



Assessing Sources of Polybrominated Diphenyl Ether (PBDE) Flame Retardants Impacting Juvenile Chinook Salmon in the Snohomish River Watershed

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Toxics in Juvenile Chinook Program



Contaminants in juvenile Chinook Indicator

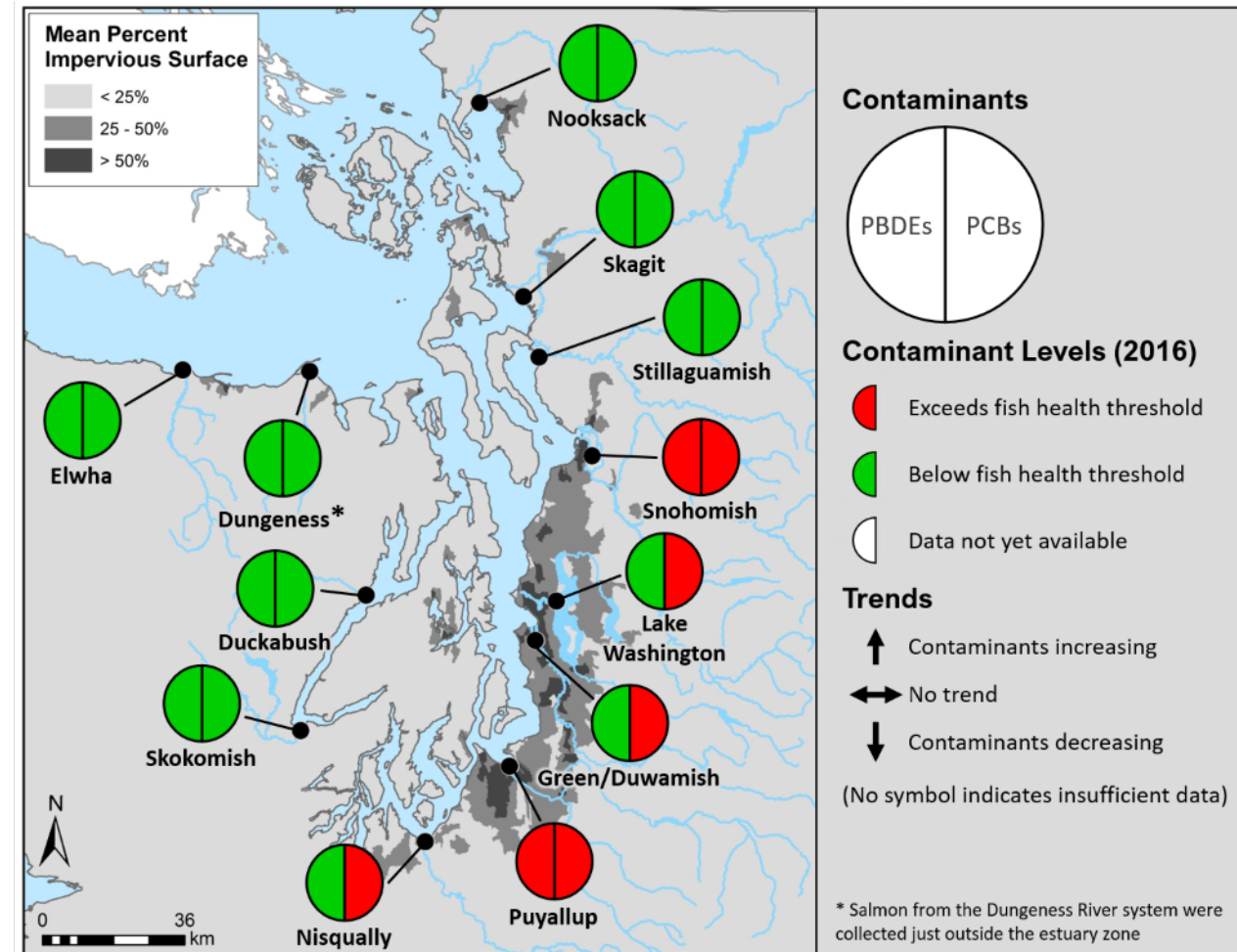
Partnership between WA Dept. of Ecology & Dept. of Fish & Wildlife

Goal

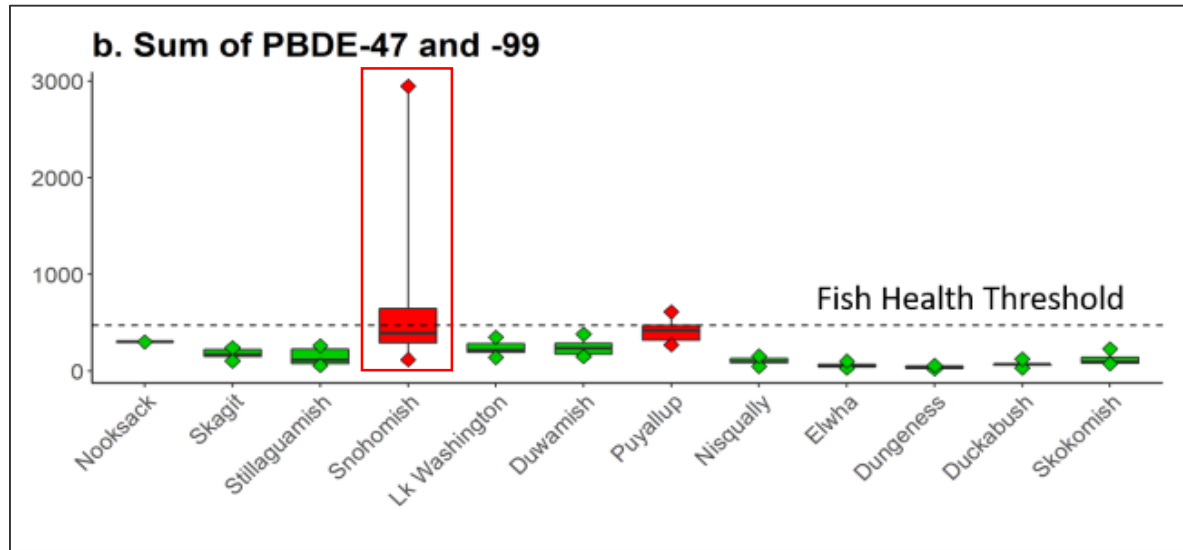
Assess and prioritize potential sources of toxics that may be impacting the health of out migrating juvenile Chinook

Objectives:

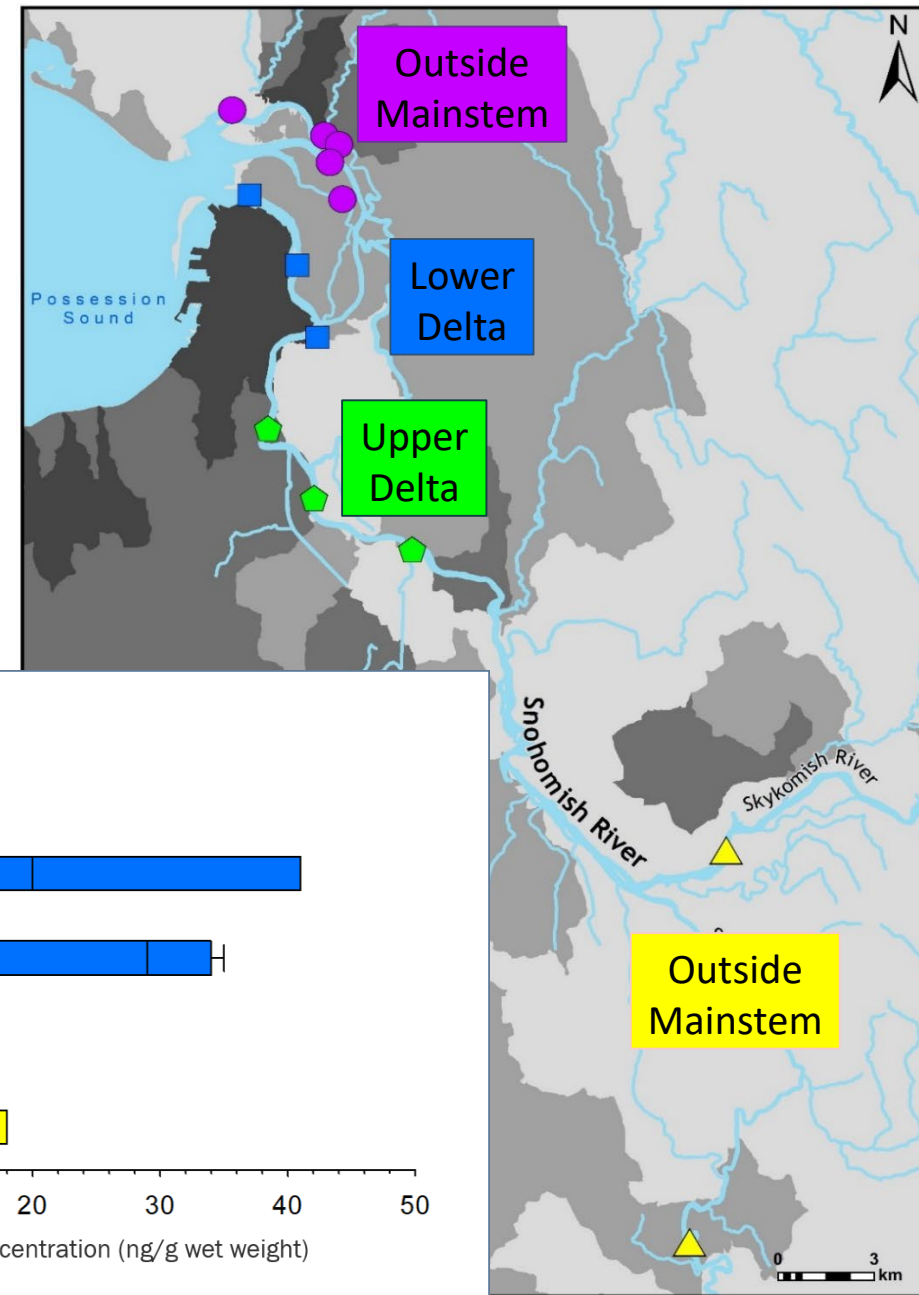
1. Assess the spatial distribution of toxics in migratory rivers
2. Assess the vectors, or pathways of toxics



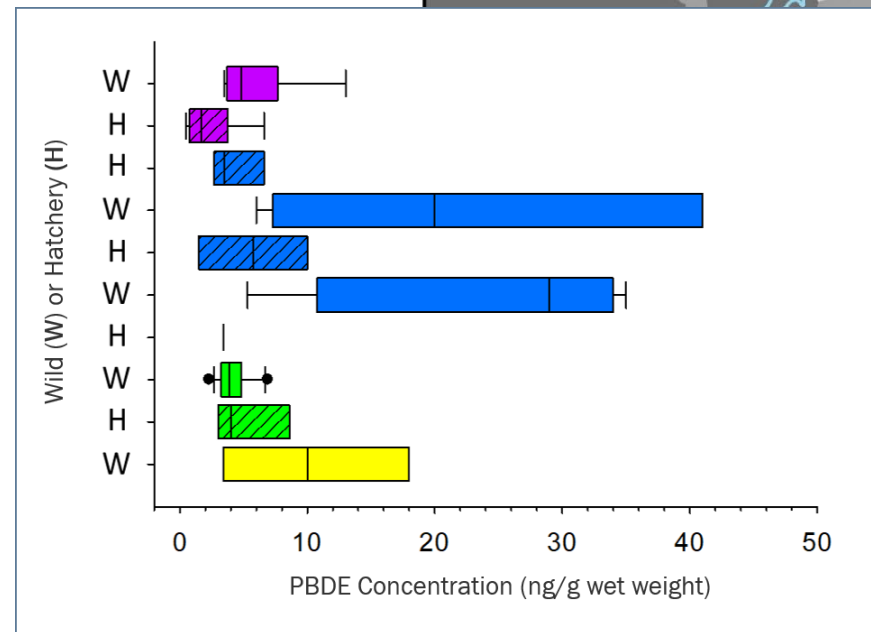
Toxics in Snohomish Watershed



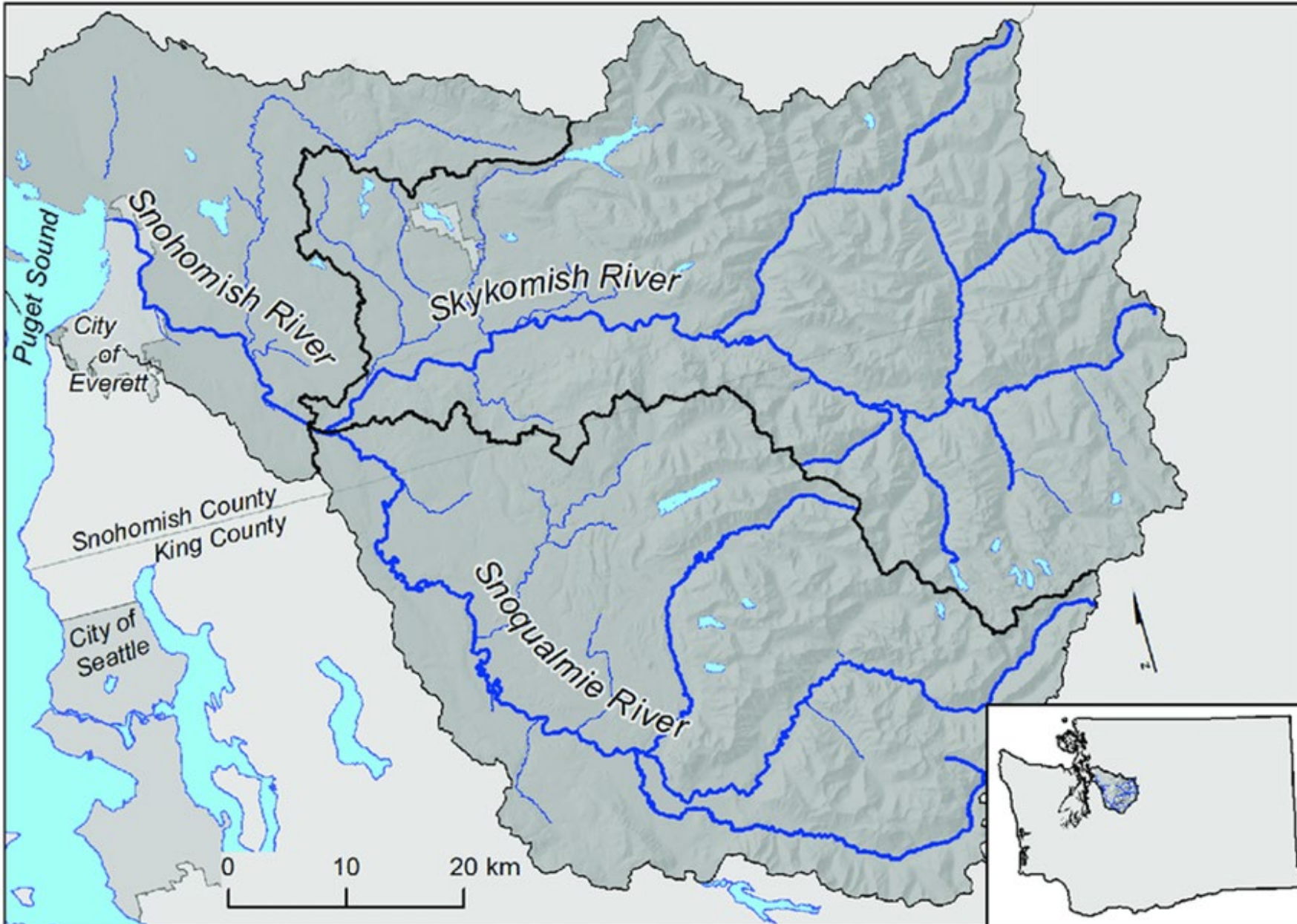
Juvenile Chinook PBDE Tissue Concentration



Only WILD fish in the Lower Delta exceeded critical tissue level



Snohomish Watershed



- Made up of Snohomish, Snoqualmie, Skykomish Rivers
- Runs from Cascades to Possession Sound
- Hosts populations of threatened Chinook
- Extensive restoration of tidal marshlands in Snohomish estuary to restore habitat

PBDE Source assessment

- Sampled Snohomish, Skykomish, Snoqualmie Rivers
- Sampled 29 sites from 2019-2021
- 4 Sampling events: 1 high flow, 3 low flow
- Analyzed for 36 PBDE congeners

Sampling Methods

Passive Sampler



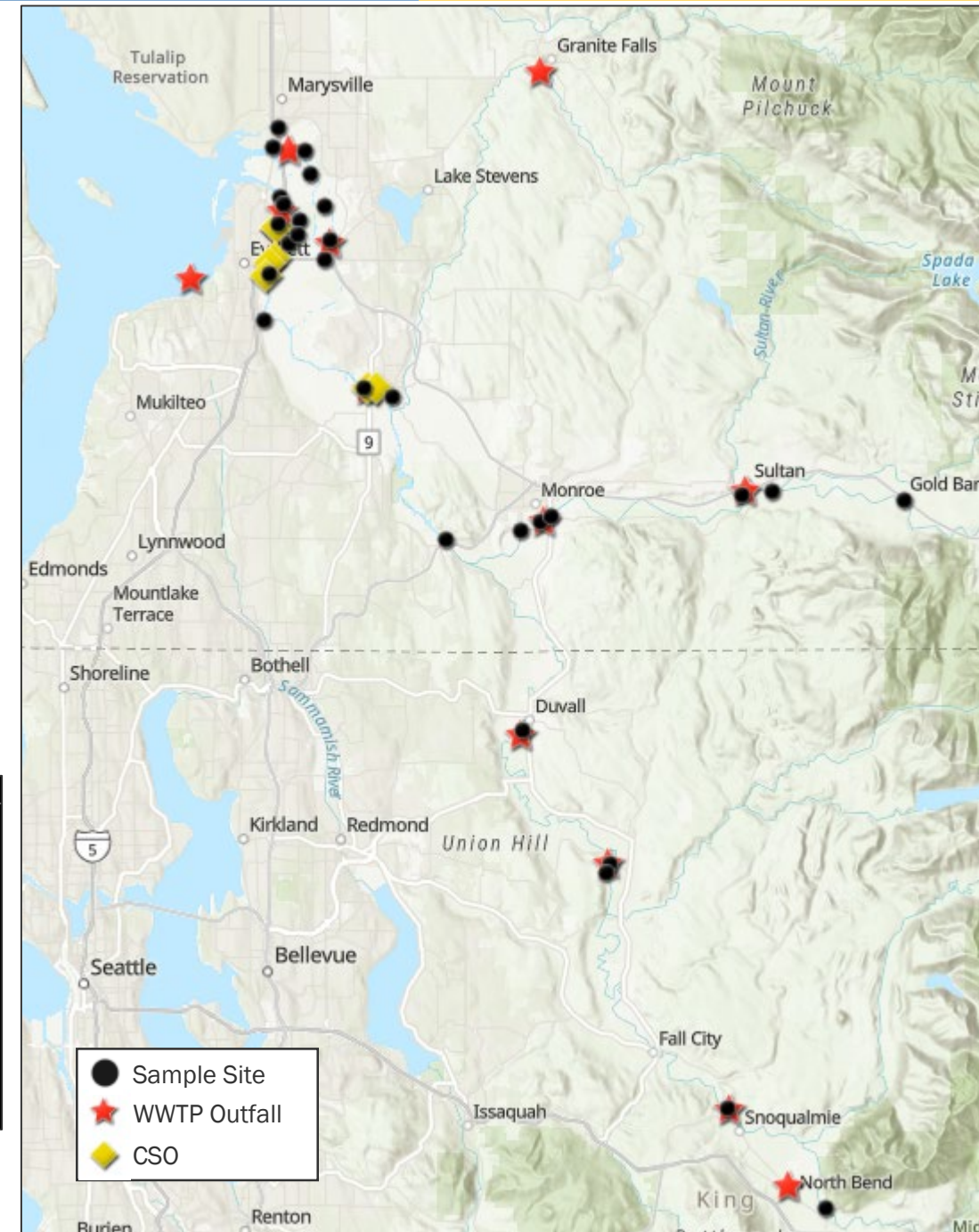
Biofilms



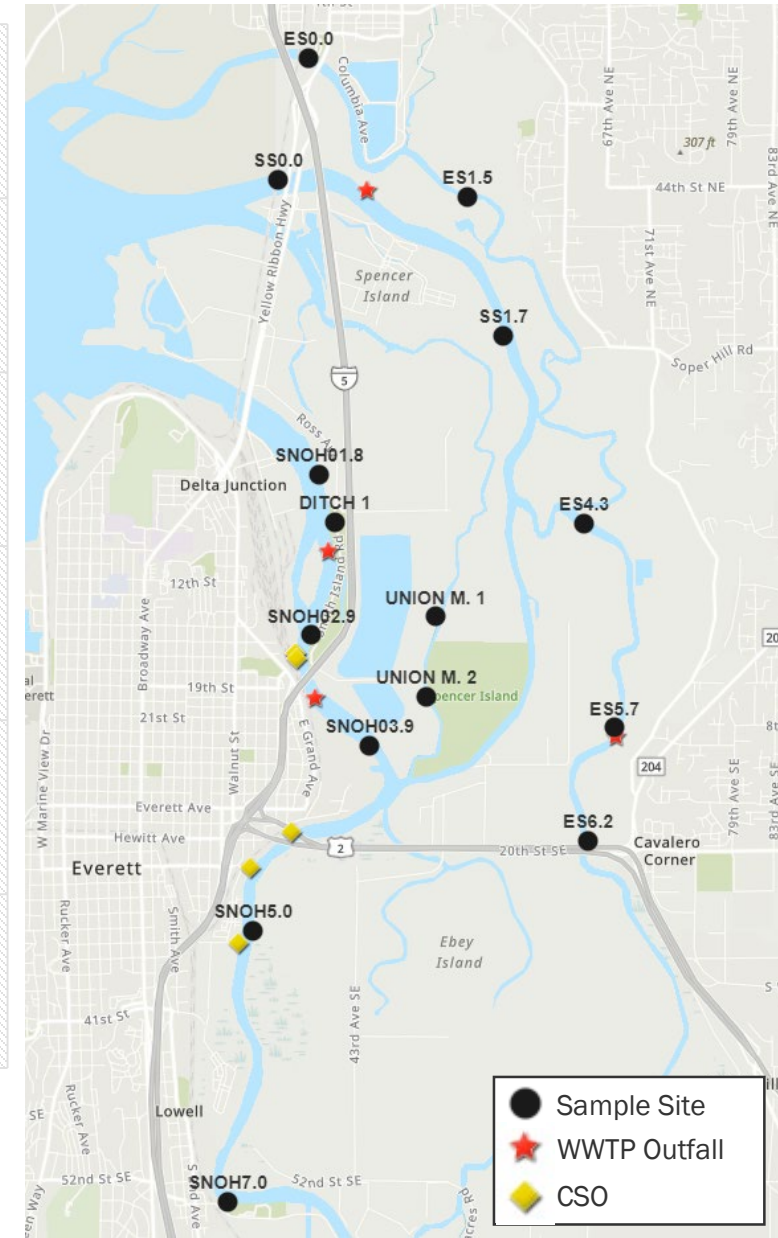
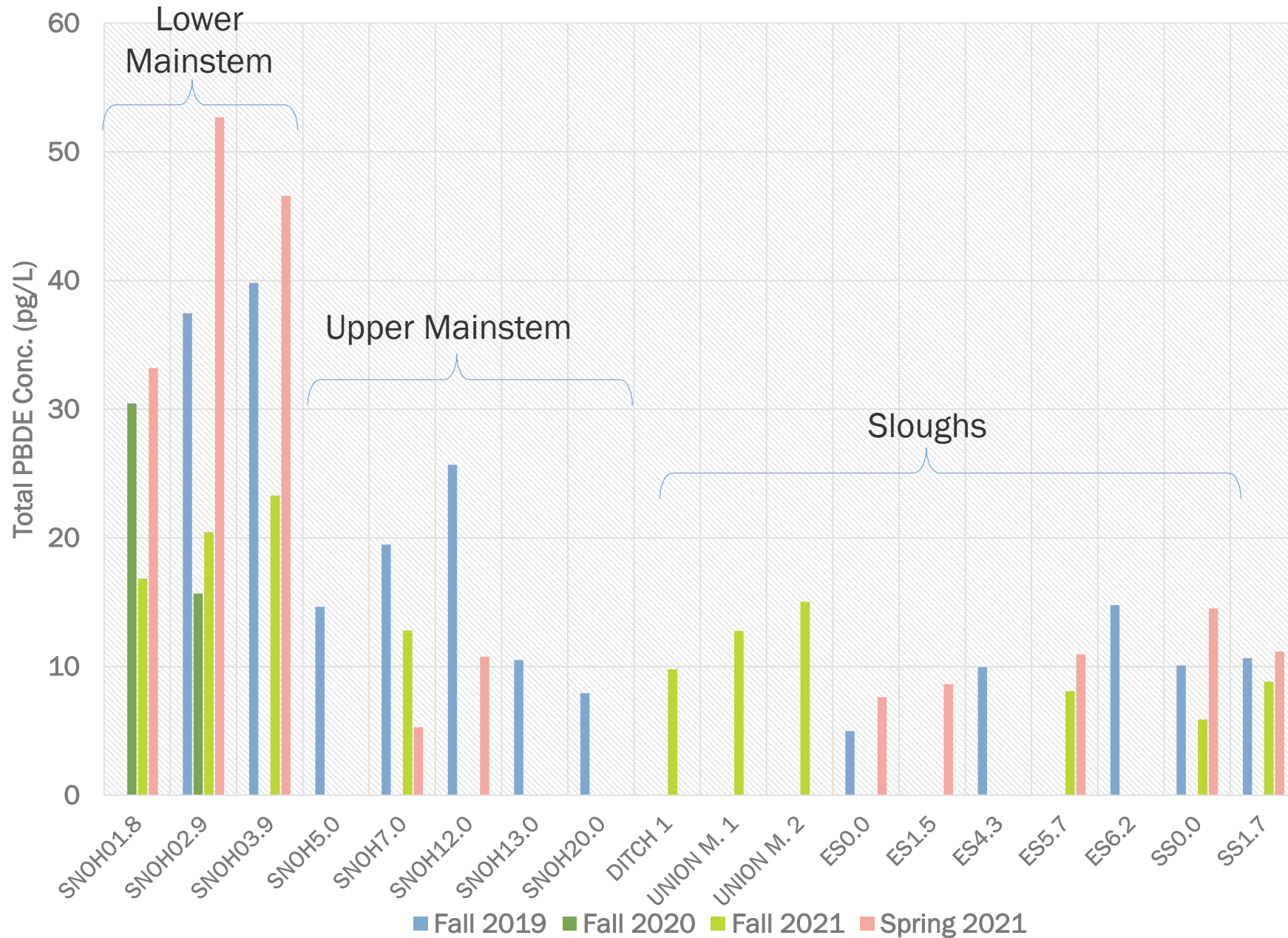
Sediments



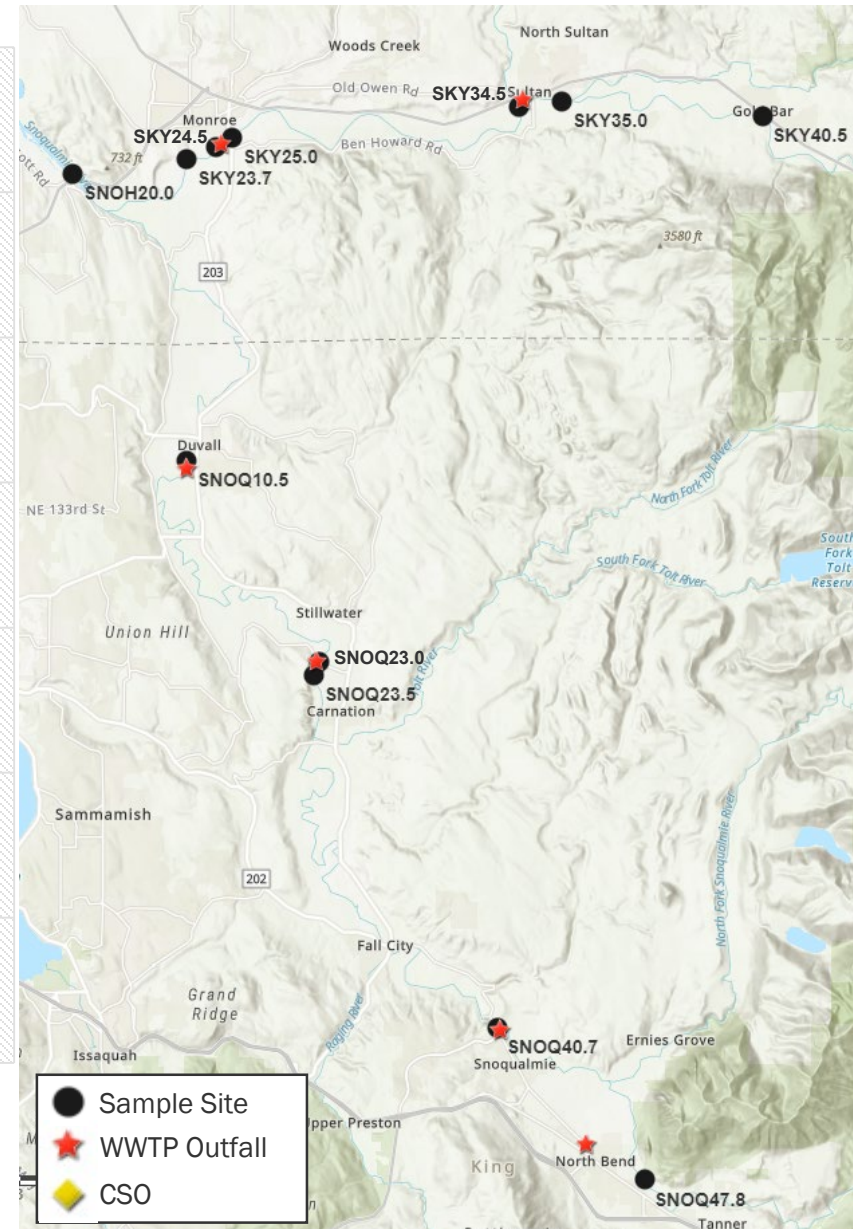
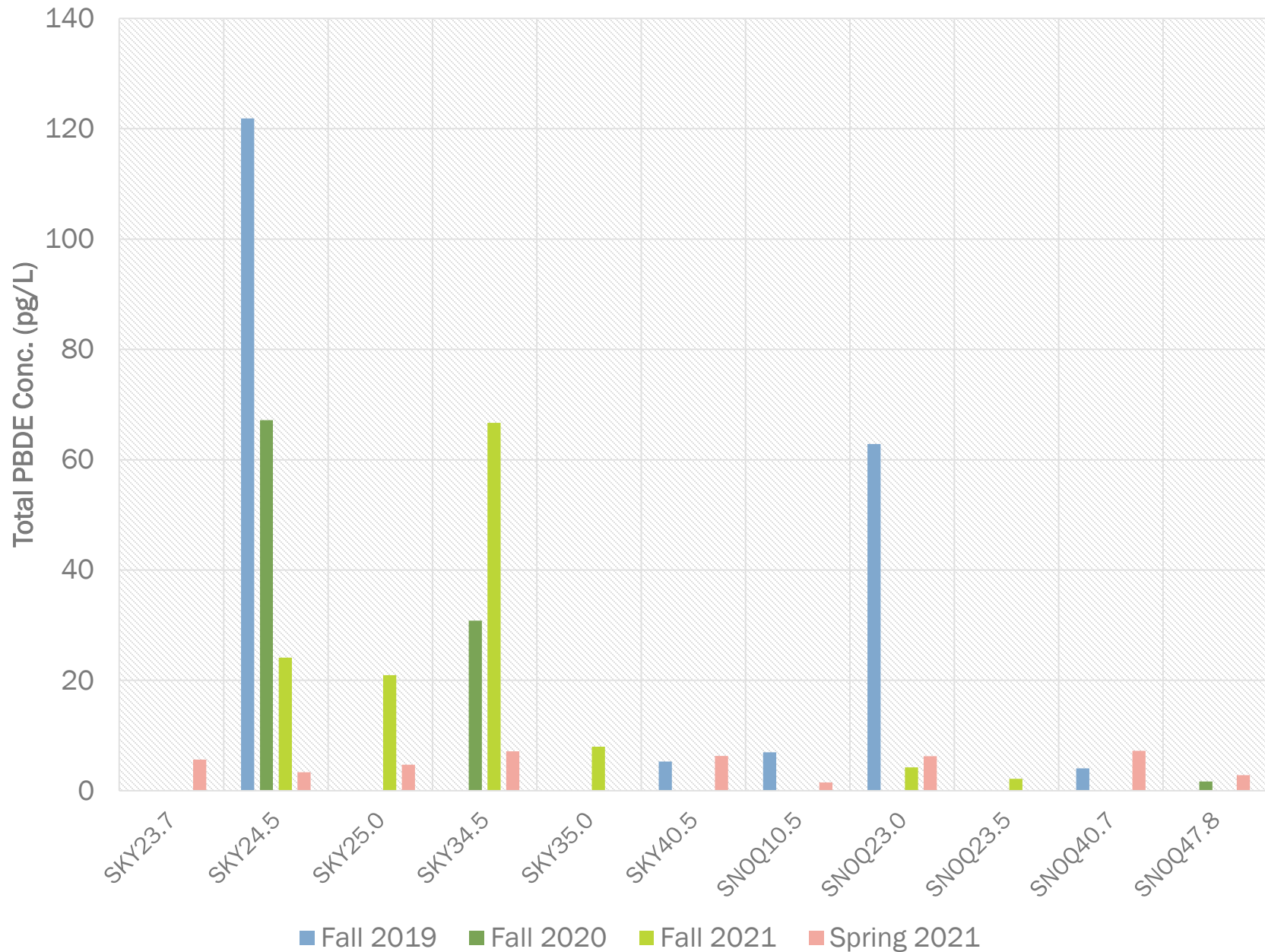
Invertebrates



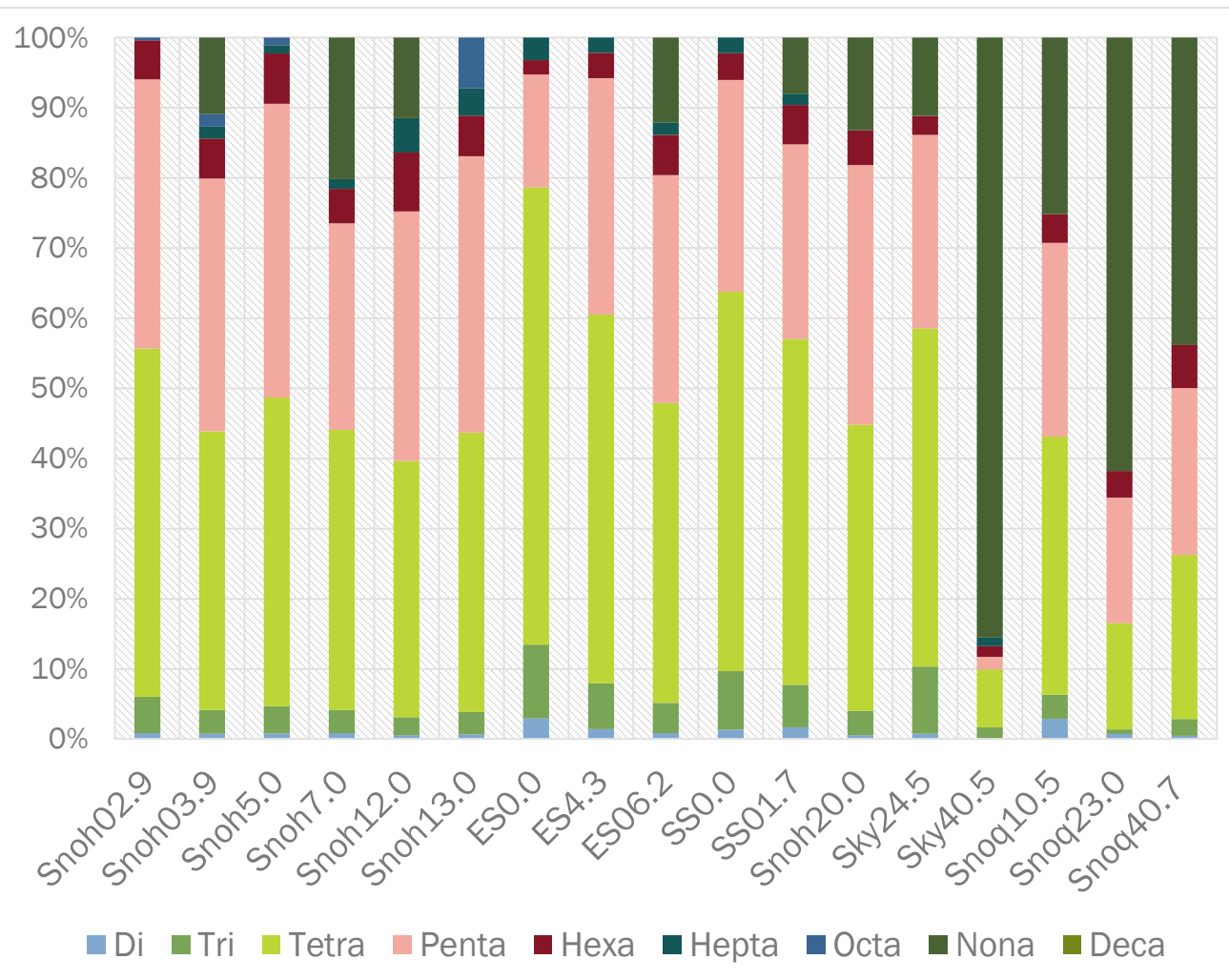
2019-2021 Total PBDE Water Concentration in Snohomish River & Estuary



2019-2021 Total PBDE Water Concentration in Skykomish & Snoqualmie Rivers



Fall 2019 PBDE Homolog Proportions in water

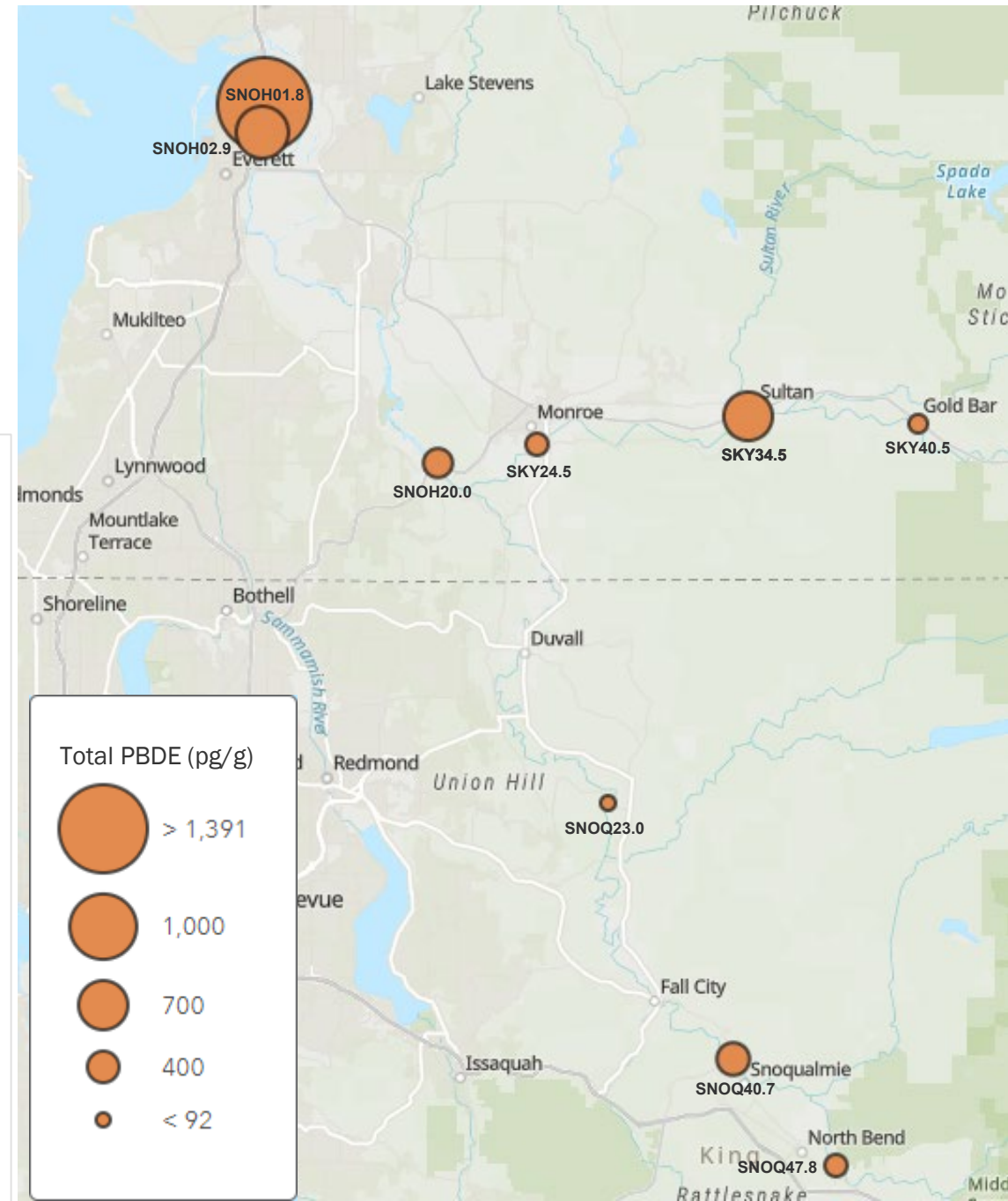
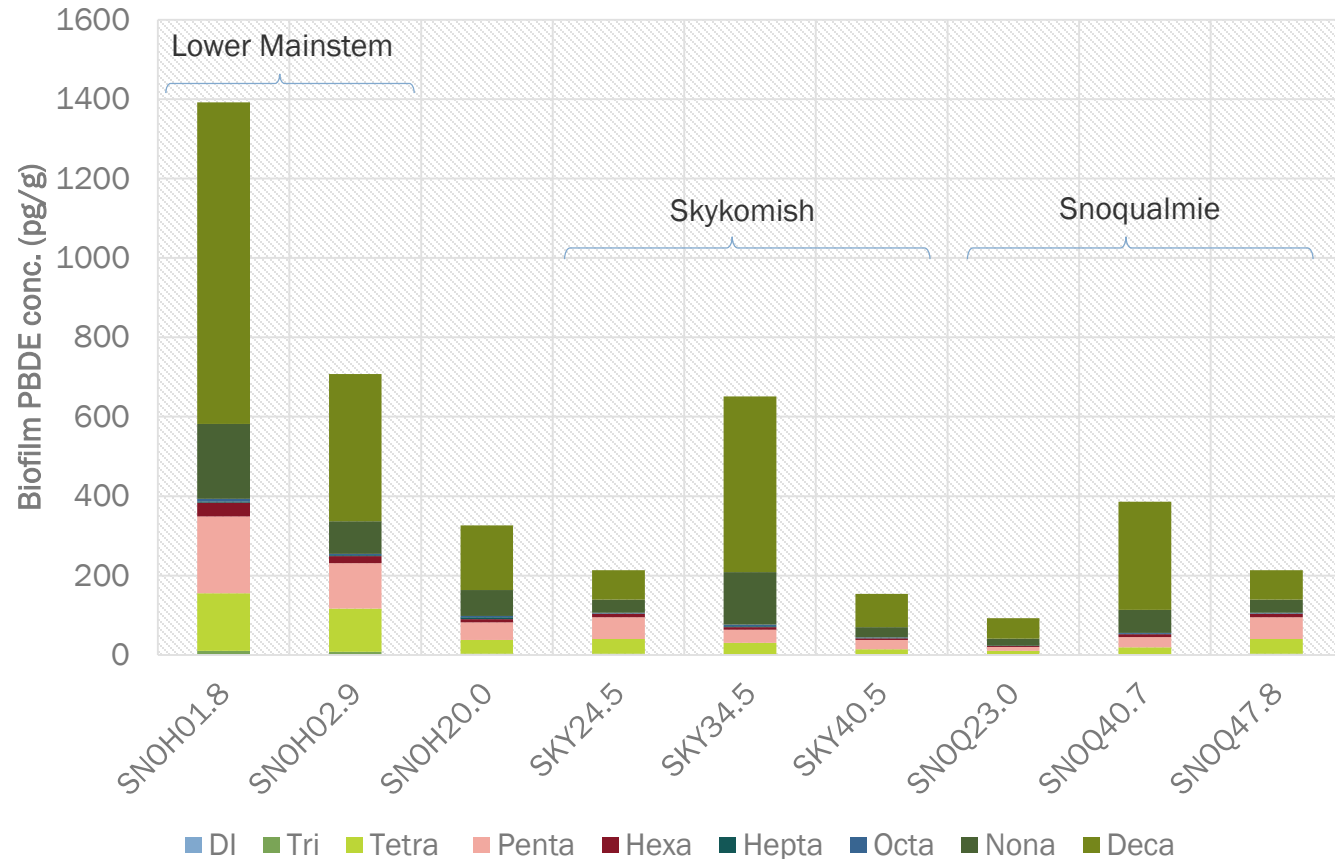


- Tetra and Penta dominate homologs
- BDE47/49 & BDE99/100
- Lesser amounts of Hexa, BDE-153/154

All major components of industrial PBDE mixes

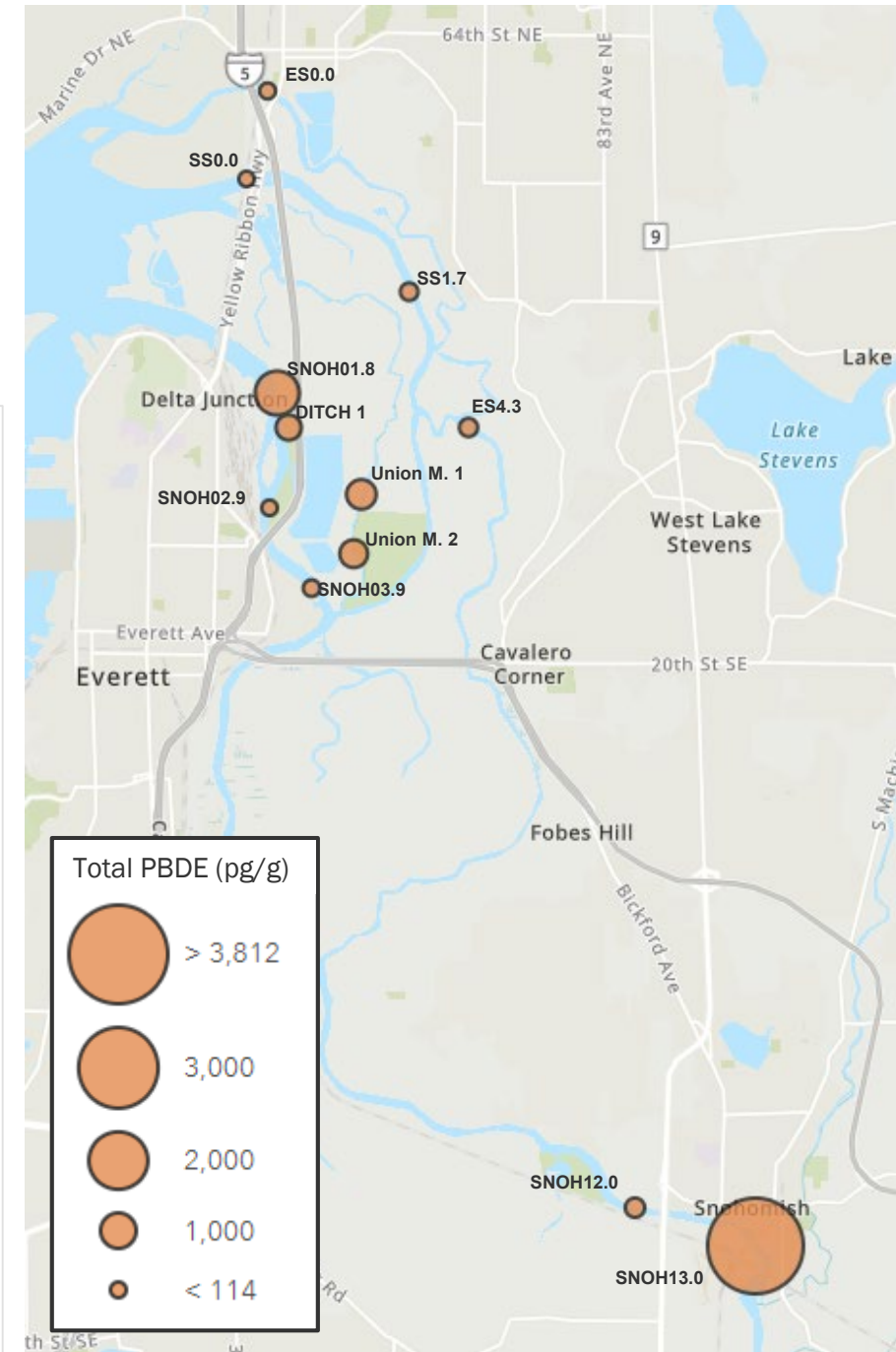
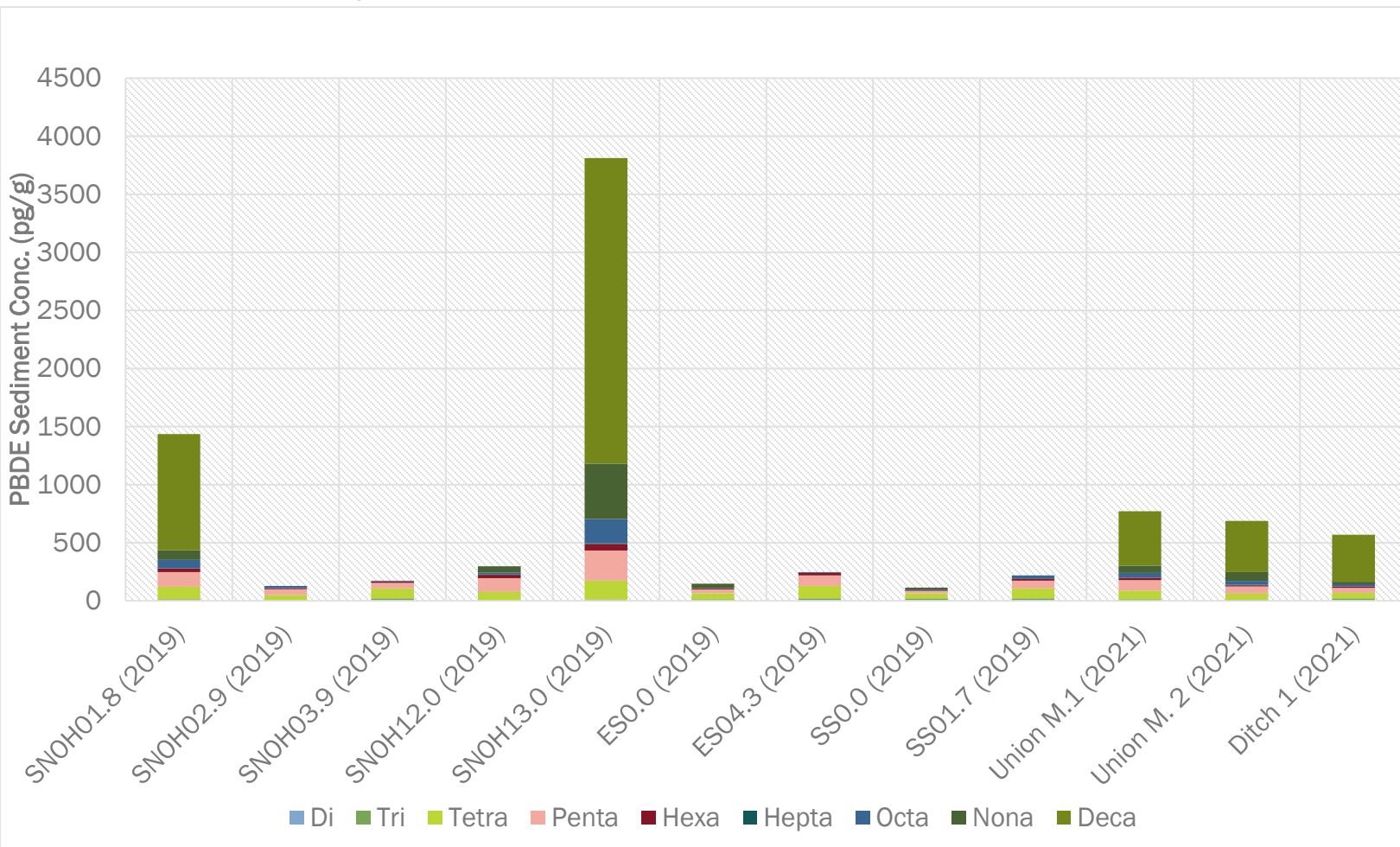
PBDEs in Biofilms

- Collected during 2019 low flow event
- Highest concentrations located in mainstem of Snohomish
- Elevated concentrations near city of Sultan and Snoqualmie



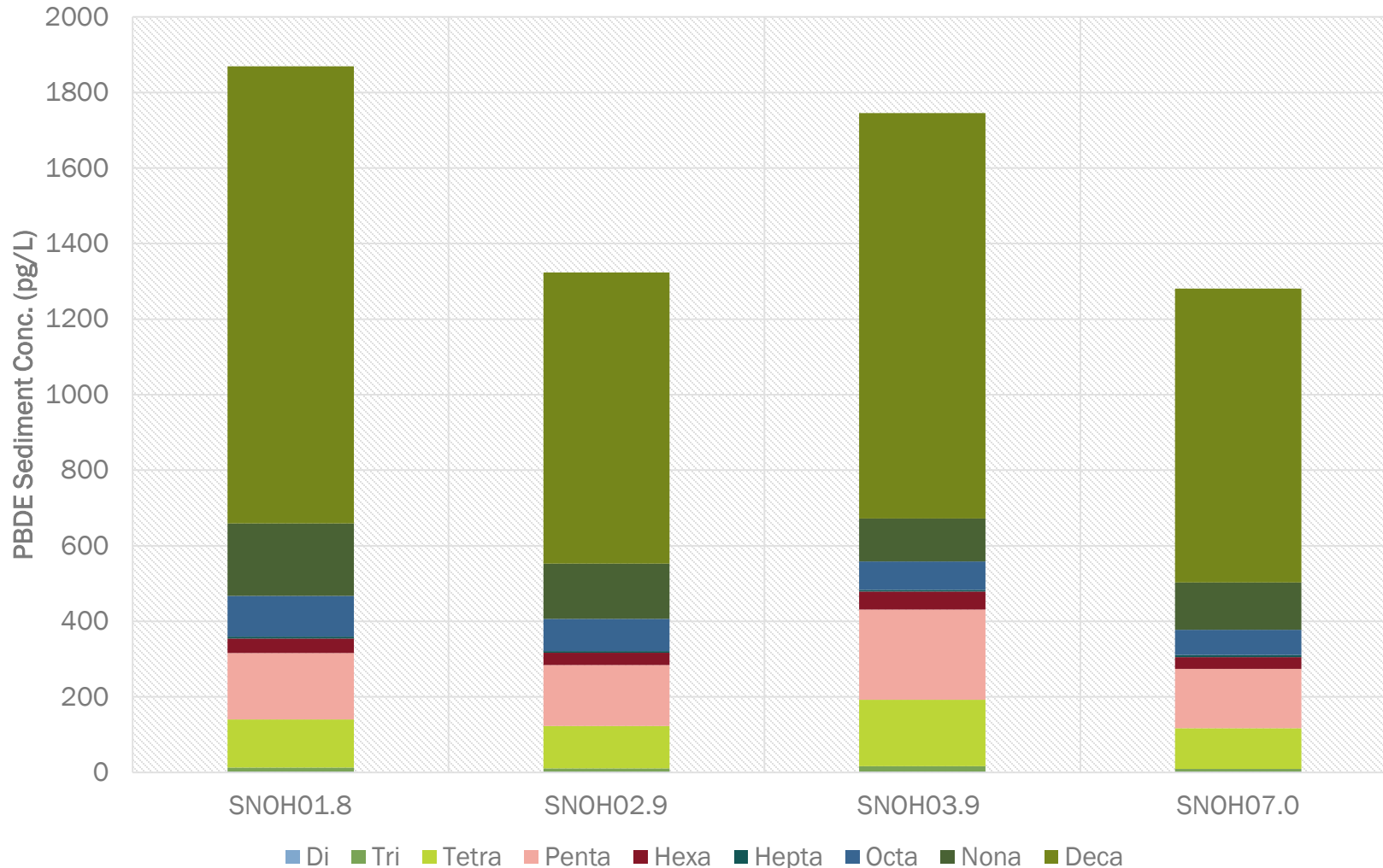
PBDEs in Bottom Sediments

- Concentration Range from 115 to 3800 pg/g
- Highest concentrations at SNOH01.8 & 13
- Union slough elevated compared to other sloughs
- Dominated by BDE-209



PBDEs in Suspended Sediments

PBDE Concentrations in Suspended Sediments in Snohomish Mainstem



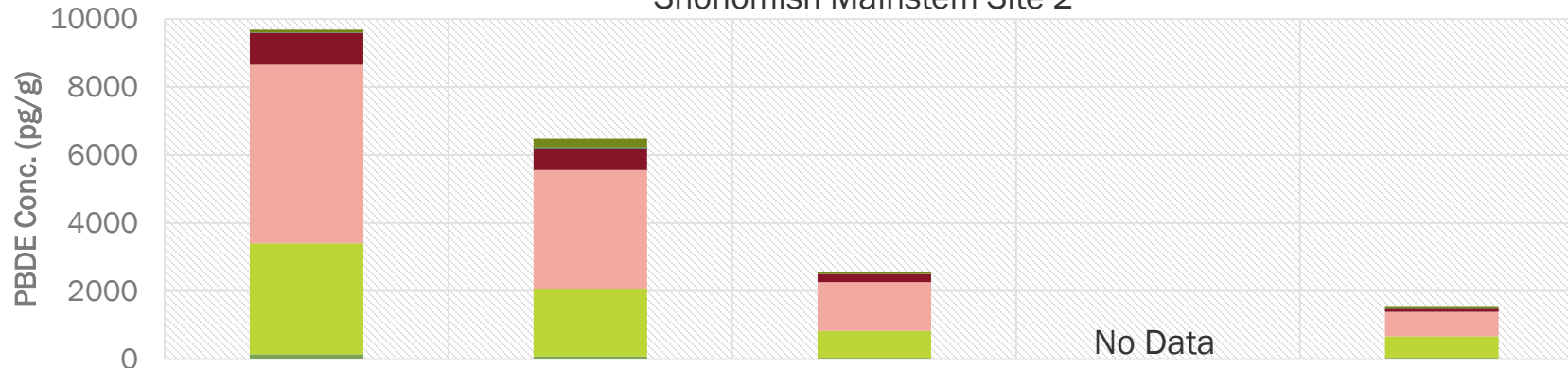
- Similar concentrations from RM1.8 up to RM7
- BDE-209 dominate
- Demonstrates suspended particulates contain high concentrations of PBDEs

Invertebrates

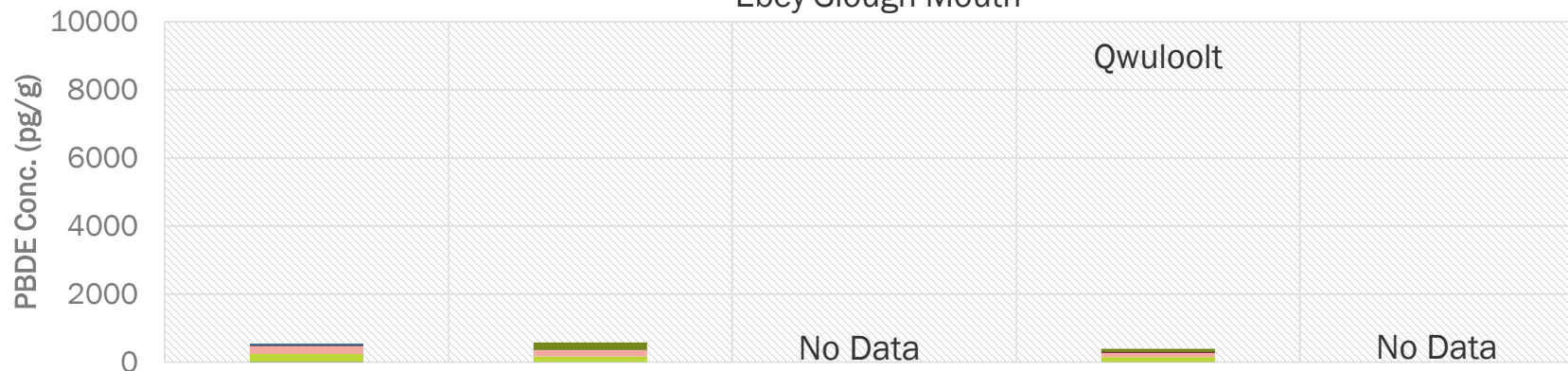
Snohomish Mainstem Site 1



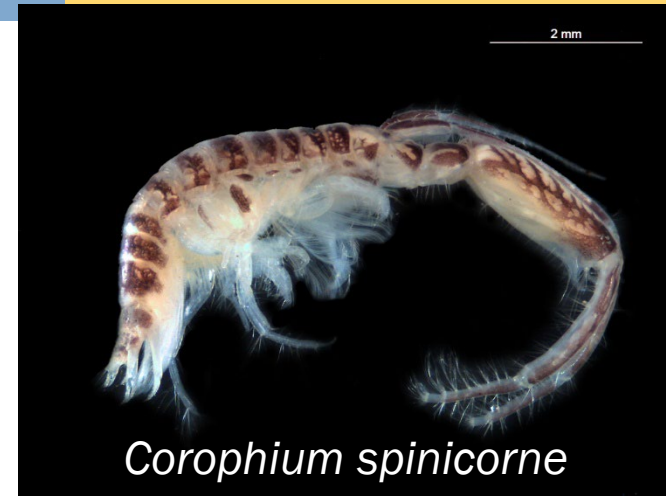
Snohomish Mainstem Site 2



Ebey Slough Mouth



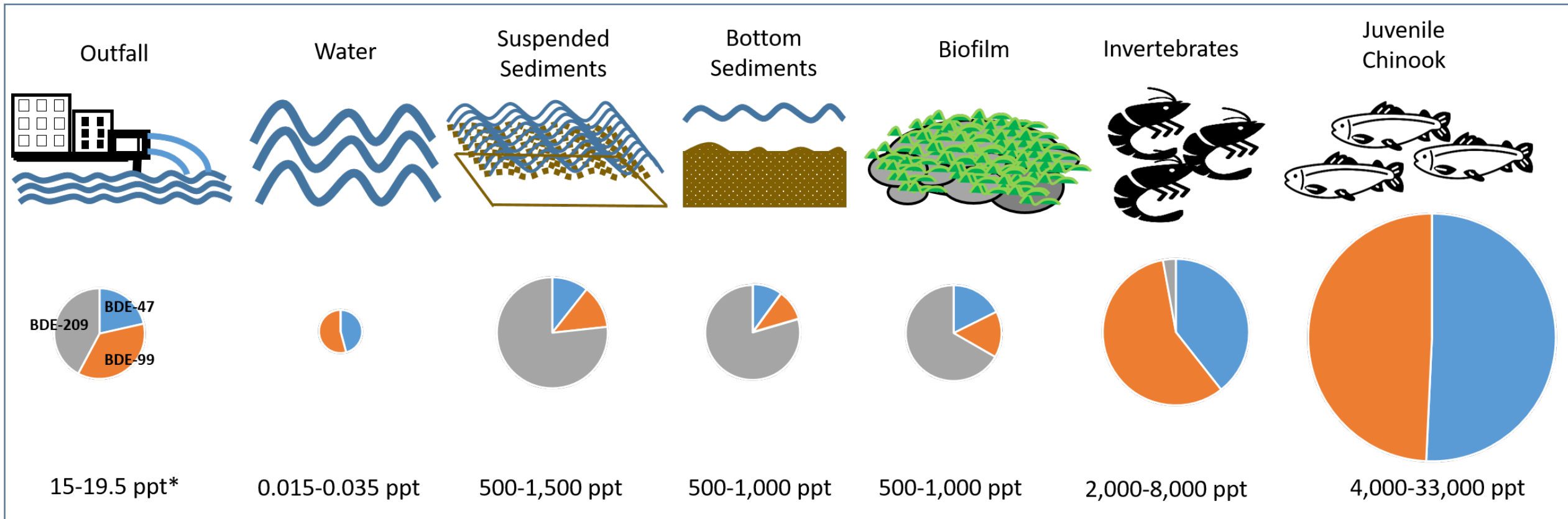
Qwuloolt



Corophium spinicorne

- Higher concentrations found in main stem vs. Ebey slough
- Dominated by Tetra & Penta BDEs (47 & 99)
- Main stem inverts. concentration trended lower over sampling events
- Similar concentrations in Aug/Sept 2019 & 2021 samples

PBDEs Across the Environment



ppt = parts per trillion

*Preliminary Data

Summary

- PBDE concentrations in the lower main stem are consistently elevated
- Sloughs throughout estuary do not show elevated PBDE concentrations
- PBDE concentrations directly downstream of Monroe and Sultan WWTP outfalls are elevated during low flow events
- Invertebrates collected in the main stem have higher concentrations than those collected in Ebey slough
- PBDEs accumulate in sediments, biofilms, and biota
- Invertebrates, fish tissue, and water: mostly BDE-47 & 99
 - Mostly BDE-209 in sediments
- WWTP outfalls are a direct input of PBDEs into the Snohomish Watershed

Next Steps (2022)

- Follow up high flow sampling (spring)
 - Concentrated around Snohomish mainstem
 - Passive samplers and suspend sediments
- Invertebrate time series study
 - February through August/September
 - Monthly sampling at RM 2.9
 - Comparative samples collected at RM 7.0
 - Paired with suspended sediment sampling
- 2022 low flow sampling
 - Targeting period with no WWTP discharge to lower mainstem
- Publish Results

Questions

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