DEPARTMENT OF ECOLOGY
State of Washington

6PPD Stormwater Management: Research and Action

NEBC: Managing Stormwater in Washington
March 3, 2026

Agenda

- Background of 6PPD
- Ecology's Agency Strategy
- Stormwater BMP Effectiveness Research
- Stormwater Regulation and Rulemaking
- Stormwater BMP Research and Data
- Question and Answer Session

Background on 6PPD

Photo: Coho returning to spawn (courtesy of USFWS, 2018)

6PPD and 6PPD-quinone

- **6PPD** is a chemical added to tires since the 1960s that prevents rubber from cracking
- In 2020, discovered that **6PPD** transforms into **6PPD-quinone (6PPDQ)** when exposed to ozone
- Both are emitted in tire wear particles and are in all tires globally
- **6PPDQ** is acutely toxic to coho salmon

With 6PPD Without 6PPD

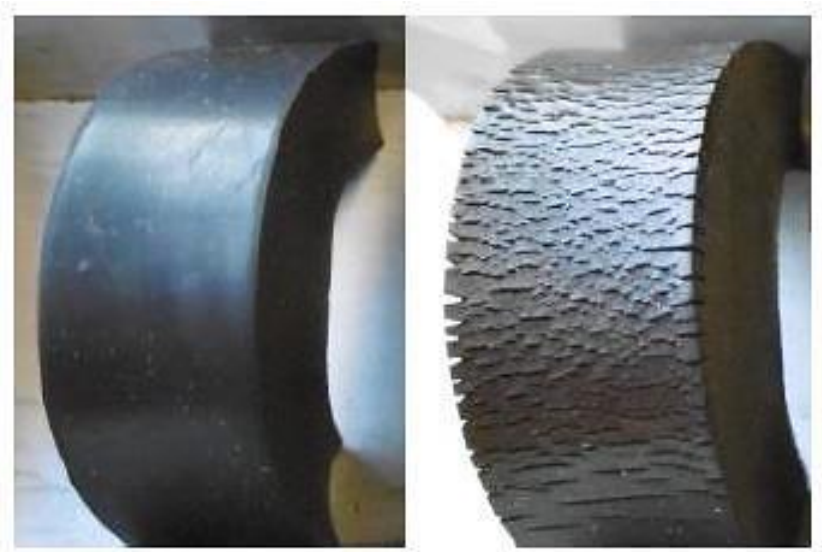


Photo: U.S. Tires Manufacturer's Association

Photo: Clear Creek coho (courtesy of Wild Fish Conservancy, 2021)

Ecology's Agency Strategy

- **Reducing sources** of 6PPD and evaluating safer alternatives
- **Mapping and monitoring** to support stormwater planning
- Evaluating **tire recycling and disposal impacts**
- Researching and implementing **stormwater best management practices**

Stormwater Best Management Practices (BMPs) Research

Challenges of Sampling Stormwater BMPs

- Many BMPs are **not designed to be sampled and monitored**
- Event-based sampling (i.e. **storm chasing**) is **unpredictable and difficult**
- **Sample collection and equipment issues**
- Capturing **representative samples** that reflect BMP performance over time is difficult
- **Standard sampling and analytical methods** are still being developed

Photo: Snoqualmie Indian Tribe

Our 20+ Research Studies

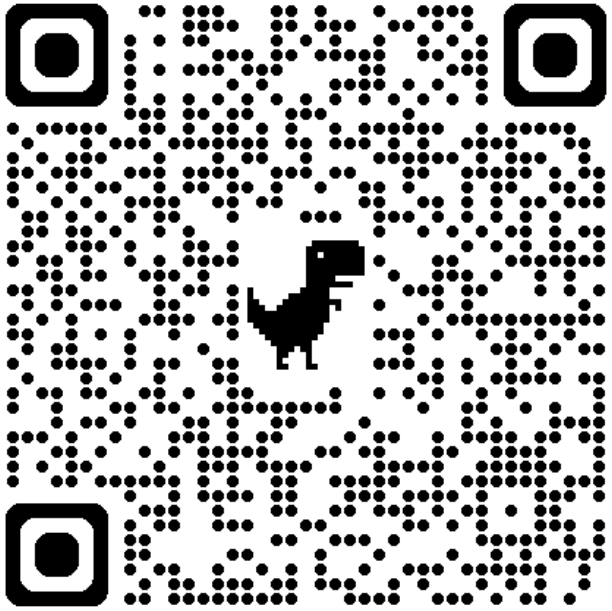
- **Stormwater characterization** for different land uses
- **Testing BMP Effectiveness:** Street sweeping, decant facilities, grassy swales, floating wetlands, road embankments, sorbent media, bioretention soil mixes, media filters, proprietary treatment (TAPE) devices
- Testing runoff from **crumb rubber mulch** or **turf**
- Understanding the **fate and transport** of 6PPD and 6PPDQ
- Developing **sampling and analytic methods**

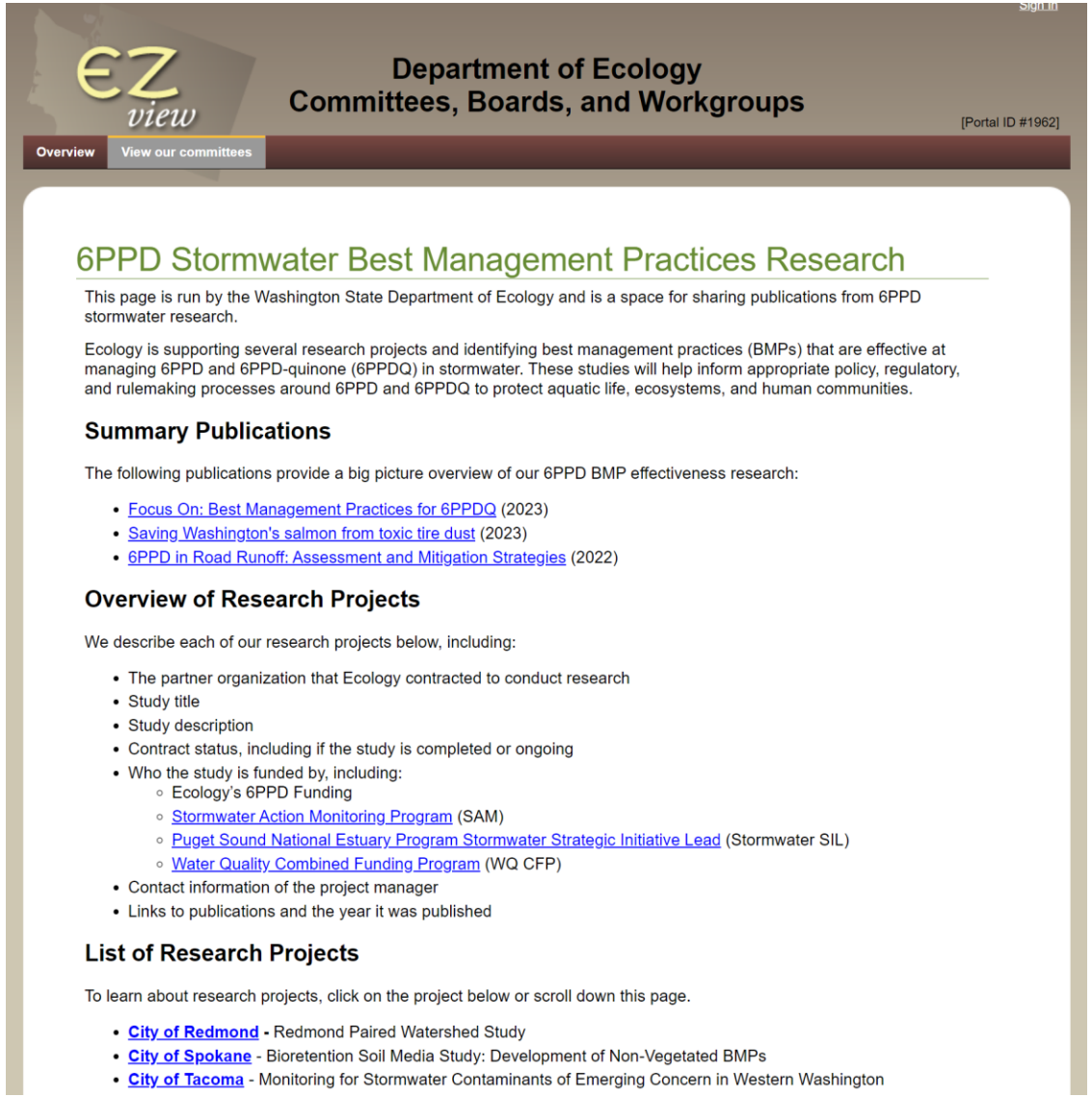
Ecology 6PPD Partners

Project Partners	Project Partners
Herrera Environmental	Evergreen StormH20
King County Environmental Lab	Washington State University
King County	Washington Stormwater Center
University of Washington-Tacoma	Seattle Public Works
Snoqualmie Indian Tribe	City of Redmond
City of Tacoma	City of Des Moines
Pierce County	Long Live the Kings
NV5	Stewardship Partners
EA Engineering, Science, and Technology Inc.	Osborn Consulting Inc
City of Spokane	The Nature Conservancy
USGS	

6PPD Stormwater Research Website

Scan QR code to access the site:





EZ view

Department of Ecology
Committees, Boards, and Workgroups

[Portal ID #1962]

Overview | View our committees

6PPD Stormwater Best Management Practices Research

This page is run by the Washington State Department of Ecology and is a space for sharing publications from 6PPD stormwater research.

Ecology is supporting several research projects and identifying best management practices (BMPs) that are effective at managing 6PPD and 6PPD-quinone (6PPDQ) in stormwater. These studies will help inform appropriate policy, regulatory, and rulemaking processes around 6PPD and 6PPDQ to protect aquatic life, ecosystems, and human communities.

Summary Publications

The following publications provide a big picture overview of our 6PPD BMP effectiveness research:

- Focus On: Best Management Practices for 6PPDQ (2023)
- Saving Washington's salmon from toxic tire dust (2023)
- 6PPD in Road Runoff: Assessment and Mitigation Strategies (2022)

Overview of Research Projects

We describe each of our research projects below, including:

- The partner organization that Ecology contracted to conduct research
- Study title
- Study description
- Contract status, including if the study is completed or ongoing
- Who the study is funded by, including:
  - Ecology's 6PPD Funding
  - Stormwater Action Monitoring Program (SAM)
  - Puget Sound National Estuary Program Stormwater Strategic Initiative Lead (Stormwater SIL)
  - Water Quality Combined Funding Program (WQ CFP)
- Contact information of the project manager
- Links to publications and the year it was published

List of Research Projects

To learn about research projects, click on the project below or scroll down this page.

- **City of Redmond** - Redmond Paired Watershed Study
- **City of Spokane** - Bioretention Soil Media Study: Development of Non-Vegetated BMPs
- **City of Tacoma** - Monitoring for Stormwater Contaminants of Emerging Concern in Western Washington

Summary of Study Results

- Stormwater concentrations for **high traffic, urban runoff** range from **600 - 700 ng/L**
- **Potentially effective BMPs** based on recent studies
  - Bioretention and High Performance Bioretention Soil Medias
  - Granular Activated Carbon
  - Unamended soils
  - Components of engineered media
- **Standard Operating Procedure for 6PPDQ in Sediment**

Photo: Shelby Giltner

Current Research Topics

- **Field Testing BMPs:** Testing already installed BMPs and treatment trains in the field
- **BMP Maintenance and Cost Effectiveness**: Ensuring long-term effectiveness and reasonable costs
- **Stormwater Characterization:** Sampling influent concentrations for diverse land uses
- **Fate and Transport:** Understanding how 6PPDQ moves through and persists in the environment

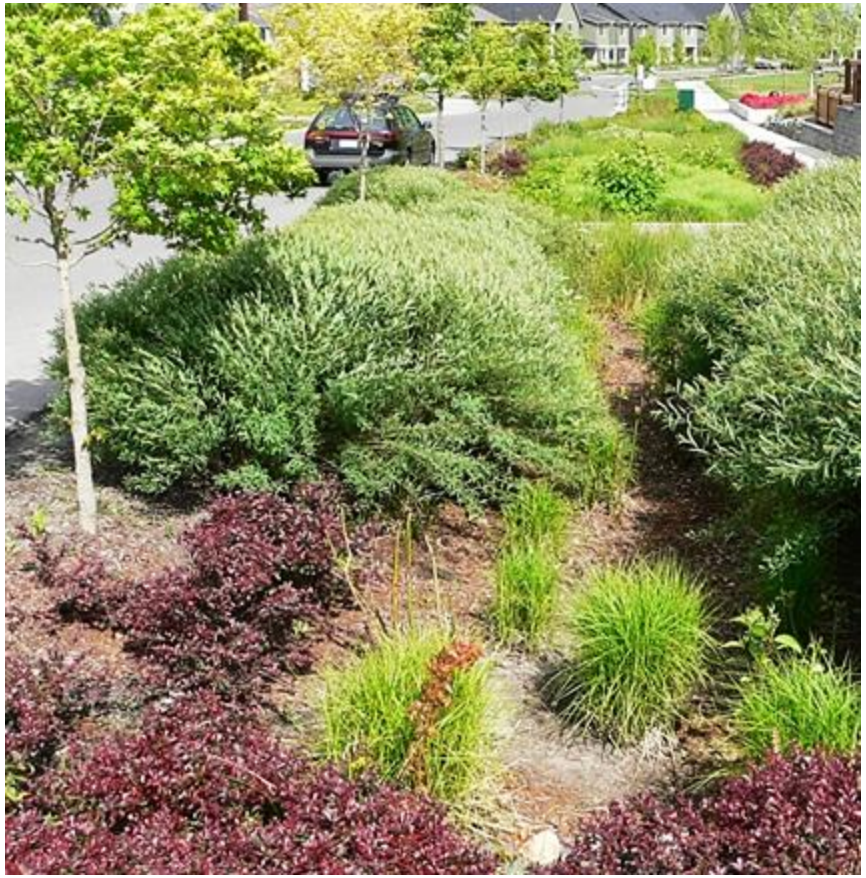
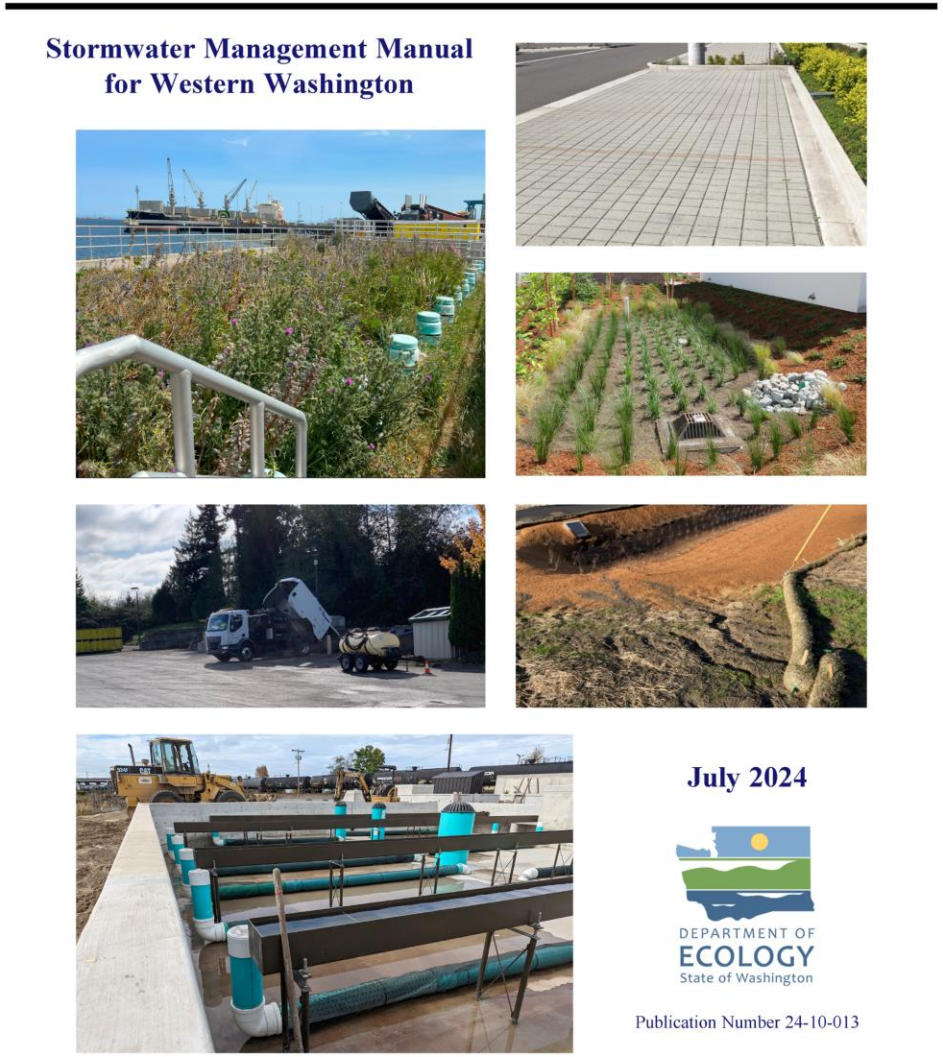


Photo: A bioretention swale in a residential area



What is the end goal?

- Synthesize research and provide guidance to regulators, permittees, and communities
- Update Stormwater Management Manuals with effective BMPs
- Continue to share research findings publicly

Stormwater Regulations and Rulemaking

Clean Water Act (CWA) Permits

- Ecology has delegated authority to issue CWA permits
- Reissued **Municipal Stormwater Permits and Manuals** in 2024
  - Reduced project thresholds, retrofits, street sweeping
- Reissued **Industrial Stormwater General Permit (ISGP)** in 2024
  - Monitoring and reporting 6PPDQ; no standards or limits
- Draft **WA Department of Transportation (WSDOT) municipal stormwater permit** publication date TBD

Aquatic Life Toxics Criteria

- 6PPDQ **Aquatic Life Toxics Criteria** for freshwater acute mortality
- Ecology adopted rule in August 2024 and submitted to the EPA for review and approval
- Next step: Endangered Species Act Section 7 consultation (NOAA)

	Freshwater Acute (ng/L)	Freshwater Chronic (ng/L)	Saltwater Acute (ng/L)	Saltwater Chronic (ng/L)
EPA	11	-	-	-
Washington Rule	12 (1-hour)	-	-	-

Testing 6PPD-Q on the Snoqualmie Indian Tribe Reservation

Jen Hartke

Water Quality Program

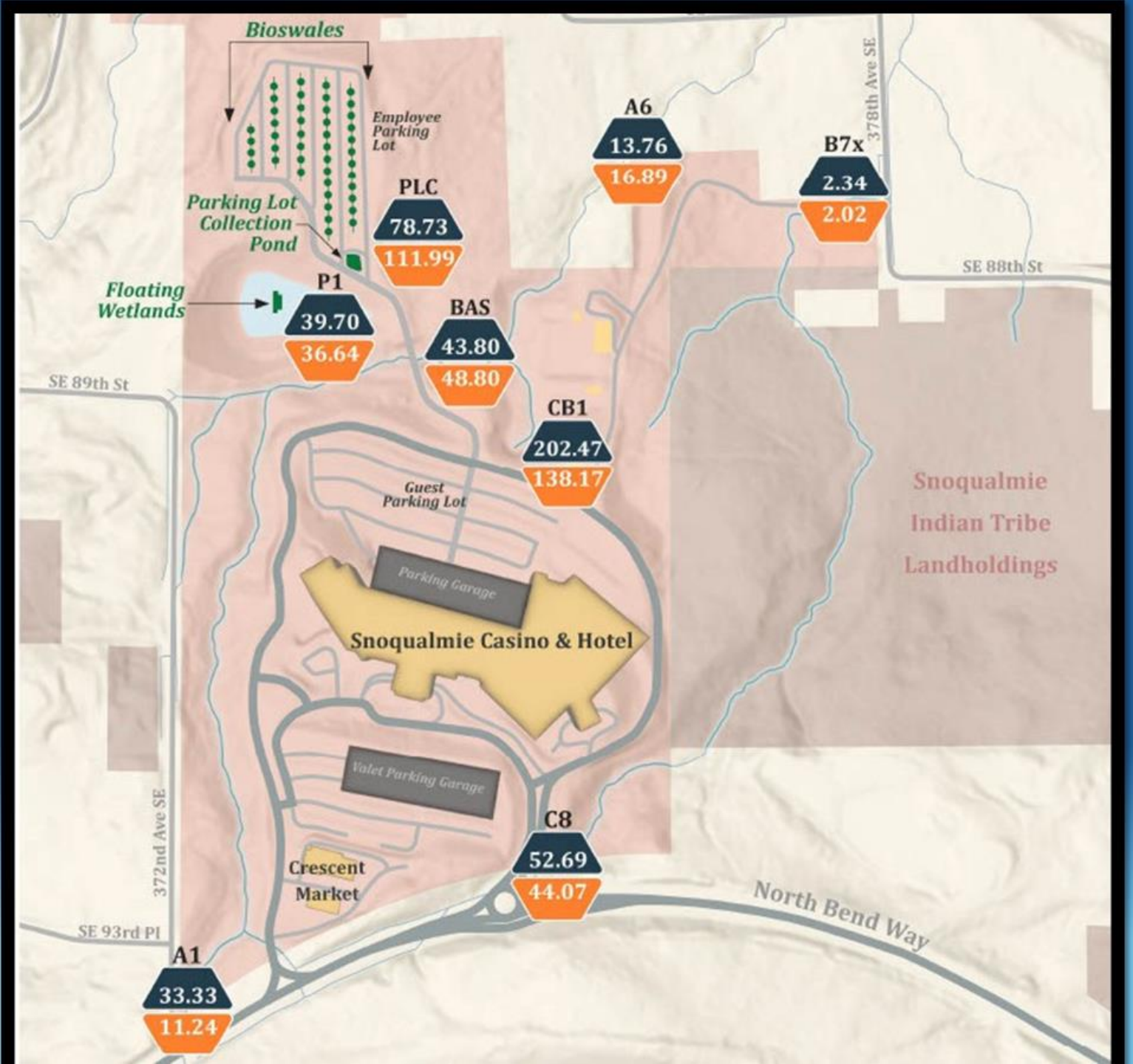
Snoqualmie Indian Tribe

Managing Stormwater in Washington 3/02/2026

DEPARTMENT OF ECOLOGY
State of Washington

SNOQUALMIE TRIBE

la?la gəs



Rain Event Considerations	Quantitative
Minimum Amount of Rainfall	> 0.2 inches, no maximum
Rainfall Duration	1 hour minimum
Sampling Period	One sample at the beginning of storm event (within 4 hours) and following sample (within 4 hours of initial sample).

Early Samples Average (ng/L)

Late Samples Average (ng/L)

Future Work

- 6PPD Project Phase II, working with Department of Ecology
- Replace soil in the Parking Lot Collection Pond with high-performance bioretention mix and replant with native plants
- The Snoqualmie Tribe publicly supports House Bill 2421 to ban 6PPD use in motor vehicle tires

Stormwater BMP Research and Data

Non-Vegetated Bioretention Soil Media Study
City of Spokane and Evergreen StormH20

Project Goal

Evaluate whether non-vegetated bioretention meets TAPE treatment performance goals and 6PPDQ reduction.

Bioretention Soil Media (BSM)

- 60% sand & 40% Compost (60:40 BSM)
- High Performance BSM (HPBSM)

Project Driver

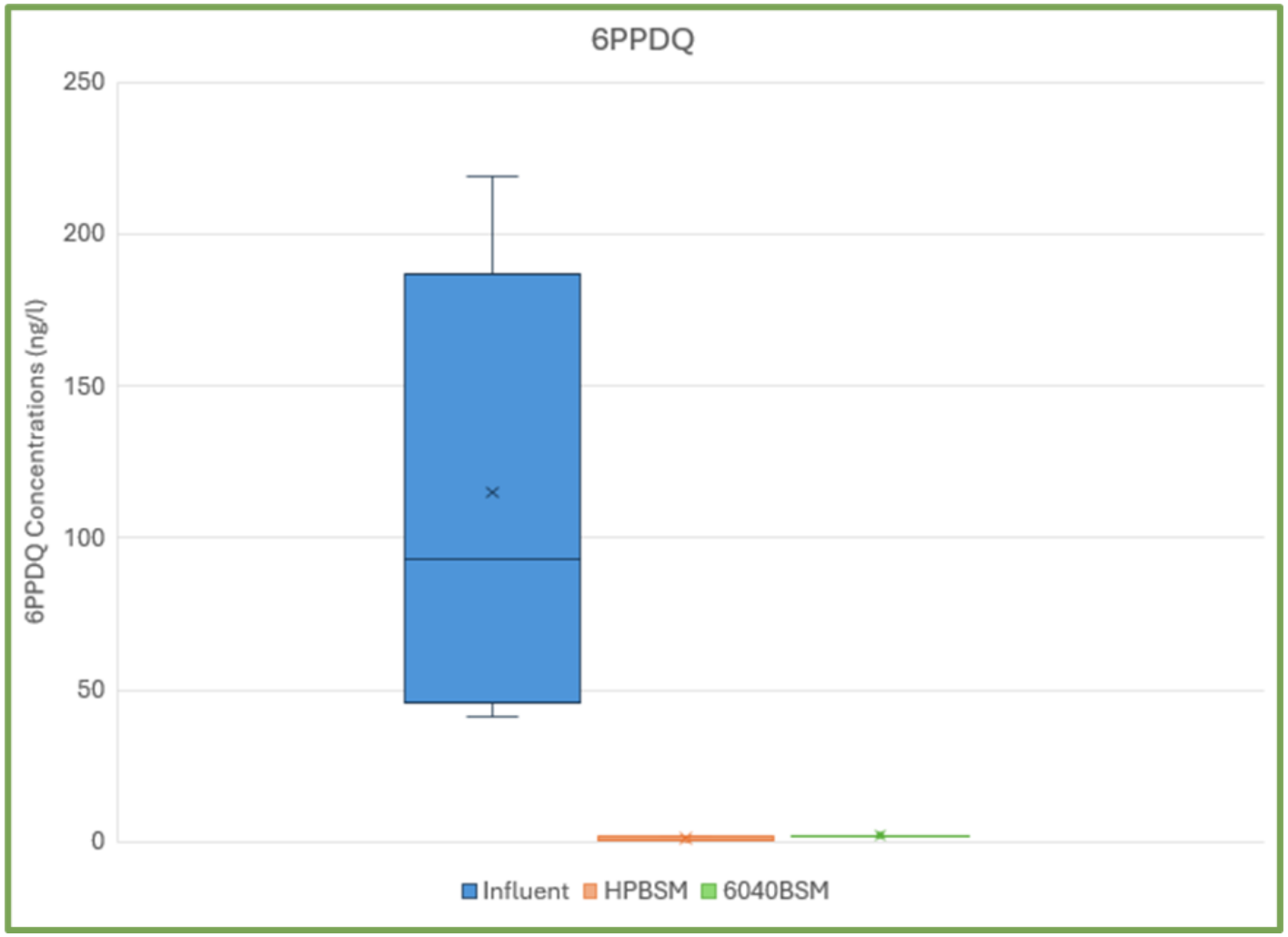
- Non-vegetated desirable for location with hot and dry summer; no Irrigation needed

HPBSM

60:40 BSM

Photo: Evergreen Storm H20

Non-Vegetated Bioretention Soil Media Study: City of Spokane and Evergreen StormH20



Sampling Overview

- Round 1: 2/25 to 5/25
- Round 2: 10/25 to 12/26
- 11 samples collected
- 7 samples included in analysis

Average Removal Efficiencies

HPBSM	60:40 BSM
98%	97%

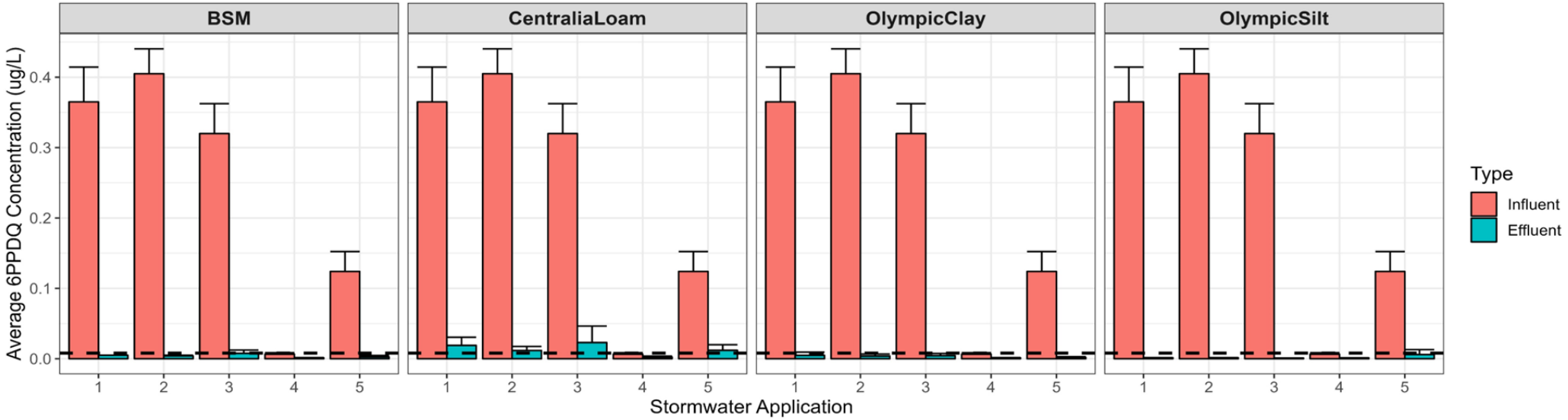
n = 7 samples

The Use of Unamended Soils for Treatment of 6PPDQ
EA Engineering, Science, and Technology, Inc

- Three soils were collected from Capitol State Forest in Olympia, WA.
- Collected soils were analyzed for particle size, pH, CEC, metals, PAHs, and background 6PPDQ concentrations
- A standard bioretention soil mix was procured for comparison to native soils: 60 % mineral aggregate, 40% compost.

Images from Drew Roberts, EA.

The Use of Unamended Soils for Treatment of 6PPDQ
EA Engineering, Science, and Technology, Inc



- Two of the three tested unamended soils had comparable 6PPDQ removal (95% percent reduction) to WA State's BSM
- Effluent concentrations were below proposed aquatic life criteria for 2/3 tested unamended soils

Pierce County Decant Study

- Conducting 6PPDQ sampling and analysis in different stages of stormwater treatment at Pierce County's **decant facility**
- Testing **Granular Activated Carbon (GAC)**

Dumping Pad

Pre-settling (Moat)

Flocculation

GAC Filtration

Results: Pierce County

- 6PPDQ concentration in treatment processes

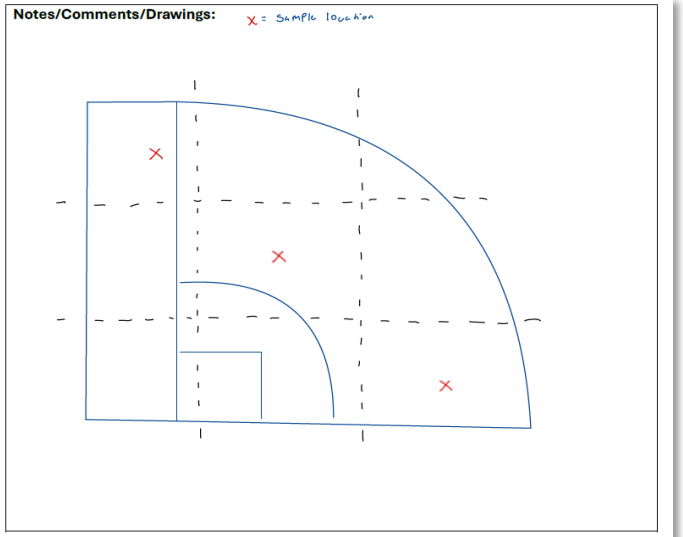
6PPD-quinone (ng/L)				
Sample Date	Pre-Settling Tank	Flocculation Tank	GAC	% Removal
7/11/2025	83.3	49.7	1.88	98%
7/25/2025	89	53.7	2.05	98%
8/22/2024	52.5	31.6	2.2	96%
9/5/2024	143	29.4	2.03	99%
9/19/2024	59.7	39.1	2.61	96%

Note: First sample taken on 7/11/2024 was from existing GAC bed that has been in service for 2 years. All other samples are taken after a new GAC media bed was put in service.

Crumb Rubber Study: NV5

Athletic Fields with Crumb Rubber Application

- 6 locations in 6 different cities (WA & OR)
- 3 different age ranges
  - (<1 yr, ~5 yrs, 10+ years)
- Crumb Rubber Collection (solids + leachate),
  - 3 subsamples each Field
- Stormwater Runoff Grabs
  - 5 per field
- Analysis for 6PPDQ & metals



Crumb Rubber Study: NV5

Leachate Sample Results (SPLP - Artificial Rainwater)

Field Age	N	Detects	Mean Concentration (ng/L)	Median Concentration (ng/L)	Range (ng/L)
<1 yr	6	6	1,897	3,250	257 – 3,780
~5 yrs	6	6	864	885	577 – 1,270
10 years	5	5	333	271	227 - 489

Crumb Rubber Study: NV5

Stormwater Runoff Results (preliminary data)

Field Age	N	Detects	Mean Concentration* (ng/L)	Median Concentration* (ng/L)	Range of Detected (ng/L)
<1 yr	9	7	32.7	13.1	3.3 – 158
~5 yrs	10	3	2.4	2.6	2.1 – 3.0
10 years	9	1	4.4	4.4	4.4

* Based on detected

Questions?

ADA Accessibility

The Department of Ecology is committed to providing people with disabilities access to information and services by meeting or exceeding the requirements of the Americans with Disabilities Act (ADA), Section 504 and 508 of the Rehabilitation Act, and Washington State Policy #188.

To request an ADA accommodation, contact Ecology by phone at 360-407-6831 or email at ecyadacoordinator@ecy.wa.gov. For Washington Relay Service or TTY call 711 or 877-833-6341. Visit Ecology's website for more information.

Shelby Giltner
6PPD Environmental Engineer
shelby.giltner@ecy.wa.gov

Thank you!

Christine Nancarrow
Managing Principal
Pacific Stormwater
Nancarrow@pacificsws.com

Jenée Colton
Supervisor, Toxic Chemical Assessment, King County
Jenee.Colton@kingcounty.gov

Jennifer Hartke
Water Quality Program Assistant
Snoqualmie Tribe
jennifer.hartke@snoqualmietribe.us

Shelby Giltner
6PPD Environmental Engineer
Department of Ecology
shelby.giltner@ecy.wa.gov