VOLUME FY00, NUMBER 1
WINTER 1999

Marine Environmental Update

NEPSS

Court Restricts EPA Overfiling Authority In RCRA-Authorized States, EPA Appeals

On September 16, 1999, a three-judge panel of the U.S. Eighth Circuit Court of Appeals ruled that the Environmental Protection Agency has no authority under the Resource Conservation and Restoration Act (RCRA) to bring enforcement action against a company that has already settled with an authorized state agency for the same violations. This decision comes out of the *Harmon Industries v. Browner* case (8th Circuit, No. 98-3775), in which Harmon Industries appealed the decision of the Missouri state court stating that the EPA could bring legal action and fines against Harmon Industries despite the fact that they had already settled the issue with the Missouri local government.

The issue began when Harmon Industries voluntarily notified the Missouri Department of Natural Resources (MDNR) that for more than ten years, and without management's knowledge, volatile solvent residue was being dumped on the ground behind its circuit board manufacturing plant in Grain Valley, MO. The MDNR worked with Harmon Industries in order to set up cleanup and compliance planning. The state agency decided not to impose any fines, having concluded that the past disposal practices posed no threat to human health or the environment. During this period, the EPA initiated its own enforcement action, originally imposing over two million dollars in civil penalties. Harmon Industries appealed the EPA's action, and the court ruled that RCRA itself gives a state action the same force and effect as an action taken by a Federal agency, thereby prohibiting the EPA's move.

The EPA filed papers on November 15, 1999, seeking a rehearing by the full Eighth Circuit Court of Appeals.

ALSO IN THIS ISSUE:

Read me on-line at: http://environ.spawar.navy.mil/Programs/MESO/Newsltr

The full text of the court's ruling is available from MESO (77.3 KB Adobe™ Acrobat™ file).

http://ls.wustl.edu/8th.cir/opinions.html.

EPA To End Mixing Zones In The Great Lakes

The EPA announced September 24, 1999, that it will phase out the discharge of bioaccumulative chemicals of concern (BCCs) in the "mixing zones" of the Great Lakes. BCCs include mercury, polychlorinated biphenyls, dioxins, chlordane, DDT, and mirex. Mixing zones are considered to be areas where these chemicals are allowed to mix with receiving waters and become diluted. The EPA's proposal would prohibit any new discharges of BCCs and existing mixing zones would be phased out over a ten year period for Illinois, New York, Ohio, and Pennsylvania. Mixing zones in Indiana, Michigan, Minnesota, and Wisconsin have already been phased out.

The phaseout of mixing zones was originally sought out by the EPA in 1995 when it developed its Final Water Quality Guidance for the Great Lakes System as part of the Great Lakes Initiative. This issue was challenged in 1997 and the U.S. Court of Appeals for the District of Columbia Circuit abandoned the mixing zone component.

The full text of the proposed rule is available from MESO (128 KB Adobe™ Acrobat™ file).

Federal Register, Volume 64, Number 191, Monday, October 4, 1999, pp. 53632-53648.

Court Rules EPA Can Issue NPDES Permits Without Numeric Limits

On September 15, 1999, the U.S. Ninth Circuit Federal Court of Appeals upheld the decision of the Environmental Protection Agency to issue permits to five municipalities in Arizona to discharge some pollutants from their separate storm water sewer systems without being subject to numeric limitations. The Defenders of Wildlife and the Sierra Club filed suit against the EPA for allowing the cities of Tempe, Tuscon, Mesa, Phoenix and the County of Pima, Arizona to use Best Management Practices (BMPs) instead of numeric limitations on discharges to ensure compliance with state water quality standards.

For the full text of the court's ruling, see *http://www.ce9.uscourts.gov/web/newopinions.nsf/* (search for Case Number 98-71080).

Bull Trout Given Threatened Status By FWS

On October 28, 1999, the U.S. Fish and Wildlife Service have listed five distinct population segments of bull trout *(Salvelinus confluentus*) as threatened under the Endangered Species Act. This determination was based on findings that the Coastal-Puget Sound and St. Mary-Belly River population segments are threatened, coupled with earlier findings of threatened status for the Klamath River, Columbia River, and Jarbidge River population segments. These population segments are disjunct and geographically isolated from one another with no genetic interchange between them due to natural and man-made barriers. These population segments collectively encompass the entire range of species in the coterminous United States. Therefore, these five populations segments are to be considered interim recovery units.

The Coastal Puget Sound Bull Trout population segment encompasses all Pacific Coast drainages within the Washington, including Puget Sound. The St. Mary-Belly River bull trout population segment occurs in northwest Montana. Bull trout are threatened by the combined effects of habitat degradation, fragmentation and alterations associated with dewatering, road construction and maintenance, mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species. The effective date of this listing is December 1, 1999.

The full text of this listing is available from MESO (177 KB Adobe™ Acrobat™ file).

Federal Register, Volume 64, Number 210, Thursday, October, 28, 1999, pp. 58910-58936.

FWS Designates Pacific Coast Critical Habitat for the Western Snowy Plover

The U.S. Fish and Wildlife Service has designated 28 areas along the coast of California, Oregon, and Washington as critical habitat for the Pacific coast population segment of the western snowy plover (*Charadrius alexandrinus nivosus*). This small shorebird is listed as a threatened species under the Endangered Species Act of 1973, as amended. Section 7 of the ESA requires Federal agencies to ensure that actions they authorize, fund, or carry out are not likely to destroy or adversely modify designated critical habitat. Table 1 lists the areas designated by the FWS.

Table 1. Designated critical habitats for the Western Snowy Plover (see Federal Register notice for details).

Washington	
• Damon Point	• Leadbetter Point
Oregon	
• Bayocean Spit	• Umpqua River to Horsfall Beach
• Heceta Head to Sutton Creek	• Horsfal Beach to Coos Bay
• Siltcoos River North	• Bandon Park to Floras Lake
• Siltcoos River to Threemile Creek	
California	
• Humboldt Coast Lagoon Beaches	• Morro Bay Beaches
• Eel River Beaches	• Pismo Beach/Nipomo Dunes
• Bodega Bay	• Point Sal to Point Conception
• Dillon Beach	• Santa Barbara Coast Beaches
• Half Moon Bay Beaches	• Oxnard Lowlands
• Santa Cruz Coastal Beaches	• San Nicholas Island Beaches
• Monterey Bay Beaches	• Malibu Beaches
• Point Sur Beach	• Mission Bay and Beach
• Arroyo Hondo Creek Beach	• South San Diego Coast Beaches (Tijuana River Beach & Silver Strand/Delta Beach)
• Arroyo Laguna Creek Beach	

Activities that could adversely affect critical habitat of the coastal population of the western snowy plover fall into seven general categories and include, but are not limited to:

1. Activities that cause, induce, or increase human-associated disturbance on beaches, including operation of off-road vehicles (ORVs) on the beach and beach cleaning. These activities may reduce the functional suitability of nesting, foraging, and roosting areas. Activities within posted, fenced, or otherwise protected nesting areas that may adversely modify critical habitat areas include camping, ORV use (day or night), walking, jogging, clam digging, livestock grazing, sunbathing, picnicking, horseback riding, hang gliding, kite flying, and beach cleaning. On a case-by-case basis, restrictions could be removed after the plovers have finished breeding. Activities that may adversely modify critical habitat areas that support wintering birds include beach cleaning that removes surfcast kelp and driftwood, and ORVs driven at night.
2. Actions that would promote unnatural rates or sources of predation. For example, producing human-generated litter that attracts predators or designing exclosures that promote perching by

avian predators may adversely modify critical habitat by reducing its functional suitability to support nesting snowy plovers.

3. Actions that would promote the invasion of nonnative vegetation.
4. Activities associated with maintenance and operation of salt ponds. Activities that may adversely modify or destroy critical habitat when conducted during the snowy plover nesting season include flooding inactive salt ponds; raising the water level in active salt ponds; grading, resurfacing, emplacing riprap, or placing dredge spoils on levees; and driving maintenance vehicles on levees.
5. Dredge spoil disposal activities that may adversely modify critical habitat when conducted during the nesting season include deposition of spoil material, laying of pipes to transport the material, and use of machinery to spread the material. However, dredge spoil disposal sites also may benefit snowy plovers by providing nesting habitat free of European beachgrass (*Ammophila arenaria*).
6. Shoreline erosion control projects and activities that may alter the topography of the beach, sand transport, and dune processes. Activities that may adversely modify or destroy nesting, foraging, and roosting habitat include, but are not limited to, beach nourishment (sand deposition, spreading of sand with machinery); construction of breakwaters and jetties (interruption of sand deposition); sand and gravel mining; dune stabilization using native and nonnative vegetation or fencing (decreased beach width, increased beach slope, reduction in blowouts and other preferred nesting habitat); beach leveling (increased tidal reach, removal of sparse vegetation used by chicks for shelter, destruction of rackline (a debris line) feeding habitat). Beach nourishment projects, however, also may have the potential to benefit nesting or wintering plover habitat on some sites experiencing serious erosion.
7. Contamination events. Contamination through oil spills or chemical releases may adversely modify critical habitat by contaminating snowy plovers and/or their food sources.

For further information contact: Ms. Karen J. Miller, Endangered Species Division Chief, at the U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, 2800 Cottage Way, Room W-2605, Sacramento, CA 95825; telephone: (916) 414-6600, facsimile: (916) 414-6713. This final rule is effective January 6, 2000.

The full text of this rule is available from MESO (698 KB Adobe™ Acrobat™ file).

Federal Register, Volume 64, Number 234, Tuesday, December 7, 1999, pp. 68507-68544.

Definition Of “Harm” Of Endangered Species Includes Habitat Modification

The National Marine Fisheries Service has issued its final rule defining the term “harm”, which is contained in the definition of “take” in the Endangered Species Act (ESA). The purpose of the

rulemaking was to clarify the type of actions that may result in a take of listed species under the ESA. The final rule defined the term "harm" to include any act which actually kills or injures fish or wildlife, and emphasizes that such an act may include significant habitat modification or degradation that significantly impairs essential behavioral patterns of fish or wildlife. The final rule is a clear notification that habitat modification or degradation may harm a listed species and therefore constitutes a "take" under the ESA.

The following list identifies several examples of habitat-modifying activities that may fall under the scope of this final rule. In all instances, a link must be established between the habitat modification and the injury or death of a listed species.

1. Construction or maintaining barriers that eliminate or impede a listed species access to habitat or ability to migrate;
2. Discharging pollutants, such as oil, toxic chemicals, mutagens, radioactive carcinogens, teratogens, or organic nutrient-laden water including sewage water into a listed species habitat;
3. Removing, poisoning, or contaminating plants, fish, wildlife, or other biota required by the listed species for feeding, sheltering, or other essential behavioral patterns;
4. Removing or altering rocks, soil, gravel, vegetation or other physical structures that are essential to the integrity and function of a listed species habitat;
5. Removing water or otherwise altered streamflow when it significantly impairs spawning, migration, feeding or other essential behavioral patterns;
6. Releasing non-indigenous or artificially propagated species into a listed species' habitat or where they may access the habitat of a listed species;
7. Constructing or operating dams or water diversion structures with inadequate fish screens or fish passage facilities in a listed species habitat;
8. Constructing, maintaining or using inadequate bridges, roads, or trails on stream banks or unstable hill slopes adjacent to or above a listed species habitat;
9. Conducting timber harvest, grazing, mining, earth-moving or other operations which result in substantially increased sediment input into streams;
10. Conducting land-use activities in riparian areas and areas susceptible to mass wasting and surface erosion, which may disturb soil and increase sediment delivered to streams, such as logging, grazing, farming, and road construction.

Incidental take exceptions are allowed by approval of the National Marine Fisheries Service. The effective date of this rule is December 8, 1999.

The full text of this rule is available from MESO (41.8 KB Adobe™ Acrobat™ file).

Federal Register, Volume 64, Number 215, Monday, November 8, 1999, pp. 60727-60731.

Other EPA News

Comment Period Extended

The Environmental Protection Agency has extended the comment period on the proposed revisions to the Water Quality Planning and Management Regulation (64 FR 46012) and the Revisions to the National Pollutant Discharge Elimination System Program and Federal Antidegradation Policy in support of proposed revisions to the Water Quality Planning and Management Program (64 FR 46058) to January 20, 2000. Comments must be received on or before January 20, 2000 to be considered. See *Marine Environmental Update*, Vol. FY99, No. 4 or http://www.epa.gov/OWOW/tmdl/index.html for details.

Federal Register, Volume 64, Number 207, Wednesday, October 27, 1999, pp. 57834-57835.

Human Health PCB Criteria Revised

The Environmental Protection Agency has revised the human health water quality criteria for polychlorinated biphenyls (PCBs) listed in the National Toxics Rule based on the EPA's reassessment of the cancer potency of PCBs. The revised criteria will apply in Alaska, the District of Columbia, Kansas, Michigan, Nevada, New Jersey, Puerto Rico, Rhode Island, Vermont, and Washington. The effective date of this ruling is December 9, 1999. The full text of the final rule is available from MESO (184 KB Adobe™ Acrobat™ file).

Federal Register, Volume 64, Number 216, Tuesday, November 9, 1999, pp. 61181-61196.

EPA To Revise Aquatic Life Criteria

On October 29, 1999, the Environmental Protection Agency issued a Notice of Intent (NOI) to revise the aquatic life criteria for copper, silver, lead, cadmium, iron, and selenium and to develop new aquatic life criteria for atrazine, diazinon, nonylphenol, methyl tertiary-butyl ether (MtBE), manganese and saltwater dissolved oxygen (Cape Cod to Cape Hatteras). The EPA is also soliciting any additional pertinent data or scientific views that may be useful in revising or developing these criteria. The full text of the notice is available from MESO (20.2 KB Adobe™ Acrobat™ file).

Federal Register, Volume 64, Number 209, Friday, October 29, 1999, pp. 58409-58410.

California ISWP And EBEP Update

In April 1991, the California State Water Resources Control Board submitted to the Environmental Protection Agency for review and approval the original Inland Surface Waters Plan (ISWP) and Enclosed Bays And Estuaries Plan (EBEP). Shortly after the SWRCB adopted the ISWP and EBEP, several dischargers filed suit alleging that the State had not adopted the two plans in compliance with State law.

In July of 1994 the Superior Court of California, County of Sacramento, ordered the SWRCB to rescind the ISWP and EBEP. On September 22, 1994, the SWRCB formally rescinded the two statewide water quality control plans. Since then, the State of California has not been in compliance with Section 303(c)(2)(B) of the Federal Water Pollution Control Act.

The rescinded ISWP and EBEP included water quality objectives (equivalent to federal water quality criteria) for the majority of the priority pollutants. To bring California into compliance with Section 303(c)(2)(B), the Environmental Protection Agency proposed to promulgate the California Toxics Rule (CTR; see *Marine Environmental Update* Bulletin, August 05, 1997). The SWRCB is developing a new ISWP and EBEP in two phases. Phase 1 entails the development and adoption of the proposed Policy. Phase 2 will involve incorporating the Policy provisions, together with State-adopted water quality objectives, into a new ISWP and EBEP. The SWRCB released a draft of the proposed Policy for public review on September 11, 1997, and public hearings on the proposed Policy were held on November 17 and December 3, 1997.

Following the release of the September 1997 draft of the proposed Policy, several revisions are being proposed based on the review of public comments and updated analyses. The key revisions to the proposed Policy are summarized, by issue, below:

Establishing Water Quality-Based Effluent Limitations

Determining Pollutants Requiring Effluent Limitations. The proposed Policy has been revised to: (a) eliminate the condition that an effluent limitation is required when the maximum effluent concentration exceeds the ambient background concentration of the pollutant; and (b) clarify the treatment of data reported as not detected.

Calculating Effluent Limitations. The proposed Policy has been revised to: (a) eliminate the procedure for calculating mass-based limitations based on concentration-based limitations; and (b) clarify the treatment of data reported as not detected. Note that "wasteload allocation (WLA)" was renamed "effluent concentration allowance (ECA)" to avoid confusion with wasteload allocations derived from a total maximum daily load (TMDL).

Translators for Metals and Selenium. The proposed Policy has been revised to: (a) change the default translator from 1:1 to the applicable EPA conversion factors; and (b) require Regional Water Quality Control Board (RWQCB) approval of the translator study plan after consultation with the California Department of Fish and Game and prior to conducting the study.

Mixing zones and dilution credits. The proposed Policy has been revised to: (a) change the discharged effluent flow to be used in determining dilution credits; and (b) clarify that a mixing zone may be considered for the chronic toxicity objective established by the proposed Policy.

Ambient Background Concentrations. The proposed Policy has been revised to: (a) require that the ambient background concentration be the maximum observed value (rather than the upper 99 percent confidence level of the 99th percentile of the maximum observed concentration), except that in

calculating an effluent limitation based on a human health criterion/objective for a carcinogen, the ambient background concentration shall be the arithmetic mean of measured or estimated concentrations; and (b) clarify the treatment of data reported as not detected.

Intake Water Credits. The proposed Policy has been revised to allow intake water credits to be considered by the RWQCB after the end of the compliance schedule for the criterion/objective.

Determining Compliance With Water Quality-Based Effluent Limitations

Compliance Schedules. The proposed Policy has been revised to more specifically define how compliance schedules should be established.

Interim Requirements. The proposed Policy has been revised to require that, to the extent feasible, data and other information be submitted with the application for the issuance or reissuance of the permit as needed to: (a) determine which pollutants require effluent limitations; and (b) calculate effluent limitations.

Monitoring Requirements. The proposed Policy has been revised to specify that the use of methods that are more sensitive than the 40 CFR 136 methods may be required.

Reporting Requirements. The proposed Policy has been revised to: (a) clarify the relationship between Minimum Level (ML) and Reporting Level; (b) delete the procedure for estimating pollutant concentrations reported between the ML and the Method Detection Limit; (c) add the condition that there be evidence that an effluent limitation below the ML is exceeded before requiring the pollutant minimization program; and (d) clarify what does and does not constitute non-compliance.

2,3,7,8-TCDD Equivalents

The proposed Policy has been revised to change the monitoring frequencies of these compounds for major and minor POTWs and industrial dischargers.

Toxicity Control Provisions

The proposed Policy has been revised to clarify that Toxicity Reduction Requirements may be coordinated among multiple dischargers to the same water body.

Special Provisions

Site-Specific Objectives. The proposed Policy has been revised to clarify that: (a) the provisions apply to both CTR criteria and State-adopted priority pollutant objectives; and (b) use attainability analyses may involve participants in addition to the RWQCB.

Exceptions. The proposed Policy on categorical exceptions has been revised to: (a) clarify that the applicable resource and pest management activities are conducted by governmental agencies; and (b) advise dischargers to file information required for categorical exceptions in advance of RWQCB approval, to the extent possible.

The complete text of the Proposed Implementation Policy – Inland Surface Waters Plan (ISWP) and Enclosed Bays and Estuaries Plan (EBEP) can be found at http://www.swrcb.ca.gov/html/iswp.html.

OPNAVINST 5090.1B Change 2 Issued

The Navy Environmental Protection, Safety and Occupational Health Division of the Office of the Chief of Naval Operations (OPNAV N45) recently issued sweeping revisions to the *Environmental And Natural Resources Program Manual* (OPNAVINST 5090.1B). Change Transmittal 2, dated September 9, 1999, affects Chapters 1 – Environmental Policy, Organization and Funding; 2 – Procedures for Implementing the National Environmental Policy Act (NEPA); 3 – Pollution Prevention; 4 – Procedures for Implementing the Emergency Planning and Community Right-To-Know Act (EPCRA); 6 – Management of Ozone Depleting Substances; 8 – Safe Drinking Water Act Compliance Ashore; 9 – Oil Management Ashore; 10 – Oil and Hazardous Substances Contingency Planning; 13 – Pesticide Compliance Ashore; 14 – Solid Waste Management and Resource Recovery Ashore; 15 – Installation Restoration; 16 – Storage Tanks; 19 – Environmental Compliance Afloat; 20 – Environmental Quality Assessment Ashore; 22 – Natural Resources Management; and several appendices. It also adds a chapter, 27 – Natural Resources Damages, and a new appendix.

OPNAV Instruction 5090.1B Change Transmittal 2 supercedes CNO ltr 5090 Ser N456/8U95188 of 9 Mar 98, Modification of Procedures for Implementing the National Environmental Policy Act and Report Symbol OPNAV 5090-1, and is available from the Navy Electronic Directives System.

The Use of Sediment/Contaminant Geochemical Fingerprinting to Frame Management Questions: A Case Study

By Sabine E. Apitz, Ernest Arias, Bryan Ayers, Sheri A. Clawson and Victoria J. Kirtay

Knowing the geographic extent of sediment contamination within a bay or estuary does not provide sufficient information for a site manager or stakeholder to make optimal decisions on how to manage sediments deemed an ecological risk or regulatory violation. Interactions between contaminants and sediment components, the mode of introduction of contaminants into the sediments, postdepositional weathering and diverse mobility characteristics control behavior of contaminants in marine sediments, their bioavailability, risk, and the best approach to their management.

Improved decision-making processes can be developed if contaminant distributions and behaviors at the micro- and macro-scales are understood. In such an approach, a site assessment is followed by advanced characterization of those sediments deemed to be candidates for management. First, sediments are divided up into sediment management units (SMUs). A characterization of these SMUs includes an assessment of contaminant/sediment biogeochemistry, as it will impact bioavailability, risk, and management choices. With such information in hand, a site manager can make a streamlined and informed decision about what remedial options are available, based upon the site specific sediment characteristics, allowing for rapid progress toward a decision and completion. Thus, advanced characterization of SMUs of concern can bridge the gap between raw concentration and toxicity data obtained from chemical and biological analysis of the sediments (site assessment) and intelligent sediment management plans (feasibility studies and site management) by offering a guide to meaningful interpretation of the data.

This article demonstrates some of the applications of sediment/contaminant geochemical fingerprinting, with results from Seaplane Lagoon, Naval Air Station Alameda, as a demonstration site.

Site Background and Sampling

Seaplane Lagoon, NAS Alameda is a semi-enclosed lagoon 110 acres in area, with water depths of 4 – 5 meters (see Figure 1). The potentially impacted sediments consist of a "Young Mud Layer," 0 – 7 feet in thickness, which overlays a stratigraphically and visually distinct Merritt Sand Layer, which is considered uncontaminated. Historically, the lagoon has been a discharge point for NAS Alameda's storm sewer system. From 1940 – 1975 it received wastewater from industrial and storm sewer outfalls. As a result, a mixed bag of contaminants has been observed: heavy metals, solvents, paints, detergents, acids, caustics, fuel, PCBs, pesticides and organotins. After 1975, it received only storm sewer discharge and surface runoff. There are seawalls around most of lagoon that inhibit the natural flushing processes of bay tides. There has been no regular dredging program.

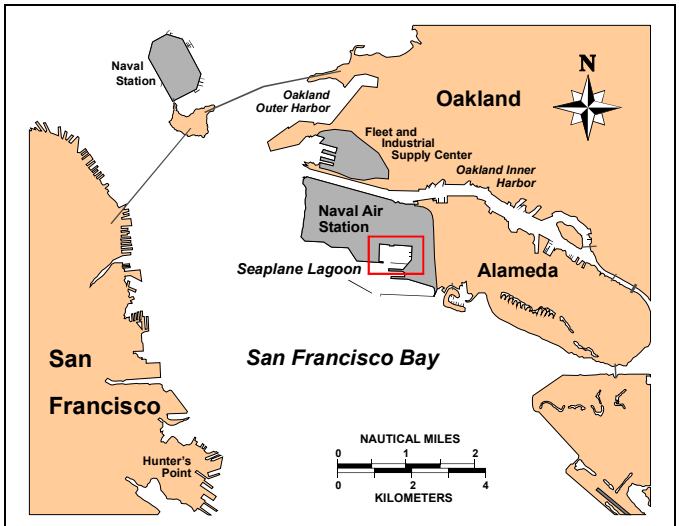

Figure 1. Location of Naval Air Station Alameda and Seaplane Lagoon.

There are a number of features about the lagoon that make it an ideal site for the demonstration of sediment evaluation strategies. There is an extensive history of diverse site characterization data, so even if uncertainty remains, much information exists to help frame questions. The lagoon represents a small,

contained volume of sediment, with walls around it. The Merritt sand bounds the bottom unit. Thus, the lagoon is a "box" of known volume for modeling, calculations and measurements.

A large body of sediment chemistry data exists for the site, although more information is available for surface sediments than buried sediments. A review of the data clearly suggests that contaminant trends exist within the surface sediments in the lagoon. For the most part, contaminant levels that exceed ER-M are associated with the NE and NW corners, which are at historical outfall sites (Figure 2). However, much less is known about volumes of sediment throughout the lagoon than about surface sediments.

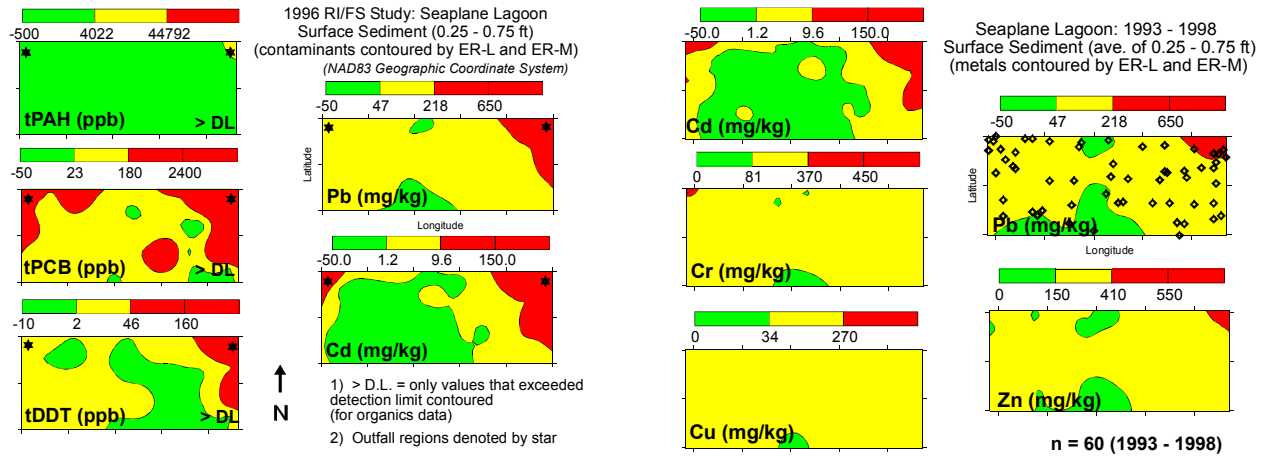

Figure 2. Left: Surface sediment chemistry data for Seaplane Lagoon (1996 RI/FS study) shows that contaminants are primarily associated with outfalls. Right: Surface sediment metals results pooled from 1993, 1996 and 1998 studies show tighter delineation of contaminant contours.

While the contaminant levels and behaviors in surface sediments are of critical importance for an ecological risk assessment, these data alone are not enough to help frame discussion of the potential benefits and consequences of various management options for the sediment units. Particularly for a BRAC site, which will leave Navy control, it is important to consider the potential impact of currently buried sediments that may be disturbed or exposed due to management activities or to future uses of the lagoon. The sub-surface chemistry data (1993 – 1996) provides extensive evidence that many contaminants have maxima at depth near the outfalls, but what information is available for the central areas of the lagoon suggests that deeper areas do not exhibit these downcore increases (Figure 3).

The objective of the sampling design for Seaplane Lagoon was to delineate areas of sediment that might potentially be managed as units (*i.e.*, sediment management units). The sampling plan for Seaplane Lagoon was designed using historical chemistry data from the site that were collected as part of a Remedial Investigation (RI). Because the goal of the project was to delineate potential sediment management units in the lagoon, a stratified random sampling approach was chosen. This design approach makes use of prior information to divide a heterogeneous population into subgroups (*i.e.*, strata) that are internally homogeneous.

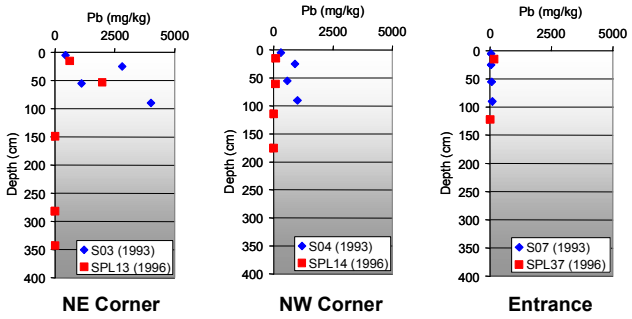

Figure 3. Lead depth profile for Seaplane Lagoon core samples taken in 1993 and 1996. Concentration of Pb, in mg/kg, increases with depth in outfall corners, but not near entrance of lagoon.

As discussed above, contours of available chemistry data from the site suggested that contamination was highly localized at the outfalls, and that the rest of the lagoon appeared fairly homogeneous. Based on the concentration gradients observed from the contours, the lagoon was divided into five strata. As illustrated in Figure 4, an arc was drawn around the NE and NW corners to isolate what was observed to be the two "hotspots" regions. Two more arcs were drawn to encapsulate regions adjacent to the outfall representing less contaminated units of sediment, leaving a final stratum of relatively uncontaminated sediment in the central area of the lagoon. One stratum was also designated outside the mouth of the lagoon. Each stratum was defined as a sediment management unit (SMU).

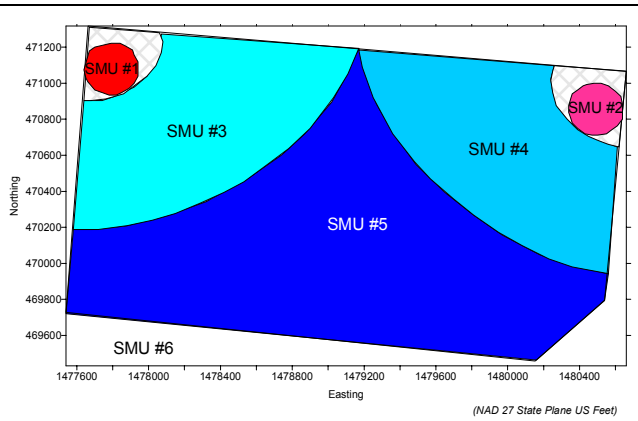

Figure 4. Proposed Seaplane Lagoon Sediment Management Units (SMUs).

A total of 18 samples were taken from within Seaplane Lagoon with the two remaining samples taken from outside the entrance of the lagoon (Figure 5). Sediments were vibracored until the underlying compacted sediment unit (Merritt Sand) was encountered, so each core collected represented the entire column of impacted sediment at that spot. Core lengths ranged from approximately three feet to eight feet. Once cores were on shore, they were extruded from the core liners, up to the sand layer, if any was recovered. The sediment cores were then homogenized, subsampled, and composited (Figure 6). These composited samples were then analyzed as follows:

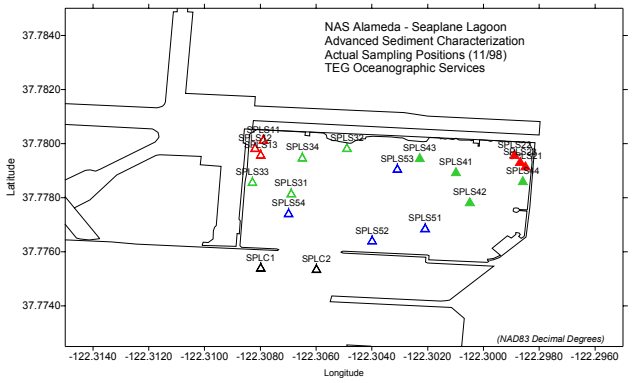

Figure 5. Seaplane Lagoon sediment sampling plan.

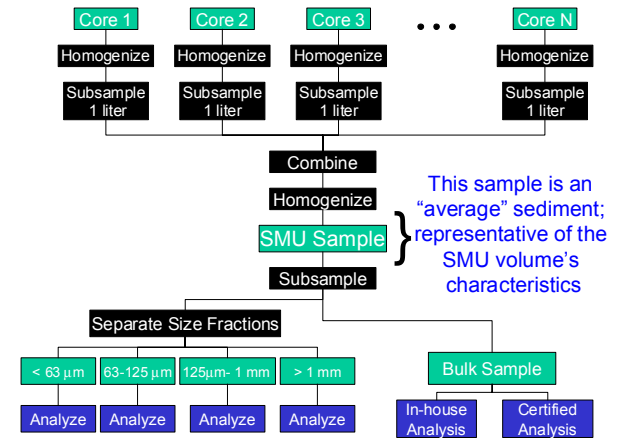

Figure 6. Sample handling for a given Sediment Management Unit (SMU).

Bulk SMU Samples

Contract (Standard) Analyses

- Organics: PAHs, PCBs, Chlorinated pesticides
- Metals (ICP)

In-House Analyses

- Grain size distribution
- Metals (EDXRF)
- PAHs, TPH
- % carbon (organic and total)
- Surface area
- Imaging (microscopic)

Size Fractions

- Metals (EDXRF)
- PAHs
- % carbon (organic and total)
- Surface area
- Imaging (microscopic)

The results of the analyses listed above comprise a large body of information about the sediments at the site. These data can be presented and evaluated in a number of ways to frame management questions and options at the site.

Question 1: How do contaminant levels within the bulk sediments from each SMU compare with each other, sediments outside the lagoon, regional levels and potential benchmarks?

The following figures show concentrations of selected metals (Figure 7) and organic Contaminants of Potential Concern (COPCs) (Figure 8) in the SMU sediments, as compared to regional sediments and potential sediment quality guidelines (SQGs). In all subsequent figures, the color scheme used to represent each SMU will follow the colors in the sampling plan above (Figure 4). The outfall SMUs (SMUs 1 and 2) stand out in red and pink, the SMUs in the central areas of the lagoon (3 – 5) are shades of blue and olive green represents sediments outside the mouth of the lagoon (SMU 6). Where represented, bright green is used to represent COPC concentrations in regional reference sediments (based upon the 85th confidence interval for sediments deemed to be relatively uncontaminated) and light and dark purple represent effects range low (ER-L) and effects range medium (ER-M) of Long *et al.*, (1995), as example SQGs.

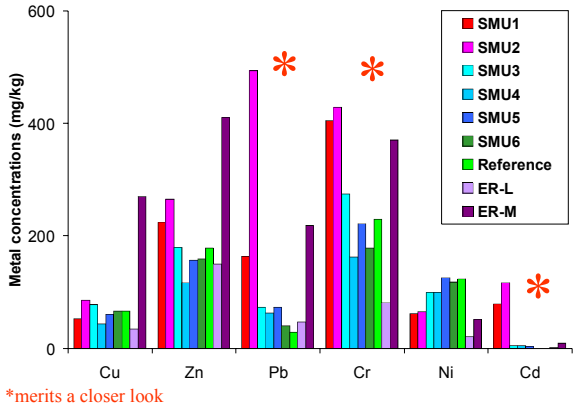

Figure 7. Bulk metal concentrations in SMU samples can be compared with each other and potential benchmark values to identify and rank areas of potential concern.

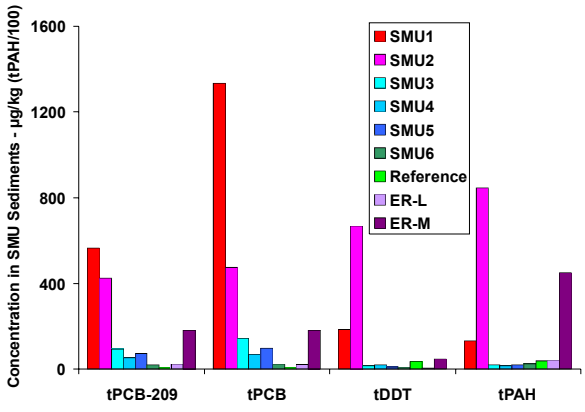

Figure 8. Concentrations of organic contaminants in SMU sediments compared to potential benchmark values

As can be seen, the outfall SMUs stand out as the only units which exceed ER-M for a number of COPCs (Pb, Cr, Cd, tPCB, tDDT, tPAH). For some COPCs (*e.g.*, Pb, Cd, PCBs), the central SMU sediments somewhat exceed the levels outside the lagoon and/or in regional ambient sediments, but the offset is significantly lower than that for the outfalls, and in all cases, lower than ER-M values.

This information confirms observations made in site assessments – COPCs are largely concentrated in the outfall sediments. However, the SMU samples used in this study are based upon homogenized cores which are designed to represent sediment volumes, rather than only surface sediments, which have been the focus of much of the past work, especially in the central areas of the lagoon. Thus, the fact that the central SMU samples did not show COPC levels higher than those observed in surface site assessments

supports the hypothesis that there are not buried, large-scale "hidden" plumes of contamination in the central areas of the lagoon.

Question 2: Do sediment/metal fingerprints provide insight into distinct contaminant sources? (Do the metals seem to associate with a particular sediment type or fraction? Are contaminants co-associating? Does this provide any insight into form, character or source of contamination? Are there multiple sources or forms?)

Figure 9 and Figure 10 show the distribution of the metal Cd and other metals in the sediments as a function of grain size. For these analyses, sediments were wet sieved, and individual size fractions were subjected to analyses. As can be seen, Cd (Figure 9), as well as several other metals (Figure 10), have a bimodal distribution in the sediments – suggesting two potential sources of metals – the "traditional" fines-associated fraction often observed in sediments which are contaminated via sorption or flocculation, and a very metals-rich coarse-grained fraction. Because these two fractions may have different sources, mobilities and bioavailability, a complete risk assessment or management plan should consider these fractions separately, rather than managing on a "total metal" basis.

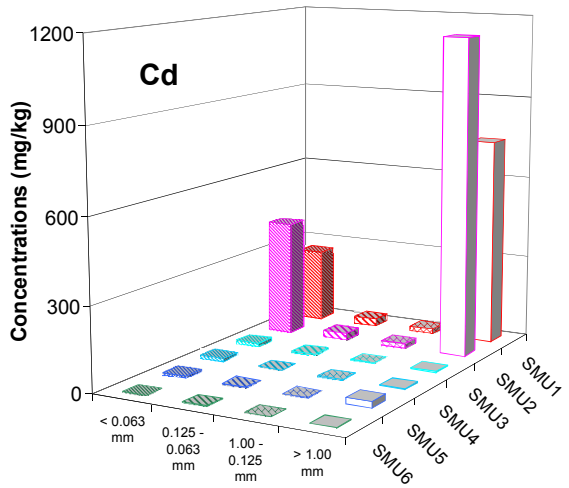

Figure 9. Cadmium concentration in each grain size fraction of each SMU sample.

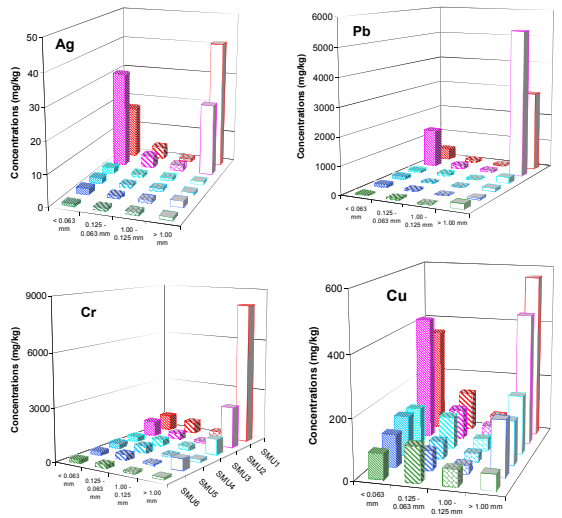

Figure 10. Grain size fraction-metal concentrations for silver, lead, chromium and copper. The bimodal distribution seen for cadmium (Figure 9) is repeated.

The metals "fingerprints" of these sediments may suggest that the nature of the coarse-grained, metals-rich fraction should be examined. In order to justify more detailed examination of the coarse-grained fraction, it is necessary to determine whether this fraction alone could be expected to account for exceedance of a chosen benchmark. If the eventual decision about the disposition of these sediments

hinges upon the exceedances of metals in these SMUs, then a closer examination of the coarse-grained particles, and their ecological relevance, is indicated.

Question 3: Are petroleum hydrocarbons signatures in the SMUs the same or different? Do they provide insight into sources or biodegradability?

An examination of the PAH signatures in each SMU provides evidence of the distinctive nature of the outfall SMUs, when compared to other sediment units. Figure 11 shows the relative distribution of PAHs in extracts from each of the SMUs. PAHs are ordered from left to right progressing from the lightest aromatics (naphthalene and the substituted naphthalenes) to the heaviest (up to benzo[g,h,i]perylene). As can be seen, the PAH fingerprint (the relative pattern of PAHs in the sediment) is very similar for SMUs 3-6; it is dominated by heavier, less degradable PAHs. This pattern, with tPAH concentrations for all four SMUs at about 2 ppm, is typical of what is observed in coastal sediments in urbanized areas as the result of chronic, low level input of PAHs.

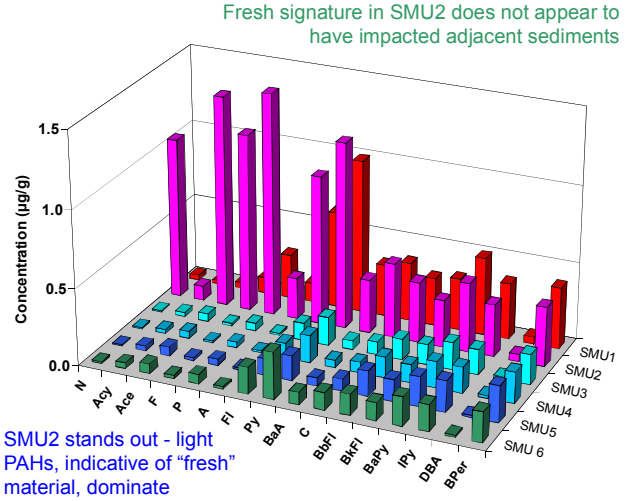

Figure 11. Distribution of PAHs in SMUs provides insight into potential sources and degree of weathering.

SMUs 1 and 2, on the other hand, have PAH fingerprints dominated by naphthalenes and the light PAHs, much more indicative of fresh inputs of petroleum hydrocarbons. In order to examine the total petroleum hydrocarbon (TPH) signature, samples from each SMU were analyzed by GC-FID (Figure 12). Briefly, GC-FID chromatograms from SMUs 1 and 2 had signatures quite similar to those of fuel standards. SMU1 looked much like a jet fuel standard, while SMU2 had two main humps, one similar to a jet fuel and one more like a weathered marine diesel fuel. At this point, chromatogram comparisons have not been carried out at a level of detail which would define actual fuel sources. Rather, standards have been used as a basis for general comparison. In any case, GC-FID

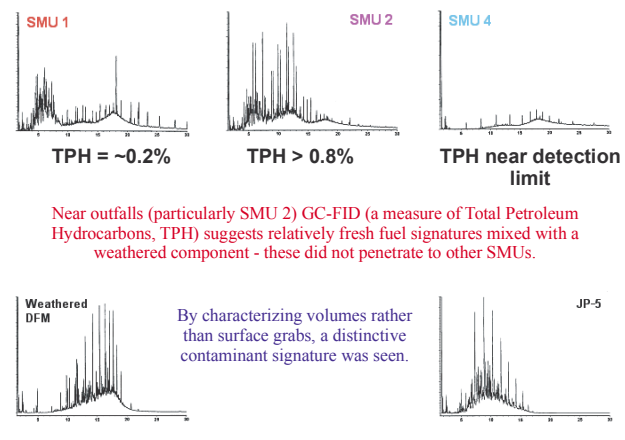

Figure 12. Seaplane Lagoon total petroleum hydrocarbon signature, samples from each SMU analyzed by GC-FID.

chromatograms from SMUs 3-6 did not show fuel signatures, but instead reflected a classic low-level unresolved complex mixture (UCM; Volkman *et al.*, 1992) typical of sediment extracts in urbanized areas.

With tPAH levels of about 17 and 84 ppm for SMUs 1 and 2, respectively, the concentrations are much higher than in the other regions. Interestingly, PAH fingerprints generated from surface grab samples taken in these regions during field screening efforts did not show evidence of the fresh petroleum signature. Since these light components are generally quite degradable, this suggests that either the PAH input is occurring more deeply, or that a buried signal is being preserved. There is no evidence that this "fresh" source has impacted the rest of the lagoon. While it is possible that SMU sampling was not dense enough to reflect such an impact, the fact that none is observed in units 3-6 may suggest that any impact may be minimal. In summary, both tPAH concentration values and PAH fingerprints suggest that SMUs 1 and 2 are quite distinct from the rest of the lagoon, which does not differ appreciably from sediments outside the lagoon.

Question 4: Does the relative distribution of PCB congeners provide insight into potential sources?

PCBs were analyzed as congeners, rather than Aroclor mixtures, to provide insight into potential differences in PCB sources, toxicity and degree of weathering. Figure 13 shows the relative distribution of the individual PCB congeners in representative SMUs. It should be noted that the y-axis for each SMU is scaled differently – the goal here is to show the relative distribution of the congeners in each unit. Examination of these distributions reveals a number of interesting features. If one examines the general distribution of the congeners in each SMU barring congener 209, the distributions are quite similar, if absolute concentrations are not, suggesting similar sources and/or weathering patterns. However, congener 209 dominates the PCB distributions in many of the SMUs – for some it is the largest contributor to the tPCB values, and the relative abundance of congener 209 to the other congeners in each SMU represents the greatest difference between the SMUs.

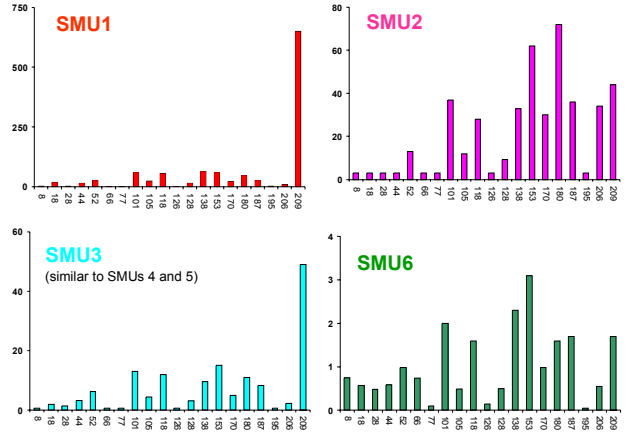

Figure 13. PCB congener concentrations in Seaplane Lagoon.

If one considers Aroclor mixtures as the primary source of PCB congeners within the environment, the dominating presence of congener 209 is difficult to explain. Figure 14 shows the congener distribution of two common Aroclors containing congener 209 (data courtesy of Arthur D. Little, Inc.). As can be seen, in Aroclor mixtures, congener 209, if present, is dwarfed by congener 206. Figure 15 shows a "typical"

regional PCB distribution, based upon the regional Bay Protection and Toxics Cleanup Program (BPTCP) data. Though congener 209 is somewhat higher relative to the other congeners than is observed in the Aroclors, there is not the dominance observed in SPL samples.

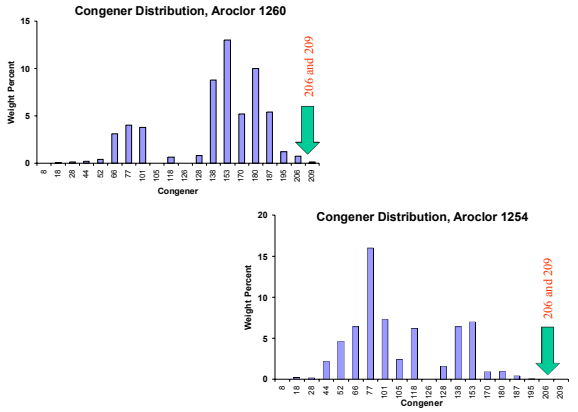

Figure 14. Congener distribution of two common Aroclor mixtures containing congener 209.

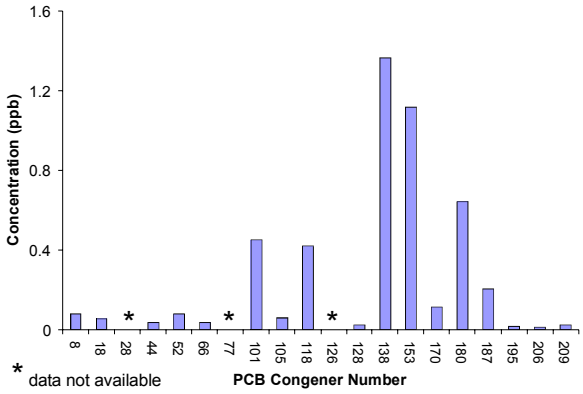

Figure 15. Regional PCB signature based upon Bay Protection and Toxics Cleanup Program (BPTCP) predictive intervals.

A probable explanation for the high levels of congener 209 observed in samples is the use of "deka" or decachlorobiphenyl, a product produced in Europe decades ago, which was just congener 209, rather than a mix of congeners, and was used for casting, among other things (Chris Reddy, Woods Hole Oceanographic Institution, pers. comm.). This product may have been used in the area in various industrial processes.

While it was not within the scope of this work to extensively evaluate the signatures and sources of PCBs in the sediments, this information may be important to ultimate decisions made at the site. If a single PCB congener dominates the PCB levels at a site, or drives exceedance above a chosen benchmark, then it is possible that benchmark and toxicity values generated based upon standard Aroclor mixtures will not be appropriate for evaluating the site. It will be important, in this case, if PCB levels drive a management decision at the site, to determine how the toxicity of congener 209 compares to that of standard Aroclor mixtures.

Question 5: Are contaminants disproportionately distributed within certain regions of the lagoon? What would be the consequence of removing or containing specific SMUs?

While absolute concentrations of COPCs in sediments are an important part of assessing site sediments, there are a number of reasons that this alone does not provide a full picture of what is going on at the site. Both organic and inorganic contaminants can exist in a region at background, ambient or natural levels, either because they have natural sources or because entire regions in urbanized, industrialized and other areas are exposed to ubiquitous levels of anthropogenic input. In many cases, since such contaminants have a tendency to associate with fine-grained sediments, there is a general regional tendency to have a

"mixing curve" of contaminated fines, and relatively uncontaminated coarse-grained sediments. While ambient or background levels of COPCs can be bioavailable, and may cause ecological impact, they are almost impossible to manage for on a site-specific basis – cost and logistics make it unlikely that an entire region will be remediated, and if specific sites are remediated to below ambient levels, those sediments are likely to be subject to re-contamination by background sediments. Thus, it is important at a given site to examine contaminant distribution relative to regional ambient or background levels (how are contaminants which may be controllable or site-specific distributed?).

Also, while absolute concentrations of a given COPC are important to know, another useful approach is to examine the distribution of contaminants in sediments which exceed chosen SQGs. What SQGs are appropriate at a given site depends upon risk models used, the priorities of the stakeholders involved, and the questions being asked of the sediment. In this section, we will discuss COPC distributions in the SMUs relative to regional reference levels and ER-M levels (Long *et al.*, 1995). ***It is not the intent of this article to suggest that these are the criteria which should be applied to the site for assessment or management purposes. Rather, these were selected as examples to demonstrate how data can be manipulated to frame and address questions at the site.***

SMU bulk COPC levels were used to calculate distributions of selected COPCs relative to ER-M and Regional Reference values. Figure 16 shows absolute distribution of contaminants throughout the SMUs, as well as the distribution of those contaminants exceeding ER-M and Regional Reference Levels. Figure 17 and Figure 18 show this graphically for tPCBs and Cd. As can be seen, SMUs 1 and 2, either individually or combined, can account for the bulk of most COPCs, and, in all cases listed, account for 100% of the contaminants exceeding ER-M levels. Thus, by removing, containing or controlling sediments from about 8% of the lagoon sediments, a large proportion of total COPCs, a significant proportion of these compounds exceeding regional levels and 100% of those sediments exceeding ER-M for the listed COPCs would be removed from potential redistribution or food chain exposure. Of course, this is based upon the assumption that the SMU composites are completely representative of the SMU volumes. Actually, it is probable that the occasional sample throughout the lagoon can be found which may exceed any given SQG. Also it is possible that the sampling plan, as designed, over- or under-estimates unit COPC loadings. Any final management plan should include some FS-level sampling to confirm three-dimensional distribution of contaminants and take into account all historical sampling.

Evaluating Management Options:

If SMUs 1, 2 or both were removed or contained, what would be the net percent reduction in the following parameters?

As can be seen, removing or containing SMUs 1 and 2 (8% of sediment volume) removes 100% of the sediments which exceed ER-M for the contaminants listed, and significant percentages of total contaminants and sediments exceeding regional reference levels

Which of these parameters, if any, is of greatest importance depends on the management priorities agreed upon by stakeholders, and a ranking of COPCs

ex.: exceeding, RR: Regional reference levels

	SMU1	SMU2	SMUs 1&2
Sediment Mass	3	5	8
LMW PAH	8	88	96
HMW PAH	5	17	22
tPAH	7	66	73
tPAH ex. ERM	100	-	100
tPAH ex. RR	7	93	100
tDDT	12	63	75
tDDT ex. ERM	13	87	100
tDDT ex. RR	14	86	100
tPCB	28	14	42
tPCB ex. ERM	73	27	100
tPCB ex. RR	29	15	44
Cr	6	9	15
Cr ex. ERM	29	71	100
Cr ex. RR	23	38	61
Cd	22	46	68
Cd ex. ERM	30	70	100
Cd ex. RR	22	49	71
Ag	12	26	38
Ag ex. ERM	23	77	100
Ag ex. RR	14	30	44
Pb	6	25	31
Pb ex. ERM	-	100	100
Pb ex. RR	7	35	42

Figure 16. Absolute distribution of contaminants throughout the SMUs in Seaplane Lagoon.

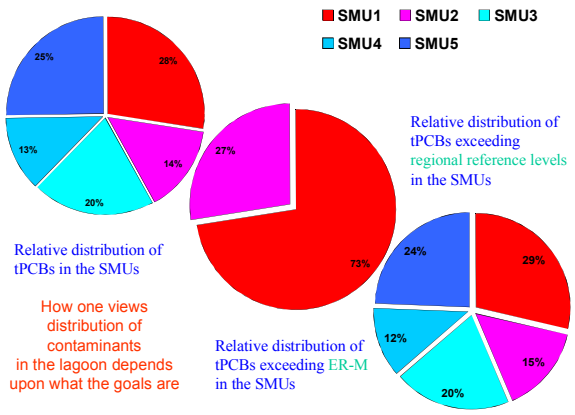

Figure 17. Relative distribution of tPCBs in the Seaplane Lagoon SMUs.

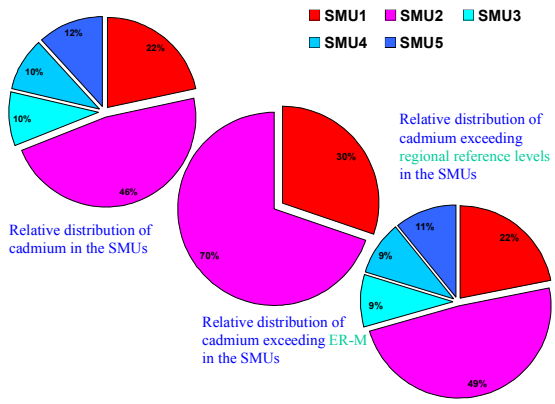

Figure 18. Relative distribution of cadmium in the Seaplane Lagoon SMUs.

Question 6: What is the long-term risk of leaving contaminated sediments in place?

If a volume of contaminated sediment is left in place for an extended period of time, a number of things can happen which may affect potential risk to the overlying biota and to the relatively uncontaminated sediment. In one scenario, sediments can remain undisturbed, and can over time be buried with clean sediment (assuming sources have been controlled) resulting in lower risk of food chain impact as exposure risk is reduced. In a second scenario, the sediment may be dispersed over time and mixed with the less contaminated sediments. Such mixing may result in contaminated sediments being diluted with cleaner sediments to such an extent that risk is reduced over time, or if sediments are contaminated at a high enough level relative to the relatively uncontaminated sediments, this may result in larger volumes of sediment of concern. Actually, if the reservoir of sediments with which a contaminated unit can mix is unlimited, the former will always eventually occur. However, over time, such mixing can result in the short term in a transitory state with larger volumes of sediment of concern.

Because the sediments in Seaplane Lagoon are essentially contained and of known volume, and because the relative volumes and concentrations of each SMU are known, it is possible to calculate the potential impact of selected SMUs to the contaminant levels in the entire lagoon, if the sediments were completely mixed. These calculations can be done with all the sediment, and with selected units removed. Of course, this is just an “endmember” calculation – it is extremely unlikely that the whole lagoon would ever be mixed. However, if sediments are left in place, with uncontrolled future activities, it is plausible that some unknown degree of mixing, resuspension and transport may occur.

The effect of mixing, before and after hypothetically removing or containing SMU 1 and/or SMU 2 sediments can be determined, by generating weighted average contaminant concentrations. Examples are shown for Cd (Figure 19), Pb (Figure 20) and tPCB (Figure 21). For the organic COPCs, only the total Seaplane Lagoon weighted average concentration of tDDTs and low molecular weight PAHs exceed the all the SQGs after mixing. For both these COPCs the removal or containment of SMU 1 by itself has a minimal impact whereas the removal or containment of SMU 2 reduces the weighted average concentration to below both ER-M and RR values. For the low molecular weight PAHs, the removal of both SMUs 1 and 2 brings the weighted average concentration below all three SQGs considered. For the metals examined, only cadmium has the potential of increasing lagoon weighted average concentrations to the point where they exceed all the SQGs (Figure 19). In this case, the removal or containment of only SMU 1 has half the impact as the removal or containment of SMU 2. Combined removal or containment of both SMUs 1 and 2 reduces the theoretical mixed cadmium level by approximately 2/3, bringing it below the ER-M but still above ER-L and RR values.

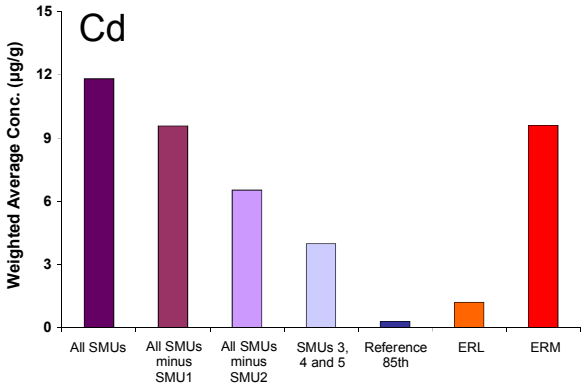

Figure 19. Weighted average concentrations of cadmium in the Seaplane Lagoon SMUs.

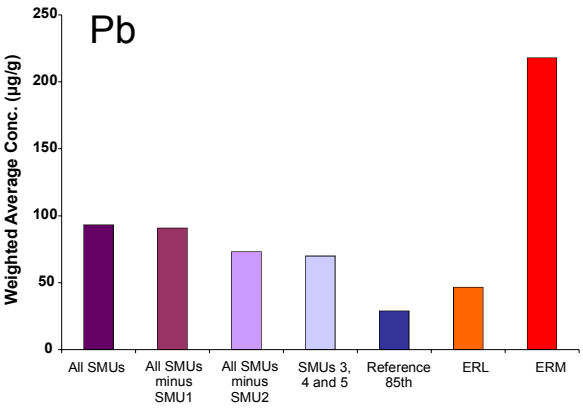

Figure 20. Weighted average concentrations of lead in the Seaplane Lagoon SMUs.

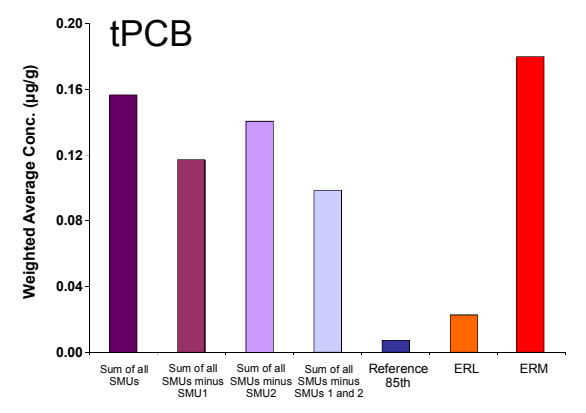

Figure 21. Weighted average concentrations of tPCB in the Seaplane Lagoon SMUs.

Such calculations can be used to examine the worst-case scenario risk of leaving contaminated sediments in place, with no controls. Even if contaminant levels are lower at the sediment/seawater surface, causing no current impact to biota, the potential for long-term risk or liability remains, if sediments are disturbed by weather, benthic biota or human activity.

Question 7: What do contaminant/sediment fingerprints imply about remedial options?

The analyses carried out help frame a number of management options. One range of options considered in a sediment management scenario are treatment options. Due to the bimodal distribution of many contaminants, this sediment is not a good candidate for particle separation for volume minimization. Due to the mix of degradable and non-degradable contaminants, these sediments are not good candidates for bioremediation, since even if biodegradation of some of the organic COPCs was successful, metals, and, most likely many chlorinated organics would remain. While there are advanced treatment options on the market, the quoted costs are for large on-site physical plants. Such an approach would not be practical at this site unless a large regional solution was addressed.

Dredging/removal of contaminated sediments is another option to be considered. The bulk of the contaminants at this site are in only 8% of sediment volume, making them good candidates for removal, if an acceptable disposal site is available. However, it should be pointed out that removal of contaminated sediments and placement upland does not guarantee that potential risks of those contaminants are eliminated. The disposed-of material must still be contained or monitored on land.

In-place containment of contaminated sediments, by capping or other means, is also one of the management strategies which may be indicated. Because the outfall sediments are in corners with land on two sides, they are easily contained by a variety of engineering options with no or minimal loss of area available for reuse.

No action is also an option which must be considered in a management strategy. The choice of this option requires consideration of priorities outside the scope of this work.

The purpose of this discussion is to show how sediment/contaminant geochemical fingerprints can be used to help frame management decisions. Seaplane Lagoon is used as an example. However, it is not the intent of this article to prescribe management solutions at the site, which is still undergoing site investigation. Development of an ecological risk assessment and management strategy at the site will involve consideration of many aspects not addressed in this article.

Summary

If contaminant/sediment geochemistry is well characterized, questions about management options can be intelligently framed and focused. Specific sediment units can be put in perspective relative to other regional sediments, selected benchmarks and criteria. However, it should be pointed out that sediment sites are complex and rarely clear-cut. How data are interpreted depends upon the ranking of goals by all concerned parties. For an analysis to have the most power, it is critical that management goals and priorities, and decision drivers, are defined. If this is done, data can be plotted and presented in a goal-specific way.

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For more information about this study, or on how contaminant/sediment geochemical fingerprinting can aid in contaminated sediment management, please contact the Remediation Research Laboratory at SPAWARSYSCEN D361, 53475 STROTHE RD RM 267D, SAN DIEGO CA 92152-6325; e-mail: rrl@spawar.navy.mil; telephone: (619) 553-2810 or DSN 553-2810 (voice); (619) 553-8773 or 553-6305 (facsimile). An in-depth technical report on this study is currently in final revision, and will be available soon.

Editor's Note: The preceding article depicts a "real world" demonstration of the use of technologies developed by research scientists at the Space and Naval Warfare Systems Center, San Diego, under the NAVFAC Y0817 RDT&E program. The work described therein was not performed as the result of any ER-N or BRAC initiative, or Federal, State or local regulatory requirement.

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