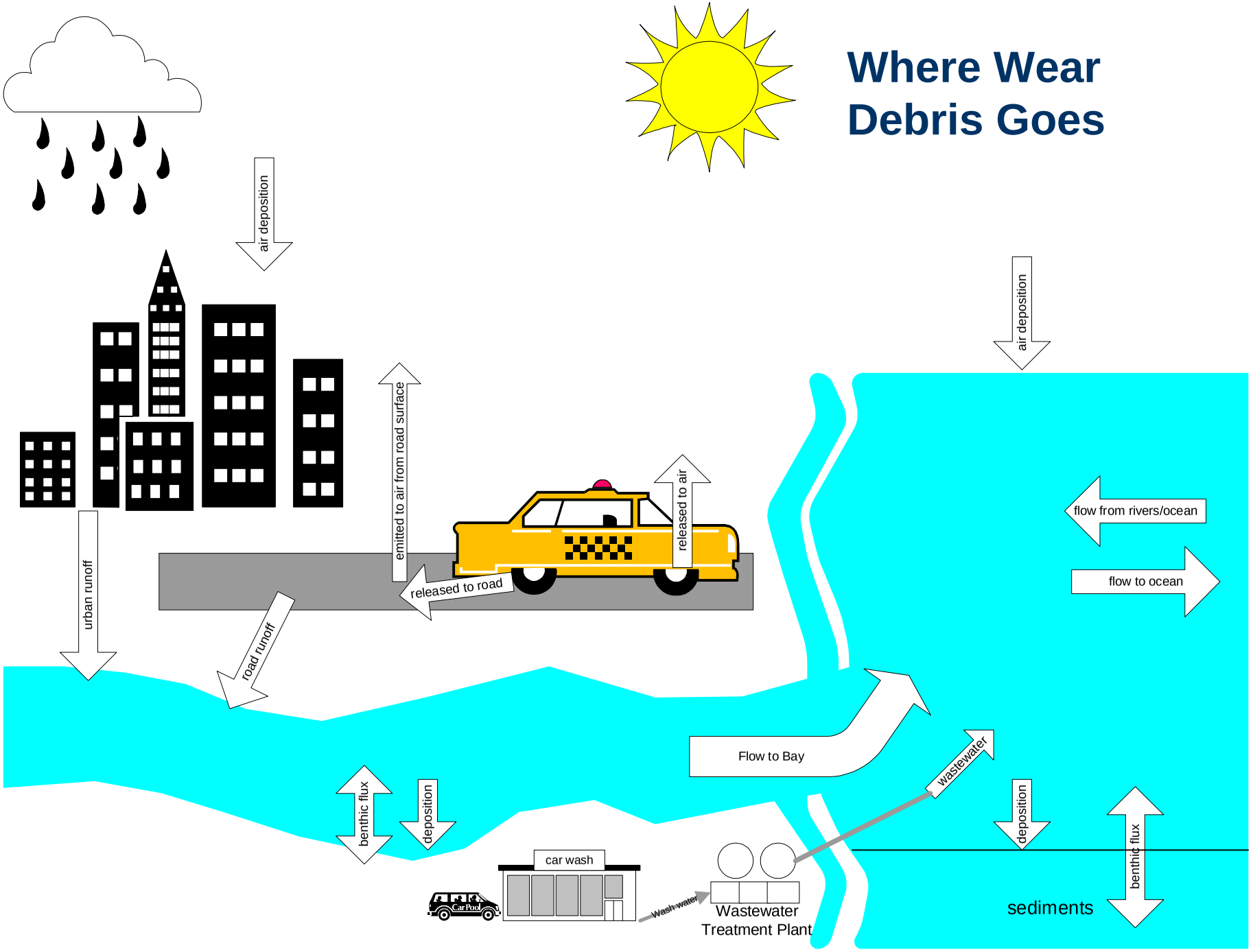
What We Have Learned About Copper and Brake Pad Wear Debris Transport in the Environment:

Conceptual Overview

Where Wear Debris Goes

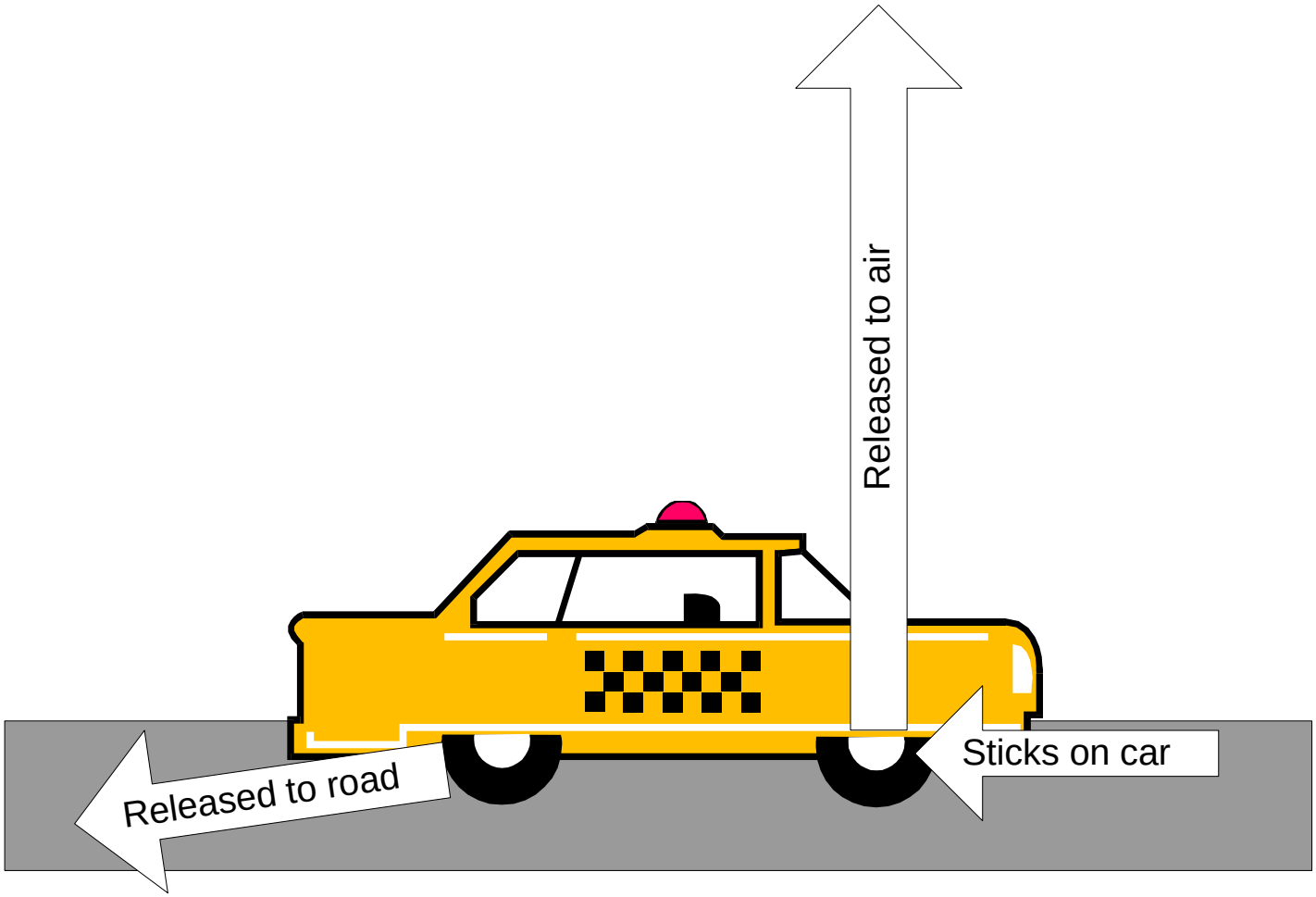


Lessons Learned: Overall

- Total copper is important in tracking where copper ends up
  - Particulate when formed during braking.
  - Dissolved and particulate when running off in storm water
- Lag time between deposition and runoff, so accumulation on land is important to the loading
  - Deposition occurs continuously but runoff occurs intermittently
  - Not all material washes off with each runoff event
- Amount of wear debris is insignificant compared to amount of creek sediment load

Box 1: Initial Release

Outcomes:
(1) Sticks on car
(2) Released directly to air
(3) Deposited on road



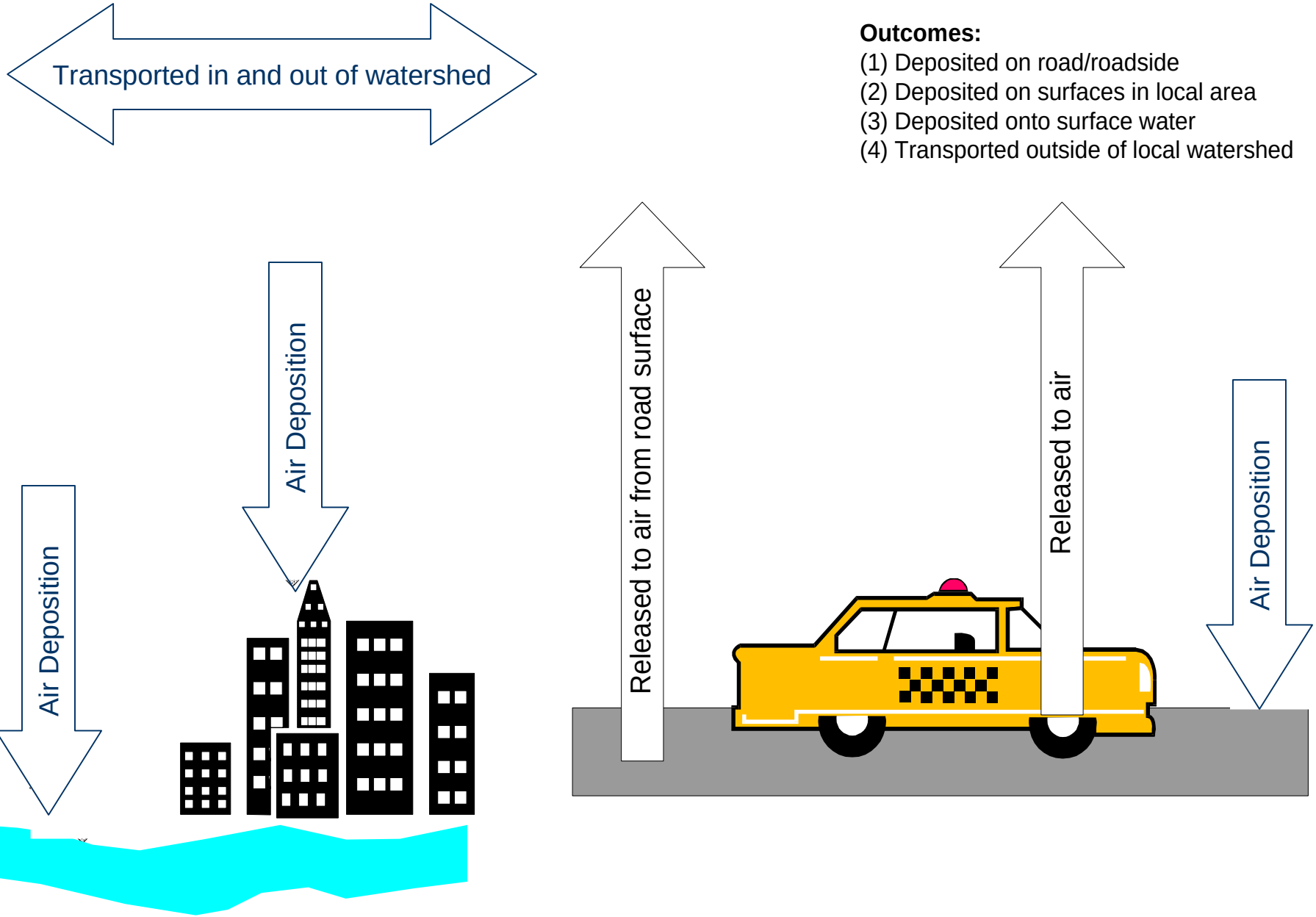
Questions Addressed: Sources

- How much copper is generated from brake pad wear debris?
- How much copper comes from other sources?
- What is the uncertainty in source contributions?

Box 2: Air Transport to Deposition Location

Sources:
(a) Release directly to air
(b) Emission from road surface (wind/traffic)
(Both wet and dry deposition)

Outcomes:
(1) Deposited on road/roadside
(2) Deposited on surfaces in local area
(3) Deposited onto surface water
(4) Transported outside of local watershed



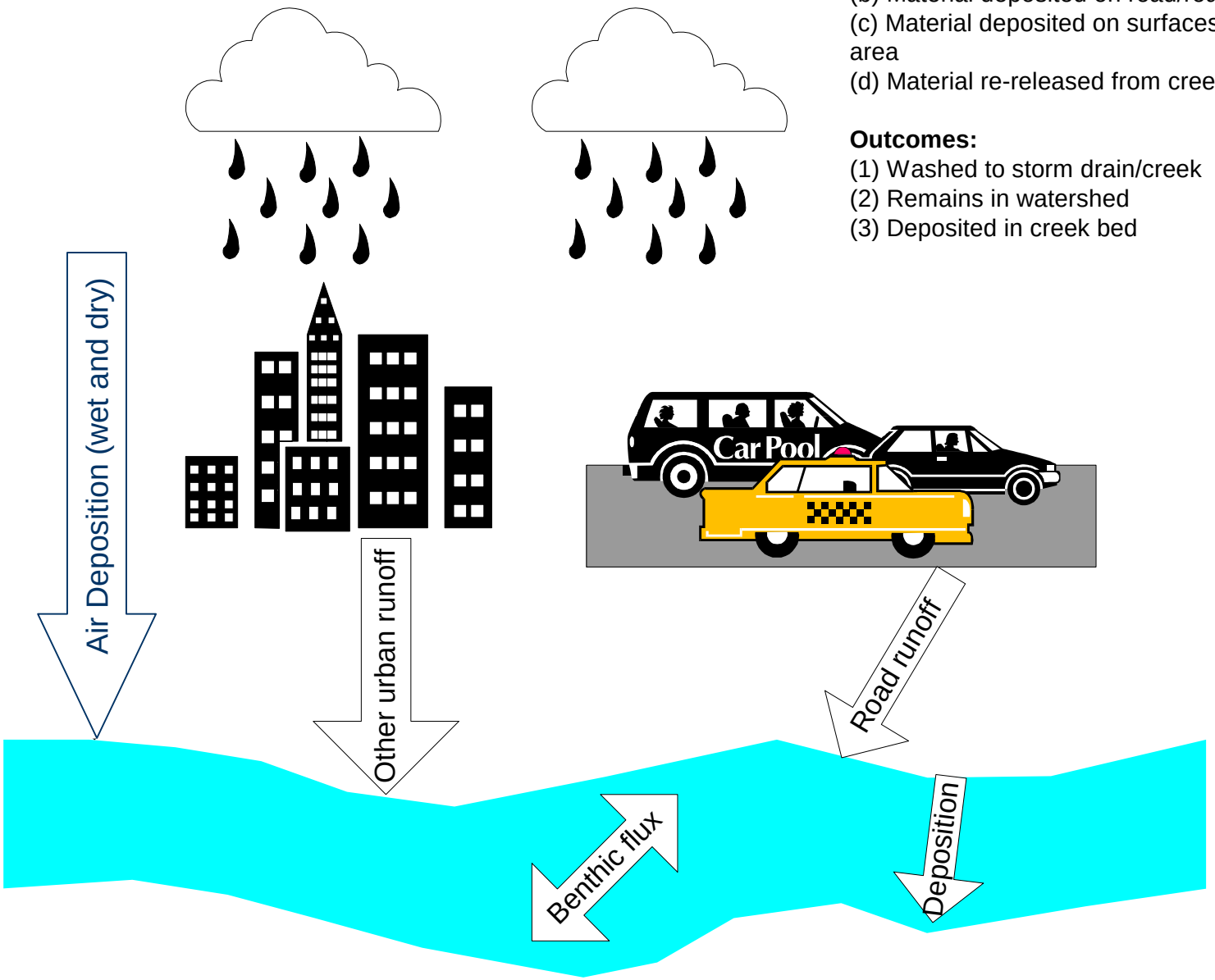
Questions Addressed: Air Deposition

- Are particles small enough to be air transported?
- Where does wear debris (and the associated copper) fall?

Box 3: Watershed - Releases to Creeks

Sources:
(a) Air deposition (wet and dry)
(b) Material deposited on road/roadside
(c) Material deposited on surfaces in local area
(d) Material re-released from creek bed

Outcomes:
(1) Washed to storm drain/creek
(2) Remains in watershed
(3) Deposited in creek bed



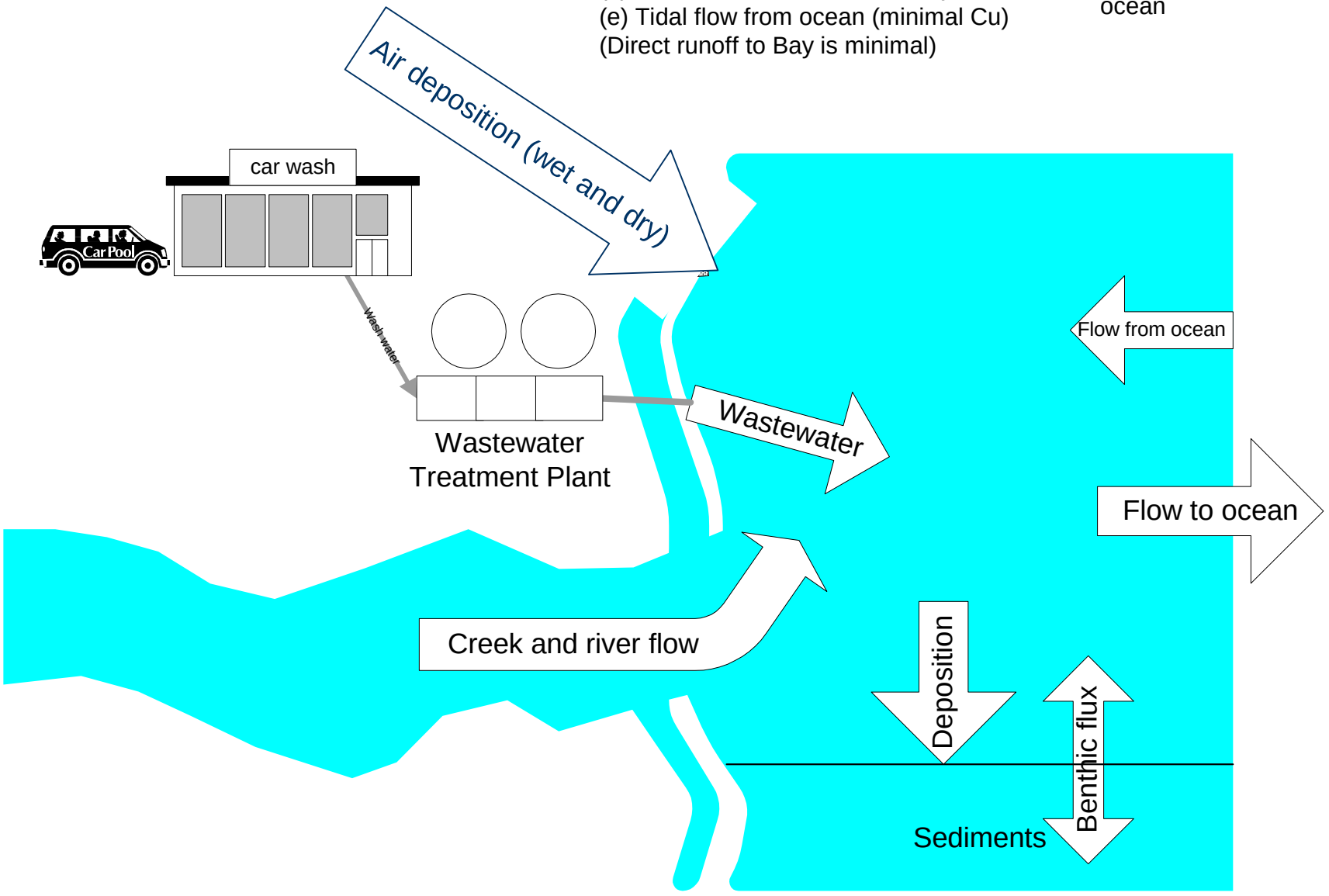
Questions Addressed: Watershed Modeling

- How significant a source of copper to watersheds is wear debris?
- How does land use affect the relationship between sources of copper and the amount in runoff?
- How much copper goes into the Bay?

Box 4: Releases to Bay

Sources:
(a) Air deposition (wet and dry)
(b) Creeks and rivers
(c) Wastewater treatment plants
(d) Material re-released from Bay bottom
(e) Tidal flow from ocean (minimal Cu)
(Direct runoff to Bay is minimal)

Outcomes:
(1) Copper in water column
(2) Copper deposited in sediments
(3) Copper discharged to ocean



Questions Addressed: Bay Modeling

- How much copper in Bay is from wear debris?
- How long the copper from wear debris stays in the Bay?