

Toxic Chemicals in the Puget Sound Basin

Identification of the Primary Sources of Selected Toxic Chemicals and Estimates of Quantities Released in the Puget Sound Basin

Project Overview

Conceptual Big Picture:

Sources versus **Delivery**

Puget Sound Toxicant *Delivery*

Conceptual Model

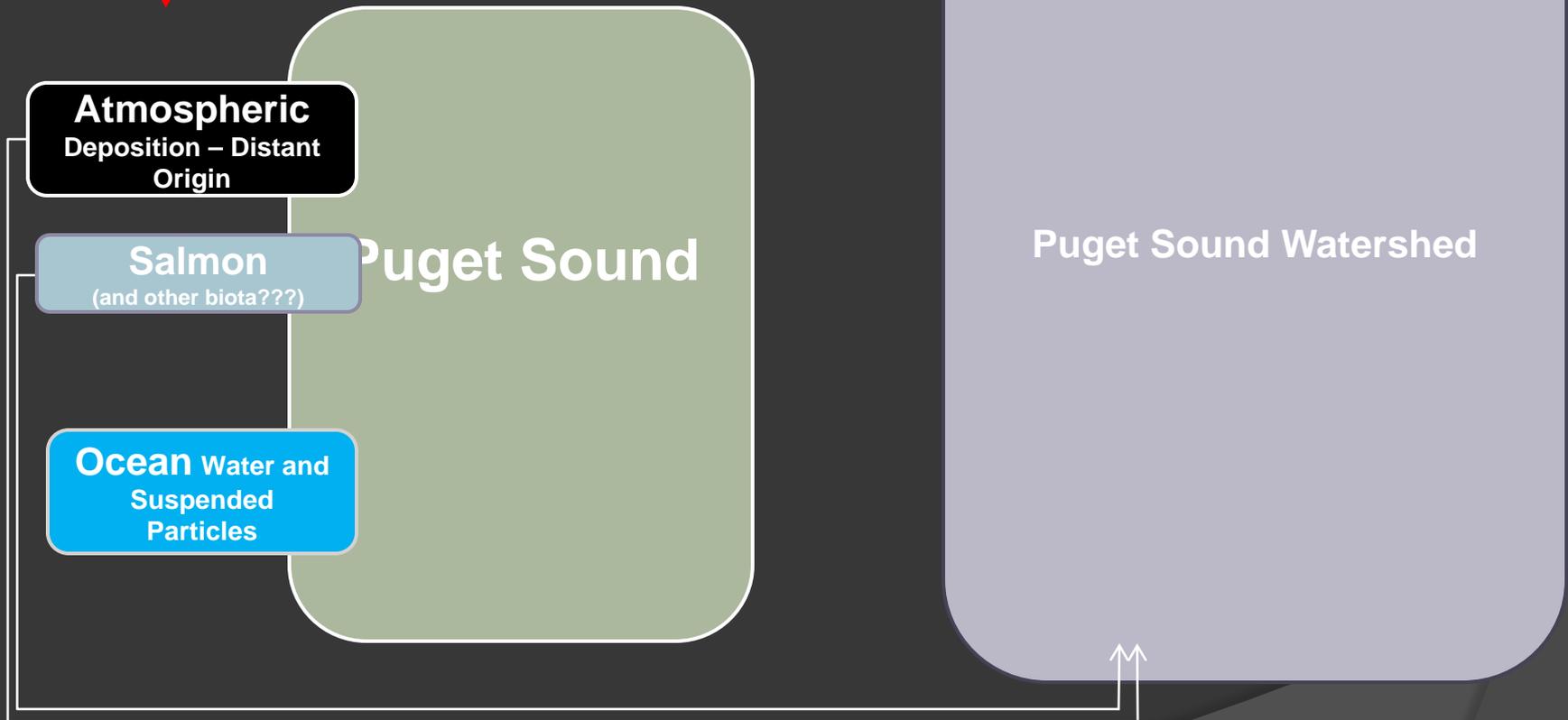
Puget Sound

Puget Sound Watershed

Puget Sound Toxicant *Delivery*

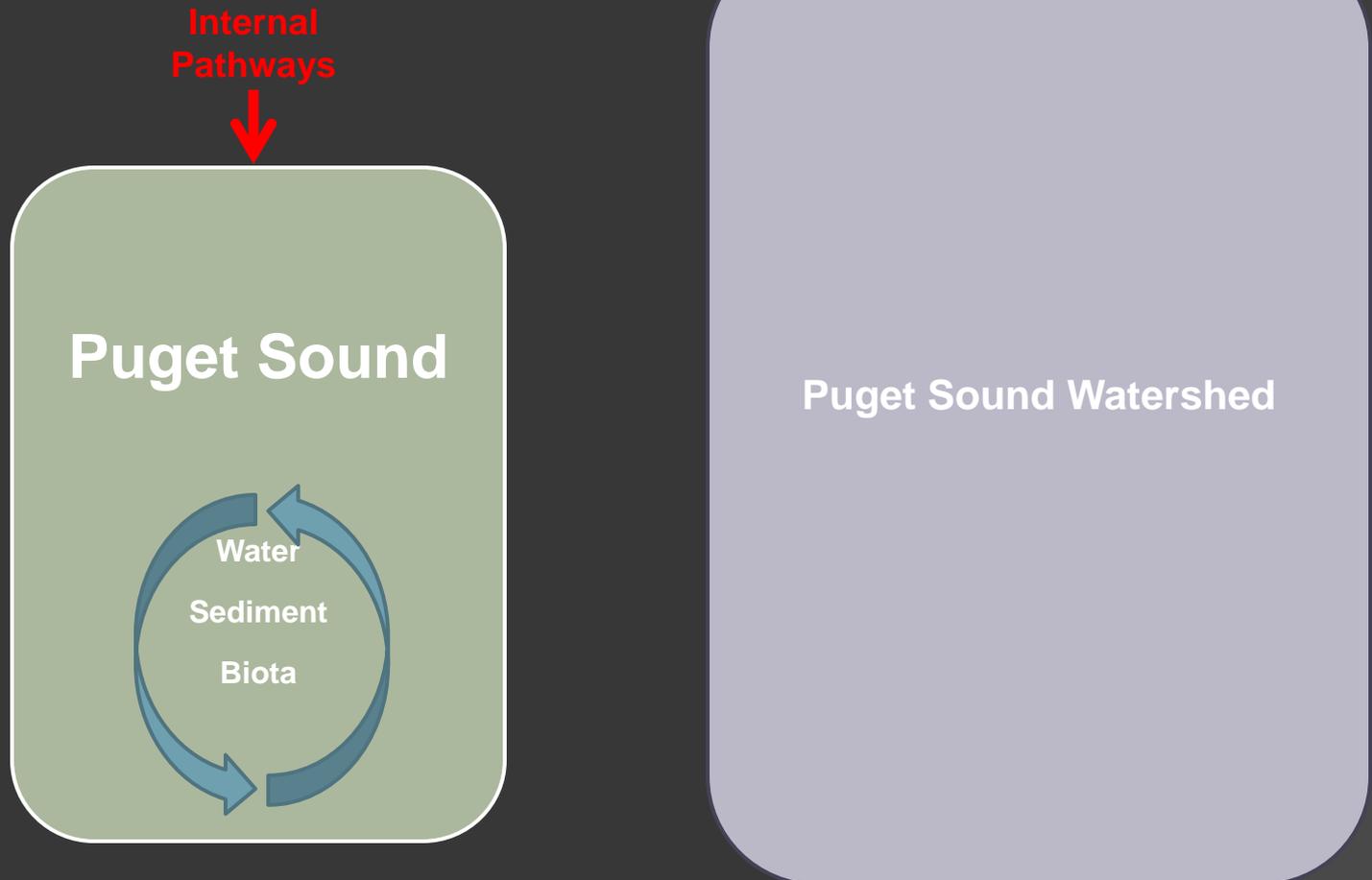
Conceptual Model

Out of Basin
Pathways



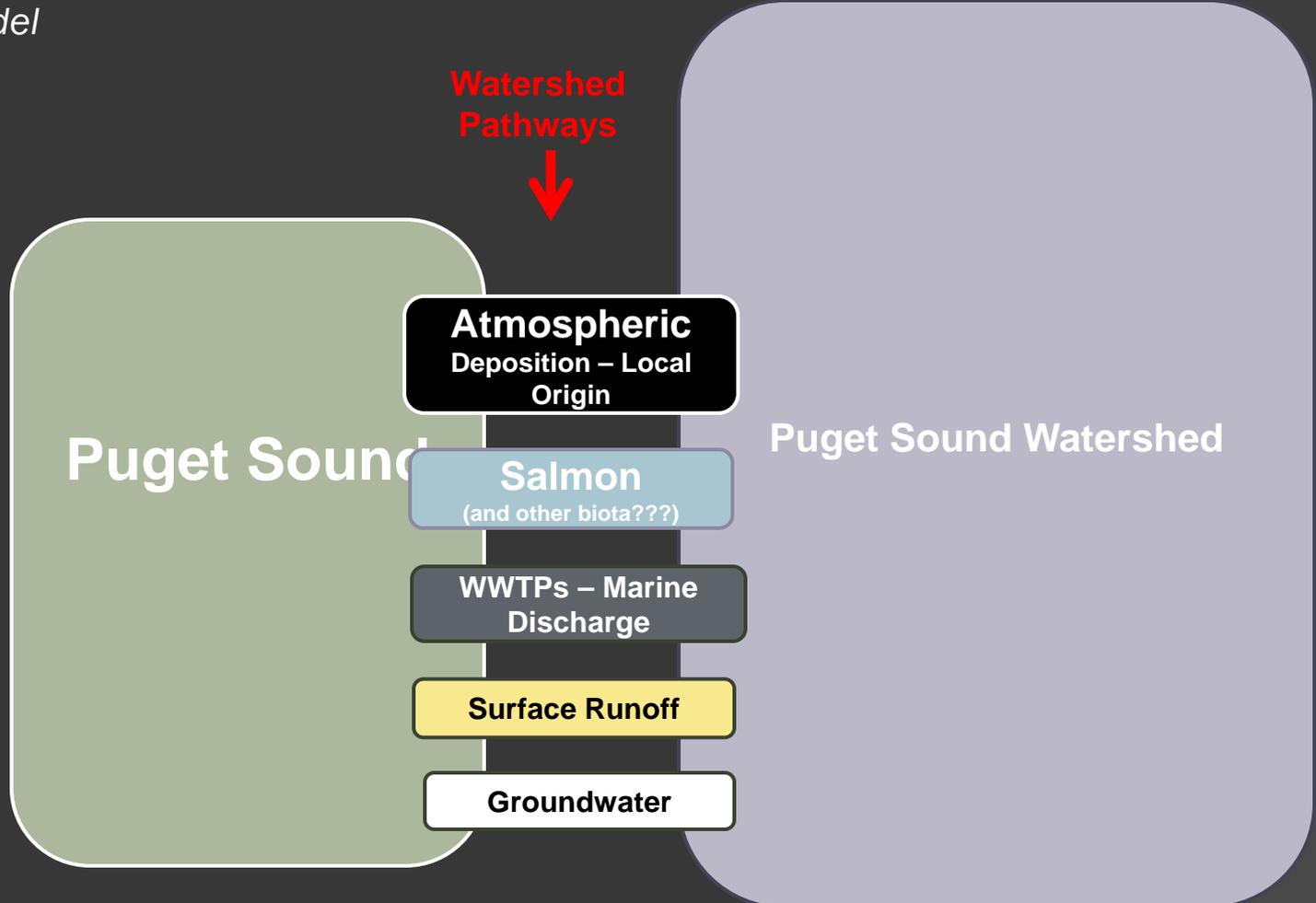
Puget Sound Toxicant *Delivery*

Conceptual Model



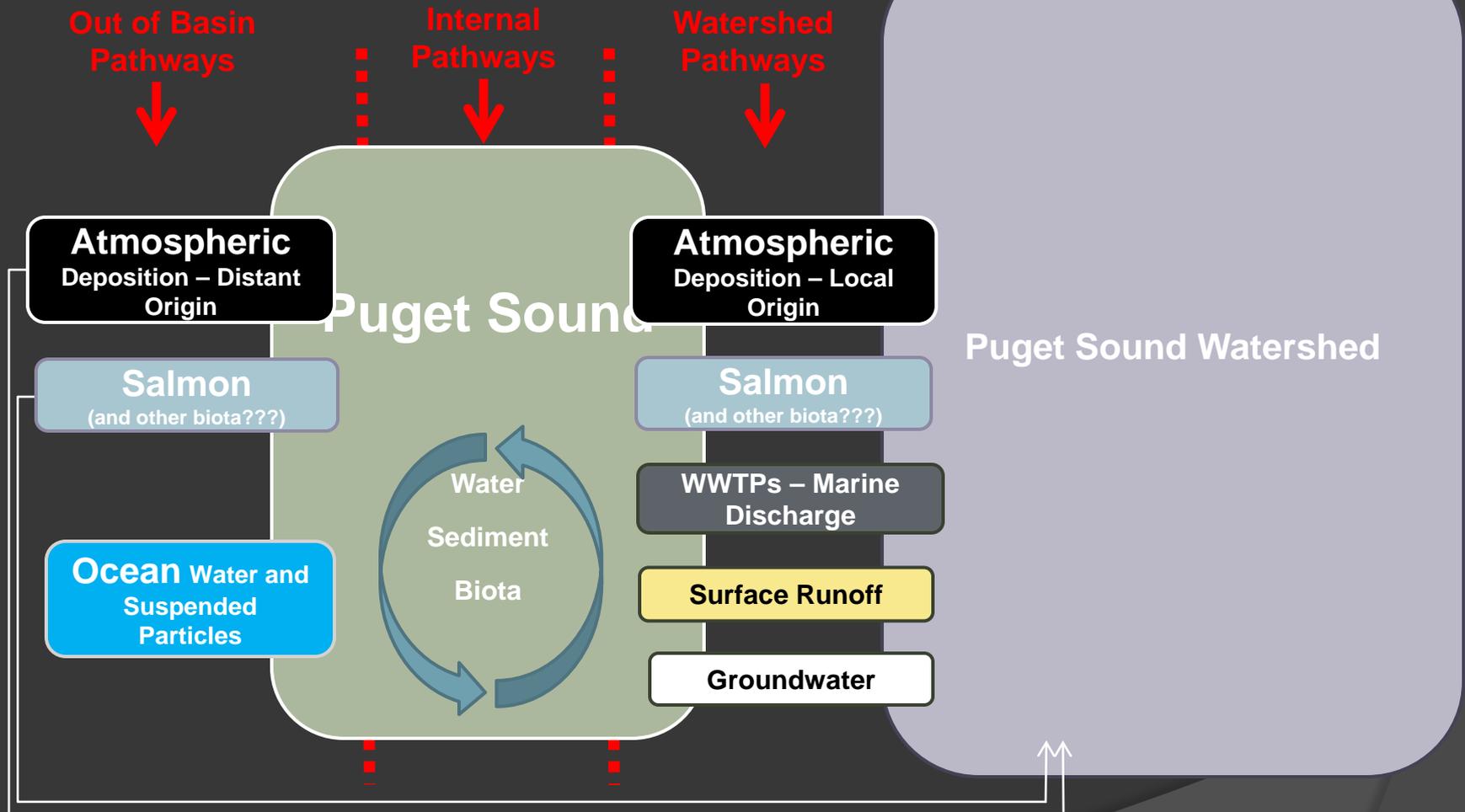
Puget Sound Toxicant *Delivery*

Conceptual Model



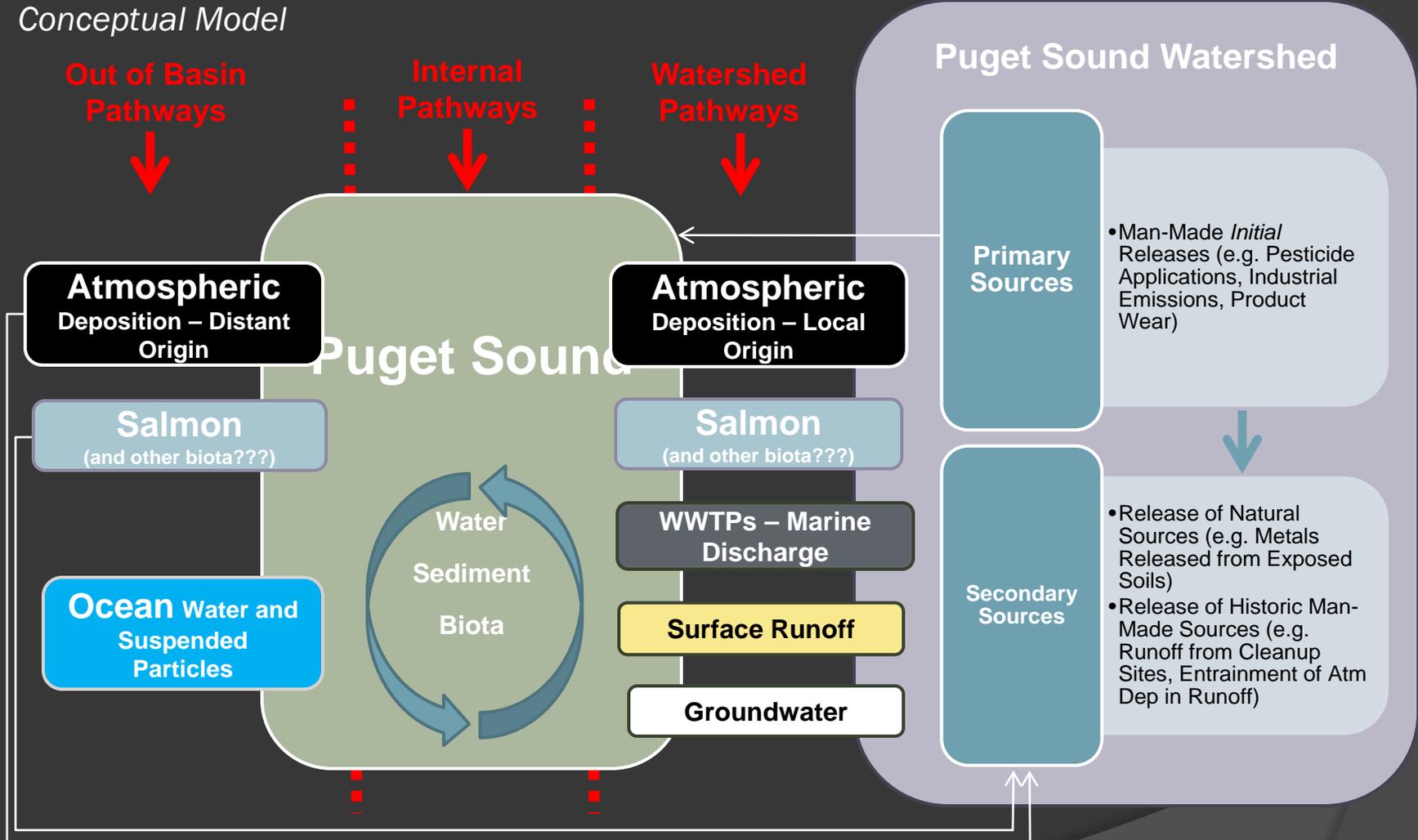
Puget Sound Toxicant *Delivery*

Conceptual Model



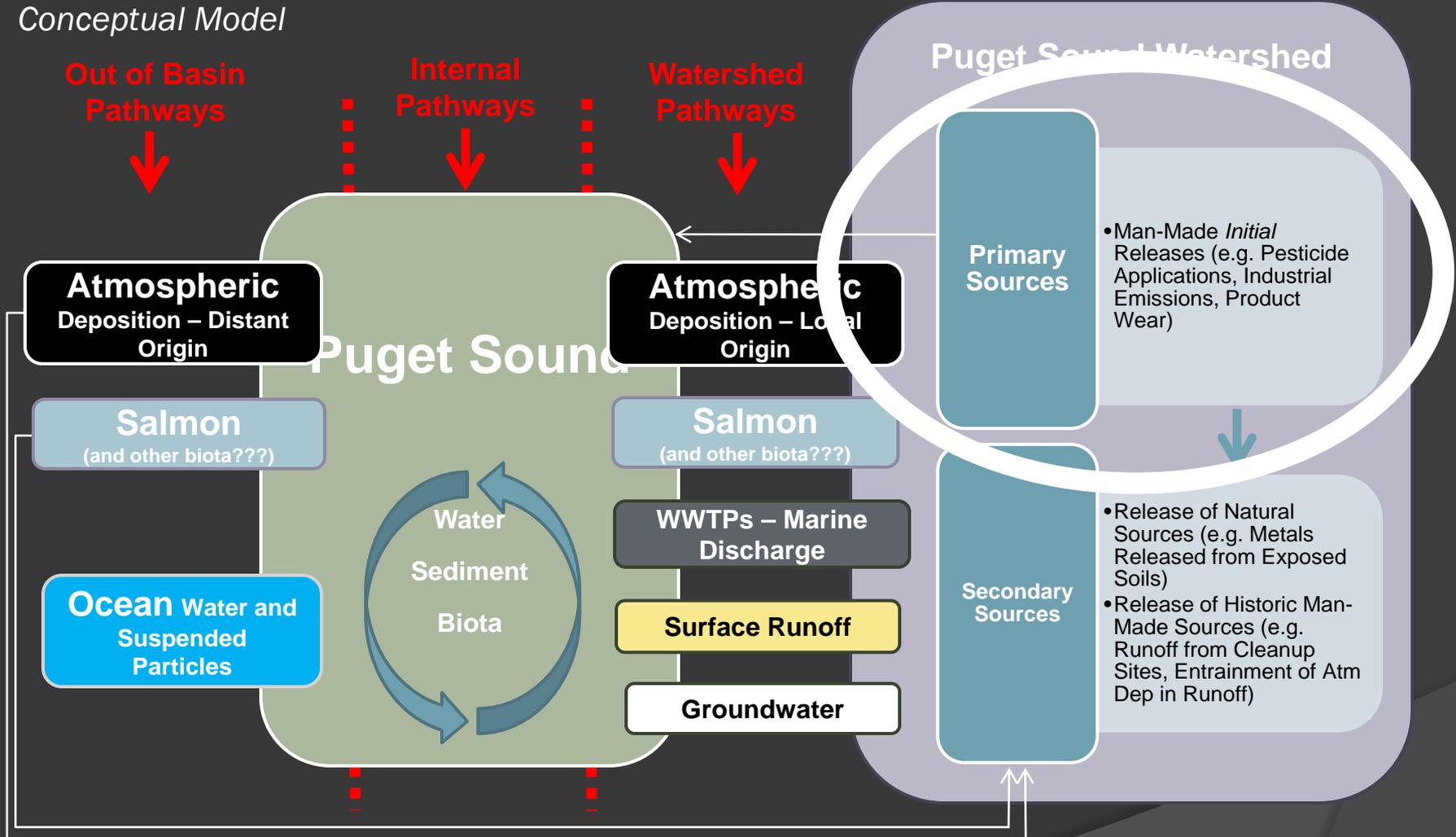
Puget Sound Toxicant *Delivery*

Conceptual Model



Puget Sound Toxicant *Delivery*

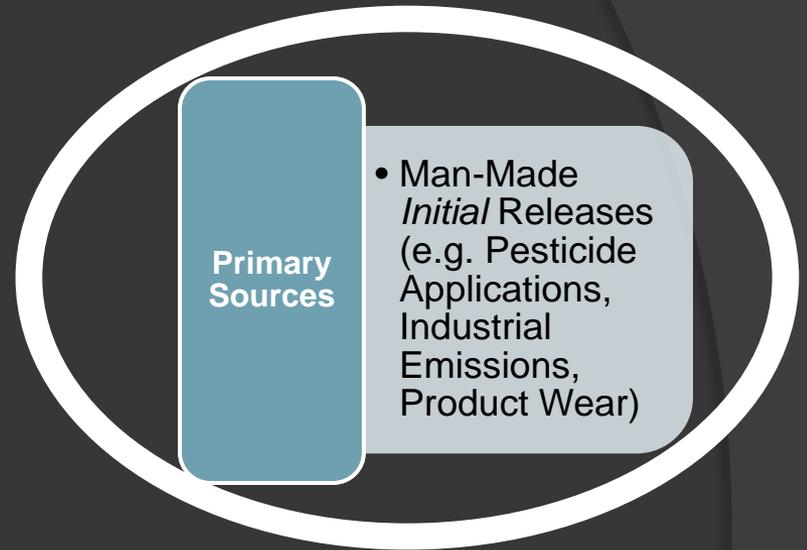
Conceptual Model



Puget Sound Toxicant Sources

Definition of COC Sources

- **What do we mean by *Primary Source*?**
 - *The source from which a COC is initially released to environmental media or released in a form which can be mobilized and transported in an environmental pathway*
 - **Examples of Primary Sources are:**
 - PAHs from wood burning
 - Copper from brake pad wear
 - PCBs from transformer leakage
 - Triclopyr from roadside ditch application
 - PBDEs from fabric washing

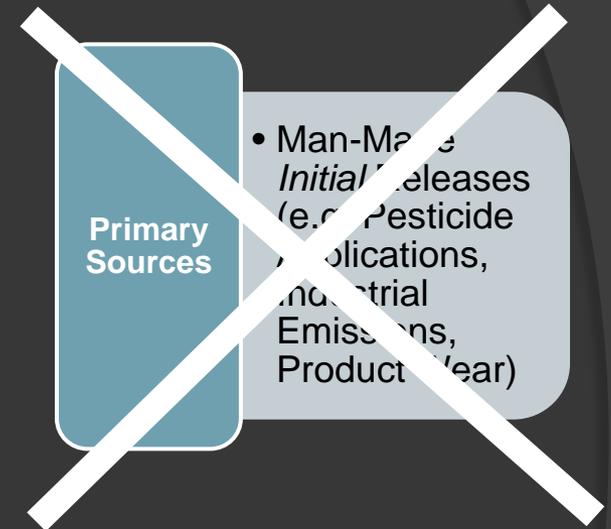


Puget Sound Toxicant Sources

Definition of COC Sources

- **These are Delivery Pathways, not Primary Sources:**

- Atmospheric deposition
- Stormwater
- Contaminated soil
- Surface runoff
- WWTPs



Puget Sound Toxicant Sources

Sources versus Delivery

Sources versus Delivery - Distinctions are important

- **Control Strategy – Sources**

- Education
- Technology
- Alternatives
- Bans

- **Control Strategy – Delivery**

- Technology
- BMPs

Linking Sources Project

Objectives

◎ **Project Objectives**

- **Identify the primary sources of selected chemicals released to the environment**
- **Make initial estimates of the *quantity* of chemicals released from each source**
 - **110 Separate Sources**
 - **90 Diffuse Sources**
 - **20 Point Sources**

Chemicals of Concern

Metals

Arsenic

Cadmium

Copper

Lead

Mercury

Zinc

Halogenated Organics

PCBs

PBDEs

Dioxins/Furans

Other Organics

PAH

Phthalates

Triclopyr

Nonylphenol

Petroleum

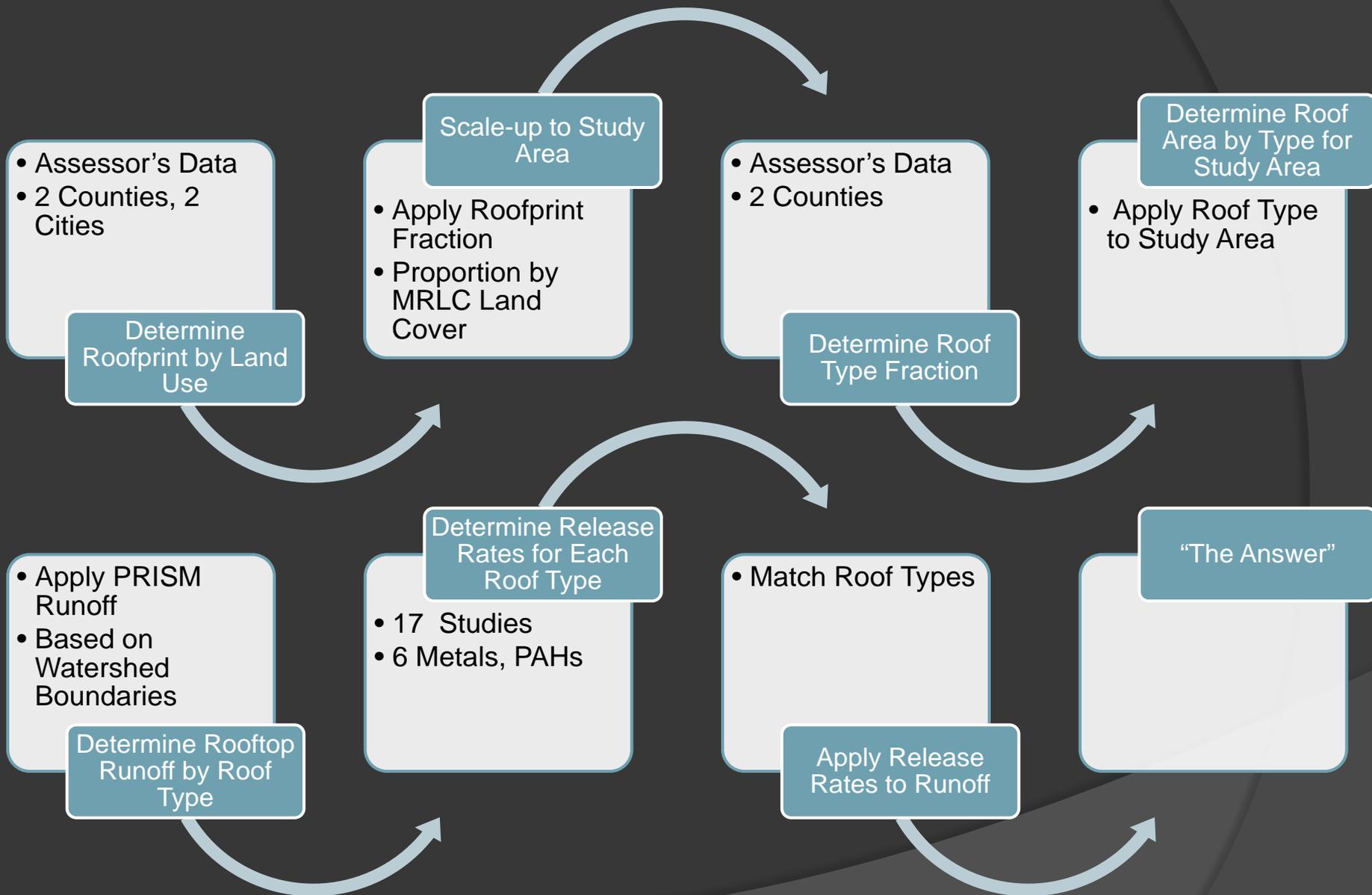
Linking Sources Project

Approach

◎ **Methods for Calculating COC Releases**

- **Basic Formula:**
 - ***COC Release per Unit x Number of Units in PS Basin***
- **Published data for release rates (where available)**
- **Reliance on assumptions for some variables**
 - Wide range of confidence in assumptions
- **Statewide estimates already available in some cases**
 - Example: Chemical Action Plans for Lead, Mercury, and PBDEs
 - TRI

Method for Estimating Loads from Rooftops



Buildings and Grounds

- Backyard Burn Barrels
- Indoor commercial office space
- Indoor residential space
- Lawn and Garden Equipment Emissions
- Plumbing fixtures, pipes, and solder
- PVC Cables (indoor)
- PVC Coil coated roofing
- PVC Flooring
- PVC Hoses and profiles (indoor)
- PVC Hoses and profiles (outdoor)
- PVC Roofing material
- PVC Wall coverings
- Residential Fuel Use, except Wood
- Residential Trash Burning
- Residential Yard Waste Burning
- Roofing materials - asphalt shingle
- Roofing materials - total
- Sealants (Caulking)
- Urban lawn & garden use of pesticides
- Urban Residential and Commercial Use
- Washing machine rinse water
- Woodstoves and Fireplaces

Industrial and Institutional Point Sources

- Aluminum Mills
- Army Base
- Boat Manufacturer
- Cement Plants
- Crematoria Emissions
- Ind, Comm, Inst Sources (primarily Title V)
- Medical Waste Incineration
- Metal Foundries
- Naval Shipyard
- Other Industrial and Military Facilities
- Paint and Coatings Manufacturers
- Petroleum Refineries
- Plastics Manufacturer
- Point Sources
- Pulp and Paper Mills
- Residual Fuel Emissions
- Specialty Glass Manufacturer
- Steel Galvanizers
- Steel Mills
- Various Industrial Facilities, not including pulp mills
- Wood-Treatment Facility

Miscellaneous Material Use

- Auto Convenience Switch Disposal
- Button Cell Batteries
- Fertilizers and Micronutrients
- Fluorescent Lamp Disposal
- Lacquers and paint
- Large capacitors
- Micronutrients
- Petroleum spills (major)
- Printing inks
- PVC Cables (outdoor)
- PVC Coated fabric
- PVC Films, sheets, coated products
- Sealants, adhesives, etc.
- Shoe soles
- Small capacitors
- Thermostat Disposal
- Transformers

Non-Point Combustion Sources

- Agricultural Equipment Emissions
- Airport Service Equipment Emissions
- Aviation fuel combustion
- Cigarette smoke
- Commercial Equipment Emissions
- Construction Equipment Emissions
- Industrial Equipment Emissions
- Locomotive Emissions
- Logging Equipment Emissions
- Oil Field Equipment Emissions
- Railroad Maintenance Equipment Emissions
- Recreational Boat Emissions
- Recreational Equipment Emissions

Pesticides and Wood Preservation

- ⦿ Agricultural use of pesticides - total
- ⦿ Antifouling paint – total
- ⦿ Aquatic-use algaecides in pools, fountains, spas, etc.
- ⦿ Aquatic Weed Control
- ⦿ CCA-treated wood
- ⦿ Creosote Treated Marine pilings - total
- ⦿ Creosote Treated Railroad ties
- ⦿ Creosote Treated Utility poles
- ⦿ Crop and Golf Course Use
- ⦿ Forest Herbicide Use - State Forests
- ⦿ Total Right-of-Way Maintenance

Vehicles and Roads

- Asphalt – total
- Brake pad wear
- Car undercoating
- Coal tar sealants
- Distillate Fuel Oil Emissions
- Gas Station Emissions
- Gasoline Emissions
- Heavy Duty Diesel Vehicle Emissions
- Improper disposal of used oil following oil changes
- Light Duty Diesel Vehicle Emissions
- Minor gasoline spills from fueling vehicles and non-road equipment
- Motor oil drips and leaks
- Petroleum spills, leaks, and improper motor oil disposal
- Right-of-Way Maintenance - State Highways
- Tire wear
- Wheel weight loss

Personal Care Products

- Body lotion
- Dental Amalgam Excretion
- Deodorant (solid)
- Fragrance
- Hair spray (aerosol and pump spray)
- Nail polish

Outdoor Product Use

- ⦿ Ammunition, Hunting shot use
- ⦿ Fishing sinker loss

Total Annual Releases

Petroleum > 5,000 t

Zinc > 1,000 t

Lead > 500 t

PAH

Copper > 100 t

Triclopyr

Phthalates > 10 t

PCBs > 1 t

Cadmium

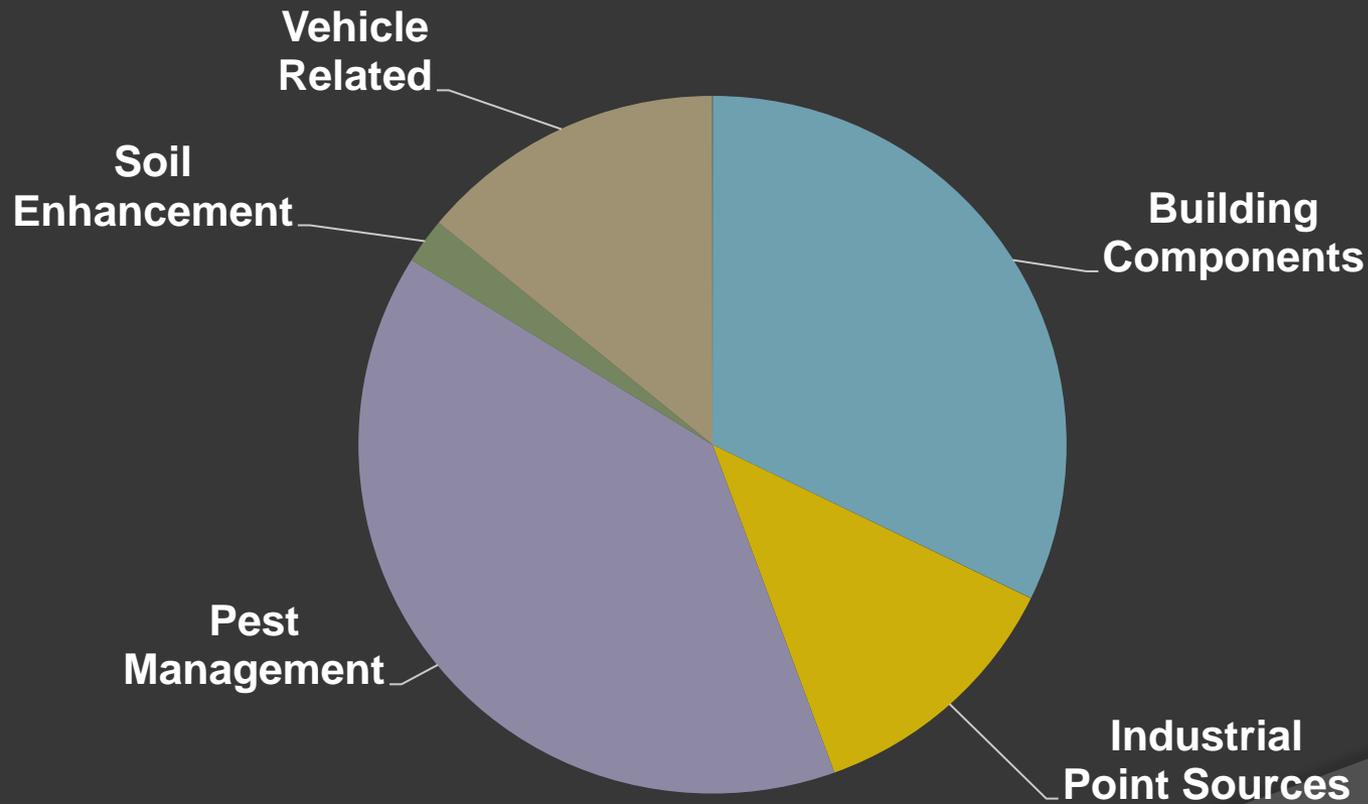
Mercury
PBDEs > 0.5 t

Arsenic

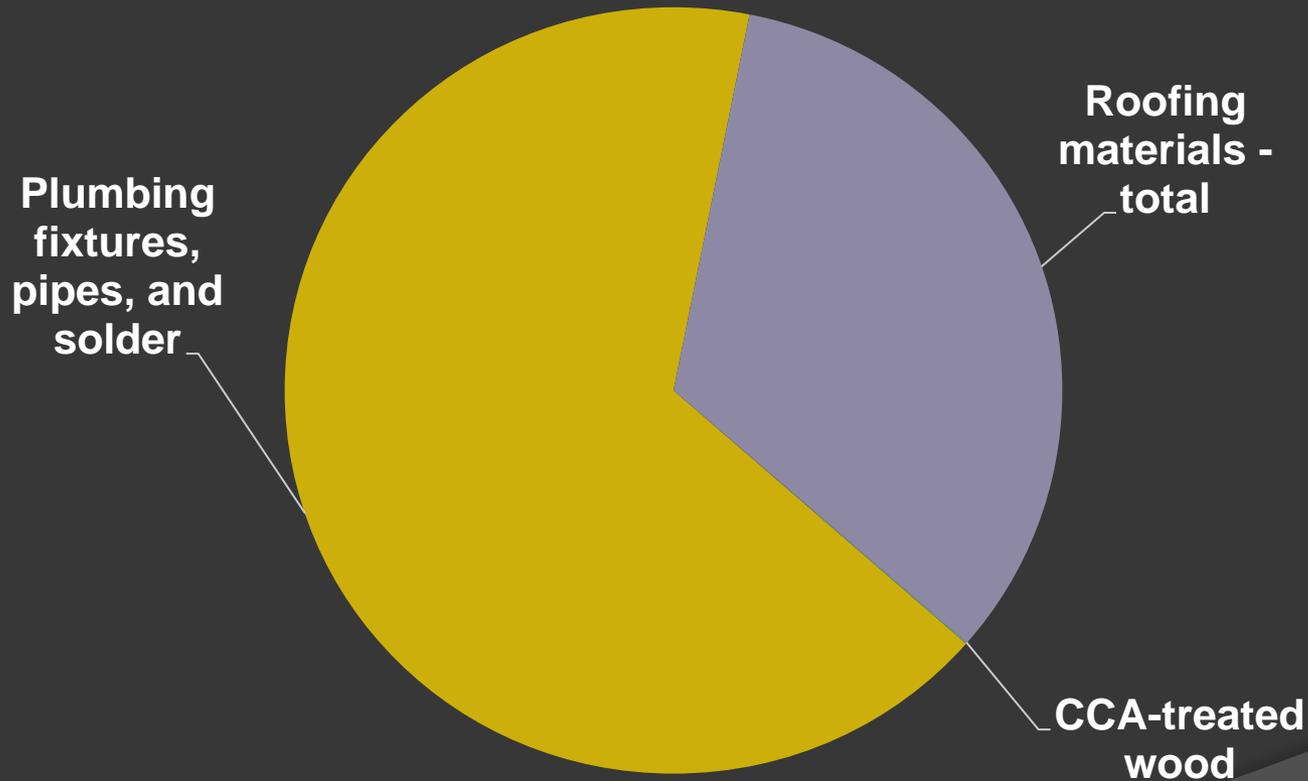
Nonylphenol > 0.1 t

Dioxins/Furans < 0.001 t

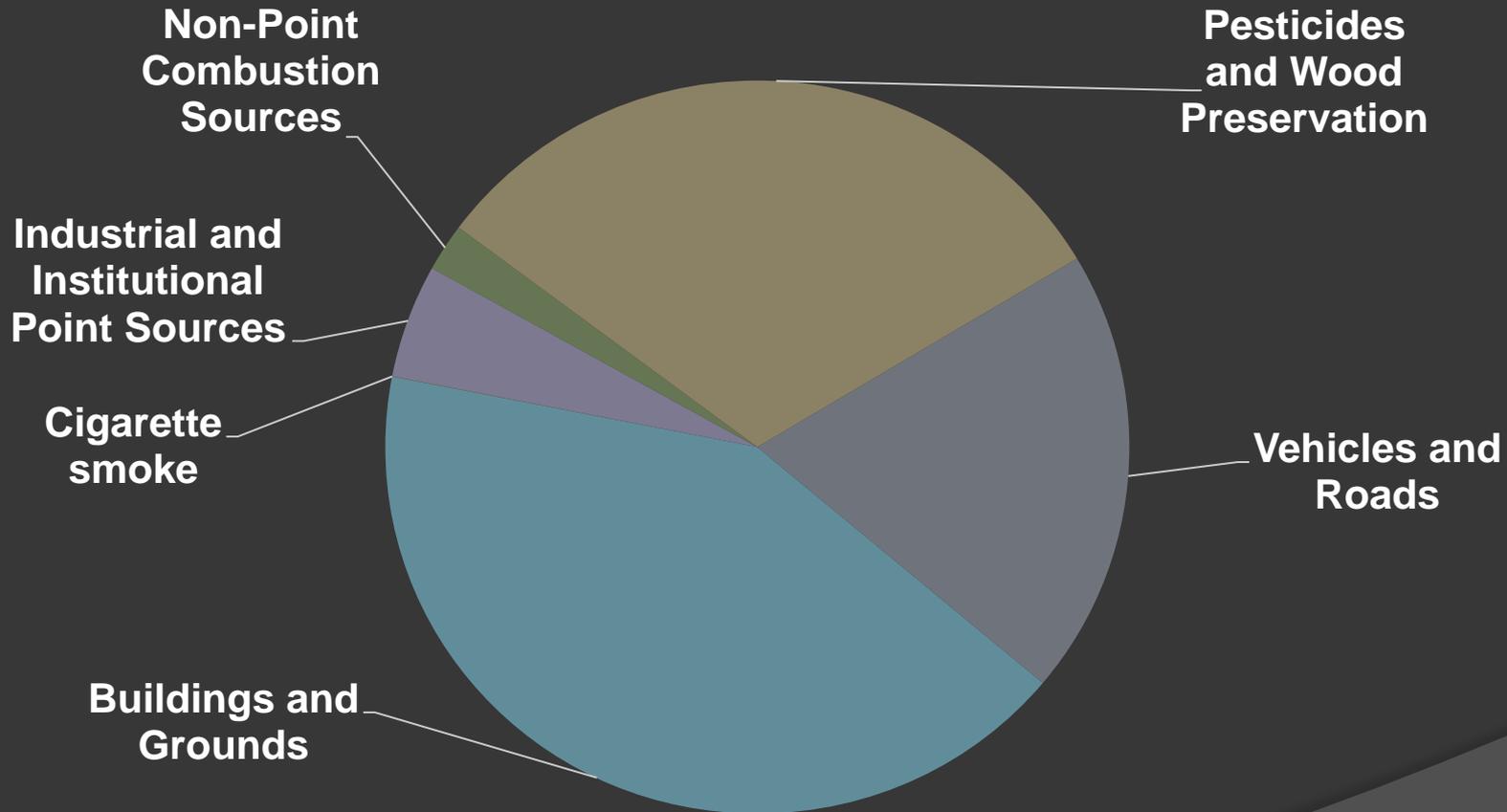
Total Copper Releases



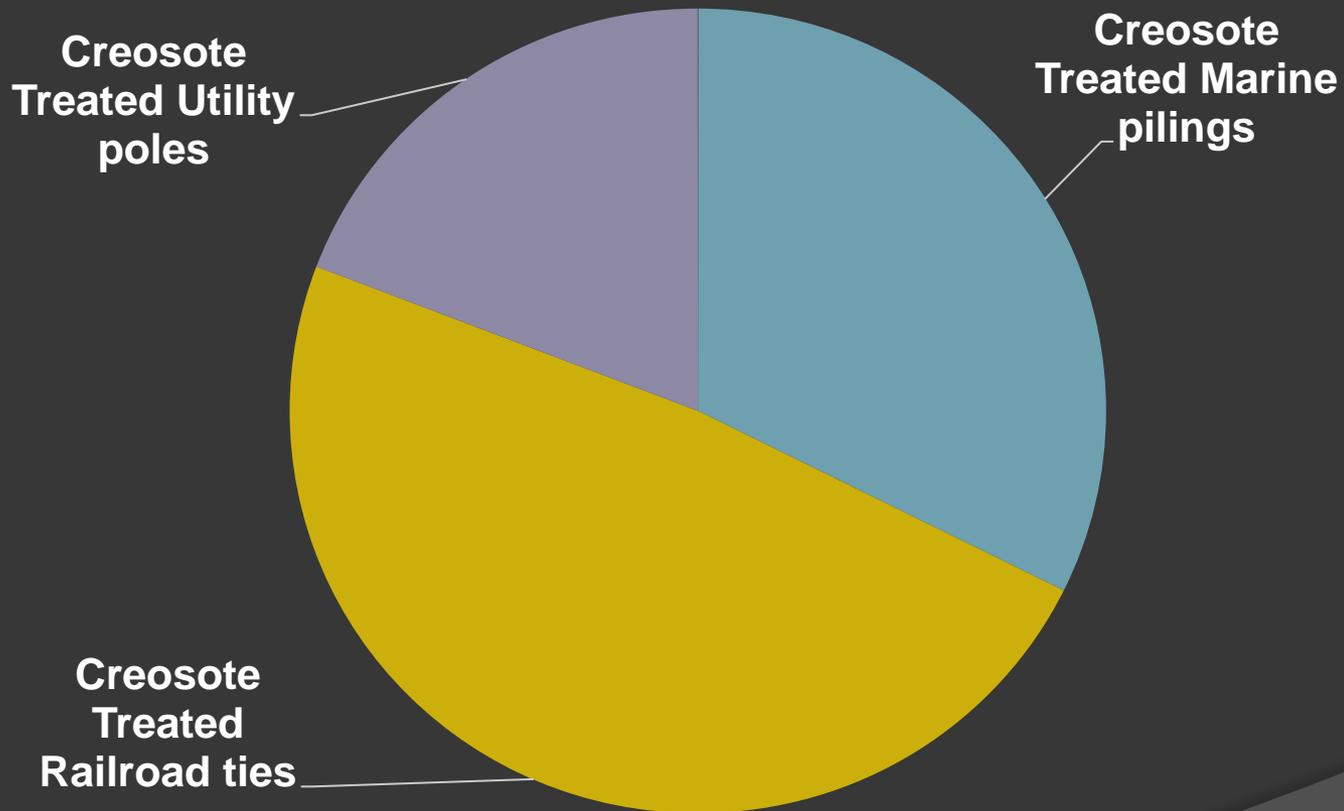
Copper – Building Components



Total PAH Releases

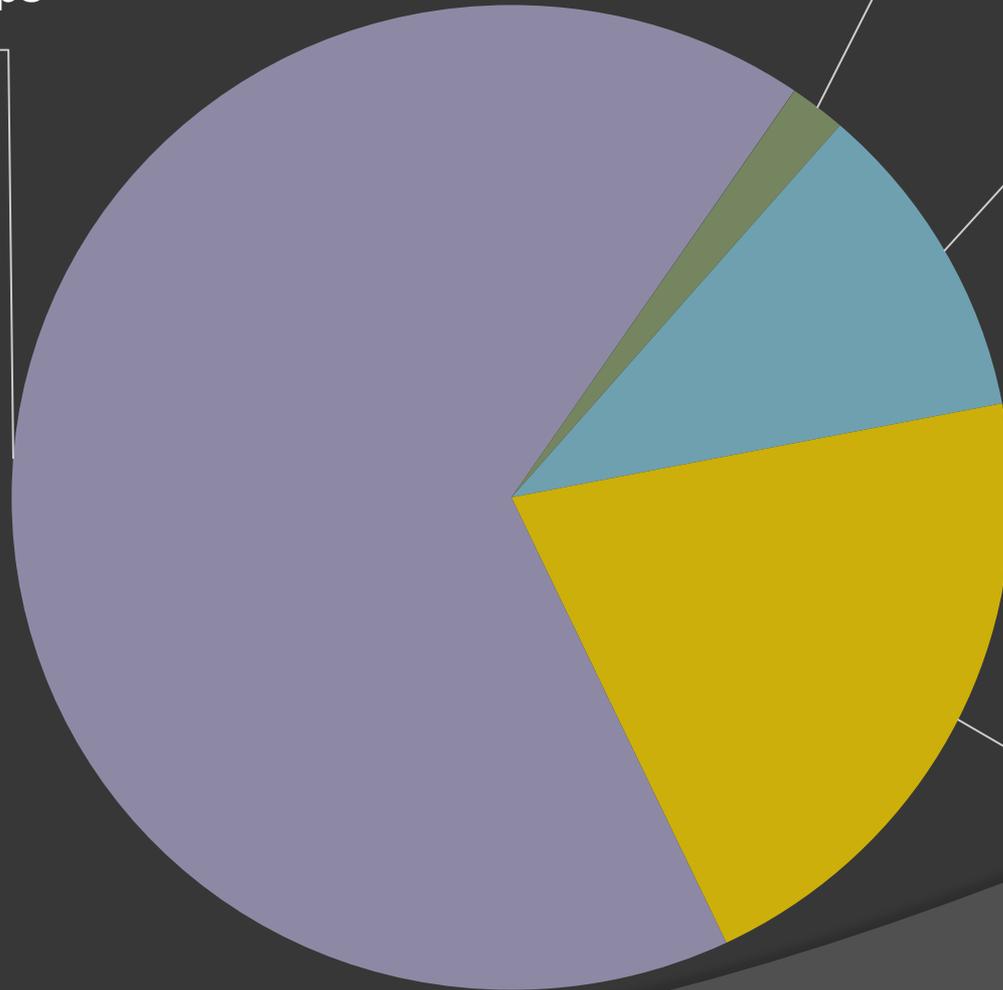


Releases from Creosote Treated Wood



Petroleum Releases

Motor oil drips
and leaks



Petroleum spills
(major)

Improper
disposal of used
oil following oil
changes

Minor gasoline
spills from
fueling vehicles
and non-road
equipment

Largest Source by COC

COC	Largest Source	Pct of Total		
		> 25%	> 50%	> 75%
Arsenic	Ind, Comm, Inst Sources (primarily Title V)		X	
Cadmium	Roofing materials - total		X	
Copper	Urban lawn & garden use of pesticides	X		
Lead	Ammunition, Hunting shot use		X	
Mercury	Distillate Fuel Oil Emissions	X		
Zinc	Roofing materials - total			X

Largest Source by COC

COC	Largest Source	Pct of Total		
		> 25%	> 50%	> 75%
PCBs	Large capacitors		X	
PBDEs	Indoor commercial office space		X	
Dioxins/Furans	Backyard Burn Barrels	X		
PAH	Woodstoves and Fireplaces	X		
Phthalates	PVC Cables (outdoor)	X		
Triclopyr	Crop and Golf Course Use			X
Nonylphenol	Point Sources			X
Petroleum	Motor oil drips and leaks		X	

Combustion Releases

COC	Total from Combustion	Largest Single Source
Arsenic	2%	Residential Fuel Use, except Wood
Cadmium	1%	Woodstoves and Fireplaces
Lead	3%	Aviation fuel combustion
Mercury	40%	Distillate Fuel Oil Emissions
Zinc	< 1%	Steel Mills
PCBs	10%	Residential Trash Burning
Dioxins/Furans	> 95%	Backyard Burn Barrels
PAH	60%	Woodstoves and Fireplaces

Roofing Material

COC	Total from Roof Materials	Largest Source Type
Arsenic	30%	Asphalt Comp.
Cadmium	60%	Asphalt Comp.
Copper	10%	Metal (other than Cu)
Lead	3%	Asphalt Comp.
Zinc	90%	Asphalt Comp. (Galv. Components)
PCBs	5%	Sealants (caulking)
PAH	< 1%	Asphalt Comp.

Pesticide/Wood Preservatives

COC	Total from Pest./Wood Preserv.	Largest Release Type
Copper	40%	Urban lawn & garden use of pesticides
Copper	30%	Excluding Antifouling Paint
PAH	30%	Creosote Treated Railroad ties
Triclopyr	100%	Crop and Golf Course Use

Vehicle Component Wear

COC	Total Vehicle Component Wear	Largest Wear Source
Cadmium	4%	Tire wear
Copper	10%	Brake pad wear
Lead	5%	Wheel weight loss
Zinc	5%	Tire wear
PAH	< 1%	Tire wear
Phthalates	7%	Car undercoating

⦿ **Recommendations**

- Refining and Adding Sources

⦿ **Final Report**

- End of March

Primary Sources Project Team

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