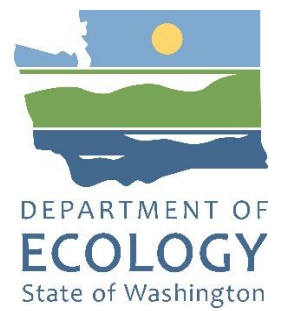




Photo Credit: Richard Bell

Source Assessment of PBDEs Impacting Juvenile Chinook in the Snohomish River System



Alex Gipe

EAP, Toxics Studies Unit

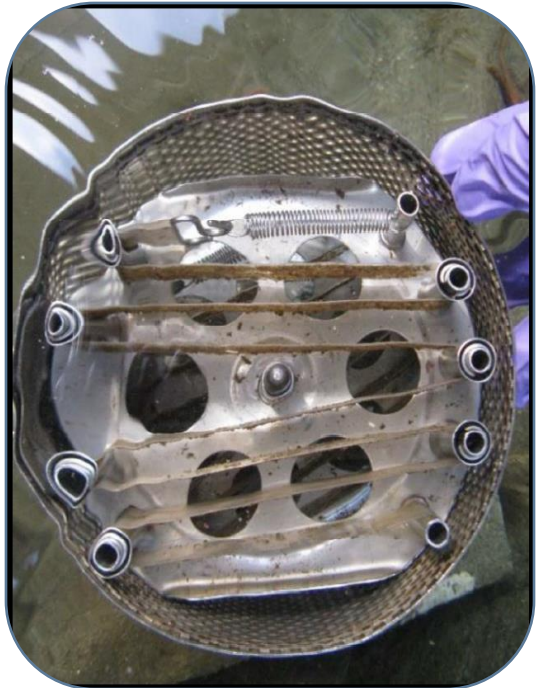
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Snohomish PBDE Source Assessment

- Ecology lead source assessment of PBDEs from 2019 to 2022 in Snohomish, Skykomish, Snoqualmie Rivers
- Assess and prioritize potential sources of PBDEs that may be impacting the health of outmigrating juvenile Chinook
- Identify potential pathways of PBDEs from source to juvenile Chinook
- Monitored PBDEs during low (late summer) and high (spring) river flow conditions
 - 6 sampling event, 4 low flow, 2 high flow

Methods

- Water – passive samplers (SPMDs), estimate water conc. integrated over ~30 days
- Biofilms – mixture of algae, cyanobacteria, detritus; collected from river substrates
- Sediment – benthic and suspended, collected throughout estuary
- Invertebrates – mixture of species; juvenile Chinook prey items; surface tows/algae mats
- Analyzed samples for 43 PBDE congeners by EPA Method 1614A



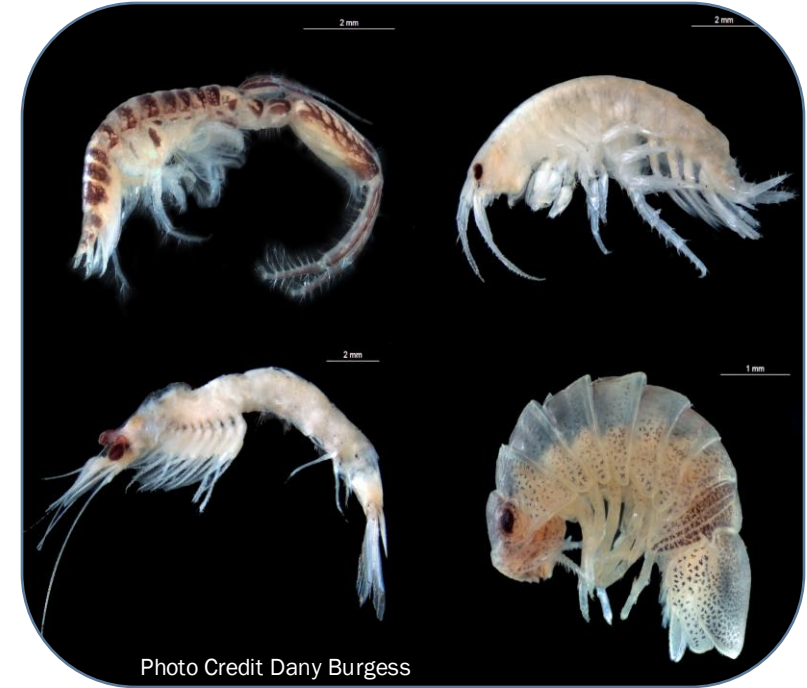
Passive Sampler



Biofilms



Sediments



Invertebrates



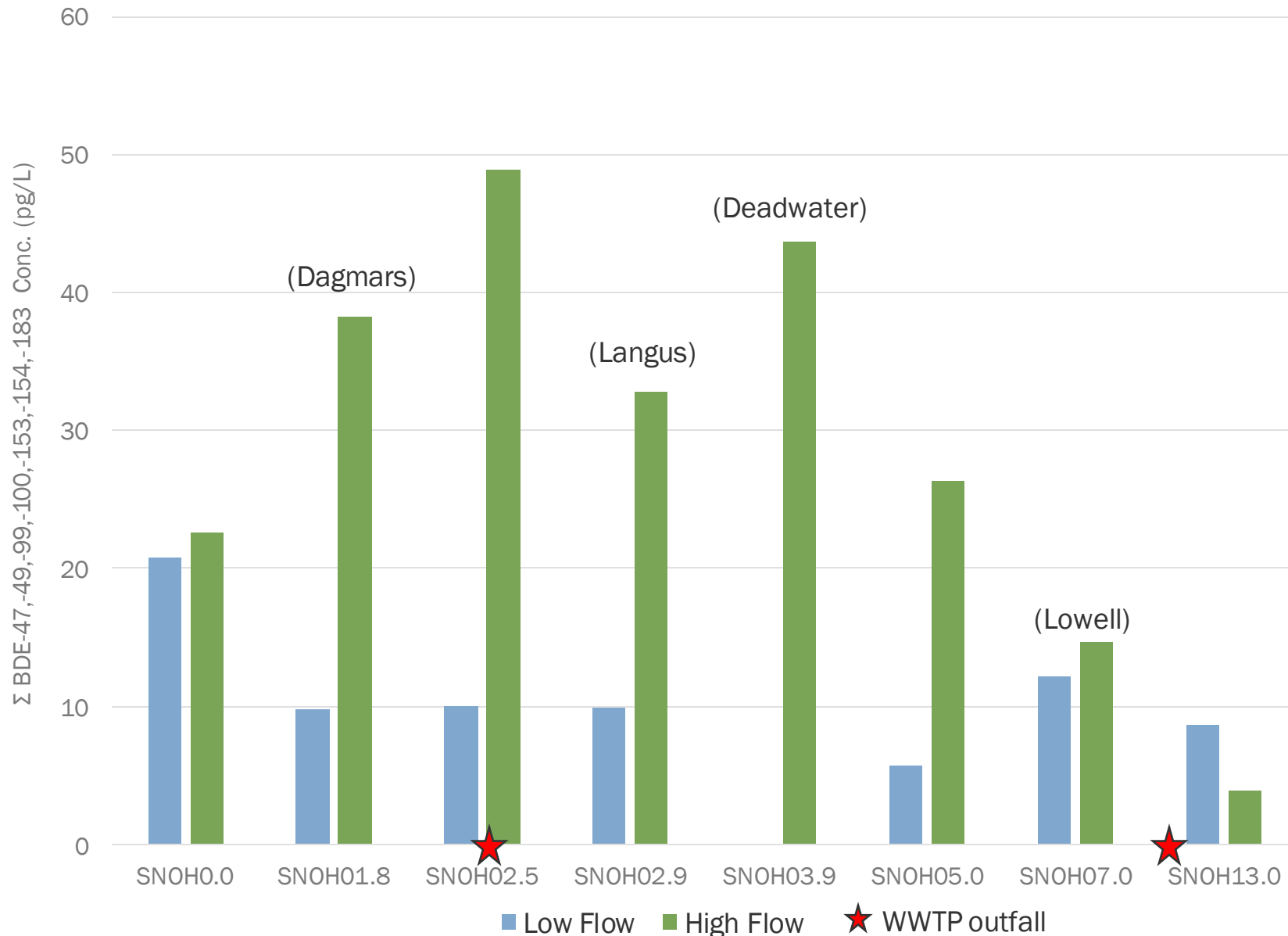
Study Results

PBDEs in water
& sediments

Prey Item
Concentrations
and Temporal
Trends

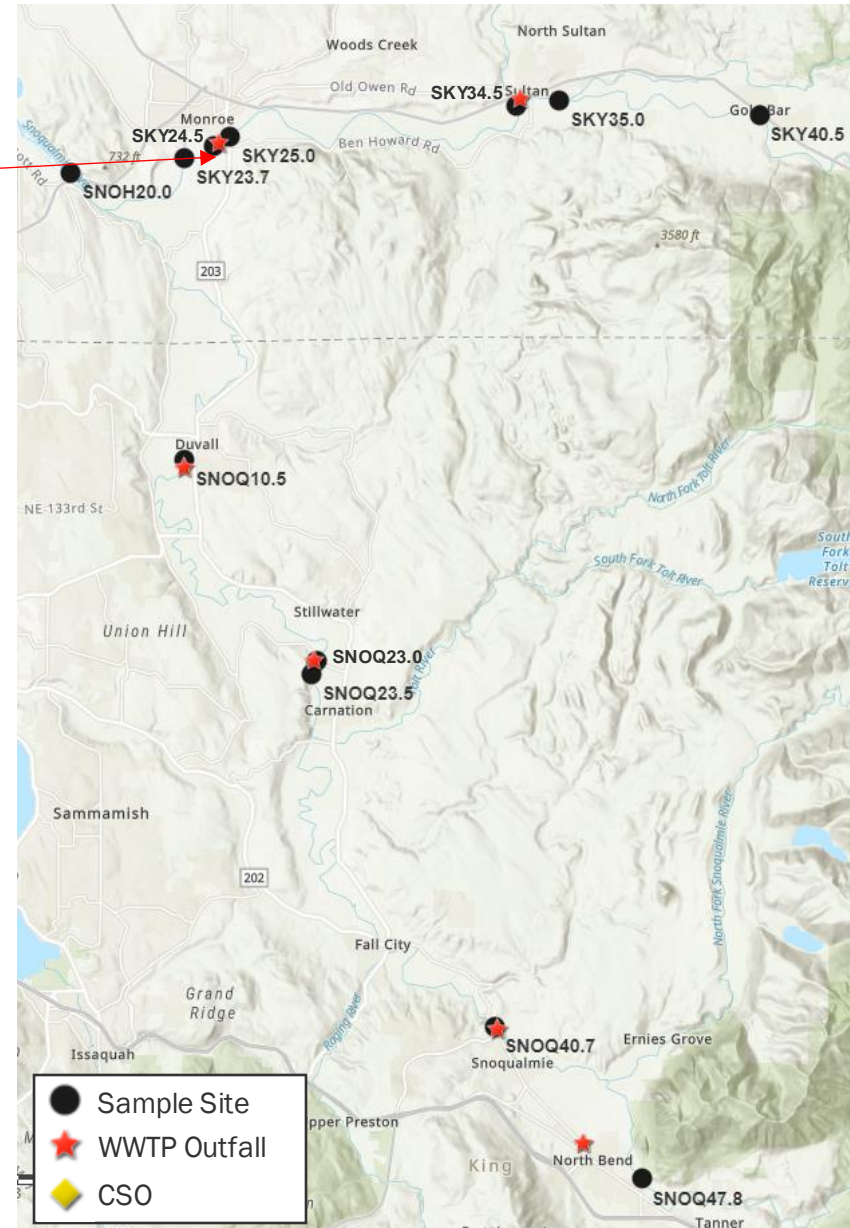
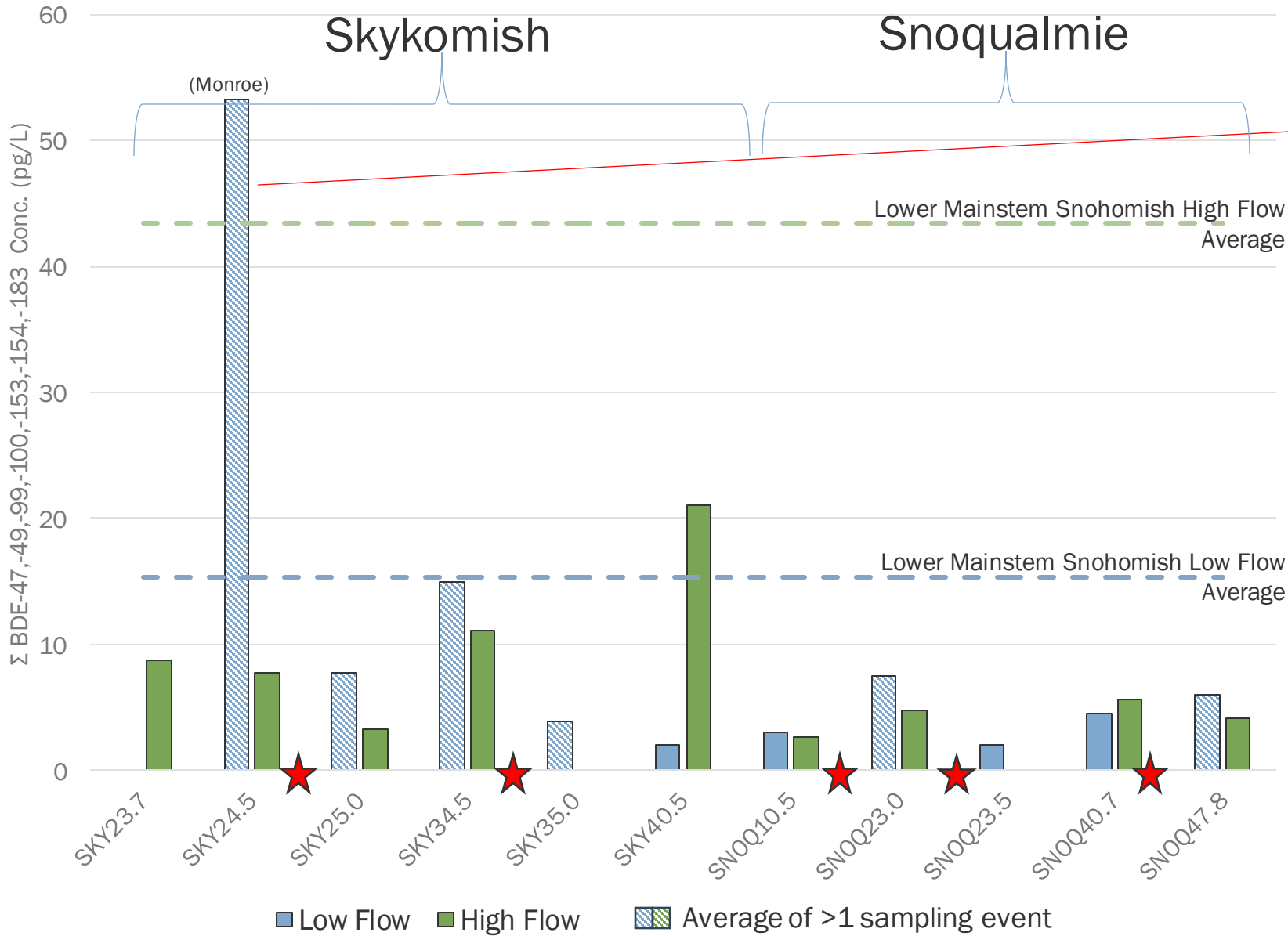
PBDE
Accumulation
and
Concentration

2022 Snohomish Main Stem High vs Low Flow PBDE Water Concentrations



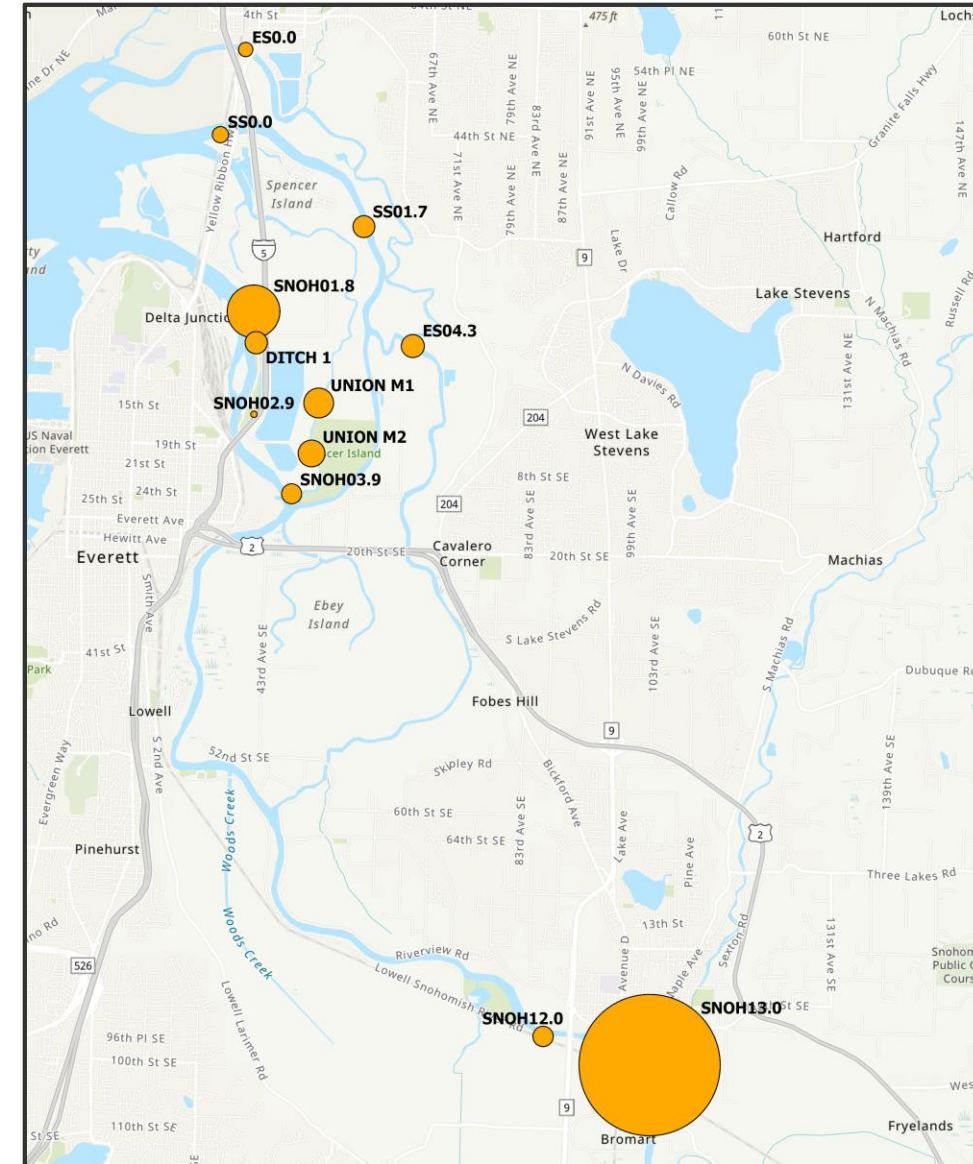
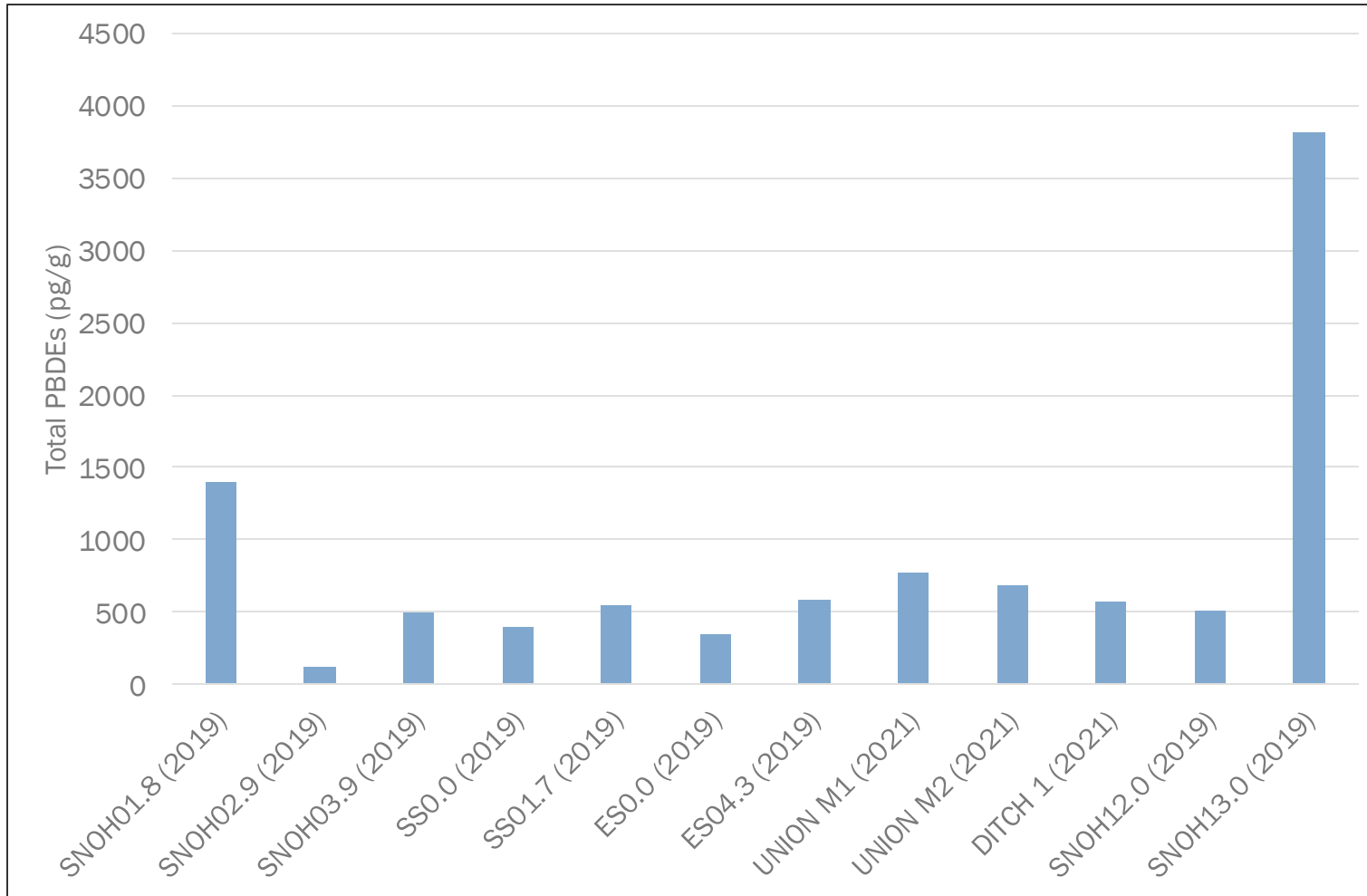
- Everett WWTP Outfall 015 discharge
 - No Discharge during Low Flow Sampling period
 - Active Discharge during High Flow Sampling period

2019-2022 Total PBDE Water Concentration in Skykomish & Snoqualmie Rivers



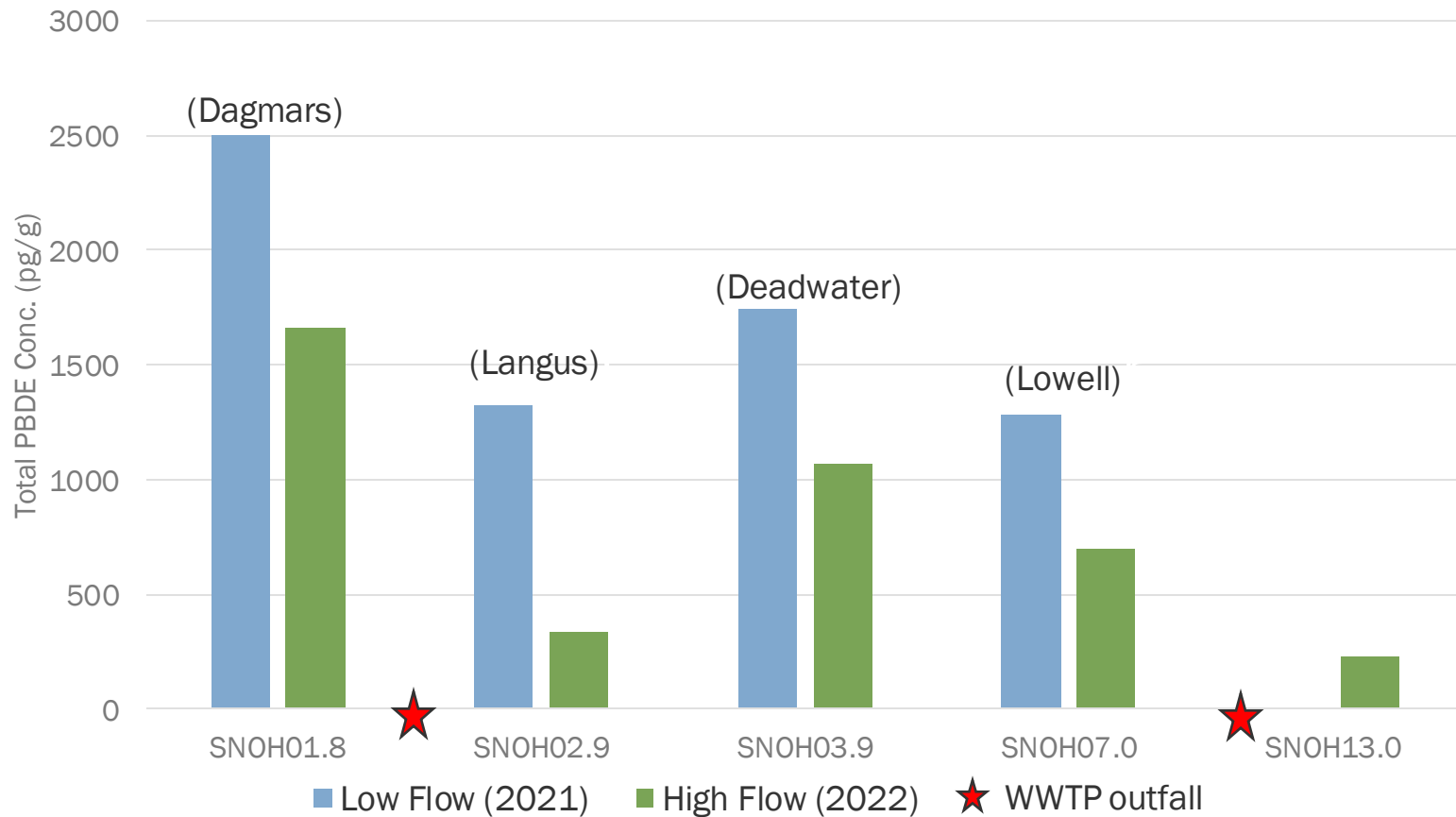
PBDEs in Bottom Sediments

- Concentration Range from 130 to 3800 pg/g
- Highest concentrations at SNOH01.8 & 13
- Similar concentration across sloughs



Suspended Sediments

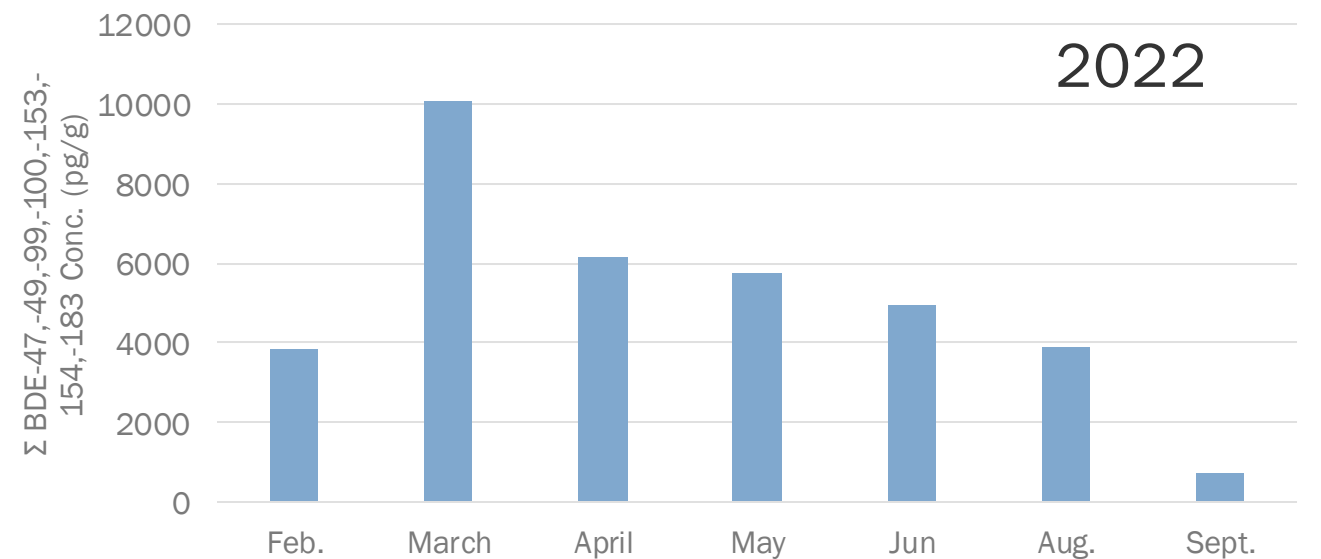
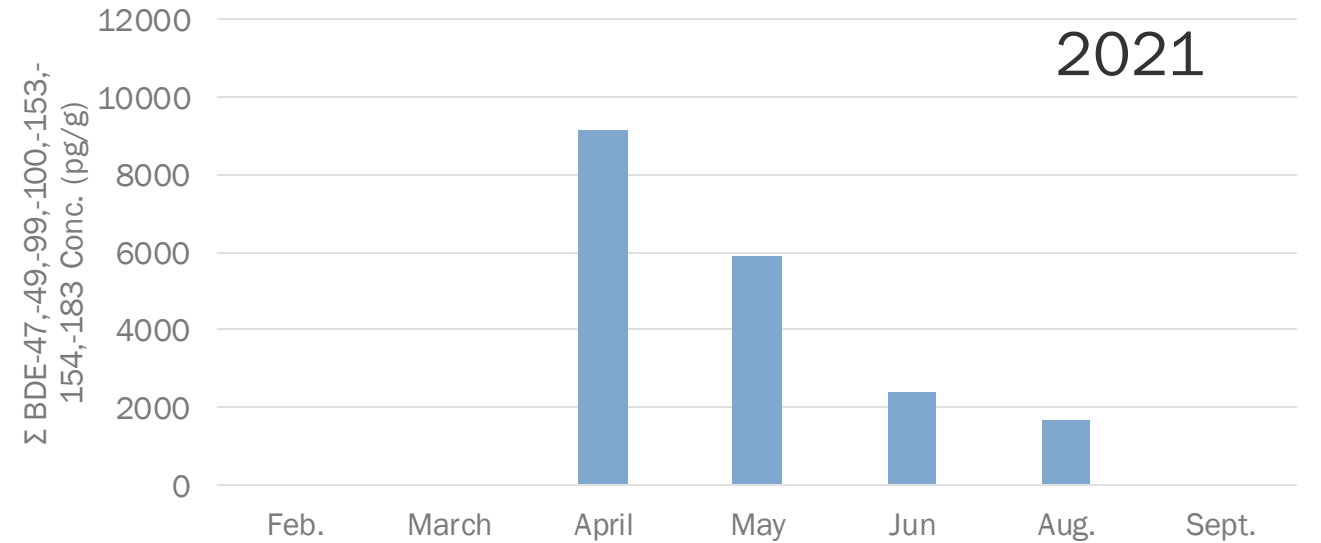
High vs Low Flow Suspended Sediment Total PBDE Concentrations



- Low Flow- similar concentration of PBDEs along main stem
- High Flow- varying PBDE concentrations
- Active WWTP discharge during both events

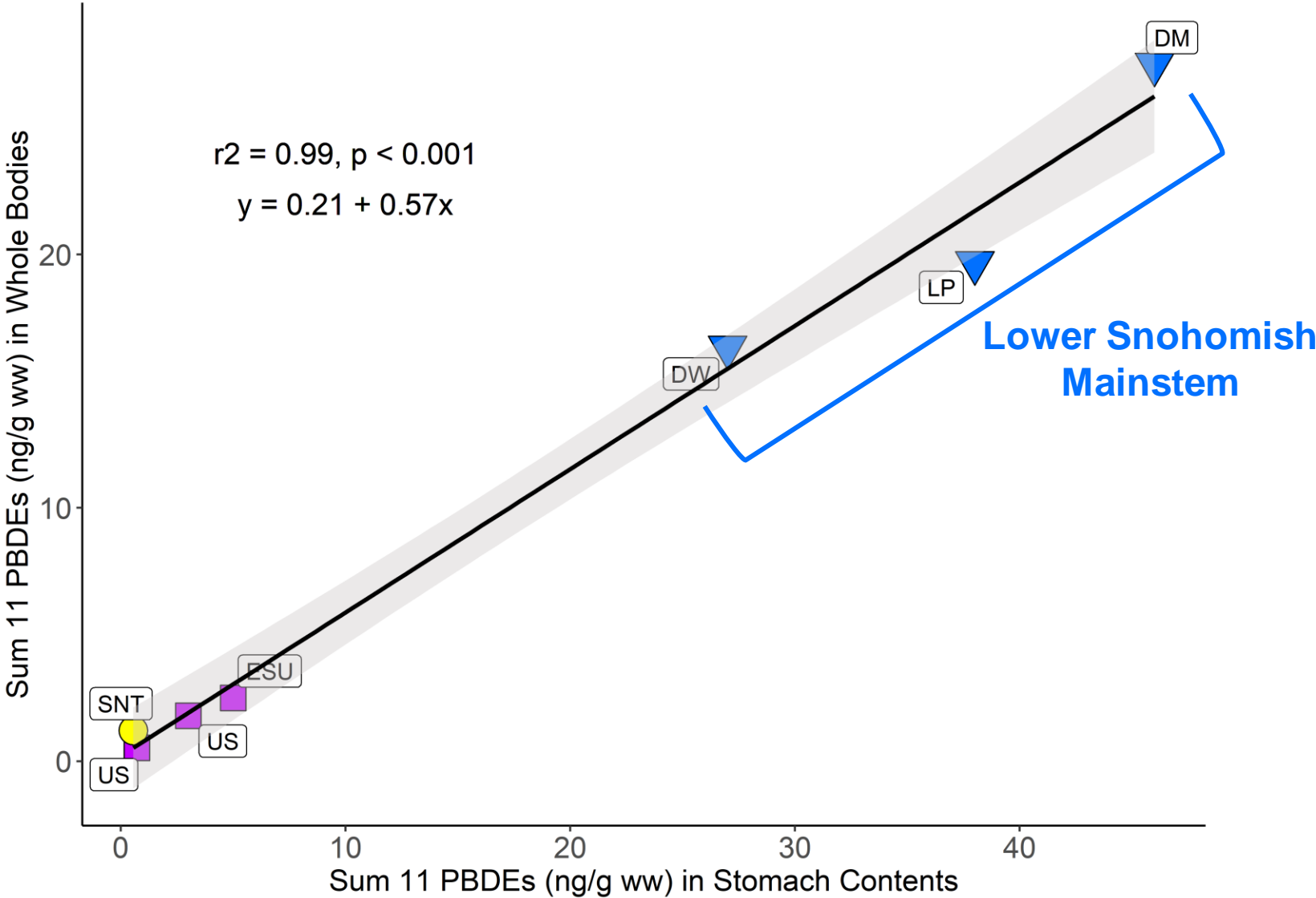
Temporal Variations in Invertebrate PBDE Concentrations

- Highest PBDE concentrations occur in spring
 - Coincides with occurrence of juvenile Chinook in Snohomish estuary
- Declining trend in concentrations over summer
- Similar temporal pattern in 2021 & 2022
- Max 2021-2022 PBDE concentration ~7x greater than 2019 low flow event invertebrates

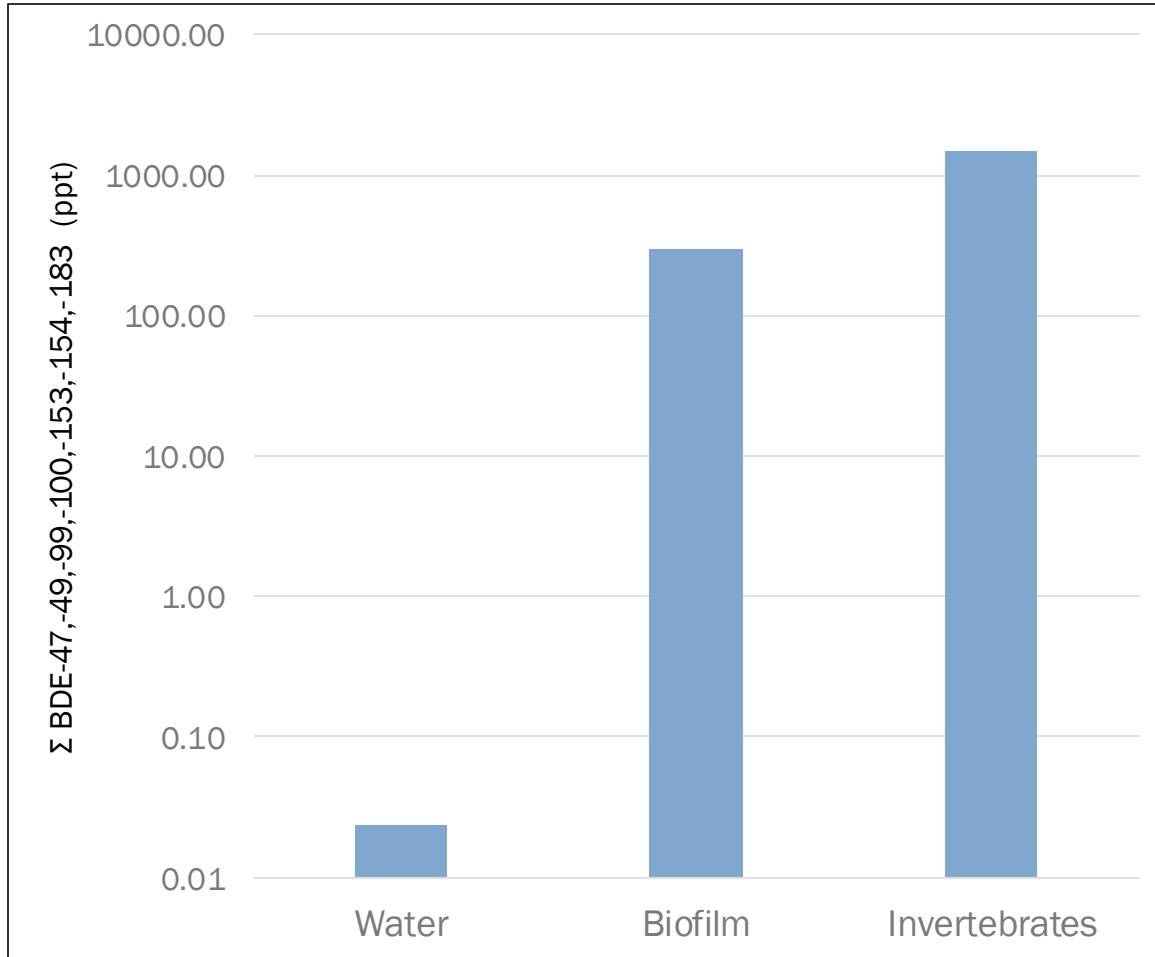


PBDEs in Juvenile Chinook Stomach Contents

Juvenile Chinook are accumulating the PBDEs from their food source

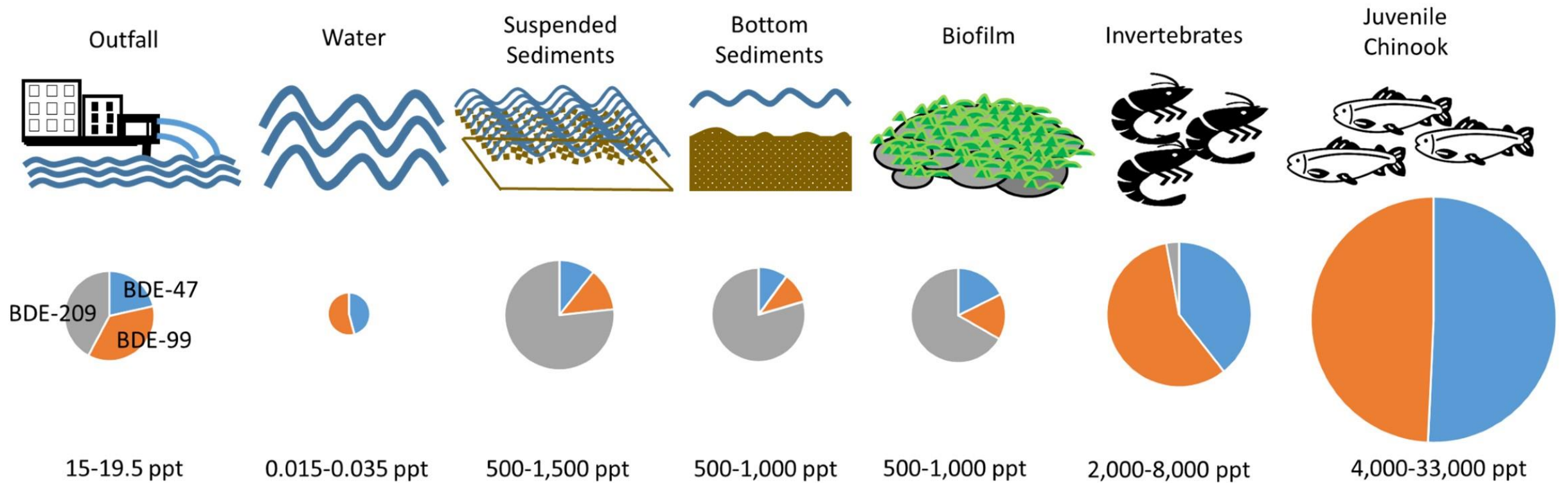


PBDE Accumulation & Concentration



- Water conc. average = 0.024 ppt
- Biofilm conc. average = 297.1 ppt
 - ~12,500x increase from water
- Invertebrate conc. average = 1477.3 ppt
 - ~5x increase from biofilms
- Primary producers (biofilms) and invertebrates concentrate and accumulate PBDEs
- Calculated from average conc. measured during 2019 low flow sampling event

PBDEs in the Snohomish Estuary



Results Summary

- Elevated PBDE concentrations in lower Snohomish main stem & near city of Monroe
 - Elevated PBDEs in water, sediment, biofilms, & inverts.
 - Associated with WWTP discharges
- Bioconcentration and bioaccumulation of PBDEs from water to biofilms and invertebrates
- Temporal trend of invertebrate PBDE concentrations in Snohomish mainstem
 - Highest in spring, declining through summer
 - Juvenile Chinook prey contain high levels of PBDEs
- PBDE congener accumulation differs across environmental media

Study Conclusions

- WWTP discharges of PBDEs impact localized areas surrounding the discharge zone in the Snohomish mainstem and near the city of Monroe
- Uptake and transformation of PBDEs in the food web concentrates and increases potential impacts on outmigrating juvenile Chinook salmon in the Snohomish estuary





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Tonya Lane

Kevin Leung

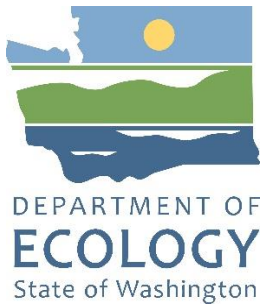
Jakub Bednarek

Elisa Rauschl

Susan Smith

Long Live the Kings

Lucas Hall

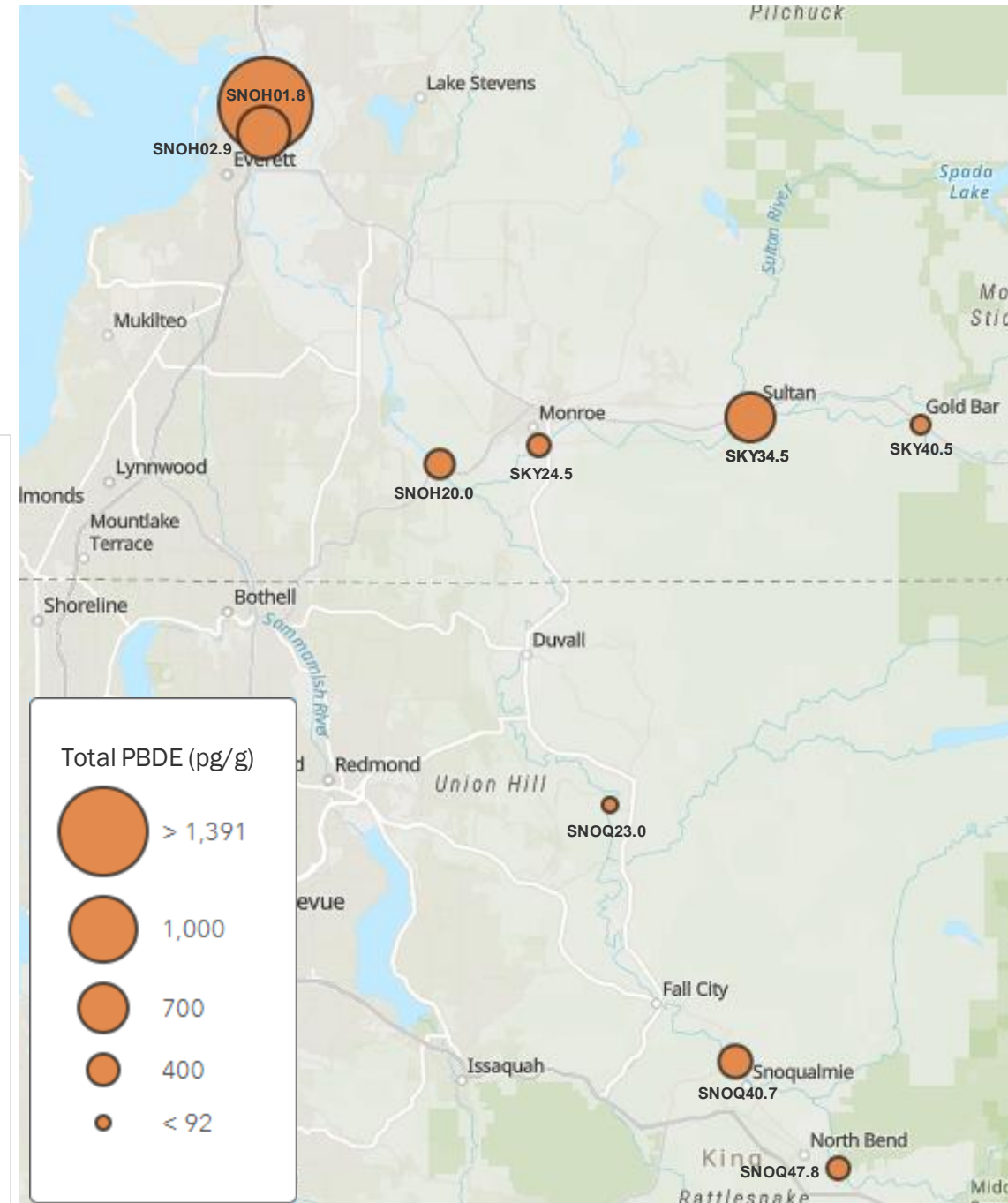
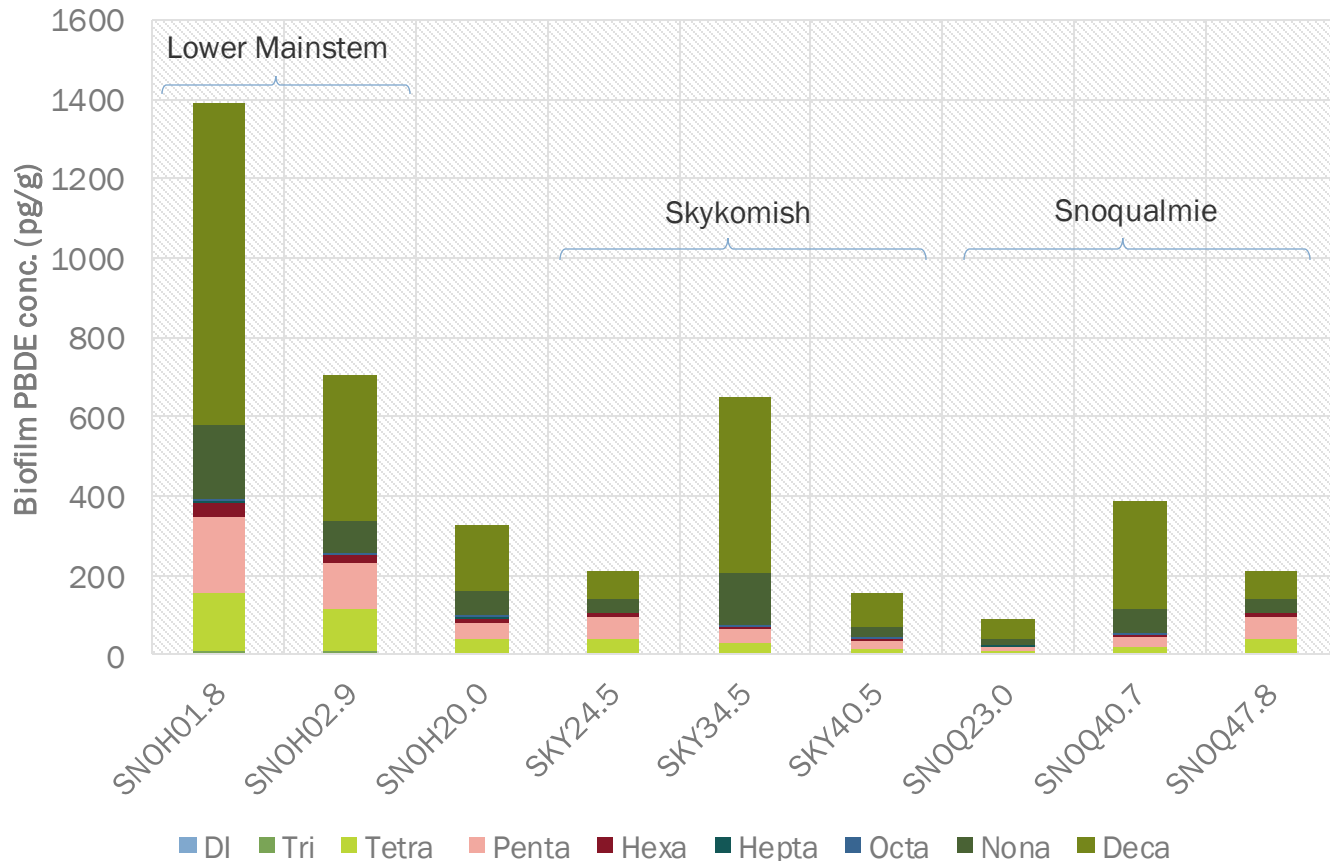


Questions?

Email: agip461@ECY.WA.GOV

PBDEs in Biofilms

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



2022 Temporal Trends of Suspended Sediment Total PBDE Concentrations

