BELLINGHAM BAY
WA

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Bellingham Bay Overview

Whatcom Waterway Site Overview

- Mercury from former Georgia-Pacific facility became widely dispersed in Bellingham Bay
- Mercury collocated with five other Bellingham Bay cleanup sites
- Collocated contaminants included dioxins/furans, PAHs, TBT, wood waste, phenols, and other metals (As, Cd, Pb, Zn, and Cu)

Objectives of Remediation

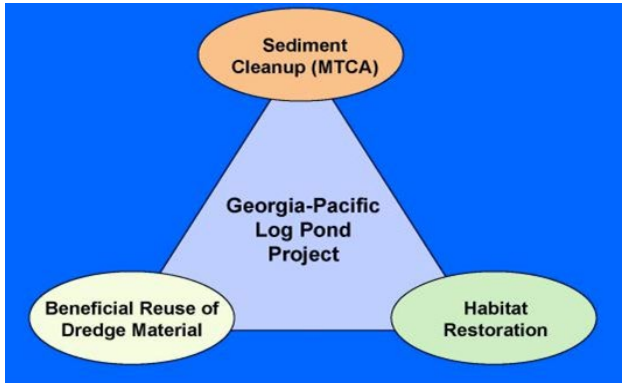
- Reduce surface sediment toxicity to benthos
- Reduce mercury bioaccumulation (esp. in Dungeness crab)
- Put early emphasis on source control
- Make sediment cleanup compatible with changing land uses and habitat goals
  - Waterfront District redevelopment since 2003
- Provide adaptive management for nearly 50 years

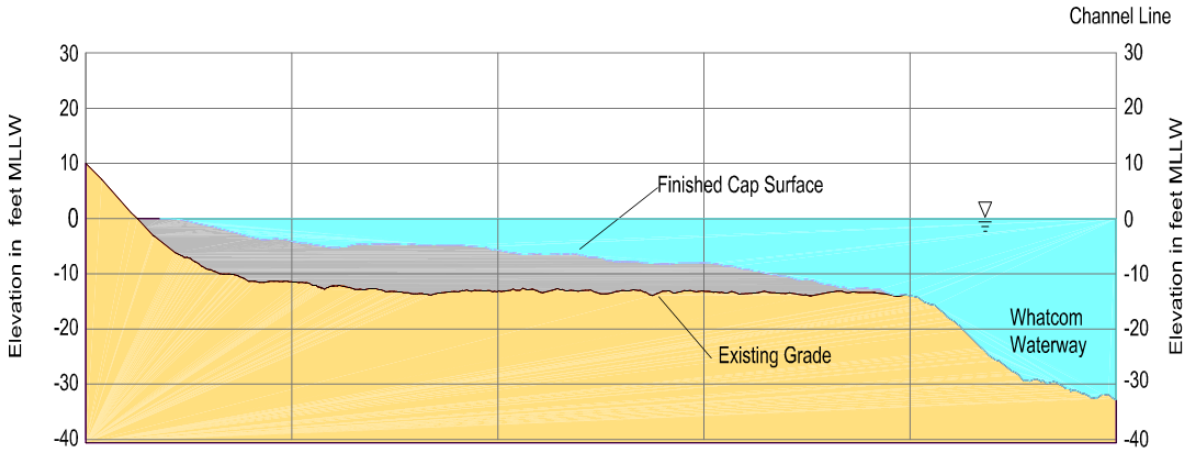
Summary of Remedy

- 1970 to 1972: Point source controls
- 1996 to 2007: RI/FS and cleanup decisions
- 1998 to 2001: Bellingham Bay Pilot Project
- 2001: Log Pond Interim Action
- 2015 to 2016 Phase 1: Whatcom Waterway Cleanup Phase 1
  - Consent Decree amendment to address changed conditions
  - 110,000 cubic yards of material dredged and disposed of off site
  - 100,000 cubic yards of capping material placed
- Pending: Whatcom Waterway Cleanup Phase 2

2001 Log Pond Interim Action

- Accelerated natural recovery by capping highest concentration deposit
- Concurrent beneficial reuse of clean dredged material and habitat restoration
- 3-foot cap for cleanup
- Up to 10 feet placed to restore productive 6-acre intertidal beach and eelgrass habitat





2015 to 2016 Cleanup of Phase 1 Areas

Dredging areas

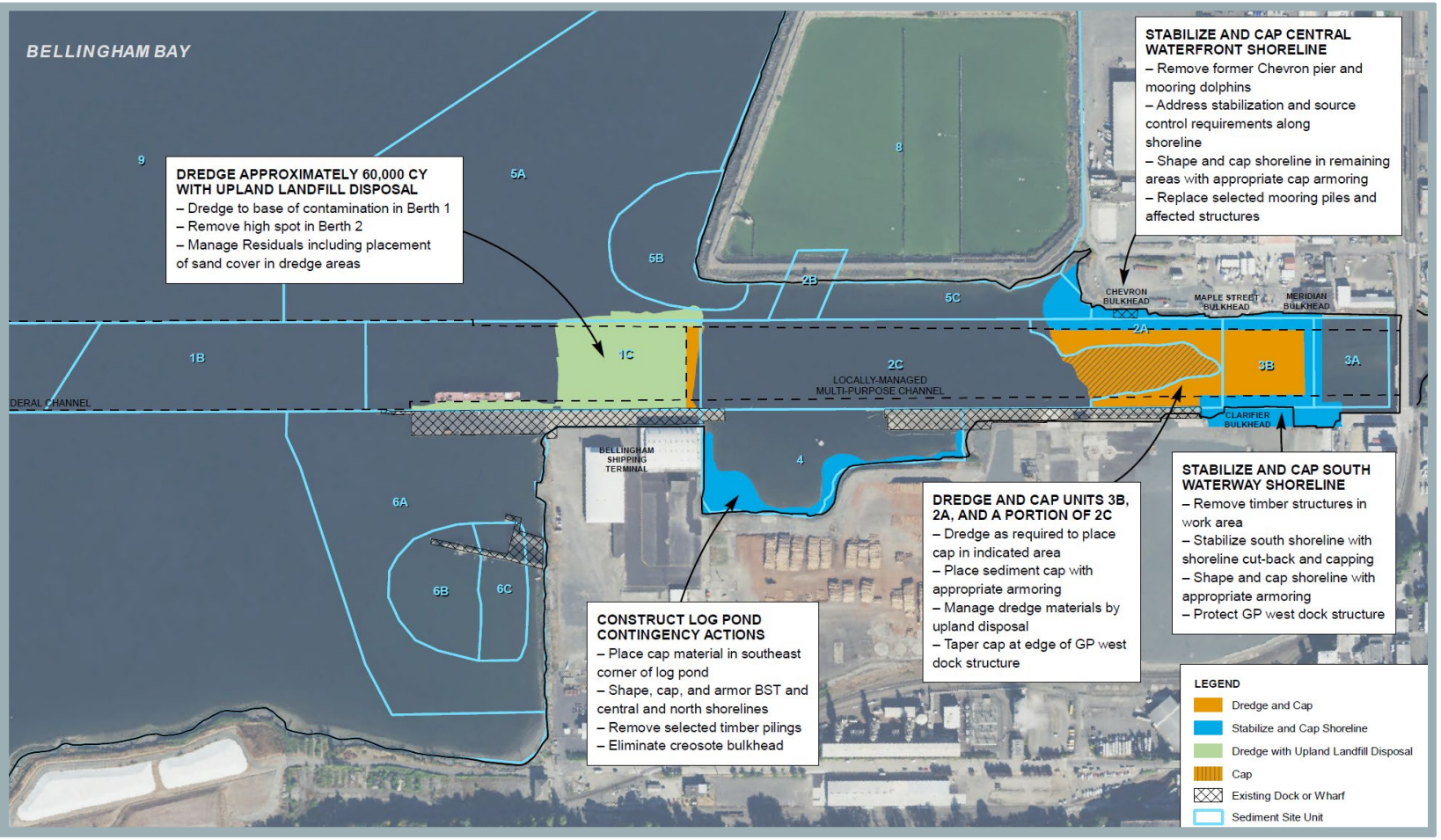
- Federal channel
- Multi-purpose channel
- Central Waterfront

Capping areas

- Multi-purpose channel
- Shoreline areas

Source control

- Groundwater plume
- Central Waterfront bulkhead replacement



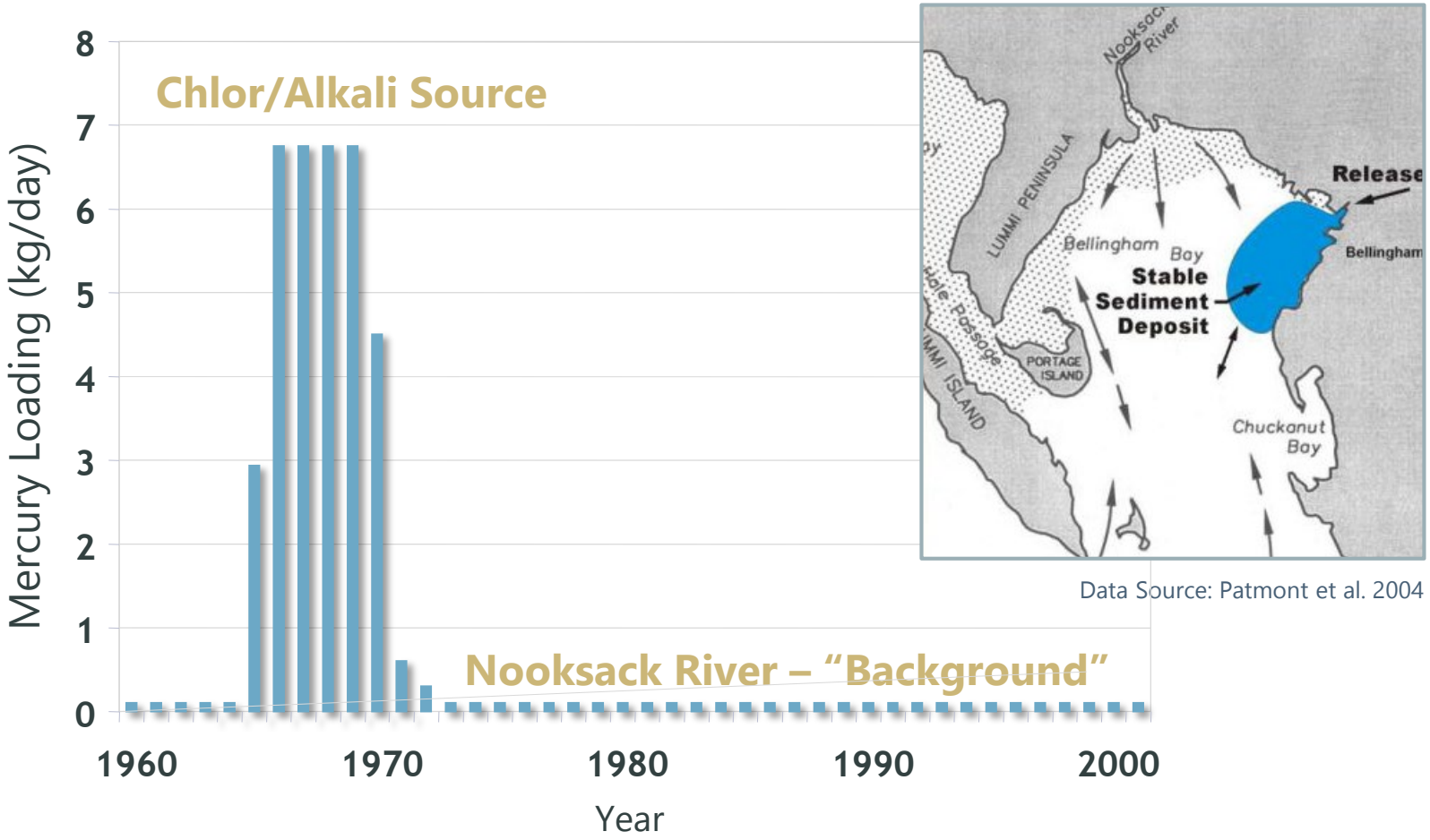
Significant Remedy Scope or Schedule Deviations

- Changes in land uses and regulatory focus
  - Port purchases property 2005 > plant closure occurs
  - Sediment toxicity > mercury > dioxins/furans
  - Required changes in cleanup remedy
- Constraints on project funding availability
  - Project supported by state grant program (50% match; funding constraints)
  - Phasing required to align project with funding availability
- Longer permitting timeline due to stakeholder concerns
  - Tribes requested water quality monitoring during construction and biological (tissue/seafood) monitoring post-construction and voiced concerns about increased vessel traffic

When Were External Sources Characterized and Addressed?

- Point source controls addressed from 1970 to 1972
- Pulp “fiber mat” sediment removed in 1974
- Localized bank sources identified and addressed through monitoring and adaptive management during design
  - Integration of source control and sediment remediation in two areas
  - Localized source removal and groundwater containment walls
- Effectiveness of source controls documented by monitoring
  - Groundwater, porewater, and sediment monitoring

Mercury Release and Source Control



Data Source: Patmont et al. 2004

Primary Pre- and Post-Remedy Effectiveness Monitoring Elements

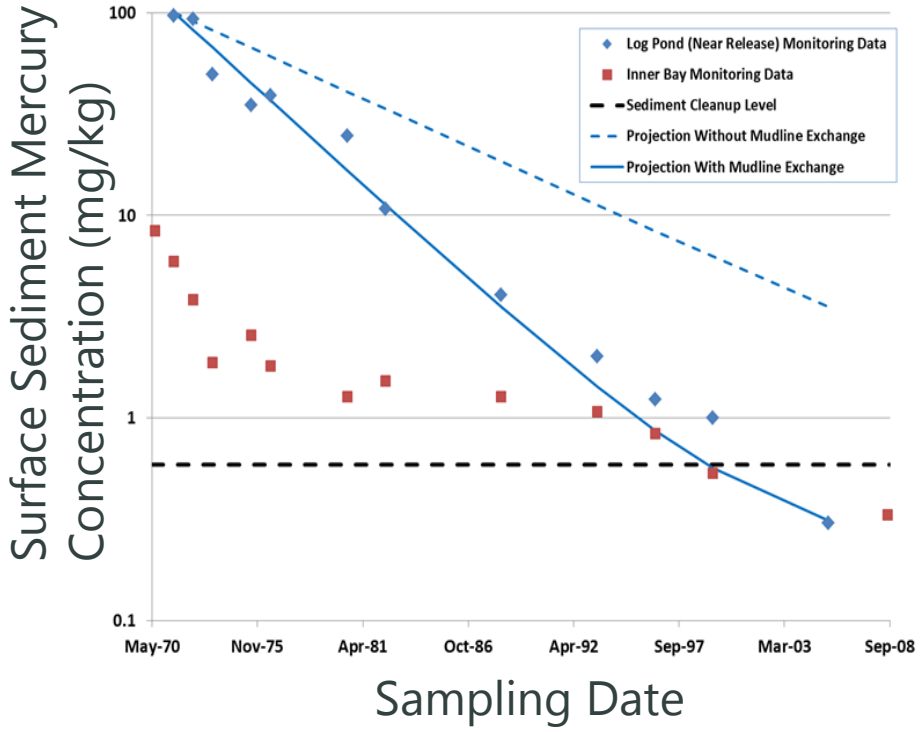
- Surface sediment and core monitoring (mercury and dioxins/furans)
- Sediment bioassays (amphipod, larval, and polychaete)
- Bioaccumulation (mercury and dioxins/furans)
  - Porewater mercury testing (total and methylmercury)
  - Dungeness crab (adult and juvenile)
  - Clams (in situ testing of caged clams)
  - Flatfish
  - Other contingent testing

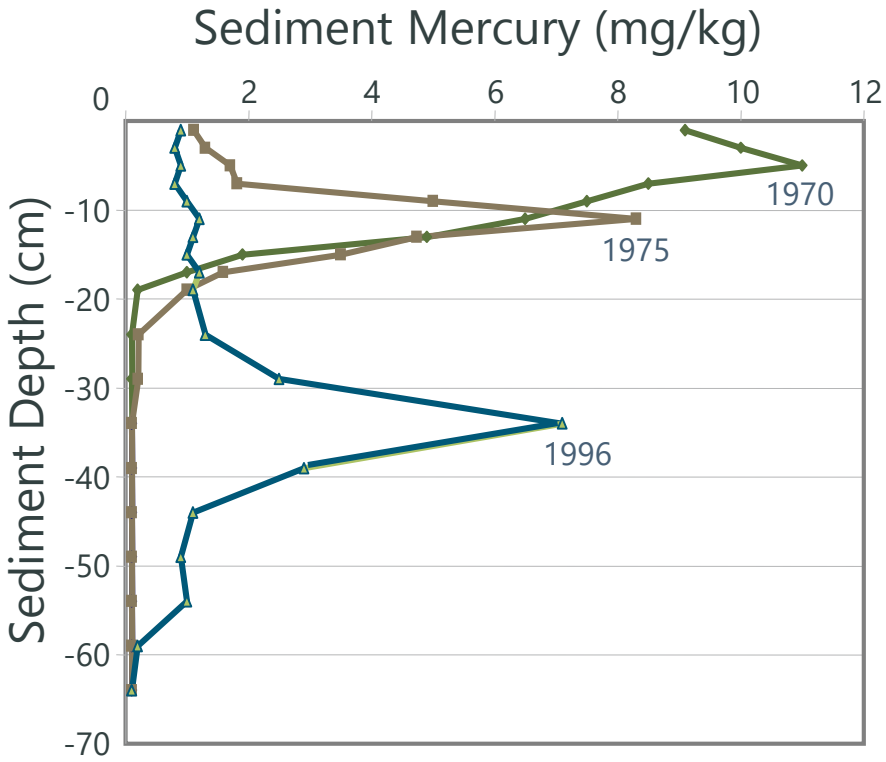
Did the Remedy Achieve Short- and/or Long-Term Remediation Objectives for Surface Sediment?

- Sediment mercury recovery accelerated by complex exchange processes
- Mercury SWAC now nearly equivalent to natural background
  - 2017 Whatcom Waterway SWAC: 0.24 mg/kg total mercury
  - Puget Sound natural background: 0.20 mg/kg total mercury
- Compliance with bioassay performance testing criteria
- Dioxin/furan levels reduced to less than bay-wide regional background (less than 15 ng/kg TEQ)

Sediment Mercury Recovery Accelerated by Complex Exchange Processes

- Recovery occurred five times faster than simple model projections
- Attributed to surface sediment exchange during storm surges





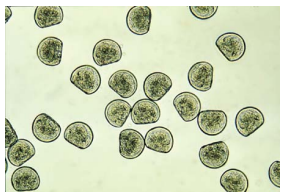
Source: Patmont et al. 2004

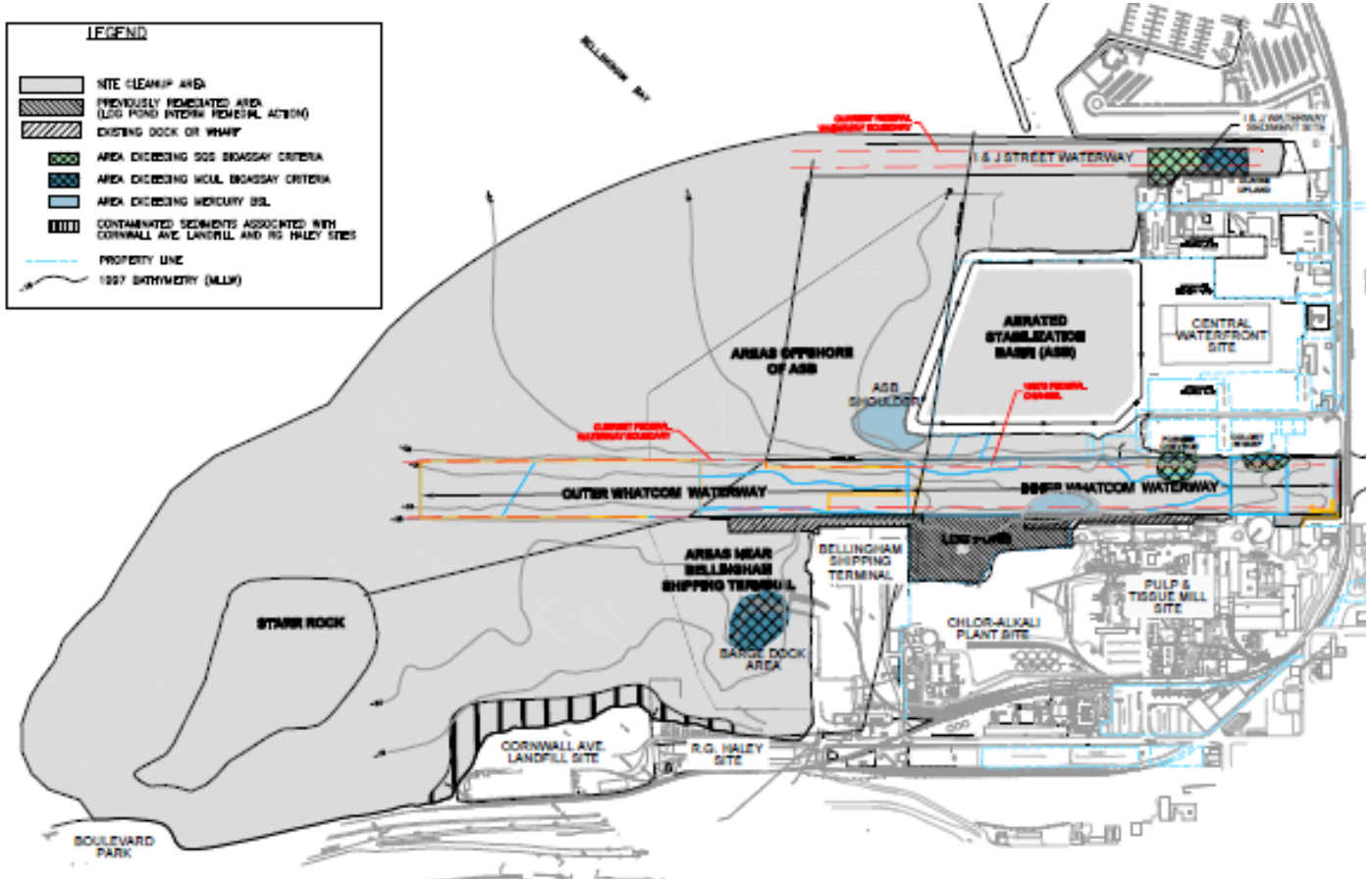
Is the Remedy on Track to Achieve Long-Term Remediation Objectives for Water and/or Biota?

- Source controls and natural recovery reduced sediment toxicity
- 2001 Log Pond cap continues to be protective
  - Productive benthic/epibenthic communities by first year
  - Increased utilization by salmon and forage fish
  - Eelgrass meadow restoration after several years
- Dungeness crab bioaccumulation approaching background
  - Mercury less than risk-based thresholds
  - Dioxins/furans within regional background range

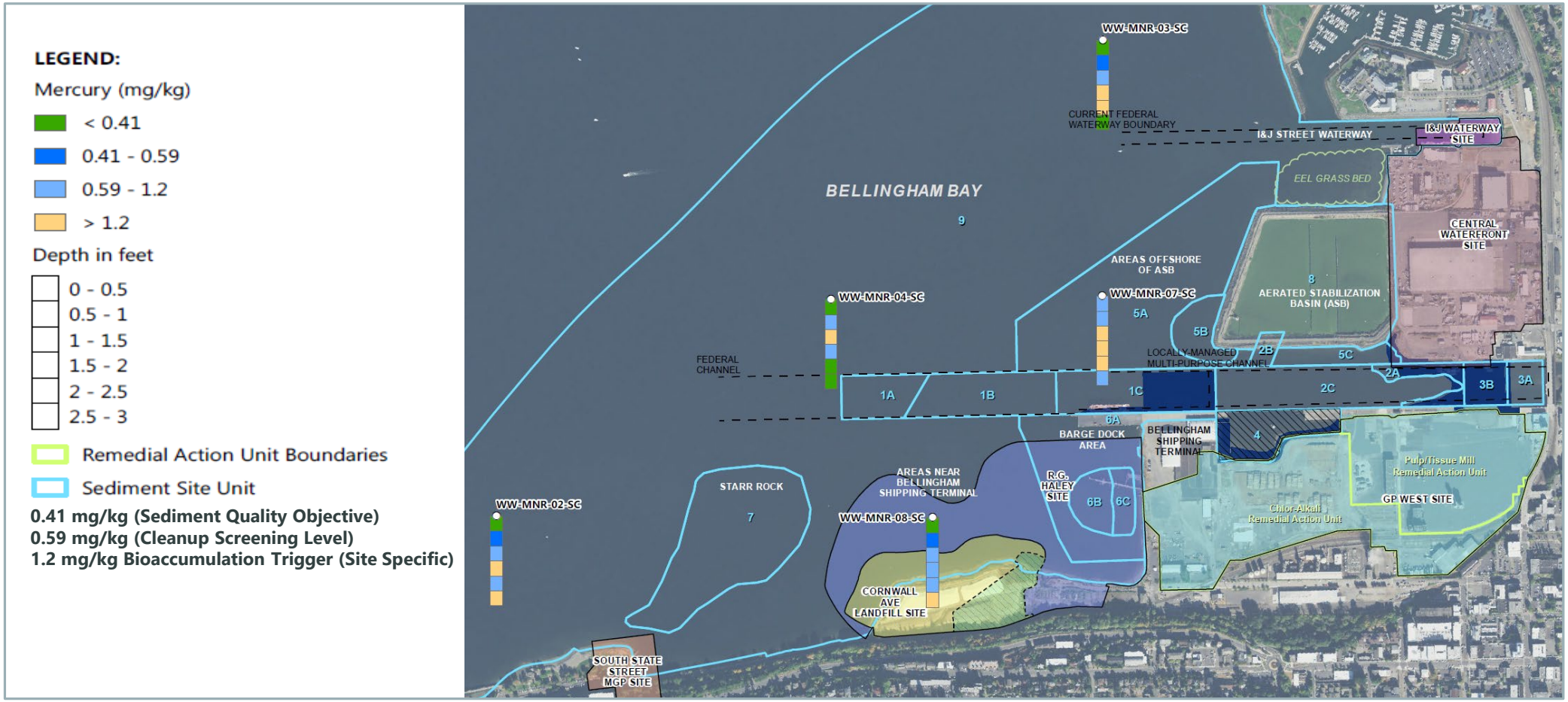
Biological Recovery Following Source Controls: Sediment Toxicity

- Sediment toxicity tests
  - Amphipod: acute toxicity
  - Larval: acute toxicity and abnormality
  - Polychaete: chronic toxicity and growth



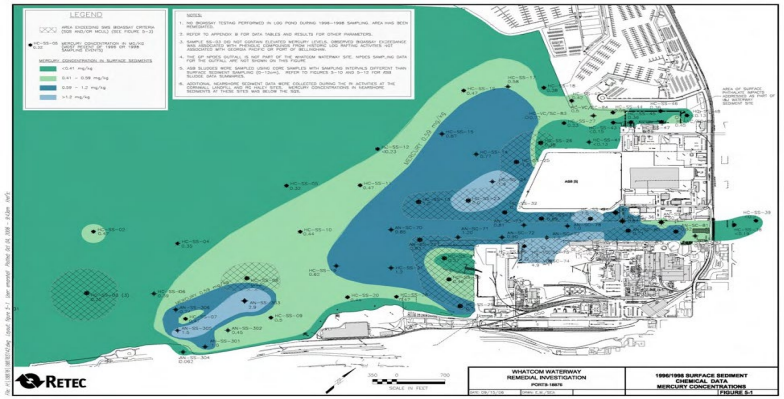


Sediment Cores Show Progressive Natural Recovery through Burial and Mixing



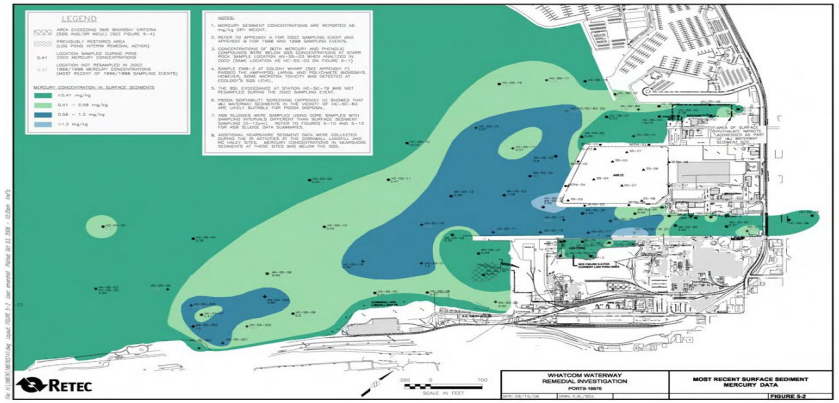
Progressive Natural Recovery through Burial and Mixing

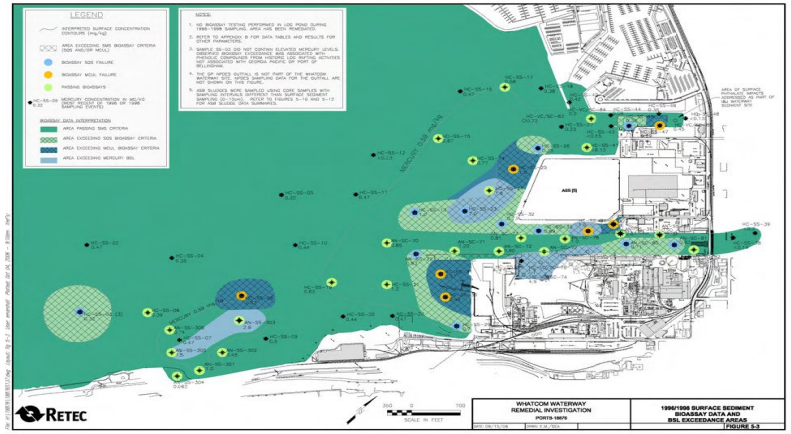
1996-1998



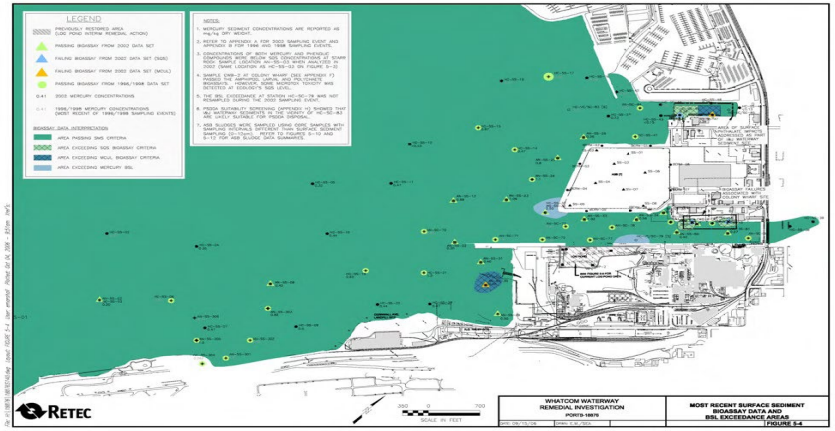
Mercury Concentrations
down 31%

2002

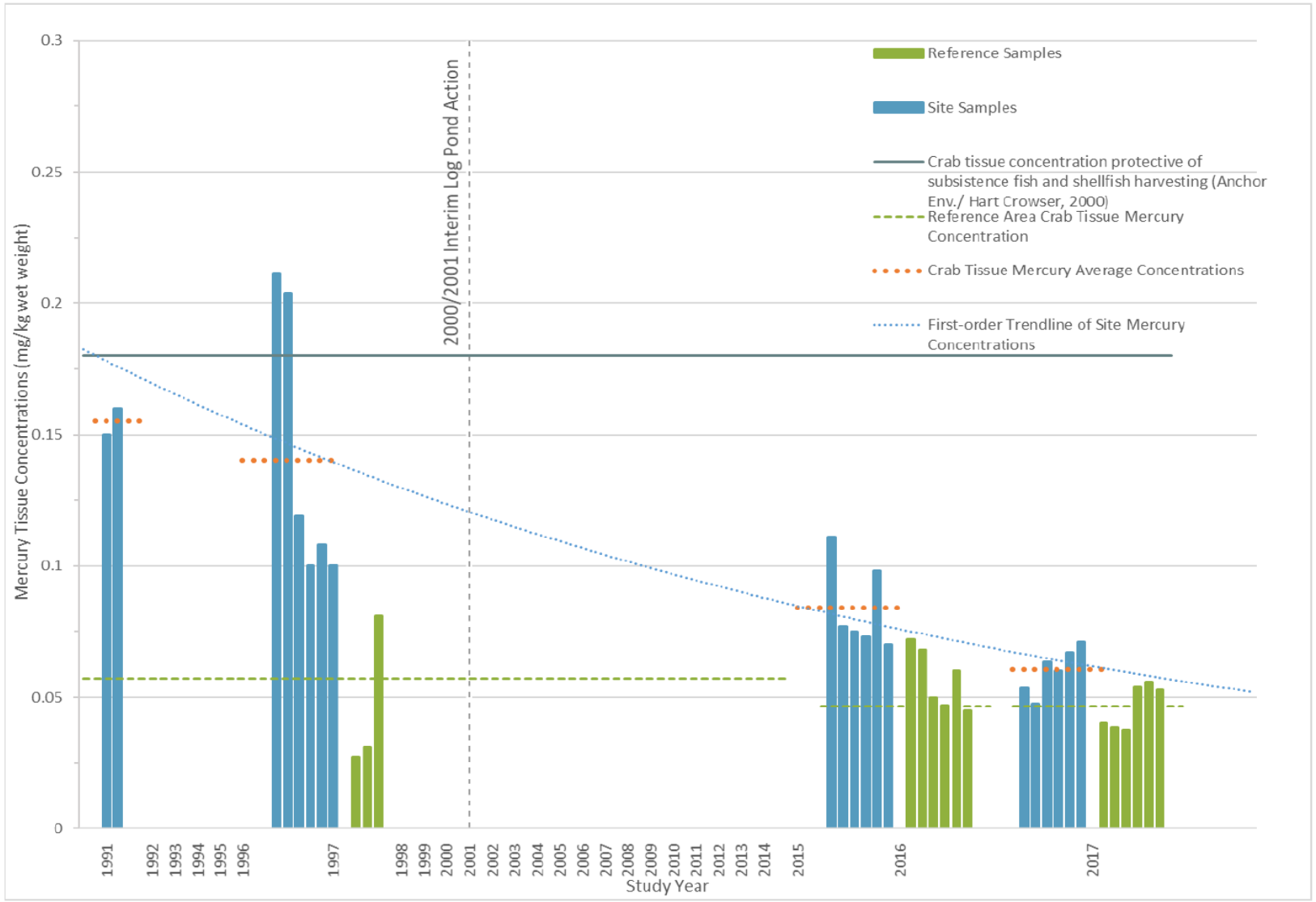




Bioassay and Bioaccumulation Screening Level Reduction



Dungeness Crab Mercury Levels Approaching Background



Key Take-Home Messages

- Active stakeholder and community involvement is worth the effort
- Cooperative projects have multiple benefits
  - Integrated habitat restoration and cleanup
  - Better fit with community land use needs
- Natural recovery progressed five times faster than simple model projections
- Adaptive management required to address changing land use and regulatory focus

What's Next?

- Cleanup remainder of site (Phase 2)
  - Port considering changes in land use, may require remedy modification
- Community redevelopment ongoing in Waterfront District areas