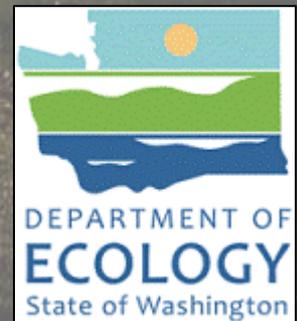


Atmospheric Deposition of Toxics

**William Hobbs and Brandee Era-Miller
Environmental Assessment Program**



Internal memo: Statewide Atmospheric Deposition of Toxics Review and Scoping Study

Aims:

- Review and assess the state-of-the-science for atmospheric deposition of toxic chemicals in Washington.
- Broadly outline the necessary scope to quantify atmospheric deposition at the local, regional, and statewide scale.

Relevance to SRRTTF:

- Summarizes the available data on the deposition of PCBs in Washington

Take Home:

- There is a measurable atmospheric contribution of toxics worth quantifying
- In Spokane, it is likely minor and related to indirect inputs
- A thorough assessment of atmospheric deposition requires an extensive field and lab program

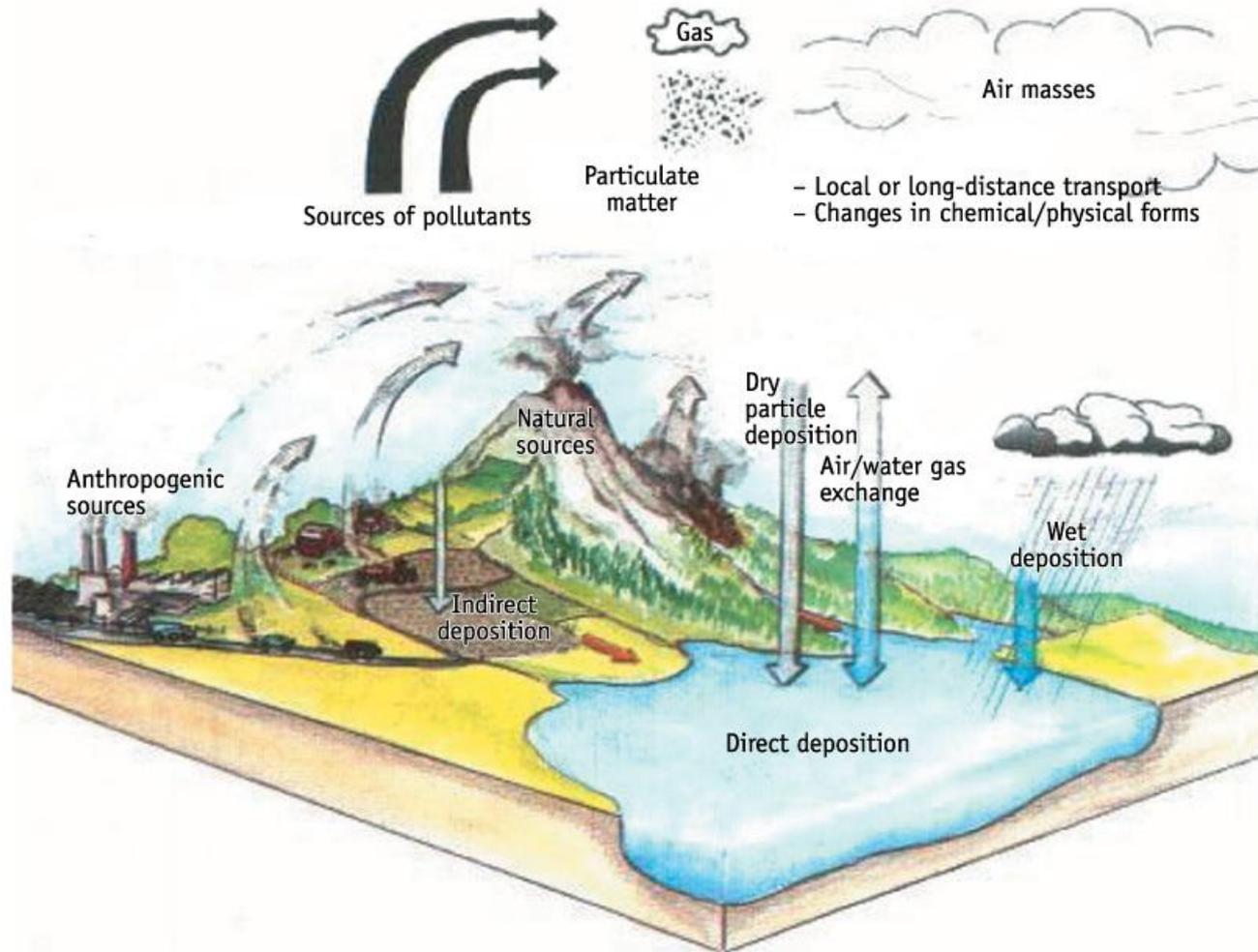
Background

Direct deposition:
deposition direct to the
water surface (lakes)

Indirect deposition:
deposition to the
watershed and transport
to waterbodies (runoff)

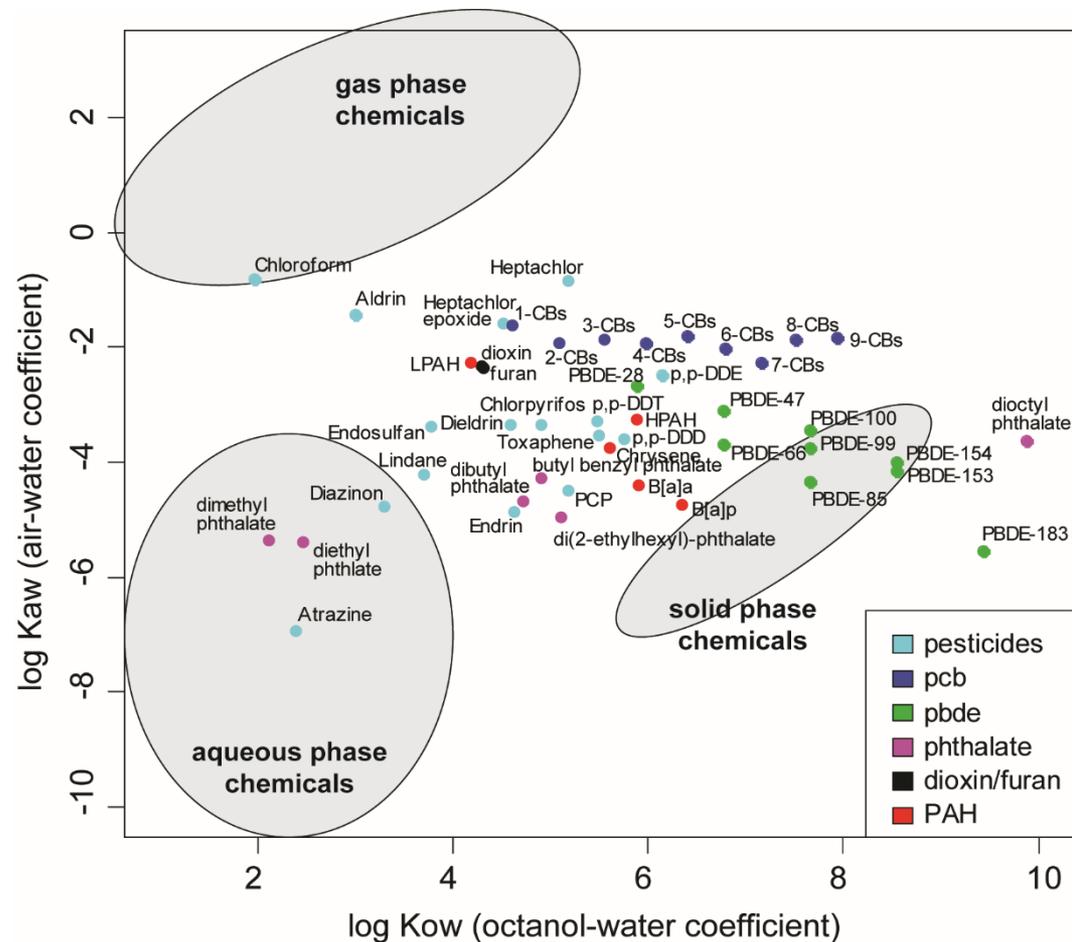
Wet deposition: rain,
snow, fog, and clouds

Dry deposition: particles
(dust or soot)



Background

- Atmospheric deposition of chemicals both directly and indirectly (i.e., to a watershed) to surface waters in Washington has not been an area of active research.
- Wet deposition (precipitation); dry deposition (dust); gas phase (diffusion into wet and dry)
- Behavior of chemicals is controlled by physical structure
- Memo highlights many chemicals, but data constraints mean the focus is on PCBs and mercury



Background

- Only a handful of studies in Washington with measurements of atmospheric deposition
- Large amount of uncertainty
- One long-term atmospheric deposition site in Seattle for mercury

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the
FEDERAL HIGHWAY ADMINISTRATION

**Methodology and Significance of
Studies of Atmospheric Deposition in
Highway Runoff**

Open-File Report 01-259

A Contribution to the
NATIONAL HIGHWAY RUNOFF DATA AND METHODOLOGY SYNTHESIS



U.S. Department
of Transportation



USGS
science for a changing world



Control of Toxic Chemicals in Puget Sound,
Phase 3: Study of Atmospheric Deposition
of Air Toxics to the Surface of Puget Sound
Publication no.10-02-012



DEPARTMENT OF
ECOLOGY
State of Washington



Pacific Northwest
NATIONAL LABORATORY



NAVFAC
Naval Facilities Engineering Command

**Lower Duwamish Waterway
Source Control:
Supplemental Bulk
Atmospheric Deposition
Study Final Data Report**

May 2015

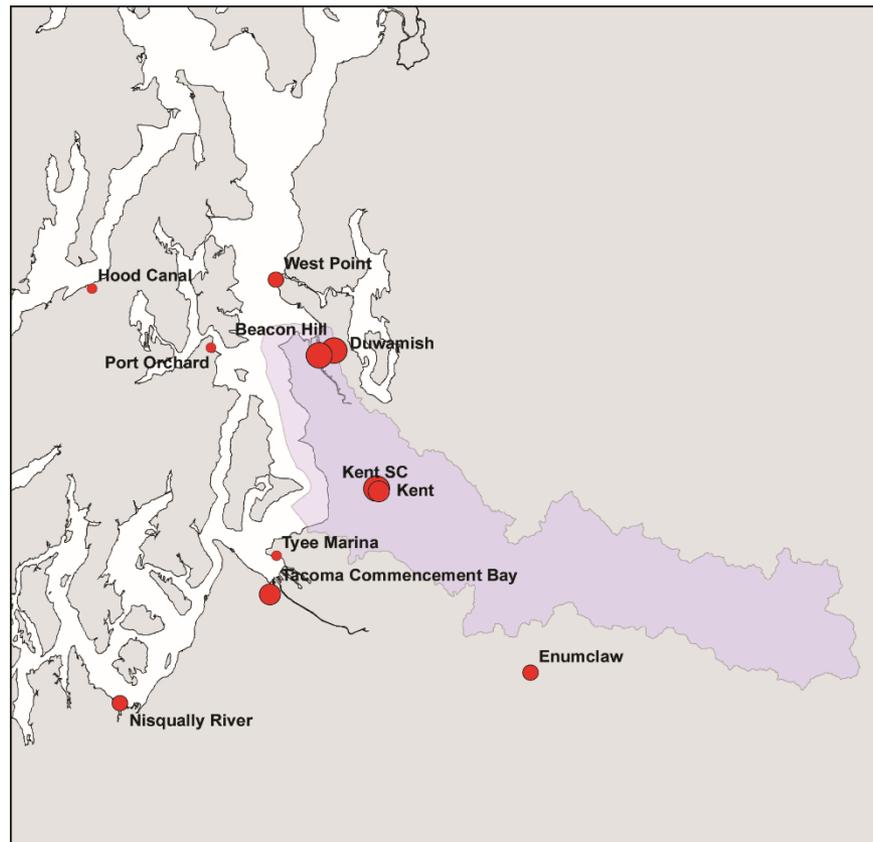


King County

Department of Natural Resources and Parks
Water and Land Resources Division
Science and Technical Support Section
King Street Center, KSC-NR-0600
201 South Jackson Street, Suite 600
Seattle, WA 98104
206-477-4800 TTY Relay: 711
www.kingcounty.gov/EnvironmentalScience

Current Data

- Largest datasets exist for Puget Sound region
- For PCBs – urban areas are local sources for bulk (wet and dry) deposition



Current Data



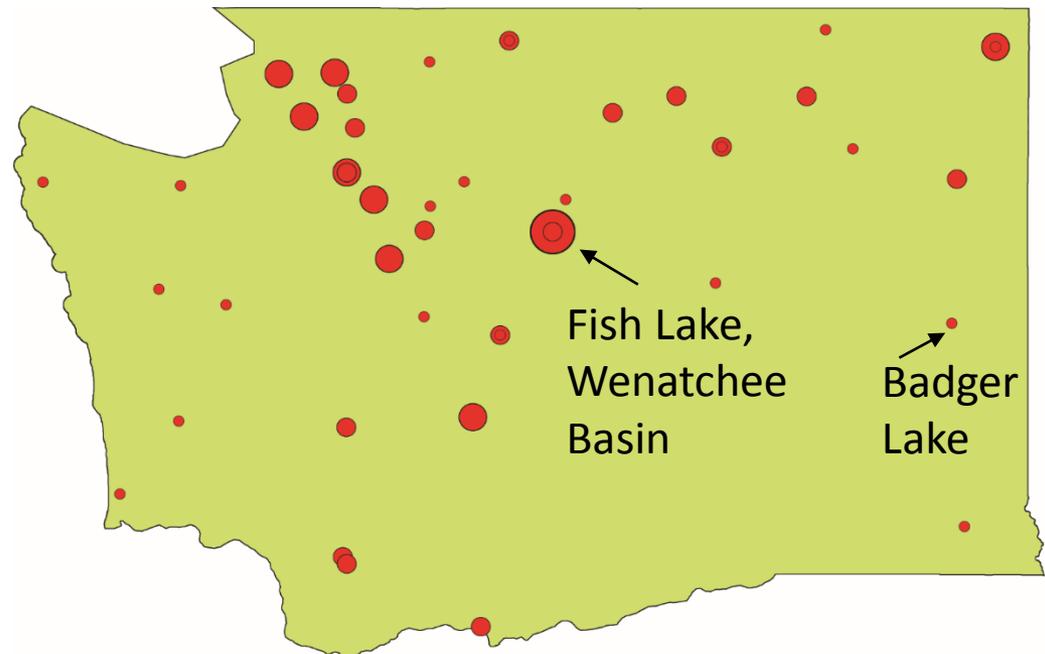
An Assessment of the PCB and Dioxin Background in Washington Freshwater Fish, with Recommendations for Prioritizing 303(d) Listings



January 2010

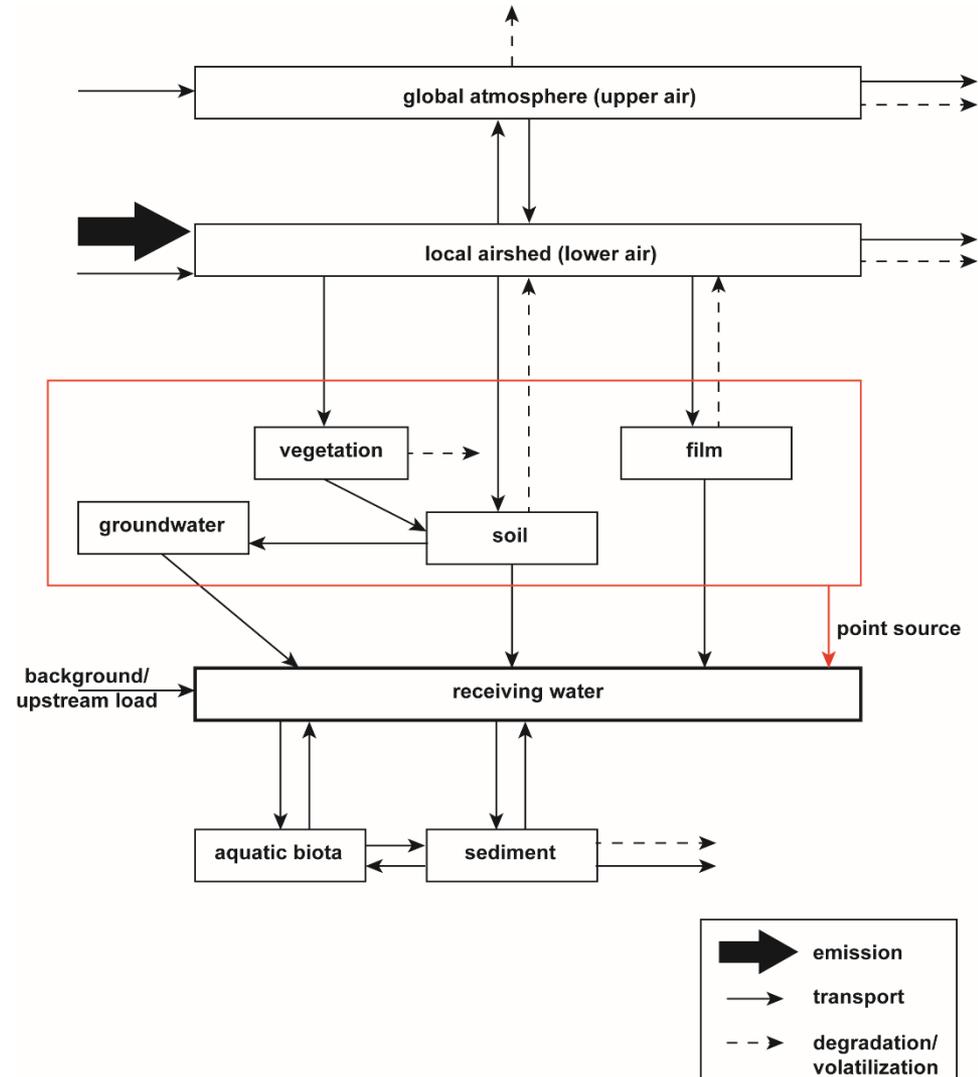
Publication No. 10-03-007

- On a regional scale, we know that atmospheric deposition is an important mechanism for delivery of toxics to lakes, PCBs and Hg data.
- Johnson et al (2010) – highest concentrations found on the east slope of the Cascades



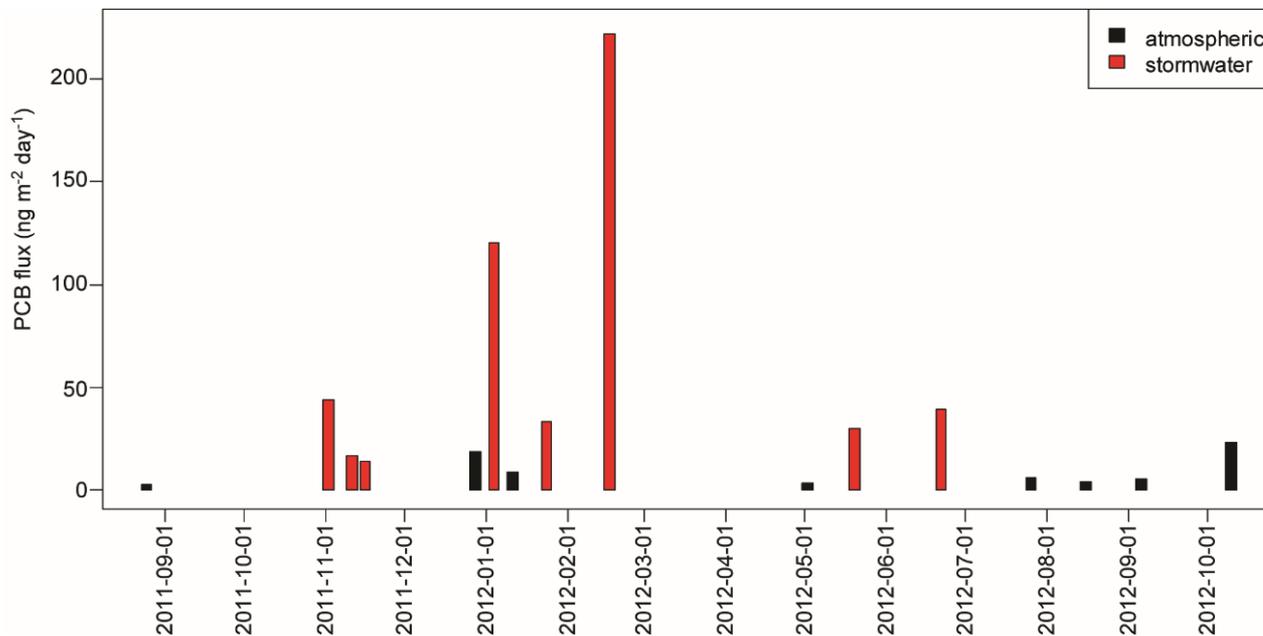
Local Deposition

- The degree to which atmospheric deposition influences the discharge or runoff from an urban site will vary with location, season, and land use.
- Vast majority of emissions are transferred to the upper air.
- Films on impervious surfaces bind toxics until wash-off occurs
- For rivers, the majority of toxics are likely “indirect” inputs.



Indirect Deposition

- No work has been completed to evaluate indirect deposition to watersheds and transport of toxics to waterbodies.
- Would require a watershed model to predict fate and transport or extensive monitoring to infer indirect deposition (e.g. Delaware Basin – Rodenberg, Rutgers University)
- Data collected from Lower Duwamish suggests that indirect deposition may be a measurable fraction of the stormwater PCB load



Indirect Deposition

Lower Duwamish Waterway Air Deposition Scoping Study

Data Gaps Report

Prepared for



Toxics Cleanup Program
Northwest Regional Office
Washington State Department of Ecology
Bellevue, Washington

Prepared by



18912 North Creek Parkway, Suite 101
Bothell, WA 98011



115 2nd Avenue N, Suite 100
Edmonds, WA 98020

December 2013

- Scoping study completed for Lower Duwamish
- Modeled emissions
- The ranges of % contribution to “lateral” loads from the landscape were ~10% to >100%
- Similar conclusions to other studies – too much uncertainty

Indirect Deposition

- Example from memo – back of the envelope using King Co and USGS data

Table 5: Estimates of indirect atmospheric deposition of PCBs in the Green-Duwamish Watershed.

Land use	pass-through rate	atmospheric PCB flux (ng m ⁻² -day) ^a	land use area (km ²) ^a	indirect load (g day ⁻¹)
forested	5%	0.71	786	0.028
commercial/industrial	75%	7.51	75	0.422
residential	50%	4.26	223	0.475
agricultural	25%	0.71	13	0.002
transportation	75%	7.51	86	0.484
cumulative indirect load				1.412
median instantaneous load ^b				5.136
% indirect deposition				27%

^a Colton et al., 2013

^b Conn and Black, 2014

Spokane

- Dry deposition is likely an important contribution to atmospheric deposition
- Does fugitive dust classify as atmospheric deposition?
- Evapotranspiration likely has a big impact on runoff – precipitation relationships, which affects the build-up of toxics and our ability to predict stormwater loads
- Atmospheric deposition may contribute directly to Lake Coeur D'Alene, but would be accounted for by Stateline sampling site on the river.

Upcoming EAP project to measure bulk deposition of PCBs in Spokane

Measuring Atmospheric Deposition in the Spokane River Watershed

Sampling Plan:

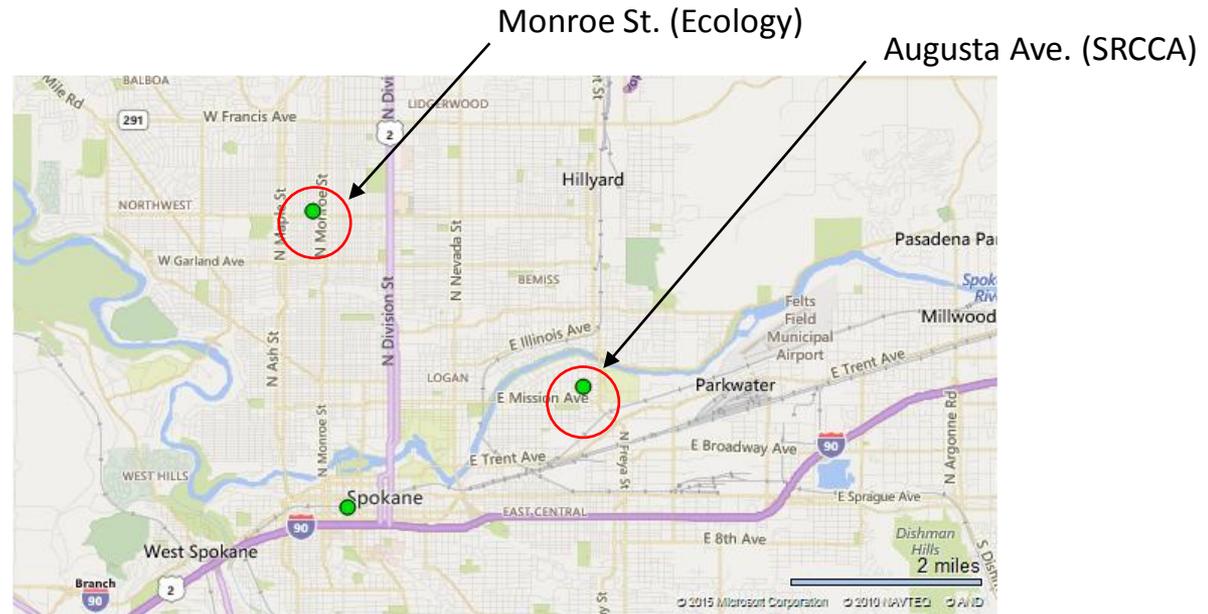
- Bulk Deposition (Wet + Dry)
- Similar to King County and Puget Sound Studies
- 1 year of Monitoring
- Covering >3 seasons (3 – 5 month deployments)
- Analyze for PCB congeners
- QAPP in late 2015
- Start sampling in early 2016

2 Urban Sites:

- Monroe St. (urban residential)
- Augusta Ave. (urban industrial)

1 Background Site:

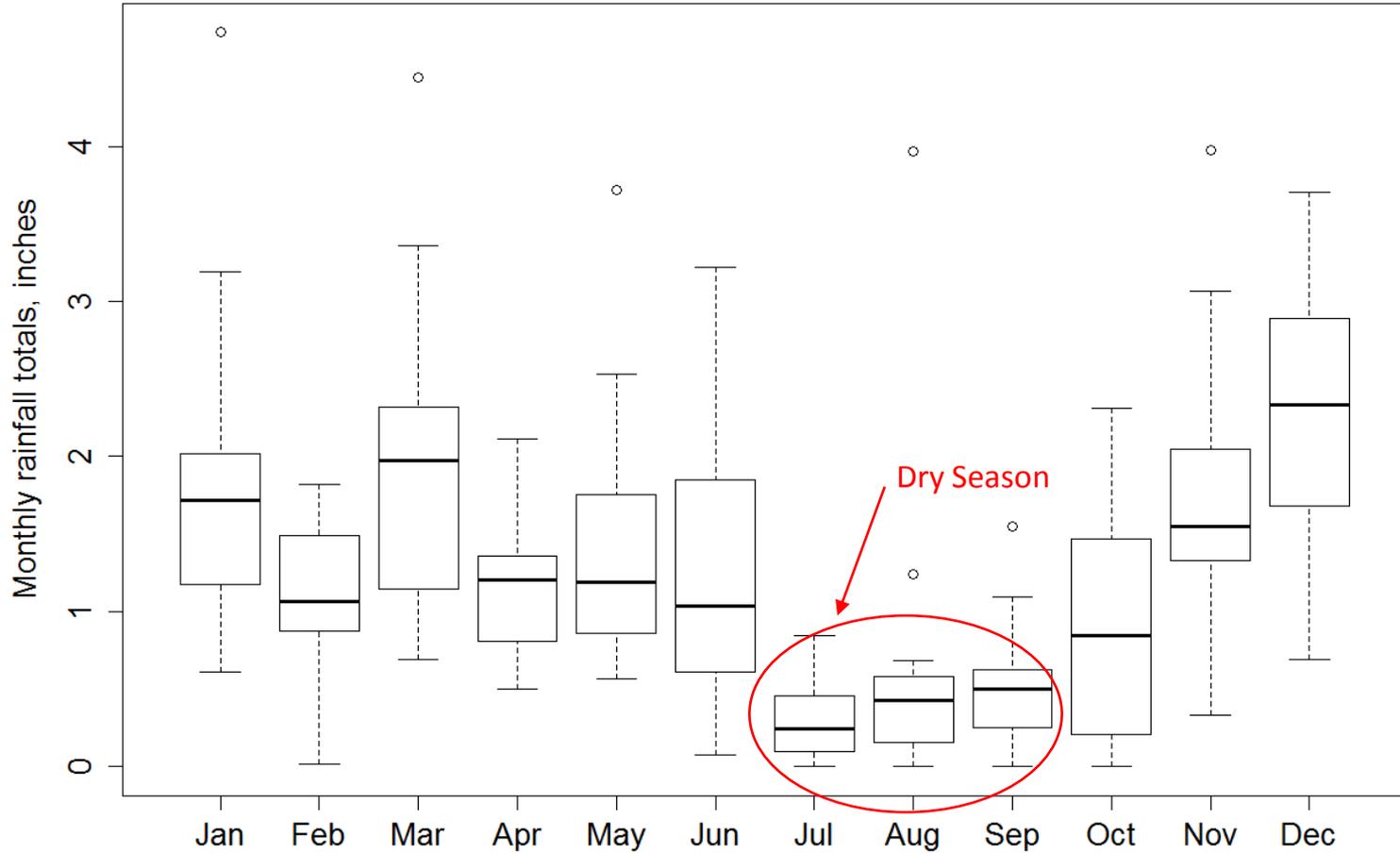
- Cheney – Turnbull NWR



Bulk Sampler (used by King County)



Spokane Airport: Jan 2000- Oct 2015



Secondary Study Objective:

- Estimate the % input of PCBs to Cochran basin stormwater from atmospheric deposition
- Use bulk deposition data from the Monroe St. monitoring site
- Use PCB and flow data from the City of Spokane's Cochran basin
 - Draft QAPP currently under review
 - Monitoring to start in April 2016

Questions?

