ARCADIS BBL
Infrastructure, environment, facilities

A Risk Management Case Study: Selecting an Effective Risk-based Remedial Alternative for Contaminated Sediments

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Presentation Outline

- Overview of risk management process
- Sediment management tool box
  - Investigation
  - Remediation
- Case Study
  - Former Naval Base

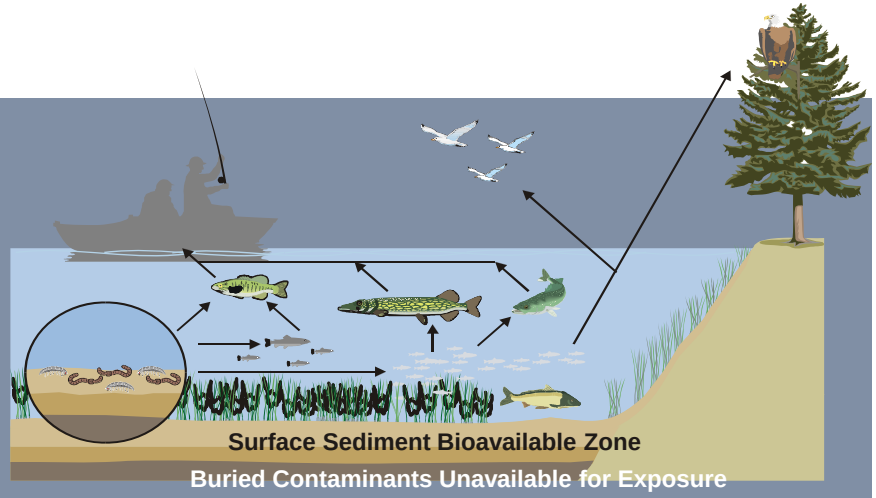
Overview of Risk Management Process

Risk Management Process

- Goal: Identify, evaluate, select and implement actions to reduce risk in a scientifically sound and cost-effective manner
- Sources of information
  - risk assessment results
  - regulatory requirements
  - public values
  - economic analysis
- Complex process - can be additionally challenging when current land use and potential redevelopment plans are addressed

Impacts of Contaminated Sediments

- Human health impacts from eating fish/ shellfish, wading, and swimming
- Ecological impacts on wildlife and aquatic species
- Loss of recreational fishing, swimming and boating opportunities

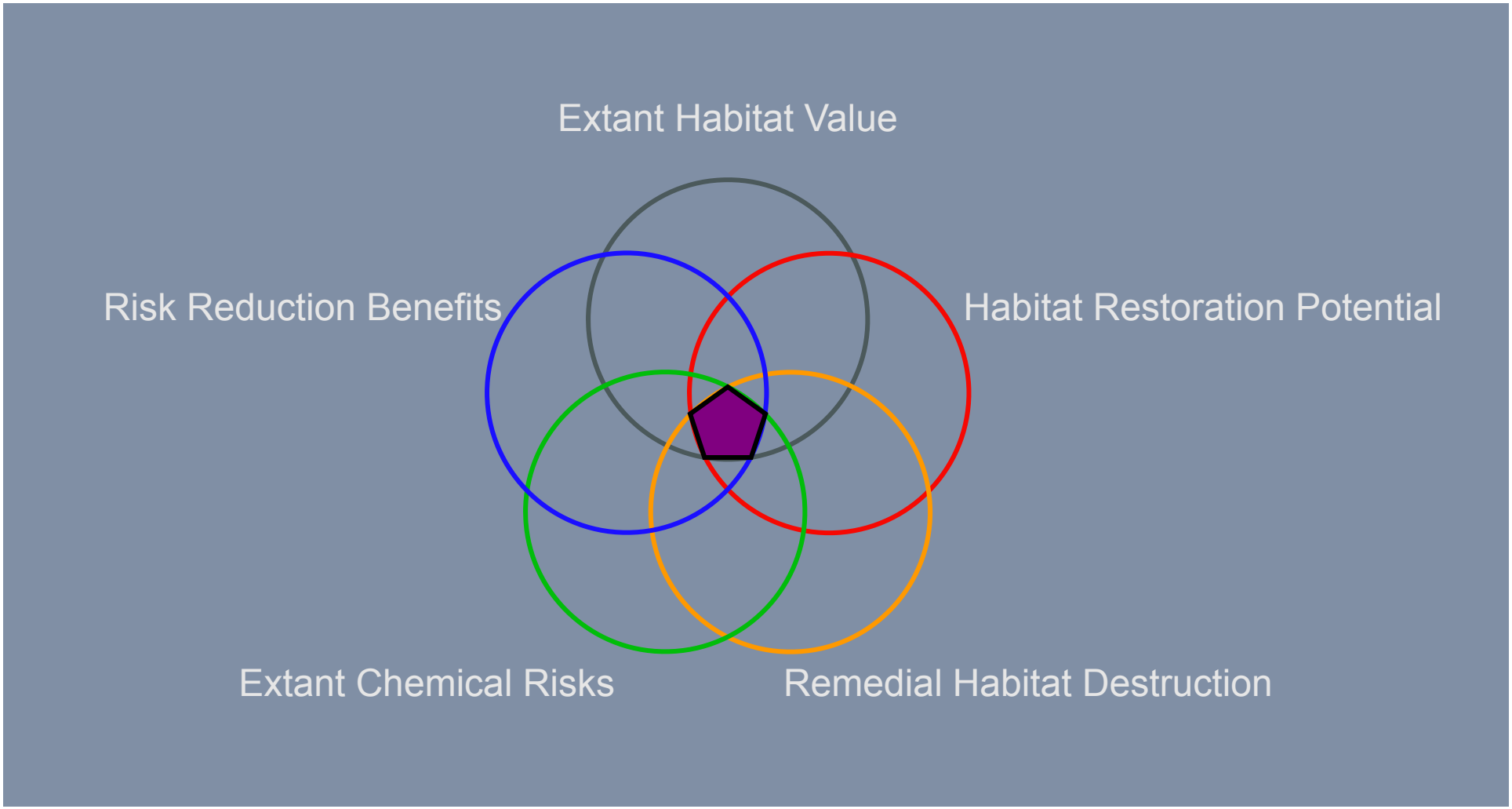


- Loss of traditional cultural practices by indigenous peoples and others
- Economic effects of loss of fisheries, on development, reduction in property values, property transferability or tourism
- Increased costs of drinking water treatment, other effects on drinking water, and other water uses
- Loss or increased cost of commercial navigation

Key principles for managing contaminated sediments

1. Control sources early
2. Conceptual site model that considers sediment stability
3. Identify risks to human health and the environment - iterative approach in a risk-based framework
4. Evaluate assumptions and uncertainties with site characterization data and models
5. Avoid poorly conceived, one-size-fits-all solutions: select site-specific, project-specific, and sediment-specific risk management approaches that will achieve risk-based goals
6. Ensure that sediment cleanup levels are clearly tied to risk management goals
7. Maximize the effectiveness of institutional controls and recognize their limitations
8. Design remedies to minimize short-term risks while achieving long-term protection
9. Monitor during and after sediment remediation to assess and document remedy effectiveness

Sediment Risk Management System

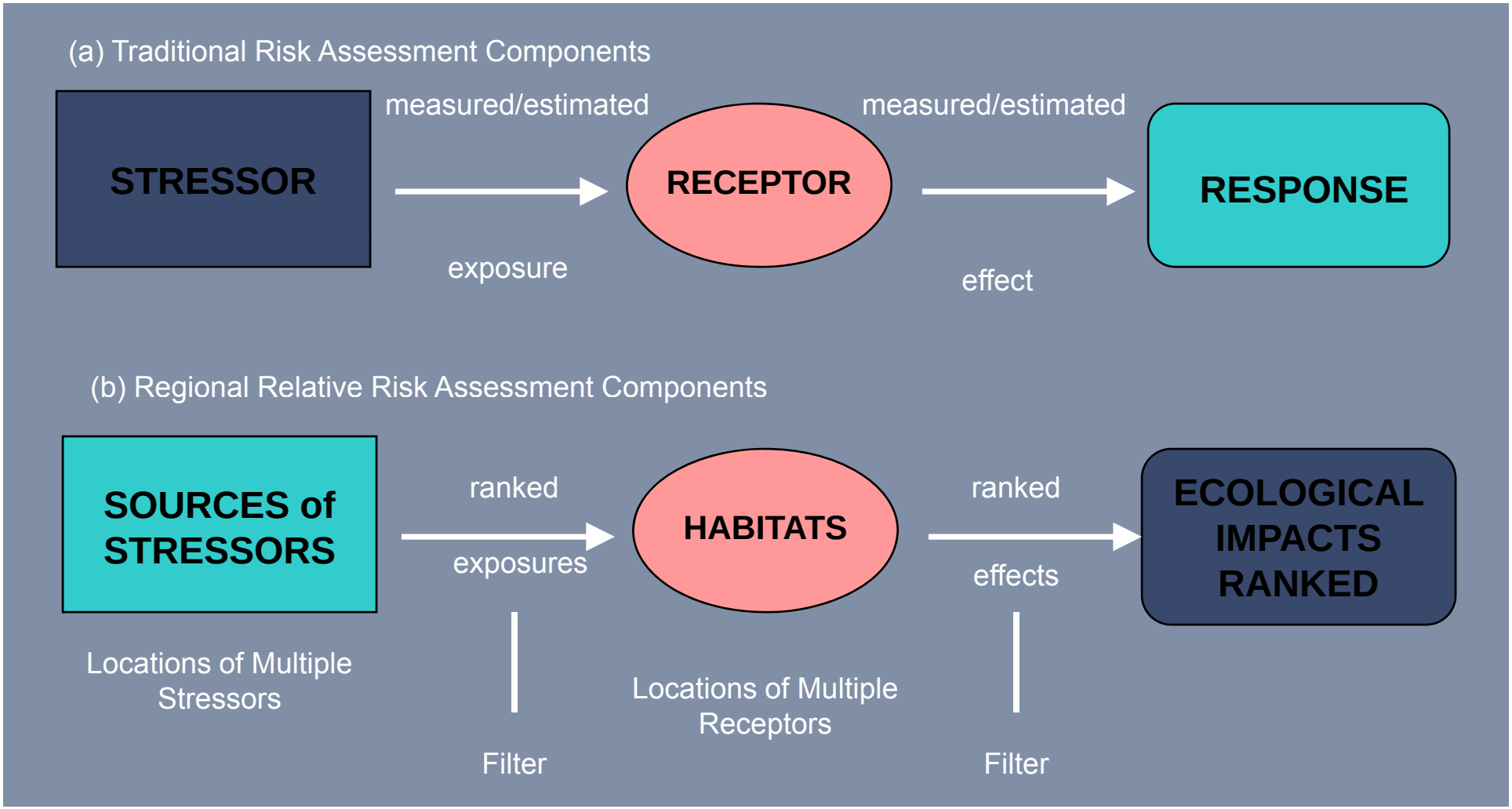


Sediment Management Tool Box

Best Practices - Site Assessments

- Determine nature and extent, assess mobility, and evaluate alternatives through a structured, tiered approach
- Identify exposure pathways, bioavailability, and sediment stability – contaminated sediments might be buried today, but that does not mean they always will be
- Identify the sources of historical contamination and quantify any continuing sources. Characterize ambient conditions.
- Identify current and future potential risks based on reuse plans
- Collect data to evaluate the potential effectiveness of natural recovery, in-situ capping, sediment removal, and promising innovative technologies
- Provide a baseline of data that can be used to monitor remedy effectiveness in all appropriate media (generally sediment, water, and biota)

Comparison of Risk Assessment Paradigms (Landis 2005)



Best Practices – Remediation technologies

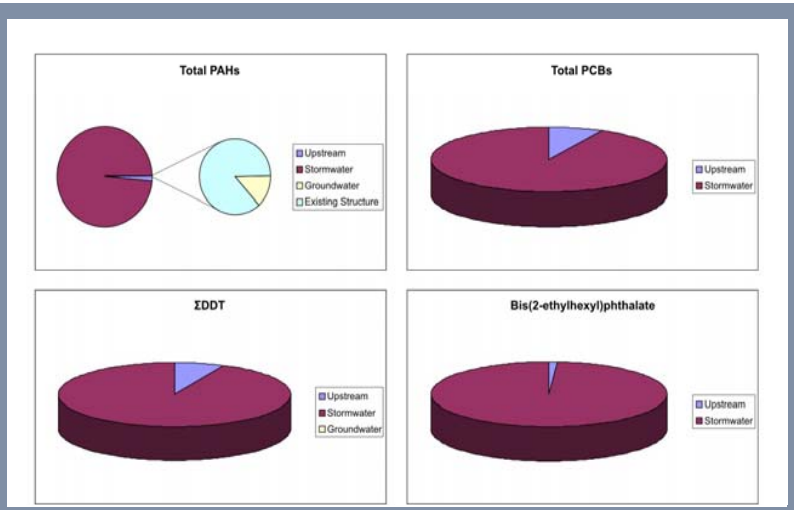
- Sediment remedy
  - Institutional controls: fishing advisories
  - Monitored natural recovery
  - Capping
  - Dredging
  - Confined disposal facility design
  - Stabilization, dewatering and treatment
- Source control

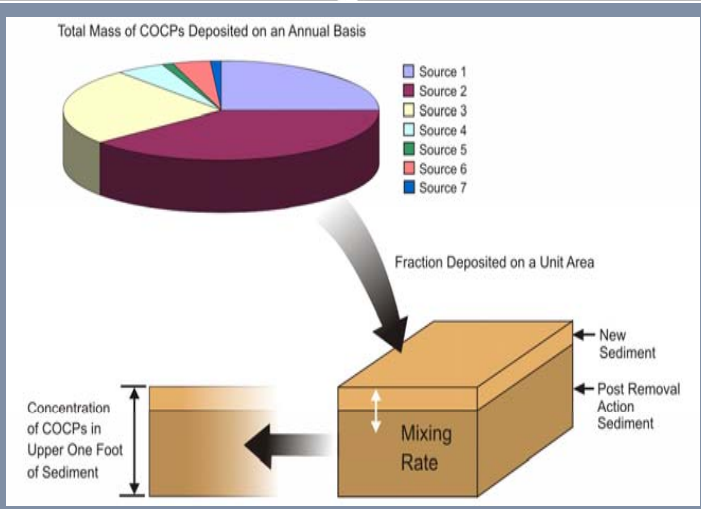
Source Control

- If uncontrolled external contaminant sources are not controlled, they can undermine the effectiveness of the remediation
- Identify and neutralize sources of recontamination to protect cleanup investments
- Define potential through data collection and recontamination modeling
- Stormwater is one of several potential recontamination sources
- If necessary, select and implement stormwater BMPs to prevent recontamination and monitor effectiveness of stormwater BMPs

Analysis of Recontamination or Natural Recovery

- Objective: to assess the potential for post-dredging or capping recontamination of sediment or for natural recovery
  - determine potential sources
  - collect data from sources
  - estimate mass loading rates
  - evaluate recontamination potential





Case Study: Former US Naval Base - Clear source and identified reuse

Site Characteristics and History

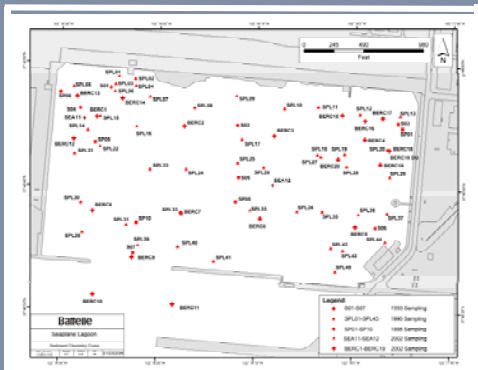
- History
  - Constructed in 1930s by dredging a former tidal flat and used to dock seaplanes for repair
  - From 1940 to 1975, received ≈ 300 million gallons of untreated industrial wastewater and stormwater
- Characteristics
  - 18 to 20 feet deep
  - Completely enclosed except for an 800 foot opening in the southern jetty/breakwater
  - Southern boundary is an engineered seawall/jetty and filled pier; other boundaries are bulkhead sheetpile walls or engineered seawalls
  - Protected from significant wind and tidal energy

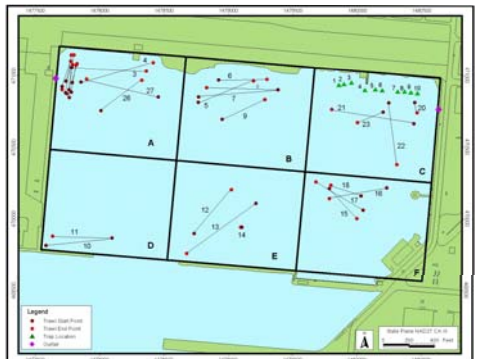
Potential Future Site Uses

- Private and public boating (including boat clubs)
- Ferry service
- Yacht facilities (including deep draft vessels)
- Boat repair maintenance
- Dry storage
- Training facilities (yachting)

Sampling Design

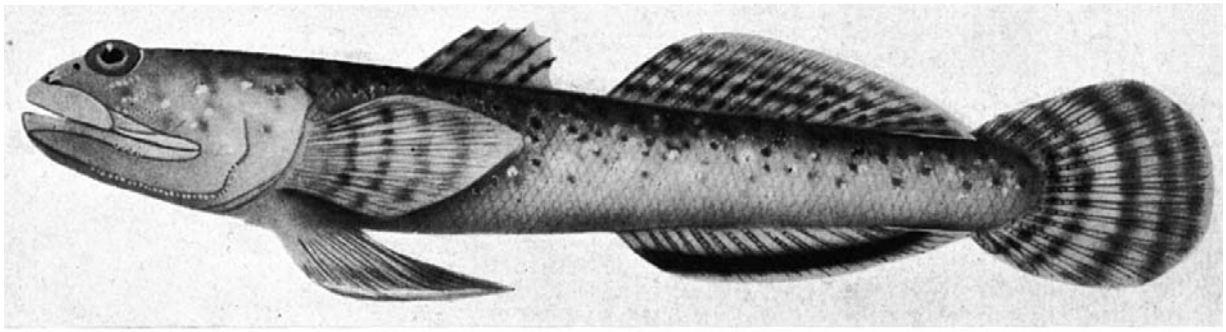
- Numerous investigations over 15-year period
  - Grab samples and sediment cores
  - Benthic flux sampling
  - Toxicity bioassays with both invertebrate and fish species
  - Bioaccumulation bioassays
  - Site-specific fish tissue collection
- Identification of potential sources
  - Source control measures implemented
  - Cleaning of storm sewers and stormwater prevention plan

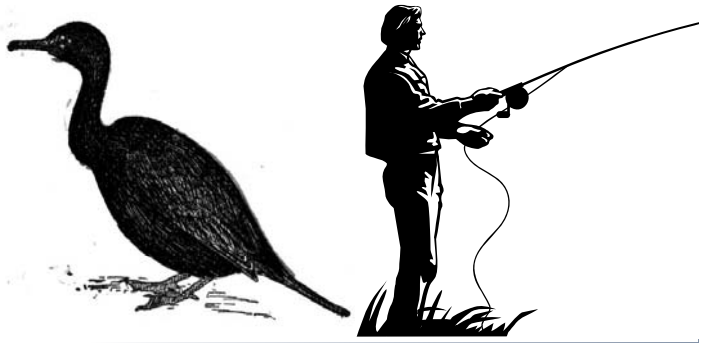




Conclusions of the Investigation

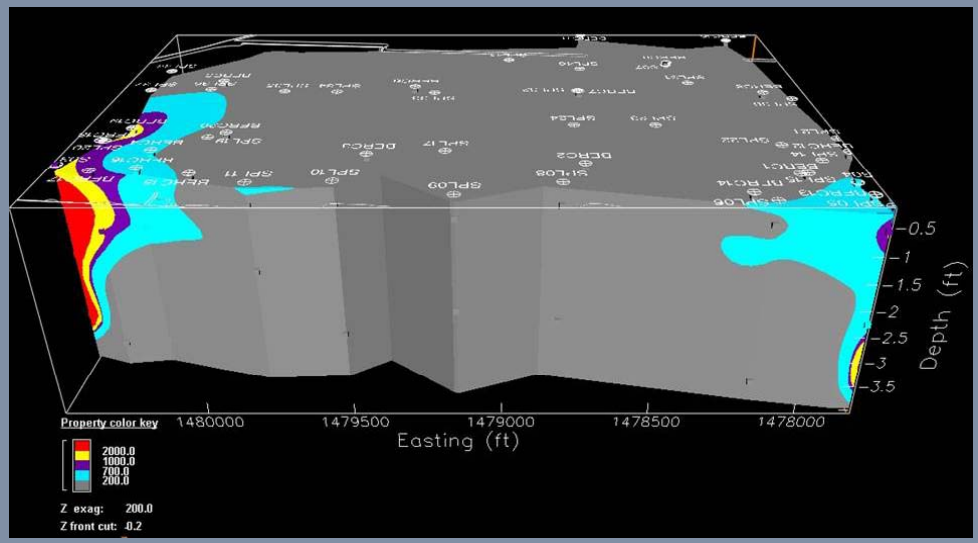
- The primary areas of concern: northeast and northwest corners of lagoon where historical outfalls released waste water
- Low potential for impacts to benthic invertebrate community
- Potential risks to fish and birds from pesticides, PCBs and cadmium
- Potential risks to humans from ingestion of fish contaminated with PCBs





Areas with Remediation Goal Exceedances

- Potential risks concentrated in the northeast and northwest corners of the lagoon near outfalls
- Area of contamination is ≈ 8 acres (5 acres in NE corner and 3 acres in NW corner)
- Highest concentrations of chemicals no more than 2 to 4 feet below the sediment surface



Remedial Alternative Evaluation

- Preliminary Remedial Alternatives Considered
  - Alternative 1 (No action)
  - Alternative 2 (Monitored natural recovery)
  - Alternative 3 (Isolation capping using clean cap)
  - Alternative 4 (Thin-layer capping that also promotes biological activity and natural recovery processes)
  - Alternative 5 (Uniform dredging, dewatering, and upland disposal)
  - Alternative 6 (Focused dredging based on remedial goal exceedances, dewatering, and upland disposal)
  - Alternative 7 (Focused dredging with monitoring and ex-situ treatment and reuse)

Remedial Alternative Evaluation

- Initial Evaluation Criteria
  - Evaluated with respect to three criteria:
    - Effectiveness
      - Short and long term effectiveness in providing protection of human health and the environment
    - Implementability
      - Technical and administrative feasibility, including ability to construct, reliably operate, and meet regulations until remedy is complete
    - Cost
      - Relative present worth costs accurate to +50 to -30% based on cost estimating
- Based on initial criteria, three remedial alternatives (3, 5 and 6) were retained and compared

Comparison of Alternatives

	Alternative	(3) Isolation Capping/Monitoring/ Institutional Controls	(5) Dredging/ Monitoring/Dewatering/ Upland Disposal at a Permitted Off-Site Waste Disposal Facility	(6) Focused Dredging/Monitoring/ Dewatering/Upland Disposal at a Permitted Off-Site Waste Disposal Facility
Threshold Criteria	Would Achieve Overall Protection of Human Health and the Environment	MODERATE	HIGH	MODERATE to HIGH
	Would Achieve Compliance with ARARs	HIGH	HIGH	HIGH
Modifying Criteria	Long-Term Effectiveness	MODERATE	HIGH	MODERATE to HIGH
	Reduction in Toxicity, Mobility, and Volume Through Treatment	LOW	MODERATE	LOW to MODERATE
	Short-Term Effectiveness	HIGH	MODERATE	MODERATE to HIGH
	Implementability	HIGH	HIGH	HIGH
	Cost	$5.3 million	$9 million	$7.6 million

Selected Alternative

- Alternative 5: Dredging/monitoring/dewatering/upland disposal
  - Dredge to 4 ft throughout remediation areas
  - Construction quality control (water quality and post-dredge confirmation sampling using sediment cores and water depth)
  - Dewatering
    - 3 to 4 ft high on-site drying beds
  - Upland Disposal
    - Off-site disposal in a Class II Landfill
- Summary: Risk management process developed clear management objectives resulting in a final remedy that was the best balance of trade-offs. Allowed for a mutually acceptable approach after 20 years of investigation and debate.

EPA Superfund project manager said, “The best cleanup remedies come when all interested parties have a seat at the table and make decisions on the best approach to a site. The EPA is satisfied that the cleanup alternative for the Seaplane Lagoon will be protective of the bay and other aquatic resources.”

Summary

- Risk-management strategy to investigate and to select remedial options for sediment sites allows:
  - Focused investigation and cost-effective solutions specific to site conditions and potential re-use
  - Avoids poorly conceived, one-size-fits-all solutions: selects site-specific, project-specific, and sediment-specific risk management approaches that will achieve risk-based goals
  - Minimizes the possibility that the “Cure will be worse than the illness”