Earthjustice

Please see attached comment letter submitted by Earthjustice with attachments, part 1 of 3.

EARTHJUSTICE

January 31, 2024

Tricia Miller, Permit Administrator
WA State Dept of Ecology – NWRO
PO Box 330316
Shoreline, WA 98133-9716

Re: City of Everett Water Pollution Control Facility
National Pollutant Discharge Elimination System (NPDES) Wastewater Discharge Permit

Dear Ms. Miller:

I. INTRODUCTION AND SUMMARY

The undersigned submit these comments on the draft National Pollutant Discharge Elimination System (NPDES) Permit (No. WA0024490) for the City of Everett Water Pollution Control Facility located in Snohomish County, Washington. In renewing an NPDES permit, the Department of Ecology (Ecology) must address violations of water quality standards and the harm such violations cause to people, water, and aquatic life. In this permit cycle, it is imperative that the permit have measures that will eliminate or significantly reduce discharges of persistent bio-accumulating toxic chemicals and nutrients.

At a minimum, the permit must contain effluent limits and other controls to address three pollution streams:

(1) the permit must eliminate discharges of PBDEs (polybrominated diphenyl ethers) that are causing a hot spot in the Lower Snohomish River, where concentrations in juvenile Chinook salmon are above levels that suppress the immune system and impede survival;

(2) the Everett Wastewater Treatment Plant must require testing of industrial user discharges for PFAS chemicals and impose pollution prevention measures or treatment requirements on the sources of these toxic pollutants; and

(3) the permit must impose effluent limits to prevent harmful nutrient discharges from the Plant, which is a major source of nutrient pollution into Puget Sound, with compliance deadlines that ensure the limits will be fully met in this permit cycle.

Before addressing each of these waste streams, we note that the draft permit suffers from Ecology's consistent failure to conduct the required analysis of all known, available, and reasonable treatment methods (AKART) for each of these waste streams in order to establish technology-based limits. Nor did Ecology set limits to prevent ongoing violations of water quality standards from the Plant's discharges. These analyses and limits are imperative in order to inform pretreatment agreements with industrial users to reduce toxic pollutants at the source, as well as to address additional efforts the Plant must undertake.

Below is a summary of our recommendations for each pollutant stream.

A. The Permit Must Eliminate PBDE Discharges That Are Harming Juvenile Chinook Salmon In Violation Of Water Quality Standards.

The Everett Plant's discharges of persistent, bioaccumulative, and toxic PBDEs are causing a hot spot in the lower Snohomish River. Juvenile Chinook salmon in the area — listed as threatened under the Endangered Species Act — have PBDE concentrations in their tissues associated with increased disease susceptibility and mortalities. Ecology identified the PBDE hot spot as long ago as 2010. Subsequent studies by WDFW and NOAA Fisheries systematically eliminated stormwater or other wastewater treatment plants as the cause of the hot spot, circling in on the Everett Plant as the cause of the harmful levels of PBDEs in juvenile Chinook salmon.

Alarmingly, PBDE concentrations in juvenile Chinook in the lower Snohomish River have increased in recent years. Sampling in 2021 found that the proportion of juvenile Chinook with PBDEs concentrations at levels that harm the immune system rose to 80% (up from 73% in 2016 sampling). This is in contrast to elsewhere in Puget Sound where PBDE concentrations in fish and other marine species have declined as production of most PBDEs has been phased out. The aerospace industry, however, has had an exemption from the state ban on PBDEs as well as an exemption from the new federal ban on decaBDE, which allows production and use of decaBDE for replacement parts for aerospace vehicles over the next 30-40 years. Since the large Boeing facility discharges into the Everett Plant, this exemption may lead to the Snohomish River hot spot persisting for decades unless the plant is required to carry out strong pollution reduction measures, including identifying and using safer alternatives to PBDEs.

The Snohomish estuary is crucial to Chinook survival and recovery, providing vital rearing habitat to juveniles as they feed and undertake the physiological transformation in preparation for their migration to the marine environment. The juveniles are vulnerable to the PBDEs that currently inundate the water in which they reside and that bioaccumulate and bioconcentrate through the local food web, including the prey on which they depend. The Chinook are prey for endangered Southern Resident Killer Whales, whose numbers are precariously low in large part due to food scarcity. Additionally, Chinook are an essential treaty-protected resource for Northwest Tribes. The Plant's PBDE discharges ae harming this treaty resource and Tribal rights.

PBDEs also harm human health. PBDEs are passed onto children in utero and through breastfeeding. Studies have found that children with higher levels of PBDEs have lower IQs:

about a five-point deficit is associated with a tenfold higher PBDE level. Tribal members are more highly exposed to PBDEs in fish than the general population because of higher fish consumption rates.

The State of Washington does not have a numeric water quality standard for PBDEs. However, permits must meet narrative water quality standards, which require that discharges of toxics be below levels that adversely affect designated uses, like supporting salmon, and below levels that individually or cumulatively cause acute or chronic toxicity to fish. The current PBDE discharges from the Everett Plant violate these standards. The permit must contain measures to end these violations.

We were pleased that the draft permit recognizes the imperative of addressing PBDE contamination from the Everett Plant and that it features pretreatment agreements and pollution reduction as a key control strategy. Reducing PBDE pollution at the source is the best strategy, given the persistence and bioaccumulating properties of PBDEs. Source control also avoids saddling ratepayers with the costs of treating the pollution generated by the industries. The draft permit, however, does far too little, given the severity of the violations of water quality standards and harm to Chinook salmon. The permit must be strengthened in the following ways.

1. Baseline and Effectiveness Monitoring

The permit must call for a monitoring program that is sufficiently comprehensive, reliable, and frequent to establish credible baselines for the Plant and industrial users and to assess the effectiveness of permit limits and other pollution reduction measures. The permit must require testing by each industrial user of its pretreated wastewater, as well as testing by Everett of total influent into and effluent from the Plant. During the permit's first year, each industrial user must be required to conduct quarterly sampling of its pretreated wastewater using the most sensitive test method to establish IU-specific PBDE baselines. Such sampling must be conducted every odd-numbered year thereafter to provide a basis for assessing the efficacy of pollution reduction measures. The permit must also require that Everett conduct semi-annual monitoring of total influent into and effluent out of the Plant with one sampling event coinciding with high flow conditions. The sampling results must be reported by IUs to Everett and by Everett to Ecology and must be made available to the public.

2. The Permit Must Have Stringent Controls to Reduce PBDE Discharges.

The permit must be strengthened to eliminate the serious water quality standard violations from the Everett Plant's PBDE discharges. It must set limits to stop PBDE discharges that will cause or contribute to harmful PBDE concentrations in fish tissues, yet the draft permit has no effluent limits for PBDE. Ecology undertook no review of available methods for treating PBDEs as a predicate for establishing technology-based limits, as it is legally required to do. Ecology must go back to the drawing board to develop more stringent permit limits that will meet its legal obligation to eliminate the pervasive and severe water quality standard violations.

Ecology should also require that the Plant route its discharges through the deep-water Port Gardner outfall into Puget Sound during the juvenile salmon outmigration season. PBDE concentrations are lower at the Port Gardner outfall and likely will cause less harm to juvenile salmon than discharges into the Snohomish River where juvenile Chinook salmon feed during the spring outmigration and rearing season. In pursuing this operational modification, the permit should require monitoring of PBDEs in sediments, invertebrates, and salmon impacted by releases through the Port Gardner outfall to assess the impacts of rerouting the discharges through that outfall and make appropriate adjustments if the monitoring documents harm to aquatic resources from Port Gardner releases.

3. The Permit Must Direct Everett to Establish Pretreatment Requirements That Mandate Pollution Reduction or Effective Treatment Methods.

The draft permit calls for modifications of pretreatment permits to require that each IU evaluate and propose a plan to reduce or eliminate PBDE discharges, without requiring that the IUs take any specific actions during this permit cycle. Instead, the permit must require modification of pretreatment permits to achieve substantial PBDE reductions by all IUs that discharge PBDEs to the Everett Plant. In the first year under the permit, Everett must impose such pretreatment requirements on the industrial laundry and landfill that have been shown through monitoring to discharge substantial PBDE volumes and concentrations into the Everett Plant and on the Boeing facility that almost certainly discharges high volumes and concentrations of PBDEs, in light of the use of decaBDE in aerospace vehicles and replacement parts, which is permitted to continue under the aviation exemption from the federal deca-BDE phase-out. In the second year, Everett must impose such pretreatment requirements on other IUs shown through the baseline monitoring to discharge PBDEs into the plant. The pretreatment permits must establish technology-based limits or more stringent water-quality based limits to ensure the IUs will not discharge PBDEs that lead the Plant to cause or contribute to water quality standard violations and specifically to violations of the permit's effluent limits.

4. Everett Must Submit and Obtain Ecology Approval of a Toxics Reduction Plan and Update that Plan Annually.

The permit must require that Everett adopt a toxics reduction plan, with Ecology's approval, to reduce PBDE concentrations in fish tissues below levels that impair immunity and meet the permit's effluent limits. Modeled on the Spokane Riverside Park Water Reclamation Facility permit, this plan must, at a minimum, contain specific actions with implementation deadlines to achieve quantified PBDE reduction targets. Based on monitoring by IUs and the Everett Plant sampling and on fish tissue sampling by WDFW, Everett must develop annual updates to the toxics reduction plan, subject to Ecology approval, to ratchet up pollution prevention measures if the demonstrated performance falls short of achieving the targets and the overall goal of reducing PBDE concentrations in juvenile Chinook salmon to below harmful levels and meeting the permit's effluent limits.

5. *Halt the application of sludge/biosolids until sampling and pretreatment measures are in place.*

The permit, as drafted, allows PBDE-contaminated biosolids to be spread on agricultural lands. Ecology should halt land application of biosolids until they are sampled for PBDEs and PFAS, notification can be provided to entities receiving the wastes, and Ecology and Everett explore applying greater restrictions on disposal of biosolids containing high concentrations or quantities of persistent bioaccumulating toxics.

B. <u>The Permit Must Identify and Limit PFAS Pollution.</u>

The Everett Plant is a likely source of PFAS contamination in the Snohomish River and Puget Sound, and therefore the permit must contain concrete and effective measures to assess and reduce the level of PFAS discharge.

PFAS, sometimes called "forever chemicals," are a class of persistent, bioaccumulating toxics linked to cancer and harm to the liver, thyroid, immune system, and fetal development in animals and humans. Wastewater treatment plants have been identified as a primary source of PFAS releases, due in part to receiving PFAS-laden wastewaters from industrial users and landfills and in part to standard wastewater treatment methods that inadvertently transform PFAS precursors into PFAS compounds. Additionally, sampling data from various categories of industrial users in Washington demonstrates that these industries may discharge large concentrations of PFAS into wastewater.

Spurred by the nationwide crisis created by PFAS pollution from wastewater treatment plants, the U.S. Environmental Protection Agency ("EPA") recently issued guidance urging states to modify wastewater treatment permits to include requirements for monitoring discharges from industries associated with PFAS releases and the development of pollution prevention plans. The Everett permit must require testing to identify the industrial sources of PFAS discharges into the Plant and pollution controls to reduce or eliminate discharges to avoid violations of Washington's water quality standards.

The permit provisions must be strengthened to meaningfully address PFAS pollution. We applaud that the draft permit includes the recognition of PFAS as a concern and requires an industrial user inventory update, and new or updated pretreatment agreements that include requirements for those sources to evaluate pollution prevention and source reduction measures. However, the current draft permit includes ambiguous and weak provisions that the Plant will "evaluate" and "encourage" other best management practices and pollution prevention strategies for dischargers. The permit must include technology-based or water-quality based effluent limits, sampling specific to each industrial user, pretreatment pollution reduction requirements with implementation deadlines, and an adaptive management approach that sets targets for reductions in PFAS discharge and updates strategies and targets as needed.

The permit must be strengthened with the following provisions:

1. Establish effluent limits in the permit.

Ecology must, as it is legally obligated, evaluate AKART for PFAS. That analysis can, in turn, inform the establishment of technology-based effluent limits. Ecology must also determine whether a more stringent, water quality-based effluent limit is necessary to prevent PFAS discharges that have the potential to adversely affect designated water body uses or protected fish.

2. Clearly define PFAS in the permit.

We support incorporating Washington's definition at RCW 70A.350.010 to ensure that attention is paid to the broad range of existing and new compounds within this chemical class.

3. Expand the categories of users "suspected or known" to discharge PFAS to include aerospace and aircraft modification, industrial laundries, industrial gas manufacturing, and inorganic chemical manufacturing.

The draft permit currently lists several industries considered to be known or suspected dischargers of PFAS, but it is underinclusive. Ecology sampling shows that aerospace and aircraft modification and industrial laundries are some of the highest contributors to PFOS (one PFAS compound of particular health concern) in wastewater; these industries should be considered for the expanded IU inventory. Furthermore, national research has shown that industrial gas manufacturing and inorganic chemical manufacturing are significant sources of PFAS nationwide; these industries should also be included in the expanded IU inventory.

4. Require source-specific sampling of influent from IUs and sampling of total Plant influent and treated effluent.

The draft permit contains no sampling or monitoring measures to assess the discharge of industrial dischargers of PFAS, the efficacy of source reduction strategies, or the severity of Everett's current or future contributions to PFAS pollution in the affected waterways. The permit should require that IUs conduct initial sampling to determine PFAS discharge quantities and concentrations, and then require quarterly sampling for the IUs found to discharge PFAS. The permit should also require that Everett determine a sampling schedule that enables it to assess relative contributions from IUs and non-regulated sources of wastewater (such as domestic wastewater), as well as to assess whether PFAS volumes or concentrations increase during treatment at the Plant.[1] Sampling data should be disclosed to the Plant and Ecology and made available to the public.

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[1] As discussed in the PFAS section below, conventional wastewater treatment may cause some PFAS precursors to transform into PFAS compounds, inadvertently worsening the pollution problem.

5. *Strengthen requirements for industrial users discharging PFAS.*

The permit should specify that Everett and its IUs must not only evaluate potential source reduction (such as product substitution) and operational changes to reduce PFAS, but that they must also consider treatment technologies to remove PFAS from wastewater before it is sent to Everett. The latter is particularly important for industrial users with relatively little ability to prevent toxic pollutants from entering their waste streams, such as landfills.

6. *Specify implementation timelines for sampling and pollution prevention or pollution treatment practices.*

The permit must include implementation deadlines to ensure timely establishment of sampling schedules and implementation of source reduction and treatment practices as needed. The initial screening of industrial users for PFAS discharges and setting baselines for those found to discharge should be completed within a year of the effective date of the permit. Implementation plans should be completed by the second year, and phased-in implementation should begin in the third year. Installation of waste treatment, particularly for those with few opportunities for source reduction, should be completed within the five-year permit cycle.

7. *Halt the application of sludge/biosolids until sampling and pretreatment measures are in place.*

PFAS-contaminated biosolids present a high risk of contaminating soil, air, surface water, and groundwater, as well as food grown on agricultural land. Ecology should halt land application of biosolids until they are sampled for PFAS—and other bioaccumulating persistent toxics, like PBDEs—so that, at the very least, users of the waste can be notified of the presence and concentration of PFAS in the biosolids. Ecology should otherwise consider whether to apply more restrictions on biosolid use if they contain high concentrations of PFAS or PBDEs.

C. The Permit Must Limit Nutrient Pollution.

The draft permit contains no provisions to control nutrient pollution, despite the Everett Plant being one of the largest point sources of nutrient pollution into Puget Sound. Nutrient pollution can cause increases in algal growth, which results in reduced levels of dissolved oxygen, toxic algae blooms, and harm to aquatic life. Nutrient pollution from wastewater treatment plants is a major contributor to violations of Washington's dissolved oxygen water quality standards, including in Puget Sound at Port Gardner. The permit fails to include provisions on nutrients ostensibly because there is a general nutrient permit for Puget Sound, but that general permit also fails to set nutrient limits based on AKART or water quality for dischargers such as Everett. Even if the general permit addressed these concerns, it is being litigated and is indefinitely stayed, in part, indicating a serious need for specific and actionable provisions in this permit.

The permit must have effluent limits on key sources of nutrient pollution: nitrogen and phosphorous. Based on available technologies widely used elsewhere, the limits should be 3 micrograms/liter (mg/L) nitrogen and 0.3 mg/L phosphorous. To achieve these limits, the Everett plant will need to make long-overdue upgrades to its treatment technologies. The permit must establish stringent compliance deadlines for Everett to adopt and implement upgraded treatment technologies to achieve the effluent limits during this permit cycle.

II. LEGAL REQUIREMENTS UNDER THE CLEAN WATER ACT AND STATE LAW.

Congress passed the federal Clean Water Act (CWA) with the intent to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a). Toward that end, the discharge of pollutants from a point source into navigable water is prohibited unless the discharge occurs in accord with a National Pollutant Discharge Elimination System (NPDES) permit. 33 U.S.C. § 1311(a); 33 U.S.C. § 1362. The Environmental Protection Agency (EPA) has delegated authority to issue and enforce NPDES permits to the Washington Department of Ecology. Both federal and state statutory and regulatory requirements apply to Ecology's issuance of this permit.

A. Federal Requirements.

Federal regulations prohibit the issuance of an NPDES permit when the permit's conditions do not ensure compliance with all applicable requirements of the Clean Water Act and its implementing regulations, or when the imposition of conditions cannot ensure compliance with water quality standards. 40 C.F.R. §§ 122.4(a), (d). Under federal requirements, wastewater treatment plants must implement effluent limits; meet water quality standards; and avoid degradation of water quality.

Federal regulations require that each NPDES permit include technology-based effluent limits (TBELs) and such other more stringent effluent limits (*e.g.*, water quality-based effluent limits, or WQBELs) necessary to achieve water quality standards, including any state narrative criteria. 40 C.F.R. § 122.44(a), (d). Effluent limits must control all pollutants or pollutant parameters which will cause or contribute to (or have the potential to cause or contribute to) an exceedance of any water quality standard, including narrative criteria. 40 C.F.R. § 122.44(d)(1)(i).

When developing effluent limitations, as required by these provisions, Ecology must ensure that the level of water quality achieved through the permit's limits will meet water quality standards. 40 C.F.R. § 122.44(d)(1)(vii). Permit effluent limits for publicly owned treatment works must be stated as average weekly and average monthly discharge limitations. 40 C.F.R. § 122.45(d).

Finally, permits must address pollution that could cause the water quality of the receiving waters to degrade. This requirement is part of statewide antidegradation policy which mandates that "[e]xisting instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." 40 C.F.R. § 131.12(a)(1); *see also* 40 C.F.R. § 131.12(a)(2) ("Where the quality of the waters exceeds levels necessary to support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State makes specific findings through an elaborate intergovernmental coordination and public participation process).

B. State Requirements.

Ecology is required by state statute and the agency's own regulations to ensure the highest level of protection for all Washington waters through technology-based limits, permit conditions that ensure compliance with water quality standards, and the antidegradation policy.

When issuing a waste discharge general permit, Ecology must ensure that the permit conditions "apply and insure compliance" with "[t]echnology-based effluent limitations" that reflect "all known, available, and reasonable methods of prevention, treatment, and control," or "AKART." RCW 90.48.010; RCW 90.48.520; RCW 90.54.020; WAC 173-220-130(1)(a); *see also Wash. State Dairy Fed'n v. State of Wash.*, 18 Wn. App. 2d 259, 275–76 (Wash. Ct. App. 2021). AKART involves use of "the most current methodology that can be reasonably required for preventing, controlling, or abating the pollutants associated with a discharge." WAC 173-201A-020. AKART is required regardless of the quality of the receiving water. RCW 90.48.520; RCW 90.54.020(b). That is, AKART is the minimum standard that must be applied to all discharges to ensure clean water stays clean and pollutants are controlled.

AKART is implemented using effluent limitations. WAC 173-220-130. The phrase "effluent limitation" refers broadly to "any restriction established by the state or the administrator on quantities, rates, and concentrations of [discharges] from point sources into surface waters of the state." WAC 173-220-030(9); *see also* 33 U.S.C. § 1362(11) (defining effluent limitation under the CWA).

In addition to AKART, state law dictates that no permit may be issued that causes or contributes to the violation of any water quality standard, whether in narrative or numeric form. RCW 90.48.520; WAC 173-201A-510(1). Washington's water quality standards are designed to protect existing water quality and preserve beneficial uses of Washington's surface waters. WAC 173-201A-510. Therefore, a permit may be required to incorporate water quality-based effluent limits where, for instance, technology-based limits would be insufficient to protect water quality standards.

While Ecology has adopted numeric standards for certain pollutants in order to protect aquatic life, recreation, and human health, it also has narrative criteria to protect the specific designated uses of the state's fresh and marine waters. WAC 173-201A-210; WAC 173-201A -200; *see also PUD No. 1 of Jefferson County v. Wash. Dep't of Ecology*, 511 U.S. 700 (1994) (upholding Washington's use of broad narrative criteria in addition to numeric standards). The Snohomish River is designated for protection of salmonid spawning, rearing, and migration, among other uses. WAC 173-201A-600.

In addition to protecting designated uses, narrative criteria limit toxic or deleterious discharges to levels below those that have the potential to adversely affect designated water uses or cause acute or chronic toxicity to biota. WAC 173-201A-240(1) ("Toxic substances shall not be introduced above natural background levels in waters of the state which have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic toxicity to the most sensitive biota dependent upon those waters, or adversely affect public health, as determined by the department"). To implement this prohibition, Ecology "shall employ or require chemical testing, acute and chronic toxicity testing, and biological assessments, as appropriate, to evaluate compliance with subsection (1) of this section and to ensure that aquatic communities and the existing and designated uses of waters are being fully protected." WAC 173-201A-240(2). Water quality-based effluent limits must control all pollutants that "are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion of state ground or surface water quality standards." WAC 173-226-070(2)(b); *see also Wash. State Dairy Fed'n*, 18 Wn. App. 2d at 289.

As required, Washington has adopted an antidegradation policy. RCW 90.54.020(3)(b). State regulations also require that there shall be no degradation of water quality. WAC 173-201A-300; WAC 173-201A-310. The purpose of the antidegradation policy is to: (a) Restore and maintain the highest possible quality of the surface waters of Washington; (b) Describe situations under which water quality may be lowered from its current condition; (c) Apply to human activities that are likely to have an impact on the water quality of a surface water; and (d) Ensure that all human activities that are likely to contribute to a lowering of water quality, at a minimum, apply AKART. WAC 173-201A-300. Under the antidegradation policy as applied to the Snohomish River and estuary, no degradation may be allowed that would interfere with, or become injurious to, existing or designated uses and Ecology must take appropriate and definitive steps to bring the water quality back into compliance with the water quality standards where the waters do not protect existing or designated uses. WAC 173-201A-310(1), (2).

While the rules at both federal and state levels provide that a permitting agency may use compliance plans to allow a polluter time to come into compliance with new permit requirements, 40 C.F.R. § 131.15; WAC 173-220-140; WAC 173-201A-510(4)(a), compliance plans do not excuse or negate the requirements described above: that limits be explicitly stated in the permit and that the permitting agency determine those limits will ensure compliance with water quality standards. Finally, any compliance plan, to the extent it is allowed, must include strict and enforceable progress deadlines within the terms of the permit itself, and should not extend compliance deadlines for meeting effluent limits beyond the term of the permit.

C. Pretreatment Requirements

In addition to direct discharges from a wastewater treatment plant, the Clean Water Act established a regulatory program to address discharges that originate from industrial and commercial users and are sent to publicly owned treatment works (POTWs). This National Pretreatment Program requires such dischargers, dubbed "industrial users," to obtain permits for discharge or otherwise control discharge. The pretreatment program covers toxic, conventional, and non-conventional pollutants. Under the program, industrial users can be required to pretreat or implement management practices that enable them to meet an effluent quality specified in the permit.

Source control through pretreatment requirements is designed to ensure that pollutants will not be discharged into receiving waters or end up in sludge that may be land applied. Pretreatment requirements also ensure that the polluter pays the cost of treating harmful discharges instead of ratepayers. Control at the source, through both pollution reduction and treatment, can also mean the costs of treatment will be lower because the industry can prevent pollution load and treat only its wastewater, whereas the POTW would need to treat the entire influent entering the plant. *See* RCW 90.48.465(1), (3).

Federal pretreatment regulations require POTWs meeting certain criteria, including the Everett WWTP, to establish local pretreatment programs that enforce national standards as well as any additional local requirements. *See* 40 C.F.R. § 403.8; Everett Mun. Code Ch. 14.40 (Everett pretreatment regulations). Local pretreatment programs include minimum requirements to identify and locate possible IUs, characterize discharges, receive reports, and sample and analyze IU effluent. 40 C.F.R. § 403.8(f). The POTW has authority to deny or condition IU discharges to the POTW, require pretreatment requirement compliance – including by establishing compliance schedules to bring IU discharges into compliance, and to inspect and monitor IUs. POTWs can use categorical limits, numeric case-by-case discharge limits, or best management practices. As described by EPA, "local limits should correct existing problems, prevent potential problems, protect the receiving waters, [and] improve sludge use options."[2]

All IUs are prohibited from introducing pollutants to a POTW that cause pass through of pollutants in quantities or concentrations that, alone or in conjunction with discharges from other sources, causes violation of the POTW's NPDES permit.[3] 40 C.F.R. § 403.5. Additionally, EPA has identified certain categories of industries that are major sources of pollutants; it has over time investigated and initiated rulemakings to establish technology-based effluent limit guidelines for various industry categories. 40 C.F.R. §§ 405-471. These guidelines and standards can be concentration-based, mass limits, prohibitions of a discharge entirely, or required use of best management practices. EPA has not yet established effluent guidelines for industrial discharges of PBDEs and PFAS, but the pretreatment requirements to prevent pass through apply to all pollutants that can pass through POTWs, and Everett can establish effluent limits regardless of whether EPA has promulgated guidelines for the particular pollutant.

As summarized in EPA guidance, federal regulations require that control mechanisms imposed by a POTW in its pretreatment agreements be enforceable and contain the following minimum provisions (selected for relevance to these comments):

- Effluent limits, including BMPs, that are based on applicable standards
- Self-monitoring, sampling, reporting, notification, and record-keeping requirements
- An identification of the pollutants to be monitored
  […]
- Sampling location, sampling frequency, and sample type
  […]

[2] EPA Pretreatment Program Guidance at 3-8.

[3] "The term *Pass Through* means a Discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation)." 40 C.F.R. § 403.3(p).

- A schedule of compliance (where appropriate).[4]

Everett can impose more stringent standards and requirements on discharges to the POTW than those imposed under federal or state law. 40 C.F.R. § 403.4; EMC 14.40.100. Everett's program requires that IUs "shall" provide AKART as required to comply with its pretreatment standards and requirements, and authorizes the director of the City of Everett Public Works Department to establish BMPs for particular groups of users. EMC 14.40.130.

General Pretreatment Regulations require significant IUs to self-monitor *at least* semiannually, and POTWs must monitor each significant IU at least annually.[5] IUs with greater potential to cause pass through or interference, contaminate sewage sludge, or violate standards are typically required to sample and report more often.

For an IU that is not in compliance with applicable standards, POTWs must develop and impose a compliance schedule for that IU to install technology or modify its practices to attain compliance. 40 C.F.R. § 403.12. These schedules must include progress points (with maximum time frames of 9 months per event) for major actions to install a pretreatment system or otherwise modify IU processes, along with progress reports at each increment. *Id*. If IUs do not meet the schedule, a POTW may take corrective enforcement action.

All information submitted to the POTW or the state must be available to the public, with the exception of confidential business information. 40 C.F.R. § 403.14. POTWs are also subject to reporting requirements; they must submit annual reports to the relevant approval authority (here, Ecology) documenting that year's program status and activities performed. 40 C.F.R. § 403.12(i).

III. THE PERMIT MUST BE STRENGTHENED TO REDUCE HARMFUL PBDE DISCHARGES FROM THE EVERETT PLANT.

A. PBDEs Harm Salmon, Orcas, and People

PBDEs (polybrominated diphenyl ethers) are a class of flame retardants developed using the element bromine. PBDEs were once used extensively, including in airplanes, electronics, insulation, vehicles, upholstery, and textiles. They were widely used in furniture throughout the U.S. due to a California mandate that was rescinded when the scientific basis for it was called into question and evidence of the health and environmental harms from PBDEs mounted. They are highly toxic, persistent organic pollutants.

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[4] EPA Pretreatment guidance at 4-3 to 4-4 (referencing 40 C.F.R. § 403.8).

[5] Significant IUs are those subject to categorical pretreatment standards, that discharge above certain levels, or that are designated by the POTW as having the potential to cause adverse effects or violate pretreatment requirements. 40 C.F.R. § 403.3(v). Categorical users that are not "significant" IUs, are often subject to less frequent monitoring requirements. *See* 40 C.F.R. § 403.12 (reporting requirements). Of note, a POTW can charge an IU a fee for, among other activities, monitoring, inspection, surveillance, and enforcement procedures. *See* EMC 14.40.790.

PBDEs bioaccumulate and bioconcentrate in the aquatic food chain, ultimately finding their way into salmon, Southern Resident Killer Whales or orcas, and people. As explained below, juvenile Chinook salmon impacted by discharges from the Everett Plant have PBDE concentrations in their tissues at levels associated with immune suppression and altered thyroid hormone levels. Southern Resident orcas have PBDE concentrations substantially higher than levels associated with altered thyroid hormone levels in other marine mammals. Mongillo, 2016.[6] In fact, one juvenile killer whale had concentrations of PBDEs in its blubber that were 10 times greater than those associated with endocrine disruption in grey whales. Krahn, 2007.[7]

In people, PBDEs are associated with serious health effects. DecaBDE is an endocrine disrupting chemical, adversely affecting thyroid hormone levels.[8] It also has been correlated with developmental neurological effects and reproductive toxicity, even at low environmental levels.[9] Higher levels of PBDEs in children have been correlated with lower IQs: a roughly five-point deficit is associated with a tenfold higher PBDE level.[10] PBDEs are ubiquitous in the environment due to their persistence and their previous widespread use. Virtually everyone has PBDEs in their bodies. By way of example, PBDEs have been widely detected in breast milk, posing health risks for breastfeeding infants. Schreder, 2023.[11] Infants and toddlers have the

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[6] Teresa M. Mongillo, *et al., Exposure to a Mixture of Toxic Chemicals: Implications for the Health of Endangered Southern Resident Killer Whales*: NOAA Technical Memorandum NMFS-NWFSC-135 (Nov. 2016), at https://www.webapps.nwfsc.noaa.gov/assets/25/8314_11302016_111957_TechMemo135.pdf.

[7] Margaret M. Krahn, *et al*., *Persistent organic pollutants and stable isotopes in biopsy samples (2004/2006) from Southern Resident killer whales*, Marine Pollution Bulletin, Volume 54, Issue 12, (December 2007), Pages 1903-1911, at https://www.sciencedirect.com/science/article/abs/pii/S0025326X07002846

[8] EPA, *Environmental and Human Health Hazards of Five Persistent Bioaccumulating Chemicals* (June 2018), at https://www.epa.gov/sites/default/files/2018-06/documents/environmental_human_health_hazard_summary_five_pbts.pdf.

[9] *Id*.; U.N. Env't Programme Stockholm Convention on POPs, *Risk Profile on Decabromodiphenyl Ether* at 25, 27–28 (2015) at file http://chm.pops.int/Portals/0/download.aspx?d=UNEP-POPS-POPRC.11-INF-7.English.pdf; *see also* EPA, *Toxicological Review of Decabromodiphenyl Ether (BDE-209), In Support of Summary Information on the Integrated Risk Information System* (June 2008), at https://iris.epa.gov/static/pdfs/0035tr.pdf; Consumer Product Safety Comm'n, Guidance Document on Hazardous Additive, Non-Polymeric Organohalogen Flame Retardants in Certain Consumer Products, 82 Fed. Reg. 45,268, 45,269 (Sept. 28, 2017).

[10] Juleen Lam, *Developmental PBDE Exposure and IQ/ADHD in Childhood: A Systematic Review and Meta-analysis*, Environmental Health Perspectives, 086001-1 (Aug. 3, 2017), at https://doi.org/10.1289/EHP1632.

[11] Erika Schreder, *Brominated flame retardants in breast milk from the United States: First detection of bromophenols in U.S. breast milk, Environmental Pollution*, Environmental

highest PBDE body burdens.[12] PBDEs have been listed as persistent organic pollutants under the Stockholm Convention. United Nations, Stockholm Convention Annex A.[13]

PBDEs differ in the number and location of bromines with 209 possible congeners. PBDEs with fewer bromines – *e.g.*, BDE-47 (four bromines) – are smaller and more readily biologically available and therefore more toxic to aquatic life. PBDEs with more bromines – *e.g.*, BDE-209 (ten bromines or decaBDE) – are highly toxic and can be converted through various processes to the lower-brominated congeners. Thus, the ongoing release of decaBDEs can contribute to the presence of not only BDE-209, but also BDE-47, BDE-99, and other congeners in the water, sediments, and biota.

Fortunately, use of PBDEs is declining. Two major commercial formulations, pentaBDE and octaBDE, have not been manufactured in or imported into the United States for nearly 20 years. Washington banned decaBDE, the remaining major commercial formulation, in some uses (such as TVs, computer monitors, residential upholstered furniture), effective in 2011, being the first state to do so. RCW 70A.405.030. The U.S. EPA is phasing out many uses of decaBDE, but with some exceptions, including for use in new aerospace vehicles until 2024 and for aviation replacement parts for the service lives of the aerospace vehicles. 86 Fed. Reg. 880 (Jan. 6, 2021) (manufacture, distribution, processing, and import); *see* 88 Fed. Reg. 82,287 (Nov. 24, 2023) (proposed revisions). The exception for the service life of aerospace vehicles means decaBDE may be in use for years to come, since, according to the Aerospace Industries Association, "[m]any aerospace products are designed for a lifespan of 30 or 40 years or more."[14] Because a vast quantity of products containing PBDEs have long service lives, PBDEs will continue to enter the environment for years to come.

B. Scientific Evidence Shows that the Everett Wastewater Treatment Plant is Discharging PBDEs in Amounts that Impair Juvenile Chinook Salmon Health and Survival.

While significant amounts of PBDEs enter aquatic environments via atmospheric deposition and stormwater runoff, discharges from wastewater treatment plants have been

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Pollution Volume 334, 1 (October 2023), 122028, at https://www.sciencedirect.com/science/article/abs/pii/S0269749123010308.

[12] Lucio G. Costa, *Polybrominated Diphenyl Ether (PBDE) Flame Retardants: Environmental Contamination, Human Body Burden and Potential Adverse Health Effects*, Acta Biomed, 2008 Dec;79(3):172-83 (Dec. 2008), at https://pubmed.ncbi.nlm.nih.gov/19260376/.

[13] United Nations, *Stockholm Convention Annex A* at https://chm.pops.int/Implementation/Alternatives/AlternativestoPOPs/ChemicalslistedinAnnexA/tabid/5837/Default.aspx (calling for elimination of major commercial congeners in products, but with some exemptions).

[14] Aerospace Industries Association, *Comment Letter to TSCA Rulemaking,* Docket EPA-HQ-OPPT-2019-0080 (Oct. 26, 2019).

identified as a major source of PBDEs in the Puget Sound, particularly in the Whidbey Basin into which the Snohomish River empties. Osterberg & Pelletier, 2015.[15]

Two studies released in 2010 identified a potential link between PBDEs in wastewater from the Everett Plant and high levels of PBDEs in outmigrating juvenile Chinook salmon in the Snohomish River. NOAA Fisheries researchers found PBDE concentrations in juvenile Chinook gathered from the lower Snohomish River at a site "adjacent to a sewage treatment plant" to be higher than found in fish from other locations in the Puget Sound, even in more-urbanized locations. Sloan, 2010.[16] In a study of effluent discharges from major wastewater treatment plants in Puget Sound, Ecology found the highest PBDE concentrations at the Everett Plant's Outfall 100, which discharges into Port Gardner Bay, over two times higher than from other plants. Ecology & Herrera, 2010.[17] The Snohomish hotspot spurred additional monitoring and research by state and federal agencies, as well as by the City of Everett.

In 2013, scientists with the Washington Department of Fish and Wildlife (WDFW) and NOAA Fisheries sampled juvenile Chinook salmon from various locations around Puget Sound, and found 100% of the samples collected in the lower Snohomish River had PBDEs at levels associated with increased disease susceptibility. O'Neill, 2015.[18] Moreover, 75% of the Snohomish River estuary fish had PBDE levels at the higher concentrations associated with altered thyroid functioning. O'Neill, 2015; *see* Arkoosh, 2010 (identifying concentrations that cause immune suppression and alter thyroid functioning in juvenile Chinook salmon).[19] The study noted concern because "the health and ultimately the marine survival of juveniles migrating from freshwater into Puget Sound in route to the Pacific Ocean are more likely to be reduced by contaminant exposure as this [i.e., juvenile] life stage also undergoes tremendous physiological stress associated with smolting" and because juvenile Chinook, in particular, "are especially vulnerable to contaminant exposure because they spend considerably more time than

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[15] Wash. Dep't of Ecology (David Osterberg and G. Pelletier), *Puget Sound Regional Toxics Model: Evaluation of PCBs, PBDEs, PAHs, Copper, Lead, and Zinc* (Aug. 2015), https://apps.ecology.wa.gov/publications/SummaryPages/1503025.html.

[16] Catherine A. Sloan, *et al.*, *PBDES in Outmigrant Juvenile Chinook Salmon from the Lower Columbia River Estuary and Puget Sound, Washington*, Arch Environ, Contam. Toxicol. (Feb. 2010) (58:403-414), at https://pubmed.ncbi.nlm.nih.gov/19771462/.

[17] Wash. Dep't of Ecology and Herrera Environmental Consultants Inc., *Control of Toxic Chemicals in Puget Sound* (Dec. 2010), https://apps.ecology.wa.gov/publications/documents/1010057.pdf

[18] This study refers to the Snohomish River sampling sites as "freshwater," while subsequent studies call the same sites "estuary" or "lower mainstem." WDFW Sandra M. O'Neill, *et al., Toxic contaminants in juvenile Chinook salmon (Oncorhynchus tshawytscha) migrating through estuary, nearshore and offshore habitats of Puget Sound,* 58, Wash. Dep't of Fish and Wildlife (Oct. 2015), at https://wdfw.wa.gov/sites/default/files/publications/01796/wdfw01796.pdf.

[19] Mary R. Arkoosh, *et al.*, *Disease susceptibility of salmon exposed to polybrominated diphenyl ethers (PBDEs)* (Feb. 2010), Aquat. Toxicol. 98, 51-59, at https://pubmed.ncbi.nlm.nih.gov/20207027/.

other salmonid species feeding in estuaries … where contaminant inputs may be quite high." Carey, 2017.[20]

These findings prompted the researchers to broaden the geographic scope of their Snohomish sampling sites in 2016 to include the "distributary channels," the "lower mainstem," and the "upper mainstem." They analyzed three lines of evidence to identify the source of the elevated PBDE levels in the juvenile Chinook and pointed to the Everett Plant as the cause of the hot spot. O'Neill, 2020.[21]

First, they found that 73% of the juvenile Chinook samples taken in 2016 had PBDE concentrations at levels high enough to alter their immune systems, and 4–10 times higher than those found in juvenile Chinook salmon in the other locations. Arkoosh, 2010; Arkoosh, 2018.[22] They noted that immune suppression increases susceptibility to naturally occurring infectious and parasitic diseases that cause direct mortality or increase risks of predation. The 2016 WDFW studies found higher PBDE concentrations in natural-origin salmon than hatchery-origin salmon, which are larger when they are released into the river and move through the Snohomish estuary more rapidly than natural-origin salmon. The lower PBDE concentrations found in the hatchery-origin salmon strengthened the conclusion that no upriver source is the primary cause of the PBDE exposures. O'Neill, 2019.[23]

The graphic below identifies the lower mainstem sampling sites with blue triangles and the Everett Plant's Outfalls 015 and 100 with yellow stars. While Outfall 015 is downstream of a key sampling site, significant tidal influences move effluent discharged at Outfall 015

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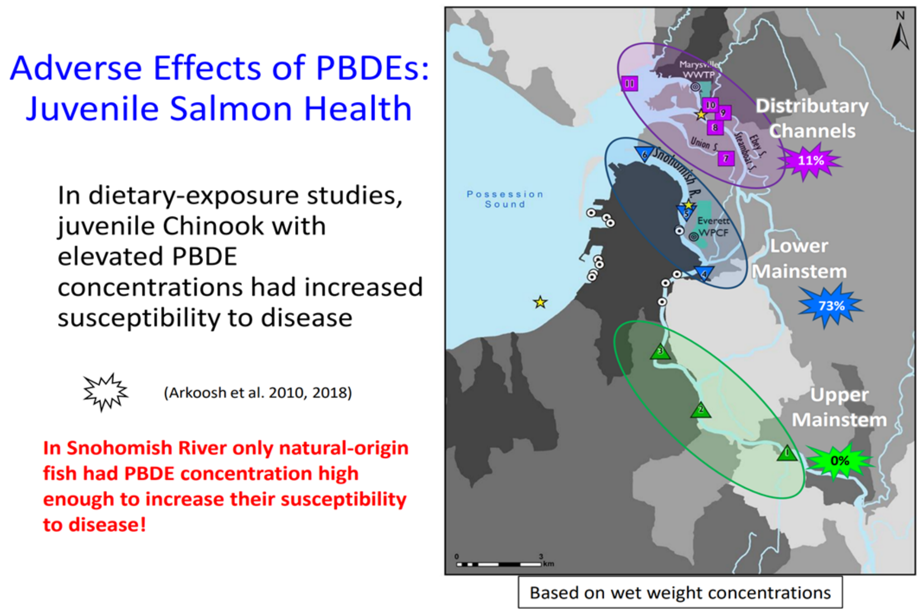
[20] Andrea Carey, *et al.*, *Toxic contaminants pose a threat to early marine survival of Chinook salmon from Puget Sound," in* Puget Sound Ecosystem Monitoring Program*, 2016 Salish Sea Toxics Monitoring Review: A Selection of Research* 15 (2017), at https://www.eopugetsound.org/sites/default/files/features/resources/PSEMP_2016_ToxicsSynthesis%202017.05.09.pdf.

[21] Sandra M. O'Neill, *et al.*, *Chemical tracers guide identification of the location and source of persistent organic pollutants in juvenile Chinook salmon (Oncorhynchus tshawytscha), migrating seaward through an estuary with multiple contaminant inputs*, Science of the Total Environment 712 (Apr. 10, 2020), at https://www.sciencedirect.com/science/article/pii/S004896971935510X.

[22] Mary R. Arkoosh, *et al.*, *Dietary exposure to a binary mixture of polybrominated diphenyl ethers alters innate immunity and disease susceptibility in juvenile Chinook salmon,* (Nov. 15, 2018), Ecotoxicol. Environ. Saf. 163, 96-103, at https://pubmed.ncbi.nlm.nih.gov/30041130/.

[23] O'Neill, Sandra M. *et a*l., *Source of PBDEs in juvenile Chinook salmon along their out-migrant pathway through the Snohomish River, WA* (2019), *PowerPoint Presentation to Snohomish Basin Salmon Recovery Forum* (Feb. 17, 2019), available at https://snohomishcountywa.gov/DocumentCenter/View/61874/2719_Oneill-ppt.

upstream to this location. Carey, 2018.[24]



Second, the study found that the composition of the persistent organic pollutants ("POPs") in the juvenile Chinook salmon in the lower Snohomish indicated they were exposed to PBDEs from wastewater, rather than from stormwater runoff. These natural-origin Chinook juveniles "had a distinct pattern from other region and origin samples, with a much higher proportion of the sum of 11 PBDE congeners in the total Persistent Organic Pollutant (POP) concentration," indicating wastewater as the likely contaminant source. O'Neill, 2020.

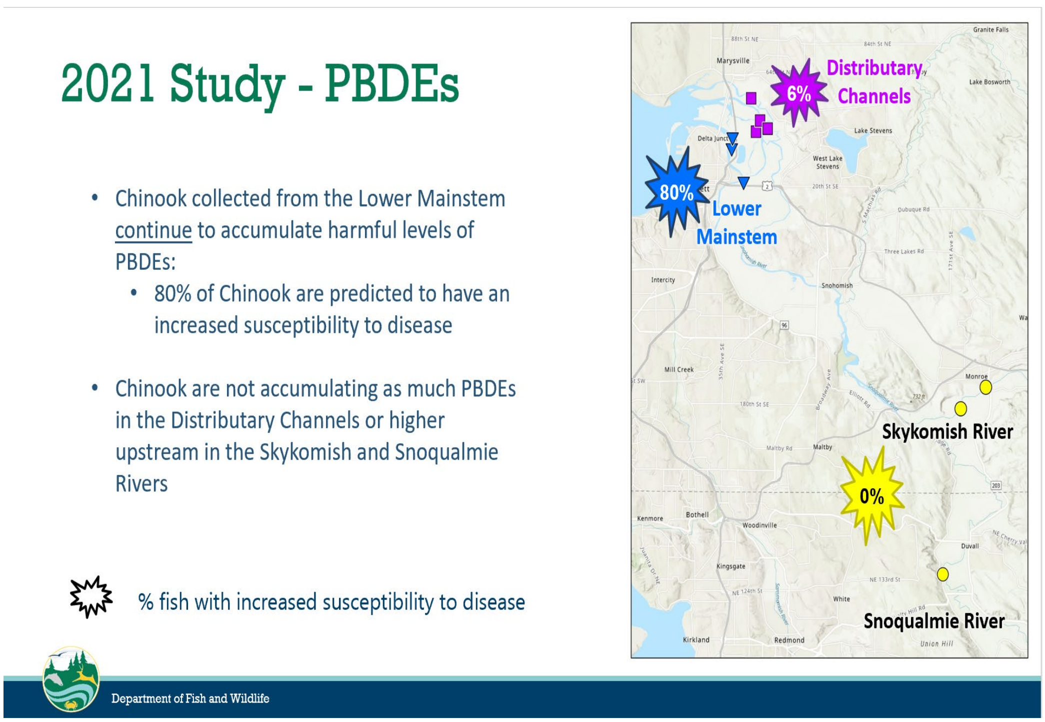
Third, the study found that stable nitrogen isotopes, which are incorporated into the aquatic food web through the uptake of wastewater with high nutrient concentrations, indicated that wastewater, rather than stormwater, is the source of PBDEs in the lower Snohomish juvenile Chinook. Scientists found a depleted nitrogen signal typical of that associated with "secondary treated sewage with insufficient nutrient removal," such as the Everett Plant, which has "a higher proportion of ammonium compared to nitrates and nitrites." The depleted nitrogen isotope tracers and POP fingerprints "suggested a common source for both the high PBDEs exposure and the depleted nitrogen isotopic signal." O'Neill, 2020.

This study, sometimes called "the smoking gun" study, correlated discharges from the Everett Plant with the Snohomish PBDE hot spot. It spurred further studies by WDFW and the Department of Ecology's Environmental Assessment Program (EAP), which provided further

[24] Andrea J. Carey, *et al.*, Input of PBDE exposure in juvenile Chinook salmon along their out-migrant pathway through the Snohomish River, WA (2018). Presentation to Salish Sea Ecosystem Conference (May 18, 2018), PowerPoint available at https://cedar.wwu.edu/ssec/2018ssec/allsessions/355/?utm_source=cedar.wwu.edu%2Fssec%2F2018ssec%2Fallsessions%2F355&utm_medium=PDF&utm_campaign=PDFCoverPages

evidence that Everett's discharges are causing harmful PBDE concentrations in juvenile Chinook.

In 2021, WDFW scientists sampled juvenile Chinook in the Skykomish, Snoqualmie, and Snohomish Rivers, adding a site that is closer to Everett's Outfall 015 than the other Snohomish sites. The study found that 80% of juvenile Chinook from the lower Snohomish had PBDE concentrations at levels that increase their susceptibility to disease, making them more likely to die and ultimately affecting "their marine survival." Carey, 2023.[25] This percentage is even more dire than the 73% figure found in previous studies. Juvenile Chinook from the Skykomish and Snoqualmie Rivers did not have harmful PBDE concentrations.



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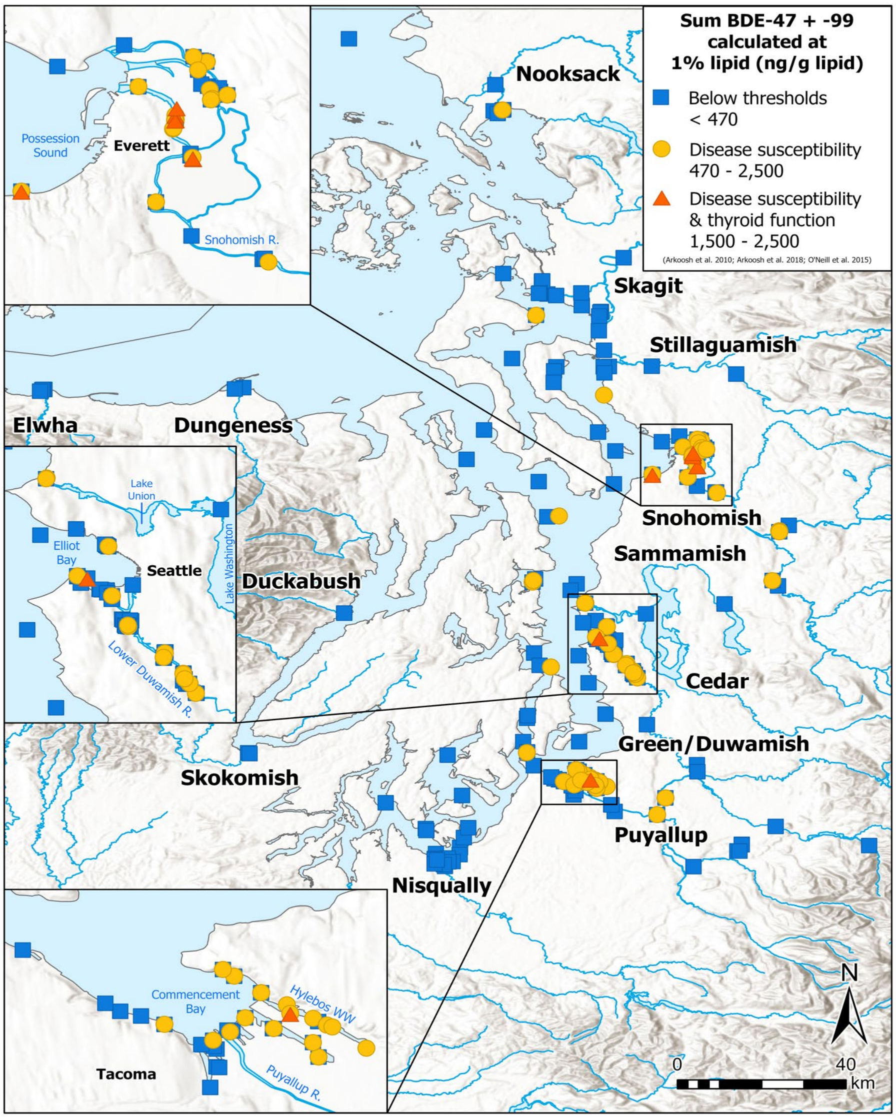
[25] Carey & O'Neill, *An Update on PBDEs in Juvenile Chinook from the Snohomish River* (Nov. 30, 2023) PowerPoint, Slide 17.

Some of the 2021 samples had PBDE concentrations at the higher levels also associated with impaired thyroid function. On the WDFW map below, which portrays the results of samples gathered over the 2013-2021 timeframe, these higher levels are denoted by orange triangles.[26] The locations where juvenile Chinook had PBDEs at levels associated with impaired immune function are marked by the yellow circles on this map.



Data collected over the 15-year period from 2006 to 2021 showed that PBDE concentrations in lower Snohomish juvenile Chinook are not declining, in contrast to

[26] WDFW, Calculations of Sum BDE-47 and -99 (ng/g lipid calculated at 1% lipids) Measured in Juvenile Chinook Salmon in Various Habitats of Puget Sound River Systems in 2013-2021 (Jan. 2024).

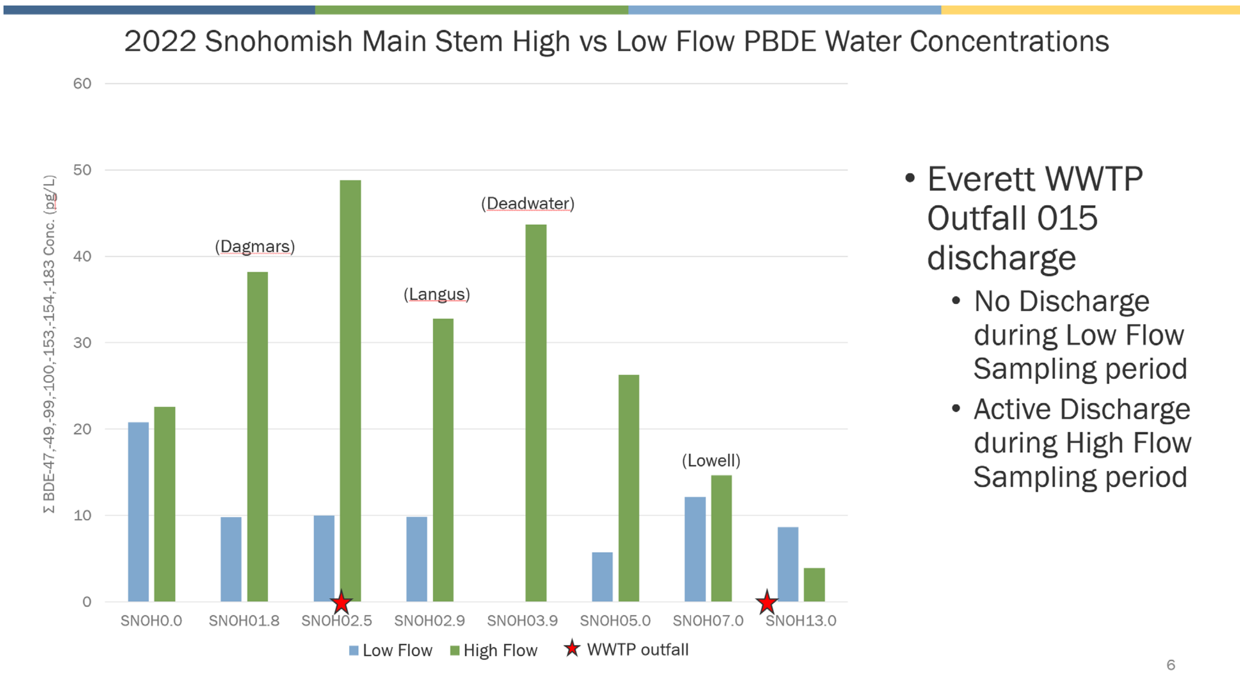
improvements elsewhere in Puget Sound. Juvenile Chinook in close proximity to the Everett Outfall 015 continued to have PBDE body burdens at harmful levels. Carey, 2023, Slides 178.

In 2021, WDFW sampled stomach contents from juvenile Chinook, which confirmed that "juvenile Chinook are getting large amounts of PBDEs from their diet." The PBDE concentrations found in their stomachs correspond to the PBDE concentrations in the aquatic invertebrates that are a source of prey for juvenile Chinook. Carey, 2023, Slide 15.

Sampling by the Department of Ecology's Environmental Assessment Program in 2019, 2021, and 2022 demonstrated the connection between the Everett facility and elevated PBDE levels in the lower Snohomish. Beginning in 2019, Ecology's EAP sampled surface water, suspended and bottom sediments, algae/biofilm, and aquatic macroinvertebrates at several locations upstream and downstream of the Everett Plant in low flow and high flow conditions. Ecology Quality Assurance Project Plan, 2019.[27] EAP found elevated PBDE levels in surface water in the vicinity of effluent discharges from wastewater treatment plants. The concentrations in the vicinity of the Everett Plant generally dwarfed those measured elsewhere and diminished significantly with distance from the source. Additionally, EAP's 2022 sampling compared water concentrations during a period in which the Everett Plant was *not* actively discharging through Outfall 015 (green bars) with a period in which it was actively discharging through this outfall (blue bars), as shown in the bar graph below. The location of the Everett outfall is indicated by the leftmost red star. The data showed markedly greater concentrations of PBDEs present in the waters influenced by the Everett Plant during periods in which it is actively discharging effluent to the lower mainstem. Gipe, 2023.[28] While most of the concern focuses on bioaccumulation of PBDEs in the food chain, juvenile Chinook rearing in these waters take in some amount of the PBDEs in the water over their gills.

[27] Wash. Dep't of Ecology, *Quality Assurance Project Plan: Assessing Sources of Toxic Chemicals Impacting Juvenile Chinook Salmon* (Aug. 2019), Pub. No. 19-03-110, at https://apps.ecology.wa.gov/publications/documents/1903110.pdf.

[28] Gipe, EAP, *Source Assessment of PBDEs Impacting Juvenile Chinook in the Snohomish River System* (Nov. 30, 2023), PowerPoint, Slides 12-13.



EAP's sampling of aquatic invertebrates, which included species known to be prey for juvenile Chinook, found higher PBDE concentrations in invertebrates from the vicinity of the Everett Plant compared to those collected elsewhere. Gipe, 2023. The invertebrates also had higher PBDE concentrations in the spring, which coincides with the period when juvenile Chinook feed and rear in the lower Snohomish. The invertebrates sampled during 2022 and 2021, when the Everett Plant was actively discharging to the Snohomish through Outfall 015, had significantly higher PBDE concentrations than those gathered in 2019, during a time when the Everett Plant was not actively discharging – indeed, seven times greater. Gipe, 2023.

EAP sampling in the lower Snohomish across multiple years and flow conditions found PBDEs in every medium studied: receiving water, suspended and bottom sediments, biofilms, and invertebrates. EAP's data, combined with the City of Everett's sampling of PBDEs in the Everett Plant's effluent through Outfall 015 and WDFW's sampling of PBDEs in juvenile Chinook, demonstrate the bioaccumulation of PBDEs through the food web. PBDE concentrations in invertebrates were greater than in the sediments – 4-8 times greater (2,000-8,000 parts per trillion (ppt)) – and PBDE concentrations in juvenile Chinook were 2-4 times higher than in invertebrates (4,000-33,000 ppt) as of 2019.[29]

The graphic below illustrates increasing concentrations of PBDEs as they move through the water, sediments, and biota in the Snohomish. PBDE concentrations in suspended sediments, bottom sediments, and biofilm were orders of magnitude greater than those in water.

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[29] Gipe, *et al.*, *Assessing Sources of Polybrominated Diphenyl Ether (PBDE) Flame Retardants Impacting Juvenile Chinook Salmon in the Snohomish River Watershed, in PSEMP, 2022 Salish Sea toxics monitoring synthesis: A selection of research 20-23* (Sept. 2023), at https://www.eopugetsound.org/articles/2022-salish-sea-toxics-monitoring-synthesis-selection-research.

Note that this graphic reflects data gathered through 2019; if the more recent (2021 & 2022) invertebrate data were included, the invertebrate figure would be 2,000-10,000 ppt. Gipe, 2023.

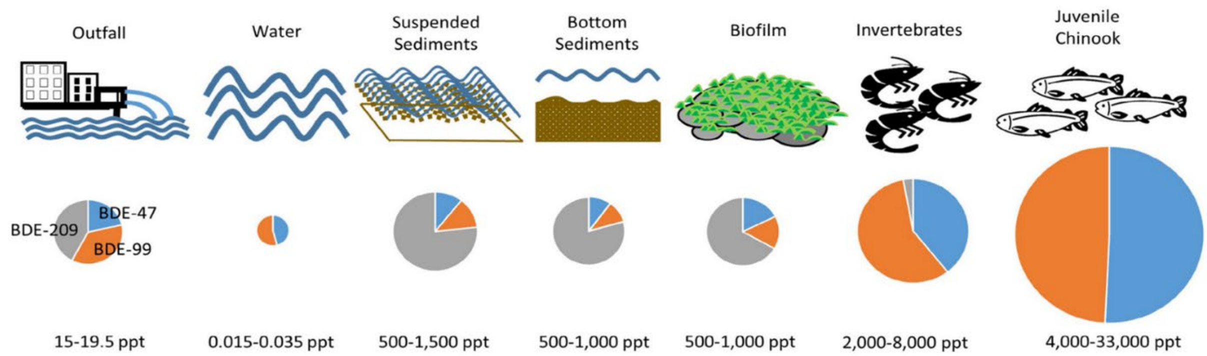

Figure 1. Concentrations of PBDE congeners BDE-209 (Gray), BDE-99 (Orange), and BDE-47 (Blue) in wastewater treatment plant effluent, ambient water, suspended sediments, bottom sediments, biofilms, invertebrates, and juvenile chinook from the lower Snohomish mainstem. ppt= part per trillion. Preliminary wastewater treatment plant outfall concentrations provided by City of Everett Public Works. Juvenile Chinook PBDE tissue concentrations provided by WDFW.

C. City of Everett and EAP monitoring of wastewater influent and effluent.

In 2020-2022, the City of Everett tested influent into and effluent out of the Everett Plant (at both Outfall 100 and Outfall 015), with five samples, covering all four quarters of the year. The City measured PBDEs in the total influent without measuring contributions from particular industrial users discharging to the Plant. Kerlee, 2023.[30] The City of Everett's monitoring revealed lower PBDE discharges through Outfall 100, which discharges into deeper receiving waters in the Sound, than from Outfall 015, which discharges into the lower Snohomish. By way of example, during the third quarter of 2022, PBDE concentrations at Outfall 100 were less than half those at Outfall 015. *Id.*

In 2020, Ecology's EAP began sampling pretreated wastewater from nine industrial users (IUs) that discharge into four wastewater treatment plants in Puget Sound, including the Everett Plant, and found PBDEs in the wastewater of all nine IUs. Ecology (Wong), 2020.[31] Ecology kept the specific identities of the facilities anonymous, describing them only by the general type of industry, *e.g.*, food processing, metal finishing, steel foundry, landfill, industrial laundry, and ship building and repair. The study authors disclosed that the industrial laundry and landfill discharge into the Everett Plant, but did not indicate which of the two industrial laundries and two landfills that meet this description were subject to influent testing. The industrial laundry had the highest PBDE concentrations (an order of magnitude higher than the other sites) and highest total load of PBDEs. *Id.*; Wong PowerPoint (2022).[32] The landfill had

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[30] Kerlee & Sinclair, City of Everett, *Everett Water Pollution Control Facility, PowerPoint* (Nov. 30, 2023).

[31] S. Wong, *Chemicals of Emerging Concern in Pretreated Industrial Wastewater in Northwestern Washington State: Screening Study Results, 2021* (Aug. 2022), at https://apps.ecology.wa.gov/publications/documents/2203013.pdf;

[32] S. Wong, *Sampling of Pretreated Industrial Wastewater in NW Washington*, PowerPoint Slides 6-9 (2022).

the third highest PBDE concentrations and second highest total load of PBDEs. One of the aerospace/aircraft modification facilities (which does not discharge to Everett) had the second highest PBDE concentrations and fourth highest total load of PBDEs.[33]

D. PBDE Discharges from the Everett WWTP are Causing Serious Water Quality Standard Violations.

While Ecology has yet to set numeric criteria for PBDEs, its narrative standards make salmon spawning, rearing, and migration a designated use of the Snohomish River and require that toxic discharges be below levels that individually or cumulatively cause acute or chronic toxicity to the most sensitive of the biota dependent on these waters. Scientists with NOAA Fisheries, the federal expert agency with jurisdiction over Chinook salmon, have established concentration levels for PBDEs associated with adverse effects levels in juvenile Chinook, *i.e.,* that suppress immunity, thereby increasing susceptibility to disease, and that alter thyroid functioning. Arkoosh, 2010; Arkoosh, 2018. Where discharges lead or contribute to documented PBDE levels in salmon above these toxicity thresholds, they violate the narrative standards that prohibit discharges that individually or cumulatively cause toxicity to salmon and thereby impair the ability of the Snohomish River to support salmon rearing.

To ensure aquatic life is being fully protected, Ecology regulations direct Ecology to employ chemical testing, acute and chronic toxicity testing, and biological assessments. In *A Primer on Using Biological Assessments to Support Water Quality Management* at 7-8, 50-52 (2011), EPA indicates biological assessments can be used for NPDES permitting to assess whether discharges are leading to violations of water quality standards.[34] If a biological assessment shows that the applicable water quality standards are not being attained, it would trigger reopening and modifying the permit. While biological assessments generally are tied to numeric water quality standards, here the smoking gun and other studies show that Everett's discharges are leading to PBDE concentrations in fish tissues that NOAA Fisheries scientists have correlated with immune suppression and impaired thyroid functioning. The studies provide irrefutable evidence that the Everett Plant is causing or contributing to violations of water quality standards.

The monitoring conducted by Ecology shows that the Everett Plant is discharging PBDEs into the lower Snohomish and that PBDE concentrations increased markedly in surface waters influenced by the Everett Plant when it was actively discharging. Monitoring by Ecology and WDFW documented the bioaccumulation of PBDEs in sediments, biofilms, invertebrates that are prey for juvenile Chinook salmon, and ultimately the juvenile Chinook. The 2021 sampling of juvenile Chinook stomach contents identified diet as the key route of exposure, correlating the PBDE levels in the juveniles with PBDE bioaccumulation in the

[33] While two of the facilities are categorized as aerospace/aircraft modification engaged in "chemical metal finishing, aircraft cleaning and painting," we understand that neither one is the Boeing facility that discharges into the Everett Plant.

[34] EPA, *A Primer on Using Biological Assessments to Support Water Quality Management*, (Oct. 2011) at https://www.epa.gov/sites/default/files/2018-10/documents/primer-using-biological-assessments.pdf

Snohomish biota. And the smoking gun study correlated the PBDE discharges from the Everett Plant with the Snohomish hot spot.

WDFW has consistently found PBDE concentrations in juvenile Chinook salmon at levels associated with suppressed immune functioning and in some samples, even at the higher levels associated with impaired thyroid functioning. The proportion of lower Snohomish juvenile Chinook with PBDE concentrations at harmful levels is increasing, rather than decreasing. In 2016, WDFW found PBDE concentrations in 73% of the juvenile Chinook salmon at levels that increase susceptibility to disease and reduce Chinook survival rates, while that proportion rose to 80% in 2021, and the PBDE concentrations also rose to exceed the higher thresholds associated with impaired thyroid functioning. Carey, PowerPoint Slides # 8, 15, 2023. Juvenile Chinook are particularly vulnerable to contaminant exposure at the sensitive life stage when they rear in the lower Snohomish as they are undergoing the physiological stresses and demands of smolting in preparation for their transition to the marine environment.

The adverse health impacts to the Chinook are likely even greater than suggested by considering PBDEs alone, as there are likely additive or synergistic effects from exposure to contaminant mixtures such as those found in urbanized Puget Sound systems. In particular, exposure to both PBDEs and PCBs has been found to enhance adverse neurobehavioral effects and to compound reductions in learning and memory. Mongillo, 2016, at 58-60, 70; Carey, PowerPoint Slide #19, 2023.[35] It is noteworthy that WDFW monitoring has documented PCB concentrations in juvenile Chinook salmon at levels associated with adverse health effects.[36]

In sum, extensive data gathered and analyzed by expert agency scientists demonstrates that the Plant's PBDE discharges not only have a "reasonable potential" to cause or contribute to violations of water quality standards, but they are actually causing violations with pervasive and serious harm to juvenile Chinook salmon. The discharges are causing or contributing to PBDE levels that harm juvenile Chinook salmon in violation of the prohibition on causing acute or chronic toxicity to biota. The discharges are thereby impairing the lower Snohomish River mainstem's ability to support salmon rearing and migration – a designated use for this waterbody.

E. It Is Imperative to Eliminate the PBDE Hot Spot Given the Harm the Discharges Are Causing to ESA-Listed Puget Sound Chinook Salmon.

Puget Sound Chinook Salmon have suffered such precipitous declines that they were listed as threatened under the federal Endangered Species Act ("ESA") in 1999. 64 Fed. Reg. 14,308 (March 24, 1999). Preventing further declines and moving toward recovery of Puget

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[35] *See also* ESA Biological Opinion, *Reissuance of National Pollutant Discharge Elimination System (NPDES) permit (#CA0107409) for the Point Loma Wastewater Treatment Plant and Ocean Outfall,* NMFS Consultation Number: WCRO-2021-03010, at 88 (March 2022) at https://repository.library.noaa.gov/view/noaa/37544 (non-linear dose response curves thyroid hormone impacts from PBDEs and other POPs).

[36] WDFW, Calculations of Total PCBs (ng/g lipid calculated at 1% lipids) Measured in Juvenile Chinook Salmon in Various Habitats of Puget Sound River Systems in 2013-2021 (Jan. 2024).

Sound Chinook is also imperative because Chinook salmon are the preferred prey for Southern Resident Killer Whales, which are listed as endangered and whose total population is less than 75 individuals. 70 Fed. Reg. 66,903 (Nov. 18, 2005) (endangered listing of Southern Resident Killer Whales). The orca recovery plan identifies pollution and toxic contamination as a major threat and specifically identifies PBDEs. Recovery Plan for Southern Resident Killer Whales at 100-01, 106-08, 113-16 (2008).[37] To address this threat, NOAA Fisheries and the federal EPA have convened technical workshops on the effects of PBDEs on orcas and on ways to remove PBDEs from wastewater.

Once a species is on the endangered species list, the statute imposes legal obligations on the federal government to avoid taking actions that jeopardize the species' survival and to work toward recovery of the species to the point that it no longer needs the ESA's protections to be viable. 16 U.S.C. §§ 1532(3), 1533(f), 1536(a)(2). The ESA also prohibits any entity, including state and local governments, from causing a take of members of the species unless it has obtained a permit from NOAA Fisheries constraining and authorizing the take. 16 U.S.C. §§ 1536(b)(4), 1538(a)(1)(B); *see* 50 C.F.R. § 223.203 (take prohibition applicable to listed salmon). Take includes significant habitat modification that impairs essential behavioral functions, including rearing and migrating, that actually injures or kills members of the listed species. 50 C.F.R. § 222.102; *see Babbitt v. Sweet Home Chapter of Communities for a Greater Oregon*, 515 U.S. 687 (1995) (upholding this regulatory definition of "harm"). In listing Puget Sound Chinook Salmon, NOAA Fisheries identified discharges of toxics into salmon habitat among the activities likely to violate the take prohibition. 64 Fed. Reg. at 14,326.

In carrying out their ESA obligation to ensure their actions avoid jeopardizing listed species' recovery, federal agencies must consult with the expert fish and wildlife agency, NOAA Fisheries for salmon and orcas. While this obligation is inapplicable to Ecology's issuance of this NPDES permit because it is a state agency not the federal government that is issuing the permit, it did apply to EPA's issuance of an analogous permit for the Fort Lewis (Joint Base Lewis McChord) (JBLM) Wastewater Treatment Facility at Solo Point, which authorized discharges of PBDEs, among other pollutants, into Puget Sound. NOAA Fisheries found that the PBDE discharges are likely to adversely affect Puget Sound Chinook and Southern Resident Killer Whales and will cause incidental take of Puget Sound Chinook.[38] The Biological Opinion noted the need to reduce PBDE discharges due to the harmful effects of PBDEs on both Chinook salmon and orcas, but ultimately determined that the PBDE discharges over the 5-year life of the permit would not be likely to jeopardize either species' survival, although the conclusion might be different if PBDE discharges are not reduced over the long-term. *Id*. at 84-86, 111-14, 123, 127-29.

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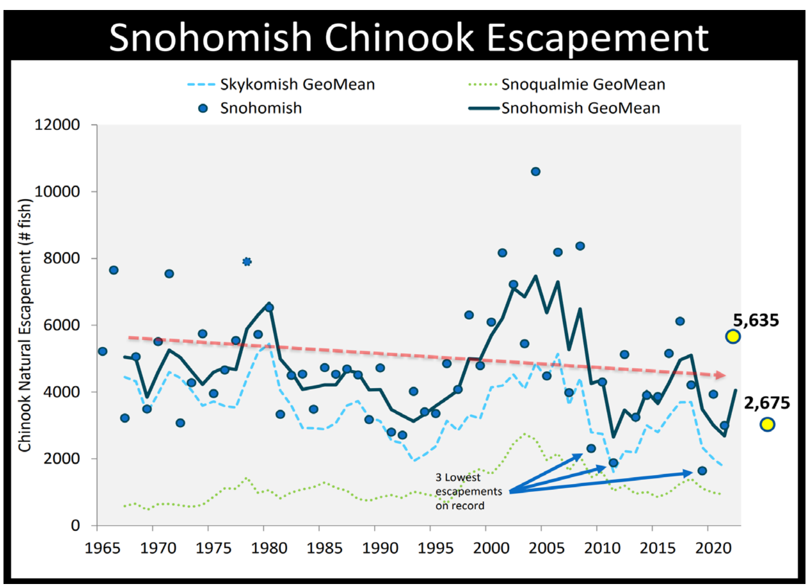
[37] NMFS, *Recovery Plan for Southern Resident Killer Whales (Orcinus orca)* (2008), https://repository.library.noaa.gov/view/noaa/15975.

[38] NOAA Fisheries, *Biological Opinion on Reissuance of the Fort Lewis (Joint Base Lewis McChord) Wastewater Treatment Facility NPDES Permit* (WA-002195-4), NMFS Consultation Number: 2009/03531 (2012), at file: I75R5GWY/BiOp%20NOAA_JBLM_NPDES_2-06-2012FinalTR_1_.pdf.

In contrast to the wealth of monitoring of PBDE discharges from the Everett Plant, no monitoring had been conducted for the Solo Point Plant. NOAA Fisheries' no-jeopardy determination hinged, in part, on this lack of information, but it required monitoring to fill this data gap during the life of the permit. Because the PBDE discharges are likely to cause the incidental take of thousands of Puget Sound Chinook, *id*. at 131-32, NOAA Fisheries issued an incidental take statement, authorizing the take, conditioned on monitoring of PBDEs in influent and effluent and on the monitored PBDE concentrations in fish tissues staying below adverse biological effects thresholds in fish. *Id*. at 11, 134. JBLM also had to consider treatment technologies for PBDEs and rerouting discharges to deeper water as the base planned for an upgrade at Solo Point. *Id*. at 12, 129,134.

The body of scientific evidence correlating Everett's PBDE discharges with harmful PBDE levels in juvenile Chinook salmon supports a finding that the Plant is causing the take of listed Chinook. Ecology must construct permit conditions that will stop discharges that injure and even kill juvenile Chinook. To do so, Ecology should draw from the Solo Point biological opinion to minimize the take of Puget Sound Chinook and harm to orcas. Specifically, it should mandate comprehensive monitoring of PBDEs in influent and effluent, require that PBDE concentrations in fish tissues not exceed adverse biological effect levels, direct Everett to consider treatment technologies for PBDEs, and require rerouting discharges to deeper waters. Proposed permit conditions that would meet these goals are described further below.

The Snohomish River is the second largest producer of Puget Sound Chinook, but its Chinook population is at less than10% of historic levels. The 2023 numbers – just 2,675 returning adults – fall far short of recovery goals, which range from 14,000-64,000. [39]



[39] Matt Pouley, *Tulalip Tribes Natural Resources, Fish In, Fish Out (2023) (annual update of Snohomish salmon data and trends. Snohomish Basin Salmon Recovery Technical Committee, PowerPoint* (Dec 5, 2023), at https://snohomishcountywa.gov/3826/Technical-Committee

Chinook numbers have declined markedly in the last 20 years. *Id*. The PBDE hot spot with concentrations in juvenile Chinook at levels associated with adverse effects in natural-origin juvenile Chinook poses a serious threat to the population's recovery.

Persistent PBDE contamination that causes salmon mortalities imposes significant societal costs. Millions of dollars are being spent on salmon recovery, including on improving Snohomish freshwater, estuary, and nearshore habitat for Chinook. To cite one metric, between 2005-2017, the Snohomish River Basin received $127,578,772 in restoration funding.[40]

The ESA listings underscore the critical importance of ensuring that this permit will stop PBDE discharges that are harming Chinook salmon. Urgent actions are needed to reduce this serious threat to Chinook salmon and the orcas.

F. The Permit Must Contain Measures to Stop These Serious Water Quality Standard Violations.

This permit must be strengthened to contain effective measures to stop discharges causing or contributing to this harm expeditiously, given the imperiled condition of this Chinook salmon population. As written, the draft permit focuses on modifying pretreatment requirements to reduce PBDE discharges by IUs into the Plant. We applaud this approach because source control and pollution reduction are the ultimate solutions to limiting the entry of persistent PBDEs into the Snohomish River and Puget Sound. IU discharges of PBDEs into the Everett Plant simply moves the pollutants around with their re-release via sludge, landfill leachate, or incinerator emissions. Reducing pollution at the source also avoids saddling the City of Everett and ultimately ratepayers with the costs of limiting PBDE pollution that is sent to the Plant by the IUs it serves. We are particularly concerned that imposing such costs on Everett and its ratepayers would impose burdens on those least able to bear the costs.

While Ecology's fact sheet represents (at 38) that the draft permit "requires" Everett to "take actions to identify and control" sources of PBDEs, the draft permit's provisions fall far short. The permit must include at least the following measures to reduce PBDE discharges expeditiously: (1) effective monitoring; (2) effluent limits and other requirements to reduce PBDE discharges from the Plant that cause or contribute to water quality standard violations; (3) pollution reduction requirements in pretreatment permits; and (4) adoption and implementation of a toxics reduction plan to reduce PBDEs..

1. Establish An Effective Monitoring Program, Including of Each IU's Pretreated Wastewater.

The draft permit lacks sufficient monitoring requirements to establish a credible baseline and assess the efficacy of pollution reduction measures. Ecology seems to recognize the importance of establishing a baseline, but it proposes to do so in an ineffectual way. It proposes

[40] Snohomish County, *Snohomish River Basin Salmon Conservation Plan Status and Trends* (Dec. 2019), at https://www.snohomishcountywa.gov/DocumentCenter/View/71060/SnohomishBasin10YearReport_2019-12-30_reduced

to begin gathering baseline data by requiring that Everett revise its inventory of IUs by April 2025 to indicate which ones currently discharge or historically have discharged PBDEs. Draft Permit S6.E(1). Ecology indicated at the January 11, 2024, public hearing that Everett will satisfy this requirement by canvassing its industrial users to obtain this information. In other words, through a survey, the industrial users will tell Everett whether they discharge or have discharged PBDEs. The result will be a list of current or past PBDE dischargers. Later, in 2026 and 2027, the draft permit would require semi-annual monitoring of aggregate PBDE concentrations in the total influent into the Plant. Draft Permit S6.E(4).

Inexplicably, the permit would not require that Everett either conduct or require its IUs to conduct monitoring of the pretreated wastewater each IU discharges into the Everett Plant. Other permits, like the City of Spokane's permit for the Riverside Park Water Reclamation Facility,[41] require this type of IU-specific monitoring, and EPA is recommending quarterly IU-specific monitoring for PFAS. *See infra* at 44. The permit must require monitoring of each IU's pretreated wastewater both to establish a baseline and to evaluate the effectiveness of the permit's pollution reduction measures. Only with monitoring of each IU's pretreated wastewater, coupled with monitoring of the Plant's total influent and effluent, will Everett be able to identify which IUs are contributing the greatest amounts and concentrations of PBDEs. Furthermore, both IU-specific sampling and sampling of total influent and effluent are needed for Everett (and Ecology and the public) to be able to assess the efficacy of pollution reduction measures.

The permit must require monitoring of PBDE concentrations and volumes in total influent and effluent at the Everett Plant on a semi-annual basis, with one sample coinciding with high-flow conditions. The monitoring must use a testing method that is sufficiently sensitive to detect total PBDEs and individual PBDE congeners in order to provide the necessary quantitative data about the nature and sources of the PBDE contamination in the influent and the effluent. Specifically, the permit must require that total influent and effluent from both Outfalls 100 and 015 be sampled quarterly (by 24-hour composite sample), using the most sensitive method capable of distinguishing the congeners, EPA Method 1614, expressing the results in picograms/liter (pg/L) units. This is the test method required in the City of Spokane's monitoring program.[42]

The permit must also require that Everett establish pretreatment requirements for each IU to undertake quarterly monitoring of total PBDEs and individual PBDE congeners in its pretreated wastewater. The monitoring must be done quarterly in keeping with EPA's guidance as to the frequency of PFAS monitoring by IUs. It also should require 24-hour composite samples and use of the EPA test Method 1614, expressing the results in pg/L units. The initial year of monitoring will establish a baseline for each IU. The monitoring should be undertaken

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[41] NPDES *Waste Discharge for City of Spokane Riverside Park Water Reclamation Facility (RPWRF) and Combined Sewer Overflows (CSOs)* Permit No. WA0024473 (July 27, 2022), at file: WA0024473 Spokane Riverside Park Water Reclamation Facility Permit 2022-09-01 (spokanecity.org).

[42] City of Spokane, *Quality Assurance Project Plan: PCB and PBDE Wastewater Monitoring* (Sept. 2023)

thereafter in every odd numbered year to allow assessments of the extent to which the permit and pretreatment requirements are reducing PBDE discharges. The IU-specific monitoring should be undertaken to coincide with Everett's monitoring of total influent into the Plant to facilitate an understanding of each IU's contribution to total influent.

The permit must require that all results of this sampling be submitted by IUs to Everett and by Everett to Ecology within three months, including all lab sheets, raw data, and analyses, paralleling the requirements in the Spokane Permit. The sampling results must also be made available to the public, preferably automatically by being posted on available websites.

2. The Draft Permit Must Limit PBDE Discharges.

The draft permit has no effluent limits for PBDEs, even though there is no question that Everett's PBDE discharges have the potential to cause or contribute to water quality violations. Indeed, they are already causing pervasive violations. As noted above, NOAA Fisheries scientists have identified PBDE concentration levels that suppress immunity, thereby increasing susceptibility to disease, and that alter thyroid functioning in juvenile Chinook salmon. Arkoosh, 2010; Arkoosh, 2018. WDFW studies have consistently found PBDE concentrations in juvenile Chinook tissues at levels that cause immune suppression, and some studies have also found concentrations above the higher threshold for impaired thyroid functioning. Numerous studies, most particularly the smoking gun study, have correlated the PBDE hot spot with discharges from the Everett Plant. Despite this evidence that the Everett Plant is causing violations of water quality standards, Ecology has made no attempt to develop limits on PBDEs in Everett's effluent to prevent fish tissue concentrations that cause these adverse effects.

In establishing effluent limits, Ecology typically conducts an AKART analysis to establish technology-based water quality limits. Only when a more protective standard is needed to avoid causing or contributing to violations of water quality standards does Ecology generally establish water quality based effluent limits. Here, however, the WDFW and Ecology studies show that Everett's PBDE discharges are harming salmon in violation of water quality standards. While PBDE concentrations are declining in fish and marine life throughout Puget Sound,[43] they are 4-10 times higher in juvenile Chinook salmon in the Snohomish River region that receives Everett's discharges. And the percentage of juvenile Chinook with harmful PBDE levels increased from 73% to 80% between 2016-2021. Ecology must establish limits on PBDE discharges to enforce the narrative water quality standards by prohibiting PBDE discharges that will cause or contribute to harmful PBDE concentrations in fish tissues. By way of analogy, the biological opinion for the Solo Point NPDES permit used adverse biological effects levels in Chinook salmon as an indicator of the prohibited effects of that Plant's PBDE discharges.[44] Since Ecology must "ensure" that water quality meeting effluent limits will meet water quality standards, it must prohibit PBDE discharges that contribute to harmful fish tissues. The effluent

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[43] Mongillo, 2016, at 20.

[44] Biological Opinion at 131-32. While the Solo Point biological opinion used thresholds associated with other adverse biological effects, the NOAA Fisheries studies and WDFW monitoring use well-settled thresholds for impaired immune suppression and thyroid functioning.

limit should be zero or no detect, unless Ecology can establish a different limit that will meet its obligations.

We acknowledge that the Everett Plant will not be able to meet the PBDE effluent limit on day one of the permit. Accordingly, the permit can contain a compliance plan with benchmarks that must be met over time. Given the severity of the water quality standard violations and serious impacts on listed Chinook, the compliance plan should require a substantial % reduction in PBDE discharges by year three (we recommend 50%) and additional reductions annually in each subsequent year (we recommend an additional 10% reduction each year).[45]

Unless Ecology establishes water-quality based PBDE limits, as it should, it must conduct an AKART analysis to establish technology-based PBDE effluent limits. To date, it has failed to conduct an AKART analysis for PBDEs. There are many emerging treatment processes and technologies capable of removing a wide range of pollutants from wastewater. Ecology should survey the available technologies and determine which will best address PBDEs and the other pollutants of concern discharged by Everett. One available technology is granular activated carbon filters that work through adsorption, a process by which a solid holds molecules of a gas or liquid as a thin film. Activated carbon can function either as a single intervention or a step in a larger pre-treatment process.[46] Studies show that activated carbon is effective at removing many PBDEs.[47] Other treatments use membrane systems, including reverse osmosis and nanofiltration, that drive wastewater at high pressure through a membrane to separate out pollutants. Membrane separation technologies have shown promise at efficiently removing many emerging contaminants not removed by conventional wastewater treatment

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[45] Ecology also failed to consider imposing more stringent limits on total suspended solids (TSS). PBDEs bind to solids, and studies have found correlations between reduced PBDE concentrations and TSS removal. M. Kim, *et al.*, *Parameters Affecting the Occurrence and Removal of PBDES in Twenty Canadian Wastewater Treatment Plants, Water Research* 47 (May 1, 2013), 2213-2221, at https://pubmed.ncbi.nlm.nih.gov/23466032/. In a lagoon system, like that at Everett's North Plant that discharges through Outfall 015, more stringent TSS limits would lower PBDE concentrations in the effluent.

[46] *E.g.*, Rabia Amen, et al., *A Critical Review on PFAS Removal from Water: Removal Mechanism and Future Challenges*, Sustainability 2023 (Nov. 21, 2023), https://doi.org/10.3390/su152316173.

[47] Yao Ma, et al., *Treatment of PBDEs from Soil-Washing Effluent by Granular-Activated Carbon: Adsorption Behavior, Influencing Factors and Density Functional Theory Calculation* (2022), https://www.mdpi.com/2227-9717/10/9/1815 (finding that granular activated carbon can effectively reduce bioavailability of BDE-15 in sediment, with a maximum adsorption capacity of 623.19 μmol/g); Gia, Fang et al., Comparing black carbon types in sequestering polybrominated diphenyl ethers (PBDEs) in sediments, 184 Env'tl Pollution at 131 (Jan. 2014), https://doi.org/10.1016/j.envpol.2013.08.009 (finding that activated carbon displayed a substantially greater sequestration capacity than biochar or charcoal).

processes.[48] Hybrid technologies that combine multiple processes—such as membrane bioreactors, which combine activated sludge and membrane separation processes—have also shown promise in addressing emerging contaminants.[49] Because PBDEs are persistent and can break down into more toxic PBDE congeners, scientists have observed that effectively removing PBDEs from water and soil is likely to require a combination of technologies.[50]

Ecology should also consider the impacts of upgraded treatment systems at Solo Point and Spokane. The Solo Point wastewater treatment plant upgraded its treatment technology to utilize pressure membrane filtration and UV disinfection in 2016. PBDE monitoring showed that PBDE concentrations discharged by the Solo Point Plant were considerably reduced (*i.e.,* by roughly an order of magnitude) in effluent as compared to influent for several congeners of concern to Chinook and orcas.[51]

The City of Spokane upgraded its treatment technology at the Riverside Park Water Reclamation Facility in 2021 to incorporate a new membrane filtration system to address nutrient pollution issues. In 2022, Spokane reported that the new system removed PBDEs, but

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[48] *E.g.,* Wash. Dep't of Ecology, *Contaminants of Emerging Concern and Wastewater Treatment* (June 2021), https://apps.ecology.wa.gov/publications/documents/2110006.pdf (finding that reverse osmosis efficiently removed four studied contaminants of emerging concern as well as nutrient pollution); Suhas P. Dharupaneedi et al., *Membrane-based separation of potential emerging pollutants*, (Feb. 8, 2019), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7592717/ (finding that membrane-based separation processes including microfiltration, ultrafiltration, nanofiltration, reverse osmosis, and forward osmosis, as well as hybrid technologies that combine processes, are more effective than conventional wastewater treatment techniques at removing emerging pollutants).

49 E.g., Arijit Sungupta, et al., *Removal of Emerging Contaminants from Wastewater Streams Using Membrane Bioreactors: A Review*, 12 Membranes at 60, https://doi.org/10.3390/membranes12010060. For an example of a membrane bioreactor wastewater treatment system in Washington, Ecology can look to King County's Brightwater Plant. *See*, *e.g.*, King County, *Treatment Process at Brightwater*, https://kingcounty.gov/es-es/dept/dnrp/waste-services/wastewater-treatment/facilities/brightwater/treatment-process/.

[50] Bin Yao, et al., *Current progress in degradation and removal methods of polybrominated diphenyl ethers from water and soil: A review*, 403 Journal of Hazardous Materials 123674 (Feb. 2021), https://doi.org/10.1016/j.jhazmat.2020.123674 (noting that removing PBDEs likely requires a combination of technologies because of the recalcitrant nature of PBDEs and the toxic intermediate compounds that can be formed during breakdown of some PBDE congeners).

[51] EPA, *NPDES Permit for Joint Base Lewis-McChord Solo Point Wastewater Treatment Plant in Washington* (April 1, 2012) https://www.epa.gov/npdes-permits/npdes-permit-joint-base-lewis-mcchord-solo-point-wastewater-treatment-plant; NPDES 2018 Solo Point Monitoring Report; NPDES 2016 Solo Point Monitoring Report.

even with this improved removal rate, the new Spokane permit requires a toxics reduction plan to reduce PBDE concentrations further.[52]

Ecology should have considered evidence about the efficacy of treatment technologies for PBDEs and other pollutants discharged from the Plant. Yet Ecology failed to conduct an AKART analysis of available treatment technologies to establish a technology-based PBDE limit, nor did it set a limit to prevent continuation of the demonstrated water quality standard violations.

3. *Rerouting Discharges Through Outfall 100 During the Juvenile Chinook Outmigration*

The permit should also require Everett to reroute discharges through Outfall 100 into the Puget Sound rather than Outfall 015 into the Snohomish River during juvenile Chinook outmigration season. Doing so would reduce the amount of PBDEs entering Snohomish waters that serve as primary juvenile rearing habitat during the outmigration period.

Because PBDE discharges are lower through Outfall 100, this operational measure would reduce PBDE discharges at the Everett Plant. Everett's data show that effluent discharged through Outfall 100 has lower PBDE concentrations than effluent discharged through Outfall 015. The third quarter data for 2022, for example, showed a total PBDE concentration of 15,500.7 pg/L at Outfall 100 and a total PBDE concentration of 37,975.8 pg/L at Outfall 015. In other words, routing discharges through Outfall 100 results in lower PBDE discharges from the Plant.[53]

Between 2020 and 2023, Everett minimized discharges through Outfall 015 to some extent during the juvenile Chinook salmon outmigration to lessen the interaction of the juvenile salmon with PBDEs. The permit should require that Everett continue this operational measure. Doing so is consistent with the biological opinion for the Solo Point permit, which encouraged relocating the outfall to deeper water. Solo Point BiOp at 135.

This rerouting requirement should be accompanied by a sampling program to assess the impacts of PBDE discharges into the Sound through Outfall 100. The monitoring should be modeled on that conducted by Ecology and WDFW to determine PBDE levels in sediments, biofilm, invertebrates, and aquatic species. Everett should either conduct the sampling or fund other government agencies to do so.

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[52] Spokane, 2023 *Toxics Reduction Best Management Practices Plan (BMPs Plan) for PCBs and PBDEs* at 21 (Aug. 2022), https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=454985.

[53] The Everett Plant's discharge monitoring reports show that Outfall 100 consistently meets more stringent TSS standards than Outfall 015, confirming the correlation between TSS and PBDEs.

4. *Pretreatment Permit Requirements to Reduce PBDE Discharges*

The draft permit fails to include adequate measures to prevent IUs from discharging PBDEs in their pretreated wastewater that will pass through the Everett Plant and cause or contribute to water quality standard violations. It fails to require that Everett seek immediate toxic reductions from sources that are "known or suspected sources of PBDEs." Instead, it only requires Everett to "begin" by July 1, 2025, "the process of modifying pretreatment permits for IUs identified as known or suspected sources of PBDEs to include a requirement to complete a PBDE pollution prevention/source reduction evaluation." Draft Permit S6.E(2). This evaluation "must assess whether the facility uses or has historically used any products containing PBDEs, whether use of those products or legacy contamination reasonably can be reduced or eliminated, and include a plan to take action on those findings." *Id*. This direction is vague and would not capture sources like industrial laundries and landfills whose PBDE discharges are not associated with the use of products containing those chemicals or their legacy. It also mandates no specific outcomes. Everett must merely "begin the process" of modifying the agreements and the industrial users must "include a plan to take action," without requiring that any particular actions will be undertaken. *Id*.

The draft permit also requires that, by July 1, 2025, Everett must evaluate other best management practices and pollution prevention strategies that it could include in pretreatment permits to control PBDE discharges. Such control methods may include "encouraging pollution prevention, product substitution, and good housekeeping practices." Draft Permit S6.E(3). Again, the draft permit compels no pollution reduction actions. Everett would simply identify pollution prevention strategies that "it could include in pretreatment permits."

These evaluation and planning requirements are logical first steps, but they fall short of ensuring compliance with water quality standards. The permit must mandate pretreatment requirements that will reduce PBDE discharges to levels that will no longer lead to concentrations in juvenile Chinook salmon that exceed adverse effect levels.

While the IU-specific monitoring will identify the largest industrial PBDE sources, Ecology has sufficient information now to identify industrial sectors that are key sources and that need to be subject to immediate pollution reduction measures. Ecology's monitoring found that an industrial laundry that discharges into the Everett Plant had the highest PBDEs measured in terms of both PBDE concentrations in wastewater and as total volumes discharged. The monitoring also documented high PBDE concentrations and volumes from a landfill that discharges into the Everett Plant. Ecology (Wong), 2022. In light of this evidence, the permit should direct Everett in year one to impose pretreatment requirements on these facilities, including, at a minimum, effluent limits based on AKART, to achieve the limits in Everett's permit with compliance deadlines that require measurable reductions on an annual basis and compliance with the limits by the permit's end.

The Ecology monitoring also found high PBDE discharges from aircraft modification facilities that send their pretreated wastewater to other wastewater treatment plants. While Ecology did not sample influent from the Boeing facility or other aircraft facilities that discharge into the Everett Plant, Boeing is also certainly a major source of PBDEs, given that the federal phase out of decaBDE has an exemption for replacement parts for the service lives of aerospace vehicles. 86 Fed. Reg. 880 (Jan. 6, 2021). The permit should direct Everett to modify the pretreatment permits for these aircraft industries to have effluent limits based, at a minimum, on AKART with compliance deadlines calling for measurable reductions annually and meeting the limits by the end of the permit.[54]

Once the baseline monitoring identifies which IUs are discharging PBDEs and in what amounts, Everett's permit must require modification of pretreatment permits for all IUs discharging PBDEs to incorporate pollution reduction measures. Accordingly, in the permit's second year, the IUs should be required to identify the product substitution, AKART, and pollution reduction measures that would eliminate or substantially reduce their PBDE discharges, and Everett must modify the pretreatment permits with industrial users who discharge PBDEs into the Everett Plant to incorporate effluent limits based, at a minimum, on AKART, and other pollution reduction measures to reduce the PBDE discharges below levels that cause harm to juvenile Chinook salmon.

In addition, as part of its pretreatment program requirements, the permit should require that Everett reevaluate its local limits, within one year, in consultation with Ecology, to determine whether these local limits need to be strengthened to reduce PBDEs and prevent pass through PDBE pollution.

5. Toxics Reduction Plan

The severity of the harm to salmon from the PBDE hot spot necessitates immediate actions to reduce PBDE concentrations in fish tissues to below adverse effects levels and effluent limitations set in the permit. The draft plan acknowledges this need, but merely directs Everett to evaluate best management practices and pollution prevention strategies, without requiring implementation of such practices and strategies. Draft Permit S6.E(3). Because the Everett Plant is causing water quality violations, not just showing a reasonable potential to do so, a toxics reduction plan will help ensure that the Plant will meet the permit's effluent limits and compliance deadlines.

Toward that end, the permit should require that Everett adopt and implement a toxics reduction plan modeled on the recent NPDES permit for the City of Spokane's Riverside Park

[54] EPA recently proposed an amendment to its decaBDE rule that would prohibit releases of decaBDE to water "during the manufacturing, processing, and distribution in commerce of decaBDE [and] decaBDE-containing products." 88 Fed. Reg. 82,287, 82,298 (Nov. 24, 2023). Any processing of decaBDE by Boeing or other IUs to manufacture replacement parts would be subject to this ban. Further, public comments from Earthjustice and others urged EPA to expand this prohibition to apply to facilities that manufacture, process, distribute, or dispose of "articles" (basically durable products) that contain decaBDE. Ecology should either incorporate the final federal prohibition into this permit or require Everett to do so. https://www.regulations.gov/comment/EPA-HQ-OPPT-2023-0376-0313.

Water Reclamation Facility.[55] Spokane must obtain Ecology approval for its plan and annual updates that, at a minimum: (1) specify pollution reduction actions to be taken; (2) set timelines for implementing of the actions; (3) quantify pollution reduction targets to be achieved by the actions; (4) have methods for assessing effectiveness using the most sensitive methods; and (5) include additional measures in the annual updates, if the actions fall short of achieving the reduction targets.

Building on this precedent, the permit must require that Everett adopt, and obtain Ecology approval of, a toxics reduction program to reduce PBDE discharges to below levels that lead to harmful concentrations in juvenile Chinook salmon and to conform to the permit's effluent limits. The plan must, at a minimum, set forth quantified PBDE reduction targets, specify actions that will be taken to achieve those reductions and timelines for implementing them, include a method for assessing the efficacy of the identified actions, and quantify toxic reductions resulting from the actions.

The permit, like the Spokane permit, must require that Everett submit annual updates for Ecology approval. In developing the updates, Everett must be required to evaluate all PBDE sampling data, including the influent/effluent data from the Everett Plant and the pretreated wastewater testing data for the individual IUs, WDFW's ongoing monitoring of PBDE concentrations in juvenile Chinook salmon, and the efficacy of the pollution reduction measures in the pretreatment permits and implemented through the toxics reduction plan. If the pretreatment requirements and the toxics reduction plan are not achieving pollution reduction targets that reduce PBDE concentrations in fish tissues below harmful levels and the permit's effluent limits, the annual updates must include additional measures to achieve the targets. The annual updates to Everett's toxics reduction plan would incorporate an adaptive management approach in which Everett updates its plans to respond to new sampling data and other new information, employing all additional PBDE-reduction measures that the evidence indicates are necessary to meet the effluent limits in accordance with the permit's compliance deadlines.

The permit must require that the toxics reduction plan, updates, and Everett's evaluations be made public.

6. Testing of Biosolids and Restrictions on Disposal

The draft permit allows biosolids to be spread on agricultural lands, but this could allow PBDEs to re-enter the environment through air deposition, runoff, or migration into groundwater. The permit should require testing of biosolids before allowing them to be spread on agricultural lands, as discussed below for PFAS, and should require Everett to pursue more effective disposal of PBDE-laden sludge.

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[55] Spokane NPDES Permit; *see also* City of Spokane, *Toxics Reduction Best Management Practices Plan (BMPs Plan) for PCBs and PBDEs* (Sept. 2023), at https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=45498; Spokane *2023 Monitoring Quality Assurance Project Plan* at https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=455049.

IV. THE PERMIT MUST ADDRESS PFAS DISCHARGES FROM THE EVERETT WASTEWATER TREATMENT PLANT

A. PFAS Background

PFAS, called "forever chemicals," are a class of persistent, bioaccumulating toxics. Some PFAS compounds, such as PFOA and PFOS, have been linked to adverse health effects in humans and animals, including cancer and harms to the liver, thyroid, immune system, as well as impacts to fetal development.[56] Industry and regulators have worked to phase out "long-chain" PFOA and PFOS compounds, though they continue to persist in the ecosystem and be present in fish tissues sampled in Washington.[57] Yet these compounds have to a significant extent been replaced by short-chain compounds that may be *more* persistent in the environment though potentially less bioaccumulative.[58] Nearly everyone in the United States is exposed to PFAS through various media, including water, air, soil, and food.

In 2010, Ecology analyzed the discharge from 10 WWTPs discharging into Puget Sound, including the Everett WWTP. All the plants discharged several PFAS compounds; Everett's total discharge for sampled PFAS compounds was almost 200 ng/L in February 2009 and nearly 11 ng/L in July 2009.[59] Other Ecology studies that sampled wastewater treatment

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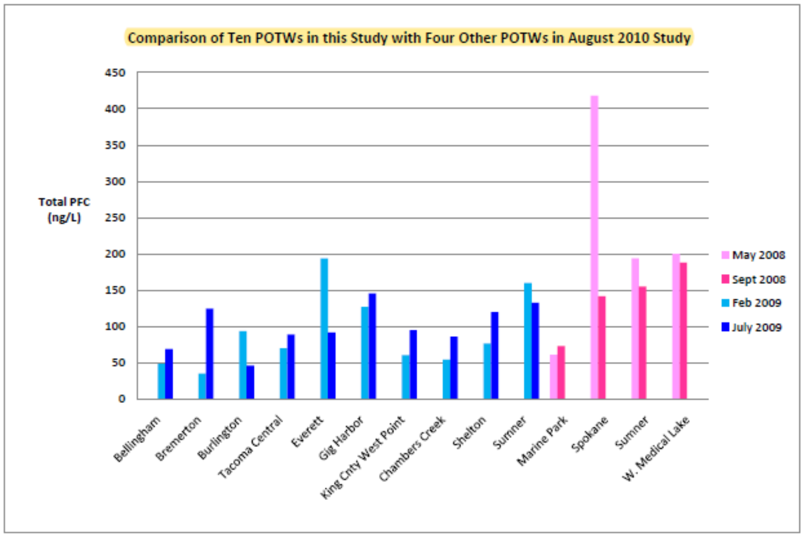
[56] U.S. EPA, *EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan* (Feb. 2019) at 13, https://www.epa.gov/sites/default/files/2019-02/documents/pfas_action_plan_021319_508compliant_1.pdf (hereinafter "EPA Action Plan"); U.S. Dep't of Health & Human Servs., Div. of the Nat'l Toxicology Program, *Monograph on Immunotoxicity Ass'n with Exposure to Perfluorooctanoic Acid (PFOA) or Perfluorooctane Sulfonate (PFOS)* (Sept. 2016); Interstate Technology Regulatory Council, Human & Ecological Health Effects and Risk Assessment of PFAS, (Sept. 2023); *PFAS 'Forever Chemicals' Are Getting Into Ocean Ecosystems*, *Where Dolphins, Fish and Manatees Dine – We Traced Their Origins,* The Conversation (Nov. 14, 2023), https://theconversation.com/pfas-forever-chemicals-are-getting-into-ocean-ecosystems-where-dolphins-fish-and-manatees-dine-we-traced-their-origins-216254.

[57] PFAS compounds have varying lengths of carbon-fluorine chains. Compounds can be divided into "long-chain," such as PFOS and PFOA, or "short-chain," such as PFBS and PFBA. Callie Mathieu & Melissa McCall, *Survey of Per- and Poly-fluoroalkyl Substances (PFASs) in Rivers and Lakes,* 2016 (Sep. 2017), Dep't of Ecology, https://apps.ecology.wa.gov/publications/documents/1703021.pdf.

[58] Guomao Zheng, Stephanie M. Eick, & Amina Salamova, *Elevated Levels of Ultrashort- and Short-Chain Perfluoroalkyl Acids in US Homes and People*, 57 Envt. Sci. & Tech. 15771 (2023), https://pubs.acs.org/doi/10.1021/acs.est.2c06715.

[59] Wash. Dep't of Ecology and Herrera Environmental Consultants Inc., *Control of Toxic Chemicals in Puget Sound* (Dec. 2010), https://apps.ecology.wa.gov/publications/documents/1010057.pdf.

plants in Washington show that virtually every plant discharges measurable levels of PFAS.[60] Puget Sound waters and sediment have measurable PFAS contamination.[61]



Wastewater treatment plants have been identified as a primary source of PFAS releases nationwide, due in part to receiving PFAS-laden wastewaters from industrial users and landfills, and in part to standard treatment methods that inadvertently transform PFAS precursors into PFAS compounds.[62] In Washington, sampling data from various industrial users and from treatment plants show that large concentrations of PFAS are discharged into wastewater from

[60] *See Chad Furl & Callie Meredith, Perfluorinated Compounds in Washington Rivers and Lakes* (Aug. 2010), Wash. Dep't of Ecology, https://apps.ecology.wa.gov/publications/documents/1003034.pdf; Callie Mathieu & Melissa McCall, *Survey of Per- and Poly-fluoroalkyl Substances (PFASs) in Rivers and Lakes, 2016* (Sep. 2017), Wash. Dep't of Ecology, https://apps.ecology.wa.gov/publications/documents/1703021.pdf;

[61] Margaret Dutch, et al., *Pharmaceuticals, Personal Care Products, and Per- and Polyfluoroalkyl Substances in Puget Sound Sediments: 2010-2019 Data Summary*, Wash. Dep't of Ecology (Dec. 2021), at 57, https://apps.ecology.wa.gov/publications/documents/2103015.pdf (sediment sampling, with PFHxA detectable at Everett sampling site).

[62] *See, e.g.*, EPA Action Plan at 12, 29; Wash. Dep't of Ecology and Herrera Environmental Consultants Inc., (2010); Xindi C. Hu, et al., *Detection of Poly- and Perfluoroalkyl Substances (PFASs) in U.S. Drinking Water Linked to Industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants*, 3 Envtl. Sci. & Tech. Letters 344-350 (Oct. 11, 2016), https://pubs.acs.org/doi/10.1021/acs.estlett.6b00260.

both sources.[63] Therefore based on existing data, we know the Everett plant and its industrial users are discharging PFAS into wastewater at unknown volumes and concentrations.

Like PBDEs, although Washington has not adopted numeric water quality criteria for PFAS, the discharge of PFAS into surface waters is subject to narrative water quality standards that prohibit toxic discharges at levels that individually or cumulatively harm biota or impair designated uses including salmonid spawning, rearing, and migration. PFAS have the potential to harm aquatic species,[64] and can act synergistically with other chemicals to cause endocrine disruption and reproductive harm to species such as Puget Sound Chinook salmon.[65] Though the concentrations of PFAS discharges and subsequent accumulation in aquatic species' body tissues requires more study, it is without question that PFAS pollution is a problem in Puget Sound and must be addressed.

Everett's PFAS discharges are particularly concerning because Puget Sound and the Snohomish River are home to several fish species regularly consumed by people.[66] Several studies have demonstrated that consuming fish and shellfish exposed to PFAS can dramatically increase PFAS in the human body, and may pose an even greater risk to human health than PFAS in drinking water.[67]

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[63] Siana Wong, *Chemicals of Emerging Concern in Pretreated Industrial Wastewater in Northwestern Washington State (hereinafter "Chemicals of Emerging Concern")*, Wash. Dep't of Ecology (Aug. 2022), at 28, https://apps.ecology.wa.gov/publications/documents/2203013.pdf; Callie Mathieu, *Per- and Polyfluoroalkyl Substances in Freshwater Fish, 2018: Lake Meridian, Lake Sammamish, and Lake Washington*, at 8, Wash. Dep't of Ecology, (March 2022) https://apps.ecology.wa.gov/publications/documents/2203007.pdf.

[64] *See generally* Gerald T. Ankley, et al., *Assessing the Ecological Risks of Per- and Polyfluoroalkyl Substances: Current State-of-the Science and a Proposed Path Forward, 40 Envtl. Toxicology & Chemistry* 539 (Mar. 2021), https://setac.onlinelibrary.wiley.com/doi/full/10.1002/etc.4869.

[65] Suzanne C. Ball, *Exposure of Juvenile Chinook Salmon to Effluent From A Large Urban Wastewater Treatment Plant: Part 1. Physiological Responses*, Aquaculture & Fisheries (June 19, 2023), https://www.sciencedirect.com/science/article/pii/S2468550X23000898.

[66] *See* Wendee Nicole, *Meeting the Needs of the People: Fish Consumption Rates in the Pacific Northwest* (2013), 121 Envt'l Health Perspectives 335, https://ehp.niehs.nih.gov/doi/pdf/10.1289/ehp.121-A334.

[67] Nadia Barbo, et al., *Locally Caught Freshwater Fish Across the United States Are Likely a Significant Source of Exposure to PFOS and Other Perfluorinated Compounds*, 220 Env'tl Research (March 1, 2023), https://doi.org/10.1016/j.envres.2022.115165 (finding that consumption of one locally caught freshwater fish per year per year could yield equivalent PFOS levels to drinking water with 48 ppt PFOS); Krista Y. Christensen, et al., *Perfluoroalkyl Substances and Fish Consumption*, 154 Env'tl Research 145 (2017), https://mejo.us/wp-content/uploads/2018/08/2017-Christenson-et-al.PFAS-and-fish-consumption.pdf (multi-year analysis finding correlation between consumption of fish or shellfish and PFAS in humans).

Meaningful efforts to conduct regular sampling for PFAS pollution and reduce or treat any PFAS-containing discharge are necessary. Indeed, the EPA has issued guidance urging states to include requirements for sampling discharges from industries associated with PFAS releases and the development of pollution prevention plans in NPDES permits.[68] Additionally, several states have established PFAS water quality standards or guidance to set effluent limits in NPDES permits. Ecology should incorporate EPA's guidance into Everett's NPDES permit to ensure the treatment plant does not exacerbate PFAS problems and that its actions correspond to sound scientific principles.

B. PFAS Provisions in the Draft Permit

The draft permit for the Everett Plant would require Everett to update its industrial user inventory to identify users in industries known or suspected to discharge PFAS, enter into pre-treatment agreements with these users, and update those pretreatment agreements to require those sources to evaluate pollution prevention and source reduction measures. It also requires Everett to evaluate other best management practices and pollution prevention strategies for PFAS dischargers, which may include "encouraging" identification and implementation of reduction activities by industrial users, where feasible. But, as with PBDEs, the permit does not contain any technology-based or effluent limits and would not require monitoring specific to each industrial user, implementation of any pollution reduction measures, establishment of compliance deadlines, or achievement of any reductions in PFAS pollution.

Ecology should seize this opportunity to construct meaningful sideboards in Everett's permit that will ensure effective PFAS monitoring and PFAS discharge reductions and can serve as a model for other facilities associated with significant PFAS pollution.

C. Permit Recommendations

1. Include AKART analysis and establish effluent limits in the permit

The draft permit recognizes that Everett discharges PFAS. But Ecology has not attempted to fulfill its duty to evaluate AKART and establish technology-based or water quality-based effluent limits. Ecology must do so.

EPA has been investigating PFAS dischargers for the purpose of establishing nationwide effluent guidelines. To date, EPA is engaged in an ongoing POTW influent study for PFAS, an ongoing study of PFAS discharges from textile manufacturers, and has prioritized revisions to effluent guidelines for landfills, metal finishing and electroplating, and organic chemicals,

[68] Memorandum from Radhika Fox, EPA Assistant Administrator to EPA Regional Water Division Directors, Regions 1-10, re: *Addressing PFAS Discharges in NPDES Permits and Through the Pretreatment Program and Monitoring Programs* (Dec. 5, 2022) (hereinafter "EPA PFAS Guidance for NPDES Permits"), https://www.epa.gov/system/files/documents/2022-12/NPDES_PFAS_State%20Memo_December_2022.pdf.

plastics, and synthetic fibers (OCPSF).[69] These investigations demonstrate that PFAS must — and will — be subject to effluent limitations. Rather than simply waiting, Everett should be addressing these toxic compounds of concern in this permit cycle.

Ecology has previously reviewed PFAS treatment technologies, as have other research and regulatory bodies.[70] Many wastewater treatment technologies are effective at removing many PFAS compounds. Studies show that, on aggregate, granular activated carbon (GAC) filters are 80–90% efficient at removing long-chain PFAS.[71] Another treatment relies on ion exchange resins—a technology that works like tiny magnets to attract and hold contaminated materials passing through the water system.[72] Ion exchange resin technology is also effective at removing some PFAS compounds, including short-chain compounds that are not remediated by activated carbon adsorption processes.[73] High-pressure membrane systems like reverse osmosis and nanofiltration are also highly efficient at removing some PFAS compounds, achieving reductions from 90% to greater than 99% of PFAS.[74] Ecology will, of course, have to consider whether and how removal of toxics from wastewater discharges may cause increased accumulation in sediments and biosolids generated at the Plant. This issue is discussed further below.

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[69] EPA, *Effluent Guidelines Program Plan* 15 (Jan. 2023), https://www.epa.gov/system/files/documents/2023-01/11143_ELG%20Plan%2015_508.pdf.

[70] *See, e.g.*, Wash. Dep't of Ecology, *Guidance for Investigating and Remediating PFAS Contamination in Washington State* (June 2023), https://apps.ecology.wa.gov/publications/documents/2209058.pdf; Interstate Technology Regulatory Council, *Treatment Technologies* (updated Sep. 2023), https://pfas-1.itrcweb.org/12-treatment-technologies/.

[71] *Id.*

[72] U.S. EPA, *Science in Action: Perfluoroalkyl and Polyfluoroaklyl Substances (PFAS)* (Oct. 2019), https://www.epa.gov/sites/default/files/2019-10/documents/pfas_drinking_water_treatment_technology_options_fact_sheet_04182019.pdf.

[73] Fuhar Dixit, et al., *PFAS Removal By Ion Exchange Resins: A Review*, 272 Chemosphere 129777 (June 2021), https://doi.org/10.1016/j.chemosphere.2021.129777.

[74] Caihong Liu et al, *Evaluating the Efficiency of Nanofiltration and Reverse Osmosis Membrane Processes for the Removal of Per- and Polyfluoroalkyl Substances From Water: A Critical Review*, 302 Separation & Purification Tech. 122161 (Dec. 1, 2022), https://www.sciencedirect.com/science/article/abs/pii/S1383586622017166.

In determining effluent limits, Ecology can look for guidance to numeric water quality standards for PFAS developed by EPA,[75] Colorado,[76] New York,[77] and Michigan,[78] as well as to the effluent limits for PFOS and PFOA developed by Michigan.[79] These regulators have amassed a large and growing body of research related to sampling, determining numeric criteria for human health and aquatic life, and addressing PFAS pollution from wastewater. Importantly, because of the bioaccumulative and persistent nature of PFAS, effluent limits should consider the existing pollution levels in the Snohomish and Puget Sound and PFAS

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[75] EPA's numeric criteria for PFOS and PFOA were released in draft form in April 2022 and are intended to protect aquatic life. U.S. EPA, *Draft Aquatic Life Ambient Water Quality Criteria for Perfluorooctane Sulfanate (PFOS)* (Apr. 2022), https://www.epa.gov/system/files/documents/2022-04/pfos-report-2022.pdf (freshwater PFOS criteria of 3.0 mg/L acute, 0.0084 mg/L chronic, plus tissue-based criteria); U.S. EPA, *Draft Aquatic Life Ambient Water Quality Criteria for Perfluorooctanoic Acid (PFOA)* (Apr. 2022), https://www.epa.gov/system/files/documents/2022-04/pfoa-report-2022.pdf (freshwater PFOA criteria of 49 mg/L acute, 0.094 mg/L chronic, plus tissue-based criteria).

[76] Colorado has developed numeric water quality standards for PFAS translated from narrative criteria that also apply to parent compounds: 70 ppt PFOA, 70 ppt PFOS, 70 ppt PFNA, 700 ppt PFHxS, and 400,000 ppt PFBS. Colo. Dep't of Pub. Health & Envt., *Policy 20-1: Policy for Interpreting the Narrative Water Quality Standards for Per- and Polyfluoroalkyl Substances (PFAS)* (July 14, 2020), available at https://cdphe.colorado.gov/wqcc-policies.

[77] New York established "guidance values" for both acute and chronic exposures to PFOS and 1,4-Dioxane, and chronic exposures to PFOA, intended to protect aquatic life. N.Y. State Dep't of Env'tl Conservation, *Water Quality Standards and Classifications* (last visited Jan. 16, 2024), https://dec.ny.gov/environmental-protection/water/water-quality/standards-classifications#Water_Quality_Guidance_Values.

[78] Michigan has established surface water quality values for PFOS, PFOA, and PFBS to protect aquatic life and human health. Mich. Dep't of Env't, Great Lakes, & Energy (EGLE), *EGLE Establishes New Surface Water Values for Two PFAS Chemicals* (July 27, 2022), https://www.michigan.gov/egle/newsroom/mi-environment/2022/07/27/egle-establishes-new-surface-water-values-for-two-pfas-chemicals.

[79] Michigan now requires effluent limits to be established in NPDES permits where PFAS is discharged. Permittees must prohibit discharges from their users that cause treatment plants to pass through levels of PFOS and PFOA to surface water in amounts greater than allowed under applicable water quality standards. *See* Mich. Dep't of Env't, Great Lakes, & Energy (EGLE), *Municipal NPDES Permitting Strategy for PFAS* (March 2023), https://www.michigan.gov/egle/-/media/Project/Websites/egle/Documents/Programs/WRD/NPDES/Municipal-permitting-strategy-PFOS-PFOA.pdf?rev=5df849e24a5d4c07b7559a714e292210&hash=7CB32D473549E943373600D00B999D1B (effluent limits based on WQVs); EGLE, *Wastewater Treatment Plants / Industrial Pretreatment Program* (March 2023), https://www.michigan.gov/pfasresponse/investigations/wastewater (updated WQVs).

(particularly PFOS) presence in fish tissues to establish a sufficiently protective limit that will ensure against harm to aquatic life or degradation of water quality.

2. *Clearly define PFAS in the permit*

The permit should explicitly define PFAS chemicals. Washington has defined them under RCW 70A.350.010 as follows: "'Perfluoroalkyl and polyfluoroalkyl substances' or 'PFAS chemicals' means a class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom." We support incorporating this definition to ensure that attention is paid to the broad range of existing and new compounds within this chemical class.

3. *Expand the categories of users "suspected or known" to discharge PFAS to include aerospace, industrial laundries, industrial gas manufacturing, and inorganic chemical manufacturing.*

Currently, the draft permit lists the following industries known to discharge or suspected of discharging PFAS: organic chemicals, plastics, and synthetic fibers (OCPFS); metal finishing; electroplating; electric and electronic components; landfills; pulp, paper, and paperboard; leather tanning and finishing; plastics molding and forming; textile mills; paint formulating; and airports.

While it includes important categories of potential PFAS dischargers, the list is underinclusive. A 2021 Ecology report sampling seven facility category types showed that aerospace and aircraft modification facilities discharged the highest total PFAS concentrations, and an industrial laundry discharged wastewater with some of the highest PFOS concentrations.[80]

Ecology should also add industrial gas manufacturing and inorganic chemical manufacturing to the list of industries known to discharge PFAS. While the permit lists organic chemicals, plastics, and synthetic fibers, the manufacture of inorganic chemicals and both organic and inorganic gases, including for refrigeration systems, is also a significant source of PFAS nationwide.[81] Analysis by the Consumer Product Safety Commission found that nearly two-thirds of manufactured and imported PFAS was from industries associated with industrial gas manufacturing and inorganic chemical manufacturing.[82]

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[80] Wash. Dep't of Ecology, *Chemicals of Emerging Concern in Pretreated Industrial Wastewater in Northwestern Washington State (hereinafter "Chemicals of Emerging Concern")* (Aug. 2022), at 28, https://apps.ecology.wa.gov/publications/documents/2203013.pdf.

[81] *See*, *e.g.*, Juliane Gluge et al., *An Overview of the Uses of Per- and Polyfluoroalkyl Substances (PFAS)*, 22 Env'tl Science: Processes and Impacts 2345 (2020), https://pubs.rsc.org/en/content/articlelanding/2020/em/d0em00291g (Table 3).

[82] Data from 2012, 2016, and 2020 shows that 32.4% of manufactured and imported PFAS by volume was from the industrial gas manufacturing [NAICS code 325120] and 31.5% was from

Everett should add these additional industrial categories to the PFAS IU inventory assessment.

4. Require source-specific, time series sampling and monitoring at IUs; sample concurrent POTW influent and treated effluent.

The current draft permit purports to update and expand the IU inventory of known or suspected dischargers of PFAS, but does not expressly require that such dischargers will be require to sample their pretreated wastewater in order to enable the Plant or Ecology to determine the volume or concentration of PFAS pollution entering the Plant from each industrial source, and does not require the Plant to monitor PFAS levels in its effluent over time. The draft permit therefore contains no measures to assess the severity of Everett's current or future contributions to PFAS pollution in Puget Sound and the Snohomish River or the efficacy of any PFAS reduction strategies. Although Ecology has indicated that it intends to incorporate into the final permit a requirement for influent monitoring for PFAS, it is our understanding that the monitoring requirement will not take effect until 2026.

Ecology can and should require more. Ecology should exercise its authority to require permittees to provide PFAS discharge information and strengthen the PFAS monitoring sampling provisions in Everett's permit.[83] The permit should require that pretreatment agreements with IUs include initial time series sampling to determine which IUs are discharging PFAS.[84] Pursuant to EPA guidance regarding PFAS provisions in NPDES permits, the permit should also require quarterly IU-specific monitoring for IUs that are found to discharge PFAS. Unless Ecology determines there is a more sensitive analytical method or one capable of analyzing more PFAS compounds, analyses should be conducted pursuant to EPA draft analytical method 1633 for the 40 PFAS analytes detectable under that method.[85] The permit should require disclosure of PFAS sampling data from IUs to the Everett Plant and Ecology and

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basic inorganic chemical manufacturing. U.S. Consumer Prod. Safety Commission, Characterizing PFAS Chemistries, Sources, Uses, and Regulatory Trends in U.S. and International Markets: Final White Paper (June 20, 2023) at 4-31, https://www.regulations.gov/document/CPSC-2023-0033-0001.

[83] *See* 40 C.F.R. 122.21(e), (g)(13); *see also* U.S. EPA, PFAS Guidance for NPDES Permits at 2.

[84] This recommendation was also made in Ecology's PFAS screening report. *See* Chemicals of Emerging Concern, at 40.

[85] The sampling method should be updated once EPA publishes an update under 40 C.F.R. part 136. Any additional PFAS compounds that can be detected through updated methods should also be analyzed.

disclosure of Everett's own PFAS sampling and monitoring data to Ecology.[86] And, as with all sampling and monitoring reports, this information should be and remain publicly available.[87]

Michigan's approach to addressing PFAS, both in industrial pretreatment agreements and in NPDES permits with municipal wastewater treatment plants, is a good model for monitoring and addressing discharges.[88] PFAS sampling is now included in routine permit compliance inspections for 56 WWTPs and 41 industrial dischargers. Additionally, WWTPs with confirmed PFAS discharges must identify and sample potential IU sources of PFAS, as well as require confirmed sources to undertake routine monitoring and reporting and implement measures to reduce PFAS such as cleaning contaminated areas, product substitution, or installation of treatment methods.[89] Michigan's program has shown immense success so far: with a few exceptions, most WWTPs have achieved reductions in PFOS discharge of over 90%, and some of these reductions resulted from pretreatment at only one industrial source.

In addition, the permit should also require that Everett determine a sampling schedule that enables it to assess relative contributions from IUs and non-regulated sources of wastewater (such as domestic wastewater), as well as to assess whether PFAS volumes or concentrations increase during treatment at the Plant. Ongoing monitoring will also enable Everett to determine the effectiveness of IU pretreatment and the effectiveness of its own secondary treatment where and if applicable.

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[86] These requirements should pose neither a surprise nor an undue burden to discharging industries; indeed, some industrial users are already subject to EPA reporting requirements for 196 PFAS compounds in the Toxics Release Inventory. U.S. EPA, *EPA Requires Toxics Release Inventory Reporting for Seven Additional PFAS* (Jan. 9, 2024), https://www.epa.gov/newsreleases/epa-requires-toxics-release-inventory-reporting-seven-additional-pfas.

[87] *See* U.S. EPA, *Introduction to the National Pretreatment Program* (June 2011), https://www.epa.gov/sites/default/files/2015-10/documents/pretreatment_program_intro_2011.pdf (explaining that monitoring data from IUs pursuant to pretreatment agreements, and from POTWs, must be publicly accessible).

[88] *See* EGLE, *Municipal NPDES Permitting Strategy for PFAS* (March 2023), https://www.michigan.gov/pfasresponse/-/media/Project/Websites/egle/Documents/Programs/WRD/NPDES/Municipal-permitting-strategy-PFOS-PFOA.pdf; EGLE, Addressing PFAS (PFOS/PFOA) *From Industrial Direct and Industrial Stormwater Discharges* (May 2023), https://www.michigan.gov/-/media/Project/Websites/egle/Documents/Programs/WRD/NPDES/ISW-PFOS-PFOA-permitting-strategy.pdf?rev=6519504b353f4fdea754ae519a5f76be.

[89] EGLE, Addressing PFAS (PFOS/PFOA) *From Industrial Direct and Industrial Stormwater Discharges* (May 2023), https://www.michigan.gov/-/media/Project/Websites/egle/Documents/Programs/WRD/NPDES/ISW-PFOS-PFOA-permitting-strategy.pdf?rev=6519504b353f4fdea754ae519a5f76be.

5. *Strengthen pretreatment requirements for industrial users discharging PFAS*

Ecology should strengthen the permit provisions pertaining to industrial users. The draft permit provisions related to PFAS reductions by industrial users are even weaker than the analogous PBDE provisions, and fail to ensure that PFAS will be reduced to non-harmful levels. As with PBDEs, the plans must identify all possible strategies for reducing PFAS in each PFAS discharger's wastewater, and any obstacles to feasibility. The permit should specify that Everett and its Ius must evaluate potential sourcing and operational changes (such as product substitution) to reduce PFAS as well as treatment technologies to remove PFAS from wastewater before it is sent to Everett. As with PBDEs, Everett should establish a toxics reduction plan to establish targets for reductions from the baseline, specify pollution reduction actions, set implementation timelines, and include additional measures in annual updates if monitoring shows the plan's targets have not been met.

Requiring consideration and phased-in implementation of treatment technologies is especially important for industrial users with comparatively little ability to prevent toxics from entering its waste stream, such as landfills. In Vermont, regulators required the state's only open landfill to evaluate pretreatment technologies that would remove PFAS from landfill leachate before sending it to the wastewater treatment facility and to devise a plan to implement a pretreatment process.[90] The planning requirement was incorporated into the landfill's pretreatment discharge permit and required the landfill to file a proposed pretreatment process for public comment and agency approval.[91] Without similarly strong pretreatment requirements, the Everett Plant risks continued acceptance and pass-through of significant quantities of toxics.

6. *Specify implementation timelines in pretreatment agreements and in the permit*

In order to meet legal requirements for enforceable control mechanisms, the permit should set deadlines for initial IU sampling and reporting, selection of best practices, and implementation of monitoring and pollution prevention/reduction practices along with regular reporting. This would establish a baseline early in the permit cycle and ensure that meaningful reduction measures are in place within the five-year permit period.

We recommend that the initial IU screening deadline be at the latest one year from date of permit issuance. IU selection of best practices and development of implementation plans should be completed by the end of the second year following permit issuance, and the phased-in implementation of best management practices should begin in the third year of the permit. For sources that identified waste treatment as a component of their source reduction/pollution prevention practices — including sources that have little capacity to prevent PFAS from

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[90] *E.g.*, Leachate Study Plan for New England Waste Services (NEWSVT) Landfill (Apr. 4, 2023), https://npr.brightspotcdn.com/c8/a8/7e90f8204411a77cc3d26b393fdb/21339-newsvt-pfas-pilot-study-plan-final-signed.pdf;

[91] *Id.*

entering their waste stream, such as landfills — installation of waste treatment should begin at the start of the fourth year of the permit.[92]

The monitoring deadlines are not particularly onerous or unreasonably short. For comparison, Michigan set a one-year compliance deadline for initial screening, and found that most WWTPs were able to complete this process within six months. EPA guidance recommends six months. In the NPDES permit for one of the largest WWTPs in the United States, Massachusetts has required categorical IUs to commence annual sampling in the first year after the effective date of the permit. These examples demonstrate that a wide variety of WWTPs and industrial dischargers can complete sampling requirements within the year, if not less.

Setting compliance deadlines for IUs to identify and implement best management practices is necessary to ensure PFAS pollution is adequately addressed. And mandating pretreatment requirements in this permit cycle is necessary to comply with applicable legal requirements.

While source reduction is the most effective approach to reduce PFAS discharge in effluent, if PFAS in the Plant's effluent remains at significant levels following the implementation of source reduction measures, the treatment facility must consider ways it can improve outcomes in the toxics reduction plan and the next permit cycle. At the end of the permit cycle there should be a stocktake of results to determine whether additional source reduction measures are required under IU pretreatment agreements, or whether other measures — such as a pilot treatment method at the Plant — should be explored.

7. Halt the application of biosolids until sampling and pretreatment measures are in place

Sewage sludge containing PFAS that is spread on land presents a high risk of PFAS migration to the soil, surface water, and groundwater, and can remain in these media for years.[93] Application of PFAS-contaminated biosolids to land can thereby become a vector for drinking water pollution, bioaccumulation of PFAS in wildlife and, in the case of agricultural land, PFAS contamination in food.[94] Some farmers have unwittingly caused serious contamination of their

[92] This was Vermont's approach for its sole landfill.

[93] Johnson, G. R., *PFAS in soil and groundwater following historical land application of biosolids*, Water Research vol. 211 (Mar. 1, 2022) at 118035, https://doi.org/10.1016/j.watres.2021.118035.

[94] Scearce, A. E., Goossen, C. P., Schattman, R. E., Mallory, E. B., & MacRae, J. D., *Linking drivers of plant per- and polyfluoroalkyl substance (PFAS) uptake to agricultural land management decisions*, Biointerphases 18(4) (July 2023), https://doi.org/10.1116/6.0002772.

lands due to application of sludge, resulting in significant concerns to their health and consequences to their livelihoods.[95]

Until the concentration of PFAS in biosolids emerging from the Everett Plant is, at the very least, ascertained, Everett should halt its practice of providing its treated biosolids for land application. Those receiving or seeking to receive sludge for land application should be notified of the presence of PFAS and have sampling results disclosed to them. Ecology should also, in proceedings separate from this permit, determine whether to establish concentration limits for land application or to stop land application altogether.[96] Finally, Everett and Ecology should ensure ongoing sampling of the sludge because treatment methods that remove PFAS from wastewater likely will cause PFAS concentrations in biosolids to increase.

V. THE PERMIT MUST ADDRESS NUTRIENT POLLUTION FROM THE EVERETT PLANT

A. Nutrient Pollutants and Puget Sound

Many, if not most, of the nation's marine ecosystems are polluted by excess nutrients; both nitrogen and phosphorus.[97] Furthermore, at least two-thirds of U.S. estuaries and marine coastal waters have been assessed as seriously degraded by chronic nutrient pollution.[98] Water systems are considered impaired when the water fails to meet the standards required to protect

[95] Tom Perkins, *I Don't Know How We'll Survive: The Farmers Facing Ruin in America's Forever Chemicals Crisis*, The Guardian (Mar. 22, 2022), https://www.theguardian.com/environment/2022/mar/22/i-dont-know-how-well-survive-the-farmers-facing-ruin-in-americas-forever-chemicals-crisis.

[96] For instance, Michigan has implemented a biosolids strategy that aims to reduce concentrations of PFOS and PFOA in biosolids. The presence of PFAS in biosolids intended for land application must be communicated to landowners, and those intending to apply biosolids containing over 50 ppb PFOS must mitigate the risk (for instance, by reducing application) and developing a source reduction program, while sludge containing over 150 ppb PFOS cannot be applied and a source reduction program must be implemented. Michigan, Maine, and some other states have established maximum concentrations of PFOS, PFOA, and PFBS that can be present in land-applied soil. The Connecticut Department of Agriculture advises not applying sludge with a combined PFAS concentration of over 1.4 ppb to farmland. Maine has outright banned application of sludge as fertilizer.

[97] U.S. EPA, *Nutrient Criteria Technical Guidance Manual: Estuarine and Coastal Waters* at xvii and 1-1 (Oct. 2001), https://www.epa.gov/sites/default/files/2018-10/documents/nutrient-criteria-manual-estuarine-coastal.pdf (hereinafter "EPA Nutrient Guidance").

[98] National Research Council, *Clean Coastal Waters – Understanding and Reducing the Effects of Nutrient Pollution*, Nat'l Acad. Press (2000); S.B. Bricker et al., *Effects of nutrient enrichment in the nation's estuaries: A decade of change*, *Harmful Algae* 8: 21–32 (2008).

specified designated uses and that includes narrative standards for aquatic life.[99] Nutrient pollution can cause increases in harmful algal growth, which in turn can result in reduced or depleted levels of oxygen, an imbalance of the ecosystem, public health concerns, loss of critical habitat for beneficial aquatic life, greatly reduced biodiversity, and a general decline in fish and aquatic life.[100] Harmful algal "blooms" (outbreaks) have been linked to major fish kills, significantly affecting local recreational and commercial fisheries.[101] Blooms of certain cyanobacterial species produce toxins that can cause disease and death of beneficial aquatic life and humans.[102] Depletion of dissolved oxygen can cause stress and death in bottom-dwelling organisms such as sessile, ecologically, and commercially important marine shellfish.[103] Moreover, all of these adverse impacts are exacerbated by warming waters inherent in climate change.

Chronic nutrient pollution and a related array of negative impacts are present in Puget Sound.[104] As acknowledged by Ecology on its own website and in the Permit Fact Sheet, "[d]ischarges of excess nutrients, particularly nitrogen, to Puget Sound from domestic wastewater treatment plants (WWTPs) are significantly contributing to low oxygen levels in Puget Sound." [105] Violations of dissolved-oxygen standards have been found so far in 194

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[99] National Research Council, *Clean Coastal Waters – Understanding and Reducing the Effects of Nutrient Pollution*, Nat'l Acad. Press (2000); S.B. Bricker et al., *Effects of nutrient enrichment in the nation's estuaries: A decade of change*, *Harmful Algae* 8: 21–32 (2008).

[100] EPA Nutrient Guidance at 1-1, 1-5; J.M. Burkholder & P.M. Glibert, *Eutrophication and oligotrophication*, *Encyclopedia of Biodiversity, Vol. 2* at 347–71 (2013).

[101] J.M. Burkholder, *Implications of harmful marine microalgae and heterotrophic dinoflagellates in management of sustainable marine fisheries*, Ecological Applications 8: S37–S62 (1998); EPA Nutrient Guidance at 4.

[102] *Toxic Cyanobacteria in Water: A Guide to Their Public Health Consequences, Monitoring, and Management* (I. Chorus & J. Bartram, eds. 1999), https://cdn.who.int/media/docs/default-source/wash-documents/water-safety-and-quality/toxic-cyanobacteria---1st-ed.pdf; EPA Nutrient Guidance at 1-1.

[103] *Toxic Cyanobacteria in Water: A Guide to Their Public Health Consequences, Monitoring, and Management* (I. Chorus & J. Bartram, eds. 1999), https://cdn.who.int/media/docs/default-source/wash-documents/water-safety-and-quality/toxic-cyanobacteria---1st-ed.pdf; EPA Nutrient Guidance at 1-1; *see also* Wash. Dep't of Ecology, *South Puget Sound Dissolved Oxygen Study Interim Data Report* at 13 (Dec. 2008); Wash. Dep't of Ecology, *Puget Sound and Straits Dissolved Oxygen Assessment* at 11 (2014).

[104] *See also* Univ. of Wash., Puget Sound Institute, https://www.eopugetsound.org/magazine/is/nutrients; Univ. of Wash., Puget Sound Institute, https://www.pugetsoundinstitute.org/2017/10/puget-sounds-growing-nutrient-problem/.

[105] Wash. Dep't of Ecology, Fact Sheet, Puget Sound Nutrient General Permit (Dec. 1, 2021), https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=434350; *see also* T. Khangoankar et al., *Analysis of Hypoxia and Sensitivity to Nutrient Pollution in Salish Sea*, Jour. of Geophysical Research (2018). More recent indications of Puget Sound being out of

designated areas within 46 bays, inlets and open-water sectors in Puget Sound, according to Ecology's Water Quality Assessment, the 303(d) list of impaired waters. Another 290 areas in 45 inlets are on the list for low-oxygen problems. According to Ecology, the Whidbey Basin section of Puget Sound, on which Everett is part and into which Everett discharges, is among the worst areas for dissolved oxygen problems. According to Ecology, approximately 20 percent of Puget Sound is currently not meeting water quality standards for dissolved oxygen and Ecology's Salish Sea Model shows parts of Puget Sound failing to meet the standards for 120+ days, one third of the year or more. Information from the Environmental Protection Agency ("EPA") confirms that dissolved oxygen standards are not being met in Puget Sound and that those conditions are trending worse, not better. https://www.epa.gov/salish-sea/marine-water-quality.

Ecology estimates over 69% of the nutrient pollution to the Sound is from WWTPs, like Everett, that discharge directly to Puget Sound, with 31% from "watershed sources" (which include WWTPs that discharge to rivers that are tributary to the Sound.)[106] The Puget Sound region (human population more than 4.5 million) is predicted to sustain a 40% increase (1.8 million more) by 2050.[107] Domestic wastewater contains a high proportion of biologically available nitrogen and phosphorus, to such an extent that sewage sources are considered much more potent and high-impact than other nutrient pollution sources.[108] As stated in Ecology's Puget Sound Nutrient General Permit ("PSNGP") Fact Sheet, "WWTPs are the dominant land-based dissolved inorganic nitrogen (DIN) source during the low flow (summer) months" and "cumulatively contribute to DO impairments in other locations due to the water exchange that

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balance from excess nutrients (nitrogen and phosphorus), which has been exacerbated by warming trends and other impacts of climate change, can be seen in the "Blob's" extreme adverse impacts on aquatic ecosystems in the northeastern Pacific Ocean, explosions of jellyfish populations, and ocean acidification interfering with shellfish being able to form shells. NOAA, *New marine heat wave emerges off West Coast, resembles "The Blob"* (2019), https://www.fisheries.noaa.gov/feature-story/new-marine-heatwave-emerges-west-coast-resembles-blob; Allegra Abramo, *Outdated sewage treatment is suffocating fish in Puget Sound*, InvestigateWest (Dec. 7, 2020), https://crosscut.com/environment/2020/12/outdated-sewage-treatment-suffocating-fish-puget-sound.

[106] Wash. Dep't of Ecology, *Puget Sound Nutrient Source Reduction Project, Volume 1: Model Updates and Bounding Scenarios, Pub. No. 19-03-001* (Jan. 2019), https://apps.ecology.wa.gov/publications/documents/1903001.pdf.

[107] Eleanor Ott, Wash. Dep't of Ecology, *Puget Sound Nutrient General Permit, ACWA Nutrients Permitting Workshop* at 7 (Oct. 27, 2020), https://www.acwa-us.org/wp-content/uploads/2020/11/Session-1-Ott.pdf.

[108] H.P. Jarvie et al., *Sewage-effluent phosphorus: A greater risk to river eutrophication than agricultural phosphorus?*, Science of the Total Environment 360: 246–53 (2006); H.K.G.R. Millier & P.S. Hooda, *Phosphorus species and fractionation – why sewage derived phosphorus is a problem*, Environmental Management 92: 1210–14 (2011); J.J. Venkiteswaran et al., *Quantifying the fate of wastewater nitrogen discharged to a Canadian river*, FACETS 4: 315–35 (2019).

occurs between basins."[109] Ecology has also clearly demonstrated the need to reduce WWTP nutrient discharges as an important path forward to controlling and reversing the devastating effects of nutrient pollution on Puget Sound.[110]

Everett is one of the top dischargers of the nutrient pollution that is causing Puget Sound to fail to meet water quality standards,[111] yet this permit includes no limits or control requirements on nutrients from the Everett Plant. As a result, the proposed Permit fails to meet the most basic requirements of state and federal law.

B. The Permit Fails To Include Numeric Effluent Limits In Violation Of State And Federal Permitting Requirements.

The Permit makes no findings regarding AKART or reasonable potential to cause or contribute to violations of water quality standards and imposes no numeric effluent limits, AKART or otherwise, on nutrient discharges by the Everett Plant into Puget Sound. As currently drafted, the Permit is indefensible both legally and factually.

As set forth above, both federal and state law require imposition of effluent limits. Under state law, Ecology must determine all known, available, and reasonable treatment technology and require that all pollutants be prevented and treated with it, regardless of the status of the receiving water. It is Ecology's affirmative duty to assess and make a formal determination, when issuing a permit, as to what constitutes AKART and to then include that requirement in the permit.[112]

Ecology has failed to do so here. Ecology is, and plainly should be, aware that technology limiting nitrogen discharges to 3 mg/L and phosphorus in the range of 0.05 to 0.3 mg/L is known, reasonable, and in use (for decades) by wastewater dischargers elsewhere.[113] EPA has

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[109] Wash. Dep't of Ecology, Fact Sheet, Puget Sound Nutrient General Permit (Dec. 1, 2021) at 30, https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=434350.

[110] Wash. Dep't of Ecology, Fact Sheet, Puget Sound Nutrient General Permit (Dec. 1, 2021) at 18, https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=434350 (noting the significant contribution of domestic WWTPs to the increasingly pervasive dissolved oxygen deficits in Washington).

[111] *See*, *e.g.*, Wash. Dep't of Ecology, Puget Sound Nutrient General Permit S1, Table 3, https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=390719 (listing Everett as a "dominant" wastewater treatment plant based on its total inorganic nitrogen load).

[112] *Port of Seattle v. Ecology*, 2004 WL 2372063 (PCHB Oct. 18, 2004); *see also* Wash. Office of the Attorney Gen., *AGO 1983 No. 23, Relationship Between Federal and Waste Discharge Permits* at 9 (Nov. 2, 1983), https://www.atg.wa.gov/ago-opinions/relationship-between-federal-and-waste-discharge-permits.

[113] *See, e.g.,* Wash. Dep't of Ecology, Nutrient General Permit S.4.E.5.e, https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=390719; *see also* U.S. EPA, *Biological Nutrient Removal Processes and Costs, EPA Fact Sheet* (June 2007),

published multiple papers showing WWTPs achieving these levels of nutrient limitations in their effluent, all accessible through EPA's website. Treatment to 3 mg/L nitrogen and 0.05 to 0.3 mg/L phosphorus has been described as readily available and current technology.[114] Further, technologies that limit nitrogen to 3 mg/L and phosphorus to 0.3 mg/L have been identified in EPA documents as worthwhile and cost-effective in terms of cost relative to pollutants removed and water quality benefits achieved.[115] This is not "new" technology. EPA's assessment of biological nutrient removal dates to 2007—well over a decade ago. Other facilities, in states such as Florida, Virginia, and Michigan, have been meeting 3 mg/L nitrogen and 0.3 mg/L phosphorus limits, or lower, since the mid-2000s. Biological nutrient removal to 3 mg/L nitrogen and at least 0.3 mg/L phosphorus is AKART and must be required for Everett as an effluent limit in this Permit.[116]

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https://19january2017snapshot.epa.gov/sites/production/files/documents/criteria_nutrient_bioremoval.pdf. EPA's fact sheet on biological nitrogen removal notes that some facilities may be able to achieve nitrogen concentrations below 3 mg/L due to site-specific conditions.

[114] To the extent that Ecology or Everett argue that only nitrogen need be controlled, that position is unsupported by the best available science on nutrient impacts and the need to control both pollutants in balance. Nutrient pollution affects aquatic ecosystems—through *supplies (concentrations)* of both nitrogen and phosphorus, and through the *balance or proportion* of N and P supplies, commonly considered as the N:P ratio. R.W. Sterner & J.J. Elser, *Ecological Stoichiometry: The Biology of Elements from Molecules to the Biosphere* (Princeton Univ. Press, 2002); J.M. Burkholder & P.M. Glibert, *Eutrophication and oligotrophication*, *Encyclopedia of Biodiversity, Vol. 2* at 347–71 (2013). To protect and improve aquatic ecosystems degraded by nutrient pollution, the highly bioavailable forms of nitrogen and phosphorus in domestic sewage must be co-managed; that is, they must be significantly decreased in concentration, and in the right proportion to re-establish the Sound's N:P balance. P.M. Glibert et al., *Ecological stoichiometry, biogeochemical cycling, invasive species and aquatic food webs: San Francisco Estuary and comparative systems,* Reviews in Fisheries Science 19: 358-417 (2011); U.S. EPA, *Preventing Eutrophication: Scientific Support for Dual Nutrient Criteria, Fact sheet #EPA-820-S-15-001* (2015).

[115] In fact, using current technology, it is possible to remove effluent Total Inorganic Nitrogen ("TIN") to less than 1 mg/L after coagulation and filtration. Even allowing for residual recalcitrant dissolved organic nitrogen—dissolved organic nitrogen that is not removed during the wastewater treatment process—of 0.5 to 1.5 mg/L in municipal wastewater, an effluent limit for total nitrogen of less than 3 mg/L can be achieved. James. L. Barnard, *Biological Nutrient Removal: Where we have been, Where we are going?*, Water Environment Federation, WEFTEC (2006).

[116] Total nitrogen, not Total Inorganic Nitrogen ("TIN"), must be the pollutant controlled to 3 mg/L. While TIN is well known to stimulate algal growth, *organic* nitrogen constituents in the total Kjeldahl N (TKN) component of the effluents include stimulatory substances as well. P.M. Glibert et al., *Ecological stoichiometry, biogeochemical cycling, invasive species and aquatic food webs: San Francisco Estuary and comparative systems,* Reviews in Fisheries Science 19: 358-417 (2011); P.M. Glibert et al., *Pluses and minuses of ammonium and nitrate uptake and assimilation by phytoplankton and implications for productivity and community*

To the extent that, based upon past statements, Ecology or the discharger argues that more must be known about Everett's specific contribution (or cause) of nutrient pollution and/or low dissolved oxygen before including limits in the permit, that position is contrary to law. Again, AKART is required to be applied to all discharges of pollutants authorized by any NPDES permit, including this one, *regardless* of the quality of the receiving water and/or Everett's specific impact on that quality. RCW 90.48.520; 90.54.020(b). AKART is effluent limits of 3 mg/L nitrogen and 0.3 mg/L phosphorus, regardless of receiving water quality.[117]

The Permit's failure to include effluent limits of 3 mg/L nitrogen and 0.3 mg/L phosphorus is a violation of RCW 90.48.010; 90.48.520; 90.54.020 and WAC 173-226-070, and of 40 C.F.R. §§ 122.44(a) and 122.45(d).

C. The Permit Fails To Ensure That Discharges Authorized Under The Permit Do Not Cause Or Contribute To Violations Of Water Quality Standards.

Independent of the failure to include limits that are AKART, the Permit also violates the requirements to ensure that pollutant discharges authorized by the permit do not cause or contribute—or even have the *potential* to cause or contribute—to a violation of water quality standards, either narrative or numeric. Ecology admits that large areas of Puget Sound already violate numeric standards for dissolved oxygen.[118] It is likely that the areas of impairment—violations of dissolved oxygen standards—are much more extensive than reflected on the latest section 303(d) list of impaired waters or than monitored to date.[119] Further, narrative standards are plainly violated considering the incidence of algal blooms, acidification, and related adverse

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composition, with emphasis on nitrogen-enriched conditions, Limnology and Oceanography 61: 165–97 (2016). For example, urea is the major organic component of human urine. Various harmful algae, including well-known bloom formers in Puget Sound such as *Heterosigma akashiwo*, can thrive on urea as a nitrogen source. P.M. Glibert et al., *Escalating worldwide use of urea – a global change contributing to coastal eutrophication*, Biogeochemistry 77: 441–63 (2006). Urea has also been related to increased toxicity of harmful taxa such as *Pseudo-nitzschia australis*, important in West Coast blooms. M.D.A. Howard et al., *Nitrogenous preference of toxigenic Pseudo-nitzschia australis (Bacillariophyceae) from field and laboratory experiments*, Harmful Algae 6: 206–17 (2007). A limit on TIN only will not be protective of the Sound ecosystem.

[117] It should be noted that as low as .1 mg/L phosphorus is achieved at other WWTPs and could be considered AKART, but experts consulted by Puget Soundkeeper have noted that achieving the proper balance between nutrient pollutants is important and that .3 mg/L phosphorus achieves that balance.

[118] *See*, *e.g.*, Wash. Dep't of Ecology, Fact Sheet, Puget Sound Nutrient General Permit at 25–27 (Dec. 1, 2021), https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=434350 (describing history of dissolved oxygen impairments in Puget Sound).

[119] *See* Wash. Dep't of Ecology, Fact Sheet, Puget Sound Nutrient General Permit (Dec. 1, 2021), https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=434350.

impacts to aquatic life, exacerbated by warming temperatures.[120] Chronic nutrient pollution to Puget Sound is impairing the designated uses of the Sound, resulting in harmful algal blooms, fish kills, contamination of seafood with algal toxins, and imbalances in the overall ecosystem. Those are violations of narrative standards that are supposed to protect the chemical, physical, and biological integrity of the Sound.

Ecology has already identified wastewater treatment plant polluters as the dominant cause of dissolved oxygen violations (and likely the cause of narrative standard violations) in the Sound.[121] Further, at a minimum, even if a polluter is not the "cause," further addition of nutrients to this already impaired and failing ecosystem will contribute to ongoing violations of water quality standards. This situation must be addressed with numeric WQBELs in the Permit. 40 C.F.R. § 122.44(d); RCW 90.48.520; WAC 173-201A-510(1); WAC 173-226-070(2), (3). Finally, it is not necessary for Ecology to pinpoint either cause or contribution to a particular degree of certainty. The law requires Ecology to impose WQBELs where there is even the *potential* that a polluter may cause or contribute to an excursion of water quality standards. *Id.*[122] (Although given the sheer size of Everett's nutrient pollution output and the proximity to extremely polluted areas in the area of Puget Sound to which Everett discharges, Everett's contribution to polluted conditions appears likely.) At the minimum, Ecology must set effluent limits on wastewater polluters at levels that will no longer contribute to water quality impairments. That step is critically needed to restore the Sound's ecosystem and create needed resiliency for the expected additional impacts of climate change.

Ecology has failed to do the required analysis for WQBELs and has failed to include a WQBEL in Everett's permit. Ecology has impermissibly done so despite knowing standards are

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[120] Ecology has been negligent in developing numeric criteria for nutrients in Puget Sound. More than twenty years ago, the National Research Council and EPA identified a critical need for states to develop numeric nutrient criteria for U.S. waters. *E.g.*, National Research Council, *Clean Coastal Waters – Understanding and Reducing the Effects of Nutrient Pollution*, Nat'l Acad. Press (2000). Even then, the problem of nutrient pollution was well-known and adversely affecting all of the nation's waters. EPA provided extensive guidance and research to aid states in carrying out their obligations under 33 U.S.C. § 1313(c). *See* U.S. EPA, Office of Water and Office of Science and Technology, *Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs, Report EPA-822-B00-001* (2000), https://www.epa.gov/sites/default/files/2018-10/documents/nutrient-criteria-manual-lakes-reservoirs.pdf.

[121] See Ecology's application of the Salish Sea Model (SSM) as described in the PSNGP Fact Sheet. Wash. Dep't of Ecology, Puget Sound Nutrient General Permit Fact Sheet, https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?Id=434350.

[122] Plainly this language is meant to address Ecology's failure to include WQBELs in this Permit. Delays in controlling pollutants can always occur where polluters or reluctant regulators search for the perfect information. That kind of delay in controlling pollutants is directly contrary to the very intent and purpose, as well as specific directives, in the Clean Water Act and applicable regulations which is to be proactive, to protect (not just restore after the fact), and to be action-forcing in that protection.

currently violated, WWTPs including Everett are a cause of or contributors to that violation, that nutrient pollution discharges will continue to make it worse and that only by limiting those discharges will we begin to fix violations of standards in Puget Sound. Ecology further knows that technology is available to impose effluent limits to at least curb some of that problem. The statutory and regulatory obligation is Ecology's, and the final permit must conform to this requirement and Ecology's obligation met. The Permit must include numeric WQBELs for all dischargers of nutrients to Puget Sound. Failure to do so violates 40 C.F.R. § 122.44(d) and RCW 90.48.520, WAC 173-201A-510(1), and WAC 173-226-070(2) and (3).

D. Ecology Cannot Defer Permit Limits To An Indefinite, Unenforceable Alternative.

Ecology cannot defer its legal obligations, under both state and federal law, to the Puget Sound Nutrient General Permit, which fails to impose any limit on nutrient discharges and thereby fails to conform to AKART and water quality requirements. Ecology claims in its statements regarding the Everett permit that nutrients are addressed elsewhere. This statement is for all intents and purposes, false.

First, due to ongoing litigation both indirect and direct challenging Ecology's regulation of nutrient pollution from wastewater treatment plants,[123] the Puget Sound Nutrient General Permit is indefinitely stayed in part,[124] and Ecology's ability to control nutrients through the PSNGP in the manner Ecology has chosen is in serious question. Second, the PSNGP also fails to meet the most basic requirements of the law in that it fails to apply AKART or effluent limits to the discharge of nutrients from dischargers such as Everett. The net result is that the PSNGP is not a viable or legal alternative to Ecology's clear legal obligation here to apply AKART to limit the discharge of nutrients by Everett WWTP to 3 mg/L total nitrogen and .3 mg/L phosphorus.[125]

[123] *See* Status Report from the Attorney General to the PCHB, *Puget Soundkeeper Alliance et al. v. Dep't of Ecology*, PCHB No. 21-082c (Oct. 16, 2023) (summarizing status of litigation); Published Opinion, *City of Tacoma et al. v. Dep't of Ecology*, No. 39494-8-III (Ct. App. Sept. 14, 2023) (summarizing litigation history); Dep't of Ecology, Petition for Review, *City of Tacoma et al. v. Dep't of Ecology*, No. 102479-7 (Wash. Oct. 16, 2023).

[124] *See* Am. Stip. For Partial Stay of Puget Sound Nutrient General Permit, *Puget Soundkeeper Alliance et al. v. Dep't of Ecology*, PCHB No. 21-082c (Mar. 4, 2022); Status Report from the Attorney General to the PCHB, *Puget Soundkeeper Alliance et al. v. Dep't of Ecology*, PCHB No. 21-082c (Oct. 16, 2023) (noting that Mar. 4, 2022 partial stay of Puget Sound Nutrient General Permit remains in effect).

[125] Ecology's claim that the general permit adequately addresses monitoring for nitrogen pollution is likewise false. The general permit does not require any monitoring for phosphorous or organic nitrogen, and requires only limited sampling for total inorganic nitrogen.

E. <u>The Permit Must Have Implementation Deadlines for the Plant to Meet Effluent Limits During this Permit Cycle.</u>

The permit must include implementation deadlines for the plant to upgrade it treatment methods to meet the effluent limits within this permit cycle. Nutrient pollution issues in the Sound, as well as treatment methods, are not new and the Plant should not be able to delay addressing this concerning pollution any further. Any planning and permitting must occur in the first year of the permit so that the Plant can shift to appropriate treatment methods by year four at the latest and fully meet the effluent limits by year five at the latest.

VI. CONCLUSION

The Permit does not require any reductions in Everett's discharge of PBDEs, PFAS, or nutrients, in violation of Ecology's legal obligations, and may ultimately result in increases to the pollution that is already harming the Snohomish River, salmon, Puget Sound, and orcas. Ecology must change the draft permit to ensure compliance with water quality standards and the law.

Thank you for the opportunity to submit comments on this critically important issue. Please do not hesitate to contact the undersigned with any questions.

Sincerely,

Patti Goldman
Molly Tack-Hooper
Noelia Gravotta
Earthjustice

Together with:

Emily Gonzalez
Staff Attorney, Director of Law & Policy
Puget Soundkeeper Alliance

Eleanor Hines
Lead Scientist/North Sound Waterkeeper
RE Sources

Laurie Valeriano
Executive Director
Toxic-Free Future

Greg Wingard
Waste Action Project

A Toxics-focused Biological Observing System (T-BiOS)

Mission Statement:

Evaluate the effects of toxic contaminants on marine and anadromous species to:

- ***guide efforts to protect fish and shellfish health,***
- ***ensure seafood safety (supply data to DOH), and***
- ***promote ecosystem recovery.***


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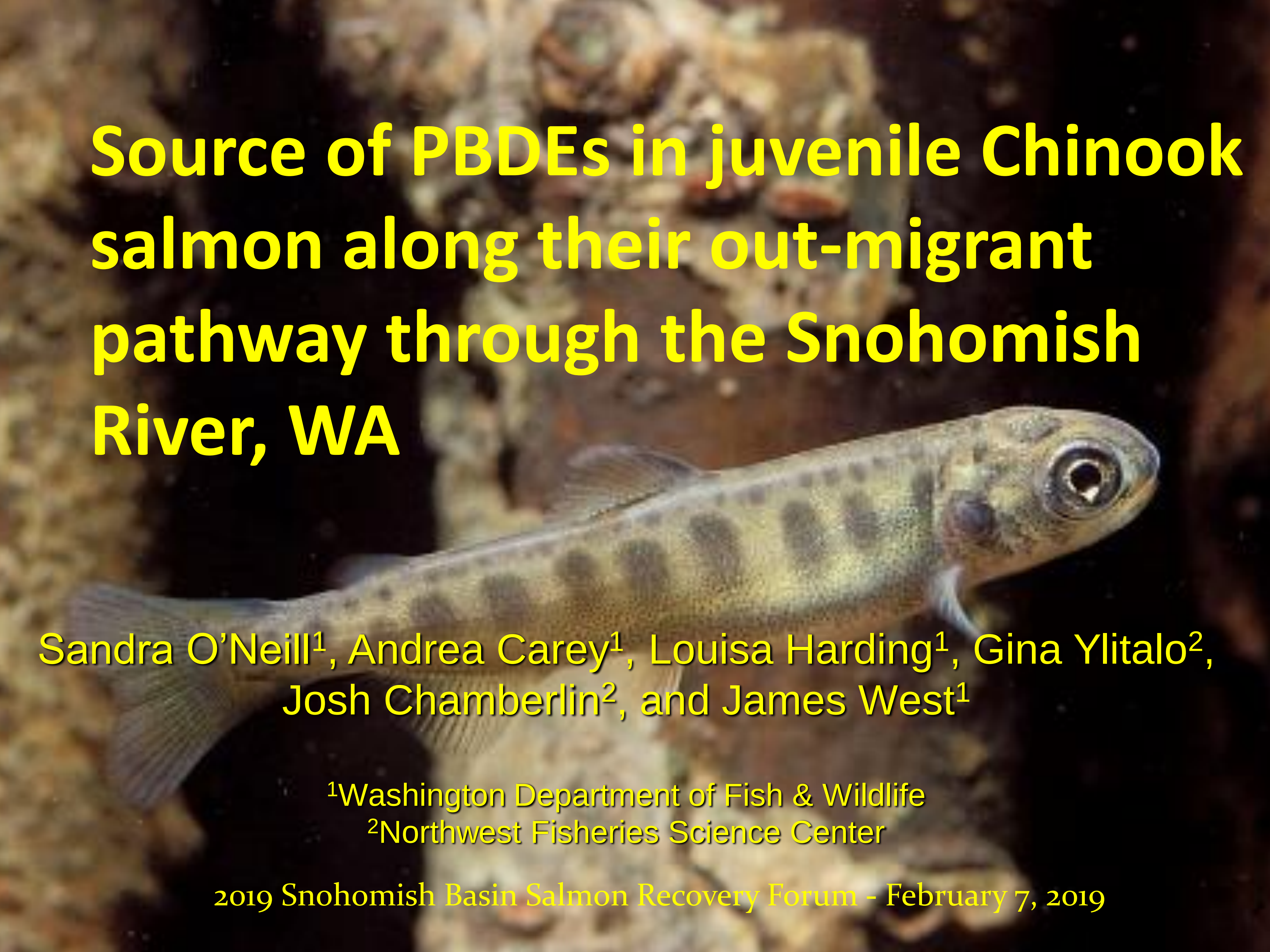

Source of PBDEs in juvenile Chinook salmon along their out-migrant pathway through the Snohomish River, WA

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Mike Crewson

Snohomish County
Michael Rustay
Frank Leonetti

Long Live the Kings
Iris Kemp
Michael Schmidt
Kathryn Sobzinski

NOAA NWFSC
Sean Sol
Dan Lomax
Julann Spromberg
Maryjean Willis
Cathy Laetz
Penny Swanson
Casey Rice
David Baldwin
Mark Meyers
David Baldwin
Lyndal Johnson

Washington Department of FISH and WILDLIFE

NOAA

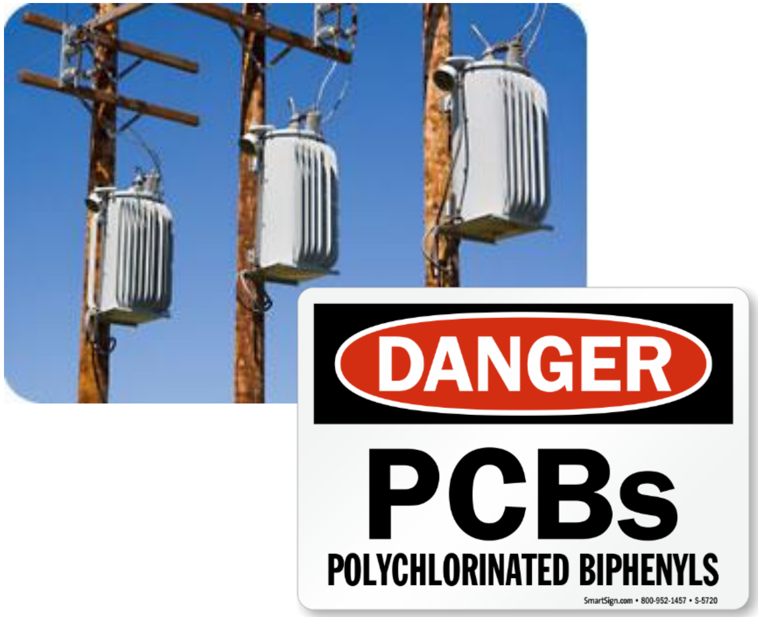
SALISH SEA MARINE SURVIVAL PROJECT
www.marinesurvivalproject.com

Talk Outline

- Background – review results of previous studies
- 2016 Snohomish Survey Design
- Results- data types to investigate PBDE "source"
  - PBDE concentrations – where exposure occurs
  - Contaminant Fingerprints – wastewater vs. stormwater source
  - Stable Isotopes – altered nitrogen source – wastewater?
- Conclusions
- Next Steps

Background

Persistent Organic Pollutants (POPs)



Background

Effects of PBDEs on juvenile salmon are evaluated by laboratory exposure studies conducted by Arkoosh et al. 2010, 2018

Aquatic Toxicology 98 (2010) 51–59

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Aquatic Toxicology

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Disease susceptibility of salmon exposed to polybrominated diphenyl ethers (PBDEs)

Mary R. Arkoosh[a,*], Deborah Boylen[a], Joseph Dietrich[a], Bernadita F. Anulacion[b], Gina Ylitalo[b], Claudia F. Bravo[c], Lyndal L. Johnson[b], Frank J. Loge[c], Tracy K. Collier[b]

Ecotoxicology and Environmental Safety 163 (2018) 96–103

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journal homepage: www.elsevier.com/locate/ecoenv

Dietary exposure to a binary mixture of polybrominated diphenyl ethers alters innate immunity and disease susceptibility in juvenile Chinook salmon (*Oncorhynchus tshawytscha*)

Mary R. Arkoosh[a,*], Ahna L. Van Gaest[b], Stacy A. Strickland[b], Greg P. Hutchinson[b], Alex B. Krupkin[b], Mary Beth Rew Hicks[c], Joseph P. Dietrich[a]

Salmon with elevated PBDEs have increased susceptibility to disease and altered thyroid function.

Background

PBDEs in Snohomish Chinook at levels high enough to increase their susceptibility to disease and alter thyroid function

Sloan et a. 2010

- 2006 study
- Snohomish plus Skagit, Duwamish, Elliott Bay, Columbia River
- PBDEs highest in salmon from Snohomish and 3 of 6 sites in Columbia River

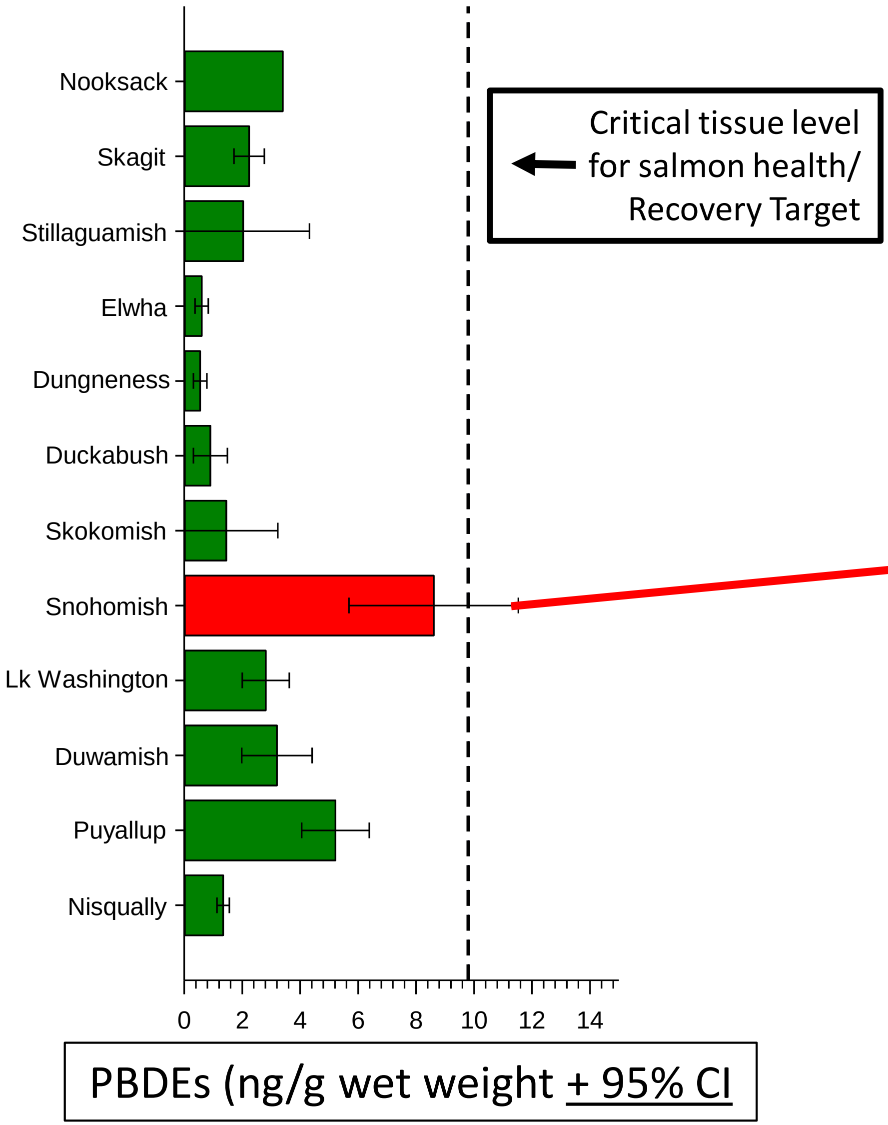
O'Neill et al. 2015

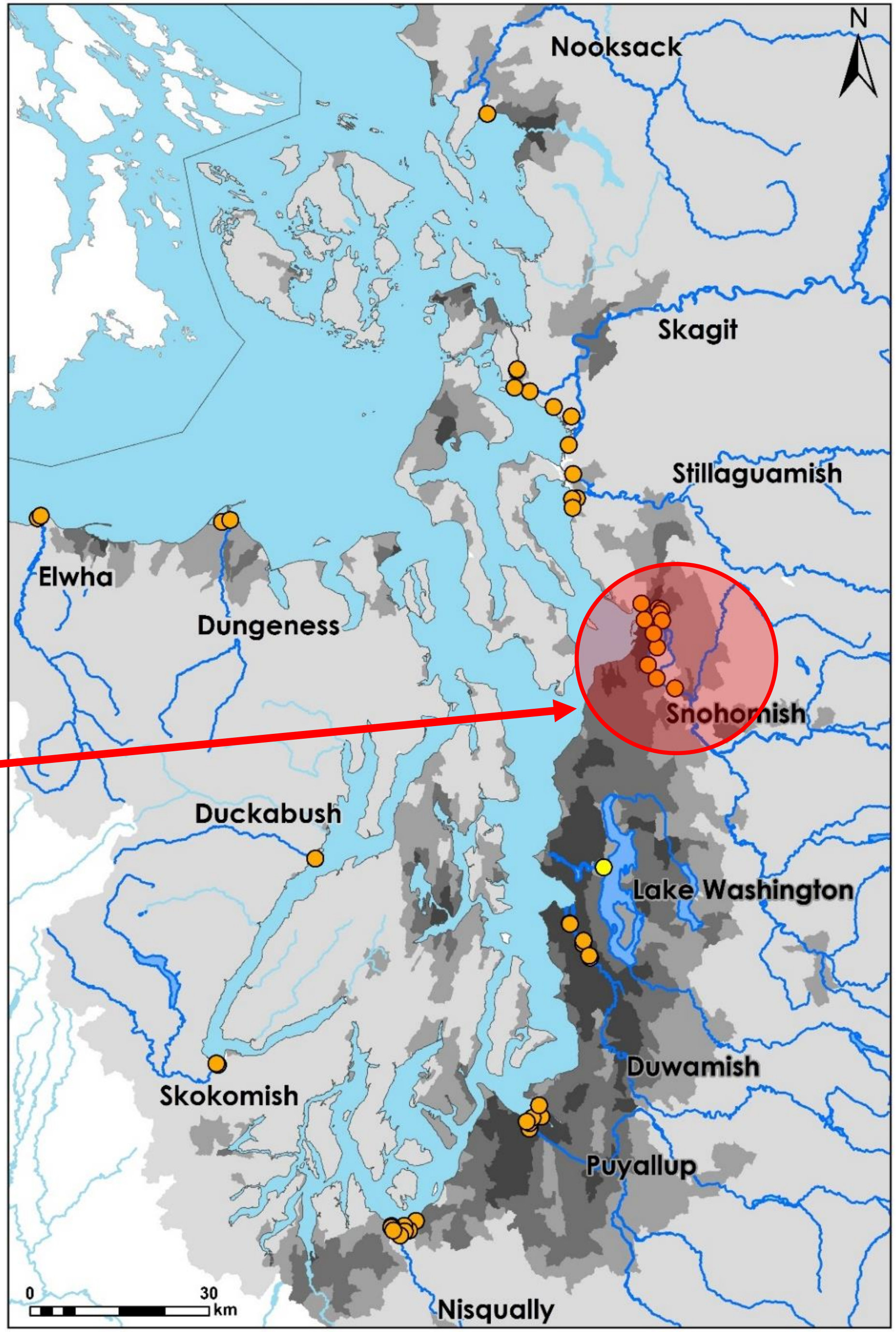
- 2013
- Snohomish plus Skagit, Duwamish, Comm. Bay, Nisqually
- PBDEs highest in fish from Snohomish

Sloan et al. 2010. Arch Environ Contam Toxicol 58:403–414

O'Neill et al. 2015. WDFW Report No FTP 16-02, 116 pages

High PBDEs in Snohomish Chinook Salmon





Talk Outline

- Background – review results of previous studies
- 2016 Snohomish Survey Design
- Results- data types to investigate PBDE "source"
  - PBDE concentrations – where exposure occurs
  - Contaminant Fingerprints – wastewater vs. stormwater source
  - Stable Isotopes – altered nitrogen source – wastewater?
- Conclusions
- Next Steps

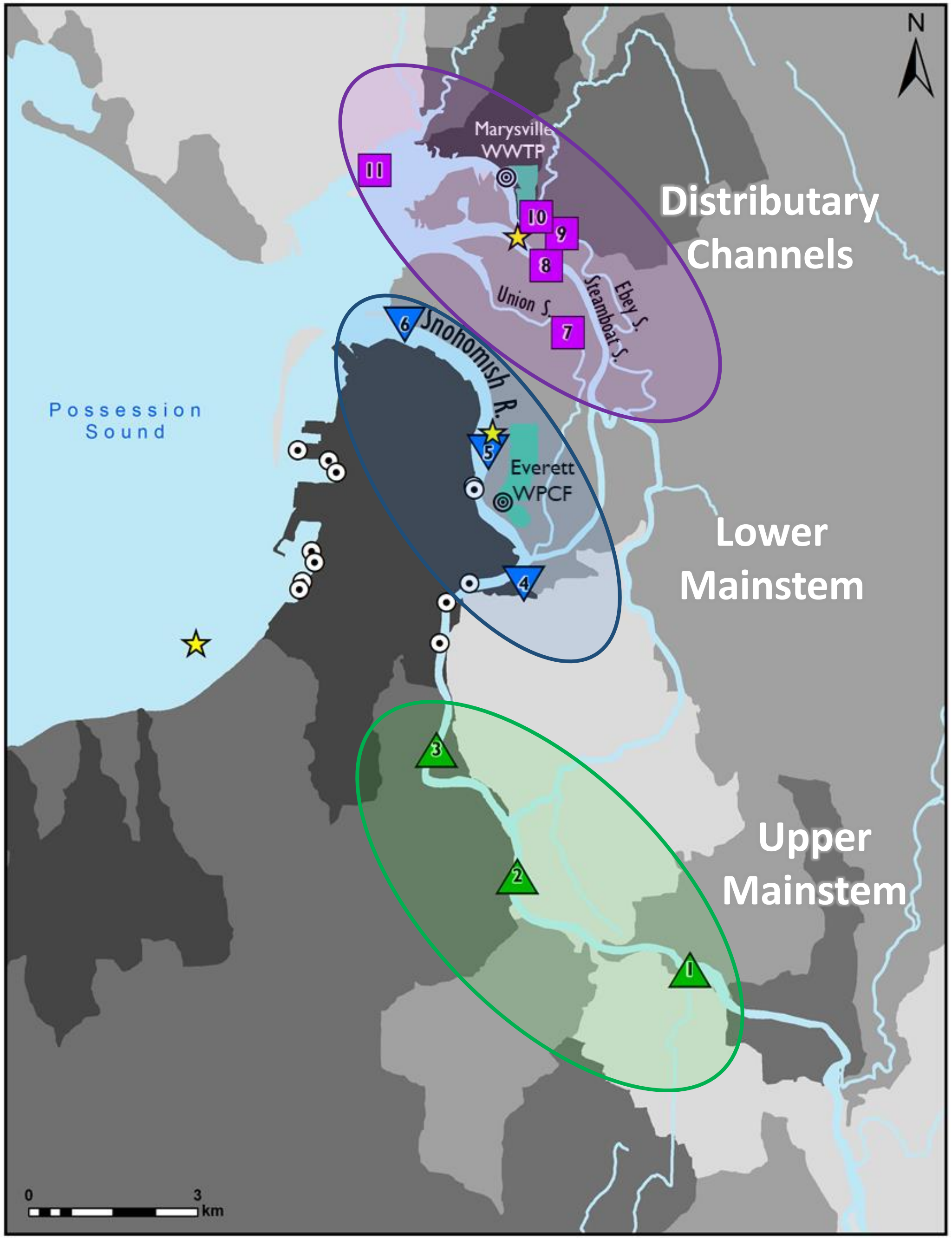
Snohomish River 2016 Study

Where are juvenile Chinook salmon exposed to and accumulating PBDEs?

- Upper Mainstem
- Lower Mainstem
- Distributary Channels

What is the "source" of PBDE inputs?

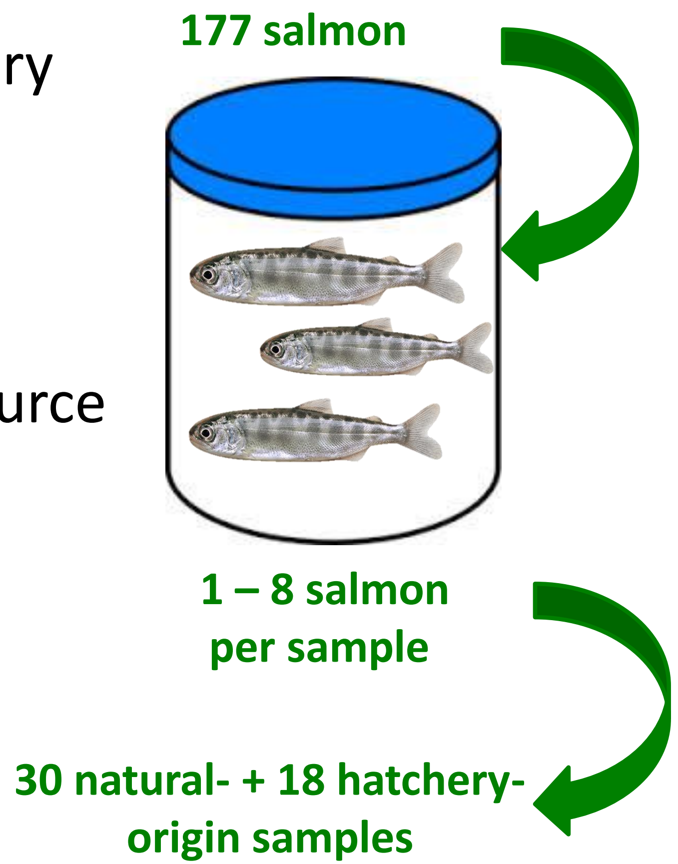
- wastewater (WWTP effluent, CSOs?)
- stormwater (storm drains, CSO, etc.?)



Snohomish River 2016 Study

Types of information collected for juvenile Chinook salmon

- Fish length, weight, origin, age, life history
- **Concentrations** of PBDEs, PCBs, DDTs
  - ✓ indicates where exposure occurs
- Contaminant **fingerprints**
  - ✓ indicates changes in contaminant source
- **Stable isotopes** of nitrogen
  - ✓ Indicates changes in nitrogen source



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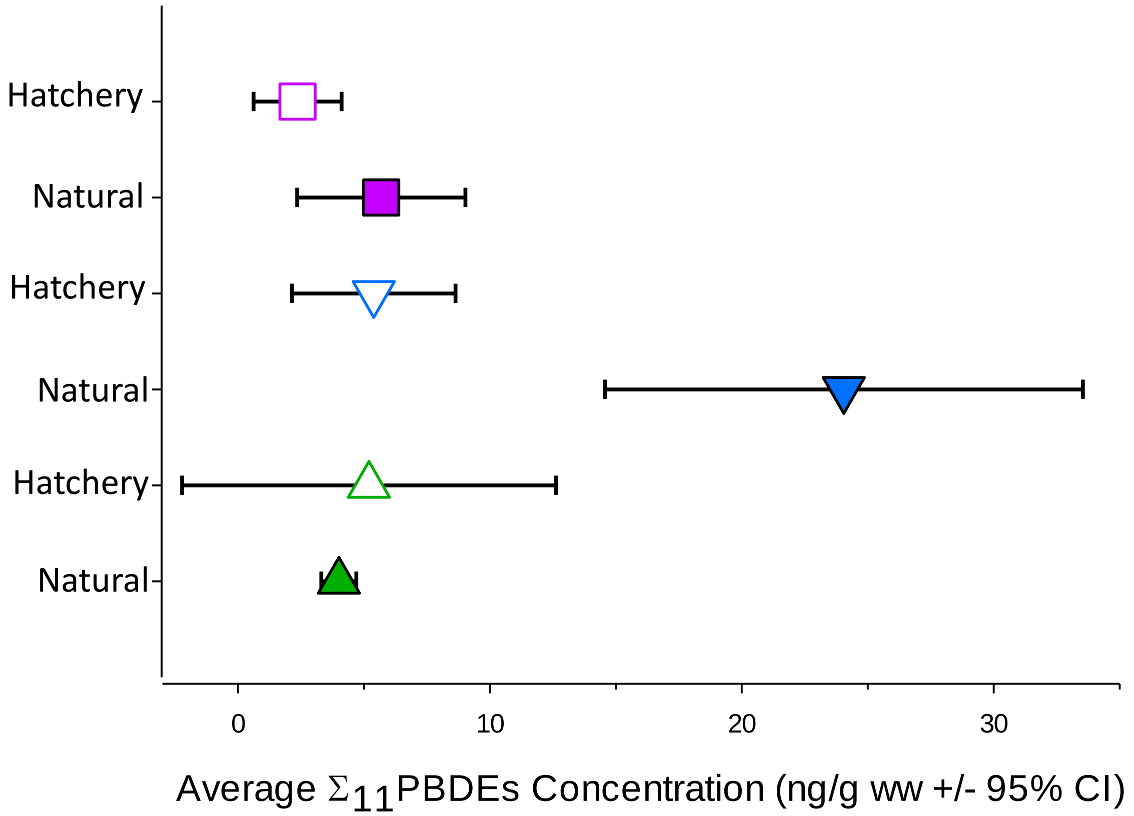
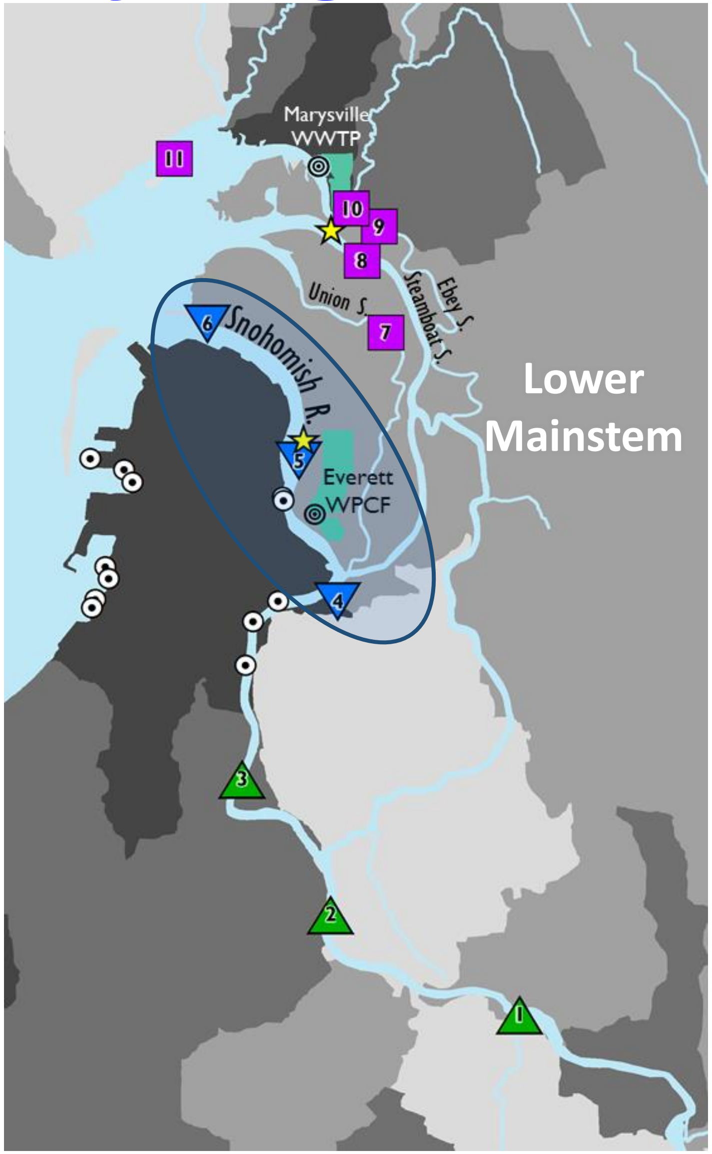
PBDE Concentrations by Region

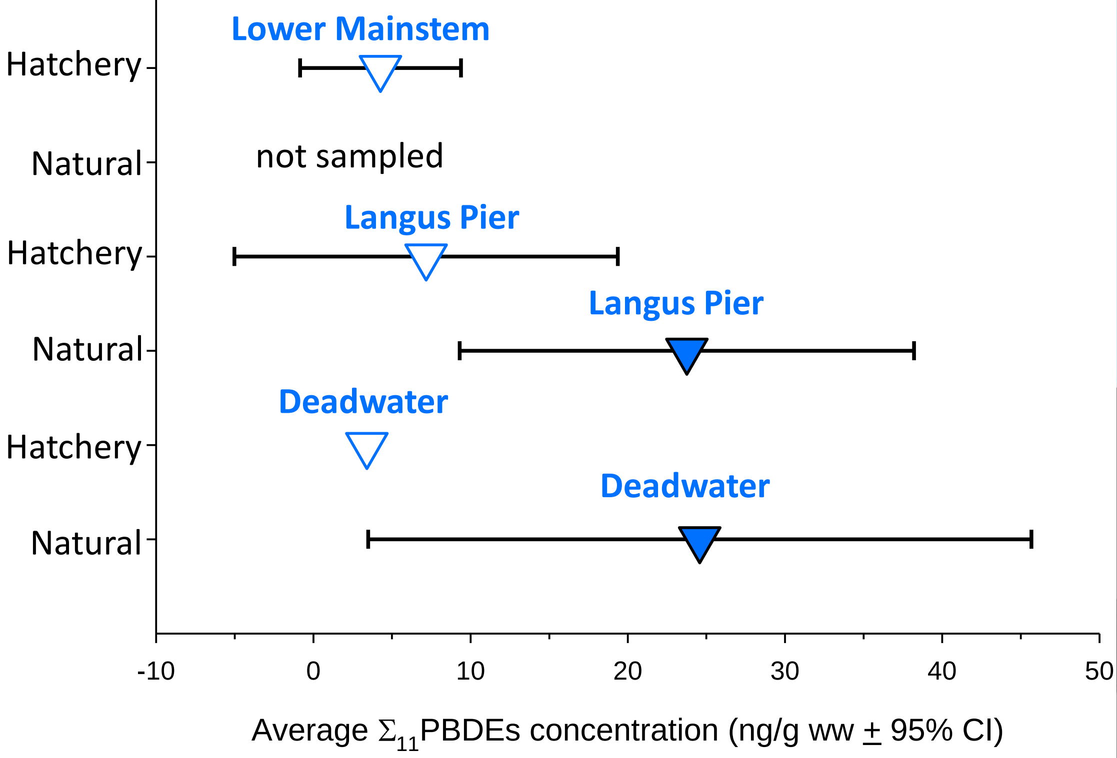
PBDEs were elevated in natural-origin Chinook salmon from the Lower Mainstem

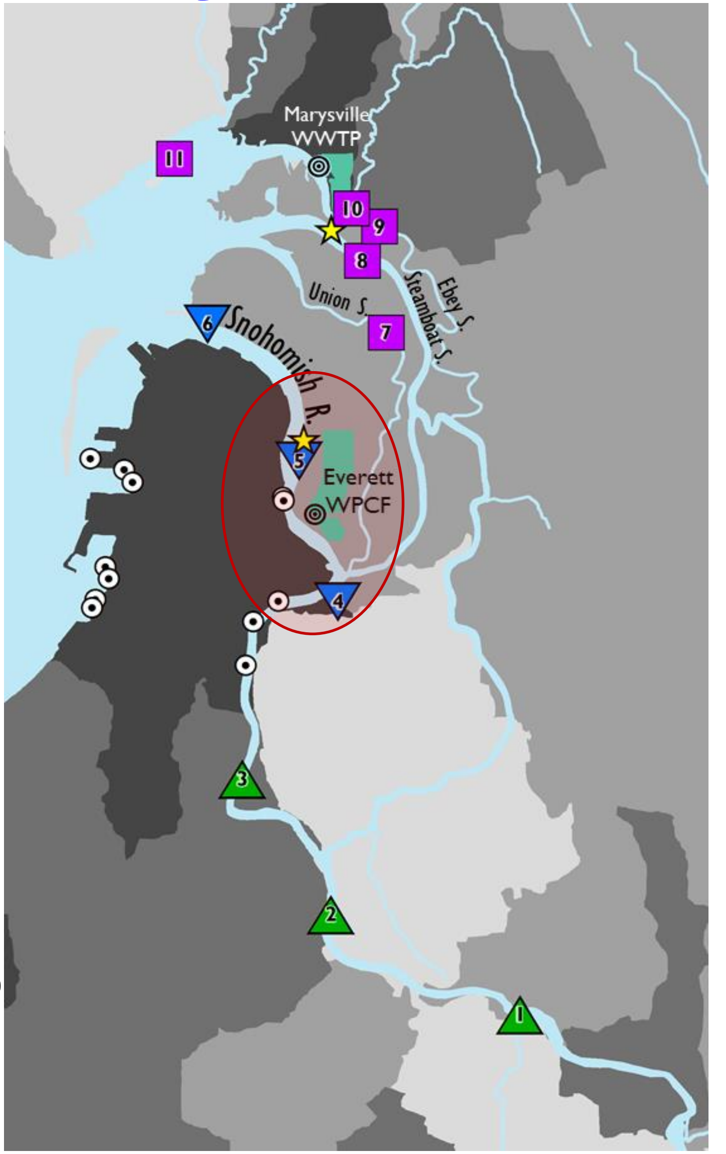




PBDE Concentrations by Site

PBDE concentrations are elevated in natural-origin Chinook from Langus Pier and Deadwater sites





Sampling locations of fish with elevated PBDEs and WWTP outfall and CSOs

Sampling locations of fish with elevated PBDEs and WWTP outfall and CSOs

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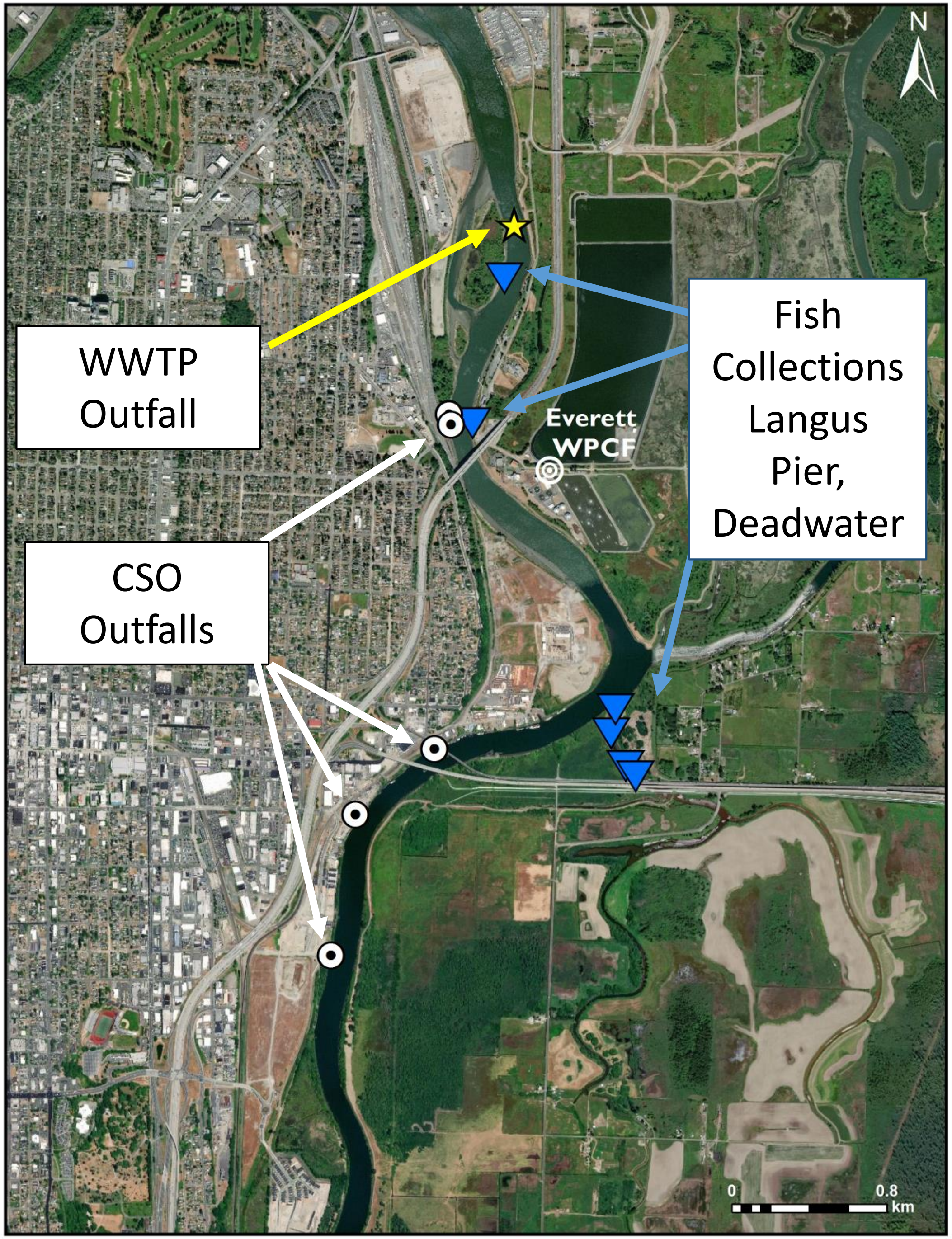
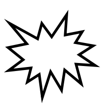


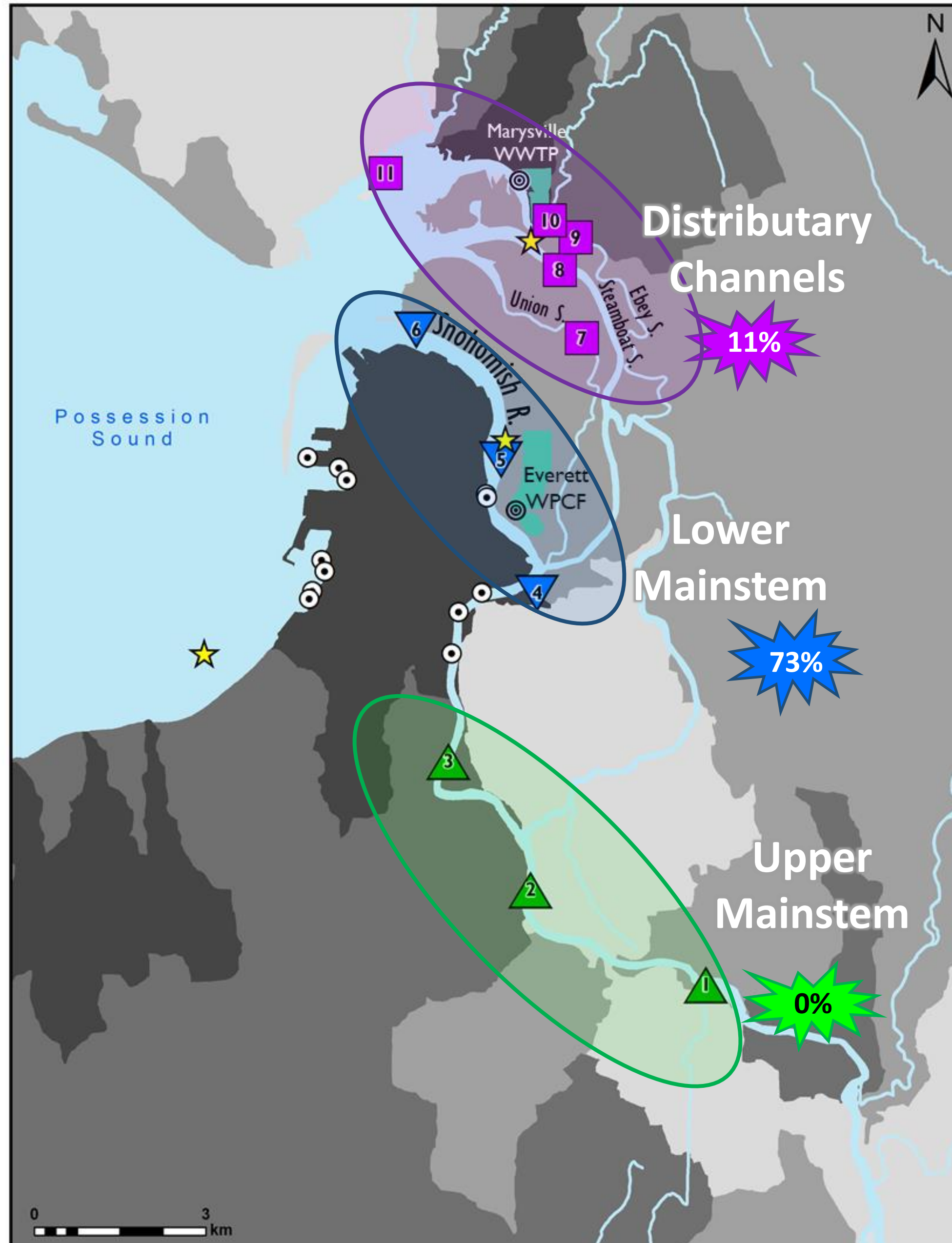
Adverse Effects of PBDEs: Juvenile Salmon Health

In dietary-exposure studies, juvenile Chinook with elevated PBDE concentrations had increased susceptibility to disease



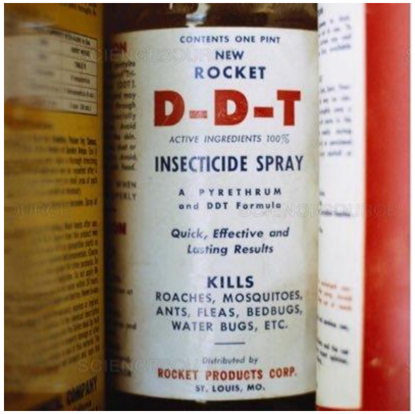
(Arkoosh et al. 2010, 2018)

In Snohomish River only natural-origin fish had PBDE concentration high enough to increase their susceptibility to disease!



Based on wet weight concentrations

What about other Contaminants?



- elevated concentrations in salmon from Lower Mainstem region
- minor differences between natural- and hatchery-origin salmon

- low concentrations in salmon from all regions
- slightly higher concentrations in natural-origin salmon

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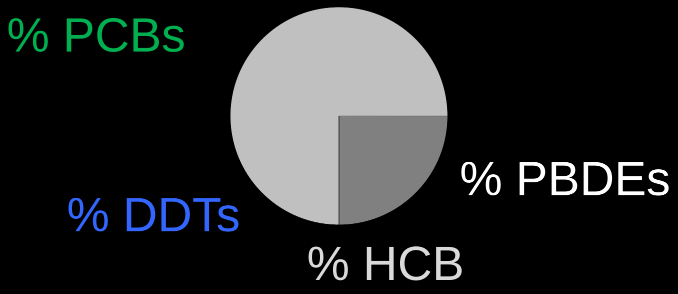
Source Identification
Using Contaminant Fingerprints

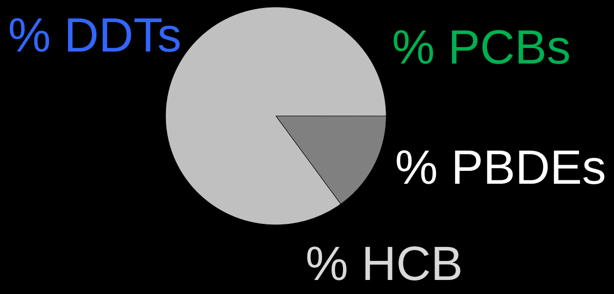
Aquatic environments have distinct patterns of persistent organic pollutants (POPs) based on inputs & environmental attributes

PCBs

DDTs

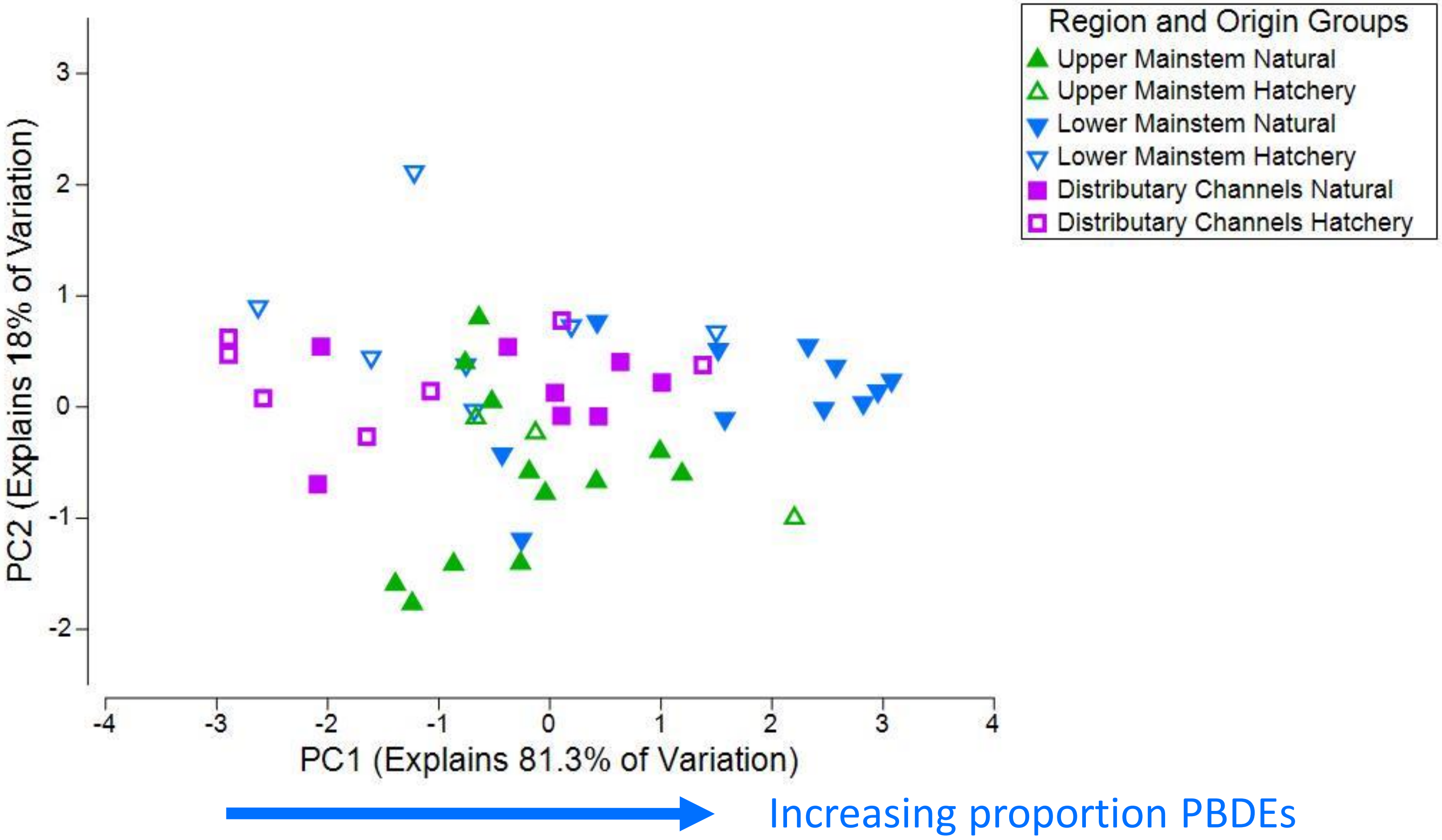
Biota foraging in regions with distinct POPs patterns accumulate specific POPs in proportion to their availability





POP Fingerprints in Chinook salmon

Higher proportion of PBDEs compared to PCBs and DDTs suggests a wastewater input (“source”).



Increasing proportion PBDEs

POP Fingerprints in Chinook salmon

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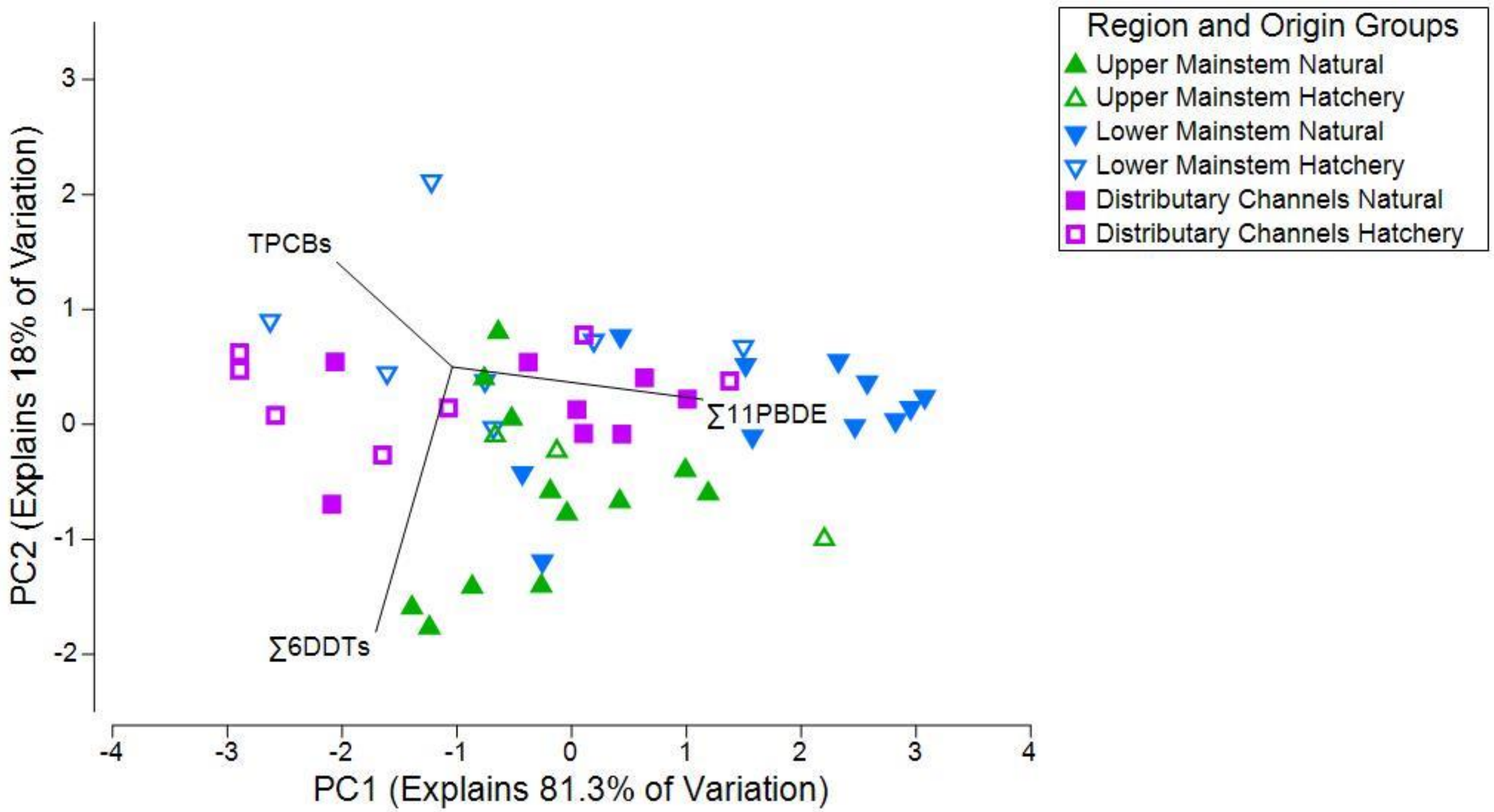

Increasing proportion PBDEs

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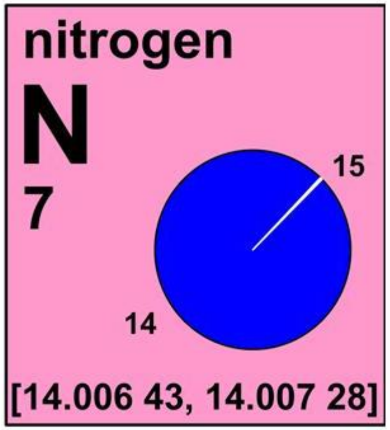
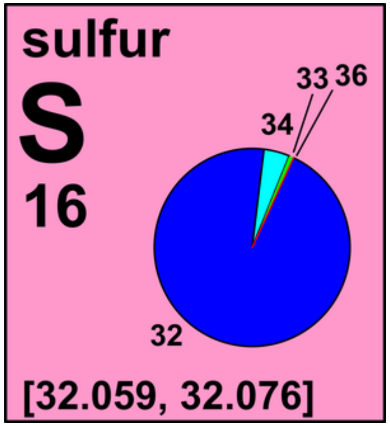
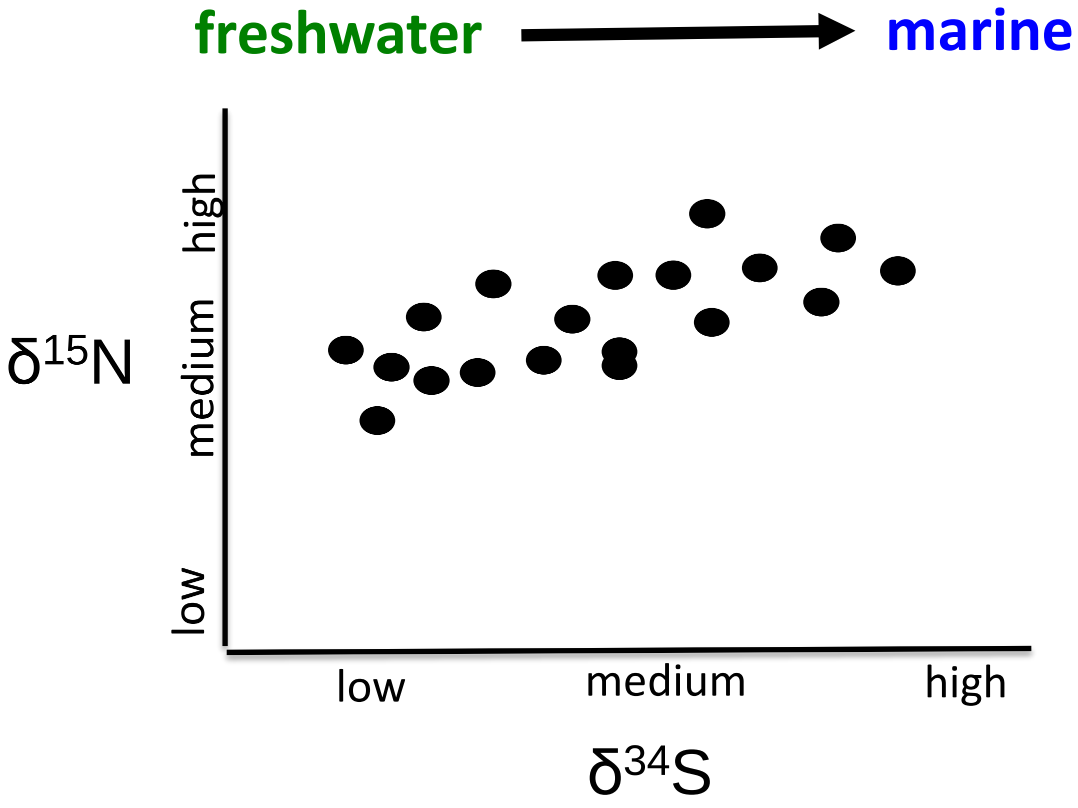
Stable Isotopes: Tools to infer food sources, habitat use & migrations





- Elements occur in various forms (isotopes).
- Stable isotopes of predators reflect characteristics and habitats of their prey.
- Heavier nitrogen isotopes enriched with trophic position but also varies with nitrogen source (fertilizers & wastewater).
- Heavier sulfur isotopes only slightly enriched with trophic levels but vary lots with types of producers.

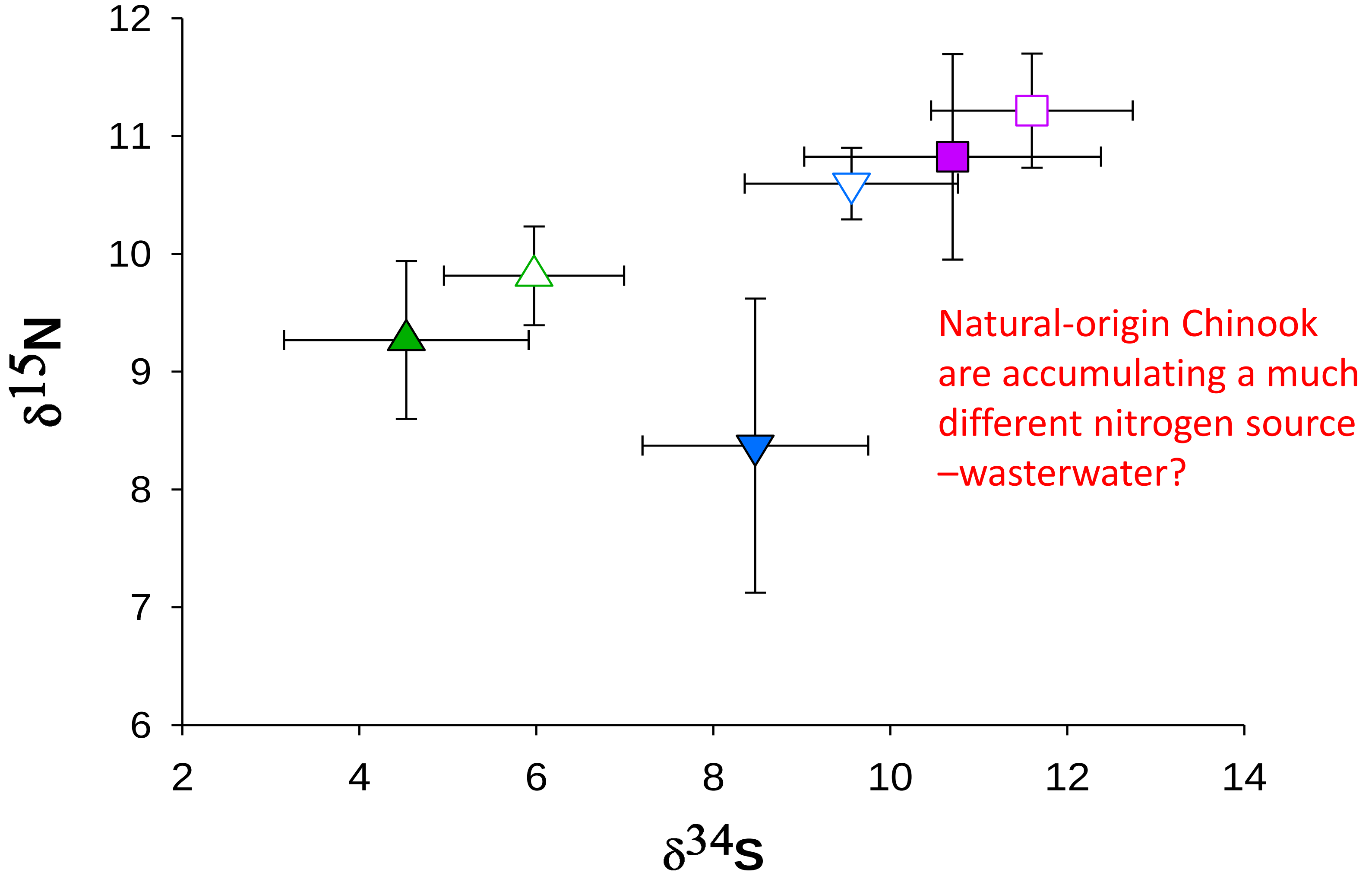
Typical Stable Isotope Signatures in Migrating Juvenile Chinook



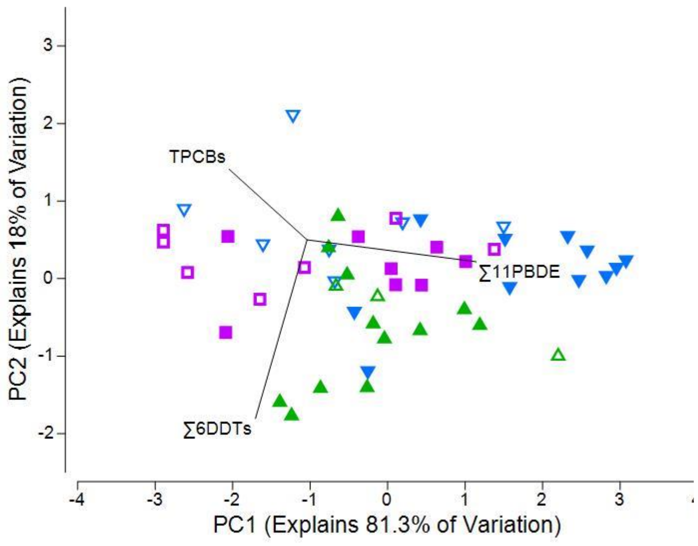
$\delta^{34}S$ becomes greatly enriched in salmon as the migrate towards marine waters but $\delta^{15}N$ is only slightly enriched

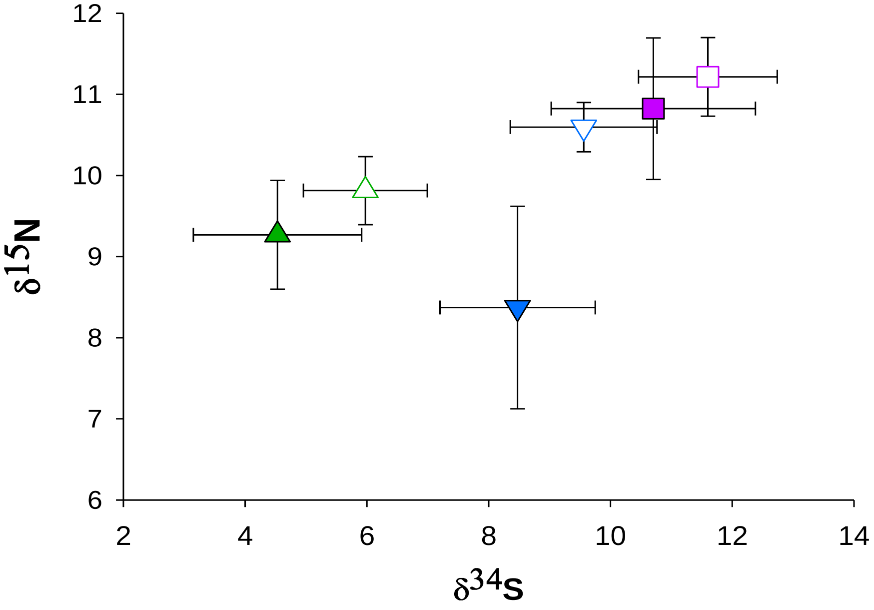
Adapted from Moore et al. 2016 MEPS 559:201-215

Altered Nitrogen Isotopes
in natural-origin Chinook from Lower Mainstem

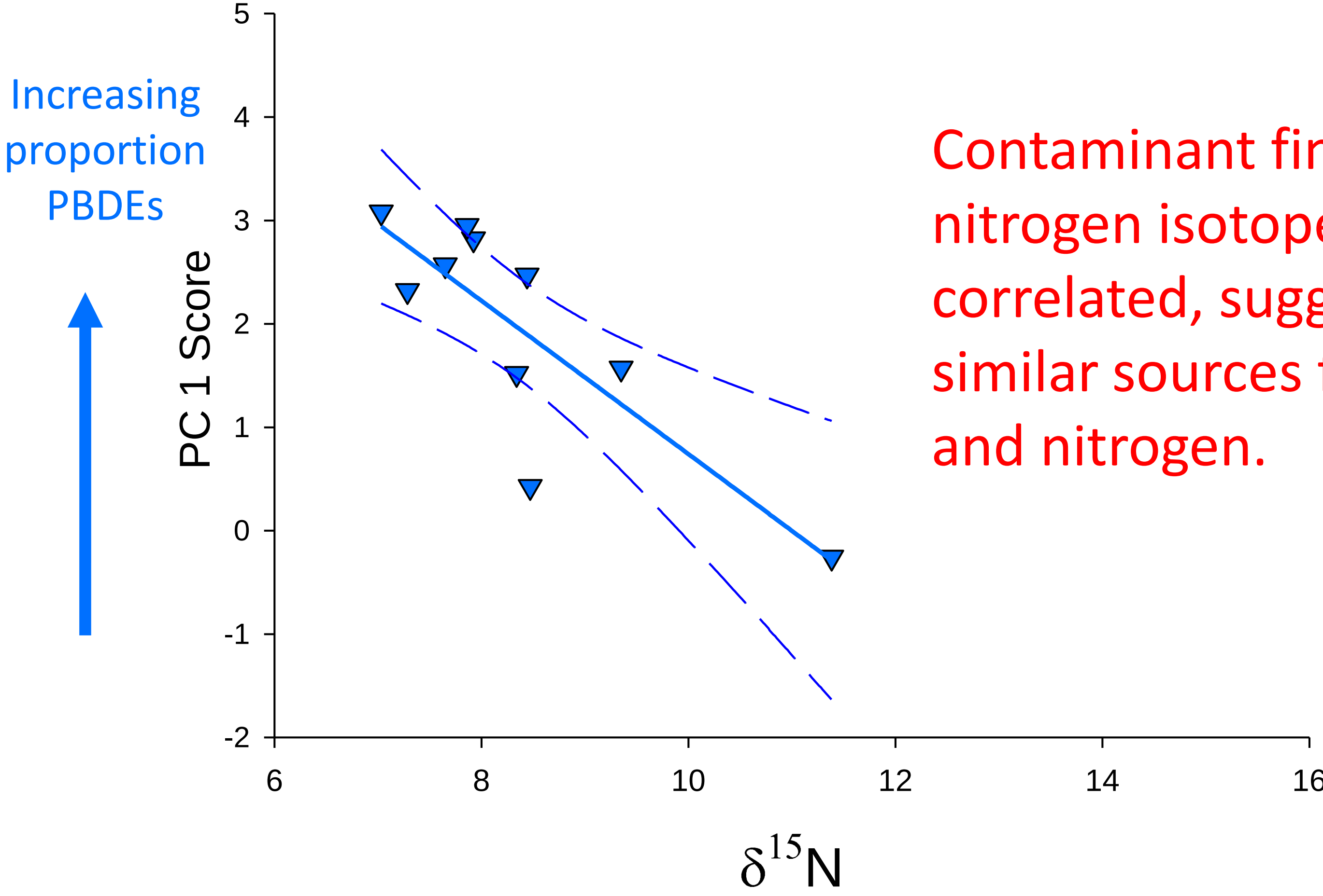


Is the nitrogen source related to contaminant fingerprint?





Sample with higher proportions of PBDES (PC1) have lower $\delta^{15}N$ (more altered nitrogen source)



Contaminant fingerprint and nitrogen isotope ratios are correlated, suggesting similar sources for PBDEs and nitrogen.

Possible Wastewater Sources

- WWTP effluent
  - Frequent discharge (avg 6.2 – 14.4 MGD)
  - nitrogen released as mostly as ammonium compared to nitrate and nitrite
  - other studies with similar release also show depleted $\delta^{15}N$

- CSOs
  - sporadic discharge (range 0.013 – 1.1 MGD)
  - nitrogen released as?

English Sole in Port Gardner

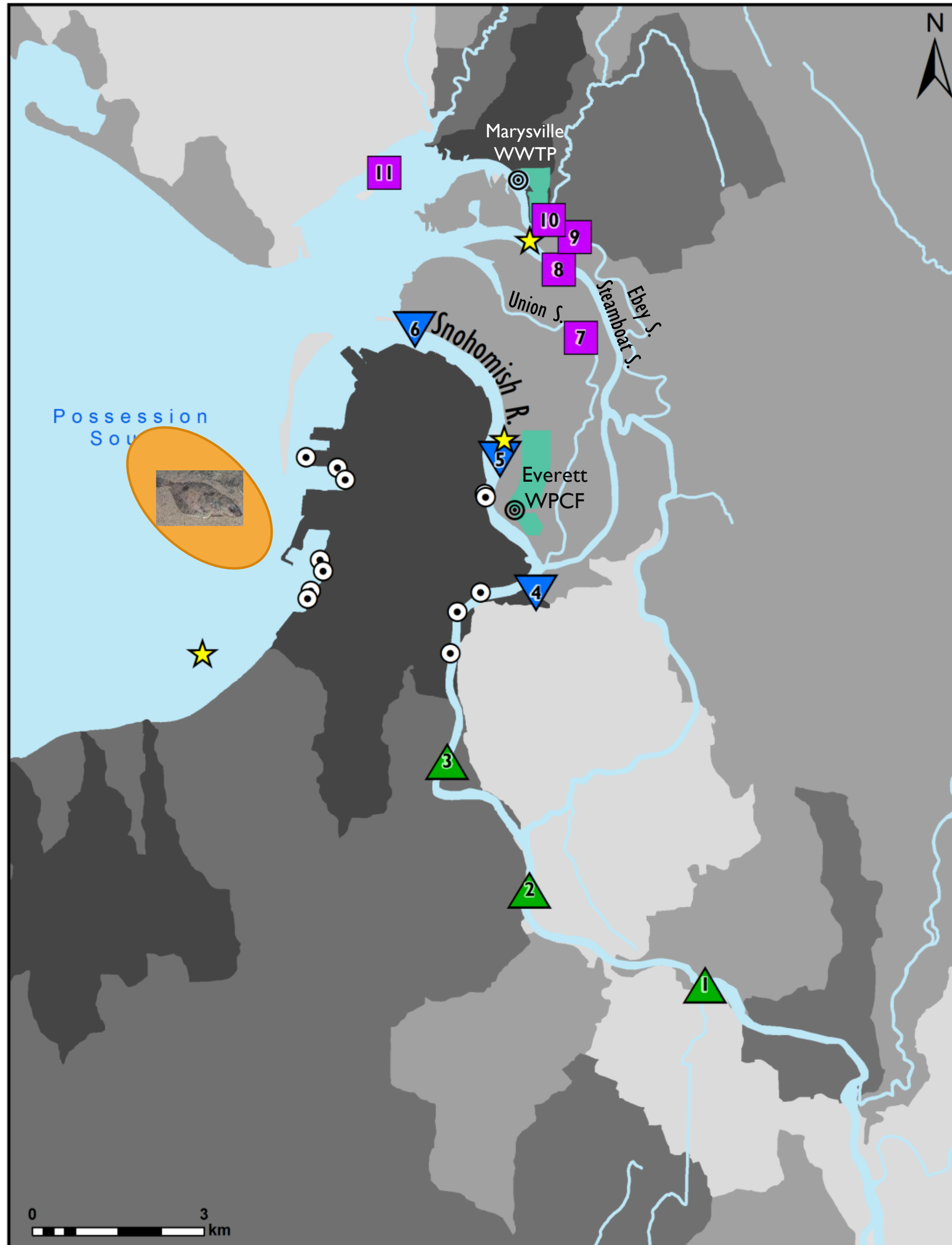
Arch Environ Contam Toxicol
DOI 10.1007/s00244-017-0383-z

SPECIAL ISSUE: INDICATORS OF OCEAN POLLUTION

Time Trends of Persistent Organic Pollutants in Benthic and Pelagic Indicator Fishes from Puget Sound, Washington, USA

James E. West[1] · Sandra M. O'Neill[1] · Gina M. Ylitalo[2]

English sole from Port Gardner have elevated PBDE levels .



Conclusions ….

- Snohomish River is a PBDE hotspot for juvenile Chinook salmon.
- Highest PBDE exposure occurs in Lower Mainstem, in vicinity of WWTP outfall and CSOs.
- Natural-origin have higher PBDE levels than hatchery-origin Chinook, likely due to longer residence time of natural-origin fish.
- PBDE concentration in juvenile Chinook salmon are high enough to increase their susceptibility to disease, and possibly their marine survival.

Conclusions …

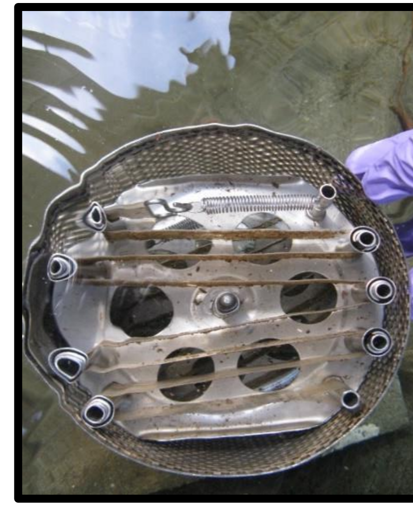
- Wastewater in the Lower Mainstem is likely source (pathway) of PBDEs to salmon:
  - Natural-origin Chinook from the Lower Mainstem have distinct contaminant fingerprints characterized by higher proportions of PBDEs than other POPs, consistent with input from wastewater source.
  - Natural-origin Chinook from the Lower Mainstem also have a distinct isotopic nitrogen ratio, suggesting of a different nitrogen source relative to other locations.
  - Contaminant fingerprint and nitrogen isotope ratios are correlated, suggesting similar sources for PBDEs and nitrogen.

- Loads from WWTP xx to xx times greater than CSOs but additional study needed to confirm which is a greater sources of PBDEs

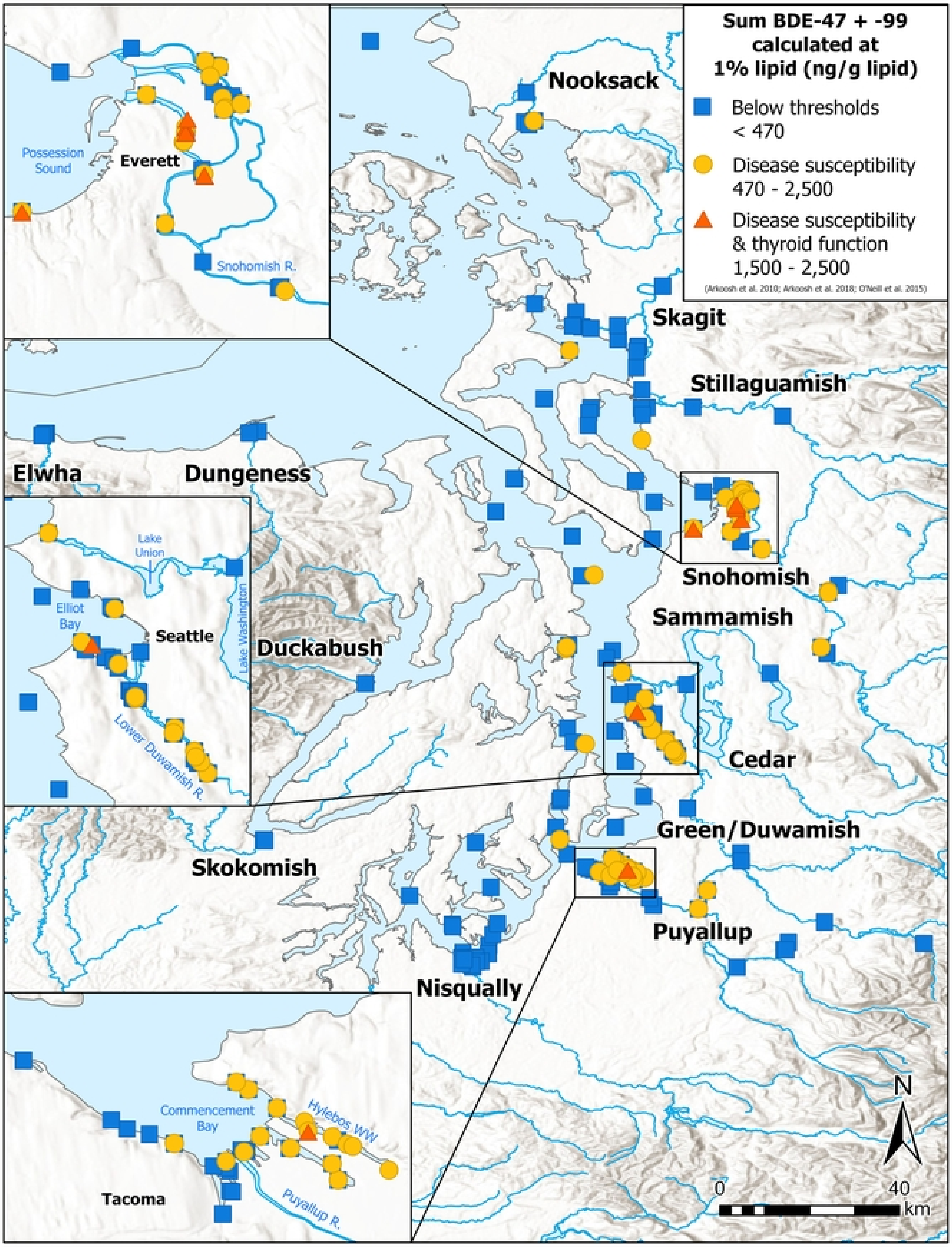
Next Steps…

1. Proposed NTA - basin-wide evaluation of PBDE in water (SPMDs) and biofilms/sediment to further define PBDE inputs:
   - sample during the first low-flow period (while WWTPs would be discharging),
   - follow-up sampling during high flow period with SPMDs and possibly other media.

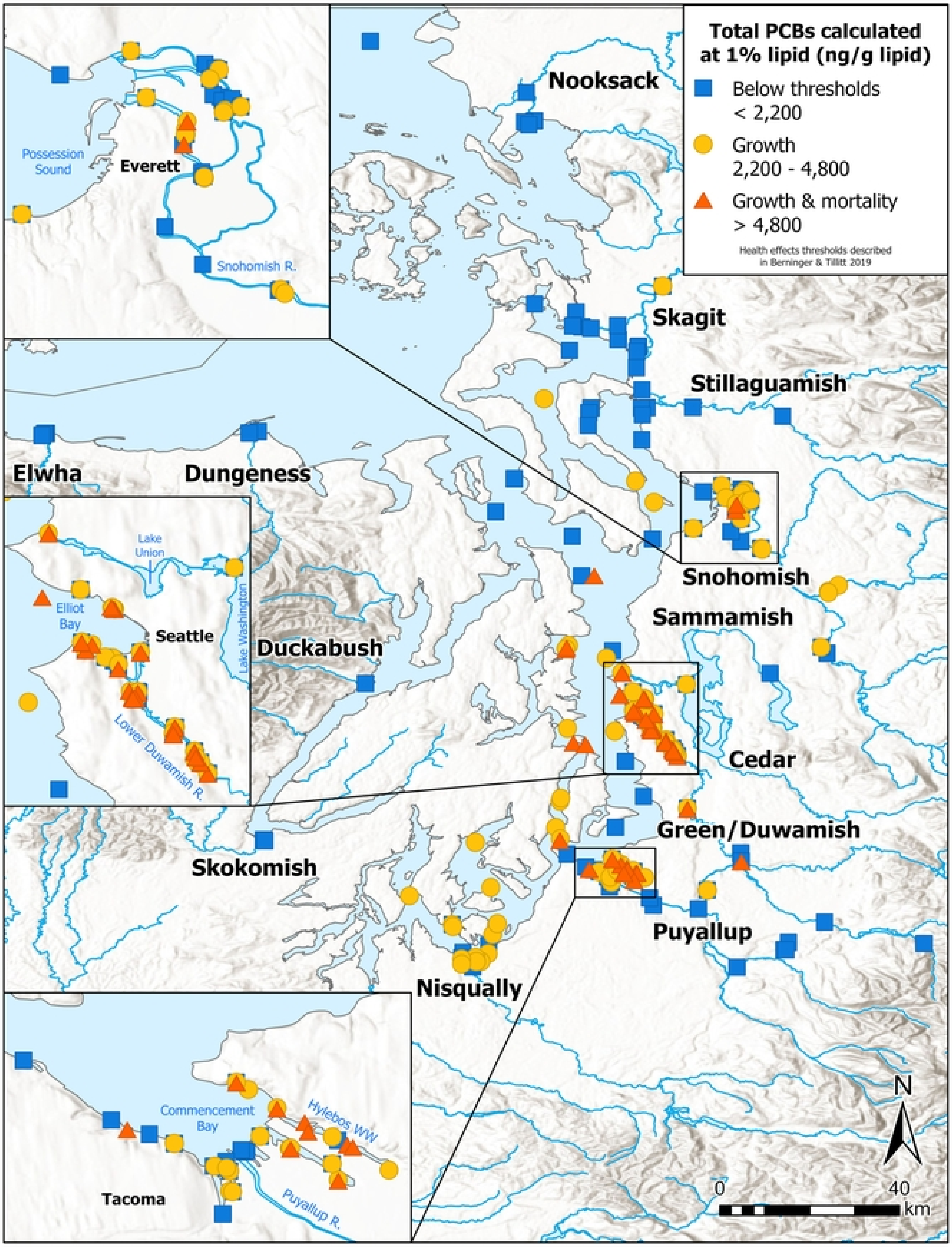
2. Measure PBDEs, other POPs, and nitrogen stable isotopes in WWTP effluent and CSO discharges??




Questions?



Sum BDE-47 + -99 calculated at 1% lipid (ng/g lipid)
Below thresholds < 470
Disease susceptibility 470 - 2,500
Disease susceptibility & thyroid function 1,500 - 2,500
(Arkoosh et al. 2010; Arkoosh et al. 2018; O'Neill et al. 2015)
Nooksack
Skagit
Stillaguamish
Snohomish
Sammamish
Cedar
Green/Duwamish
Puyallup
Nisqually
Skokomish
Duckabush
Dungeness
Elwha
Possession Sound
Everett
Snohomish R.
Lake Union
Lake Washington
Elliot Bay
Seattle
Lower Duwamish R.
Commencement Bay
Hylebos WW
Tacoma
Puyallup R.
N
0
40
km



Total PCBs calculated at 1% lipid (ng/g lipid)
Below thresholds
< 2,200
Growth
2,200 - 4,800
Growth & mortality
> 4,800
Health effects thresholds described in Berninger & Tillitt 2019
Nooksack
Skagit
Stillaguamish
Snohomish
Sammamish
Cedar
Green/Duwamish
Puyallup
Nisqually
Skokomish
Duckabush
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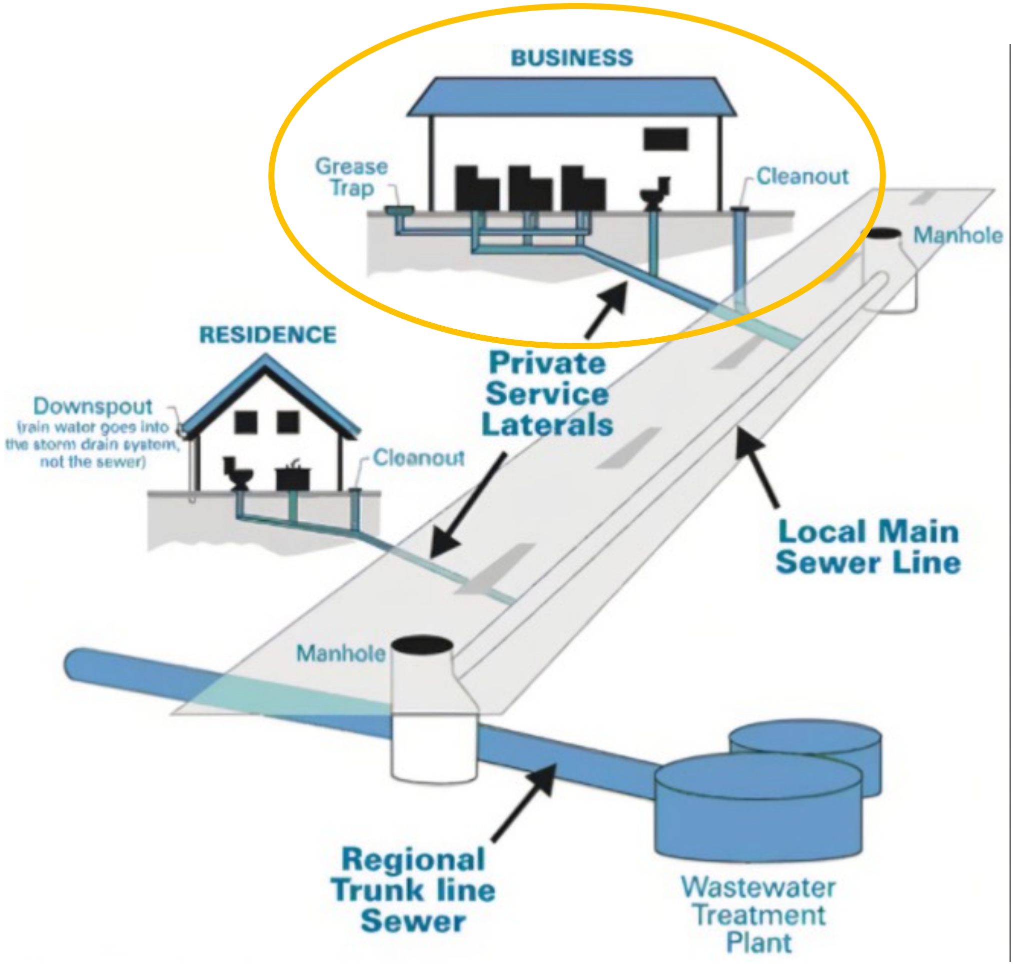
Puyallup R.
N
0
40
km

Sampling of Pretreated Industrial Wastewater in NW Washington

Siana Wong, EAP, and Maia Hoffman, WQ

February 3, 2022

Industrial Pretreatment and Permitting



- **Ecology issues permits to industrial facilities** discharging process wastewater to POTWs, implementing effluent limits and other permit conditions to **protect POTWs from pass through or interference that would impact water quality.**

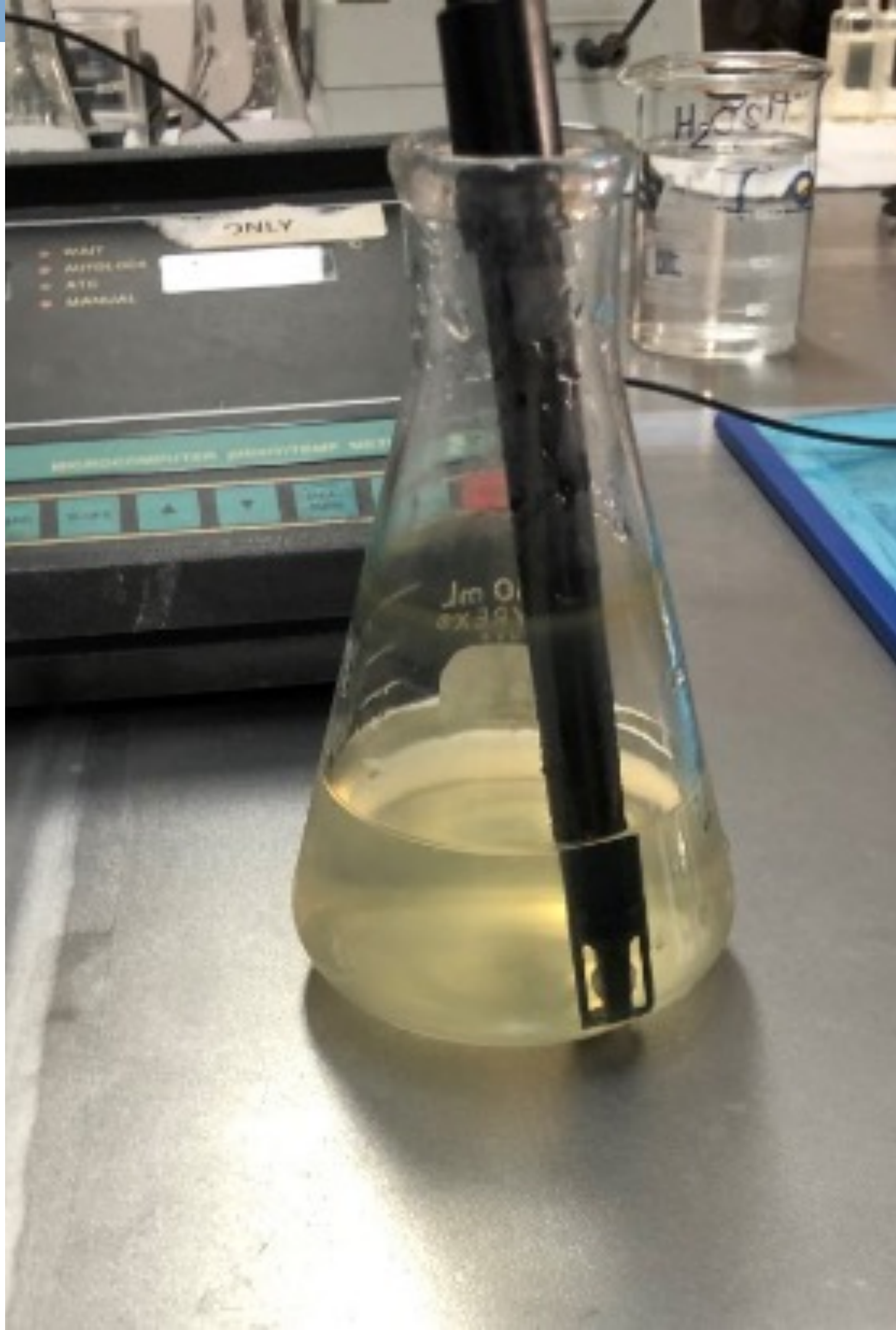
- Permits typically include **routine self monitoring and reporting** of pretreated effluent, following **BMPs**, and complying with **prohibited discharge rules.**

Sampling project

- Ecology's Environmental Assessment Program **sampled pretreated wastewater effluent** for a suite of toxic contaminants from **9 industrial facilities.**

- All facilities sampled are permitted by Ecology or City of Everett.

- In addition to **PBDEs**, parameters sampled and analyzed for include **OPFRs, PFAS, PCBs, phenolic compounds,** and **SVOCs.**



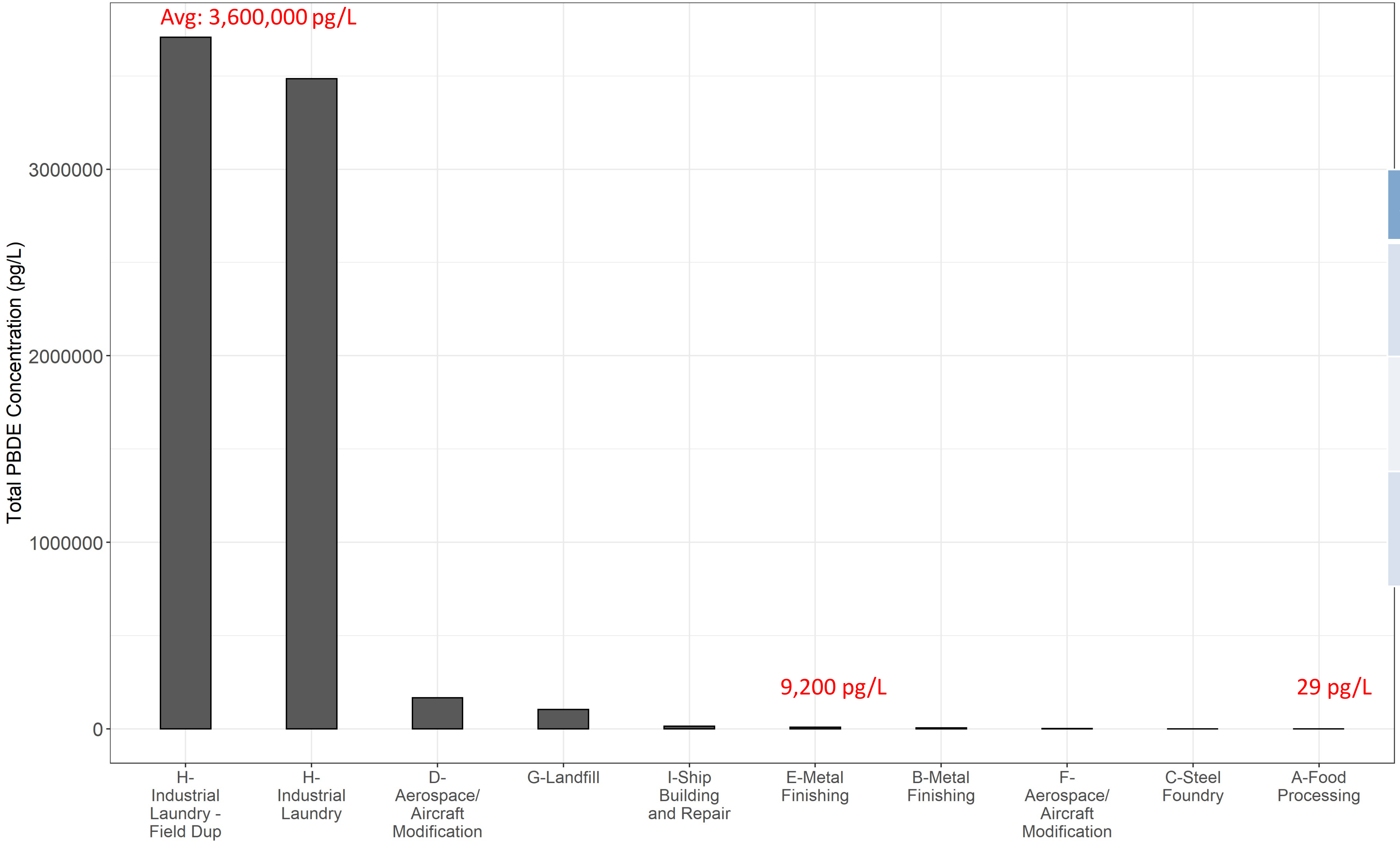
Types of industrial facilities sampled

Facility Site Study ID	Type of Industry	Description of Pretreated Industrial Wastewater Sampled
Facility A	Food Processing	Egg processing and cleanup wastewater
Facility B Facility E	Metal Finishing	Chemical metal finishing process wastewater (acid etch, chromium conversion coating, anodizing, and dyeing)
Facility C	Steel Foundry	Mechanical metal finishing process wastewater (hydroblasting of metal parts)
Facility D Facility F	Aerospace/Aircraft Modification	Chemical metal finishing, aircraft cleaning, and painting cleanup process wastewater
Facility G	Landfill	Leachate and catch basin cleanout wastewater
Facility H	Industrial Laundry	Industrial laundry process wastewater
Facility I	Ship Building and Repair	Facility wide wastewater (chemical metal finishing and various industrial wastewater and domestic wastewater)

Method Summary

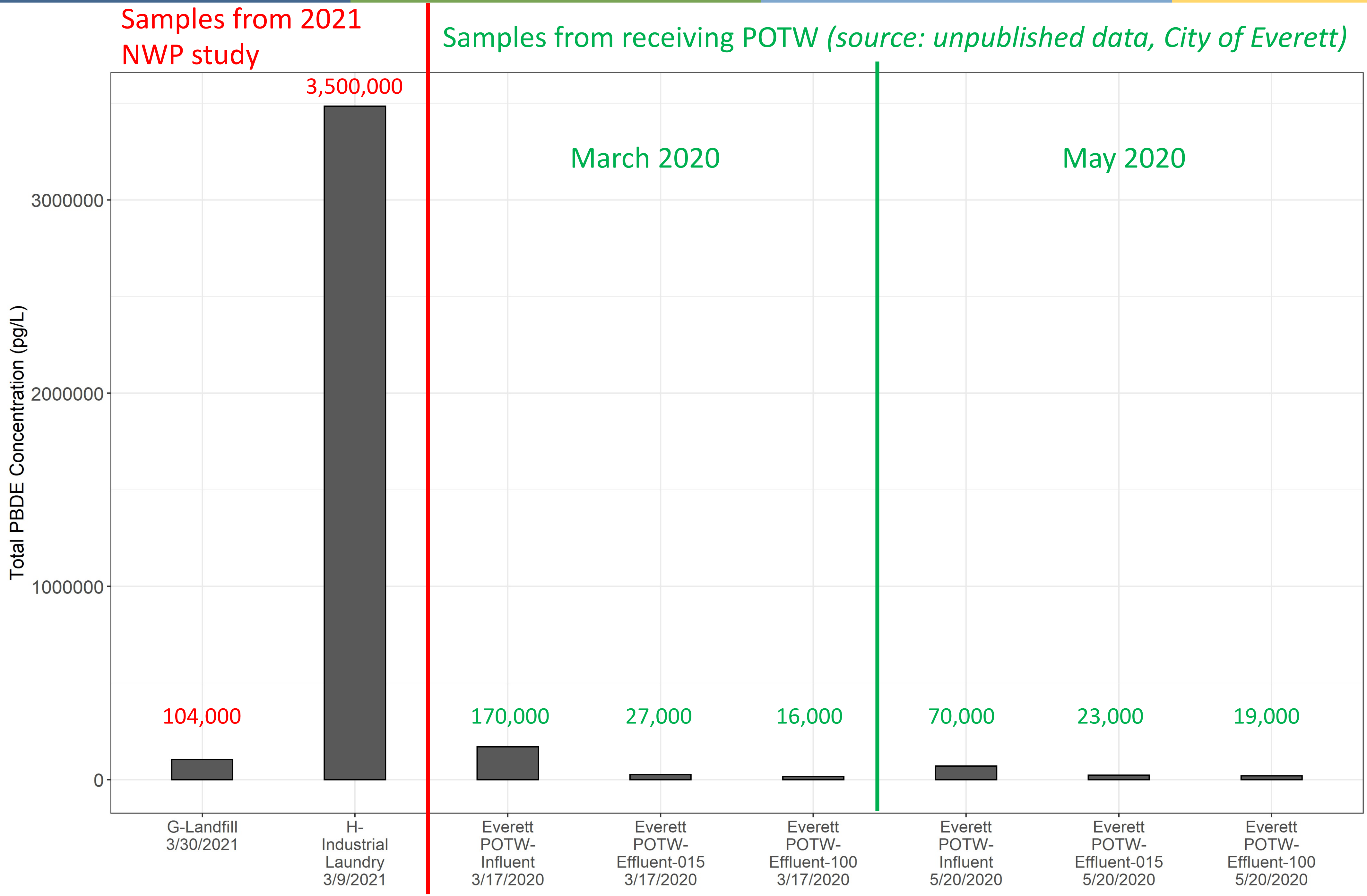
- One grab sample collected from each facility to measure various analytes
- 1 field duplicate & 1 equipment blank collected for each analyte
- PBDE samples analyzed by SGS AXYS, Sidney, BC using USEPA Method 1614
- Laboratory QC samples included laboratory blank, ongoing precision & recovery, & surrogate recovery
- Level 2B data validation performed externally by Manchester Environmental Laboratory

Total PBDEs



Summary (N=9)	
Min	29 pg/L
Max	3,600,000 pg/L
Med	9,200 pg/L

Comparison to previous POTW samples



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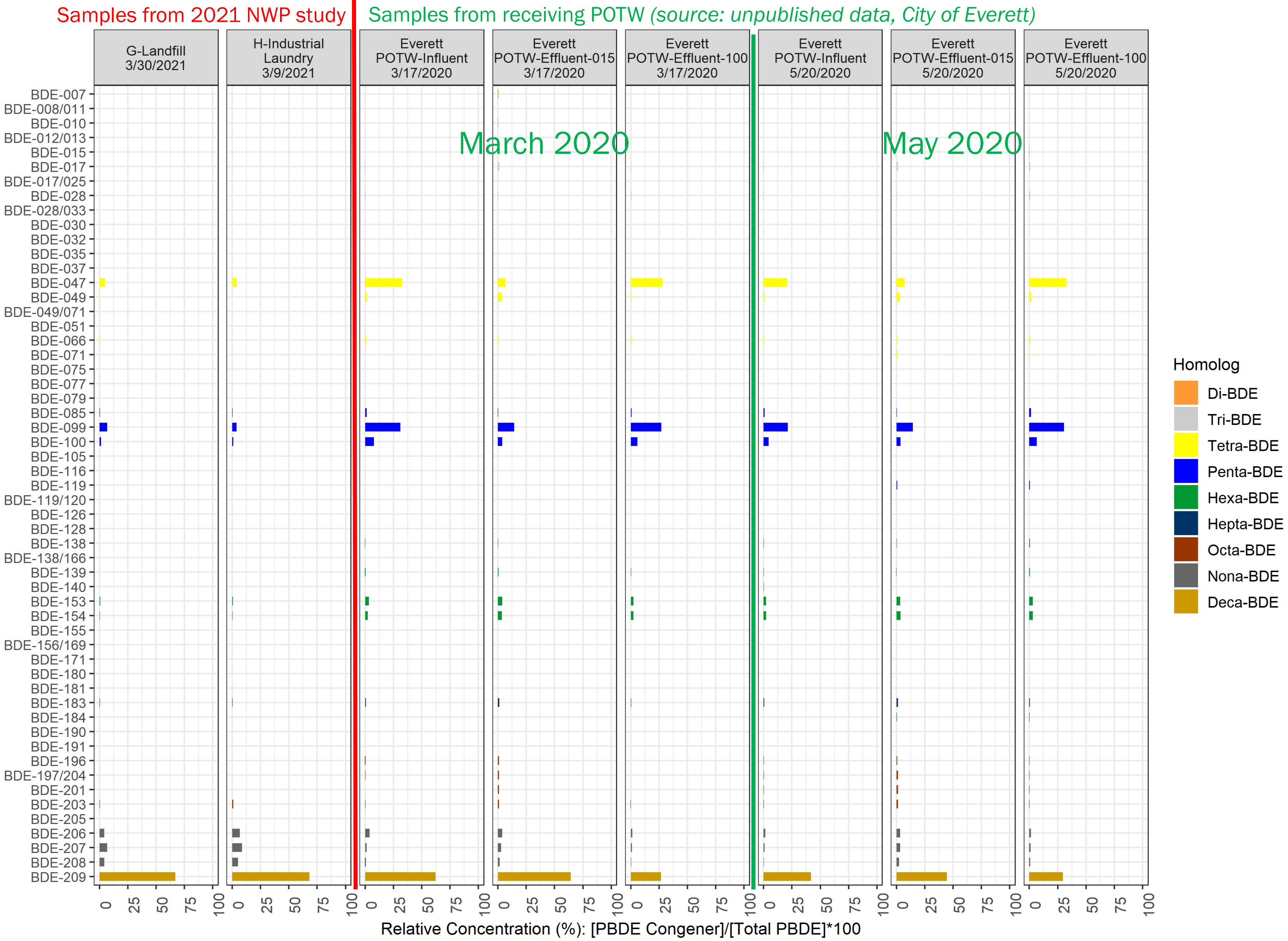

Summary

- PBDEs detected at all 9 sampled facilities
- Industrial Laundry had total PBDE concentration order of magnitude higher than the other sites (>3,000,000 pg/L)
- Aerospace/Aircraft Modification & Landfill facilities had 2nd & 3rd highest total PBDE concentration (>100,000 pg/L)
- Specific congeners were present more frequently & at higher concentrations than other congeners among samples, esp. BDE-047, 099, 209
- BDE-209 dominated the samples

Questions?

Siana Wong

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DEPARTMENT OF ECOLOGY
State of Washington