

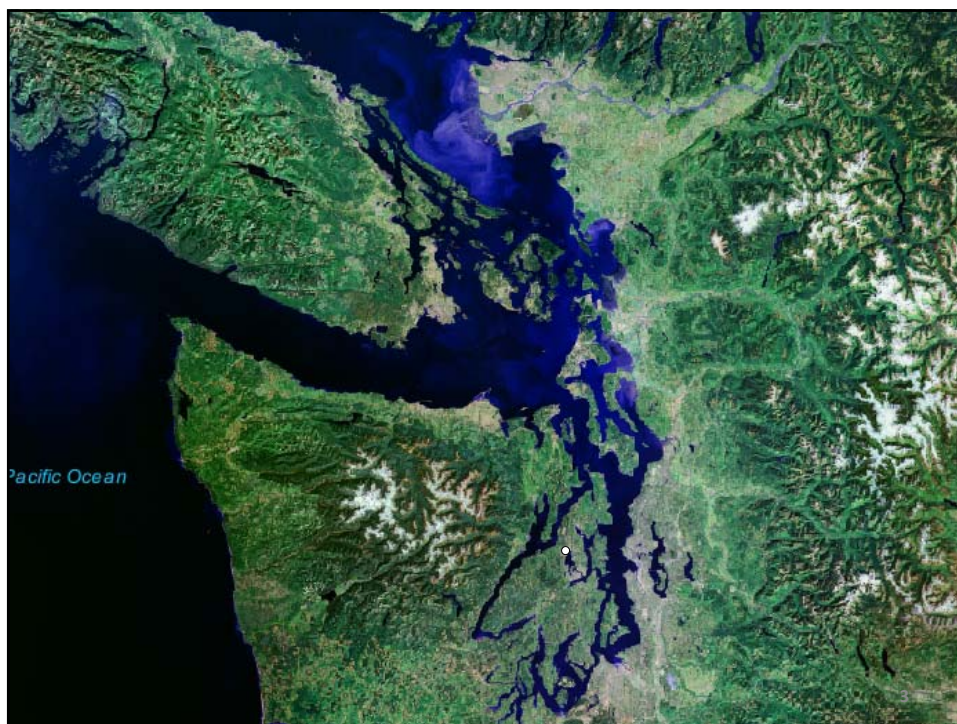
ENVVEST Mussel Watch Project: Monitoring Environmental Quality in Local Waters

Presentation for All Ports Meeting, Brownsville, WA
Jan 23, 2017

Robert. K. Johnston, Space and Naval Warfare Systems Center Pacific,
Bremerton, WA

This presentation reflects the personal views of the author and does not suggest or reflect the official policy, practices, programs, or doctrine of the U.S. Navy or any other governmental agency.



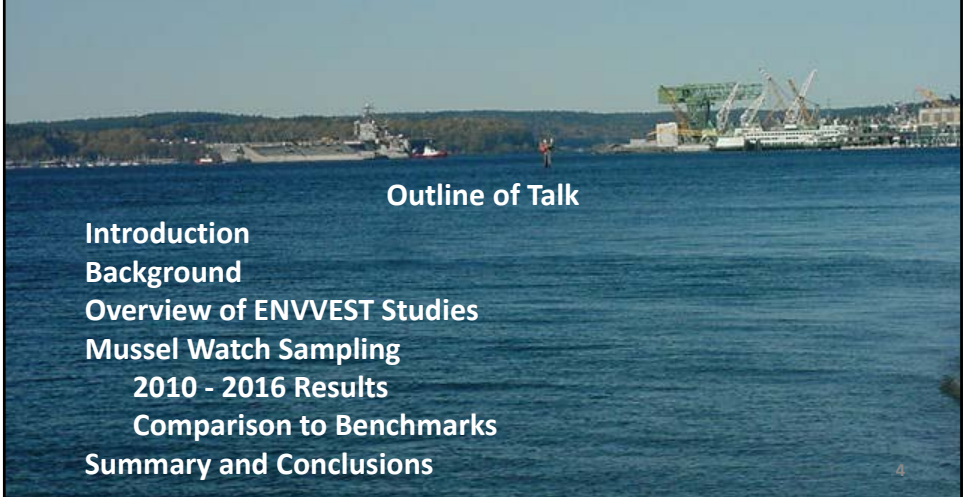


Puget Sound Naval Shipyard & IMF
Project ENVironmental inVESTment (ENVVEST)

ENVVEST Mussel Watch Project

Outline of Talk

- Introduction
- Background
- Overview of ENVVEST Studies
- Mussel Watch Sampling
 - 2010 - 2016 Results
 - Comparison to Benchmarks
- Summary and Conclusions



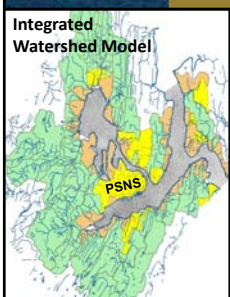


Puget Sound Naval Shipyard & IMF (PSNS&IMF) Project ENVVEST

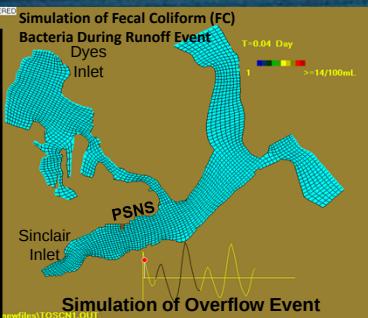
- Final Project Agreement (Sep. 2000)
PSNS&IMF/EPA/Ecology
- Cooperative technical studies with local agencies and stakeholders for watershed monitoring and modeling
- Pool resources to solve environmental problems

Pay off – Goodwill from regulatory agencies, stakeholders and public, and real improvements in environmental quality





Integrated Watershed Model

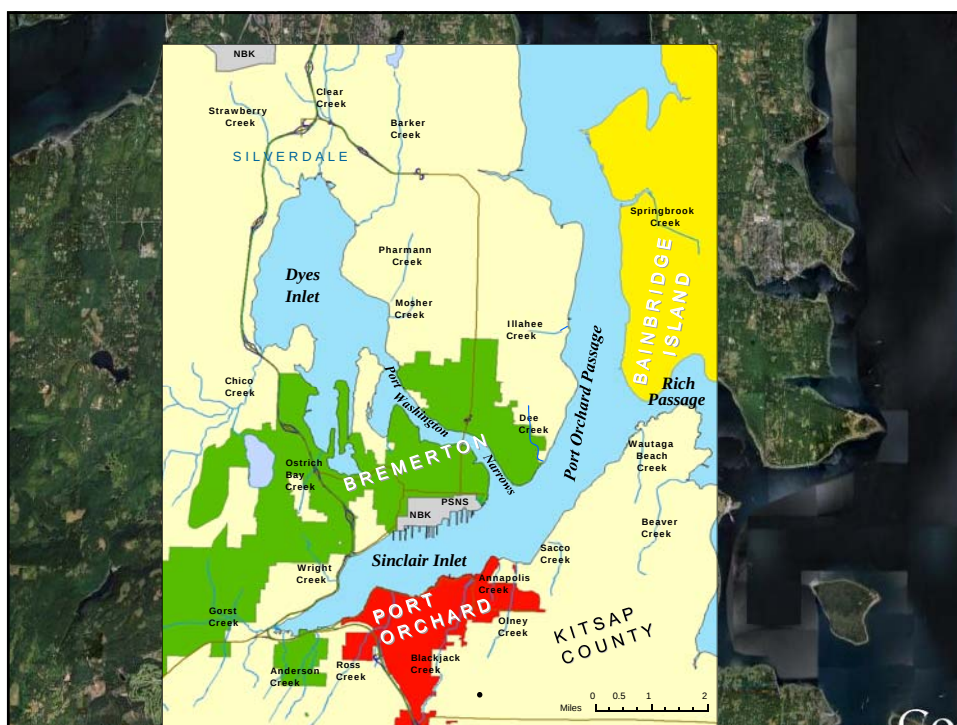


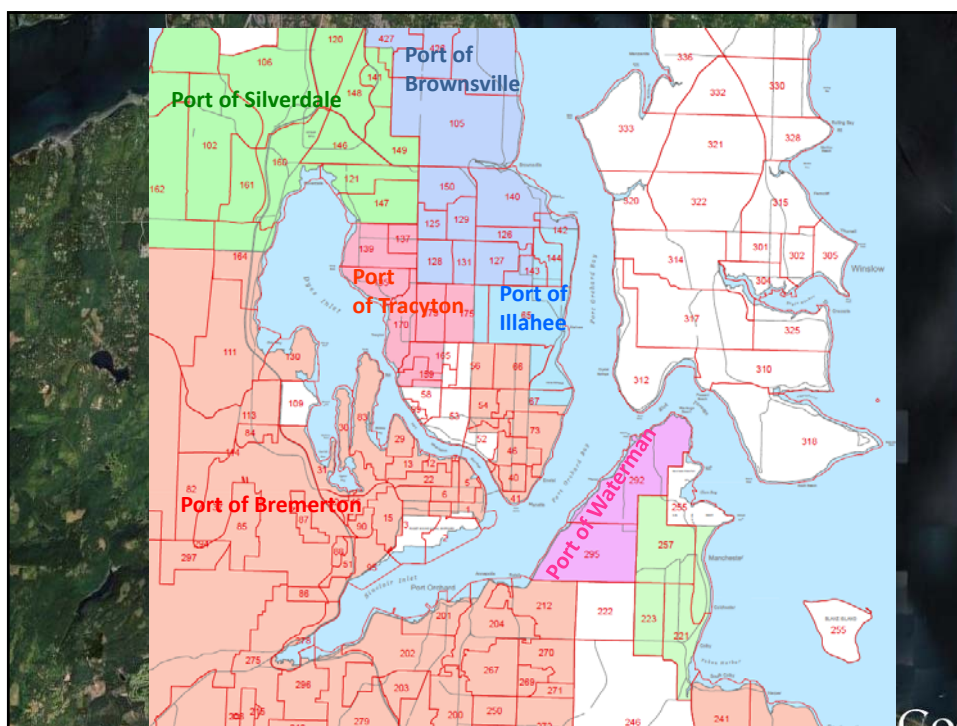
Simulation of Fecal Coliform (FC) Bacteria During Runoff Event

Simulation of Overflow Event

Major Accomplishments

- Developed model of watershed and Inlets
- Assessed contaminant loading from storm events and runoff
- Contributed to reopening of 1500 acres of shellfish beds in Dyes Inlet
- Technical Support for FC TMDL
- Providing science to inform NPDES permitting process

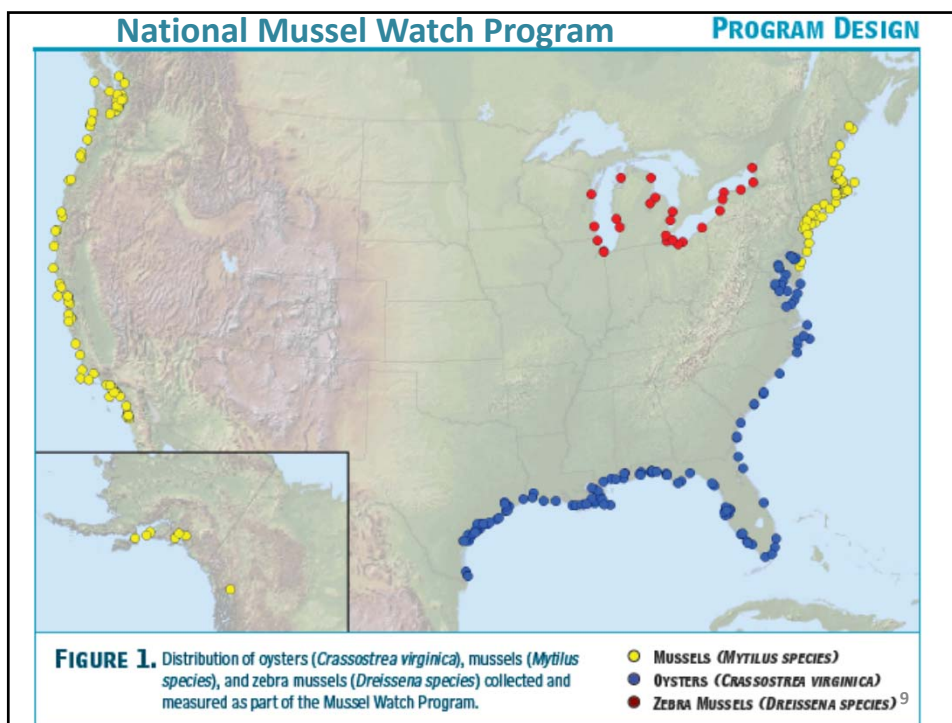




Two Main Sources of Impact

- Historical releases of pollutants
 - Past practices (Point Sources)
 - Legacy residual contamination
- Watershed Development
 - Loss of natural habitat
 - Increases in runoff from landscape
 - More Nonpoint Source Pollution

Image U.S. Geological Survey



ENVVEST Mussel Watch Sampling

Partnering with WDFW and Local Stakeholders

Coordinated with National Mussel Watch Program

West Coast Sampling Winter of Even Years (Winter 2010, 2012, 2014, 2016)

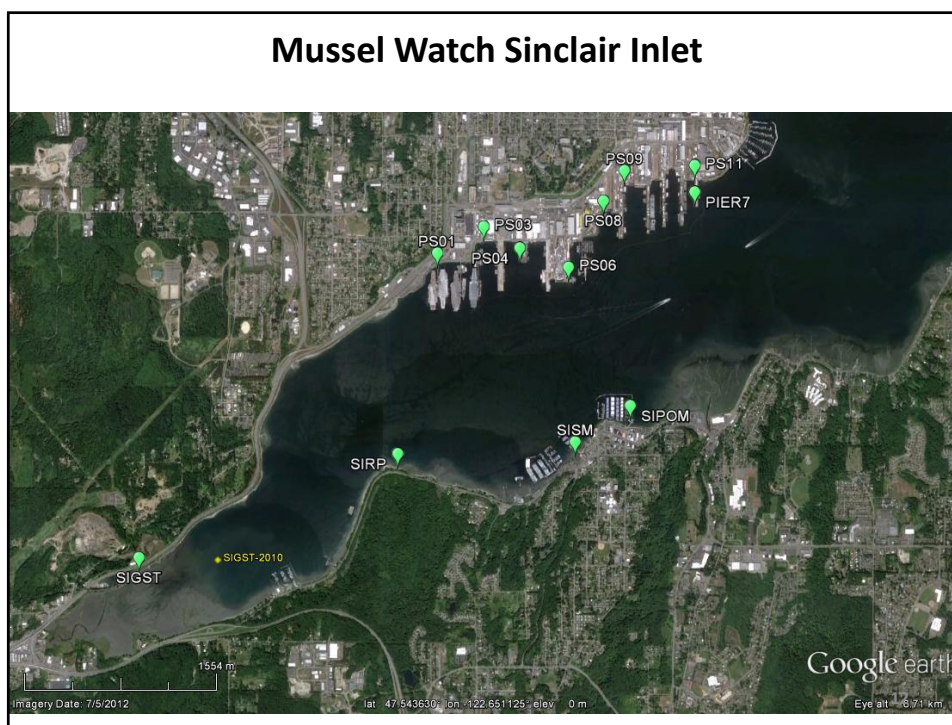
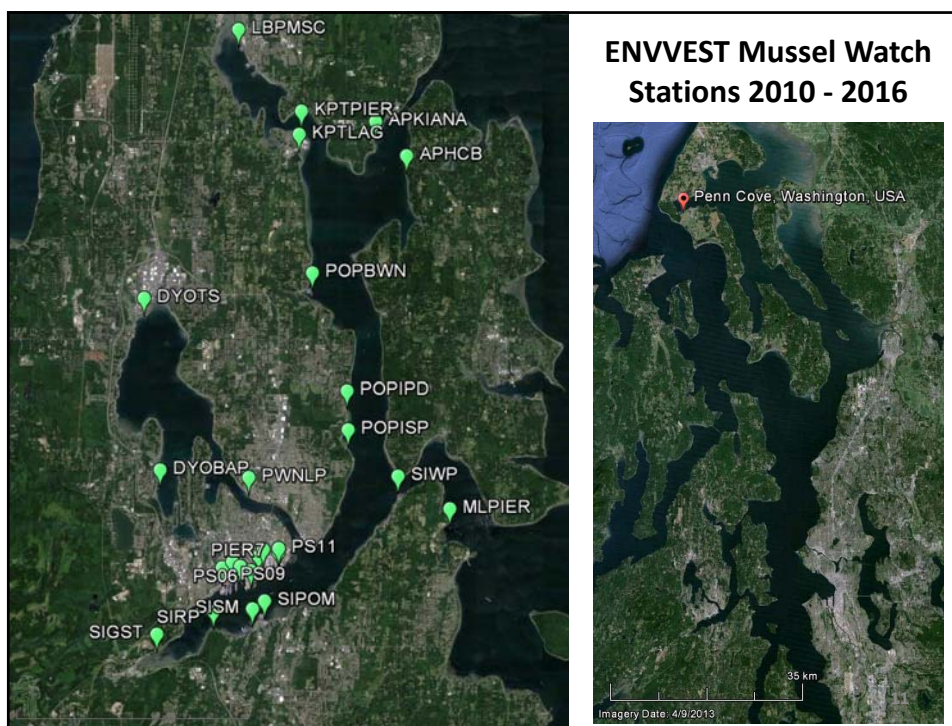
Representative Sampling Site Locations

- 3 Stations/Site, Size Distribution
- Composite Sample for Chemistry
 - Metals, PAHs, PCBs
 - $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, and Lipids

Participating Jurisdictions

City of Bremerton Parks & Rec
 City of Bainbridge Island
 Port of Bremerton
 Port of Brownsville
 Port of Illahee
 Port of Poulsbo
 Port of Silverdale
 Private Landowner
 Suquamish Tribe
 US EPA/NOAA Manchester Lab
 US Navy Naval Base Kitsap (NBK)
 US Navy Naval Undersea Warfare Center
 US Navy Puget Sound Naval Shipyard & IMF
 Washington Department of Fish and Wildlife
 Washington State Parks Illahee

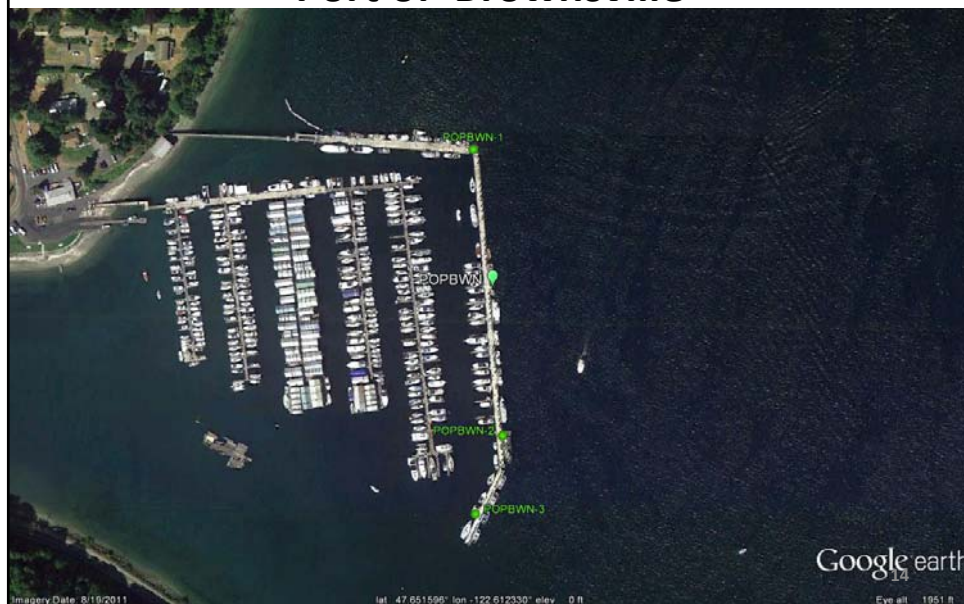




DYOTS – Dyes Inlet Old Town Silverdale Port of Silverdale



POPBWN – Port Orchard Passage Brownsville Port of Brownsville



Mussel Watch Sampling



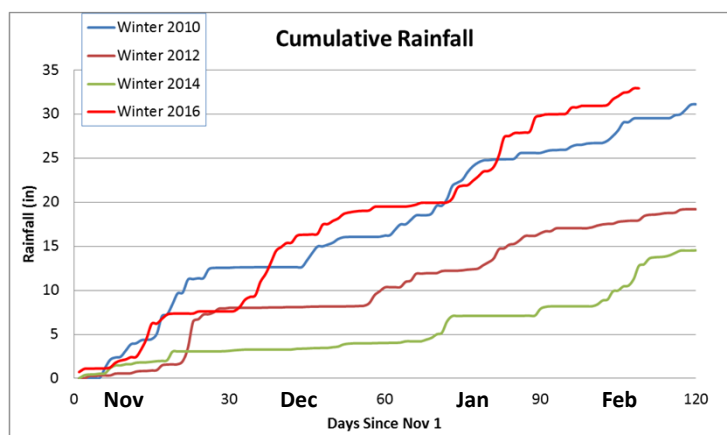
2016 Mussel Watch Sampling Port of Illahee

Photo by Jim Aho



16

Winter Sampling Nov - Feb



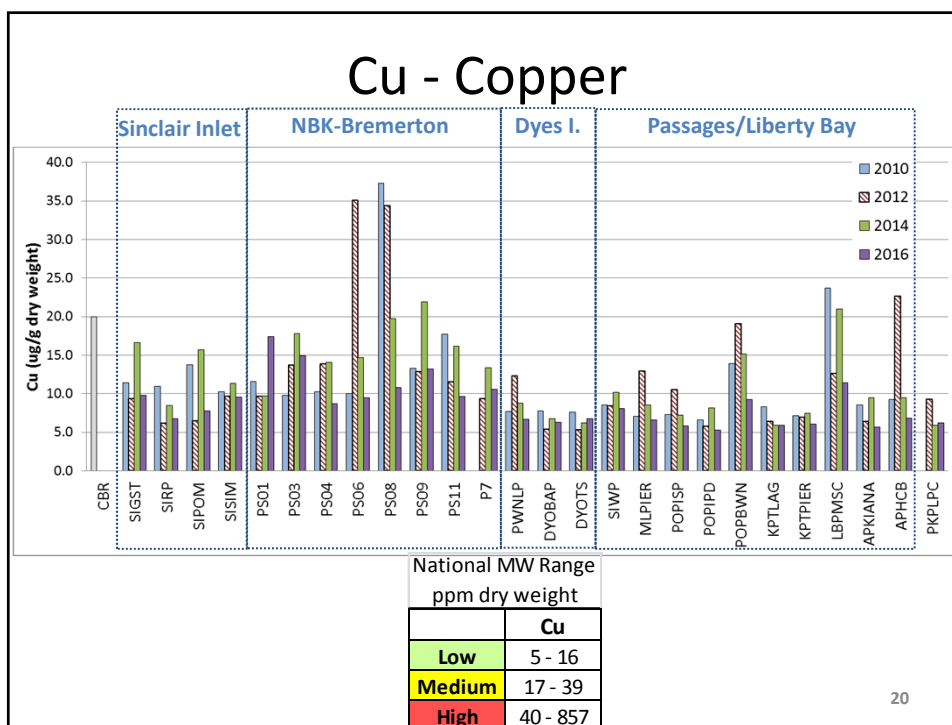
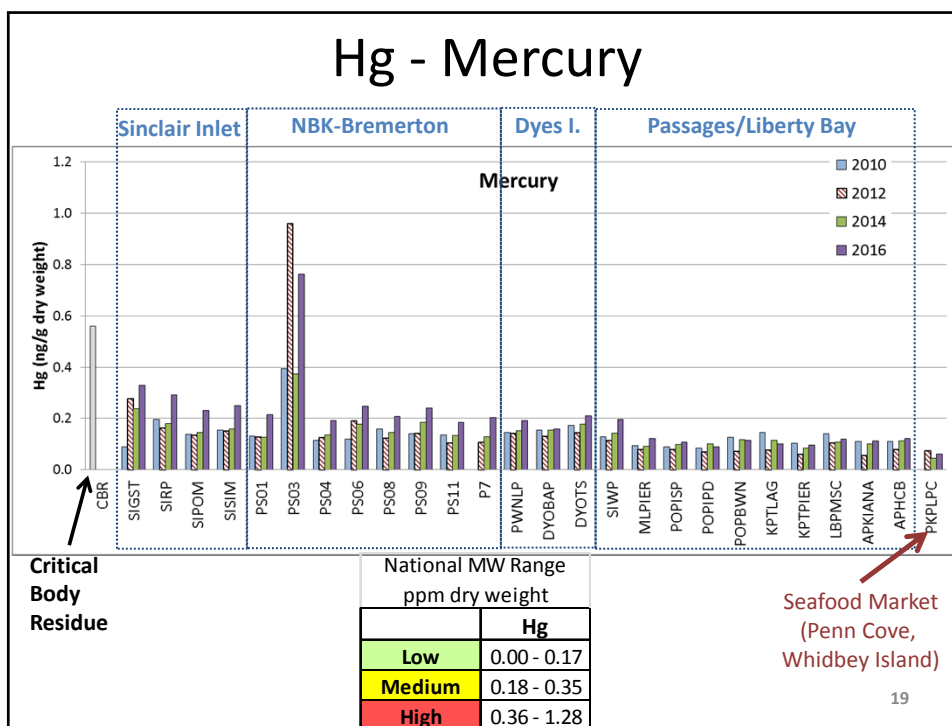
Sum of average daily rainfall reported from Kitsap County rain gauges (CoCoRaHS 2016)

17

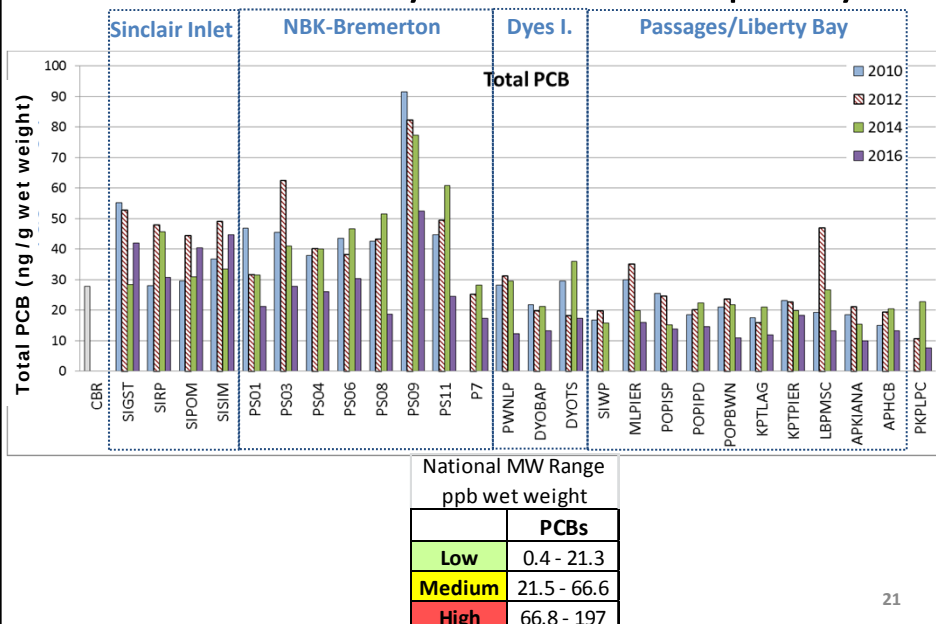
ENVVEST Mussel Watch 2010 and 2012 Data Evaluation

- Possible Trend
 - > 3x difference between years
- Possible Source
 - > 3x higher than other stations
- Possible Ecological Effect – Critical Body Residue
- Comparison to Seafood Market Sample
- Comparison to National Data Set
 - Low, Medium, and High Ranges

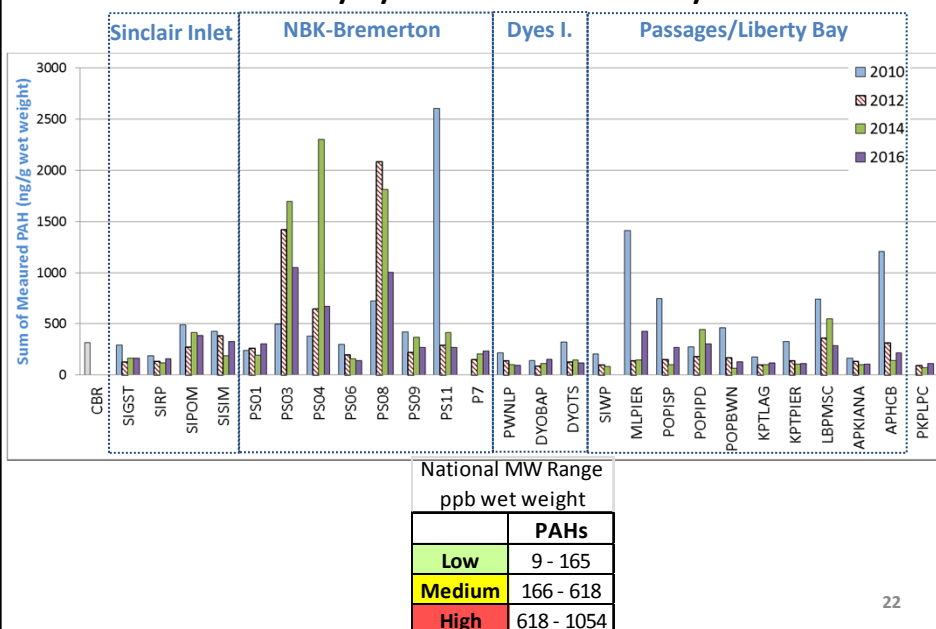
18

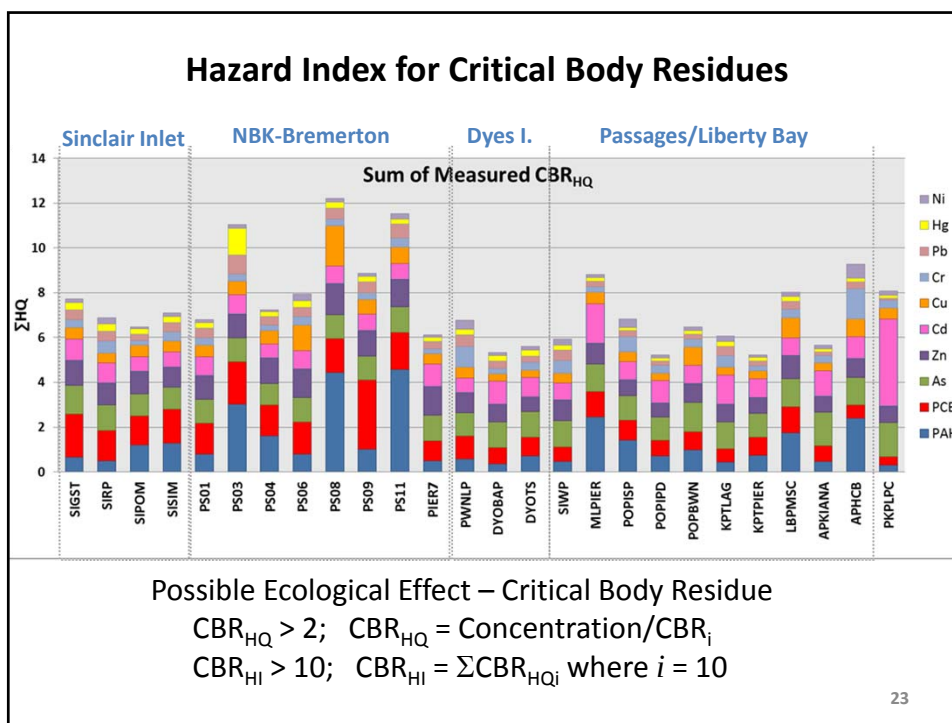


Total PCBs – Polychlorinated Biphenyls



Sum PAHs – Polycyclic Aromatic Hydrocarbons





Conclusions

- **Monitoring Program is focused on tracking environmental quality in the Inlets**
 - Can identify problems for further investigation and correction
 - Can be used to evaluate effectiveness of corrective actions
- **What are the Biota Telling Us?**
 - Some Areas were elevated with PAHs, PCBs, and metals
 - 3 of 24 sites had increased risk of ecological effects
 - Contaminants of concern were PAHs (3 sites), PCBs (2 sites), Hg (1 site), and Cu (1 site)
- **Overall decrease in contaminant levels indicates Improving Environmental Quality**
- **Monitoring framework provides context for interpretation**
 - Better information = better management

References:

Applied Biomonitoring 2009. Using Caged Mussels to Characterize Exposure & Effects over Small Spatial Scales in Sinclair Inlet: A Risk Assessment Based Approach. A Caged Mussel Study for Puget Sound Naval Shipyard & Intermediate Maintenance Facility Project ENVVEST. Final Report. Prepared for: Robert K. Johnston, Space and Naval Warfare Systems Center, Pacific, San Diego, California. Prepared by: Applied Biomonitoring, Kirkland, WA. October 16, 2009. 360pp. <https://drive.google.com/file/d/0B2b5ti0gsZXVYXY1bIVrSzF4RDA/edit?usp=sharing>

Johnston, R.K., Wang, P.F., Loy, E.C., Blake, A.C., Richter, K.E., Brand, M.C., Skahill, B.E., May, C.W., Cullinan, V., Choi, W., Whitney, V.S., Leisle, D.E., and Beckwith, B. 2009. "An Integrated Watershed and Receiving Water Model for Fecal Coliform Fate and Transport in Sinclair and Dyes Inlets, Puget Sound, WA." Space and Naval Warfare Systems Center, Technical Report 1977, Dec. 2, 2009. <http://www.mesodat.org/Public/TR1977/>

Johnston, R.K. Rosen G.H., J.M. Brandenberger, E.W. Mollerstuen, J.M. Young, and B. Beckwith, 2011. Monitoring water, sediment, and biota to assess protection of beneficial uses for Sinclair Inlet. Proceedings of the Salish Sea Ecosystems Conference 2011, Vancouver, BC, Canada http://www.verney.ca/assets/O2AProceedings_Johnston.pdf

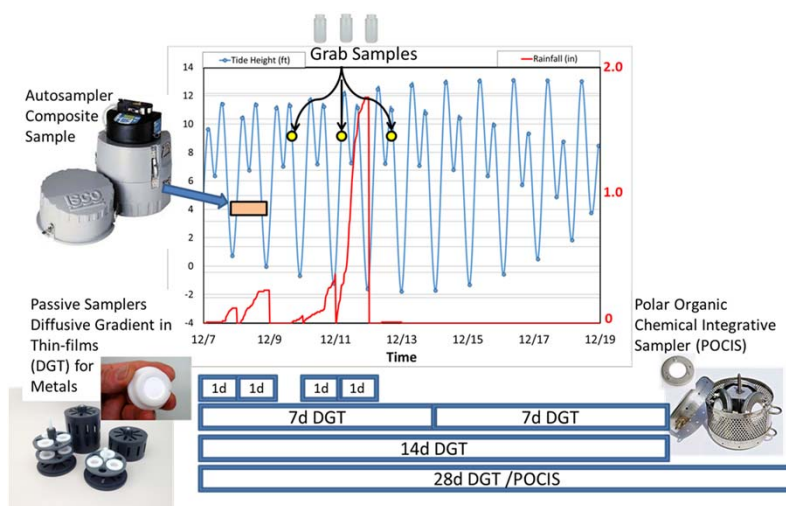
Kimbrough, K. L., W. E. Johnson, G. G. Lauenstein, J. D. Christensen and D. A. Apeti. 2008. An Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone. Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 74. 105 pp. <http://ccma.nos.noaa.gov/publications/MWTwoDecades.pdf>

Lawrence, S., M. Roberts, Karol Erickson, and R.K. Johnston, 2012. Sinclair and Dyes Inlets Fecal Coliform Bacteria Total Maximum Daily Load: TMDL and Water Quality Improvement Plan. June 2012. Washington State Department of Ecology, Northwest Regional Office, Bellevue, WA, Publication No. 11-10-051. <https://fortress.wa.gov/ecy/publications/summarypages/1110051.html>

Rosen, G., I. Rivera-Duarte, J. Thompson, and R.K. Johnston 2009. Sinclair and Dyes Inlets Toxicity Study: An Assessment of Copper Bioavailability and Toxicity in Surface Waters Adjacent to the Puget Sound Naval Shipyard & Intermediate Maintenance Facility. Space and Naval Warfare Systems Center Pacific Technical Report 1985. Prepared by: Environmental Sciences & Applied Systems Branch, Code 71750, Space and Naval Warfare Systems Center Pacific, San Diego, CA. <http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA530040&Location=U2&doc=GetTRDoc.pdf>

25

Current Work: Incorporate Passive Samplers into Stormwater Monitoring Program



26

Passive Samplers and Chemicals of Concern

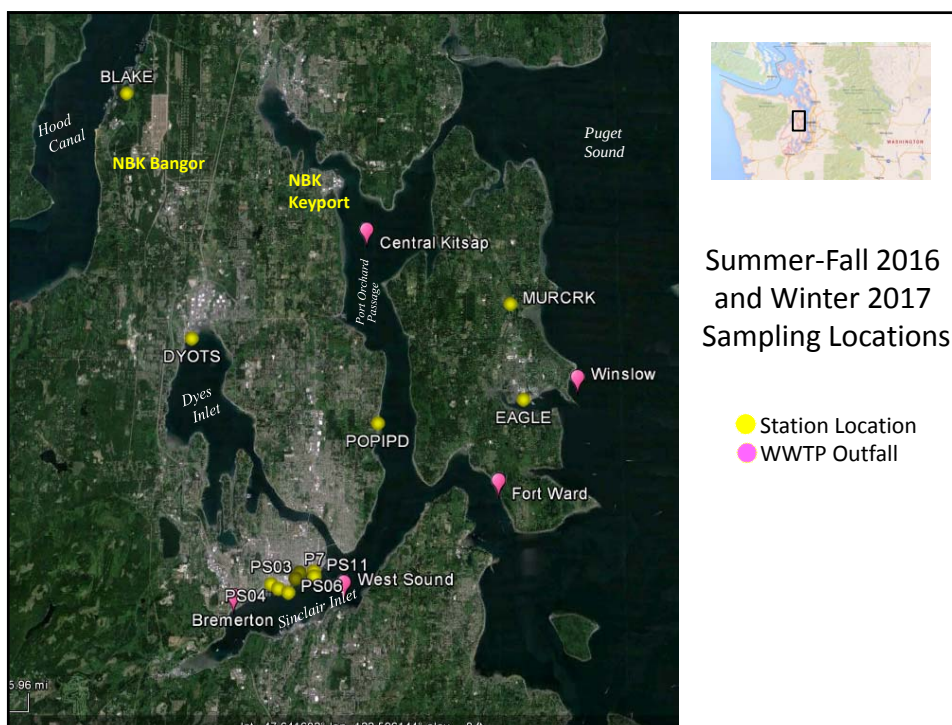
- Diffusive Gradient in Thin film (DGT) Metals
 - DGT Metals (Cd Cr Cu Ni Pb Zn)



- Polar Organic Chemical Integrative Sampler (POCIS)

- Human Activity (Wastewater) Markers

- Caffeine
- Nicotine
- Sweeteners
- Medicines
- Herbicides
- Flame Retardants



Stormwater Passive Sampling

Objectives:

1. Work with stakeholders to integrate passive sampling into existing stormwater monitoring.
2. Validate the use of passive sampling devices to capture pulse inputs from stormwater runoff and better identify sources
3. Optimize stormwater sampling designs to obtain better information with lower costs
4. Gain regulatory and public acceptance of technical approach