipt of a complete application.

Ovrhd 3-1.	Site Management
Ovrhd 3-2.	The New Monitoring Contract
Ovrhd 3-3.	PSDDA Disposal Site Monitoring Contract Proposal Evaluation Scoring Matrix
Ovrhd 3-4.	Contract Deliverables
Ovrhd 3-5.	TBT/*Leptocheirus* Toxicity Protocol
Ovrhd 3-6.	Physical Monitoring in Commencement Bay
Ovrhd 3-7.	Commencement Bay SVPS Deployments
Ovrhd 3-8.	Grain Size Distribution
Ovrhd 3-9.	Depth of Disposed Material
Ovrhd 3-10.	Assessment of Problem
Ovrhd 3-11.	Scheduled Biological Monitoring
Ovrhd 3-12.	DNR Use Authorization Processing

Discussion and Public Comment

With respect to the physical monitoring results at Commencement Bay, which indicated that dredged material was present offsite, Paul Dinnel of Dinnel Marine Research, asked what was considered as being a significant slope. He indicated that turbidity flows could occur at 1% slopes. He suggested that the agencies take a look at that.

Ted Benson agreed and thanked him for his suggestion, and asked for any other information that may help in interpreting what was occurring at the site.

An attendee inquired about the depth at the Commencement Bay disposal site.

Gene Revelas, Striplin Enviromental Associates, indicated that it was approximately 140 meters deep.

David Kendall mentioned that previous monitoring showed the dredged material was not present offsite and none of the material had drifted to the north. He suggested that the Coast Guard records should be examined to see where barge doors were opened. It is possible that the material was disposed outside of the boundary. He stated that if this was the case, then the management of the disposal at that site should be tightened up.

Ted Benson said he generally had not plotted where all the barge doors opened as reported in the site use reports, and that he would need to examine that.

Tom Gries, Ecology, asked Ted Benson to comment on the quality of the dredged material that was present offsite at the Commencement Bay disposal site.

Ted Benson indicated that it was sand, and thus may be clean. The material could have been from the Blair Waterway turning basin expansion. However, he did not have a chance to determine this prior to the meeting.

Brett Betts asked if a bathymetry site profile of the Commencement Bay site gave an indication of why the material may be present offsite at that location (northwest of site).

Ted Benson replied that they did not do a bathymetric survey as part of the assessment, but that it was done previously. Therefore, a bathymetric assessment would be possible. He agreed that a bathymetric assessment should be done.

Brett Betts also wondered if DNR was taking volunteers for the crab harvesting.

SMS Overview

6. Brian Applebury indicated that the rest of the morning would be for the SMS group overview. He then introduced Brett Betts of Ecology.

7. Brett Betts outlined the Sediment Management Standards (SMS) program presentation. He provided an update on the SMS rule revision, summarized the approach to address the Endangered Species Act (ESA) issues, described recent improvements to the sediment quality database (SEDQUAL) Information System, and described technical development progress on benthic assessment recommendations. He reviewed the background of the SMS Rule revision and indicated that the SMS Rule Draft was completed in December 1998. The focus areas of the rule revision included sediment quality criteria, human health sediment standards, and sediment cleanup. Other focus areas included working on trying to link the definition of contaminated sediment to MTCA hazardous substances, developing freshwater criteria and corresponding bioassays tests and interpretations, defining PSDDA disposal sites as sediment impact zones in the SMS rule, standardizing sampling and analysis plans and reporting requirements, and further developing laboratory accreditation requirements. Mr. Betts indicated that the SMS rule would be reviewed to ensure compliance with the Endangered Species Act. The Implementation Committee discussion for the revised draft SMS rule was scheduled for May 1999 and a formal draft rule proposal in the State Register was scheduled for the summer of 1999. In the fall of 1999, rule changes and support documents such as an Environmental Impact Statement and a Cost-Benefit Analysis would be prepared, and the rule was expected to be adopted by December 1999.

Mr. Betts then discussed the third release of SEDQUAL and its current capabilities. He concluded his presentation with a discussion of the benthic assessment development. This included refinement of benthic recommendations presented at the 1998 SMARM and the completion of the Puget Sound Reference Value Project report. Ecology would be looking at adopting some of the findings of this work into the rule (e.g., recommended preferred endpoints).

Ovrhd 4-1.	Sediment Management Standards Program Presentation Outline
Ovrhd 4-2.	SMS Rule Revision – Background
Ovrhd 4-3.	SMS Rule Revision – Focus Areas
Ovrhd 4-4.	SMS Rule Revision – Focus Areas (cont'd)
Ovrhd 4-5.	SMS Rule Revision – Endangered Species Act

Ovrhd 4-6. SMS Rule Revision – Schedule
Ovrhd 4-7. Sediment Quality Database – Release Three
Ovrhd 4-8. SMS Rule Revision – Benthic Assessment Development

8. Brian Applebury then introduced Marian Abbett of Ecology's Toxics Cleanup Program.

9. Marian Abbett gave an overview of the regional cleanup activities. Program accomplishments included the Norfolk combined sewer outfall (CSO) cleanup, entering Lake Union data into SEDQUAL, and completion of Grays Harbor, Budd Inlet, and Port Angeles Harbor studies. She then gave an update of the status of sediment cleanup sites and indicated that the number of sites that require no further action have gradually increased over the past four or five years. Contaminants of concern at most of the sites included metals, mercury, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), TBT, and wood debris. She then discussed the future plans for the cleanup activities. This included 6 record of decision documents, the start of 2 cleanups projects, source control in Bellingham Bay, moving sites forward in Lake Union, making decisions on how to manage the Duwamish River, and beginning the Columbia River study. Future plans also include developing a new protocol for deleterious waste, continuing to develop freshwater protocols, and on-going studies on bioaccumulation and human health and tissue effects.

Ovrhd 5-1. Regional Cleanup Activities
Ovrhd 5-2. Program Accomplishments
Ovrhd 5-3. Site Status
Ovrhd 5-4. Data Nugget
Ovrhd 5-5. Future Plans
Ovrhd 5-6. Future Plans (cont'd)

10. Margaret Dutch, Ecology, reviewed the results of the Year 1 survey of sediment quality in northern Puget Sound. The purpose of her talk was to relate current Puget Sound Ambient Monitoring Program (PSAMP) sediment component monitoring activities, learn the status of other Puget Sound sediment programs to identify any overlapping areas, and to solicit input regarding future PSAMP sediment monitoring. She indicated that there is a cooperative agreement between the National Oceanic and Atmospheric Administration's (NOAA) status and trends bioeffects monitoring program and Ecology's PSAMP sediment monitoring component to characterize the toxicity, chemical contamination, and benthic infaunal assemblage structure of the sediments in order to measure adverse biological effects of toxic chemicals in northern Puget Sound. The project design involves a stratified random sampling design, takes a sediment quality triad approach, and includes the collection and analysis of sediment and infauna from 300 stations throughout Puget Sound. The northern Puget Sound study area encompassed an area of 806 km^2 from the US/Canadian border to Everett Harbor. The study involved looking at sediments of similar type and texture. Samples were collected from 100 stations in June of 1997 from the top 2-3 cm of sediment for toxicity and chemical analysis, and one grab was collected per station for benthic infauna. Toxicity testing included the 10-day acute amphipod test, urchin fertilization, microbial bioluminescence (Microtox – organic solvent extract), and the cytochrome P450 RGS (organic solvent extract) test. Sediments were significantly toxic if

results were significantly different from the negative control results, and highly toxic if they were significantly different from the negative control and from specific critical values. The chemical analysis generally included the standard suite of PSDDA chemicals of concern. Chemical data results were compared to national critical values, sediment quality standards, and Puget Sound marine sediment cleanup screening levels (CSL). Benthic infauna indices calculated included total abundance, major taxa abundance, taxa richness, Pielou's evenness, and Swartz's dominance index.

The data analysis involved the determination of the incidence and severity of the sediment toxicity. It was used to identify spatial patterns and gradients in toxicity and chemical concentrations and to estimate the spatial extent of chemical contamination and toxicity in surficial sediments. Other objectives included estimating the relationships between sediment toxicity, chemical concentrations, and benthic infaunal indices, and comparing the quality of sediment throughout Puget Sound to sediments from other estuaries nationwide. The results of the toxicity testing indicated that Everett Harbor stations were the most contaminated sediments in Northern Puget Sound, and the lowest toxicity was observed at stations in Saratoga Passage, Possession Sound and most stations in Port Gardner. The spatial extent of the toxicity estimates for northern Puget Sound was generally lower than the national average. With respect to the chemical analysis, most stations were not highly toxic and chemical concentrations were most elevated in or near urbanized/industrialized embayments. Infaunal indices displayed a wide range of results between and sometimes within strata. There was a strong evidence of "pollution-induced degradation" in the Everett Harbor stations.

Future PSAMP sediment work was expected to include a continued long-term, annual sampling at 10 historical stations, and those involved in the program would be working on identifying the strata of interest to assess long-term changes. Ecology/NOAA would need to cut back somewhat on the monitoring program as this was the last year of the partnership with NOAA. She indicated that she was open to feedback on their efforts and to suggestions on other possible collaborations.

Ovrhd 6-1.	Survey of Sediment Quality in Puget Sound: Year 1 – Northern Puget Sound
Ovrhd 6-2.	Purpose of Today's Talk
Ovrhd 6-3.	NOAA's National Status and Trends' Bioeffects Monitoring Program/PSAMP Sediment Monitoring Component
Ovrhd 6-4.	Ecology/NOAA Project Design
Ovrhd 6-5.	Ecology/NOAA Study Design
Ovrhd 6-6.	Ecology/NOAA Sampling Procedures
Ovrhd 6-7.	Toxicity Testing (weight of evidence)
Ovrhd 6-8.	Toxicity Designation
Ovrhd 6-9.	Chemical Analyses
Ovrhd 6-10.	Chemical Analyses, Critical Values
Ovrhd 6-11.	Benthic Infaunal Analyses
Ovrhd 6-12.	Data Analysis to Address Objectives
Ovrhd 6-13.	Data Analysis to Address Objectives (cont'd)

Ovrhd 6-14. Data Analysis to Address Objectives (cont'd)
Ovrhd 6-15. Data Analysis to Address Objectives (cont'd)
Ovrhd 6-16. Data Analysis to Address Objectives (cont'd)
Ovrhd 6-17. Results – Toxicity Testing
Ovrhd 6-18. Spatial Extent of Sediment Toxicity
Ovrhd 6-19. Results – Chemical Analysis
Ovrhd 6-20. Results – Infaunal Analysis
Ovrhd 6-21. Forming a Weight of Evidence (Chapman, 1996)
Ovrhd 6-22. Summary
Ovrhd 6-23. Future PSAMP Sediment Work

11. Mary Lou Mills, Washington Department of Fish and Wildlife (WDFW), discussed commercial species harvest and scientific collector's permits. She indicated that typical provisions in the scientific permits for collecting biological organisms do not allow for the collection of amphipods and subsequent sale of the organisms to someone else. For example, collecting *Rhepoxynius abronius* by one party and selling them to a bioassay laboratory for the purpose of conducting toxicity tests. This could qualify as trafficking of wildlife, and is considered illegal under the scientific permit. Organisms collected under the scientific permit are to be used for research or display. She indicated that it would be a stretch to classify these organisms as fish food/shellfish so that the collection of the amphipods would fit under the commercial species harvest permit. There would also be landing taxes associated with the collection of the amphipods if it was classified under the commercial harvest permit.

Ms. Mills' suggested solution to the problem would be to create a section under the Washington Administrative Code (WAC) to include a bioassay permit that would allow people to collect, hold, utilize, and transfer certain wildlife species for the purpose of conducting toxicity tests. The addition of this permit would mean the agency (WDFW) would take on the burden of managing an additional permit, but the value of the data and environmental protection would be worth the cost of managing the permits. She was willing to propose this revision and wanted to know whether the public and regulators supported this idea, were interested in commenting on the proposed regulation as WDFW moves it through the process, or had other suggestions. Existing permits do not cover this issue. She added that only organisms protected in the wild and not organisms raised in captivity would be subject to this permit. She envisioned the requirement of keeping a log of the number of organisms collected, the location and date of collection, and where and how the organisms were used. She considered the log to be important because *Rhepoxynius* are a potential salmon food source, and since certain salmon species are listed as endangered, she indicated that it would be a good idea to keep track of this kind of information.

<u>Discussion and Public Comment</u>

Ron Wills, Hartman Consulting, asked Marian Abbett to expound further upon the deleterious waste protocol.

Marian Abbett deferred his question to Pete Adolphson.

Pete Adolphson, Ecology, responded that Ecology really did not have protocols to deal with wood waste issues and the effects that wood waste has on the overlying waters in terms of pH and dissolved oxygen. The way the protocols are currently written is that aeration is used for 24 hours prior to the placement of animals in the test vessels. However, the aeration modifies the environment, and the procedure may not actually be testing the effect wood waste has on the environment as it stands. If the current bioassays are not representative of the environment tested, then the agencies may have to consider using benthic infaunal indices, which can be quite expensive. However, right now the benthic infaunal index is the only tool in place that is indicative of what the animals are being exposed to in the environment. The agencies were looking at how to match the dissolved oxygen levels of the environments that are being tested with the dissolved oxygen levels at which the organisms are tested.

AFTERNOON SESSION

Presentation of DMMP/CSMP Issue Paper and Status Reports

12. Before the presentation of issue papers and status reports began, Nancy Musgrove of Roy F. Weston, Inc., commented on the Puget Sound reference value project, which involved the development of benthic effects sediment quality standards. Copies of the report prepared by Striplin Environmental Associates and Roy F. Weston, Inc. were available at the SMARM. The project involved the selection of benthic endpoints for evaluation, refinement of the reference database, and the testing of benthic infauna endpoints. The study found that some of the most effective endpoints to identify impacts included Swartz's dominance index and polychaete abundance enhancement, along with a few other indices. They found that it may be possible to use programmatic reference ranges as opposed to identifying project specific reference locations. They were also looking at the possibility of changing the classic benthic collection design which would involve reducing the number of replicates. The reduction in the number of replicates analyzed and the use of programmatic reference ranges instead of collecting additional samples from a reference location could make the use of benthic community structure analysis a more cost effective and viable tool. She requested feedback on their paper (Puget Sound Reference Value Project, Task 3: Development of Benthic Effects Sediment Quality Standards).

13. Erika Hoffman, EPA, discussed the transition to congener-specific PCB measurements in sediment and tissue samples. She identified some of the problems that have arisen associated with PCB analysis. One was that the Aroclor method has resulted in a variable quantification of total PCBs, and the toxic and nontoxic components could not be distinguished. The congener method was more accurate, there was better resolution of toxicologically relevant components or congeners, and there was less variable quantification of total PCBs. The congener approach was also consistent with regional monitoring and national program requirements.

The proposed modification to PCB analysis included a tiered approach. This would involve screening sediments for a core list of 25 congeners, estimating total PCBs from the sum of 18

congeners, comparing total PCBs to the existing bioaccumulation trigger (BT), conducting bioaccumulation testing should the BT be exceeded, analyzing tissues for the specific congeners, and evaluating the sediment and tissue data. Congeners proposed for the core list exhibited one or more of the following characteristics: toxicologically significant, frequently detected, prevalent component of total PCBs, appear on lists from other programs. Ms. Hoffman indicated that NOAA's National Status and Trends method of estimating total PCBs from the sum of 18 congeners was based on a 3 lab comparison of total homologues and the sum of 18 congeners from a national survey. They found that the sum of the total homologues was comparable to the sum of the 18 congeners times 2.

With respect to toxicity testing, the agencies did not yet have the basis to develop a new congener-specific bioaccumulation trigger (need much more data), and the current trigger of 38 ppm total organic carbon (TOC) normalized will be used in the interim. She did not expect to see an increase in bioaccumulation exceedances when switching to the congener-specific analyses. Target tissue level development for suitability determinations would continue to be case-specific. As part of the proposed modification, the agencies would no longer consider a DMMP screening level (130 ppb dry weight) exceedance as a trigger for the standard suite of bioassay tests. These tests tend to have shorter-term exposures and endpoints that were not expected to be PCB sensitive. Bioaccumulation tests would then be the only tests that would be triggered by PCB concentrations in a sample. However, screening level exceedances for other co-occurring chemicals would still trigger bioassay testing.

The analysis costs associated with the proposed modification would be an approximate 3- to 4-fold increase over current costs for the Aroclor method ($300-400 per sample using gas chromatograph/electron capture device [GC/ECD] methods). There would also be a cost increase associated with the tissue analysis. The USACE did a query of bioaccumulation trigger exceedances in the Dredged Analysis Information System (DAIS) database and found that only 11% of all samples in the database exceeded the bioaccumulation trigger. For any given project, the number of exceedances may be greater than 11%, but this gave a general expected number of exceedances. Ms. Hoffman added that comments and/or alternative approaches would be considered and that the public comment period had been extended until June 30, 1999. She hoped that the final approach would be determined by the fall of 1999. Some of the issues that still needed to be addressed included determining a basis for developing congener-specific target tissue levels, and determining a toxicological basis for the approach (using the toxic equivalency value approach as is done with dioxins, or looking at other modes of toxic action). The agencies also needed to determine if there were additional performance-based criteria for the analytical methods other than those outlined in the issue paper, and to determine when it may be necessary to do the more expensive testing for the non-ortho dioxin-like coplanars (77, 126, and 169).

Ovrhd 7-1.	PCB Analysis
Ovrhd 7-2.	Problem Identification: Aroclor Method – Comparing to Commercial Standard
Ovrhd 7-3.	Problem Identification: Congener Method – Congeners as Reference Material

Ovrhd 7-4.	Problem Identification: Congener Approach Consistent with Regional and National Programs
Ovrhd 7-5.	Proposed Modification: Overview of Tiered Approach
Ovrhd 7-6.	Proposed Modification: Core List of Congers (International Union of Pure and Applied Chemistry [IUPAC] Number)
Ovrhd 7-7.	Proposed Modification: Criteria for "Core List"
Ovrhd 7-8.	Proposed Modification: Sediment Screening
Ovrhd 7-9.	Proposed Modification: National Status & Trends (NS&T) Method to Estimate Total PCBs from Σ18 Congeners
Ovrhd 7-10.	Proposed Modification: Bioaccumulation Testing
Ovrhd 7-10.	Proposed Modification: Tier 3 Toxicity Testing
Ovrhd 7-10.	Proposed Modification: Costs Associated with Proposed Approach
Ovrhd 7-11.	Next Steps
Ovrhd 7-12.	Issues

Discussion and Public Comment

An attendee asked what the order of magnitude of the cost of analysis would be if the non-ortho dioxin-like coplanar congeners were analyzed.

Erika Hoffman replied that gas chromatograph/high resolution mass spectrometry (GC/HR/MS) analysis, which is used to measure the non-ortho coplanars with high accuracy and low interference, typically costs $1000-1500 per sample.

Another individual asked if there were differences in tissue requirements (quantity for analysis) when conducting congener-specific analyses on tissues from the bioaccumulation testing.

Erika Hoffman indicated that she had not asked the laboratories that question and none had indicated to her that there were differences. Therefore, she could not answer that question at this time.

Doug Hotchkiss, Port of Seattle, mentioned that when Dave Kendall spoke of conducting congener-specific PCB analysis in a previous SMARM it was concluded that before the agencies moved ahead with congener-specific analyses, a reality check would be conducted with Puget Sound data. At that time it was envisioned that the DMMP would gather more data on congener-specific PCB and Aroclor results. He did not see any ground truth reality in Ms. Hoffman's paper, and he wondered if the agencies were doing that, such as looking at PSAMP data or other national data. He would have expected to see some of the comparisons in her paper.

Erika Hoffman agreed that there was some regional data available. She had recently learned that PSAMP was running simultaneously congener-specific and Aroclor analyses in both tissues and sediments. The agencies would be looking at these results prior to finalizing the approach. One of the reasons for going for the list of congeners she presented was because it was consistent with how it is being done in programs nationally, and she felt that this would be a good approach for the interim. As the agencies gather more data for Puget Sound and analyze data that is

currently available, they will ground truth the data, and could change the list of congeners to be more representative of what is of specific concern in Puget Sound.

Doug Hotchkiss replied that it would have been good if she had mentioned in her paper that they would be ground-truthing the data.

Erika Hoffman agreed that he was making a good point.

Doug Hotchkiss was concerned that since this issue was still under research, people may be hit with the cost of these analyses when it may not be a problem or a necessity.

Erika Hoffman indicated that congener-specific PCB analysis was not really research, and that it was the direction most of the world and United States had taken.

Mr. Hotchkiss said that his point was that the DMMP agencies promised they would have the data and this issue analyzed so that when they presented the proposal to switch to congener-specific analyses, they could explain the manner in which the public would be impacted. He said he has not seen this ground truth loop. His understanding of what she said was that the total PCBs determined from the sum of the 18 congeners would not be wildly different from that determined using the sum of the Aroclors.

Ms. Hoffman clarified that she did not expect them to be wildly different.

Doug Hotchkiss said that there could be a huge bulk of samples for which extra money would have been spent on congener-specific analyses, yet the results would not be involved in the disposal decision (i.e., PCBs were below the BT or undetected for these samples). He suggested that perhaps a tiered approach could be taken for conducting PCB analyses.

Erika Hoffman believed the agencies did not envision analyses for Aroclors to continue into the future, and that the congener-specific analysis would replace the Aroclor method. However, the specific analysis methods and quality control analyses that would be used have not yet been fully established. Guidance that has come out of the USACE/EPA manual has been that all regions should be using congener-specific PCB analyses in their dredged material management programs. She agreed that there were other local pieces of information that need to be looked at.

Doug Hotchkiss wondered if the Aroclor method could be used as a cheap screening tool.

Erika Hoffman did not think that the Aroclor method was an appropriate screen, but indicated that the agencies would consider a tiered approach to PCB testing that could involve Aroclor analysis..

14. Tom Gries, Ecology, discussed the revisions to the Puget Sound Apparent Effects Thresholds (AETs). He reviewed the background of the AET updates. He indicated that current SMS criteria were based on biological effects data that were 10 years old. The draft amendments to the SMS rule included marine criteria derived from updated AETs. The revisions to the AETs

has been a collaborative process including work completed by Ecology, the Port of Seattle, and EVS. The process included a collaborative inventory, data entry, use of standard quality assurance guidelines, reference sample matching, and definitions of and statistical protocols for determining significant effects. He then reviewed policy issues concerning the AET updates and recommendations and possible decisions concerning these issues. Two of the issues concerned whether new bivalve AETs should replace 1986 oyster AETs, and if new *Neanthes* AETs should replace 1986 Microtox AETs. The recommendation was that they should, if the predictive accuracy and reliability were comparable. Ecology was still weighing the evidence before deciding on whether new bivalve larval AETs should be combined with new echinoderm larval AETs to form a single group of sediment larval AETs. Decisions had not yet been made on whether AET values for non-polar organic compounds should be normalized to dry weight of sediment or percent total organic carbon, and whether Puget Sound AETs should be the basis for criteria and guidelines for other marine waters in Washington. Possible implications of the AET updates to the SMS and DMMP programs included changes to SMS criteria and DMMP guidelines (especially screening levels). The next steps to be taken for updating the AETs included completing revisions to Puget Sound AETs, conducting reciprocal validation of the AET values, evaluating the predictive accuracy and reliability of the values, and assessing implications to SMS and DMMP.

Ovrhd 8-1.	Apparent Effect Threshold Updates
Ovrhd 8-2.	AET Updates: Outline
Ovrhd 8-3.	AET Updates: Background
Ovrhd 8-4.	AET Updates: Collaborative Process
Ovrhd 8-5.	AET Updates: Collaborative Process (cont'd)
Ovrhd 8-6.	AET Updates: Potential Trace Metal AETs for Puget Sound (April 1999)
Ovrhd 8-7.	AET Updates: Policy Issues, Recommendations, and Possible Decisions
Ovrhd 8-8.	AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)
Ovrhd 8-9.	AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)
Ovrhd 8-10.	AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)
Ovrhd 8-11.	AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)
Ovrhd 8-12.	AET Updates: Possible Implications to SMS Program and DMMP
Ovrhd 8-13.	AET Updates: Number, Rank, and Type
Ovrhd 8-14.	AET Updates: Possible Implications
Ovrhd 8-15.	AET Updates: Next Steps

Discussion and Public Comment

Kathleen Dadey, EPA Region 9, wondered if the agencies found from a scientific standpoint that a new AET was as predictive or better than an old one, but there was an outcry from the regulated community because of increased costs or some other reason, would the outcry play into the regulatory decision.

Tom Gries responded that it probably would, although he should probably defer to management on that one. He said there were two aspects to reliability that the agencies have traditionally considered. One is considered as an environmental protectiveness indicator, which is referred to

as sensitivity. For this aspect, the agencies are looking for false negatives, which are areas that are of real concern that the criteria/guidelines do not predict. This weighs heavily with the Department of Ecology and other organizations. The other accuracy measure is referred to as efficiency, which is a measure of how often biological confirmatory testing was conducted when it really was not needed. Overall, accuracy should be a good balance between sensitivity and efficiency. The agencies have been willing to allow some problem areas to be missed (the level that could be missed would be a policy decision), and on the other hand have also been willing to allow for some over testing. He added that if there was an outcry, he was sure it would be considered.

Martha Burke, City of Seattle, asked if EPA would play into the decision on normalization of data to TOC.

Tom Gries said that EPA is part of the DMMP, the CSMP, and is involved in oversight of the sediment management standards rule, and therefore would be involved.

Ms. Burke was thinking that if Ecology does the analysis to meet EPA's needs, they would also meet the state's needs.

Brett Betts said that EPA had weighed in heavily with the process of using normalization. The agencies have been trying to decide whether or not normalization really needs to be done.

15. Tom Gries then discussed the Multi-User Disposal Site (MUDS) Feasibility Study. He first discussed the background of the MUDS study. The need for a confined disposal site for contaminated sediments was recognized in 1987 in the Puget Sound Water Quality Management Plan. There have been few environmentally safe and cost effective methods for disposal of contaminated sediments. Currently, contaminated sediment is being left in place, disposed upland, out of state, or in some cases being capped. In 1996-1997 funding was made available for a feasibility study for a MUDS site, and a draft programmatic EIS was completed in February 1999. The executive summary for the draft is on Ecology's website. The programmatic EIS established the purpose and need for a multi-user disposal site, presented alternative designs for MUDS, and described likely environmental impacts. Comments on the EIS were received by April and the final programmatic EIS was expected to be completed by June or July 1999. Some of the comments included considering recent developments in treatment technology and a treatment facility alternative, refining the estimate of the need for MUDS, and the view that no contaminated sediment should be disposed in water – the MUDS site should not be a confined aquatic disposal site.

Mr. Gries discussed some of the immediate issues concerning the MUDS study. One issue was whether the agencies should continue the MUDS project as planned or to change direction. The next step would be to complete a site-specific MUDS EIS, which would include selecting 2-3 preferred MUDS sites and developing site-specific studies and plans. Alternatives to this direction would be to pursue long-term agreements with existing landfills, establishing a partnership with private developers of large capacity confined disposal facilities, or to site and build one or more facilities to treat contaminated sediment. Other issues included the need to

agree on the relative importance of various site selection criteria (e.g., environmental risk, state liability, public acceptability, cost), and the need to identify any other possible barriers to success.

The next steps for the MUDS study included incorporating additional data and public comments into the final programmatic EIS, and convening an executive committee to select a preferred alternative, seek direction on the overall project, and identify budget and/or legislative needs. He concluded the discussion by indicating that the disposal alternatives in the MUDS programmatic EIS were all feasible, although a Multi-User Sediment Treatment (MUST) facility may also be feasible and desirable.

Ovrhd 9-1.	Multi-User Disposal Site Feasibility Study
Ovrhd 9-2.	Outline
Ovrhd 9-3.	Background
Ovrhd 9-4.	Elements and Status
Ovrhd 9-5.	Programmatic EIS
Ovrhd 9-6.	Immediate Issues
Ovrhd 9-7.	Immediate Issues (cont'd)
Ovrhd 9-8.	Immediate Issues (cont'd)
Ovrhd 9-9.	Next Steps
Ovrhd 9-10.	Next Steps (cont'd)
Ovrhd 9-11.	Conclusions

16. Mike Stoner, Port of Bellingham, and Carol Lee Roalkvam, DNR, presented an update on the Bellingham Bay demonstration pilot project. Mike Stoner indicated that this project was a collaboration with communities that are trying to move forward in sediment management and cleanup. It has been a cooperative approach to expedite source control, sediment cleanup, and associated habitat restoration. The Bellingham Bay Work Group was comprised of local groups including the Port of Bellingham, city and county agencies, and Georgia Pacific. Tribal groups were involved, including the Lummi nation and Nooksack tribe. State and federal agencies were also involved such as DNR, Department of Transportation, Department of Fish and Wildlife, EPA, and the USACE. He mentioned that as part of this study, the work group hoped to integrate some of the work and approaches with salmon development.

Carol Lee Roalkvam defined the project elements. These included sediment cleanup, source control, sediment disposal siting, habitat restoration, and aquatic land use. The project has involved compiling and analyzing existing data, developing goals and evaluation criteria, identifying priorities, developing a comprehensive strategy, and preparing a pilot EIS. The ultimate goal was for them to get to a cleanup phase by the end of 1999. The pilot study process looked at ways to remediate the bay, although they looked at a small part of the bay for remediation. Primary contaminants identified were mercury and woodwaste. Alternatives for dealing with the contamination included partial removal with in-water disposal (disposal in a confined aquatic disposal site); partial removal with upland disposal; full removal from federal navigation channels, where technically feasible; removal and upland disposal of contaminated sediments from federal navigation channels and State-owned aquatic lands in areas where

mercury levels were elevated; and complete removal and upland disposal of all contaminated sediments from public lands within Bellingham Bay. These alternatives were discussed briefly and more information on the alternatives was provided in a hand-out at the SMARM. She felt they had a wide range of alternatives. They would like to receive comments on the study by mid-June.

Discussion and Public Comment

Brian Ross, EPA Region 9, asked why the deeper water capping alternative was eliminated.

Mike Stoner replied that the work group had considered a full range of disposal sites (up to 70 possible disposal sites), and then identified those which met all of their objectives, including providing additional habitat. The deeper confined aquatic disposal site looked like it could be the low cost alternative, but it did not meet the project objective of providing additional habitat.

Martha Burke asked Tom Gries if the other alternatives he mentioned were included in the MUDS programmatic EIS.

Tom Gries responded that the only other alternative not carefully evaluated in the EIS was treatment, primarily because its expense made it a less desirable alternative at the time. Things have changed since these alternatives were decided a year ago, although he still was not sure if large-scale treatment was feasible. The MUDS Feasibility Study Team will include in the Final PEIS an expanded evaluation of decontamination/treatment as an alternative. Placing the material in an existing landfill has been looked at as a stand-alone alternative solution.

Ms. Burke asked which landfill they were considering.

Tom Gries responded that the Roosevelt landfill, located in Eastern Washington, had a huge capacity, and was being used for sediment on a case-by-case basis. In his mind, the questions would be whether or not that was a wise use of the capacity of the landfill, whether or not it was cost effective, and whether or not there were long-term guarantees in exchange for liability considerations. He wondered if there was a way to facilitate disposal of a large amount of sediment in an existing landfill that has a tremendous capacity, without having to build another facility. The other solution, which was discussed in the EIS, was to make it easier for privately developed facilities to accommodate material from other generators.

Ms. Burke asked if he had a facility in mind.

Tom Gries indicated that the model for this was Southwest Harbor in which the Port of Seattle needed to dispose of a significant quantity of contaminated sediment and at the same time wanted to use capacity in the same vicinity for other material they needed to dispose (nearshore disposal facility).

Another individual asked if Erika Hoffman had considered how to deal with detection limits/undetected analytes when summing the PCB congeners to obtain total PCBs.

Ms. Hoffman replied that her assumption has been that nondetects would not be included in the total (similar to the way total PCBs are summed now). She said that detection limits for these analyses are very low. She also did not expect some of these congeners to show up, and the list of congeners could be revised accordingly. She did not want to start adding in detection limits for congeners that may not be included later.

Maggie Dutch also commented about the PCB congener-specific measurement issue. She looked at PSAMP data, and saw that there were primarily nondetects in the congeners. For those congeners that were detected, there were also some detections in the Aroclors. She said in terms of doing a more thorough comparison between the two methods she would need some help in determining what kind of comparisons people would like to see from this data set.

Presentation of Public Issue Papers

17. Clay Patmont, Anchor Environmental, gave an evaluation of the potential confined aquatic disposal (CAD) facilities in Bellingham Bay. The CAD facilities may provide an opportunity to efficiently accomplish contaminated sediment cleanup, provide protective and cost-effective disposal and allow for concurrent habitat restoration. The problem was that there are not well-established design standards for nearshore CAD facilities, there has not been a systematic review of regional case histories, and more information is needed to perform remedial investigations and feasibility studies and to make cleanup decisions. He then described various CAD designs and options. Currently, the focus for Bellingham Bay is on upland sites and a nearshore CAD site with a habitat-enhancing cap.

Objectives for this evaluation were to summarize key design considerations, review regional case histories, develop conceptual nearshore CAD designs for environmental review, and incorporate into Remedial Investigation/Feasibility Study (RI/FS) documents to evaluate cleanup options. Some of the limitations of this evaluation were that it had not been peer reviewed, was developed prior to the MUDS EIS, and did not foreclose other options such as upland disposal. This documentation will be provided as part of the Whatcom Waterway RI/FS. He commented that these disposal sites needed to be permanent solutions: time frame of 500-2500 years; maintain integrity under seismic events, wave action, and vessel operations; and maintain water quality protection. He discussed some of the current design guidance such as USACE Waterways Experimental Station (WES) and EPA capping and confined disposal guidance, and the Puget Sound MUDS EIS. He reviewed issues and case studies concerning seismic stability, cap integrity, and water quality protection. He mentioned that in Bellingham Bay, there was mercury contamination in much of the sediments, but it did not appear to be leachable. Other contaminants may behave similarly. It may also be possible to treat some of the material within the birm.

He also discussed design issues and case studies for eelgrass restoration as part of the potential for habitat enhancement associated with nearshore CAD sites. The CAD would need to be in an

appropriate location for eelgrass to grow, and the availability of plants to transplant would factor into this. Proper siting of CAD sites is critical, particularly for habitat restoration potential.

Ovrhd 10-1.	Confined Aquatic Disposal – Evaluation for Bellingham Bay
Ovrhd 10-2.	What is the Issue?
Ovrhd 10-3.	What is the Problem?
Ovrhd 10-4.	Disposal Techniques
Ovrhd 10-5.	Objectives
Ovrhd 10-6.	Limitations
Ovrhd 10-7.	Permanent Solutions: Definition of Terms
Ovrhd 10-8.	Current Design Guidance
Ovrhd 10-9.	Seismic Stability
Ovrhd 10-10.	Integrity of Caps
Ovrhd 10-11.	Water Quality Protection
Ovrhd 10-12.	Eelgrass Restoration
Ovrhd 10-13.	Conceptual Designs for Environmental Review
Ovrhd 10-14.	Conclusions

18. Eric Johnson, Washington Public Ports Association (WPPA), discussed a letter the WPPA submitted to the DMMP questioning the status of various unresolved CSMP policy issues. Their letter concerned a memo that was sent by DNR in April of 1998 to those interested in sediment management disposal criteria. A couple of months later, the other CSMP agencies replied to the commissioner of public lands and raised a number of questions and concerns about the DNR sediment disposal criteria. The concerns included the degree of coordination among the CSMP partners, concerns about defining public interest collaboratively rather than unilaterally, the scope of the criteria (was not clear as to where the criteria applied), and the implications of the policies on cleanup decisions. The letter noted that strict applications of some of the criteria could inhibit some of the cleanup operations rather than facilitate them, and could have negative effects on the Bellingham Bay Pilot Study, MUDS, and Model Toxics Control Act (MTCA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanup. There were technical issues as well. For example, the DNR memo discussed analysis of sediments for Toxicity Characteristic Leaching Procedure (TCLP) metals, which has been determined to be inappropriate. He mentioned that the letter brought out a number of issues, and as far as he knew, the issues had not been resolved. He wondered what the process would be to resolve these issues.

Discussion and Public Comment

David Kendall responded that he had been trying to set up a meeting for several months with the agency directors, which had not occurred to date, and therefore, the issues had not yet been resolved.

Jim Pendowski, Ecology, indicated that he would be spending time facilitating the process of getting the meeting together sometime within the next quarter to discuss these issues.

Mike Palko, DNR, felt that it was a fair question of Eric Johnson to ask why, when clear questions were asked, it has taken 10 months or more to sit down to begin to focus on them, particularly since the issues cycle down to the projects the agencies are working on. They will not make much progress on their work unless some of these issues are at least dealt with, if not fully resolved, right away.

Eric Johnson agreed that agency director level meetings were important, but in between those meetings a lot of staff work would need to be done on these issues.

TBT Issues Subsession: Status Reports and Public Issue Paper

19. Karen Keeley, EPA, gave a presentation on developing a tissue trigger level for bioaccumulated TBT in marine benthic organisms. She focused on a case study for the Harbor Island Superfund Site in Seattle, WA. The study concerned the marine sediments of the West Waterway. The reason for the focus on TBT was that it was elevated and widespread, and the concentrations in the sediments had potential ecological effects. There have been no state, federal, or international sediment quality values set for TBT in tissues. In addition, the standard suite of sediment bioassay tests was not appropriate. In 1996, an interagency workshop evaluated approaches to derive sediment effects-based cleanup levels, and recommended looking at TBT levels in sediment porewater and conducting bioaccumulation tests. In 1998, a legal agreement was made for a TBT field study in the West Waterway. This agreement was made between the EPA, Port of Seattle, Lockheed Martin, and Todd Shipyards. The purpose of the field study was to identify TBT contaminated sediments in the West Waterway that should be remediated under Superfund to protect for ecological effects to the benthic community. Both bulk sediment and sediment porewaters were analyzed for TBT at 30 stations. Bioaccumulation tests (45-day) were also conducted on two species for 20 stations. Using the results of the analyses, they hoped to evaluate the data to develop a TBT tissue trigger level. This trigger would also be set to protect for sublethal effects in marine invertebrates.

As part of this study, they researched to see if anyone had previously done this type of study. She indicated that there was not a protocol that agencies were implementing. They took a weight-of-evidence approach looking for sublethal effects data, estimating a geometric mean of paired no-effect/low effect tissue data, deriving critical body residues, and looking at mean tissue residue data for lethality. Based on their review of data and other available information, the EPA determined a site-specific tissue trigger value of 3 ppm dry weight TBT (this was specific to the Harbor Island West Waterway site). She mentioned some of the site-specific considerations for this waterway such as the fact that the West Waterway provided only subtidal habitat, and there were no oyster beds, no commercial harvest of shellfish, and very few meso- and neo-gastropods in the waterway. They found that none of the stations studied exceeded the site-specific trigger value.

As a result of the study, they found that TBT tissue concentrations were most strongly correlated with dry weight-sediment and organic carbon normalized sediment data. There were weak correlations with filtered and unfiltered porewater TBT, although there were lower TBT

concentrations in filtered porewater than in unfiltered porewater samples. The advantage of looking at TBT in tissues was that tissue data integrate multiple exposure pathways and provide a direct measure of exposure. However, more work was needed in how to use tissue data results for sediment cleanup. She concluded her presentation by discussing possible future considerations such as the potential use of bulk sediment TBT screening values instead of porewater, measuring sublethal effects on organisms, and TBT tissue measurements in field-collected organisms.

Ovrhd 11-1.	Developing a Tissue Trigger Level for Bioaccumulated TBT in Marine Benthic Organisms: A Superfund Case Study
Ovrhd 11-2.	Tributyltin (TBT)
Ovrhd 11-3.	Harbor Island Superfund Site, Seattle, WA
Ovrhd 11-4.	Harbor Island (photo)
Ovrhd 11-5.	Why TBT?
Ovrhd 11-6.	1996 Interagency TBT Workshop
Ovrhd 11-7.	1998 Legal Agreement for TBT Field Study in West Waterway
Ovrhd 11-8.	TBT Tissue Trigger Level
Ovrhd 11-9.	Has Anyone Done This Before?
Ovrhd 11-10.	Weight-of-Evidence Approach
Ovrhd 11-11.	TBT Tissue-Residue Effects Data for Marine Invertebrates
Ovrhd 11-12.	EPA Recommendations
Ovrhd 11-13.	How Many Stations Exceeded EPA's Site-Specific Trigger Value?
Ovrhd 11-14.	Study Results
Ovrhd 11-15.	Advantages and Limitations
Ovrhd 11-16.	Future Considerations

20. Erika Hoffman briefly introduced the next topics that would be discussed which involved obtaining information to help in the development of a protocol for measuring TBT in sediment porewater. Since the agencies determined that they should be looking at TBT in porewater a few years ago, they had been working on how to develop the extraction of porewater without losing TBT in the extraction process. They contracted Striplin Environmental Associates and Avocet Consulting to conduct a survey of the various laboratories, consultants, and regulated parties to elucidate some of the concerns about the TBT porewater analysis methods, and what methodologies the laboratories and experts suggest to address these concerns. She added that based on the study presented by Karen Keeley, the agencies should continue to consider the question as to which fraction (bulk sediment vs. porewater) should be used for regulatory purposes.

21. John Hicks, Striplin Environmental Associates, discussed the results of responses to an analytical questionnaire on TBT porewater protocols (as outlined in the DMMP clarification paper on TBT analysis mentioned by Erika Hoffman above) that was sent to various laboratories. He reviewed the questionnaire focus, which included the laboratory's experience in conducting TBT porewater analyses, their view on filtering vs. nonfiltering during the extraction process, holding time requirements, quality control practices, containers used, butyltin extraction and

analysis techniques, and their recommendations for the analysis. Sixteen laboratories responded, with an average experience of 3.3 years of conducting TBT porewater analysis.

Results of the survey indicated that the laboratories preferred borosilicate or high density polyethylene (HDPE) containers for sample collection and storage, and polycarbonate for the extracted porewater. In general, the quality control procedures followed those outlined in the respective workplans (e.g., duplicate analyses, matrix spikes, laboratory control samples, and method blanks). Approximately half of the laboratories responding extracted porewater from sediment anaerobically, and half acidified the porewater prior to storage. The laboratory's decision to filter or not filter porewater before solvent extraction was primarily based on client instructions. However, they tended to find that filtering results were rather variable due to filter plugging and suspected adhesion of butyltins to the filter material. Therefore, the laboratories favored not filtering the porewater. The laboratories' analysis method preference was split between GC/MS and Flame Photometric techniques, and they strongly recommended confirmation. The primary source of laboratory contamination was the reagents used in the analysis such as the Grignard reagent. The laboratories had some concerns about meeting the one-week holding time. However, most of the laboratories were successfully performing the interim method.

The recommendations that were derived from this survey were to conduct studies on filtering vs. non-filtering the extracted porewater prior to analysis, holding times to determine the most appropriate holding time, and on aerobic vs. anaerobic processing.

Ovrhd 12-1.	Analytical Questionnaire on TBT Porewater Protocols: Results, Discussion, and Recommendations for Analytical Studies
Ovrhd 12-2.	Purpose and Goals of Butyltin Questionnaires
Ovrhd 12-3.	Questionnaire Focus
Ovrhd 12-4.	Responses to Analytical Questionnaire
Ovrhd 12-5.	General Observations
Ovrhd 12-6.	Recommendations

Discussion and Public Comment

Erika Hoffman asked if the variability the laboratories observed when filtration was used was in the measured amount of TBT in the porewater or in the process generally.

John Hicks responded that it was in the measured amount of TBT, and appeared to be due to the filtering process. It was somewhat uncertain if the variability was due to the filtering process itself or to poor analytical technique. They would need a much larger study to determine that.

Mike Johns, EVS, wondered if the variability was between filtered vs. non-filtered analysis results for a given sample, or between replicate filtered results for a sample (i.e., high variability between replicate analyses).

John Hicks responded that the laboratories did not have a lot of side-by-side data sets of filtered and non-filtered analysis results, and indicated that the laboratories were referring to the variability observed in laboratory control sample (spiked water sample) results. The laboratory control sample would be run up to five or six times, and the labs were observing variability in these results when using filtration.

Mike Johns added that when working on the West Waterway study, they had Columbia Analytical Services do a laboratory control sample run using a variety of filters. This included silver, which appeared to be the best filter for the TBT analyses. The percent recovery using the filter was around 85-90%, which was pretty good from an analytical perspective. For the West Waterway study they compared filtered vs. unfiltered results. They found the values for analyses in which the porewater was filtered were lower, but most sample results were within the analytical variability of the unfiltered results. They performed double centrifugation when porewater was not filtered.

22. Teresa Michelsen, Avocet Consulting, presented the results of a policy questionnaire concerning TBT porewater protocols. The questionnaire was sent to local consultants, laboratories, and regulated parties, and a follow-up questionnaire was sent to national and international experts on TBT and other organometallics. The purpose of the questionnaire was to get an opinion on which TBT fraction should be analyzed and the reasons for this. The general response was that the fraction that best correlates with bioaccumulation/toxicity result should be selected. Some of the respondents referenced the West Waterway study as being the type of data that would be helpful. However, in the absence of this data, most consultants stated a preference for filtered porewater. Others noted that there were site-specific factors that need to be considered for a site (e.g., geochemical factors). The source of TBT (dissolved in the water column vs. paint chips) should also be taken into consideration. The Port of Seattle suggested reestablishing a sediment screening level as part of tiered testing framework for dredging. The suggestion was also made that the TBT fraction analyzed and protocols used should be the same for both cleanup and dredging projects. However, for contaminant mobility studies, the fraction may be different. Respondents indicated that sample processing and porewater extraction methods may introduce the most variability in the results, that oxidation and holding conditions were of concern, and that TBT in freshwater may be more susceptible to state and oxidation changes than in marine sediments. Recommended studies included evaluating holding times, determining differences in aerobic vs. anaerobic storage and porewater extraction, refining filtration and other porewater extraction techniques, and conducting additional bioavailability studies.

Another issue was TBT porewater in subsurface DMMUs, which was often difficult to analyze due to the sandy, compacted sediments. Most respondents suggested that in general subsurface DMMUS may be exempted from TBT testing based on TBT use history, sedimentation rates, and bulk sediment concentrations. Dr. Michelsen found that there were no consistent recommendations among the experts on porewater vs. bulk sediment, and that there was little agreement on the appropriateness of equilibrium partitioning to predict relationships among fractions. As a result of the survey, policy issues forwarded to the DMMP included determining whether to reinstitute the bulk sediment screening level as part of the tiered testing framework,

determining criteria for exempting subsurface sediments from TBT testing, and determining the appropriate fraction for analysis. The respondents also recommended a holding time study, and study to determined differences in aerobic vs. anaerobic porewater extraction, and freshwater vs. marine sediment holding times (should they be different).

Ovrhd 13-1.	TBT Policy Questionnaires: Purpose
Ovrhd 13-2.	Questionnaire Distribution
Ovrhd 13-3.	Q1. Selection of TBT Fraction
Ovrhd 13-4.	Q1. Selection of TBT Fraction (cont'd)
Ovrhd 13-5.	Q2. Research Needs
Ovrhd 13-6.	Q2. Research Needs (cont'd)
Ovrhd 13-7.	Q3. Evaluation of Deep Sediments
Ovrhd 13-8.	Follow-up Q1: Request for Data
Ovrhd 13-10.	Follow-up Q2: Recommendations
Ovrhd 13-11.	Summary of Recommendations: Policy Issues Forwarded to DMMP
Ovrhd 13-12.	Summary of Recommendations: Recommended Analytical Studies

23. Mike Salazar, Applied Biomonitoring, gave a presentation on characterizing exposure and effects of bioaccumulative chemicals in bivalves using tissue chemistry and sublethal points. He discussed how bioaccumulation is the link between the environment and the organism and that the focus should be on the animals rather than the water or sediment chemistry. He talked about bivalve effect endpoints including changes in the whole animal wet-weight, in shell length, in end-of-test tissue weights and in end-of-test shell lengths. When quantifying bivalve health, he found that there was not a continuum between unstressed, stressed, and dead organisms with respect to mortality (assessed by shell gape), but that a continuum occurred in growth (tissue weight). He indicated that there was a problem in differentiating chemical stress from laboratory induced stress in bivalves (bivalves are usually stressed by the laboratory). One question was whether more than just the "effect" (e.g., mortality) should be measured to confirm that the organism had been exposed (e.g., looking at tissue chemistry as well). He then discussed the relationship between TBT in seawater and tissue changes based on their studies. The studies showed that once the TBT concentration exceeded 100 ng/L in seawater, changes began to occur. For example, adverse effects on mussel growth rates became apparent. With respect to TBT levels in sediment and tissue changes, effects on the organism began to occur at TBT concentration of 0.2 μ TBT/g dry weight in the sediment. His conclusions were that those involved with sediment management should place more emphasis on what is happening with the organisms and less emphasis on concentrations of contaminants occurring in the water or sediment. The goals should be to develop a single protocol for exposure and effects, effect endpoints for *Macoma* and *Nephtys* tests, and exposure endpoints for *Neanthes* tests.

Ovrhd 14-1.	Characterizing Exposure and Effects of TBT in Bivalves Using Tissue Chemistry and Sublethal Endpoints
Ovrhd 14-2.	Why Characterize Exposure?
Ovrhd 14-3.	Why Characterize Effects?
Ovrhd 14-4.	Bivalve Effects Endpoints
Ovrhd 14-5.	Calibrating Bioaccumulation with Changes in Tissue Weight

Ovrhd 14-6.	Quantifying Bivalve Health
Ovrhd 14-7.	Test Acceptance Criteria
Ovrhd 14-8.	Exposure-Dose-Response Triad
Ovrhd 14-9.	Bioaccumulation Links
Ovrhd 14-10.	"Canary in a Coal Mine"
Ovrhd 14-11.	The Relationship Between TBT in Seawater and Tissue Changes at 100 ng TBT/L
Ovrhd 14-12.	The Relationship Between TBT in Sediment and Tissue Changes at 0.2 µg TBT/g dw
Ovrhd 14-13.	Summary and Conclusions
Ovrhd 14-14.	Recommendations

Discussion and Public Comment

David Moore, MEC Analytical Systems, said that he was a firm believer in coupling tissue residue and effects information, however, Mike Salazar alluded to extending the exposure period and measuring effects. When the exposure period is extended, other subtle things associated with the test could occur and may contribute to the effect that is measured, and these things should be taken into consideration. For example, if the exposure duration is extended to 45 days, he assumed that the animals would need to be fed, which could have an effect on the uptake kinetics. The interplay between uptake kinetics should be understood, and the need to get both measures of exposure and effects in the same test should be balanced against the logistical constraints of conducting such a test in a laboratory environment where the animals may need to be fed. He wondered if Mike Salazar had any comments concerning this issue and how he envisioned them being addressed.

Mike Salazar responded that he hoped that he did not give the impression that he was an expert in the *Neanthes* test (in which organisms need to be fed). However, he used to conduct bioaccumulation testing with *Neanthes* for Navy projects in San Diego in which they measured bioaccumulation, but did not measure growth. They did the same thing with *Macoma*. In the caged bivalve tests that he has performed, the growth and tissue weight change measurements were relatively easy to do, and did not add on substantially to cost. He did not feel that he could address the issue with respect to *Neanthes*, and indicated that this would need to be worked out. However, he felt that measuring growth and tissue changes was feasible, and made more sense than some of the data they have seen. For example, looking at hundreds of amphipod test results and not getting a single hit, did not necessarily mean that there were no problems with contamination. Based on what he has seen with respect to TBT contamination and amphipod test results, the current amphipod tests did not appear to have a sensitive enough endpoint (mortality after a 10-day exposure), and would be a waste of money. However, he believed that the work Battelle is doing on *Leptocheirus* showed promise as they look at other sublethal endpoints. He felt that it would be a lot easier to work with some of the existing protocols and measure tissue and growth changes, rather than to focus on a new test such as looking at porewater effects. Problems associated with porewater measurements could be astronomical in comparison to adding an exposure and effects endpoint to some existing protocol. He pointed out that the

Waterways Experimental Station (WES) has been working on conducting *Neanthes* tests with longer-term exposures and dealing with feeding problems.

Karen Keeley added some information concerning feeding issues associated with the extension of the bioaccumulation test from 28 to 45 days. For the 45-day test, an external food source was not added, although sediment renewal was performed. An additional supply of sediment was collected from the particular station that was studied. This additional supply of sediment was mixed in a slurry and slowly added at intervals, and provided an extra food source.

David Moore responded that the question would arise as to whether the nutritive value of the sediment itself may interplay as a noncontaminant factor into the endpoint effect that they are trying to link to contaminants present in the sediment. He was not against the methods themselves, but felt that there were a number of factors that could affect the interpretation of the tests that needed to be considered.

Mike Johns, EVS, agreed that bioaccumulative effects needed to be measured, and that one should remember that there are physiological effects such as growth and reproductive success of the organism as well as biochemical effects. Percent lipids are one of those biochemical measures. When invertebrates are stressed, they use their lipid reserves and then begin metabolizing proteins. When EVS conducted some of their bioaccumulation tests for the West Waterway, in addition to survival, they also looked at the lipid content to assess stress. They found that for these tests, the lipid content was well within the expected range for healthy *Neanthes* and *Macoma* organisms. If adult organisms are used, which *Neanthes* and *Macoma* are in the bioaccumulation tests, growth is not expected to be significant during the 45-day time frame and the organisms may put more energy into reproductive growth as opposed to tissue growth. He thought that it was possible that growth may not be the best endpoint for these organisms, and that the potential for biochemical changes such as lipid content should be evaluated. However, he felt that both physiological and biochemical measurements were valid, and that more than survival as an endpoint should be measured.

Teresa Michelsen added that the point that David Moore was making was important. She had noticed that in the *Neanthes* tests, the organisms tested did not appear to grow well in the control sediments. This may be primarily due to the fact that the controls generally were much sandier than the test sediment and had less nutritive value due to a lower organic carbon content. This could easily be controlled by the selection of an appropriate reference sediment, although typically when selecting a reference sediment the grain size as opposed to organic carbon content is primarily considered. She felt the reference sediments should be matched carefully with the test sediments when conducting these types of tests. If the organic content in the test sediments had a wide range, it may be necessary to collect more than one reference sediment to cover the range observed in the test sediments.

Bill Gardner, Battelle, asked if it was possible to look at stress hormones in these organisms.

Mike Johns replied that he was not sure if it could be easily done and within project budgets. He said it was much easier to measure responses to stress such as growth and lipid content.

Summary and Closing

24. David Kendall summarized the DMMP issues that would be addressed as a result of this meeting. The PSDDA agencies would continue to look at the Commencement Bay site to determine what may have happened to cause dredged material to be present offsite, and to make management changes as needed. The agencies would need to do a side by side Aroclor/PCB congener analysis in order to evaluate regulatory cost impacts. They would also need to ground truth results by looking at PSAMP/NOAA data and any other data they can gather to try to understand the relative difference between Aroclor and congener-specific PCB analysis results. The CSMP agencies need to resolve outstanding policy issues raised in the CSMP letter to DNR last year. The DMMP agencies should consider matching TOC levels in reference sediments to test sediments when conducting the bioassay tests, especially for the *Neanthes* test. He then asked if anyone had other concerns that were expressed during the meeting that he did not list.

Discussion and Public Comment

An individual asked if the analysis of TBT in bulk sediment vs. porewater issue had been settled.

David Kendall responded that it had not been settled, and that and a number of issues concerning TBT still need to be resolved as discussed in this meeting.

25. Brian Applebury closed the meeting and thanked everyone for attending and participating in the meeting. He stated that written comments concerning the SMARM proceedings must be submitted to the DMMP agencies by May 26, 1999 for consideration, and that written comments concerning the SMS annual review should be submitted by June 2, 1999 for consideration.

Sediment Management Annual Review Meeting (SMARM)
for the
Dredged Material Management Program (DMMP)
and the
Department of Ecology-Sediment Management Standards (SMS) Program

Location: Main Auditorium - Department of Ecology Headquarters: Lacey, WA

May 5, 1999

Final Agenda

MORNING SESSION

8:30 Coffee

9:00 Introduction and Overview

Greeting: Tom Fitzimmons, Director, Department of Ecology

Meeting Objectives: Brian Applebury, Chief, Operations Division, Seattle District

9:30 DMMP Dredging/Disposal Overview

Summary of accomplishments since the 1998 SMARM (David Kendall, Corps)

Overview of DMMP project/testing activities (David Kendall, Corps)

Disposal site monitoring and management overview (Ted Benson, DNR)

10:15 Discussion and Public Comment on above topics

10:30 Break

10:45 SMS Overview

SMS Program activities (Brett Betts, Ecology)

Regional cleanup activities (Marian Abbett, Ecology)

Survey of Sediment Quality in Puget Sound -Year 1 - Northern Puget Sound (Margaret Dutch, Ecology)

Commercial species harvest and scientific collector's permits (Mary Lou Mills, WDFW)

11:45 Discussion and Public Comment on above topics

12:00 Lunch

AFTERNOON SESSION

1:00 Presentation of DMMP/CSMP Issue Paper (IP) and Status Reports (SR)

IP: PCB Analysis: Transition to congener-specific measurements in sediment and tissues (Erika Hoffman, EPA)

SR: Revisions to Puget Sound Apparent Effects Thresholds (AETs) (Tom Gries, Ecology)

SR: Multi-user Confined Disposal Study (Steve Martin, Corps)

SR: Bellingham Bay Demonstration Pilot Project (Mike Stoner[1]/Carol Lee Roalkvam[2])

2:00 Discussion and Public Comment on above topics

2:15 Break

2:30 Presentation of Public Issue Papers (PI)

PI: Evaluation of potential Confined Aquatic Disposal facilities in Bellingham Bay (Clay Patmont, Anchor Environmental)

PI: Letter from WPPA to DMMP questioning the status of various unresolved CSMP policy issues (Eric Johnson, WPPA)

3:15 Discussion of Public Issue Papers

3:30 TBT Issues Subsession: Status Reports and Public Issue Paper (PI)

SR: Developing a tissue trigger level for bioaccumulated TBT in marine benthic organisms: A Superfund Case Study (Karen Keeley, EPA)

SR: Analytical questionnaire on TBT porewater protocols: Results, discussion, and recommendations for analytical studies (John Hicks[3])

SR: Policy questionnaire on TBT porewater protocols: Results, discussion, and recommendations for analytical studies (Teresa Michelsen[4])

PI: Characterizing exposure and effects of bioaccumulative chemicals in bivalves using tissue chemistry and sublethal endpoints (Mike Salazar[5])

4:45 Discussion and Public Comment on above topics, including Status Reports and Clarification Papers not presented

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1 Port of Bellingham
2 WA Department of Natural Resources
3 Striplin Environmental Associates, Inc.
4 Avocet Consulting
5 Applied Biomonitoring

5:00 Summary and Closing (Brian Applebury, Corps)

Public Issues Summary: The agencies will convene a post-SMARM meeting on 3 June 1999 to review and prioritize these items relative to existing DMMP and SMS action items. The meeting minutes and updated task list will be posted on the DMMO homepage at URL http://www.nws.usace.army.mil/dmmo/homepage.htm. Written comments may be submitted on the SMARM proceedings, but must be submitted to the DMMP agencies by May 26, 1999 for consideration.

SMS Issues Summary: Written comments may be submitted for SMS annual review for consideration by June 2, 1999.

5:15 Meeting Concluded

SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING
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Ross, Brian	EPA, Region 9 75 Hawthorne St. (WTR-8) San Francisco, CA 94105	415/744-1979	415/744-1078	ross.brian@epamail.epa.gov
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SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING
LIST OF ATTENDEES

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Salazar, Sandra	Applied Biomonitoring 11648 – 72nd Place N.E. Kirkland, WA 98034	425/823-3905	425/814-4998	msalazar@cnw.com
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SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING
LIST OF ATTENDEES

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SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING
LIST OF ATTENDEES

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Executive Committee
Jim Knapp
President
John Lane
Vice President

April 28, 1999

Brian Applebury
Corps of Engineers, Seattle District
PO Box 3755
Seattle, WA 98124-2255

Dear Mr. Applebury,

This letter is sent to the Cooperative Sediment Management Program (CSMP) agencies as part of the 1999 Sediment Management Annual Review Meeting (SMARM). One of the primary purposes of the SMARM is to provide an opportunity for the key planning and regulatory agencies to gather and discuss issues of general sediment and dredging policy with interested groups and technical experts.

In addition to the usual technical issues facing the CSMP agencies this year, it seems appropriate that the agencies provide a policy update to the interested public on sediment disposal issues set forth in the July 1, 1998, CSMP letter to the Department of Natural Resources. Most if not all, of these issues appear to remain unresolved a full year after publication of the original state memorandum in April 1998.

The 1999 Sediment Management Annual Review meeting is the appropriate time to discuss the type of policy issues that are highlighted in the CSMP's July 1, 1998, letter, and its accompanying attachment. I look forward to a discussion of these issues, and a presentation on the resolution of the significant potential problems that were identified.

Sincerely,

Eric

Eric D. Johnson
Environmental Affairs Director

Jennifer M. Belcher
Commissioner of Public Lands

May 4, 1999

TO: PSDDA Directors
Tom Fitzsimmons, Department of Ecology
Sid Morrison, Department of Transportation
Jeff Koenings, Department of Fish and Wildlife
Nancy McKay, Puget Sound Water Quality Action Team
Chuck Clarke, Environmental Protection Agency
James Rigsby, Army Corps of Engineers

FROM: Jennifer M. Belcher
Commissioner of Public Lands

SUBJECT: Letter from Eric Johnson

Since I'm not going to be at the staff annual review meeting tomorrow (and I assume that most of you aren't either) I wanted to get a quick note off to you with my thoughts on Eric's suggestion that the meeting be used to make decisions on disposal issues.

I share Eric's desire to see the policy issues surrounding disposal of contaminated sediments resolved, and I hope that we can have a meeting of the PSDDA directors within the next few months to assess our progress on all our issues and take whatever steps are necessary to keep us moving forward. I don't believe that tomorrow's meeting is the appropriate meeting to do that since it was planned as a staff review.

Just a little more than two years ago, in November 1996, the PSDDA directors held a two-day retreat at Port Ludlow and agreed on a plan to make progress on cleanup issues. Shortly after that we had two new directors (Ecology and the Corps) and within months we had a third new director (Fish and Wildlife). Last year, we began the process of listing salmon, which has added layers of complexity to our decisions. During that same period we've successfully launched the Bellingham

Bay pilot project and have begun to use Commencement Bay to sort through the integration of ESA and CERCLA, no small task.

Additionally, we have the ongoing work of the MUDS group, Ecology's Sediments Management Standards Implementation Committee, the Dredged Material Management Program, and the Beneficial Uses Work Group. These are all helping us to further focus the development of our joint agency policy approach.

While I'm certainly not satisfied that we've resolved the issues, I do believe that we've made significant progress. You all also know that I have been eager to have the directors begin again our regular meetings to assure that the policy issues, which our staff cannot resolve, get our attention. I hope that we can schedule a meeting soon after the end of the special legislative session and define the agenda for the rest of this year. We've accomplished many of our original objectives since our inception in 1994, but much remains to be done. I think one of the most pressing issues for us as directors is the effective integration of the policy direction of the ESA with the regulatory framework within which we work for cleanup. That issue alone could keep us busy for a day-long meeting.

I'm happy to take responsibility for pulling a meeting together, or to work with one of your offices to do that.

JMB:cwp

c: Eric Johnson, Ports Association

[illegible]

Port of Seattle

VIA FACSIMILE: ORIGINAL TO BE MAILED

May 26,1999

Mr. Brian R. Applebury, P.E.
Chief, Operations Division
Seattle District
United States Army Corps of Engineers
Post Office Box 3755
Seattle, WA 98124-2255

Mr. James Pendowski
Toxics Cleanup Program
Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Re: Eleventh Annual Sediment Management Annual Review Meeting (SMARM) – Follow-Up Comments on Sediment Management Standards (SMS) and Dredged Material Management Program (DMMP)

Dear Brian and Jim:

On behalf of the Port of Seattle (Port) and the Washington Public Ports Association (WPPA) we appreciate this opportunity to follow up on some of the key issues raised during the Eleventh Annual Sediment Management Annual Review Meeting (SMARM). The Port and WPPA have for years actively participated in the SMARM and related activities as interested and involved parties. Our comments here echo and build upon our earlier comments and participation. As in years past, our focus is on making the sediment management process in Washington – including both the SMA and the DMMP – work effectively and efficiently.

SMS

From the outset, the Port and WPPA have been involved in the dialogue over SMS implementation. We have also commented extensively on revisions to the rule needed to make it work more effectively as an environmental program and more efficiently as a regulatory program. Along these lines, we very much appreciated Tom Fitzsimmons' comments at the SMARM acknowledging the importance to the SMS program of source control, focusing agency resources on "hotspot" cleanups, protecting human health and achieving tangible results. All of these are key elements of the comprehensive strategy we have advocated over the years to make the sediment management regulatory program in Washington State work better. We look forward to continuing to work with Ecology staff and others to develop a regulatory structure for sediments that better accomplishes these key objectives.

P.O. Box 1209
Seattle, WA 98111 U.S.A.

DMMP

1. PCB Analysis

As described in Erika Hoffman's 1999 SMARM Issue Paper, the rationale for using congener PCB analysis in lieu of Aroclor analysis appears to be sound for certain aspects of an overall PCB approach. In general, we appreciate and support the use of a tiered analysis approach for PCBs that relies in part on congener analysis. However, given the substantial cost differential between Aroclor and congener analyses (3-4 fold difference according to Hoffman and probably greater based upon our experience), before completely abandoning Aroclor analysis, it is important to fully evaluate whether it could still serve a useful purpose as part of a screening step.

Given the cost implications of moving toward more reliance on congener analysis, we appreciate the DMMP agencies' recognition of the importance of conducting side-by-side Aroclor/congener comparisons. These comparisons are essential for evaluating the regulatory and cost implications of any proposed new PCB approach. We also appreciate the DMMP agencies' recognition of the need to "ground-truth" any proposed PCB approach with data from PSAMP, NOAA, and others.

We will submit more detailed technical comments on the proposed PCB approach by June 30th.

2. AET Revisions

We appreciate the collaborative efforts of Ecology, the Regulatory Work Group and the DMMP agencies to revise AETs so that they are as accurate as possible and are based on all available information. In this continuing effort, we support the Work Group's recommendations for replacing oyster abnormality data with bivalve abnormality data. We also support the Work Group's recommendations for replacing the microtox™ AET with the Neanthes AET.

At the same time, we see no reason to split a sediment larval AET into separate bivalve and echinoderm AETs. In the existing rule, the sediment larval AET is a combined oyster/echinoderm AET. With replacement of the oyster data by bivalve data, the sediment larval AET would be expected to be a combined bivalve/echinoderm AET.

The principal reason given for splitting a sediment larval AET into separate bivalve and echinoderm AETs is the supposed sensitivity of echinoderms over bivalves. The scientific community appears to be split over whether echinoderms are in fact biologically more sensitive than bivalves. In fact, the bivalve data that has been analyzed would suggest that a new bivalve AET would be very sensitive, undermining the argument that only the echinoderm AET would be sensitive. This indicates that a combined sediment larval AET would likely establish LAET and 2LAET values for some chemicals that are lower than those established under the current dataset. Furthermore, splitting the bivalve and echinoderm AETs would give undue and unjustified influence to the sediment larval criteria relative to other biological criteria.

Given these facts, we see no compelling reason to depart from the basic approach used in the existing regulatory scheme and adopt separate bivalve and echinoderm AETs. Retaining a combined sediment larval AET would be consistent with the established regulatory scheme – which uses 4 (not 5) different types of AETs to assess effects levels and determine regulatory criteria.

3. MUDS

The Port and WPPA support the MUDS process, reflected in the February, 1999 Preliminary Environmental Impact Study (PEIS), as one option for developing disposal facilities that are "environmentally sound and affordable." PEIS at S-2. Multi-user sites that are competitive with project-specific sites from economic, regulatory and environmental perspectives would facilitate both voluntary sediment cleanup and cleanup associated with economic development. *Id.* at 1-1. A successful outcome to the MUDS process would result in a multi-user site that is an environmentally sound, practicable, and cost-effective alternative to project-specific disposal sites.

Viewed in this context, the Port and WPPA support further analysis of the role of sediment treatment in the overall range of options for multi-user sites, i.e., exploring the possibility of a multi-user treatment facility. However, this should not be done at the expense of developing a site consistent with the original mission of the MUDS program – developing environmentally sound and affordable options to single project sites. We therefore encourage you to approach multi-user treatment sites cautiously within the MUDS program, as they rely on a technology that has not been demonstrated to be environmentally sound, practicable, and cost-effective in full-scale use. In this light, the use of "MUST" as the acronym for such sites is inappropriate as it indicates undue importance for this as-yet untested technology.

4. WPPA Letter

We continue to look forward to resolution of the key policy issues raised by the Cooperative Sediment Management Program (CSMP) in their July 1, 1998 letter to the Washington Department of Natural Resources. We appreciate Commissioner Belcher's May 4, 1999 commitment to promptly convene a meeting of the DMMP directors to address policy issues like those raised in CSMP's July, 1998 letter. However, given the substantial policy differences between the CSMP agencies, it is very unlikely that the issues can be solved by simply convening a meeting or two of the CSMP agency heads. What is needed instead is a commitment by the agency heads and policy staff to devote substantial time to these issues over the remainder of this year. We appreciate the DMMP directors' recognition of the importance of these issues and encourage the DMMP directors and staff to move forward with DNR in a timely manner and achieve progress toward substantive resolution of these key issues. There is no reason why resolution of these issues should be delayed any further.

5. TBT

The results of the West Waterway study (SMARM Status Report: Developing a Tissue Trigger Level for Bioaccumulated TBT in Marine Benthic Organisms: A Superfund Case Study) call into question the wisdom of adopting a TBT screening approach that is based entirely on porewater testing. In certain limited circumstances (e.g., shipyards), porewater screening may be the most appropriate approach to screening. However, the results of the West Waterway study – particularly the statistical relationship between TBT tissue concentrations and TBT bulk sediment concentrations – suggest that, for use as a general screening criterion, bulk sediment chemistry may be adequate or even more appropriate, and certainly more cost-effective, than porewater concentrations. For sediments that fail the bulk chemistry screening criterion, porewater could potentially be used to further screen for bioavailability prior to requiring bioaccumulation testing. In returning to bulk chemistry as an initial screening tool, a key task is establishing a new screening level that takes into consideration recent data, including the West Waterway data, on the correlation between bulk sediment chemistry and bioaccumulation test results. We look forward to working with the DMMP agencies to develop an appropriate tiered approach to TBT testing that builds upon the results of the West Waterway and other studies.

Conclusion

We appreciate your continued attention to these key sediment management issues, and look forward to working with the Corps and other sediment management agencies to ensure progress toward an effective and efficient sediment management strategy in Washington State – one that focuses agency and private resources on source control, hotspot cleanup, protecting human health and achieving tangible results.

Please feel free to contact any one of us to discuss the above or other sediment management issues.

Sincerely,

Douglas A Hotchkiss,
Port of Seattle

Tom Newlon,
Port of Seattle

Eric Johnson,
Washington Public
Ports Association

cc: David Bradley (Department of Ecology)
David Kendall (Corps of Engineers)
John Malek (Environmental Protection Agency)
Mike Palko (Department of Natural Resources)
Konrad Liegel (Preston Gates & Ellis LLP)
Mike Johns (Environmental Solutions Group)

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July 26, 1999
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Meeting clients' needs through the application of sound science

Erika Hoffman
USEPA Region 10
1200 6th Ave, ECO-083
Seattle WA 98101

Dear Erika,:

We would like to submit the enclosed comments on behalf of the Port of Seattle. The comments were written in response to the draft issue paper entitled "PCB Analysis- A Tiered Approach to Making Congener-Specific Measurements in Sediments and Tissues" that you presented at the 1999 SMARM meeting. Please contact Doug Hotchkiss at the Port of Seattle or Susan McGroddy at ESG if you have any questions or concerns.

Sincerely,

Susan E. McGroddy

cc: Doug Hotchkiss

200 West Mercer Street
Suite 401
Seattle, WA 98119

Response to:

PCB Analysis- A Tiered Approach to Making Congener-Specific Measurements in Sediments and Tissues, E. Hoffman, 1999. Public Review Draft of Issue Paper presented to the 1999 Sediment Management Annual Review Meeting

A tiered approach to making congener-specific measurements of all sediment samples evaluated for suitability for unconfined aquatic disposal was presented at the 1999 Sediment Management Annual Review Meeting (SMARM) (Hoffman 1999). Currently, sediment total PCB concentrations are calculated as the sum of Aroclor concentrations. Hoffman (1999) suggests that the sum of the congener concentrations should be used to calculate a total PCB concentration to compare to the existing bioaccumulation trigger concentration. If the trigger is exceeded, and bioaccumulation testing is required then sediment and the tissue PCB congener concentrations will be measured. The analysis of PCB congeners is proposed to replace the current Aroclor-based analysis because it provides a more accurate measure of the total PCB concentration and better estimates of the human health and ecological risks (Hoffman 1999).

The current proposed approach is based on a status report presented at the 1995 SMARM (Kendall 1995). Kendall (1995) suggested that the selection of the analytical method for PCB analysis should be based on whether or not there is a reason to believe that PCBs are a problem chemical in the dredging environment being characterized. In areas where PCBs are not believed to be of concern, an Aroclor-based analysis could be used to conduct a screening characterization. If total PCB concentrations exceed screening level guidelines, then congener-specific analysis could be required in a second tier analysis (Kendall 1995).

In the following sections the issues that have been raised with regard to the accuracy and toxicological significance of PCBs measured as congeners compared to Aroclors are examined and an alternative tiered approach is proposed.

Issues associated with Quantitation

Hoffman (1999) states that Aroclor-based total PCB concentrations are inaccurate due to the effects of weathering and degradation of PCB mixtures in the environment that result in mixtures that cannot be accurately quantitated on an Aroclor basis. However, when agency staff contacted several national experts in the field of PCB quantitation regarding the effect of switching to congener specific analysis, the researchers did not expect that there would be a consistent or significant difference between total PCB concentrations measured on an Aroclor-basis or a congener-basis (Hoffman 1999). If the inaccuracies associated with Aroclor-based quantitation are substantial then, one would expect to see significant differences between Aroclor-based and congener-based total PCB concentrations.

One source of analytical difficulty associated with the measurement of individual congeners is the coelution of analytes. Individual congeners with the same level of chlorination differ only in their chlorine substitution positions. The similarity of individual congeners increases the likelihood of coelution. Two congeners are said to coelute when they pass through the gas chromatograph together and the ECD detector records one peak that reflects the presence of both congeners. A recent intercalibration exercise conducted in San Francisco concluded that congener coelution with other congeners as well as unidentified interferents was responsible for most of the variability noted between labs (Davis et al. 1996).

Further complicating this issue is the fact that the NOAA Status and Trends dataset that was used to generate the regression proposed for use in converting congener concentrations to total PCB concentrations did not resolve the following congener pairs: PCB 8/5, PCB 101/90, PCB 153/132, PCB 138/160, PCB 170/190, and PCB 195/208. The analytical method selected for sediment screening analysis must be consistent with the Status and Trends method in order to use the regression based on the NOAA data.

Analytical Costs

The costs associated with PCB-congener analysis will be 3-4 times higher than the costs associated with the current Aroclor analysis (Hoffman 1999). These costs will not include the measurement of the three coplanar congeners (PCB 77, PCB126, PCB 169). The costs associated with analysis of the coplanar congeners are 10 times higher than the costs associated with the current Aroclor analysis. Additional QA/QC costs may also be incurred if GC/MS verification is required to identify coeluting congeners or potential interfering compounds.

Toxicological Data

A primary reason for changing the method of PCB analysis is that "there is a large body of congener-specific scientific information that is available to quantify risk associated with exposure to congener concentrations"(Hoffman 1999). The toxicity information cited was obtained from a limited review of the literature conducted by Valoppi et al. (1998). The results of the review for the core list of congeners in aquatic organisms is summarized in Table 1. A very limited dataset has been presented which consists of toxicity data for six congeners in four freshwater organisms. A more exhaustive review of the literature should be conducted to ensure that congener-specific data does exist to support the development of congener-specific sediment bioaccumulation trigger and target tissue level. Specifically, the availability of toxicity data for marine organisms associated with sediment exposures should be determined.

There is considerably more data available describing the toxicity of the three additional coplanar congeners, 77, 126, and 169. However, no information has been provided with respect to how these congeners will be incorporated into the proposed tiered approach. The costs associated with the measurement of these congeners are appreciable and the conditions under which this analysis would be required must be determined prior to implementing congener-specific screening.

Another important factor that must be considered when developing congener-specific sediment screening values is that organisms in the field are exposed to a mixture of congeners and the extent to which there are antagonistic and synergistic effects due to the presence of multiple

congeners will not be discernable from laboratory exposures to single congeners.

Finally, the appropriateness of comparing total PCB concentrations calculated from the sum of congeners to the total PCB BT and TTL that were developed based on Aroclor measurements is questionable. A recent review of PCB residue-effects data conducted for the West Waterway sediment operable unit summarized the results from thirty-four studies with effects and no effects tissue concentrations for invertebrates and fish (ESI 1999). For invertebrates, six studies were reviewed and only one no-effect tissue concentration was reported based on congener analyses. Twenty-eight different studies were reviewed to identify the range of total PCB tissue concentrations associated with effects on survival, growth, and reproductive success in fish. One study reported a total PCB concentration calculated on a congener basis associated with reduced egg hatchability in lake trout (Mac and Schwartz 1992). All other studies reported total PCB tissue concentrations calculated as the sum of measured Aroclor concentrations. In this case, it is difficult to determine how a congener-specific TTL could have been calculated from the available data. Before congener-specific PCB analysis is adopted as the basis for sediment evaluations, the agencies should provide information regarding the approach that will be used to derive BT and TTL values and the extent to which the necessary data is available should be determined.

Proposed Alternative Approach

We propose a tiered approach that is consistent with the approach proposed by Kendall (1995). The method of analysis would be selected based on an evaluation of the historical use and data associated with the site being considered. In areas where PCBs are not believed to be a contaminant of concern the screening level analysis would be based on Aroclor measurements. If sediment PCB concentrations exceed screening level guidelines, then congener-specific analyses may be required. In areas where PCB contamination is known to occur then congener analysis may be required for screening level analyses.

It is critical that congener-based BT and TTLs be developed prior to requiring congener analyses. It is inappropriate to compare congener-based total PCB concentrations to standards developed based on measured Aroclor measurements. Furthermore, an exhaustive review of the literature should be conducted to identify congener-specific toxicity data for marine organisms.

Conclusions

The proposed change in the method of PCB analysis for sediments has been proposed to increase the accuracy of total PCB concentrations and provide toxicologically relevant information. Very little data has been presented to support either of these assertions. However, it is clear that this change will result in a substantial increase in analytical costs.

Several issues should be resolved prior to requiring screening level PCB congener analysis.

- circumstances under which the additional analyses for coplanar congeners may be required should be clarified
- approach that will be used to derive congener-specific BT and TTL concentrations
- whether or not there is any toxicity data available for the core list of congeners in marine organisms.

Finally, we propose that PCB congener analyses be considered only in cases where sediment PCB concentrations are known to exceed screening guidelines. Furthermore, the development of congener-specific criteria should occur prior to requiring these analyses rather than using existing criteria that were developed based on measured Aroclor concentrations.

References

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Table 1: Congener toxicity summary for aquatic organisms

Congener	Organism	Freshwater or marine?	Exposure	Endpoint	Reference
8,101,155	Scud, *Gammarus pseudollmnaeus*	Freshwater	Static aqueous exposure	Mortality	Mayer et al. 1977
52	Amphipod, *Hyalella azteca*	Freshwater	Aqueous exposure with weekly water exchange	Mortality	Borgman et al. 1990
81	Rainbow trout,	Freshwater	Egg injection	Mortality	Vijayan et al. 1997
118	Mirror carp, Cyprinus carpio	Freshwater?	Interperitonial injection	MFO induction	Van der Weiden et al. 1994

SMARM Responsiveness Summary

Distillation of issues from Port of Seattle/WPPA post-SMARM letter

1. **Comment:** The Port of Seattle supports recommendations of the 1999 Regulatory Work Group (RWG) to replace 1986 oyster and Microtox AETs with new bivalve and *Neanthes* AET values, respectively.

   Response (Tom Gries on behalf of the DMMP and Ecology): Final recommendations of the 1999 RWG on use of AET values are still being drafted, but at this time they include recommendations for Ecology to replace 1986 Microtox and oyster AET values with bivalve and *Neanthes* AETs, respectively. Both recommendations are contingent on no major reduction in reliability (the ability of the resulting guidelines and criteria to predict significant adverse biological effects). Ecology is currently conducting the reliability analysis as part of the SMS rule amendment process.

2. **Comment:** The existing SMS rule is based on a combined oyster/echinoderm AET.

   Response (Tom Gries on behalf of the DMMP and Ecology): This is a common misperception that appears to have originated about 1989 when the PSDDA agencies decided to a) allow the use of either bivalve or echinoderm species in routine sediment larval testing, and b) consider test results based on all sediment larval test species to be equivalent for the purpose of making permit decisions. These decisions were made largely because spawning bivalves are not available throughout the entire year.

   In fact, there were no synoptic data for echinoderm larval toxicity available for development of the original suite of Puget Sound AETs (Tetra Tech, 1986) or for the subsequent 1988 update (PTI, Inc, 1989). The only sediment larval effects data available for AET calculations at that time were from a limited number of Commencement Bay samples, for which only oyster toxicity tests were conducted.

3. **Comment:** The Port of Seattle believes there is no justification for calculating separate bivalve and echinoderm AETs.

   Response (Tom Gries on behalf of the DMMP and Ecology). The issue of whether the bivalve and echinoderm larval species used in standard toxicity tests should be considered equivalent organisms remains controversial. It is complicated by the fact that the test protocol is used for two separate but related purposes: (1) making regulatory decisions and (2) developing guidelines/criteria that are used in combination with biological testing to make regulatory decisions. Considering bivalve and

echinoderm species equivalent might be justified for one purpose but not the other. For example, regulatory decisions are made using all available evidence ("weight-of-evidence" approach), identifying sediment samples that have contaminants and/or observed toxicity predictive of unacceptable benthic community impacts. In contrast, the main goal of sediment quality guidelines/criteria is to accurately screen for samples having significant adverse benthic community effects *using only the observed sediment chemical concentrations*. For this reason, guidelines/criteria need to be appropriately conservative and, when exceeded, confirmed with biological evaluations, e.g., bioassays that act as surrogates for benthic community analysis or an assessment of the benthic community itself.

Clearly there is reason for all sediment larval species to be considered equivalent for routine testing purposes: spawning bivalves are not available throughout the entire year. However, there are also reasons for the two groups of organisms be considered different for the purpose of developing sediment quality criteria that are designed to be protective of the overall benthic community. For example, there are great phylogenetic, physiological and ecological differences between many echinoderm and many bivalve species.

The relative sensitivity of the two groups to common sediment contaminants is not so clear. There is some developing evidence for bivalve and echinoderm taxonomic groups having generally different sensitivities to sediment contaminants. However, there also appears to be as much difference in sensitivity to specific contaminants among species within each group as there is between species in the different groups (Summary of the 1998 Sediment Larval Workshop).

The 1999 RWG has avoided some of this "lump or split" controversy by drafting a recommendation that Ecology develop a clear agency policy describing the technical and/or regulatory basis for considering different taxonomic groups of organisms to be equivalent or not. Ecology intends to develop such a policy in collaboration with other DMMP agencies, and envisions it to be based on numerous factors, including the effect that it has on the reliability of the resulting guidelines and criteria.

4. **Comment:** There is no justification for deriving sediment quality guidelines and criteria based on five groups of AETs instead of the current suite of four Puget Sound AETs.

   Response (Tom Gries on behalf of the DMMP and Ecology). There are four groups of AETs that make up the current suite of Puget Sound AETs: amphipod, benthic, Microtox and oyster. These were based on biological evaluation methods or "tools" (e.g., community analyses or toxicity tests) that represented "best science" in 1986, and used in regulatory programs to predict sediment samples most likely to show significant and unacceptable adverse effects in the benthic community. Since the

late 1980's, however, these methods have been modified and additional more sensitive "tools" have been developed. Regulatory programs cannot ignore the continually evolving science of evaluating sediment toxicity and health of the benthic community.

Ecology and the DMMP agencies recognize that different understandings may exist about the basis for regulatory guidelines and criteria. However, the primary goal of current and revised guidelines/criteria is to accurately identify sediment samples having unacceptable benthic effects. Consequently, the agencies believe that it may be appropriate to use more than four groups of AET values to establish guidelines and criteria if the ability to predict those effects is improved. Ecology is currently evaluating different alternatives for using various groups of AETs in amending the SMS rule.

5. **Comment. MUDS**. The Port of Seattle and WPPA support further analysis of the role of sediment treatment in the overall range of options for multi-user sites, i.e., exploring the possibility of a multi-user treatment facility. However, this should not be done at the expense of developing a site consistent with the original mission of the MUDS program – developing environmentally sound and affordable options to single project sites. They encourage the MUDS program to approach multi-user treatment sites cautiously, as they rely on a technology that has not been demonstrated to be environmentally sound, practicable, and cost-effective in full-scale use. In this light, they feel that the use of "MUST" as the acronym for such sites is inappropriate as it indicates undue importance for this as yet untested technology.

   Response. (Tom Gries/Steve Martin). A major conclusion in the MUDS Final Programmatic EIS is that large-scale, cost-competitive decontamination or treatment of contaminated sediment does not appear to be technically feasible today, but is very promising. Many conceptual treatment strategies and their technical feasibility have been proposed and investigated. Some technologies have proven to be feasible for reducing or removing contaminants from sediment, but are not cost-competitive when operated on a pilot or commercial scale. Other approaches propose treating contaminated sediment using technology available for treating different raw materials or wastes on a commercial scale. Still others remain unsubstantiated from a technical perspective. Although it appears that decontamination or treatment of sediment on a commercial scale is not yet technically feasible, there may be other factors that make this alternative as timely as building a multi-user disposal facility. These include a potentially greater public acceptance of a treatment facility, endangered species listings, political will, regulatory ~~a~~ preference for reuse/recycling of materials, and the time required to obtain necessary facility permits. As soon as the Final EIS is published (October,1999), the MUDS agencies plan to study in more detail the feasibility and utility of treating contaminated sediment in Puget Sound. In doing so, they will evaluate selected treatment technologies in view of their technical effectiveness, environmental impact, and cost-effectiveness.

6. **Comment. WPPA Letter**. The WPPA continues to look forward to resolution of the key policy issues raised by the Cooperative Sediment Management Program (CSMP) in their July 1 1998 letter to the Washington Department of Natural Resources.

   Response. (David Kendall/John Malek) The CSMP agency directors agreed in a October 1999 workshop to convene a one and one-half day retreat in January / February 2000 to discuss ways to revitalize the CSMP and resolve policy issues that have caused interagency conflict and friction over the past several years.

7. **Comment. TBT**. The results of the West Waterway Study (SMARM Status Report: Developing a Tissue Trigger Level for Bioaccumulated TBT in Marine Benthic Organisms: A Superfund Case Study) call into question the wisdom of adopting a TBT screening approach that is based entirely on porewater testing. In certain limited circumstances (e.g., shipyards), porewater screening may be the most appropriate approach to screening. The results of this study suggest that, for use as a general screening criterion, bulk sediment chemistry may be adequate or even more appropriate, and certainly more cost-effective, than porewater concentrations. For sediments that fail the bulk chemistry-screening criterion, porewater could potentially be used to further screen bioavailability prior to conducting bioaccumulation testing. The data collected for the West Waterway study including bioaccumulation test data should be used to establish a new bulk screening level, based on the correlation between bulk sediment chemistry and bioaccumulation test results. The Ports and WPPA look forward to working with the DMMP agencies to develop an appropriate tiered approach to TBT testing in the future.

   Response. (Erika Hoffman). The DMMP agencies agree that the results of West Waterway porewater and bioaccumulation testing suggest that porewater measurements may not be an effective means of screening for bioavailable TBT in sediments. We note, however, that the West Waterway results represent one of the first data sets with synoptic measurements of TBT in bulk sediment, porewater, and biota tissues, and that these site-specific results may not be applicable to other areas having different sources and/or partitioning of TBT in sediments. Bioaccumulation testing for several projects (e.g., East Waterway and Olympia Harbor) is currently underway and is expected to provide additional information on TBT bioavailability. The agencies have recently formed the Bioaccumulation Workgroup (BWG) as an open forum for discussion of technical/scientific issues relating to bioaccumulation and for providing recommendations on interpretive guidance to the DMMP agencies. Revision of the existing TBT screening level and/or creation of a tiered approach to TBT testing is a priority agenda item for the BWG in the coming year.

Environmental Solutions Group post-SMARM letter on behalf of the Port of Seattle

8. **<u>Comment. PCB Congener Analysis.</u> The Port and consultant raise a number of technical issues relative to the proposed quantitative measurement and summing of total PCB congeners in dredged material.**
   1) Issues associated with Quantitation (e.g., coelution of individual congeners with the same level of chlorination; consistency with Status and Trends method is required to generate regression proposed for use in converting congener concentrations to total PCB concentrations).

<u>Response: (Erika Hoffman).</u> DMMP agencies agree that GC-ECD analysis proposed in the draft Issue Paper does not provide adequate resolution, particularly of the most toxic non-ortho and mono-ortho coplanar congeners. It is, in part, for that reason that the agencies have withdrawn the proposed approach described in the issue paper pending a more thorough review of available analysis methods and regional monitoring data. The agencies expect that this review will be conducted in the context of the newly formed Bioaccumulation Workgroup.

1) Analytical Costs will be 3-4 times higher than current Aroclor analysis. These costs will not include the measurement of the three coplanar congeners (PCB 77, 126, 169), and the costs associated with analysis of the coplanar congeners are 10 times higher than the associated costs with the current Aroclor analysis. Additional QA/QC costs may be incurred if GC/MS verification is required to identify coeluting congeners or potential interfering compounds.

<u>Response: (Erika Hoffman).</u> DMMP agencies agree that any congener analysis method adopted by the program must be able to accurately and sensitively quantify the most toxic non-ortho coplanar PCB congeners. The agencies are particularly interested in developing a tiered approach to evaluating PCBs that could involve using results from lower-cost methods to determine the need for and frequency of more expensive congener-specific methods. Development of such an approach and criteria for interpreting the resulting data are priority agenda items for the BWG in the coming year.

2) Toxicological data. A more exhaustive review of literature should be conducted to ensure that congener-specific data does exist to support the development of congener-specific sediment bioaccumulation trigger and target tissue level. The potential antagonistic and synergistic effects of mixtures of congeners in sediments should be evaluated relative to developing a screening value using toxicological data from laboratory exposures to a single congener.

<u>Response: (Erika Hoffman).</u> An exhaustive review of the literature is planned as part of the Bioaccumulation Work Group's deliberations on revising the BT and TTL for PCBs.

3) Proposed Alternative Approach recommended consistent with the approach proposed by Kendall in 1995 status report. The method selected should be based on an evaluation of the historical use and data associated with the site being considered. In areas where PCBs are not believed to be a COC, the screening analysis would be based on Aroclor measurements. If sediment PCB concentrations exceed screening level guidelines, then congener-specific analysis may be required. In areas where PCB contamination is known to occur then congener analysis may be required for screening level analyses.

Response: (Erika Hoffman). The Port's proposed alternative approach will be considered by the Bioaccumulation Work Group when it begins developing a tiered-testing approach for PCB analysis.

4) Issues that should be resolved prior to requiring screening level PCB congener analysis.
   - Circumstances under which the additional analyses for coplanar congeners may be required should be clarified
   - Approach that will be used to derive congener-specific BT and TTL concentrations
   - Whether or not there is any toxicity data available for the core list of congeners in marine organisms.

Response: (Erika Hoffman). The issues raised by the Port will be considered by the Bioaccumulation Work Group both as part of developing an tiered-testing approach for PCBs as well as in the context of developing a site-conceptual model for revising all of the BTs and TTLs.

APPENDIX B

SMARM Issue Papers, Clarification Papers, and Status Reports

The issue papers and status reports presented at the 1999 SMARM are listed in the following table and posted on the U.S. Army Corps of Engineers, Seattle District, Dredged Material Management Office (DMMO) homepage. Clarification papers and status reports that were not presented at the SMARM, are also included in the table and are posted on the DMMO homepage. The following is the DMMO homepage site:

URL http://www.nws.usace.army.mil/dmmo/homepage.htm

List of 1999 SMARM Papers[1]

Title	Type of Paper	Lead Author	Topic Presented
PCB analysis: A tiered approach to making congener-specific measurements in sediment and tissues	Issue	Erika Hoffman	Yes
Clarification on the DMMP policy on blank correction for method blank contaminated chemical samples	Clarification	David Kendall	No
Clarification on the use of the amphipod, *Eohaustorius estuarius*, relative to grain size and salinity	Clarification	David Kendall	No
Discontinuation of Corps and DNR supplied Global Positioning System equipment for open-water disposal	Clarification	Tina Tong	No
Revisions to Puget Sound Apparent Effects Thresholds (AETs)	Status	Tom Gries	Yes
Puget Sound Confined Disposal Site Study	Status	Steve Babcock	Yes
National and Regional Developments of Interest	Status	Justine Barton	No
Bellingham Bay Demonstration Pilot	Status	Lucy Pebles	Yes
Policy questionnaire on TBT porewater protocols: Results, discussion, and recommendations for analytical studies	Status	Teresa Michelson	Yes
Analytical Questionaire on TBT porewater protocols: Results, Discussion, and recommendations for analytical studies	Status	John Hicks	Yes
Developing a tissue trigger level for bioaccumulated TBT in marine benthic organisms: A Superfund Case Study	Status	Karen Keeley	Yes
Evaluation of potential Confined Aquatic Disposal facilities in Bellingham Bay	Public Issue	Clay Patmont	Yes

Title	Type of Paper	Lead Author	Topic Presented
Letter from WPPA to DMMP questioning the status of various unresolved CSMP policy issues	Public Issue	Eric Johnson	Yes
Characterizing exposure and effects of TBT in bivalves using tissue chemistry and sublethal endpoints	Public Issue	Michael & Sandra Salazar	Yes

1 All papers are posted on the Seattle District/Dredged Material Management Office homepage at URL http://www.nws.usace.army.mil/dmmo/homepage.htm

APPENDIX C

SMARM Overheads

LIST OF OVERHEADS

Brian Applebury

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Ovrhd 1-4.	Dredged Material Management Program Overview
Ovrhd 1-5.	SMS Group Overview
Ovrhd 1-6.	DMMP/CSMP Issue Paper and Status Report
Ovrhd 1-7.	Public Issue Paper(s)
Ovrhd 1-8.	TBT Issues Subsession
Ovrhd 1-9.	Papers (not presented)
Ovrhd 1-10.	Summary and Closing
Ovrhd 1-11.	SMS Issues Summary

David Kendall

Ovrhd 2-1.	DMMP Program Accomplishments
Ovrhd 2-2.	DMMP Program Accomplishments (cont'd)
Ovrhd 2-3.	DMMP Program Accomplishments (cont'd)
Ovrhd 2-4.	Overview of DMMP Project Testing Activities
Ovrhd 2-5.	Dredging Year 1999 Projects
Ovrhd 2-6.	Dredging Year 1999 Projects: Suitable/Unsuitable Material
Ovrhd 2-7.	Completed Testing Outcome Summaries
Ovrhd 2-8.	DY98/99 Bioassay Hits
Ovrhd 2-9.	DY96/97 Bioassay Hits
Ovrhd 2-10.	DY98/99 Testing Summary - PCBs
Ovrhd 2-11.	DY98/99 Testing Summary - Total DDT
Ovrhd 2-12.	DY98/99 Testing Summary - Mercury
Ovrhd 2-13.	DY98/99 Testing Summary – TBT ion in porewater
Ovrhd 2-14.	Dredging Year 1999 Projects – Puget Sound
Ovrhd 2-15.	Dredging Year 1999 Projects – Grays Harbor/Willapa Bay
Ovrhd 2-16.	Dredging Year 1999 Projects – Columbia River

Ted Benson

Ovrhd 3-1.	Site Management
Ovrhd 3-2.	The New Monitoring Contract
Ovrhd 3-3.	PSDDA Disposal Site Monitoring Contract Proposal Evaluation Scoring Matrix
Ovrhd 3-4.	Contract Deliverables
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Ovrhd 3-6.	Physical Monitoring in Commencement Bay
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Brett Betts

Ovrhd 4-1.	Sediment Management Standards Program Presentation Outline
Ovrhd 4-2.	SMS Rule Revision – Background
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Ovrhd 4-4.	SMS Rule Revision – Focus Areas (cont'd)
Ovrhd 4-5.	SMS Rule Revision – Endangered Species Act
Ovrhd 4-6.	SMS Rule Revision – Schedule
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Marian Abbett

Ovrhd 5-1.	Regional Cleanup Activities
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Erika Hoffman

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Ovrhd 7-3.	Problem Identification: Congener Method – Congeners as Reference Material
Ovrhd 7-4.	Problem Identification: Congener Approach Consistent with Regional and National Programs
Ovrhd 7-5.	Proposed Modification: Overview of Tiered Approach
Ovrhd 7-6.	Proposed Modification: Core List of Congers (IUPAC #)
Ovrhd 7-7.	Proposed Modification: Criteria for "Core List"
Ovrhd 7-8.	Proposed Modification: Sediment Screening
Ovrhd 7-9.	Proposed Modification: NS&T Method to Estimate Total PCBs from Σ18 Congeners
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Tom Gries (AET)

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Ovrhd 8-5.	AET Updates: Collaborative Process (cont'd)
Ovrhd 8-6.	AET Updates: Potential Trace Metal AETs for Puget Sound (Apr 1999)
Ovrhd 8-7.	AET Updates: Policy Issues, Recommendations, and Possible Decisions
Ovrhd 8-8.	AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)
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Ovrhd 8-10.	AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)
Ovrhd 8-11.	AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)
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Ovrhd 8-13.	AET Updates: Number, Rank, and Type
Ovrhd 8-14.	AET Updates: Possible Implications
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Tom Gries (MUDs)

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Ovrhd 9-7.	Immediate Issues (cont'd)
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Ovrhd 9-9.	Next Steps

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Clay Patmont

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Ovrhd 10-3.	What is the Problem?
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Ovrhd 10-5.	Objectives
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Ovrhd 10-8.	Current Design Guidance
Ovrhd 10-9.	Seismic Stability
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Ovrhd 10-13.	Conceptual Designs for Environmental Review
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Karen Keeley

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Ovrhd 11-5.	Why TBT?
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Ovrhd 11-8.	TBT Tissue Trigger Level
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Ovrhd 11-10.	Weight-of-Evidence Approach
Ovrhd 11-11.	TBT Tissue-Residue Effects Data for Marine Invertebrates
Ovrhd 11-12.	EPA Recommendations
Ovrhd 11-13.	How Many Stations Exceeded EPA's Site-Specific Trigger Value?
Ovrhd 11-14.	Study Results
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John Hicks

Ovrhd 12-1.	Analytical Questionnaire on TBT Porewater Protocols: Results, Discussion, and Recommendations for Analytical Studies
Ovrhd 12-2.	Purpose and Goals of Butyltin Questionnaires
Ovrhd 12-3.	Questionnaire Focus
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Teresa Michelson

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Ovrhd 13-5.	Q2. Research Needs
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Ovrhd 13-7.	Q3. Evaluation of Deep Sediments
Ovrhd 13-8.	Follow-up Q1: Request for Data
Ovrhd 13-9.	Follow-up Q2: Recommendations
Ovrhd 13-10.	Summary of Recommendations: Policy Issues Forwarded to DMMP
Ovrhd 13-11.	Summary of Recommendations: Recommended Analytical Studies

Mike Salazar

Ovrhd 14-1.	Characterizing Exposure and Effects of TBT in Bivalves Using Tissue Chemistry and Sublethal Endpoints
Ovrhd 14-2.	Why Characterize Exposure?
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Ovrhd 14-4.	Bivalve Effects Endpoints
Ovrhd 14-5.	Calibrating Bioaccumulation with Changes in Tissue Weight
Ovrhd 14-6.	Quantifying Bivalve Health
Ovrhd 14-7.	Test Acceptance Criteria
Ovrhd 14-8.	Exposure-Dose-Response Triad
Ovrhd 14-9.	Bioaccumulation Links
Ovrhd 14-10.	"Canary in a Coal Mine"
Ovrhd 14-11.	The Relationship Between TBT in Seawater and Tissue Changes at 100 ng TBT/L
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Ovrhd 14-13.	Summary and Conclusions
Ovrhd 14-14.	Recommendations

1999 SEDIMENT MANAGEMENT ANNUAL REVIEW MEETING

Ovrhd 1-1. 1999 Sediment Management Annual Review Meeting

SMARM Jointly Sponsored
by the
Dredged Material Management Program
and the SMS Group

Ecology Headquarters: Main Auditorium
Lacey, WA

May 5, 1999

Hosted by Washington State Department of Ecology

Ovrhd 1-2. SMARM Jointly Sponsored by the Dredged Material Management Program and the SMS Group

MEETING OBJECTIVES AND PURPOSE

- Obtain public input on proposed changes to the Dredged Material Management Program (DMMP) Management Plans per Issue Paper and Clarification Papers posted on the Corps/Dredged Material Management Office's Homepage: (URL: www.nws.usace.army.mil/dmmo/homepage.htm)
- Discuss disposal site management actions and changes.
- Presentation and discussion of Public Issue Papers.
- Comments and discussion on Status Reports of ongoing actions of DMMP and SMS Group.

Ovrhd 1-3. Meeting Objectives and Purpose

Dredged Material Management Program Overview

- Summary of accomplishments since the previous Annual Review Meeting
- Summary of DMMP project / testing activities
- Disposal site monitoring activities

Ovrhd 1-4. Dredged Material Management Program Overview

SMS Group Overview

- SMS activities and Annual Review
- Regional cleanup activities
- Survey of Sediment Quality in Puget Sound - Year 1 - Northern Puget Sound
- Commercial species harvest and scientific collector's permits

Ovrhd 1-5. SMS Group Overview

DMMP / CSMP Issue Paper and Status Reports

- PCB Analysis: Transition to congener-specific measurements in sediments and tissues (Issue Paper)
- Revisions to Puget Sound Apparent Effects Thresholds (AETs) (Status Report)
- Multi-user Confined Disposal Study (Status Report)
- Bellingham Bay Demonstration Pilot Project (Status Report)

Ovrhd 1-6. DMMP/CSMP Issue Paper and Status Report

Public Issue Paper(s)

- Evaluation of potential Confined Aquatic Disposal facilities in Bellingham Bay (Clay Patmont, Anchor Environmental)
- Letter from WPPA to DMMP questioning the status of various unresolved CSMP policy issues (Eric Johnson, WPPA)

Ovrhd 1-7. Public Issue Paper(s)

TBT Issues Subsession:

- **Developing a tissue trigger level for bioaccumulated TBT in marine benthic organisms: A Superfund Case Study (Karen Keeley, EPA)**
- **Analytical questionnaire on TBT porewater protocols: Results, discussion, and recommendations for analytical studies (John Hicks, Striplin Environmental)**
- **Policy questionaier on TBT porewater protocols: Results, discussion, and recommended analytical studies (Teresa Michelsen, Avocet Consulting)**
- **Characterizing exposure and effects of bioaccumulative chemicals in bivalves using tissue chemistry and sublethal endpoints (Mike Salazar, Applied Biomonitoring)**

Ovrhd 1-8. TBT Issues Subsession

Papers (not presented)

- Clarification on the DSMMP policy on blank correction for method blank contaminated chemical samples (Clarification paper)
- Clarification on the use of the amphipod, Eohaustorius estuarieus, relative to grain size and salinity (Clarification paper)
- Discontinuation of Corps and DNR supplied Global Positioning System equipment for open-water disposal (Clarification paper)
- National Sediment Initiatives (Status Report)

Ovrhd 1-9. Papers (not presented)

Summary and Closing

- Public Issues Summary (Agencies will convene a post-SMARM meeting on June 3, 1999 to review and prioritize public issues for DMMP action. The meetin minutes and updated tasklist will be posted on the DMMO homepage: URL: nws.usace.army.mil/dmmo/homepage.htm
- Written comments may be submitted on the SMARM proceedings, but must be submitted to the DMMP agencies by May 26, 1999 for consideration.

Ovrhd 1-10. Summary and Closing

SMS Issues Summary

- Written comments may be submitted for SMS annual review for consideration by June 2, 1999

Ovrhd 1-11. SMS Issues Summary

DMMP Program Accomplishments

- DNR Awards contract to Battelle NW to evaluate the amphipod, Leptocheirus sensitivity to TBT relative to various endpoints (mortality, growth, and reproductive), as well as its concordance with existing DMMP species testing suite.

- DMMO is currently updating the Dredged Analysis Information System (DAIS) to make it Y2K2 compliant and windows compatible. Expected completion date is September 1999.

Ovrhd 2-1. DMMP Program Accomplishments

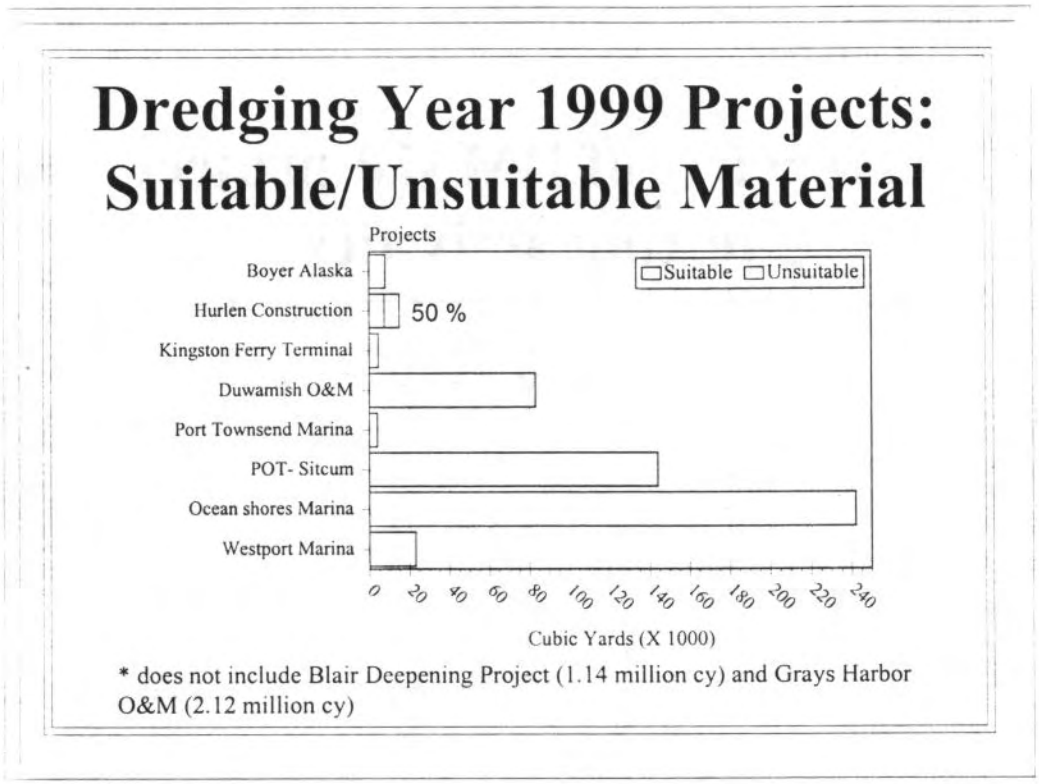
- Columbia River Dredged Material Manual finalized - November 1998

- Public review draft EIS was released for the Puget Sound Confined Disposal Site Study in February 1999.

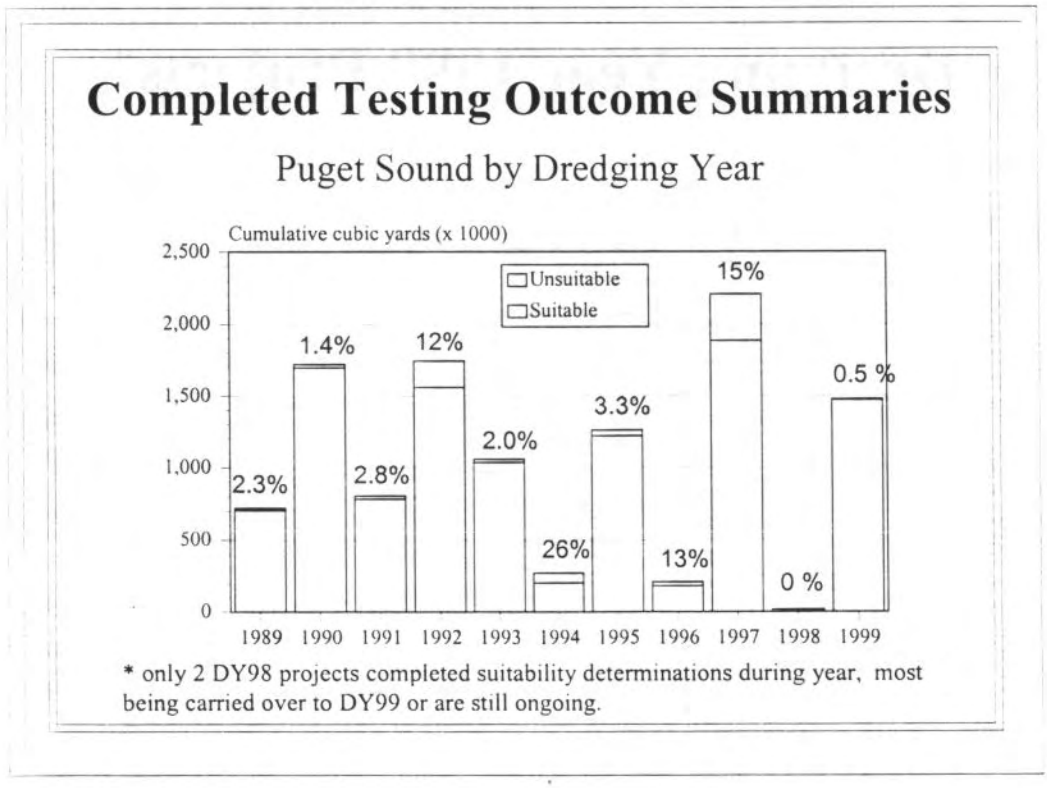
Ovrhd 2-2. DMMP Program Accomplishments (cont'd)

- The Bellingham Bay Pilot Study will issue its draft SEPA EIS in June 1999
- The DMMP agencies issued interim TBT guidance during DY 1999.

Ovrhd 2-3. DMMP Program Accomplishments (cont'd)



Ovrhd 2-6. Dredging Year 1999 Projects: Suitable/Unsuitable Material



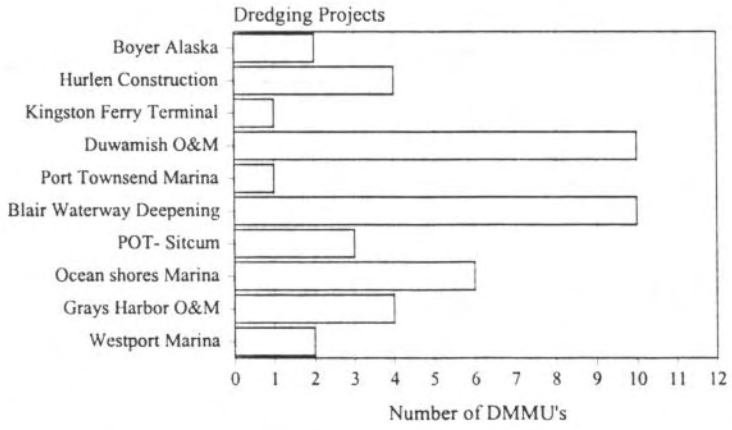
Ovrhd 2-7. Completed Testing Outcome Summaries

Overview of DMMP project testing activities

David Kendall
Dredged Material Management Office

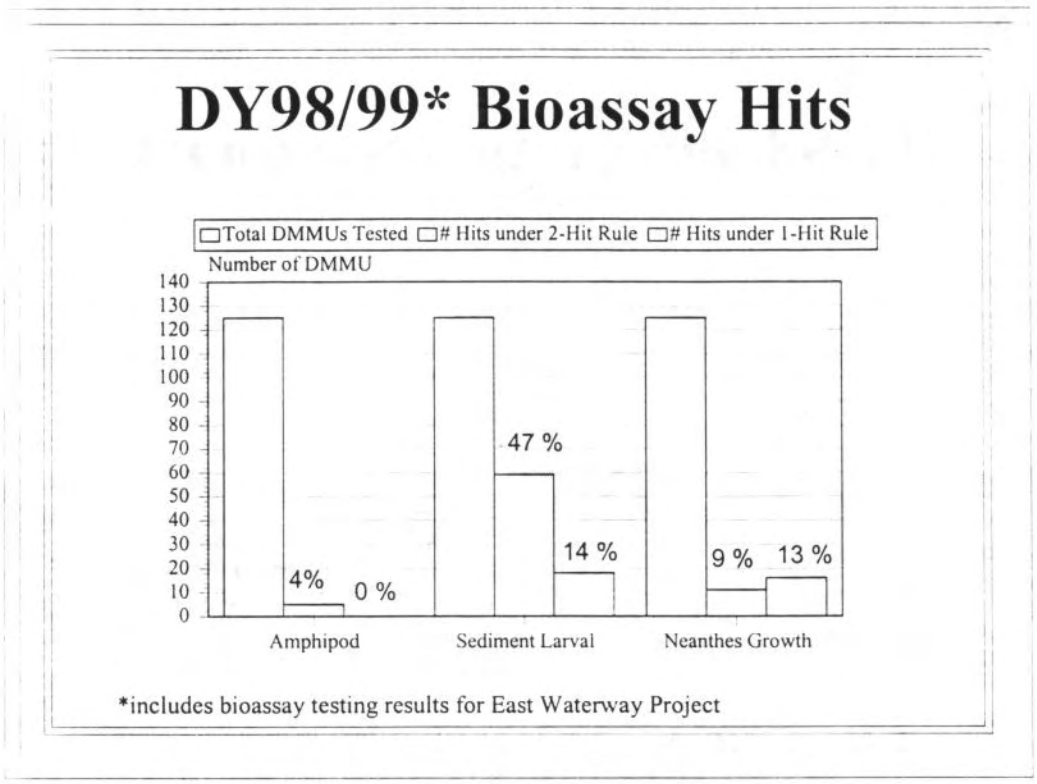
Ovrhd 2-4. Overview of DMMP Project Testing Activities

Dredging Year 1999 Projects*

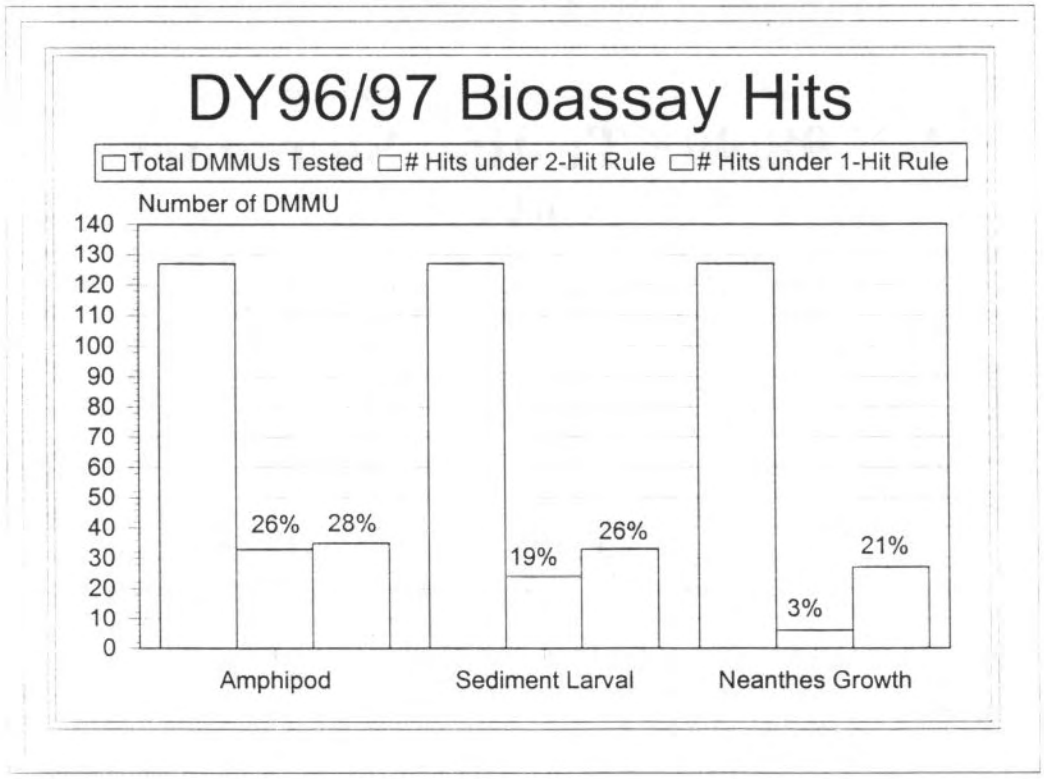


*excluding projects with no testing

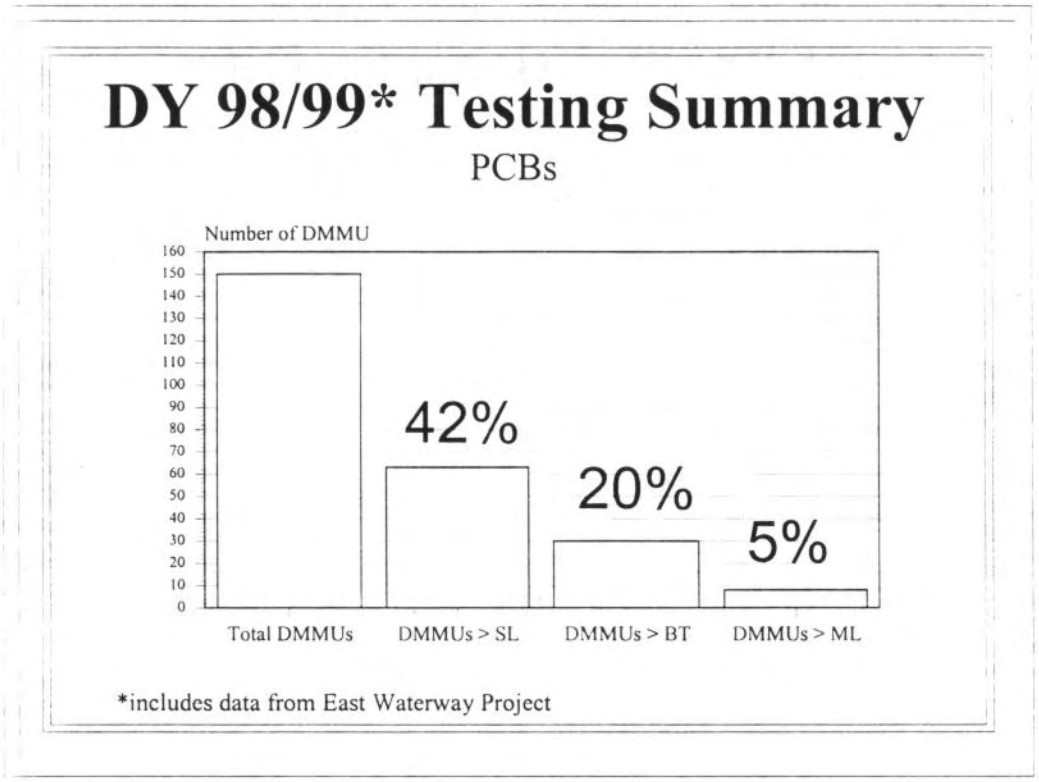
Ovrhd 2-5. Dredging Year 1999 Projects



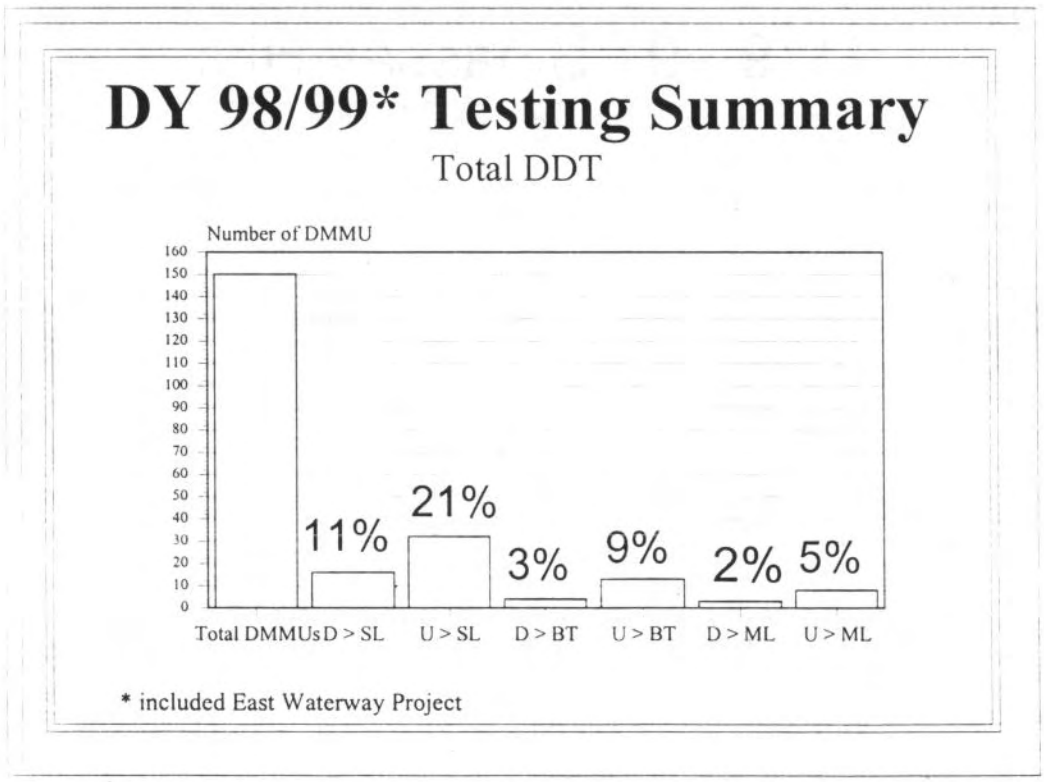
Ovrhd 2-8. DY98/99 Bioassay Hits



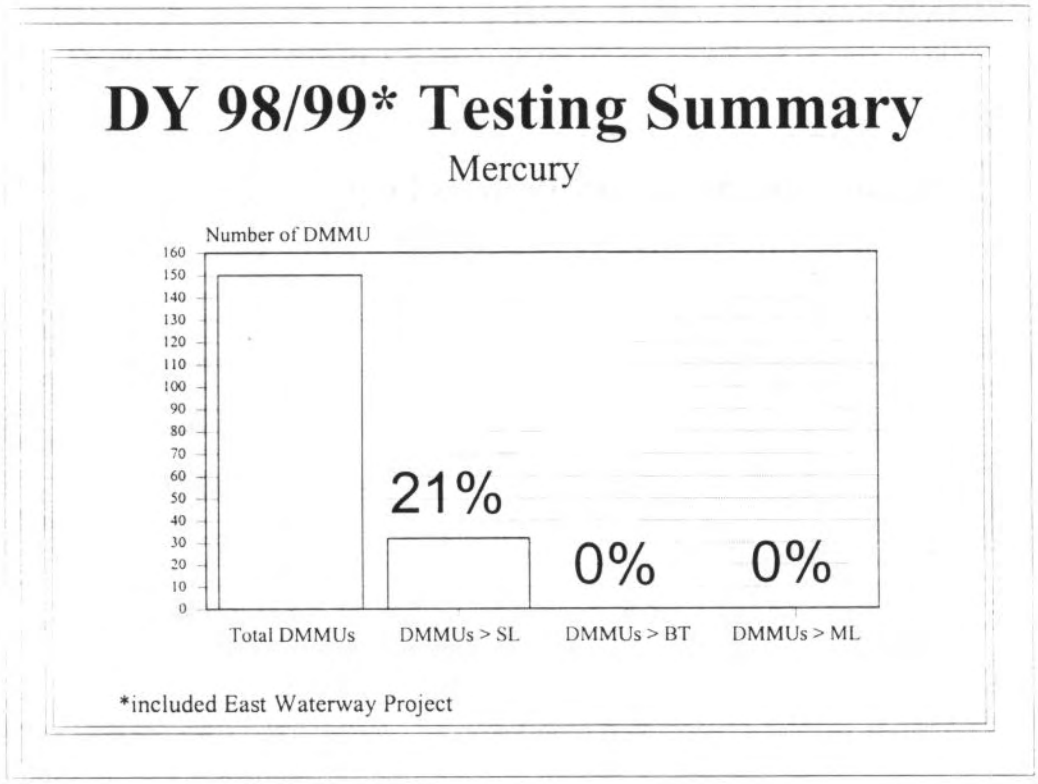
Ovrhd 2-9. DY96/97 Bioassay Hits



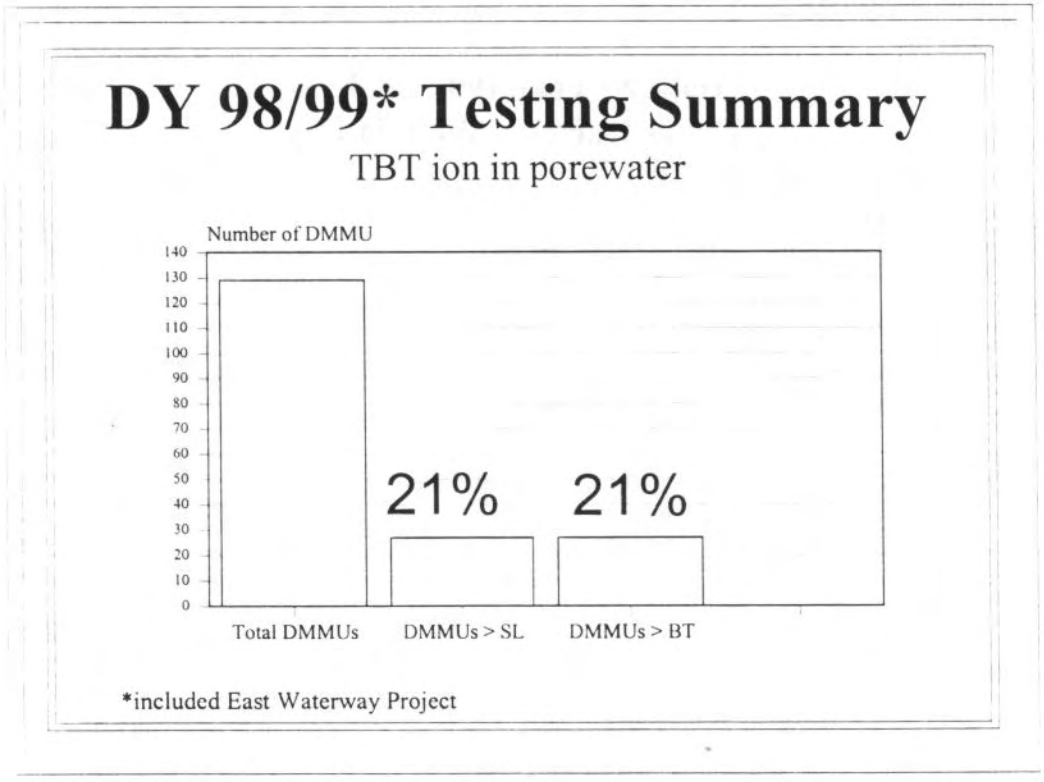
Ovrhd 2-10. DY98/99 Testing Summary - PCBs



Ovrhd 2-11. DY98/99 Testing Summary - Total DDT



Ovrhd 2-12. DY98/99 Testing Summary - Mercury



Ovrhd 2-13. DY98/99 Testing Summary – TBT ion in porewater

Dredging Year 1999 Projects Puget Sound

Hurlen Construction	15,000
Boyer Construction	8,000
Port of Anacortes - Curtis Wharf	45,000
Kingston Passenger only Ferry Terminal (WDOT)	4,500
Duwamish operations & maintenance (COE)	83,000
Port Townsend Marina	4,000
Blair Waterway Deepening (COE)	1,140,000
Lake Crockett Navigation (Keystone Ferry)(COE)	25,000
Port of Tacoma - Sitcom Waterway	144,000
Total:	1,468,600 cy

Ovrhd 2-14. Dredging Year 1999 Projects – Puget Sound

Dredging Year 1999 Projects Grays Harbor / Willapa Bay

Ocean Shores Marina (Quinault Land & Timber Enterprise)	241,920
Willapa Harbor - Bay Center Entrance (COE)	15,000
Grays Harbor operations & maintenance (COE)	2,120,000
Westhaven Cove (Westport) marina (COE)	23,000
Total:	2,399,920 cy

Ovrhd 2-15. Dredging Year 1999 Projects – Grays Harbor/Willapa Bay

Dredging Year 1999 Projects
Columbia River

Weyerhaeuser - Long View	150,000
Hells Canyon Marina (Snake River)	37,000
Total:	187,000 cy

Ovrhd 2-16. Dredging Year 1999 Projects – Columbia River

SITE MANAGEMENT

PSDDA Disposal Site Monitoring and Management by the Department of Natural Resources
Aquatic Resources Division

Ovrhd 3-1. Site Management

The New Monitoring Contract

One year contract, with 2 possible 1-year extensions.

- Two respondents to the RFP:
  - SAIC and Battelle Marine Science Laboratory;
  - SEA, EVS, AmTest, Dinnel, and Columbia Analytical.
- Proposals currently under review and assessment.
- Selection, originally scheduled for today, will be slipped 1 to 2 weeks.

Ovrhd 3-2. The New Monitoring Contract

PSDDA Disposal Site Monitoring Contract
Proposal Evaluation Scoring Matrix

Evaluation Factors	Maximum Points	Score	Comments
1. Technical Approach: Including capabilities, expertise, experience and past performance	40	_____	
2. Regional Familiarity: a. Overall knowledge of Puget Sound marine monitoring and testing	15	_____	
b. Knowledge of PSDDA biological, chemical and physical monitoring	10	_____	
3. Cost: a. Competitiveness of unit price.	20	_____	
b. Level of effort applied to items in Sec. C.	5	_____	
4. Completeness: Including clarity, organization and thoroughness of proposal	10	_____	
SCORE		_____	
5. Minority/Women Business	5% Score (BONUS)	_____	
TOTAL SCORE		_____	

Committee Member Name _____

Ovrhd 3-3. PSDDA Disposal Site Monitoring Contract Proposal Evaluation Scoring Matrix

Contract Deliverables

- A compilation of changes to the monitoring program;
  - All of the changes into a 3-ring binder;
  - Easily added into.
- One or more tiered-full monitoring events.
- Crab productivity study in Bellingham Bay.

Ovrhd 3-4. Contract Deliverables

TBT/*Leptocheirus* Toxicity Protocol

A R&D Contract with Battelle Marine Science Laboratory

- The contract is underway.
- Goal is one test with acute, chronic, and reproductive endpoints.
- Financed with existing PSDDA budget.
  - Funds from skipped biological monitoring;
  - Physical monitoring done by Corps of Engineers;
  - Scenario that allowed this probably not repeatable;
  - Final phase of Blair project due to start in September.

Ovrhd 3-5. TBT/*Leptocheirus* Toxciity Protocol

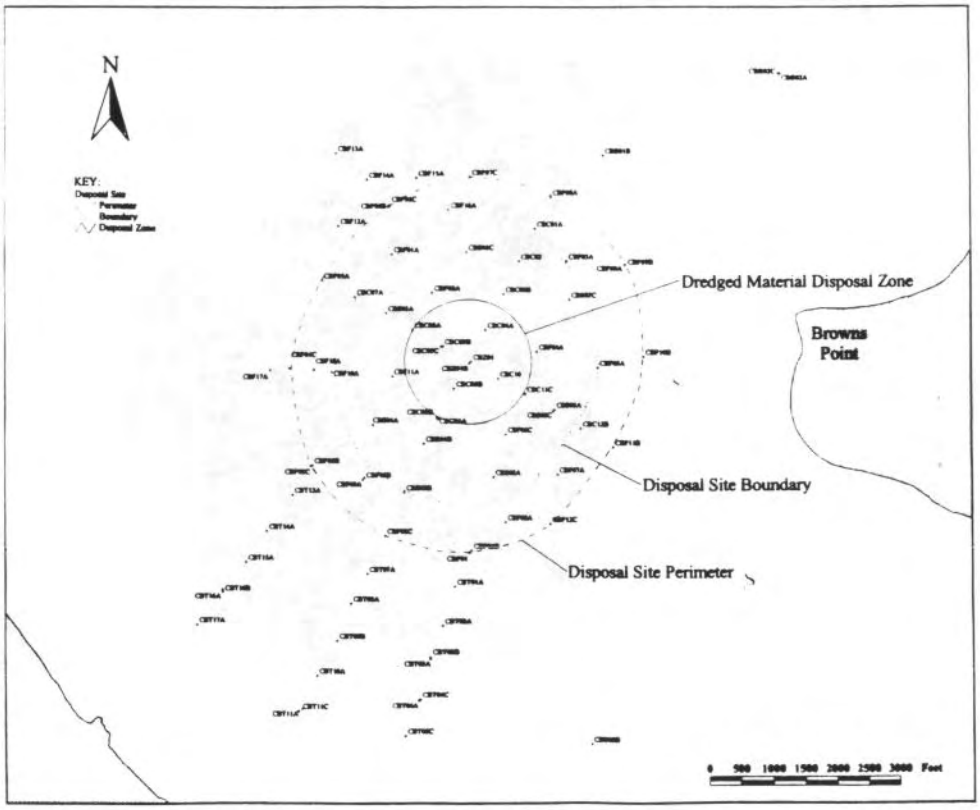
Physical Monitoring in Commencement Bay

Paid for by the Corps of Engineers

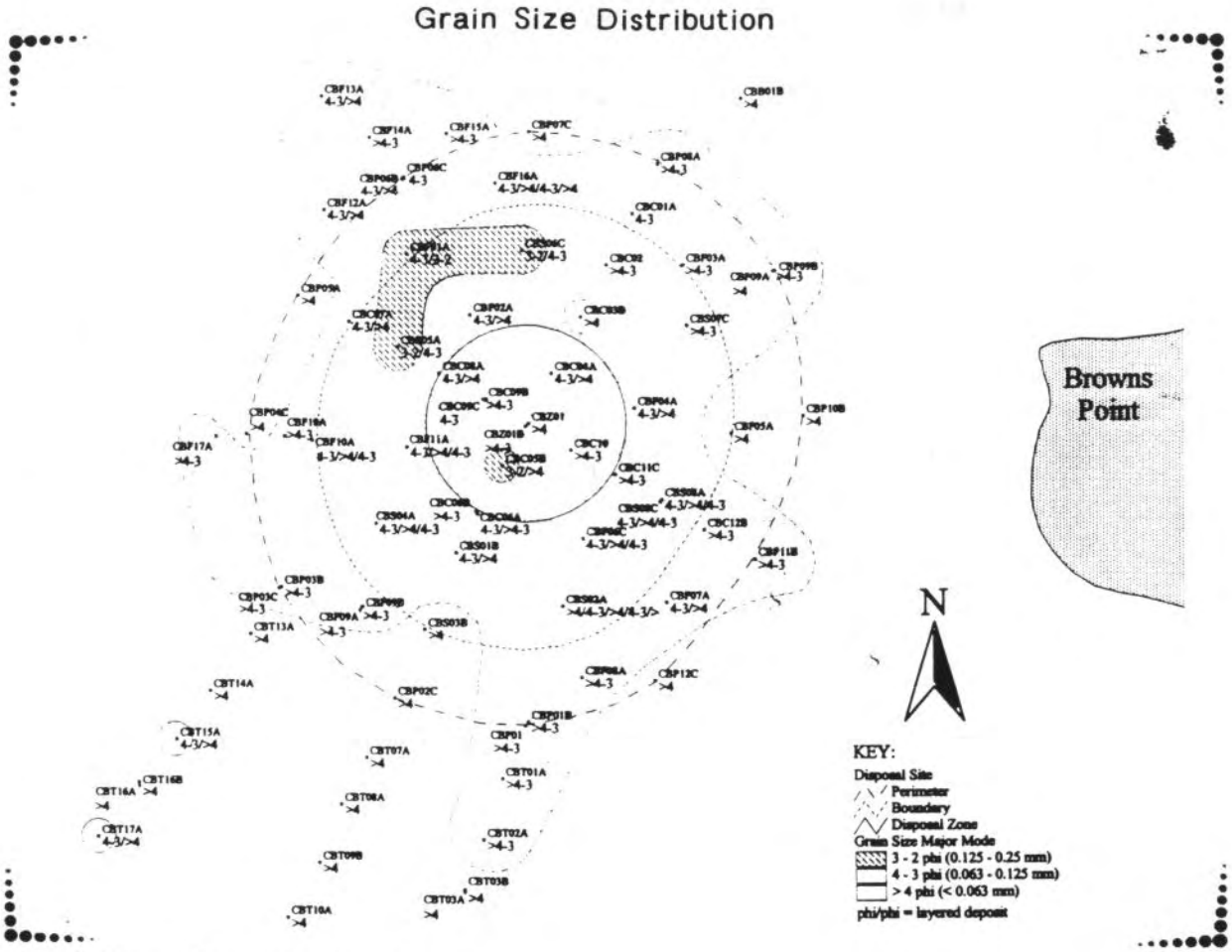
- SVPS work done by Striplin Environmental Associates.
- Interesting results, that may indicate a problem at the site.

Ovrhd 3-6. Physical Monitoring in Commencement Bay

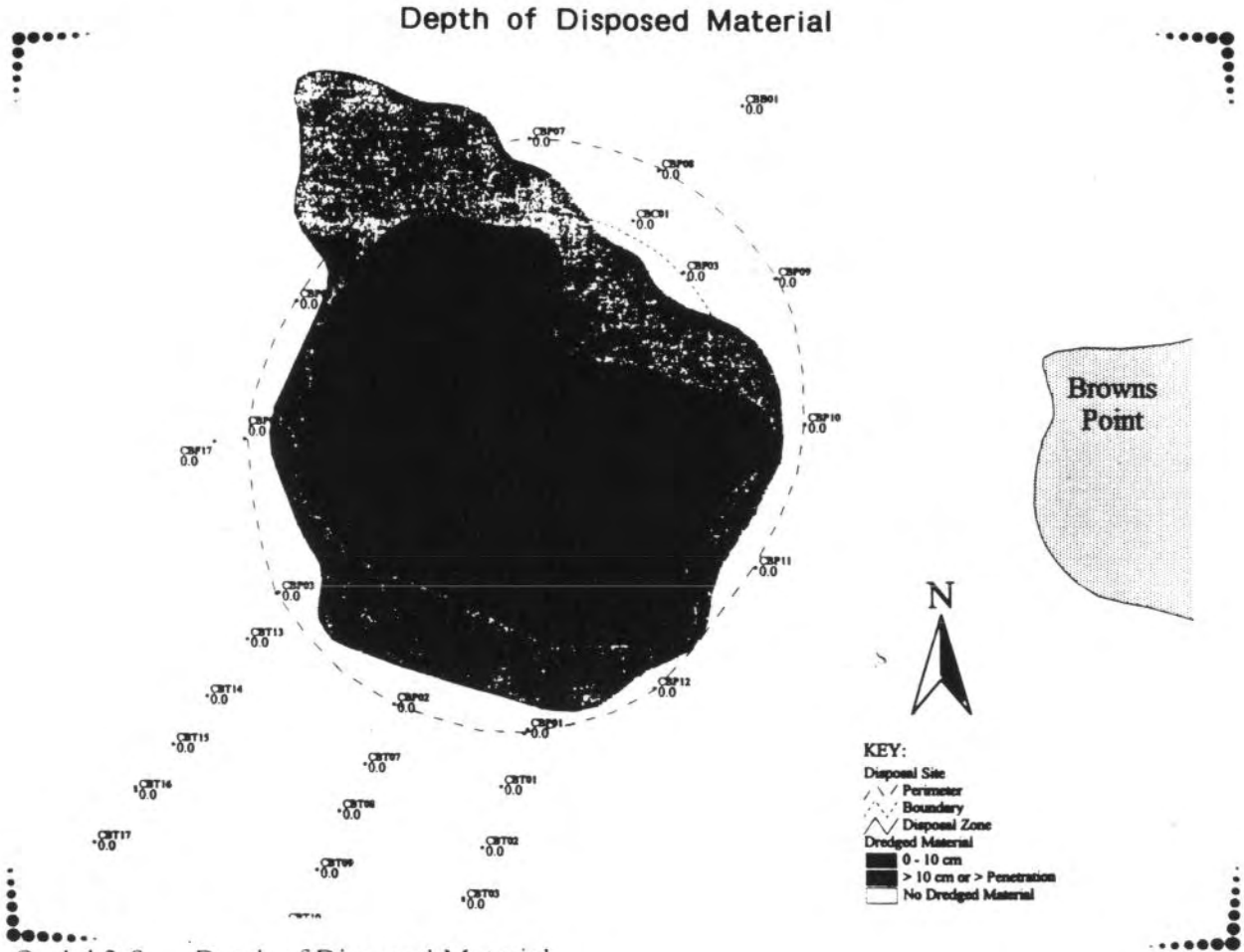
Commencement Bay SVPS Deployments



Ovrhd 3-7. Commencement Bay SVPS Deployments



Ovrhd 3-8. Grain Size Distribution



Ovrhd 3-9. Depth of Disposed Material

Assessment of Problem

- Review of Coast Guard record of barge positioning.
- Review of current patterns.
- Other research possible after above reviews.

Ovrhd 3-10. Assessment of Problem

Scheduled Biological Monitorings

To be done under the new contract.

- Port Gardner.
- Commencement Bay, after completion of the Blair Waterway deepening.
- Bellingham Bay crab productivity/harvesting assessment (possible).
- Anderson/Ketron;
  - Time triggered, not volume;
  - If funds allow.

Ovrhd 3-11. Scheduled Biological Monitoring

DNR Use Authorization Processing

- A minimum of 5 working days is required for processing.
- Processing starts after receipt of a complete application.
- Amendments usually require 3 working days after receipt of a complete application.

Ovrhd 3-12. DNR Use Authorization Processing

Sediment Management Standards Program Presentation -Outline-

- Provide update on the SMS rule revision process
- Summarize approach to address Endangered Species Act (ESA) issues
- Describe recent improvements to SEDQUAL Information System
- Describe technical development progress on benthic assessment recommendations

Ovrhd 4-1. Sediment Management Standards Program Presentation Outline

SMS Rule Revision - Background-

- **SMS Rule Review Requirements**:
  - Public comments from 1993, 1995, 1996
- **Triennial Review Started In 1995.**
  - April 1997 Draft final response to comments
- **SMS Implementation Committee**
  - Began meeting approx. every 3 weeks starting July 1998
- **SMS Rule Draft - December 1998**

Ovrhd 4-2. SMS Rule Revision – Background

SMS Rule Revision
- Focus Areas-

- **Sediment Quality Criteria**
  - December 1998 draft SMS rule identified six AET values
  - Port of Seattle AET recommendations - added *Neanthes* and Bivalve
  - Regulatory Workgroup recommendations
  - Chemical/biological criteria for other marine sediments
  - Key rulemaking issues:
    - » Number and type of AETs to consider for updating SMS rule
    - » TOC vs dry weight normalization
    - » Results of reliability analyses
- **Human Health Sediment Standards**
  - Use of consistent risk policies
  - Use of weight of evidence approach
  - Key issues to be addressed:
    - » Use of BSAF Values in criteria development
    - » Implementation Issues: background quality, cost, cleanup levels
  - Planned development of regression analyses for site-specific cleanup levels

Ovrhd 4-3. SMS Rule Revision – Focus Areas

SMS Rule Revision
- Focus Areas-

- **Sediment Cleanup**
  - SMS/MTCA Consistency
  - Types of Cleanup Actions
  - Implementation of Hotspot Approach
- **Other**
  - Sediment impact zone by rule for PSDDA disposal sites
  - Definition of contaminated sediment linked to MTCA hazardous substances
  - Freshwater bioassay tests and interpretations - RWG recommendations
- **Sampling and Analysis Plans, Recordkeeping and Data Reporting**
  - Accreditation requirements
  - Standardization of SAP / data reporting requirements

Ovrhd 4-4. SMS Rule Revision – Focus Areas (cont'd)

SMS Rule Revision
- Endangered Species Act-

- **SMS Rule will be reviewed by Services under ESA Section 7 Consultation**
  - Development of Biological Assessment
  - Early identification of SMS rule revisions to address ESA concerns
  - EPA, the Services and Ecology are exploring possible MOA for consultation process

Ovrhd 4-5. SMS Rule Revision – Endangered Species Act

SMS Rule Revision
- Schedule-

- **May 1999 - Revised draft SMS rule/Implementation Committee discussions**
- **Summer 1999 - Formal draft rule proposal in State Register**
- **Fall 1999 - Prepare rule changes and support documents:**
  - Environmental Impact Statement
  - Cost-Benefit Analysis
- **December 1999 - Adopt**

Ovrhd 4-6. SMS Rule Revision – Schedule

Sediment Quality Database
-Release Three-

- SEDQUAL developed by PTI in 1989
- Ecology initiated redevelopment in 1995 to address licensing, maintenance, distribution, GIS integration
- CD, local PC or network operations
- User and system documentation, data templates available
- Data retrieval by predefined report/query tools/wizard
- Supports data comparisons and results export
- Supports AET generation and reliability analyses
- Supports batch bioassay hit identification - test, reference and control statistical comparison
- Supports GIS integration and spatial impact area modeling

Ovrhd 4-7. Sediment Quality Database – Release Three

SMS Rule Revision
- Benthic Assessment Development

- Refinement of benthic recommendations presented at 1998 SMARM
- Final report Puget Sound Reference Value Project available includes changes to address:
  - Readability and clarification of previous work and reports
  - Explanation of revisions to benthic reference area performance standards
  - Inclusion of endpoint assessment data to support report recommendations
  - Recommended preferred endpoints and proposed a decision matrix for endpoint regulatory use

Ovrhd 4-8. SMS Rule Revision – Benthic Assessment Development

Regional Cleanup Activities

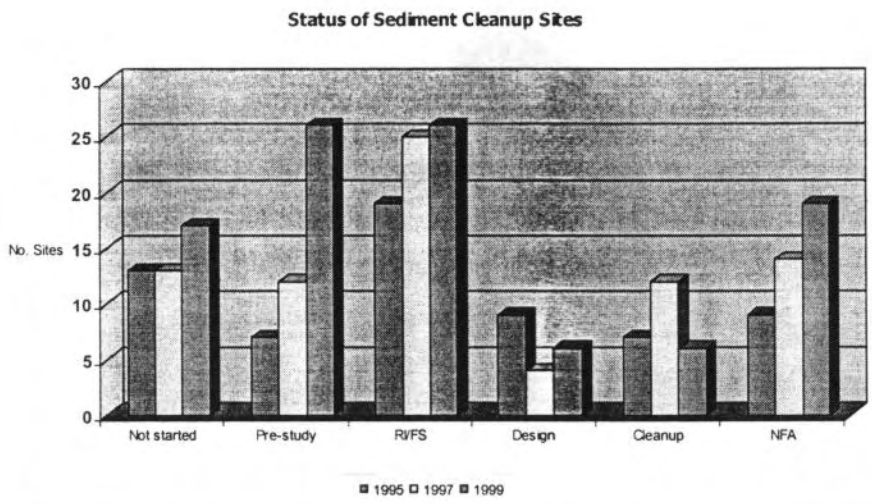
Ovrhd 5-1. Regional Cleanup Activities

Program Accomplishments

- Norfolk CSO cleaned up
- Lake Union data entered into SEDQUAL
- Completed Gray's Harbor Study
- Completed Budd Inlet Study
- Completed Port Angeles Harbor Study

Ovrhd 5-2. Program Accomplishments

Site Status



Ovrhd 5-3. Site Status

Data Nugget

- Contaminants of Concern at most sites
  - at 55% of sites - metals
  - at 18% of sites - mercury
  - at 35% of sites - PAHs
  - at 34% of sites - PCBs
  - at 14% of sites - TBT
  - at 7.5% of sites - wood debris

Ovrhd 5-4. Data Nugget

Future Plans

- 6 Record of Decision documents
- 2 cleanups to start
- Move sites forward in Lake Union
- Source control in Bellingham Bay
- Make decisions on how to manage Duwamish River
- Begin Columbia River Study

Ovrhd 5-5. Future Plans

Future Plans cont'd

- Develop new protocol for deleterious waste
- On-going freshwater protocol development
- On-going bioaccumulation, human health and tissue effects studies

Ovrhd 5-6. Future Plans (cont'd)

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

Margaret Dutch, Sandra Aasen, Christina Ricci, Kathy Welch
Washington State Department of Ecology
Marine Sediment Monitoring Team
Olympia, WA
Ed Long
National Oceanic and Atmospheric Administration
Seattle, WA

Ovrhd 6-1. Survey of Sediment Quality in Puget Sound: Year 1 – Northern Puget Sound

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

Purpose of today's talk:

- Relate current PSAMP Sediment Component monitoring activities
- Learn status of other sediment programs in Puget Sound…identify areas of overlap?
- Make contacts and solicit input regarding future PSAMP sediment monitoring

Ovrhd 6-2. Purpose of Today's Talk

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

NOAA's National Status and Trends' Bioeffects Monitoring Program

PSAMP Sediment Monitoring Component

Joint Goal:

- **To characterize the toxicity, chemical contamination, and benthic infaunal assemblage structure of the sediments as a measure of adverse biological effects of toxic chemicals in northern Puget Sound.**

Ovrhd 6-3. NOAA's National Status and Trends' Bioeffects Monitoring Program/PSAMP Sediment Monitoring Component

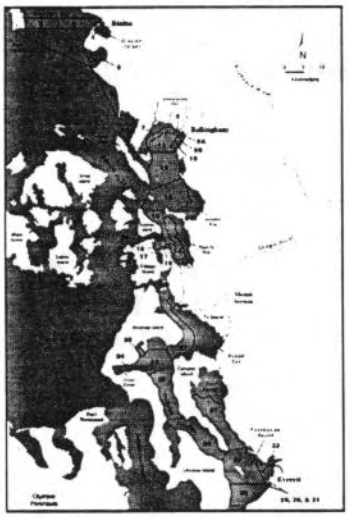
Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

Ecology/NOAA Project Design:

- **Random-stratified sampling design**
- **Sediment Quality Triad approach**
- **collection and analysis of sediment and infauna from 300 stations throughout Puget Sound:**
  - **100 stations - Northern Puget Sound - 1997**
  - **100 stations - Central Puget Sound - 1998**
  - **100 stations - Southern Puget Sound - 1999**

Ovrhd 6-4. Ecology/NOAA Project Design

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

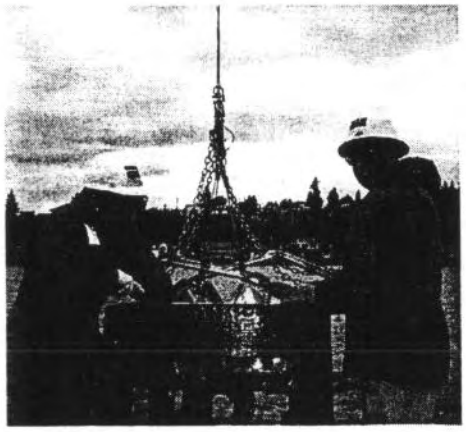


Ecology/NOAA STUDY DESIGN:

- **study area - 806 km² from US/Canadian boarder to Everett Harbor**
- **33 strata chosen - from 0.15 to 129 km² (37 km² median)**
- **100 stations - 3 (4) randomly chosen in each strata**
- **strata with "homogeneous" hydrographic, bathymetric, sedimentological conditions**

Ovrhd 6-5. Ecology/NOAA Study Design

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound



Ecology/NOAA SAMPLING PROCEDURES:

- **sampling from R/V Kittiwake, June 1997**
- **double vanVeen grab**
- **top 2-3 cm of sediment from 3-6 grabs per station homogenized for toxicity and chemical analysis**
- **1 infaunal grab per station**

Ovrhd 6-6. Ecology/NOAA Sampling Procedures

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

TOXICITY TESTING (weight of evidence):

- **Amphipod 10-day survival (*A. abdita*) - solid phase**
  - **endpoint = mean amphipod survival**
- **Urchin fertilization (*S. purpuratus*) - pore water**
  - **endpoint = mean percent fertilization**
- **Microbial bioluminescence (Microtox™) - organic solvent extract**
  - **endpoint = EC50 mean mg/ml**
- **Cytochrome P450 RGS - organic solvent extract**
  - **endpoint = benzo[a] pyrene equivalents (μg/g)**

Ovrhd 6-7. Toxicity Testing (weight of evidence)

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

TOXICITY DESIGNATION:

Endpoint measurements for each sample examined for qualification as:

- **"significantly" toxic** = significantly different from negative control values
- **"highly" toxic** = significantly different from negative control values **AND** significant difference from specific critical values (calculated with power analysis)

Ovrhd 6-8. Toxicity Designation

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

CHEMICAL ANALYSES:

- **171 physical parameters and chemical substances quantified, including:**
  - **grain size**
  - **TOC**
  - **trace metals**
  - **organics, including:**
    - **PAHs, chlorinated pesticides, PCB congeners and Aroclors, organotins, phenols, and others**

Ovrhd 6-9. Chemical Analyses

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

CHEMICAL ANALYSES, critical values:

- **Effects Range - Low (ERL) values**
- **Effects Range - Median (ERM) values**

  Long et al., 1995
- **Marine Sediment Quality Standards (SQS)**
- **Puget Sound Marine Sediment Cleanup Screening Levels (CSL)**

  Washington State Sediment Management Standards – Chapter 173-204 WAC

Ovrhd 6-10. Chemical Analyses, Critical Values

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

BENTHIC INFAUNAL ANALYSES:

- Organisms **sorted**, **enumerated**, and **identified** to lowest taxonomic level possible
- **Benthic infaunal indices calculated**, including:
  - **Total abundance** -# organisms/sample area
  - **Major taxa abundance** - # organisms/major taxa group
  - **Taxa richness** - # taxa/sample area
  - **Pielou's evenness** - equitability of distribution of individuals among taxa
  - **Swartz's Dominance Index** - # taxa accounting for 75% of total abundance per sample

Ovrhd 6-11. Benthic Infaunal Analyses

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

DATA ANALYSIS TO ADDRESS OBJECTIVES:

1. to determine the **incidence and severity** of sediment toxicity

- **HOW:**
  - **incidence** = percentage of the 100 samples identified as "**significantly**" or "**highly**" toxic
  - **severity** = range in response of the toxicity of the 100 sediment samples as compared to controls

Ovrhd 6-12. Data Analysis to Address Objectives

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

DATA ANALYSIS TO ADDRESS OBJECTIVES:

2. to identify **spatial patterns and gradients** in toxicity and chemical concentrations

➢**HOW:**

➢**toxicity endpoints** and **chemistry values** exceeding effects-based numerical guidelines **plotted on strata maps**

Ovrhd 6-13. Data Analysis to Address Objectives (cont'd)

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

DATA ANALYSIS TO ADDRESS OBJECTIVES:

3. to estimate the **spatial extent** of chemical contamination and toxicity in surficial sediments

➢**HOW:**

➢**calculate sum** of the sample-weighted sizes of each stratum (km^2) which are "highly" toxic or have chemical values exceeding criteria (i.e., cumulative frequency distribution)

Ovrhd 6-14. Data Analysis to Address Objectives (cont'd)

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

DATA ANALYSIS TO ADDRESS OBJECTIVES:

4. to **estimate relationships** between sediment toxicity, chemical concentrations, and benthic infaunal indices

➢**HOW:**

➢use of **Spearman-rank correlations** to **identify covariance** among all combinations of variables

Ovrhd 6-15. Data Analysis to Address Objectives (cont'd)

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

DATA ANALYSIS TO ADDRESS OBJECTIVES:

5. to compare the quality of sediments from north, central, and south Puget Sound, and to **compare Puget Sound sediments to sediments from other estuaries nationwide**

➢**HOW:**

➢**comparison** of **spatial extent calculations** to those from **nationwide** NOAA bioeffects surveys

Ovrhd 6-16. Data Analysis to Address Objectives (cont'd)

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

RESULTS - TOXICITY TESTING

- Highly significant toxicity:
  - **amphipod survival - 0%**
  - **urchin fertilization - 5%**
  - **microbial bioluminescence - 2%**
  - **Cytochrome P450 RGS - 0.02%**
- All tests except amphipod survival indicated **Everett Harbor stations** were the **most contaminated**
- Stations in **Saratoga Passage**, **Possession Sound**, and majority of **Port Gardner Bay** exhibited the **lowest toxicity**
- Spatial extent of toxicity estimates for **northern Puget Sound** generally **lower** than **"national average"** estimates compiled by NOAA

Ovrhd 6-17. Results – Toxicity Testing

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

Spatial extent of sediment toxicity:
Comparison of sediments from northern Puget Sound
to other US bays and estuaries

	No. of samples	Total area (km2)	Toxic area (km2)	Percent of total area
Amphipod survival:				
(from 24 U.S. bays & estuaries)				
National Average - 1995	1274	2532.6	277	10.9
National Average - 1996	1470	4158.1	286.4	6.9
No. Puget Sound	**100**	**806**	**0**	**0**
Urchin fertilization:				
(from 23 U.S. bays & estuaries)				
National Average - 1995	940	2082.6	886.3	42.6
National Average - 1996	1136	3723.26	1439.73	38.7
No. Puget Sound	**100**	**806**	**40.6**	**5**
Microbial bioluminescence:				
(from 17 U.S. bays & estuaries)				
National Average - 1995	846	2416.2	1482.3	61.3
National Average - 1996	1042	4039.22	2670.69	66.1
No. Puget Sound	**100**	**806**	**17.7**	**2.2**
Cytochrome P450 RGS				
National Average - 1995	n/a - national estimates of spatial extent could not be made due to sampling of non-random stations			
National Average - 1996				
No. Puget Sound	**100**	**806**	**0.2**	**0.02**

Ovrhd 6-18. Spatial Extent of Sediment Toxicity

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

RESULTS - CHEMICAL ANALYSIS

- **Most stations not highly contaminated**, majority of chemical concentrations were below effects-based criteria
- Chemical concentrations **most elevated** in/near urbanized/industrialized embayments - **Everett Harbor**, **Bellingham Bay**, **Anacortes**; and **lowest** near less developed areas - **Samish Bay**, **Padilla Bay**, **Saratoga Passage**, **Port Susan**, and **southern Strait of Georgia**.
- Correlation analyses suggest that responses in **toxicity tests strongly associated with presence of complex mixtures of chemicals** (urchin fertilization with metals, HPAH with Cytochrome P450RGS)
- **Correlations** between toxicity and chemical data **driven**, in part, by **Everett Harbor data**

Ovrhd 6-19. Results – Chemical Analysis

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

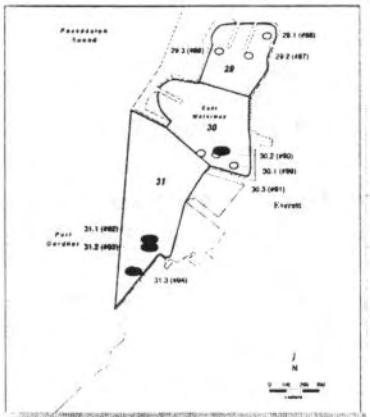
RESULTS - INFAUNAL ANALYSIS

- Infaunal indices displayed **wide range of results** between, and sometimes within, strata
- Correlation analyses indicated strong **inverse relationships** between **taxa richness** and **Mollusca abundance** vs. **percent fines**, **percent TOC**, and concentrations of many **chemicals**
- Sediment Triad data currently being examined together to form a **"weight-of-evidence"** (Chapman, 1996)
  - Data from the 9 inner Everett Harbor stations provided strong **evidence of "pollution-induced degradation"**

Ovrhd 6-20. Results – Infaunal Analysis

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

Forming a Weight of Evidence (Chapman, 1996)



Everett Harbor

Stations with evidence for pollution-induced degradation

Stratum	Sample	No. of detected compounds exceeding: ERM	SQS	CSL	Mean Urchin Fertilization in 100% pore water as % of control (all highly toxic)	Total Abundance	Species Richness
29	86	9	2	1	23	54	7
29	87	1	1	1	12	109	9
29	88	1	2	2	50	40	4
30	89	5	2	2	0	74	7
30	90	2	2	2	1	503	40
30	91	1	2	2	0	92	21
31	92	6	3	2	5	226	34
31	93	3	2	2	2	574	50
31	94	2	6	2	68	813	78

Ovrhd 6-21. Forming a Weight of Evidence (Chapman, 1996)

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

SUMMARY

- Study results **quantify** the incidence, severity, spatial extent, and spatial patterns of toxicity and chemical contamination throughout northern Puget Sound, establishing a **baseline.**
- **Relationships** between sediment toxicity, chemical concentrations, and infaunal indices are examined together, forming a **weight-of-evidence** both for and against **pollution-induced degradation** at suites of stations in northern Puget Sound.
- Northern, central, and southern Puget Sound sediments will be compared to provide quantitative **assessment of sediment quality throughout the Sound**.
- Northern Puget Sound sediments can be **compared** to sediments from estuaries around the country.

Ovrhd 6-22. Summary

Survey of Sediment Quality in Puget Sound
Year 1 - Northern Puget Sound

Future PSAMP Sediment Work

- **EPA EMAP in Puget Sound - 1999+**
- **Temporal element - 2000+**
  - **continued long-term, annual sampling at 10 historical stations**
- **Spatial element - 2001+**
  - **rescale NOAA partnership program, revisit strata of interest, assess changes over time**
- **Other efforts/focus/collaborations???**

Ovrhd 6-23. Future PSAMP Sediment Work

PCB ANALYSIS:

A tiered approach to making congener-specific measurements in sediments and tissues

Ovrhd 7-1. PCB Analysis

Problem Identification

- Aroclor Method - comparing to commercial standard
  - Requires subjective decision-making
  - Unrealistic for environmental samples
  - Variable quantification of total PCBs
  - Can't distinguish between toxic and nontoxic components.

Ovrhd 7-2. Problem Identification: Aroclor Method – Comparing to Commercial Standard

Problem Identification

- Congener method - congeners as reference material
  - More accurate
  - Better resolution of toxicologically relevant component (congeners)
  - Less variable quantification of total PCBs

Ovrhd 7-3. Problem Identification: Congener Method – Congeners as Reference Material

Problem Identification

- Congener approach consistent with Regional and National Programs
  - COE/EPA National Guidance (ITM)
  - Bioaccumulation Workgroup BT/TTL development
  - National/Regional Monitoring (NS&T and PSAMP)
  - Superfund/ RCRA guidance

Ovrhd 7-4. Problem Identification: Congener Approach Consistent with Regional and National Programs

Proposed Modification

- Overview of tiered approach
  - Screen sediments for "Core List" congeners
  - Estimate total PCBs from Σ18 congeners
  - Compare total PCBs to existing BT
  - When BT exceeded - conduct bioaccumulation testing
  - Analyze tissues for "Core List" congeners
  - Sediment/Tissue data evaluated using case-specific TTL.

Ovrhd 7-5. Proposed Modification: Overview of Tiered Approach

- Core List of Congers (IUPAC #)

NS&T		WHO	Additional
8	128	81	77
18	138	114	126
28	153	123	169
44	170	156	
52	180	157	
66	187	167	
101	195	189	
105	206		
118	209		

Ovrhd 7-6. Proposed Modification: Core List of Congers (IUPAC #)

Proposed Modification

- Criteria for "Core List"
  - Toxicologically significant
  - Frequently detected
  - Prevalent component of total PCBs
  - Appears on lists from other programs

Ovrhd 7-7. Proposed Modification: Criteria for "Core List"

Proposed Modification

- Sediment Screening
  - Core List of 25 "Core List" congeners
  - GC/ECD Recommended method
  - Performance standards
    - DL< 0.5 ppb
    - Ability to quantify 25 congeners
    - NIST certified congener SRM
  - Estimate total PCB from $\Sigma 18$ congeners

Ovrhd 7-8. Proposed Modification: Sediment Screening

Proposed Modification

- NS&T method to estimate total PCBs from Σ18 congeners
  - 3 lab comparison of total homologue and Σ18 congener from national survey

$y_{lab1} = 2.01x - 1.55$ y = total PCBs (ppb)

$y_{lab2} = 3.29x + 1.40$ x = Σ18 congeners (ppb)

$y_{lab3} = 2.84x - 0.18$

Recommends total PCBs = Σ18 congeners x 2

Ovrhd 7-9. Proposed Modification: NS&T Method to Estimate Total PCBs from Σ18 Congeners

Proposed Modification

- Bioaccumulation Testing
  - Exceedance of BT (38 ppm TOC) trigger testing
  - Tissues analyzed for 25 "Core List" congeners
  - TTL development for suitability determination continues to be case-specific

Ovrhd 7-10. Proposed Modification: Bioaccumulation Testing

Proposed Modification

- Tier 3 toxicity testing
  - SL (130 ppb dw) exceedance would not trigger testing (amphipod, larval, *Neanthes*)
  - Shorter-term exposures and endpoints not expected to be PCB sensitive.
  - Bioaccumulation only tests that can be triggered by PCBs
  - Exceeding SLs for other co-occurring chemicals still triggers testing

Ovrhd 7-11. Proposed Modification: Tier 3 Toxicity Testing

Proposed Modification

- Costs associated with proposed approach
  - Average for sediment or tissue samples $300-400 per sample
  - Approximate 3-4 fold increase over current costs for PCB analysis
  - 11% of samples expected to exceed BT

Ovrhd 7-12. Proposed Modification: Costs Associated with Proposed Approach

Next Steps

- Comments/alternative approaches will be considered in revision
- Public comment period extended until June 30, 1999
- Final approach by Fall 1999 (hopefully)

Ovrhd 7-13. Next Steps

Issues

- Basis for developing congener specific TTL and BT values/approaches?
- Toxicological basis for approach (Dioxin-like vs. other modes of toxicity)?
- Additional performance-based criteria for analytical methods?
- When necessary to analyze for non-ortho dioxin-like coplanars (77,126,169)?

Ovrhd 7-14. Issues

Apparent Effect Threshold Updates

Sediment Management Annual Review Meeting
May 5, 1999

1999 SMARM 1

Ovrhd 8-1. Apparent Effect Threshold Updates

AET Updates

Outline

- Background
- Collaborative Process for Updating AETs
- Policy Issues, Recommendations and Possible Decisions
- Possible Implications to Sediment Management Standards (SMS) Program and Dredged Material Management Program (DMMP)
- Next Steps

1999 SMARM 2

Ovrhd 8-2. AET Updates: Outline

AET Updates

Background

- Current Sediment Management Standards based on ten year old biological effects data (Original 1986 AETs and 1988 Update)
- Revising AETs based on more recent data may improve predictive accuracy of resulting criteria and guidelines
- Draft amendments to SMS rule include marine criteria derived from updated AETs

1999 SMARM 3

Ovrhd 8-3. AET Updates: Background

AET Updates

Collaborative Process

- Ecology revised amphipod and calculated echinoderm larval AETs (1993-1994)
- Port of Seattle/EVS calculated preliminary *Neanthes* AETs (1996)
- Ecology and Port of Seattle/EVS updating Puget Sound AETs based on amphipod, bivalve, echinoderm and *Neanthes* effects

1999 SMARM 4

Ovrhd 8-4. AET Updates: Collaborative Process

AET Updates

Collaborative Process

- Collaborative inventory and data entry
- Standard quality assurance guidelines, reference sample matching, definitions of significant adverse effects, statistical protocols for interpretation of significant adverse effects
- Reciprocal validation of effects interpretations ("Hits/No Hits") and AET results

1999 SMARM 5

Ovrhd 8-5. AET Updates: Collaborative Process (cont'd)

AET Updates

Potential Trace Metal AETs for Puget Sound (April 1999)

Chemical	Amphipod AET (1994)	Benthic AET (1988)	Bivalve AET (1999)	Echinoderm AET (1994)	Microtox AET (1986)	Neanthes AET (1999)	Oyster AET (1986)
Units: mg/kg or ppm DW							
Antimony	200	150		9.3	na		na
Arsenic	450	57		130	700		700
Cadmium	14	5.1			9.6	3.0	9.6
Chromium	>1100		64	>96	na		na
Copper	1300	530		390		394	390
Lead	1200	450			530	400	660
Mercury	2.3	2.1	1.7			2.2	0.59
Nickel	>370	>140	>82		--	150	--
Silver		>6.1		8.4	>.56	3.3	>0.56
Zinc	3800	410			1600	740	1600

1999 SMARM 6

Ovrhd 8-6. AET Updates: Potential Trace Metal AETs for Puget Sound (Apr 1999)

AET Updates

Policy Issues, Recommendations and Possible Decisions

① Should new bivalve AETs replace 1986 oyster AETs?

Yes, if predictive accuracy/reliability comparable

1999 SMARM 7

Ovrhd 8-7. AET Updates: Policy Issues, Recommendations, and Possible Decisions

AET Updates

Policy Issues, Recommendations and Possible Decisions

② Should new *Neanthes* AETs replace 1986 Microtox AETs?

Yes, if predictive accuracy/reliability comparable

1999 SMARM 8

Ovrhd 8-8. AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)

AET Updates

Policy Issues, Recommendations and Possible Decisions

③ Should new bivalve larval AETs be combined with new echinoderm larval AETs to form a single group of "sediment larval" AETs?

Weigh evidence and need before deciding

1999 SMARM 9

Ovrhd 8-9. AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)

AET Updates

Policy Issues, Recommendations and Possible Decisions

④ Should AET values for non-polar organic compounds be normalized to dry weight of sediment or percent total organic carbon?

Weigh opinion and accuracy before deciding

1999 SMARM 10

Ovrhd 8-10. AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)

AET Updates

Policy Issues, Recommendations and Possible Decisions

⑤ Should Puget Sound AETs be the basis for criteria and guidelines to be used in other marine waters of Washington or elsewhere?

Weigh opinion and evidence before deciding

1999 SMARM 11

Ovrhd 8-11. AET Updates: Policy Issues, Rec., and Possible Decisions (cont'd)

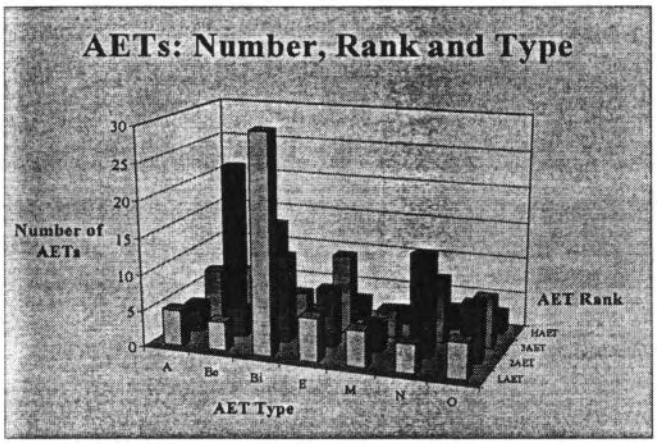
AET Updates

Possible Implications to Sediment Management Standards (SMS) Program and Dredged Material Management Program (DMMP)

1999 SMARM 12

Ovrhd 8-12. AET Updates: Possible Implications to SMS Program and DMMP

AET Updates



1999 SMARM 13

Ovrhd 8-13. AET Updates: Number, Rank, and Type

AET Updates

Possible Implications ...

- Changes to SMS marine criteria, both Sediment Quality Standards and upper regulatory levels
- Changes to DMMP guidelines, especially screening levels
- Predictive accuracy/reliability and implications will be key determinants of changes made

1999 SMARM 14

Ovrhd 8-14. AET Updates: Possible Implications

AET Updates

Next Steps

- Complete revisions to Puget Sound AETs
- Conduct reciprocal validation of AET values
- Evaluate predictive accuracy/reliability
  - Consensus-based methods to determine the most accurate suite of Puget Sound AETs
  - Dry wt. or TOC normalized AETs?
- Assess implications to SMS and DMMP

1999 SMARM 15

Ovrhd 8-15. AET Updates: Next Steps

Multi-User Disposal Site Feasibility Study

Sediment Management Annual Review Meeting

May 5, 1999

1999 SMARM 1

Ovrhd 9-1. Multi-User Disposal Site Feasibility Study

Multi-User Confined Disposal Site Feasibility Study

Outline

- Background
- Puget Sound Confined Disposal Site or "MUDS" Study: Elements and Status
- Programmatic EIS
- Immediate Issues
- Next Steps

1999 SMARM 2

Ovrhd 9-2. Outline

Multi-User Disposal Site Feasibility Study

Background

- Need for confined disposal recognized in 1987 Puget Sound Water Quality Management Plan
- Few environmentally safe and cost effective methods for disposal of contaminated sediments
- Funding for feasibility study in 1996-1997
- Feasibility/Cost Sharing Agreement, July 1997
- Draft programmatic EIS, February 1999

1999 SMARM 3

Ovrhd 9-3. Background

Multi-User Disposal Site Feasibility Study

Elements and Status

- Programmatic EIS
  - Establishes purpose and need
  - Presents alternative conceptual designs for MUDS
  - Describes likely environmental impacts
  - Appendices support future site-specific efforts
- Site Specific EIS
- Feasibility Report to Congress

1999 SMARM 4

Ovrhd 9-4. Elements and Status

Multi-User Disposal Site Feasibility Study

Programmatic EIS

- Draft released February 1999
- Comments received by April deadline
  - Refine estimate of need
  - Do not put contaminated sediment in water - "Just Say No" to aquatic disposal
  - Consider recent developments in treatment technology and a treatment facility alternative
- Final EIS expected June/July 1999

1999 SMARM 5

Ovrhd 9-5. Programmatic EIS

Multi-User Disposal Site Feasibility Study

Immediate Issues

- Continue MUDS project as planned or change direction?
  - Site-specific MUDS EIS
    - Establish regional siting board, finalize process/criteria
    - List and rank potential sites, select 2-3 preferred MUDS
    - Site-specific studies and plans, e.g., hydrogeologic studies, contingency management plans, testing procedures and monitoring requirements
    - Draft and finalize site-specific EIS

1999 SMARM 6

Ovrhd 9-6. Immediate Issues

Multi-User Disposal Site Feasibility Study

Immediate Issues

- Continue MUDS project as planned or change direction?
  - Other alternatives
    - Pursue long-term agreements with existing landfills
    - Establish partnership with private developers of large capacity confined disposal facilities
    - Site and build one or more facilities to treat contaminated sediment

1999 SMARM 7

Ovrhd 9-7. Immediate Issues (cont'd)

Multi-User Disposal Site Feasibility Study

Immediate Issues

- Need strong agreement on the relative importance of various site selection criteria
  - Environmental risk
  - State liability
  - Public acceptability
  - Disposal cost
- Need to identify other barriers to success

1999 SMARM 8

Ovrhd 9-8. Immediate Issues (cont'd)

Multi-User Disposal Site Feasibility Study

Next Steps

- Incorporate additional data and public comments into final MUDS programmatic EIS
- Convene Executive Committee
  - Select preferred alternative?
    - ? MUDS
    - ? Existing landfill(s)
    - ? Combination of alternatives

1999 SMARM 9

Ovrhd 9-9. Next Steps

Multi-User Disposal Site Feasibility Study

Next Steps

- Convene Executive Committee
  - Seek direction on overall project
    - Establish regional siting board, finalize siting process and criteria, begin siting process?
    - Negotiate agreements with solid waste facilities?
    - A Multi-User Sediment Treatment facility?
  - Identify budget and/or legislative needs

1999 SMARM 10

Ovrhd 9-10. Next Steps (cont'd)

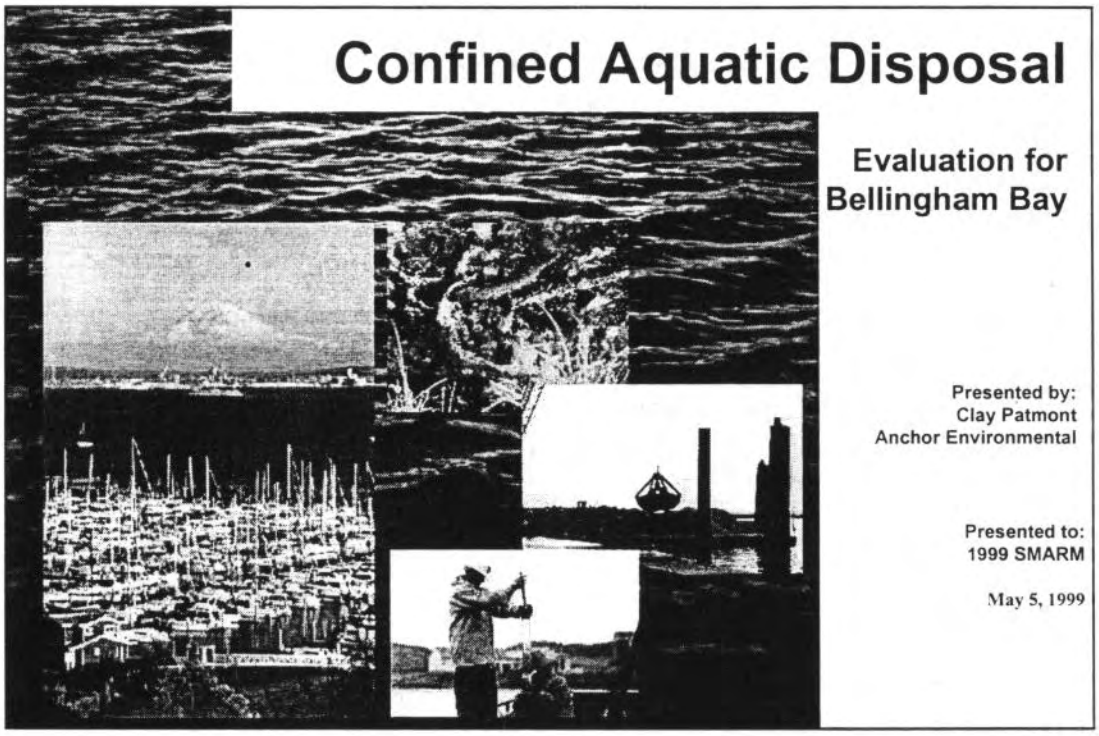
Multi-User Disposal Site Feasibility Study

Conclusions

- There is a clear need to isolate, remove and/or treat contaminated Puget Sound sediments
- The disposal alternatives identified in the MUDS programmatic EIS are all feasible
- A MUST facility may also be feasible and desirable

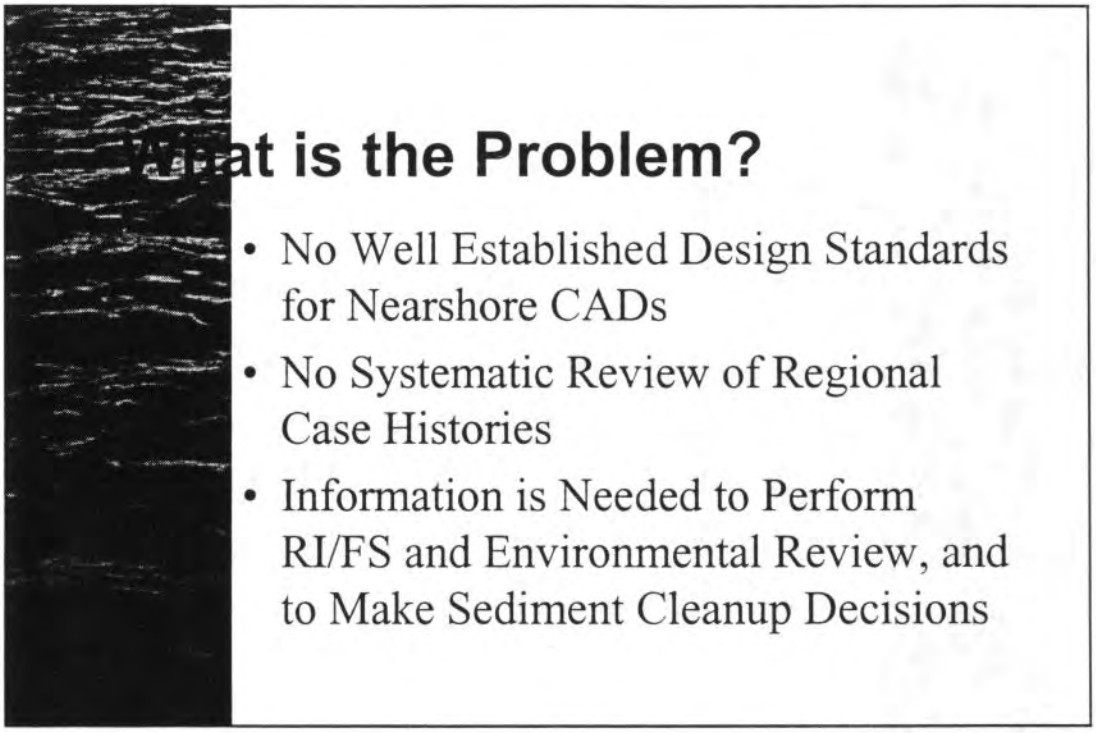
1999 SMARM 11

Ovrhd 9-11. Conclusions

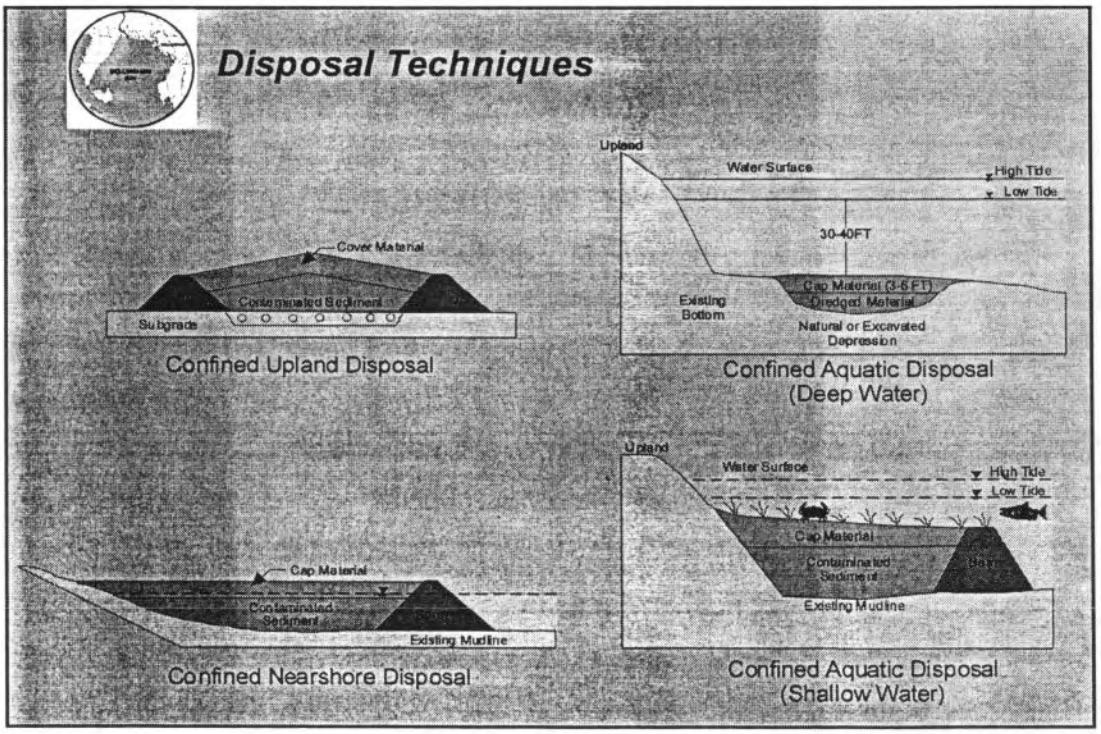


Ovrhd 10-1. Confined Aquatic Disposal – Evaluation for Bellingham Bay

Ovrhd 10-2. What is the Issue?



Ovrhd 10-3. What is the Problem?



Ovrhd 10-4. Disposal Techniques

Objectives

- Summarize Key Design Considerations
- Review Regional Case Histories
- Develop Conceptual Nearshore CAD Designs for Environmental Review
- Incorporate into RI/FS Documents to Evaluate Cleanup Options

Ovrhd 10-5. Objectives

Limitations

- Discussion Piece - Not Peer Reviewed
- Developed Prior to MUDS EIS
- Does Not Foreclose Other Options Such as Upland Disposal
- Documentation to be Provided as Part of the Whatcom Waterway RI/FS

Ovrhd 10-6. Limitations

manent Solutions: nition of Terms

- Time Frame: 500 to 2,500 years
  - Subtitle D Landfill Comparison
- Long-term Performance:
  - Integrity Under Seismic Events, Wave Climate and With Vessel Operations
  - Water Quality Protection

Ovrhd 10-7. Permanent Solutions: Definition of Terms

rent Design Guidance

- Corps (WES) and EPA Capping and Confined Disposal Guidelines
- Puget Sound MUDS EIS
- Subtitle D Landfill Design Standards
- Puget Sound Standards of Practice
  - Existing Nearshore Fill and Cap Designs

Ovrhd 10-8. Current Design Guidance

smic Stability

- Regional Case Studies:
  - Nearshore Fills in Seattle, Tacoma, Everett, and Bainbridge Island
- Key Design Issues:
  - Requires Detailed Geotechnical Studies and Engineering Analysis/Modeling
  - Use of Keys and Higher Strength Materials

Ovrhd 10-9. Seismic Stability

grity of Caps

- Regional Case Studies:
  - Sediment Caps/CADs in Seattle, Tacoma, Olympia and Bainbridge Island
- Key Design Issues:
  - Wave/Current Analysis and Modeling
  - Use of Intermediate Cap Armoring Layers and Barrier Reefs

Ovrhd 10-10. Integrity of Caps

ter Quality Protection

- Regional Case Studies:
  - Nearshore Fills in Seattle, Tacoma and Bainbridge Island
- Key Design Issues:
  - Groundwater Investigations, Leachability Testing and Transport Modeling
  - Discharge Through Permeable Berms

Ovrhd 10-11. Water Quality Protection

grass Restoration

- Regional Case Studies:
  - Recent Projects in Blaine, Boundary Bay, Clinton, Seattle and Grays Harbor
- Key Design Issues:
  - Site Characteristics (light, salinity, etc)
  - Protection from Waves (e.g., reefs)
  - Availability of Donor Material

Ovrhd 10-12. Eelgrass Restoration

onceptual Designs for nvironmental Review

- Collect Critical Data During RI/FS
- Use Conservative Conceptual Designs for Initial Environmental Review and Cleanup Decision-Making
- If Selected, Perform More Detailed CAD Engineering in Remedial Design

Ovrhd 10-13. Conceptual Designs for Environmental Review

nclusions

- Regional Design Criteria are Emerging
- Considerable Design Flexibility to Achieve Performance Criteria
- Large Habitat Restoration Potential
- Conservative Designs are Still Cost-Effective at Many Sites
- Proper Siting of CADs is Critical

Ovrhd 10-14. Conclusions

Developing a Tissue Trigger Level for Bioaccumulated TBT in Marine Benthic Organisms: A Superfund Case Study

Karen Keeley
U.S. EPA Region 10

Ovrhd 11-1. Developing a Tissue Trigger Level for Bioaccumulated TBT in Marine Benthic Organisms: A Superfund Case Study

Tributyltin (TBT)

Man-made compound - Organotin
Pesticide, Antifoulant, Preservative

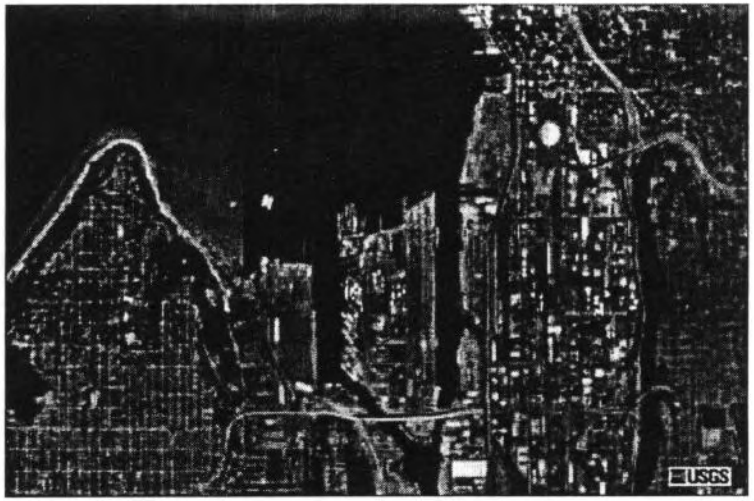
Ovrhd 11-2. Tributyltin (TBT)

Harbor Island Superfund Site
Seattle, WA

Marine Sediments of West Waterway

Ovrhd 11-3. Harbor Island Superfund Site, Seattle, WA

Harbor Island



Ovrhd 11-4. Harbor Island (photo)

Why TBT?

- Elevated and widespread concentrations in sediments → potential ecological effects
- No state, federal, or international sediment quality values
- Standard sediment toxicity bioassay tests not appropriate

Ovrhd 11-5. Why TBT?

1996 Interagency TBT Workshop

- Evaluated approaches to derive sediment effects-based cleanup level
- Results in EPA 1996 report
- Recommendations included porewater TBT analysis and bioaccumulation tests

Ovrhd 11-6. 1996 Interagency TBT Workshop

1998 Legal Agreement for TBT Field Study in West Waterway

(EPA, Port of Seattle, Lockheed Martin, Todd Shipyards)

Purpose: Identify any TBT-contaminated sediments in West Waterway that should be remediated under Superfund to protect for ecological effects to the benthic community.

- Bulk sediment (0-10 cm) and porewater (filtered and unfiltered) at 30 stations
- 45-day bioaccumulation tests (*Macoma* clam, *Nephtys* worm) at 20 stations

Ovrhd 11-7. 1998 Legal Agreement for TBT Field Study in West Waterway

TBT Tissue Trigger Level

•Develop to evaluate TBT bioaccumulation data for clam/worm tissue results

•Set to protect for sublethal effects in marine invertebrates:
- Late stage imposex in gastropods resulting in sterilization (i.e., population level effect)
- Reduction in growth
- Reproductive impairment

•Effects endpoints not considered:
- Protection from sublethal effects considered
- Early stage imposex effects
- Early stage impacts to meso- and neo-gastropods

Ovrhd 11-8. TBT Tissue Trigger Level

Has anyone done this before?

Ovrhd 11-9. Has Anyone Done This Before?

Weight-of-Evidence Approach

1. Identification of *NOEL/LOEL* for sublethal effects data
2. Calculation of *percentiles* for sublethal effects data
3. Estimation of the *geometric mean* of paired no-effect/low effect tissue data
4. Derivation of *critical body residues*
5. Application of an *acute-to-chronic ratio* based on water-only effects data to *tissue residue effects data for lethality* to estimate sublethal tissue residue threshold

marine inverts

inverts/fish

Ovrhd 11-10. Weight-of-Evidence Approach

TBT Tissue-Residue Effects Data for Marine Invertebrates

- *No-effects* concentrations range from 0.3 to 4.0 ppm dw TBT
- *Effects* concentrations range from 1 to 8.5 ppm dw TBT
- *25th percentile* of sublethal effects data = 2.65 ppm dw TBT
- *Geometric mean* of no-effects and low effects sublethal data ranges from 0.8 to 4.9 ppm dw TBT
- *Critical body residue* for TBT (relates growth effects and BCFs) derived by Meador (in prep) = 3 ppm dw TBT
- *Mean tissue residue data for lethality* (=48.4 ppm dw) *divided by the acute-to-chronic ratio* (=14.7) = 3.29

Ovrhd 11-11. TBT Tissue-Residue Effects Data for Marine Invertebrates

EPA Recommendations

Site-specific Tissue Trigger Value =

3 ppm dw TBT (0.6 ppm ww TBT)

Site-specific Considerations for West Waterway

Subtidal (~ 30 to 60 ft deep)

‰NoÂ intertidal habitat

No oyster beds/No commercial harvest of shellfish

Very few meso- and neogastropods in

Ovrhd 11-12. EPA Recommendations

How many stations exceeded EPAÁs site-specific trigger value?

Ovrhd 11-13. How Many Stations Exceeded EPA's Site-Specific Trigger Value?

Study Results

- TBT tissue concentrations most strongly correlated with dw-sediment and oc-normalized sediment
- Weak correlations with filtered and unfiltered porewater TBT
- Lower TBT concentrations in filtered porewater than in unfiltered porewater samples

Ovrhd 11-14. Study Results

Advantages and Limitations

- Tissue data integrate multiple exposure pathways
- Tissue data provide direct measure of exposure
- Use of tissue data must be coupled with effects data in literature
- Work still needed to define steps for using tissue data/tissue trigger values to define sediment cleanup

Ovrhd 11-15. Advantages and Limitations

Future Considerations

- Potential use of a bulk sediment TBT screening value rather than porewater screening value?
- Measure sublethal effects (health, effects endpoint) on organisms during bioaccumulation test?
- Identification of potential test species that have high BAFS
- Field measurements of imposex in intertidal snail populations
- TBT tissue measurements in field-collected organisms (e.g., oysters)
- Evaluate results from future case studies

Ovrhd 11-16. Future Considerations

ANALYTICAL QUESTIONNAIRE ON TBT POREWATER PROTOCOLS: RESULTS, DISCUSSION, AND RECOMMENDATIONS FOR ANALYTICAL STUDIES

DMMP STATUS PAPER

Prepared by:
John Hicks
Striplin Environmental Associates

To the DMMP Agencies

May 5, 1999

Ovrhd 12-1. Analytical Questionnaire on TBT Porewater Protocols: Results, Discussion, and Recommendations for Analytical Studies

STRIPLIN Environmental Associates

Purpose and Goals of Butyltin Questionnaires

- Gather information and opinions on butyltins (including TBT) porewater analytical protocols from experienced local, regional and national laboratories.

- Compare questionnaire responses to current recommended procedures including the DMMP Clarification Paper Tributyltin Analysis: Clarification of Interstitial Water Extraction Methods and Sample Storage-Interim

- Develop recommendations for follow-up analytical studies based on analytical and policy questionnaire responses

Ovrhd 12-2. Purpose and Goals of Butyltin Questionnaires

STRIPLIN Environmental Associates

Questionnaire Focus

- Number and type of responses
- Experience of respondents including numbers of analyses
- Sample containers and sample handling including holding time/conditions
- Quality control practices (SRM, Duplicates, MS/MSD, LCS, porewater extraction blanks, method blanks, surrogates as well as corrective action)
- Porewater extraction techniques (glassware cleaning, aerobic vs. anaerobic, sample transfer, supernatant storage, acidification)
- Filtering vs. non-filtering porewater before extraction
- Butyltin extraction, derivatization and extract cleanup
- Butyltin analysis techniques (calibration, instrument parameters)
- Laboratory recommendations

Ovrhd 12-3. Questionnaire Focus

STRIPLIN Environmental Associates

Responses to Analytical Questionnaire

- 28 lab-specific questionnaires sent out, 16 returned. 29% of responses from specialty labs, rest from full-service labs. 3.3 years average experience with TBT porewater analysis (9000 porewater analyses)
- Sample containers: Borosilicate Glass or HDPE favored followed by Polycarbonate for extracted porewater.
- Quality control practices follow workplan specifications but seem to be based on EPA guidance. Duplicates, MS/MSD, LCS, porewater extraction blanks, and method blanks are very important to document success of project.
- Porewater extraction techniques used tended to be based on Interim Method. Half of labs extracted porewater from sediment anaerobically. Half acidified porewater before storage. Centrifuge and anaerobic chamber capacity greatest limitation to sample throughput.
- Decision to filter porewater before solvent extraction was mostly based on client instructions. Filtering results somewhat variable due to filter plugging and suspected adhesion of butyltins to filter material.
- Butyltin extraction, derivatization and extract cleanup closely followed Interim method. Porewater was extracted in Tropolone-prerinsed glass separatory funnels. Contamination most often introduced in these steps.

Note: Complete, detailed responses will be published on the Corps of Engineers DMMO website at http://www.nws.usace.army.mil/dmmo/homepage.htm. Please note that the information will also be presented on the Striplin Environmental Associates website at http://www.striplin.com.

General Observations

- Non-filtering favored by labs (less variable)
- Analysis evenly split between GC/MS (SIM) and Flame Photometric techniques. Confirmation strongly recommended by labs.
- Contamination control is considered most important step in procedure (reagents primary source of contamination)
- Concerns about holding time that is achievable to labs (one week preferred)
- Most labs successfully performing Interim method

Ovrhd 12-5. General Observations

STRIPLIN Environmental Associates

Recommendations

- Filtering vs. non-filtering study (depends on policy questionnaire response and DMMP direction)
- Holding time study to document best holding time
- Aerobic vs. anaerobic study due to concerns about butyltin speciation changes

Ovrhd 12-6. Recommendations

STRIPLIN Environmental Associates

TBT Policy Questionnaires

Purpose:

- Gather information and solicit opinion on TBT policy and regulatory issues affecting porewater protocols
- Scope follow-up analytical studies

Ovrhd 13-1. TBT Policy Questionnaires: Purpose

Questionnaire Distribution

- Original questionnaire sent to local consultants, labs, regulated parties
  - 10 responses received, primarily from consultants
- Followup questionnaire sent to national and international experts on TBT and other organometallics
  - 13 responses received, mix of labs, agencies, consultants

Ovrhd 13-2. Questionnaire Distribution

Q1. Selection of TBT Fraction

- Should select fraction that best correlates with bioaccumulation/toxicity results
- Several referenced West Waterway study as the type of data that would be helpful
- In absence of such data, most consultants stated a preference for filtered porewater
- Lack of data, strong dissent, and limited distribution led to follow-up questionnaire on this topic

Ovrhd 13-3. Q1. Selection of TBT Fraction

Q1. Selection of TBT Fraction

- Suggestion from the Port of Seattle to reestablish a sediment screening level as part of tiered testing framework for dredging
- Cleanup and dredging fractions and protocols should be the same, but contaminant mobility studies may be different

Ovrhd 13-4. Q1. Selection of TBT Fraction (cont'd)

Q2. Research Needs

- Sample processing and porewater extraction methods may introduce the most variability in the results
- Oxidation and holding times are concerns
- TBT in freshwater sediments may be more susceptible to state and oxidation changes than in marine sediments

Ovrhd 13-5. Q2. Research Needs

Q2. Research Needs

Recommended studies:

- Holding time evaluation
- Aerobic vs. anaerobic storage and porewater extraction
- Additional bioavailability studies and correlations with various fractions
- Refinement of filtration and other porewater extraction techniques

Ovrhd 13-6. Q2. Research Needs (cont'd)

Q3. Evaluation of Deep Sediments

- TBT porewater testing is often difficult for subsurface DMMUs, due to sandy, compacted sediments
- Respondents recommended that most subsurface DMMUs be exempted from TBT testing, based on TBT use history, sedimentation rates, and bulk sediment concentrations

Ovrhd 13-7. Q3. Evaluation of Deep Sediments

Follow-up Q1. Request for Data

- No studies were received specifically addressing bioavailability of TBT in porewater vs. bulk sediments
- Some tissue vs. water, sediments vs. overlying water studies were available
- Straight-line regressions may not be the best way to look at sediment-tissue and water-tissue relationships
- Bioassay tests may be too short and measuring the wrong endpoints (acute)

Ovrhd 13-8. Follow-up Q1: Request for Data

Follow-up Q2. Recommendations

- There was no consistent recommendation among the experts on porewater vs. bulk sediments
- There was little agreement on the appropriateness of equilibrium partitioning to predict relationships among fractions
- Suggestions were received for improving data analysis and measures of bioavailability

Ovrhd 13-9. Follow-up Q2: Recommendations

Summary of Recommendations

Policy issues forwarded to DMMP:

- Whether to reinstitute bulk sediment screening level as part of tiered testing framework
- Criteria for exempting deeper sediments from TBT testing
- Further study and decision on the appropriate fraction for analysis

Ovrhd 13-10. Summary of Recommendations: Policy Issues Forwarded to DMMP

Summary of Recommendations

Recommended analytical studies:

- Holding time study
- Side-by-side sample holding and porewater extraction study:
  - Aerobic vs. anaerobic
  - Freshwater vs. marine

Ovrhd 13-11. Summary of Recommendations: Recommended Analytical Studies

Characterizing Exposure & Effects of TBT in Bivalves using Tissue Chemistry & Sublethal Endpoints

Michael H. Salazar & Sandra M. Salazar
Applied Biomonitoring
Kirkland, WA

1999 SMARM Meeting
Olympia, Washington
5 May 1999

Ovrhd 14-1. Characterizing Exposure and Effects of TBT in Bivalves Using Tissue Chemistry and Sublethal Endpoints

Why Characterize Exposure?

Have the clams really been exposed?

- **Confirm that exposure has occurred**
- **External vs internal exposure**
- **Establish links with effects**

Bioaccumulation is the link between environment and organism

Ovrhd 14-2. Why Characterize Exposure?

Why Characterize Effects?

Are the clams really happy?

- **Assess effects**
- **"Calibrate" bioaccumulation**
- **Acceptability of test results**

Focus on the animals rather than water or sediment

Ovrhd 14-3. Why Characterize Effects?

Bivalve Effects Endpoints

Preponderance of evidence approach

- **Changes in whole-animal wet weight**
- **Changes in shell length**
- **End-of-test tissue weights**
- **End-of-test shell weights, WAWW, changes in tissue weights, % lipids, % water**

Ovrhd 14-4. Bivalve Effects Endpoints

Calibrating Bioaccumulation with Changes in Tissue Weight

Chemical Mass	5 ug	5 ug	5 ug
Tissue Mass	2.5 g	5 g	10 g
Concentration	2 ug/g	1 ug/g	0.5 ug/g

If chemical mass remains constant,
Δ 4x tissue mass = Δ 4x tissue concentration

Ovrhd 14-5. Calibrating Bioaccumulation with Changes in Tissue Weight

Quantifying Bivalve Health

Unstressed Stressed Dead

Mortality (Shell Gape) *No continuum between unstressed & dead*

Growth (Tissue Wt) *A continuum between unstressed & dead*

Ovrhd 14-6. Quantifying Bivalve Health

Test Acceptance Criteria

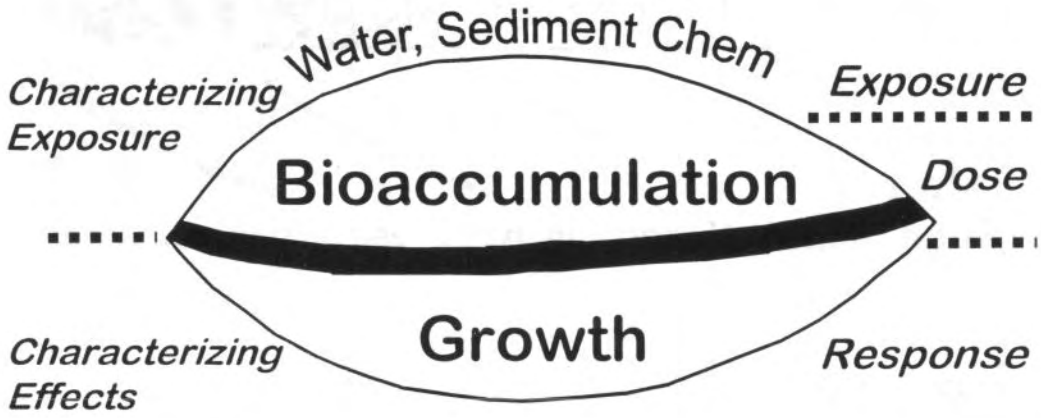
Differentiating chemical stress from laboratory-induced stress

- **Bivalves usually stressed by lab**
- **Growth rates usually less than field**
- **Minimal database for 45-d lab tests**

80% survival
< 20% loss in tissue mass

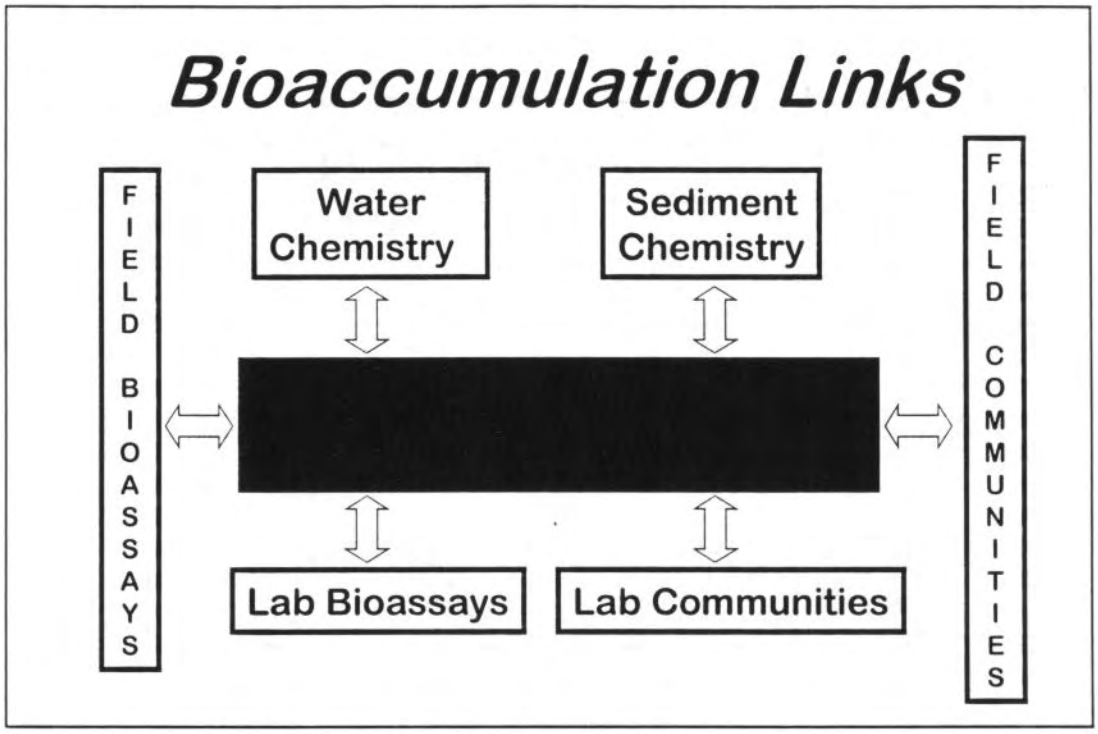
Ovrhd 14-7. Test Acceptance Criteria

Exposure-Dose-Response Triad

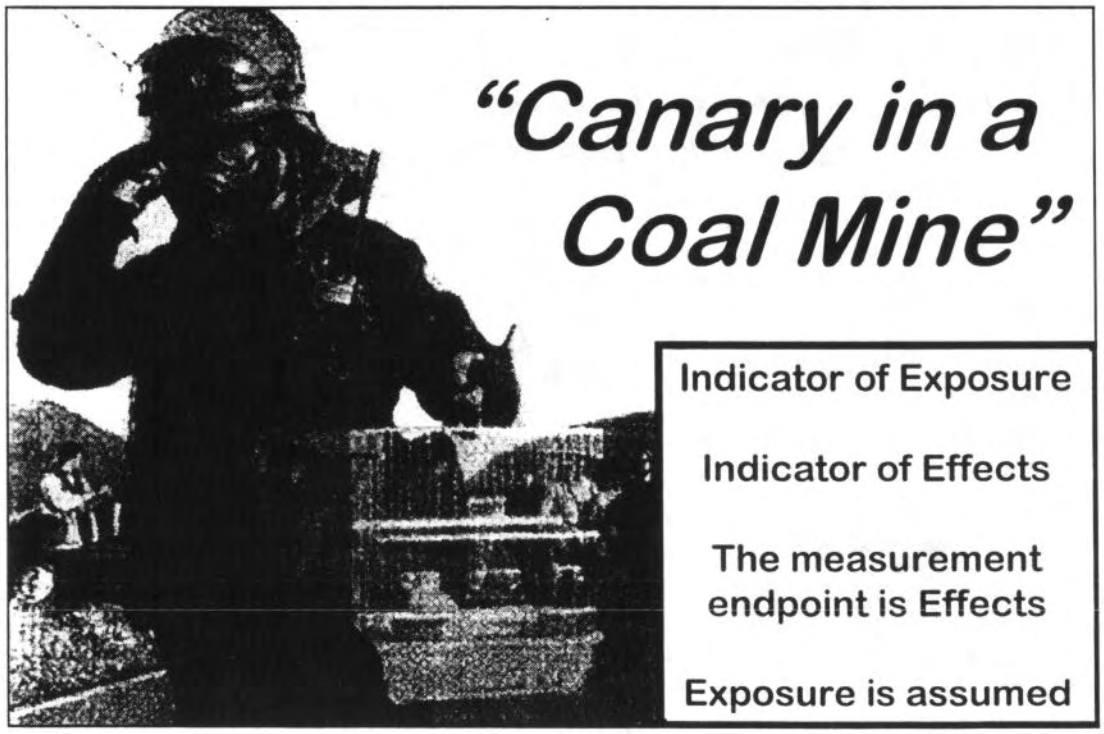


The dose makes the poison

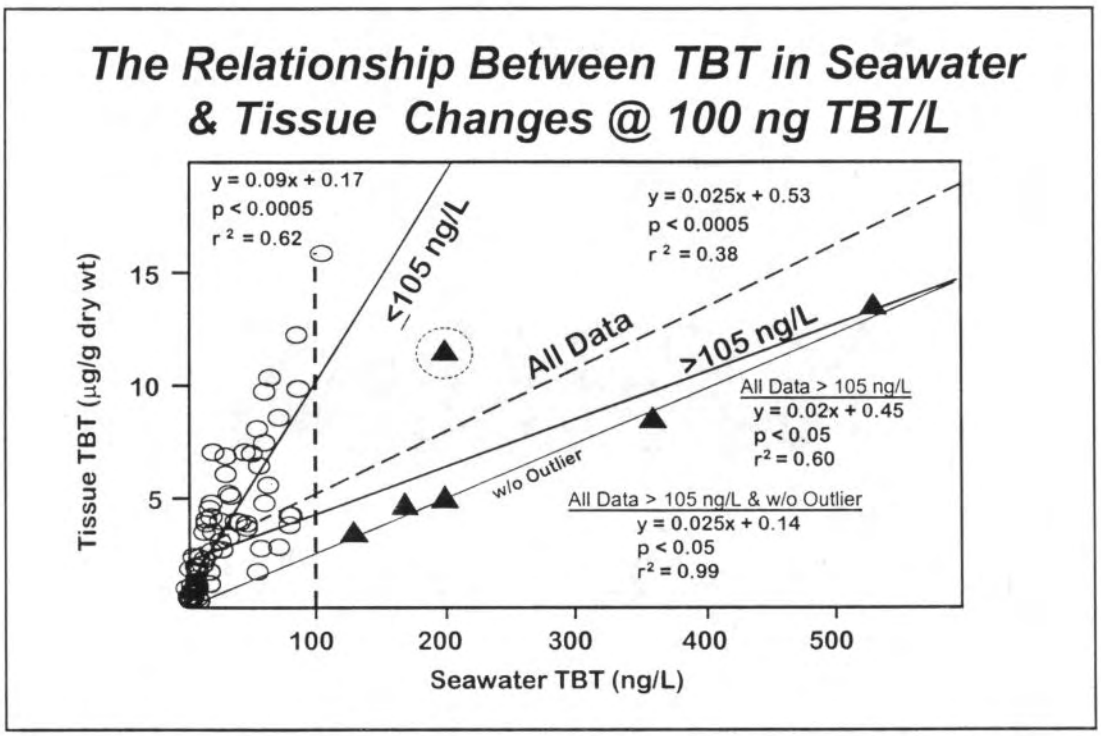
Ovrhd 14-8. Exposure-Dose-Response Triad



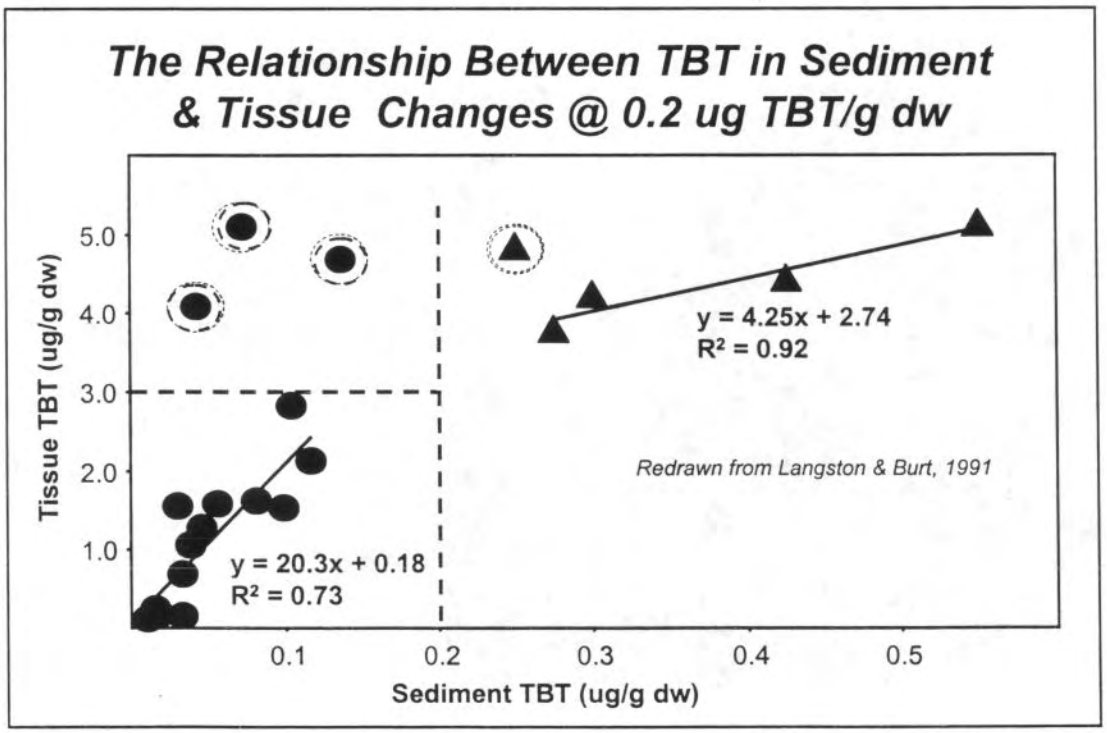
Ovrhd 14-9. Bioaccumulation Links



Ovrhd 14-10. "Canary in a Coal Mine"



Ovrhd 14-11. The Relationship Between TBT in Seawater and Tissue Changes at 100 ng TBT/L



Ovrhd 14-12. The Relationship Between TBT in Sediment and Tissue Changes at 0.2 µg TBT/g dw

Summary & Conclusions

We need to change the way we think

- **Equal emphasis on exposure & effects**
- **Endpoints in the same organism at the same time**
- **Characterize & understand the process**
- **Monitor & predict**

A single protocol for exposure and effects

Ovrhd 14-13. Summary and Conclusions

Recommendations

- **Conduct a feasibility pilot study with *Macoma***
- **Evaluate data and recommend alternatives**
- **Establish survival and growth criteria**
- **Evaluate other effects endpoints**
- **Emphasize direct measurements of exposure and effects in the same organism at the same time**

Develop effects endpoints for Macoma & Nephtys, exposure endpoints for Neanthes

Ovrhd 14-14. Recommendations