Assessing 6PPD-quinone in the Environment

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Department of Ecology – June 2023

Ecology's 3-Part Approach

Reducing sources of 6PPD & evaluating alternatives

AND

Assessing 6PPD-quinone in the environment

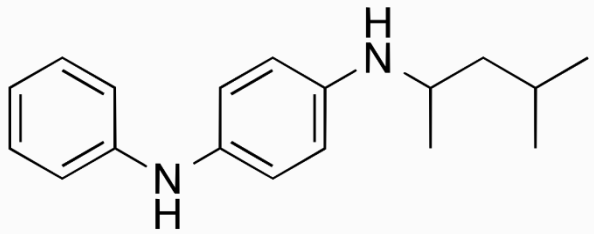
AND

Stormwater Best Management Practices (BMPs)

How 6PPD-quinone forms

6PPD

N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine



- Highly reactive
- Difficult to measure

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ozone and tire wear particles

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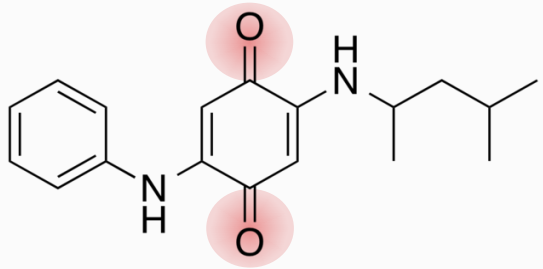
6PPD-quinone

N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine-quinone



- More stable
- Easier to measure

*Discovered in 2020 by Tian et al. 2020, 2022

Status of laboratory accreditation

- 6PPD-q Chemical Quantitation Accreditation
  - Led by Ecology's Laboratory Accreditation Unit
  - 4 labs submitted Standard Operating Procedures
  - 2 labs submitted chemistry data packages
  - As of May 2023, no lab is accredited

Method development

- Developed a laboratory method for measuring the concentration of 6PPD-q in water
- Reporting limit is much lower than the reported LC50
- Liquid Chromatography Tandem Mass Spectrometry (LCMSMS)

DEPARTMENT OF ECOLOGY
State of Washington

Next steps

- Method for sediment
- Field sampling methods
- Field study designs
- Add additional tire contaminants

Mapping and monitoring

1. Map existing data

2. Conduct initial screening studies

3. Collect baseline data

4. Identify contamination hotspots

5. Monitor changes in watersheds.

Assessing vulnerable areas

- Evaluating 6PPD-quinone in the environment
- Occurrence
- Exposure pathways
- Fate and transport
- Persistence

Graphic Mugdha Flores and Rhea Smith, WA Department of Ecology

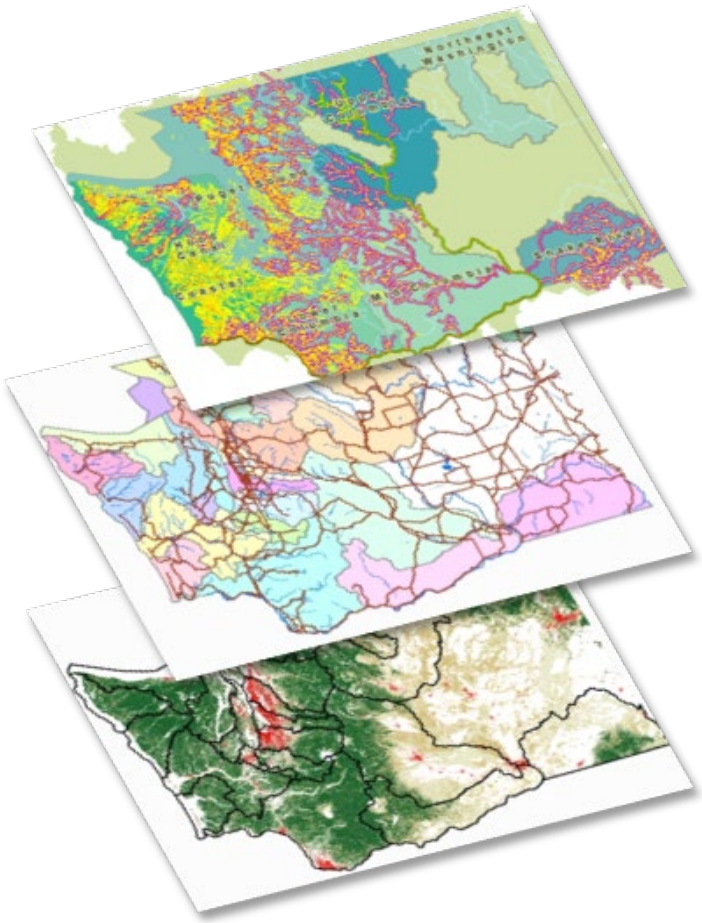
Initial monitoring in vulnerable areas

Vulnerable fish species	LC-50 (µg/L)
Coho salmon	< 0.10
White-spotted char	0.51
Steelhead/rainbow trout	0.60
Brook trout	0.59 – 1.00
Chinook salmon	> 10.00
Sockeye and chum salmon	> 10.00
Zebrafish	> 10.00
Arctic char and white sturgeon	No mortality even at 14.20 µg/L

Focus on the habitats that support the most sensitive species.

Data: McIntyre et al., 2022 Memo for 6PPD Proviso, Tian et al. 2022, French et al. 2023, Brinkmann et al., 2022.

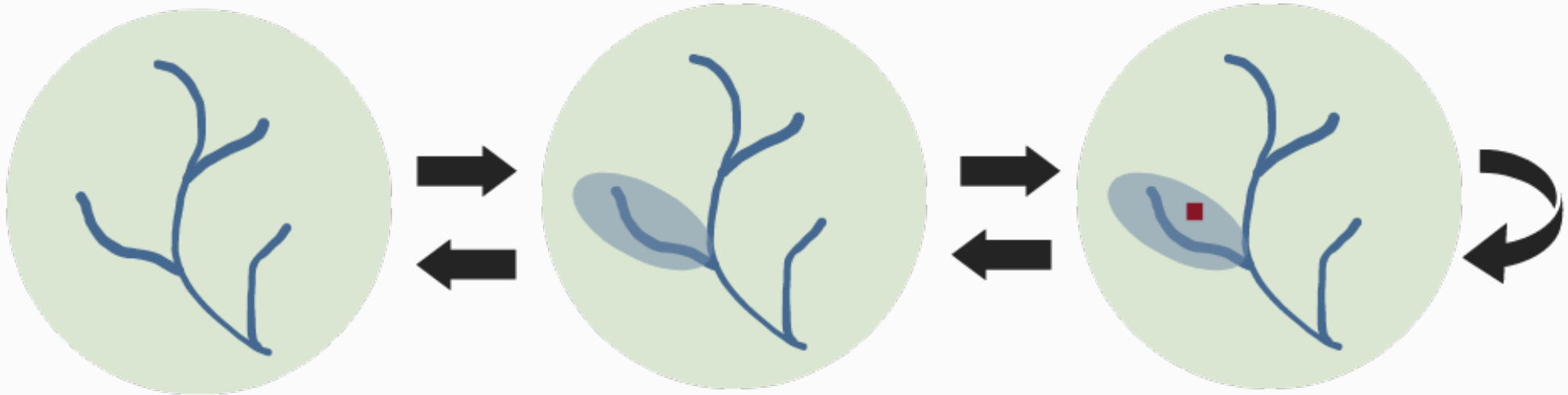
GIS layers help identify areas of concern



- Salmon Distribution
- Transportation
- Watershed Characteristics

Next Steps (continued)

Multi-scale integration and planning



Broad-scale
100s of sq. miles

Mid-scale
1 to 100 sq. miles

Fine-scale
Less than 1 sq. mile

Concentrations of 6PPD-q in streams vary widely

- Level of traffic (source)
- Impervious surfaces (land cover)
- Precipitation (transport)
- How 6PPD-q binds to other particles (TSS transport)
- Dilution factor (big river vs. small river)
- Conveyance and flow rates

Photo by NOAA Fisheries

Monitoring vulnerable areas

- Funding research to fill in the many data gaps
- Conducting field studies to further develop methods for evaluating 6PPD-q exposure in salmon-bearing streams
  - Stream reconnaissance
  - Device study to compare active and passive sampling methods

Photo by Rhea Smith, Ecology

Next steps

- Exploratory research to fill in data gaps
- Opportunistic studies
- Watershed bioassay pilot studies
- Focused studies

ITRC Tire Anti-Degradants (6PPD) Team Assessment Subgroup

https://itrc.org/home

- Federal, State, and Tribal Governments, industry, academia, nonprofit, and consultants
- Synthesizing and communicating what we know and what we don't know
- Assessment Subgroup ultimate questions:
  - How do we measure 6PPD-quinone in the environment?
  - Where and when is 6PPD-quinone impacting aquatic life?
  - Where should we focus our solutions?

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