CONTROL OF TOXIC CHEMICALS IN PUGET SOUND

ASSESSMENT OF SELECTED TOXIC CHEMICALS IN THE PUGET SOUND BASIN, 2007-2011

Water Quality Partnership Meeting
March 15, 2012

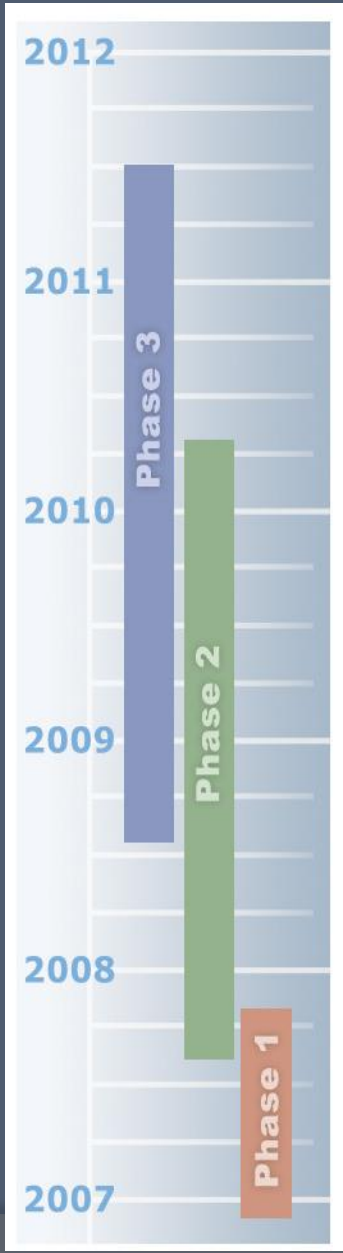
What will be covered …

- Background on the Puget Sound Toxics Loading Analysis (PSTLA)
- Key Elements of the Assessment Report
  - Sources
  - Loading and Pathways
  - Hazard Evaluation
- Approach to Prioritizing Near-Term Actions

Toxics Chemicals in Puget Sound

- ✓ Where do they come from?
- ✓ How much is being delivered?
- ✓ What delivery pathways contribute to the loading?
- ✓ What is the relative toxic hazard posed by these chemicals at observed concentrations?

Phased Approach



Targeting Priority Toxic Sources (2008-2011)

- Surface runoff
- Atmospheric deposition
- Wastewater discharges
- Ocean exchange
- Groundwater
- Pelagic Food Web
- PPCPs in WWTPs
- Primary Sources

New Monitoring Data

Improved load estimates (2008-2010)

- Surface runoff
- Wastewater discharges
- Review of Ocean data
- Sediment-Biota Flux

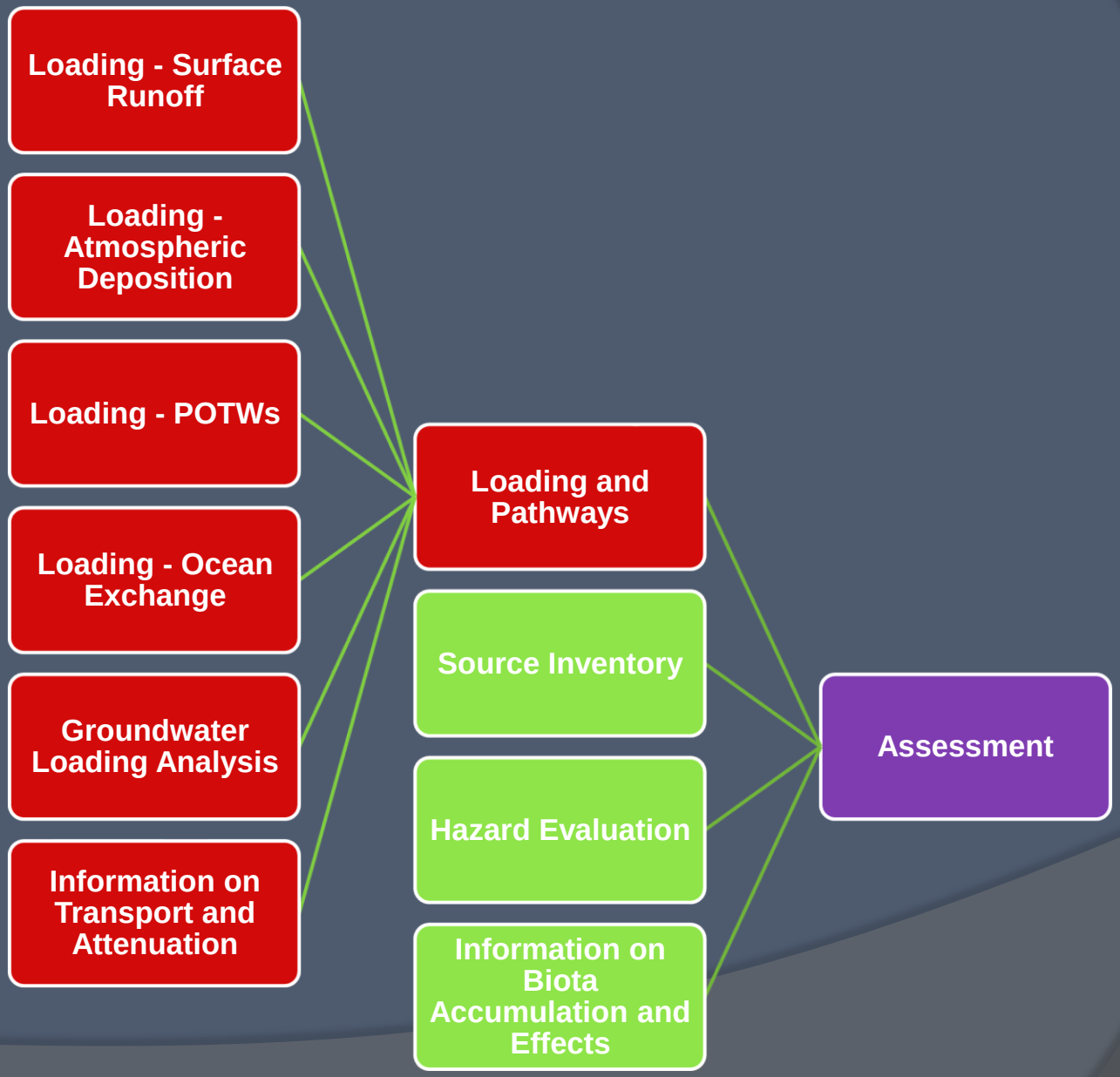
Existing Data and Modeling

Initial estimates and data gaps (2007)

- Surface runoff
- Atmospheric deposition
- Wastewater discharges
- Combined sewer overflows
- Spills to marine waters

Existing Data

Phase 3 Components Targeting Priority Toxic Sources



Chemicals Evaluated

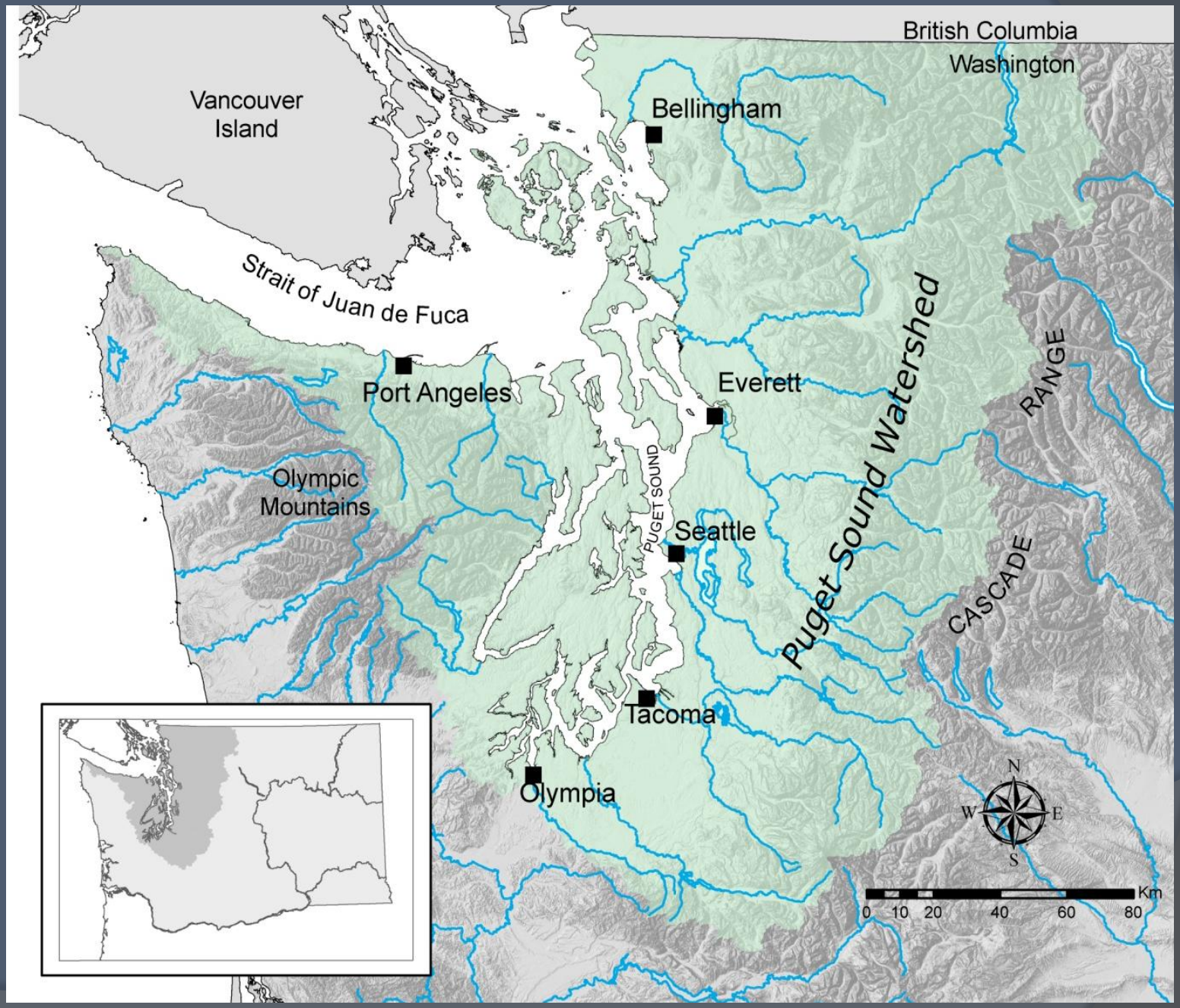
Metals

- Arsenic
- Cadmium
- Copper
- Lead
- Mercury
- Zinc

Organics

- PCBs
- PBDEs
- Dioxins and Furans
- DDT and metabolites (DDD and DDE)
- PAH (LPAHs, HPAHs, and cPAHs)
- Bis (2-ethylhexyl) phthalate
- Triclopyr
- Nonylphenol
- Petroleum

Known or suspected to cause harm in Puget Sound
Representative of pathways


British Columbia
Washington
Vancouver Island
Bellingham
Strait of Juan de Fuca
Port Angeles
Everett
Puget Sound Watershed
RANGE
Olympic Mountains
PUGET SOUND
Seattle
CASCADE
Tacoma
Olympia
N
W
E
S
Km
0 10 20 40 60 80

Toxic Chemicals in Puget Sound

Where do they come from?

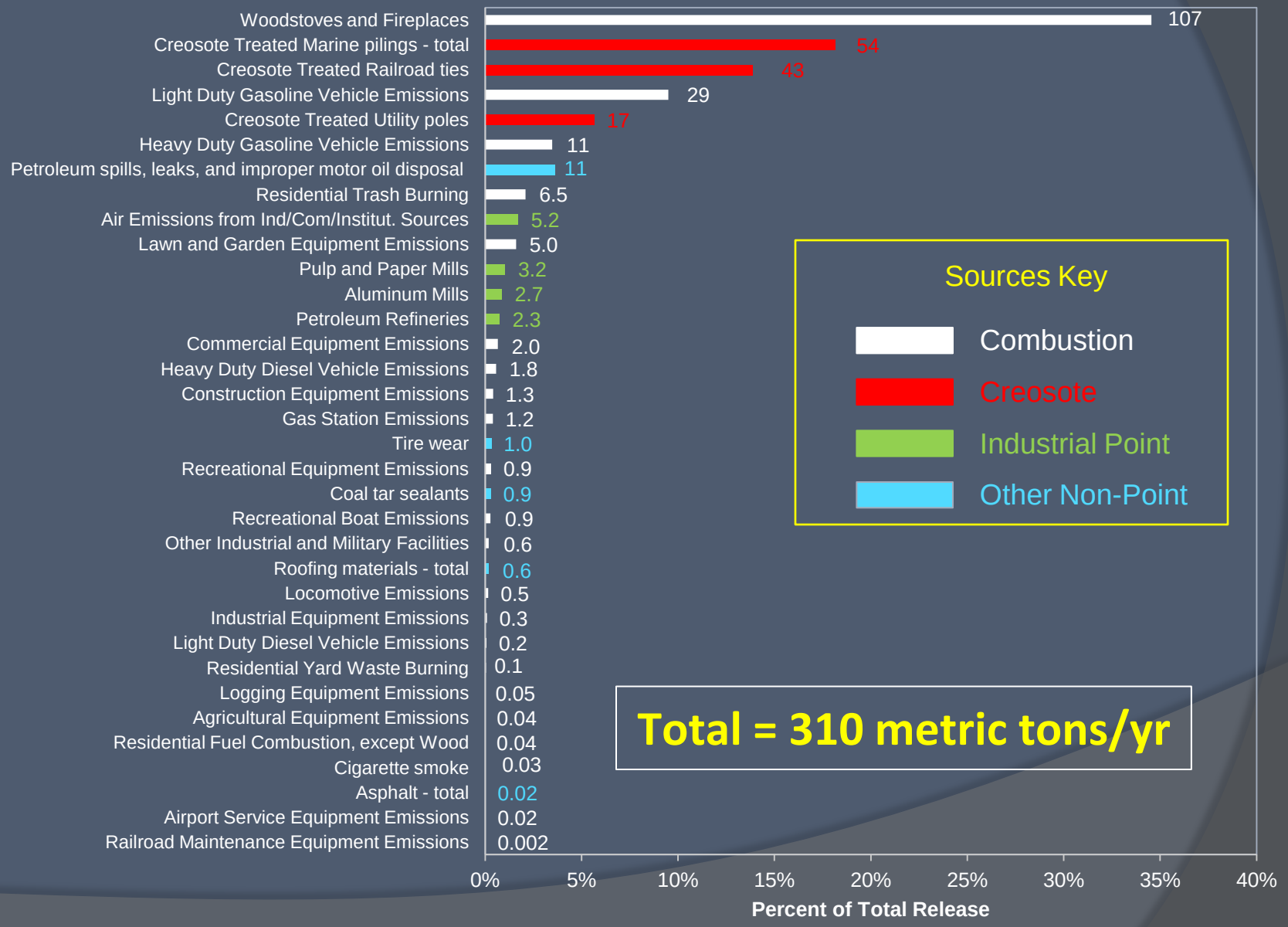
Primary Sources

- Initial release estimate from sources
  - Release estimate for unit or activity x number of units or activity in study area
  - Example: brake pad wear x number of vehicle miles
- Did not included:
  - Pathways (e.g. stormwater)
  - Natural Sources (metals, some PAH)
  - Release from historical contamination (e.g. clean-up sites)

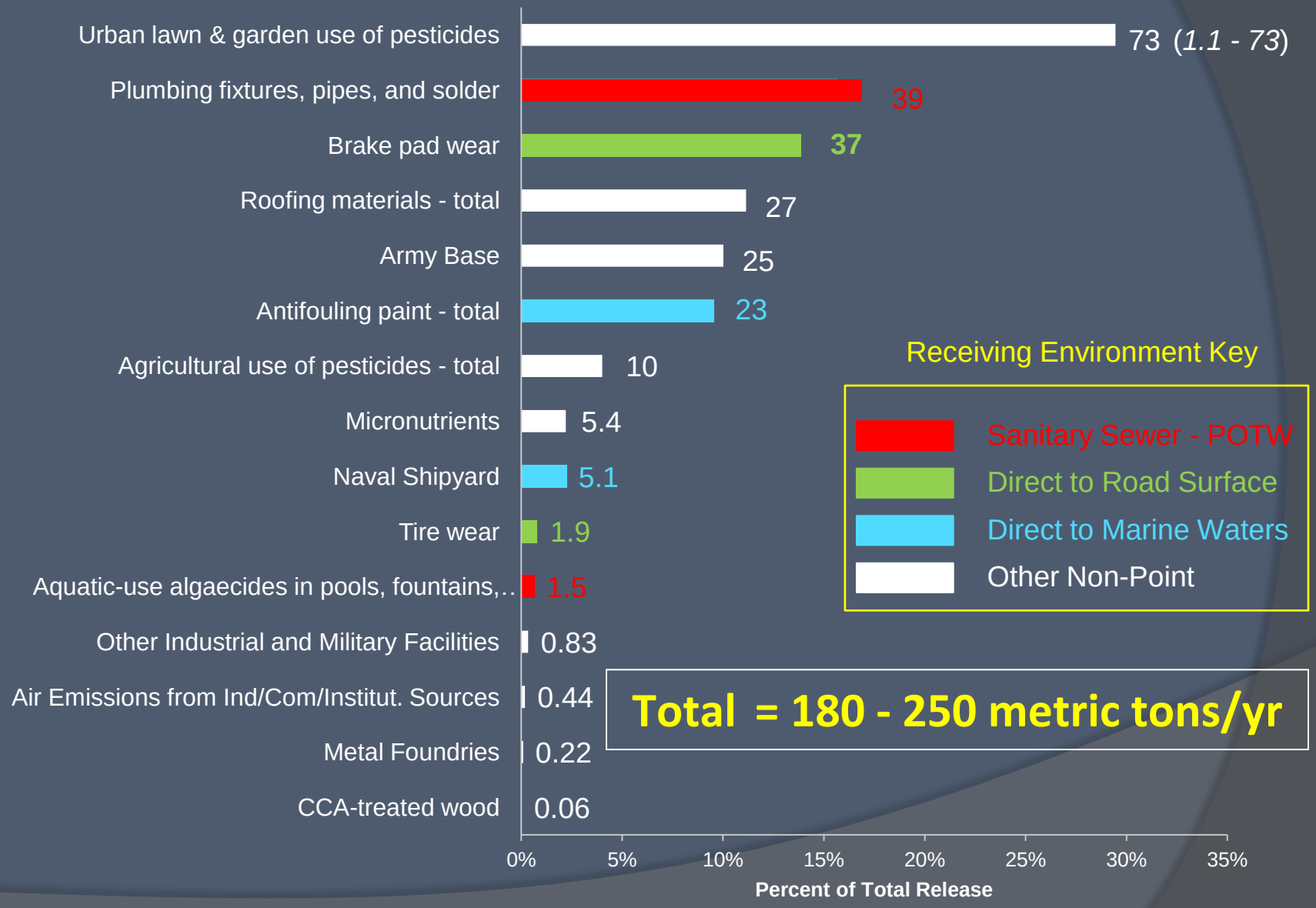
Sources Assessed

- Buildings and grounds
- Industrial and institutional point sources
- Miscellaneous material use
- Non-point combustion sources
- Pesticides and wood preservatives
- Vehicles and roads
- Personal care products
- Outdoor product use

PAH Releases



Copper Releases



Total Releases to Puget Sound Basin (metric tons/yr)

Petroleum	10,000
Zinc	2,000
Lead	500
Total PAH	300
Copper	200
Triclopyr	100
Total Phthalates	40
Total PCB	2
Cadmium	1
Arsenic	0.8
Total PBDE	0.7
Mercury	0.5
Nonylphenol	0.2
Dioxins/Furans	0.00001

Major Sources for Releases >10 metric Tons/yr

COC	Major Sources
Petroleum	Motor oil drips and leaks, and improper disposal of used oil Gasoline spillage during fueling
Zinc	Roofing material leaching Vehicle tire abrasion
Lead	Ammunition and hunting shot use Loss of fishing sinkers and wheel weights Roofing material leaching Aviation fuel combustion
Total PAHs	Woodstoves and fireplace combustion emissions Vehicle combustion emissions Creosote-treated pilings, railroad ties, and utility poles
Copper	Pesticides use on urban lawns and gardens[b] Residential plumbing component leaching Brake pad abrasion Roofing material leaching Vessel anti-fouling paint leaching
Triclopyr	Herbicide use on crops and golf courses
Phthalates	Personal care products Polymer (primarily PVC) off-gassing Industrial, commercial, and institutional air emissions Roofing material leaching

Toxic Chemicals in Puget Sound

How much is being delivered?

What delivery pathways contribute to the loading?

Puget Sound Loading Estimates

Surface Runoff (measured)

- Concentrations based on actual monitoring in Snohomish and Puyallup watersheds
- Land use based sampling (forest, agricultural, residential, and commercial/industrial
- Unit area loadings were used to extrapolate to up to watershed and Puget Sound Scale
- Precipitation based flow estimates used for extrapolating

POTWs (measured)

Direct Groundwater discharge (estimated)

Atmospheric Deposition (measured)

Total Loads (metric tons/yr)

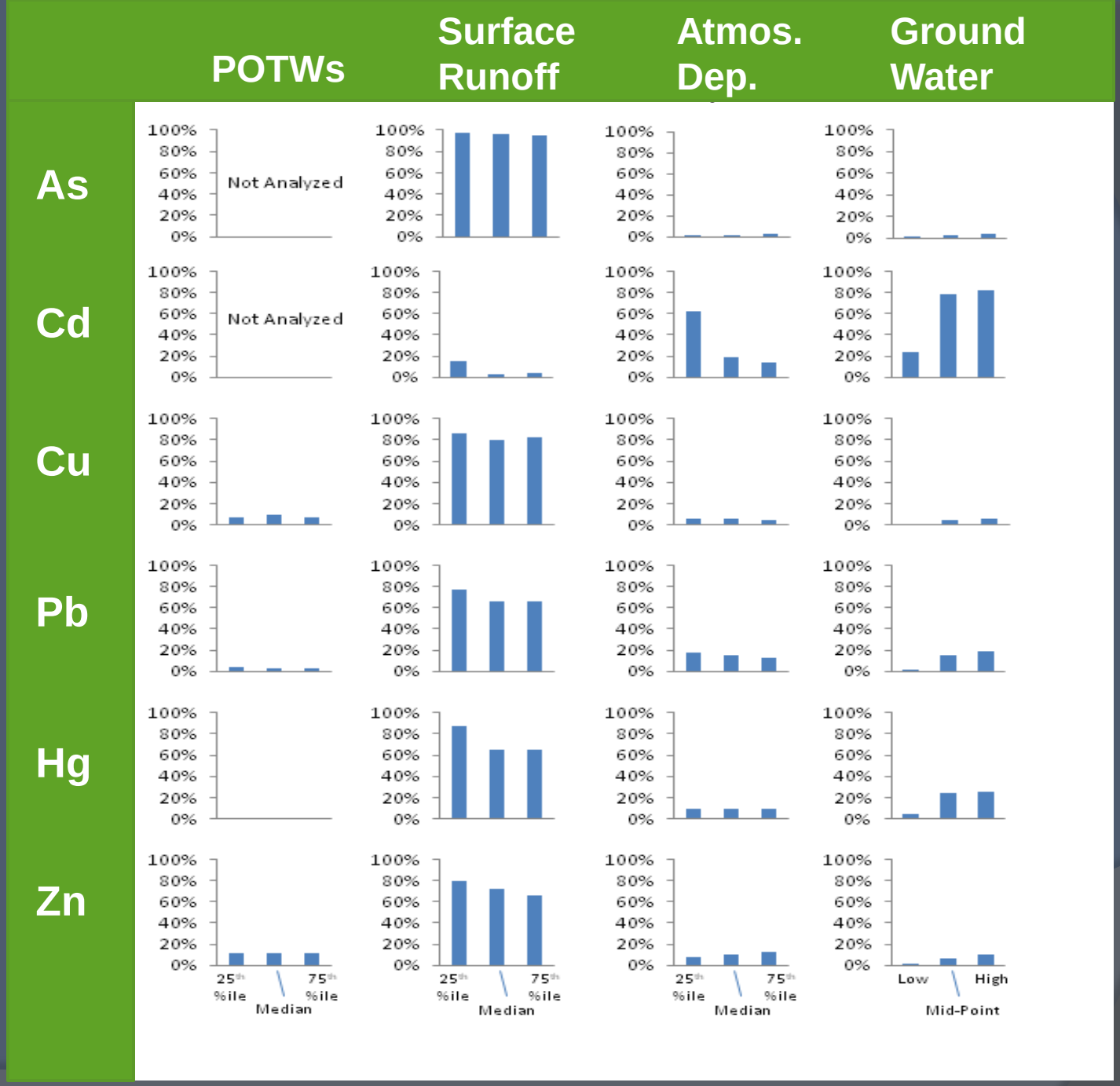
Petroleum	330 - 550
Zinc	140 - 240
Copper	33 - 80
Arsenic	14 - 25
Lead	4 - 12
DEHP	2 - 3
Total PAH	0.2 - 1
Triclopyr	0.6 – 0.7
Cadmium	0.05 – 0.5
Mercury	0.1 – 0.4
Total PBDE	0.03 – 0.05
Nonylphenol	0.02
Total DDT	0.002 – 0.03
Total PCB	0.003 – 0.02
Dioxins/Furans	NA

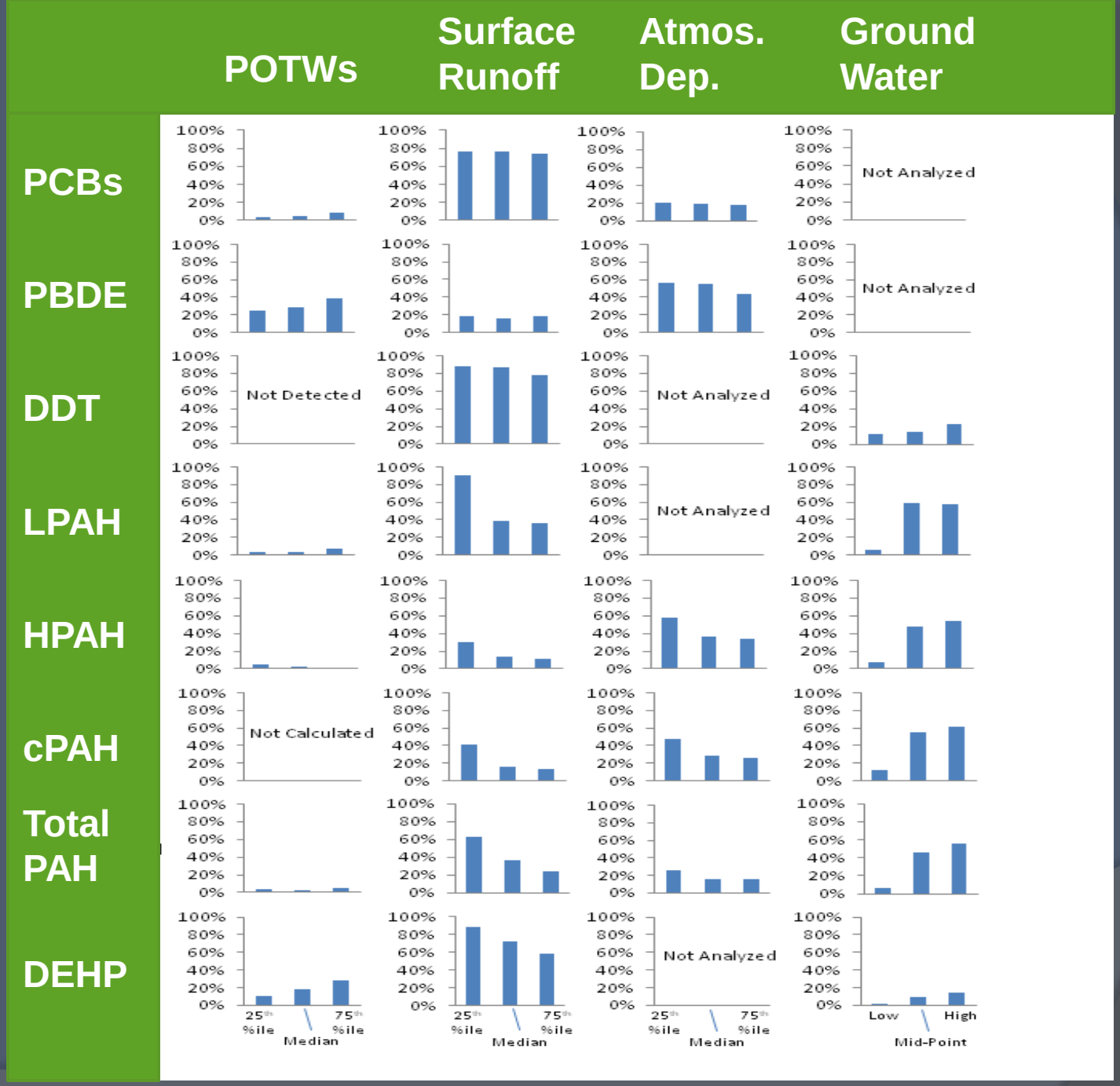
Releases and Loads for Puget Sound Basin – Metals (metric tons/yr)

COC	Releases	Loads	Major Pathway(s)
Arsenic	0.8	14 – 25	Surface Runoff
Cadmium	1.0	0.05 – 0.5	Groundwater Atm. Deposition
Copper	180 - 250	30 – 80	Surface Runoff
Lead	520	4 – 12	Surface Runoff
Mercury	0.5	0.1 – 0.4	Surface Runoff
Zinc	1,500	140 - 200	Surface Runoff

Releases and Loads for Puget Sound Basin – Organics (metric tons/yr)

COC	Releases	Loads	Major Pathway(s)
Total PCBs	2	0.003 – 0.02	Surface Runoff
Total PBDEs	0.7	0.03 – 0.05	Atm. Deposition POTWs
PCDD/Fs	0.00001	NA	NA
Total DDT	NA	0.002 – 0.03	Surface Runoff
Total PAHs	310	0.2 – 1.0	Groundwater Surface Runoff
DEHP	16	2 – 3	Surface Runoff
Triclopyr	150	0.6 – 0.7	Surface Runoff
Nonylphenol	0.18	0.02	Surface Runoff
Petroleum	9,300	330 – 500	Surface Runoff


POTWs
Surface Runoff
Atmos. Dep.
Ground Water
As
Cd
Cu
Pb
Hg
Zn
Not Analyzed
Not Analyzed
100%
80%
60%
40%
20%
0%
25th %ile
Median
75th %ile
Low
High
Mid-Point


POTWs
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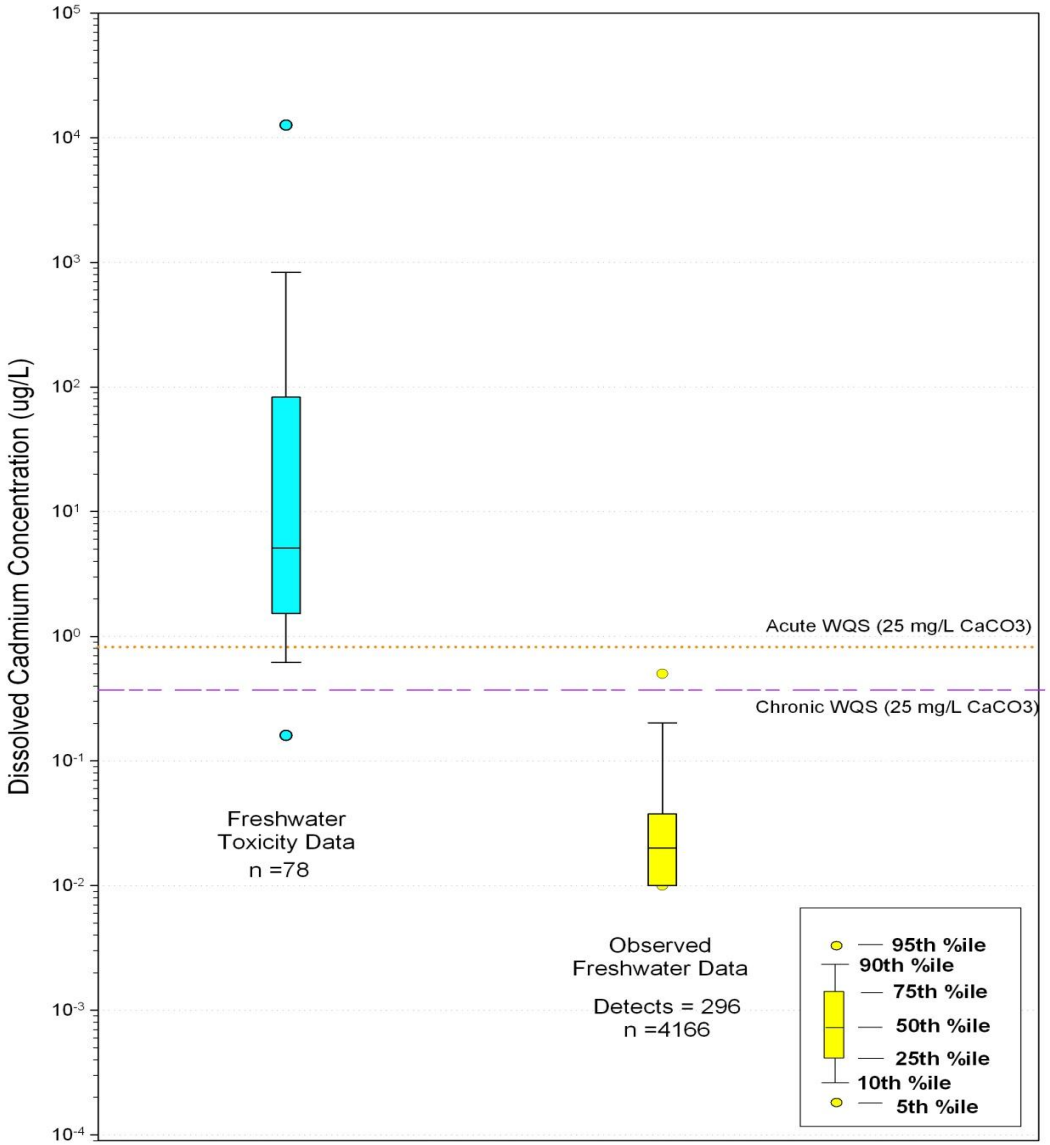
Atmos. Dep.
Ground Water
PCBs
PBDE
DDT
LPAH
HPAH
cPAH
Total PAH
DEHP
100%
80%
60%
40%
20%
0%
Not Analyzed
Not Detected
Not Analyzed
Not Analyzed
Not Calculated
Not Analyzed
25th %ile
75th %ile
Median
Low
High
Mid-Point

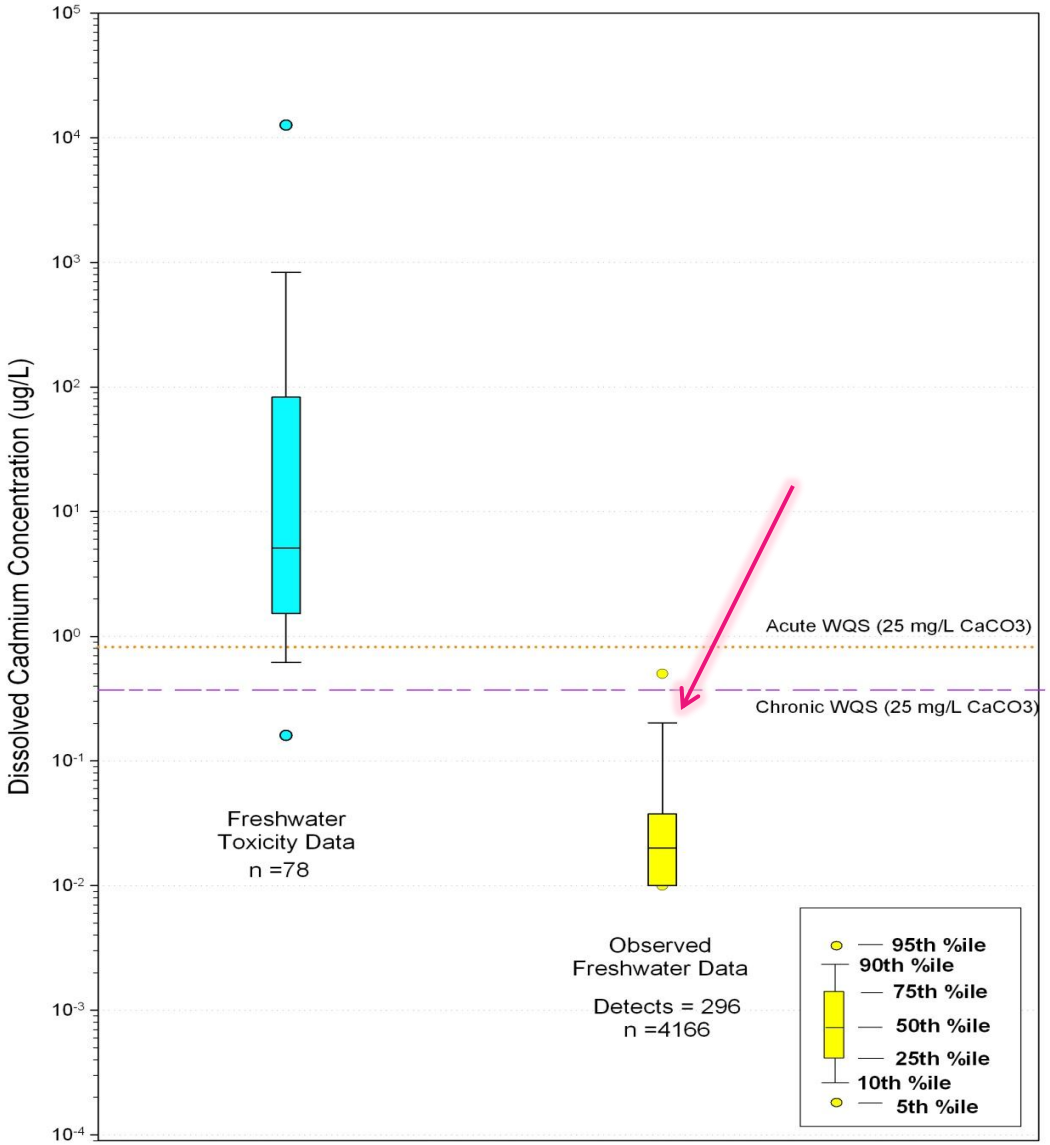
Toxic Chemicals in Puget Sound

What is the relative toxic hazard posed by these chemicals at observed concentrations?

Hazard Evaluation

- Media/Receptors evaluated:
  - Surface Water
  - Sediments
  - Tissue Residue
  - Wildlife
  - Human Health
- Compared observed concentrations (90th Percentile) to thresholds (10th percentile of effects or criteria)
- "Priority 1" if observed (90^{the}) exceeds threshold


Dissolved Cadmium Concentration (ug/L)
10^5
10^4
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
Acute WQS (25 mg/L CaCO3)
Chronic WQS (25 mg/L CaCO3)
Freshwater
Toxicity Data
n =78
Observed
Freshwater Data
Detects = 296
n =4166
95th %ile
90th %ile
75th %ile
50th %ile
25th %ile
10th %ile
5th %ile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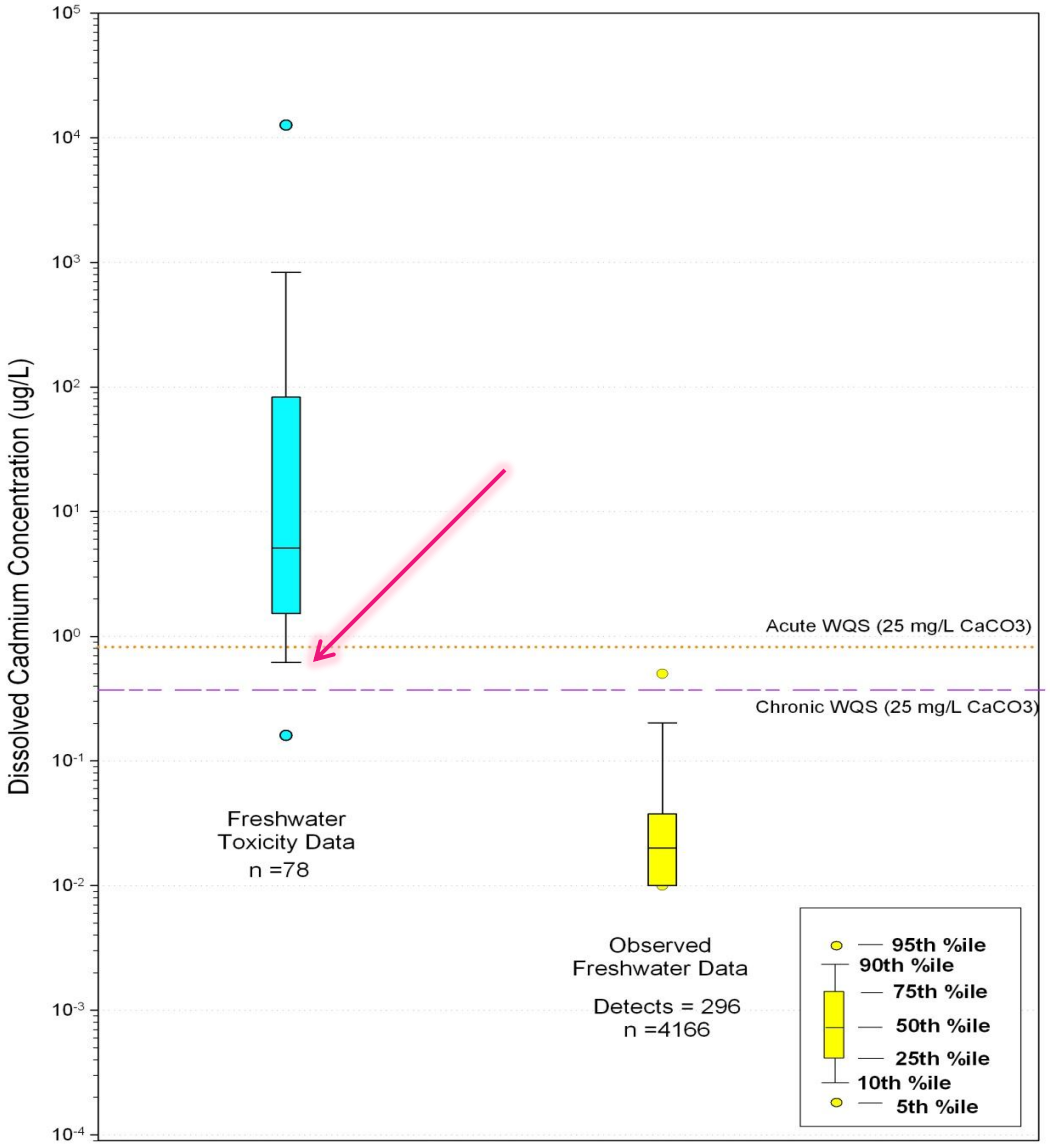
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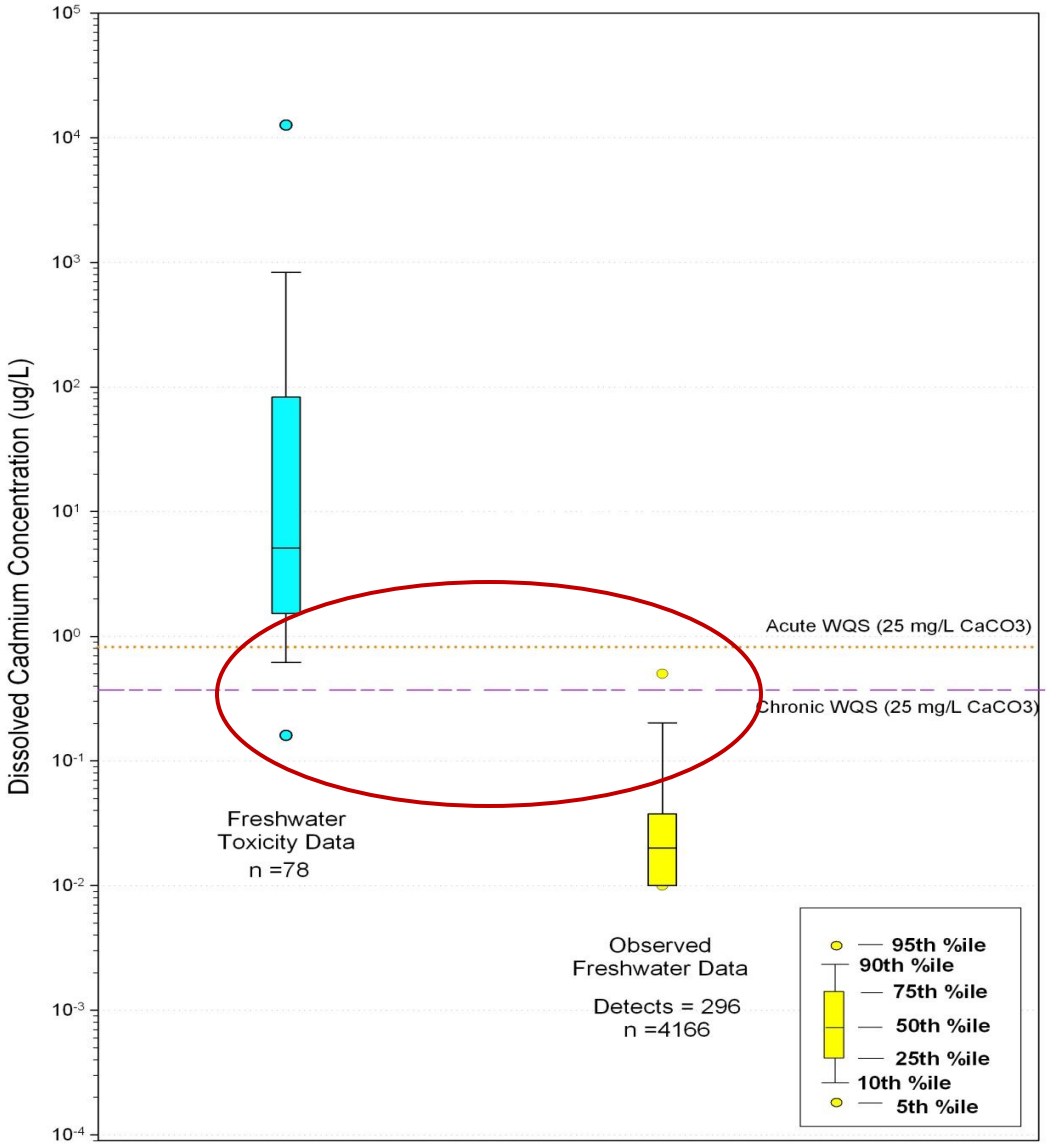
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10th %ile
5th %ile

Priority 1 Chemicals by Category

Surface Water	Sediments	Tissue Residue	Wildlife	Human Health
Copper	Arsenic	PCBs	Mercury	PCBs
Mercury	Cadmium		PCBs	PCDD/Fs
Zinc	Copper		PCDD/Fs	DDT
PCBs	Mercury		DDT	PAHs
DDT	Zinc			DEHP
	PCBs			
	PAHs			
	DEHP			

Not Analyzed:

- PBDEs
- Triclopyr
- Petroleum

Prioritizing Near-Term Actions

- Hazard Evaluation- priority one in at least two categories
- Large Opportunity for Source Control
- Substantial Loading to Puget Sound

Near-Term Actions

- Copper
  - Urban and Agricultural Pesticides
- Roof Runoff
  - Copper, zinc, cadmium and phthalates
- PAHs
  - Creosote treated Wood
  - Woodstoves
  - Vehicle Emissions
- Petroleum
  - Motor Oil Drips and Leaks
  - Minor Gasoline Spillage at Pump
  - Marine Engine Oil and Gas Leaks

Direct Follow Up Actions through Funding from National Estuary Program

- PAH Reduction Grant- Creosote piling removal (DNR) and wood stove change out program in Pierce County (Puget Sound Clean Air Agency)
- Roofing Assessment
- Urban Pesticide Use Survey (WSDA)
- Motor oil drips and leaks workshops and education
- Updating Puget Sound Toxics Box Model to evaluate reductions needed to meet Puget Sound Indicator targets

Reports available online at:

Washington State Department of Ecology Homepage

www.ecy.wa.gov

Click on Saving Puget Sound

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Ken Stone
Ian Wesley
Jim West