



Consideration of Ecosystem Services at Cleanup Sites: A Retrospective Analysis and Ongoing EPA/ORD Research

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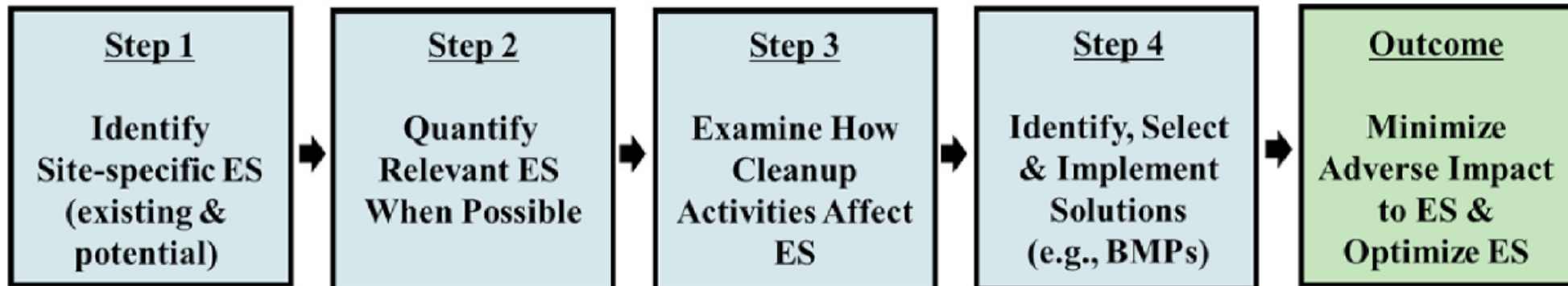
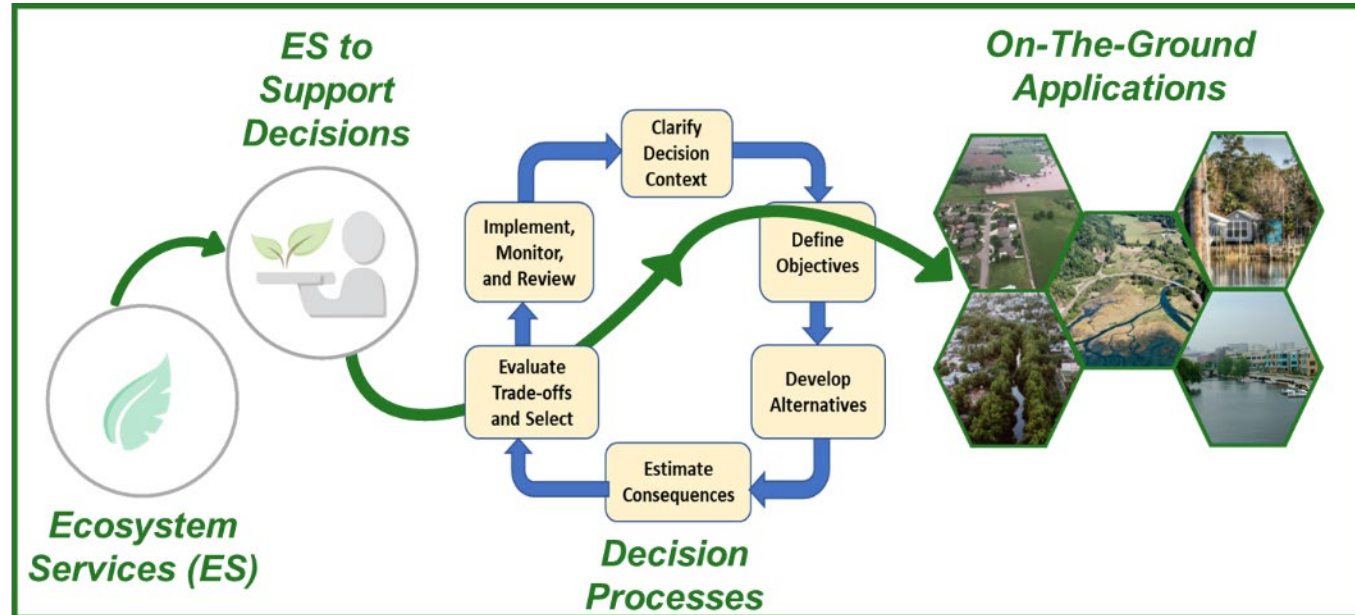
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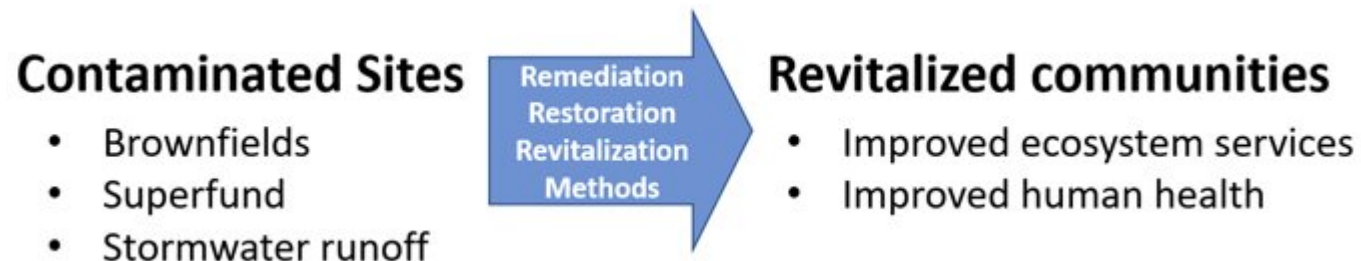
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Connecting ES & Restoration of Contaminated Sites



Remediation to Restoration to Revitalization (R2R2R)

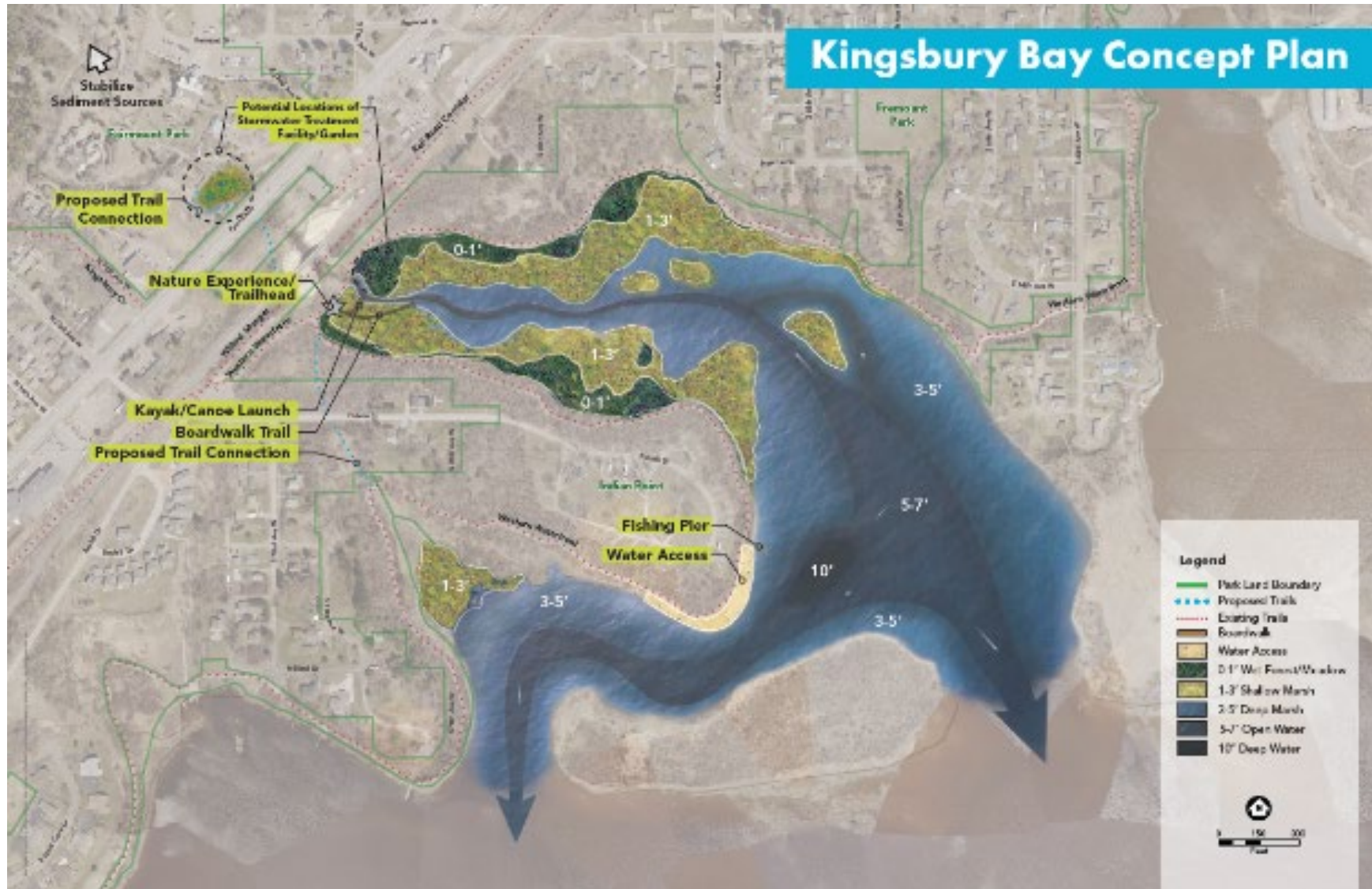
- To help transform remediation and restoration projects into sustainable revitalization of the surrounding community by maximizing the positive societal and environmental outcomes
- Local, state and federal programs need evidence to communicate links between restored site environmental condition and human health and well-being.
- Approaches are needed to integrate community priorities, redevelopment goals, and human health and well-being impacts into remediation and restoration decisions.



Ecological Connections to Health

Ecosystem Component	Ecosystem Services	Beneficiaries	Associated Health Determinant or Health Outcome
Reduced sediment contamination and improved water quality	Improved habitat for resident fish	People who consume fish from the river, including subsistence and recreational anglers	Improving water and sediment quality can decrease contaminant bioaccumulation, improve nutrition, and decrease chronic disease incidence due to consumption of contaminated fish
Wetland habitat	Habitat for marsh birds, wading birds, and migratory waterfowl	Recreational birdwatchers	Outdoor recreation can provide opportunities to engage with nature; reduce stress, cardiovascular disease, obesity, and other chronic disease; and provide opportunities for social cohesion
Natural area and green space	Accessible natural areas	Park visitors, hikers on adjacent trails	Green spaces can decrease crime; provide opportunities for physical activity, spiritual reflection, cultural fulfillment, engagement with nature, and social cohesion; reduce stress, and improve mental and overall health and well-being

Kingsbury Bay Habitat Restoration St. Louis River



Our “Retrospective” Research

➤ **Retrospective analysis** of ES and remedial BMPs employed

➤ **By:**

- Using a “**lessons-learned**” approach
- **Drawing** conclusions about **changes in ES as result of cleanup**
- **Drawing** conclusions about **potential for improving ES** for site reuse
- Advancing **generalizable guidelines** for considering ES, including:
 - **Effective communication** of ES concepts
 - **Involving the public** in site decisions

Site Selection Criteria:

- Data availability & access
- Type of site cleanup
 - Different contaminants
 - Histories
 - Ecosystems
- Stakeholders identified & engaged

Commencement Bay Nearshore/Tideflats Overview Map



From: Earth Corps



From: History and Ecology
of Commencement Bay

High-Level Overview of Commencement Bay Nearshore/Tideflats Remediation/Restoration

- Thea Foss Waterway
 - Contaminated by many years of industrial activities
 - Contaminants of Concern:
 - zinc, lead, mercury, cadmium, copper, nickel, PAHs, 2-methylphenol, 4-methylphenol, DEHP, benzo(a)pyrene, and PCBs
 - Removal Action & Remedies:
 - 425,000 cubic yards of contaminated sediment dredged, and other areas capped with clean sediment
 - Consent Decrees resulted in remediation & restoration of contaminated area 2003-2006
 - Construction of 11-acre St. Paul Waterway Confined Disposal Facility (CDF);
 - Dredging 425,674 cu yd contaminated sediment with disposal in the St. Paul CDF and capping of 24 acres;
 - An additional 8.8-acre cap;
 - Four acres of Enhanced Natural Recovery; and
 - 21 acres of Monitored Natural Recovery in the Thea Foss.

Mitigation Sites and Habitat Enhancement

Mitigation sites constructed to compensate for & offset unavoidable environmental impacts of the Thea Foss Waterway remediation project:

- North Beach Habitat
- Middle Waterway Tideflat Habitat
- Puyallup River Side Channel
- Olympic View Resource Area (OVRA)
- Swan Creek Stream Project
- Tahoma Salt Marsh
- *Hylebos Creek Mitigation Site (not part of our study)*

Additionally, habitat enhancement areas were constructed within the Thea Foss Waterway:

- Johnny's Dock Habitat Enhancement
- Head of the Thea Foss Shoreline Habitat
- State Route (SR) 509 Esplanade Riparian Habitat
- Log Step Habitat Enhancement
- Slope Rehabilitation



Overall List of Potential Ecosystem Services/Benefits

Access to nature

Access to water (inc. marina/launch)

Viewscapes

Environmental education

Air clean enough for windows to be open

Birding

Walking/jogging

Dog walking; bicycling

“Cultural” access (art, music)

Recreational boating (power, kayaks)

“Hiking trails”

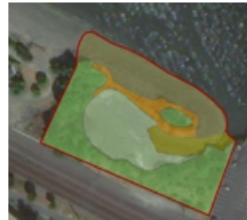
Mitigation Sites

More than
30 acres
restored



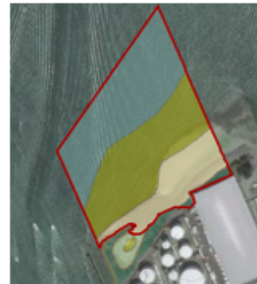
1. Tacoma Salt Marsh- 1.73 Acres total

- a. Emergent Marsh -0.38
- b. Riparian forest- 0.64
- c. Backshore- 0.13
- d. Riprap- 0.42
- e. Mudflat -0.12
- f. Riparian forest- 0.04



2. OVRA- 11.25 Acres

- a. Subtidal- 4.81
- b. Mudflat- 4.06
- c. Gravel Beach- 2.21
- d. Riprap- 0.16
- e. Scrub-Shrub- 0.50
- f. Emergent marsh- 0.33
- g. Mudflat- 0.08



3. Middle Waterway City- 1.96 Acres

- a. Riparian Forest- 0.11
- b. Backshore- 0.38
- c. Emergent Marsh- 0.44
- d. Mudflat- 0.52
- e. Riparian Forest- 0.17



4. Middle Waterway Simpson- 3.59 Acres

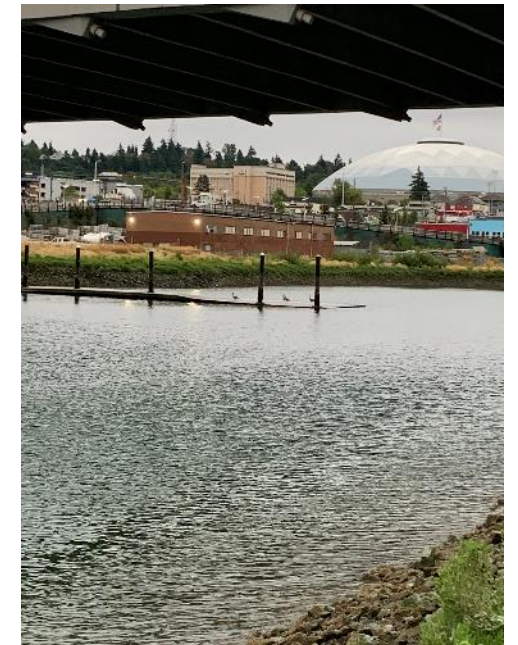
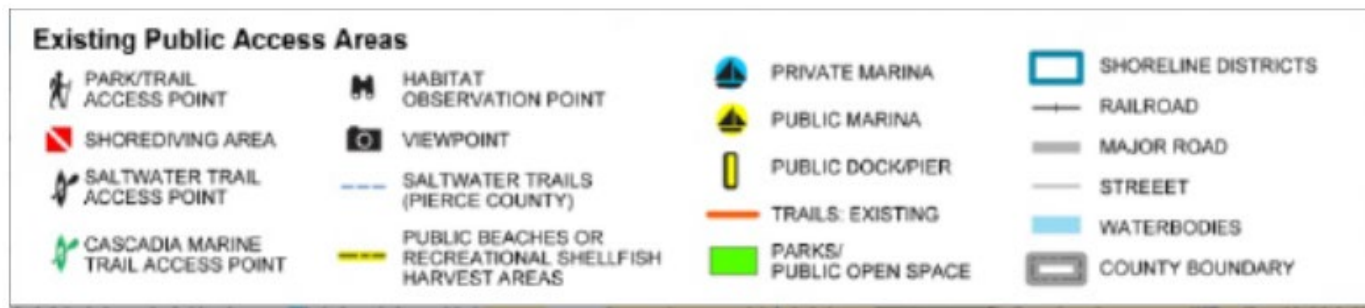
- a. Riparian Forest- 1.03
- b. Emergent Marsh- 0.73
- c. Mudflat- 1.41
- d. Backshore- 0.42

5. Swan Creek- 11.69 Acres

- a. Forested Riparian- 2.81, 1.09, 1.61, 0.17, 0.15,
- b. Open Water- 2.97
- c. Emergent Marsh- 0.45
- d. Side channel- 0.48, 0.18,
- e. Upland Forest- 1.78



Existing Public Access Sites



Commencement Bay NRDA site information including primary Functional Habitat Types (FHT), overall site goals, and affected NRDA Trust species for each site

Site	Size	Year Constructed	Site Goals	Primary FHT ¹	Primary Function	NRDA Trust Species Affected
Middle Waterway-City	1.96 acres	2000	Created estuarine wetland/shoreline w/intertidal/salt marsh/riparian buffer, preserve rare mudflat	Saltmarsh	Juvenile salmon rearing	Juvenile salmon, adult salmon, flatfish, benthic communities
Middle Waterway-Simpson	3.59 acres	1996	Created estuarine wetland/shoreline w/riparian buffer, preserve rare mudflat	Saltmarsh, mudflat	Juvenile salmon rearing	Juvenile salmon, adult salmon, flatfish, benthic communities
Olympic View	11.25 acres	2002	Softening of shoreline to enhance intertidal habitat, one of few remaining eelgrass beds in Commencement Bay	Intertidal gravel beach/ soft-bottom shallow subtidal	Juvenile salmon rearing	Juvenile salmon, adult salmon, benthic communities, flatfish, diving water birds
Swan Creek	11.69 acres	2000	Stream restoration establishing freshwater, in-channel and off-channel habitat, refuge for juvenile salmon	Off-channel/ floodplain	Juvenile salmon rearing	Juvenile salmon, adult salmon, wading birds/waterfowl, aerial searchers
Tahoma Saltmarsh	1.73 acres	2004	Salt marsh restoration w/tidal channel and mudflat	Saltmarsh	Juvenile salmon rearing	Juvenile salmon, adult salmon, aerial searchers, wading birds

From: Earthcorps 2015. Commencement Bay Stewardship Collaborative: Ecosystem Management Plan

¹ Source: Commencement Bay Natural Resource Restoration Plan and Final Programmatic Environmental Impact Statement, June 1997

A Point of Clarification

- Some of these endpoints are habitat metrics and though required for a sustainable environment, they are not Final Ecosystem Services.
- Our challenge is to: 1) translate these metrics into ecosystem services; and 2) quantify to the extent possible, services that we are documenting in this analysis.
- That will allow us to understand the benefits to human well-being that are derived from remediation and restoration of contaminated sites.

EPA's Ecoservice Models Library (ESML)

- ESML is an online database for finding, examining, and comparing ecological models that can be useful for estimating the production of ecosystem goods and services.
- The database describes over 150 ecological models
- We will attempt to quantify, where possible, the benefits associated with the Commencement Bay restoration project by using tools in the ESML database. We will also use the information gathered in ESML to better understand the applicability of our work to other sites.
- Information about ESML can be found at <https://www.epa.gov/eco-research/ecoservice-models-library>

Thank You

We hope that you enjoyed our presentation on the relatively new dimension of applying ecosystem services considerations in the realm of cleanup and restoration of contaminated sites.

We'd like to extend our appreciation to Cody Schumacher, Oak Ridge Associated Universities (ORAU) research participant, and Brooke Mastervich, ORAU student services contractor, for their technical assistance in making this presentation possible.

Questions?

Thea Foss Waterway Cleanup

A new beginning

The City of Tacoma led the cleanup of more than a century's worth of contaminants from the majority of the Thea Foss and Wheeler-Osgood Waterways. Between 2003 and 2006, about 425,000 cubic yards – enough to fill about 31 Museum of Glass cones – of contaminated sediments were dredged from the waterway and placed in a “nearshore fill” in the nearby St. Paul Waterway. Other areas of the waterway were capped with clean sediments to contain some of the contamination in place. We also worked with property owners to build and upgrade marinas during the project and to restore marine habitat in several areas around the bay.

Thea Foss Waterway

Thea's Park

Wheeler-Osgood Waterway

You are here

Marina of Duwamish

Legend:

- No action
- Natural recovery
- Enhanced natural recovery
- Slope rehabilitation
- Habitat enhancement
- Backfill
- Cap
- Dredge to clean

The U.S. Environmental Protection Agency oversees this Superfund cleanup. 1-800-426-4372

Keeping it clean

We've all made an investment in this waterway and in our community through this cleanup project. Now we need to work together to make sure that it stays clean.

The City has developed an “Institutional Controls Plan” to outline what needs to be done to protect the cleanup. For example:

- Land owners have agreed not to do things on their property which could harm the shoreline areas.
- Signs limiting boat speeds and preventing anchoring are a reminder to help minimize the threat of disturbance to the cap.
- New construction in the waterway will be done carefully to make sure that any capped contamination in the waterway is undisturbed.
- City staff and the Washington Department of Ecology are continuing to monitor potential sources of contamination to the waterway.

Through our combined efforts, we can enjoy a clean and healthy environment for generations to come.

Who paid for the cleanup?

The cleanup bill added up to about \$105 million. Here's how the cost was shared:

- City of Tacoma's Surface water rates: \$59.5 million
- Washington State Department of Ecology Grants: \$21.5 million
- Private contributions from other responsible parties: \$13 million
- Cleanup at south end by PacifiCorp and Puget Sound Energy: \$7.3 million
- Washington State Department of Natural Resources: \$3.7 million

Questions?

If you have questions or concerns about the waterway, please contact us:

Phone: (253) 591-5588
Email: fosscleanup@cityoftacoma.org
Web site: www.cityoftacoma.org/fosscleanup

Thea Foss Waterway History

- 1873** Northern Pacific Railroad chooses Tacoma as its western terminus
- 1905** Army Corps of Engineers completes dredging to form what was then called City Waterway
- 1900s** Railroad and port spur such waterway development as logging, granaries, shipyards, machine shops, forges, cement and asphalt plants, oil and petroleum distribution centers, stormwater outfalls and a coal gasification plant
- 1983** Environmental Protection Agency lists waterway as part of the larger Commencement Bay Superfund site
- 1989** Waterway is renamed in honor of early resident Thea Foss
- 1994** City volunteers to investigate cleanup options after years of legal wrangling among companies and property owners identified by EPA as responsible for contamination
- 2002** Cleanup begins after sampling, testing, design work and plan approval
- 2006** Cleanup completed, long term monitoring begins