

Anthropogenic Copper Releases in the San Francisco Bay Area

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What I'm Going to Talk About

- **How the releases were estimated**
- **The estimates**
- **Uncertainty in the estimates**
- **Q&A**

these estimates were produced for the Brake Pad Partnership and all three modelers are going to or did use them (air deposition, watershed, and bay)

Methodology

To estimate copper releases from brake pads:

- **developed air emission factors using several approaches**
- **selected the most appropriate air emission factor**
- **used partitioning information to estimate releases to roadway**

To estimate copper releases from nonbrake sources:

- **depended on type of release**

Methodology

Estimated releases apportioned to each of 23 sub-watersheds in the San Francisco Bay watershed

Releases assigned to:

- **one of three land use categories in the watershed**
- **air**
- **surface waters in the watershed**
- **the Bay**

Estimated Anthropogenic Releases of Copper in the San Francisco Bay Area

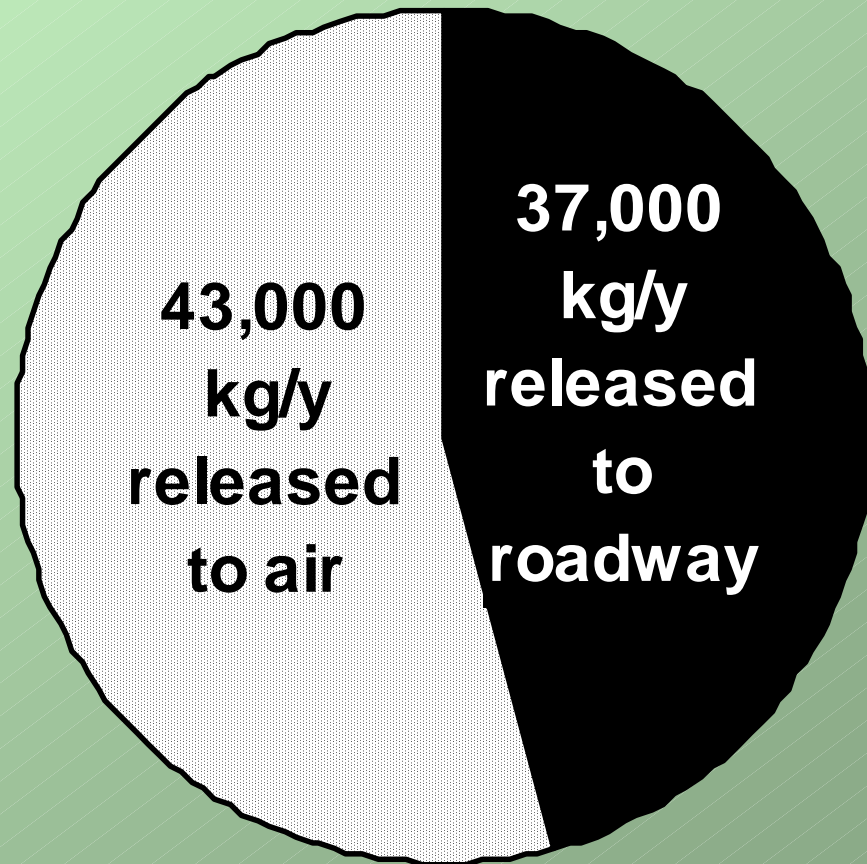
Environmental Compartment	Copper, kg/y
Air releases	44,000
Releases to fresh water	8,600
Releases to impervious surfaces (roadway)	37,000
Releases to soils (developed and agricultural)	130,000
Releases to Bay waters	24,000
Total	240,000

Releases of Copper from Brake Pads

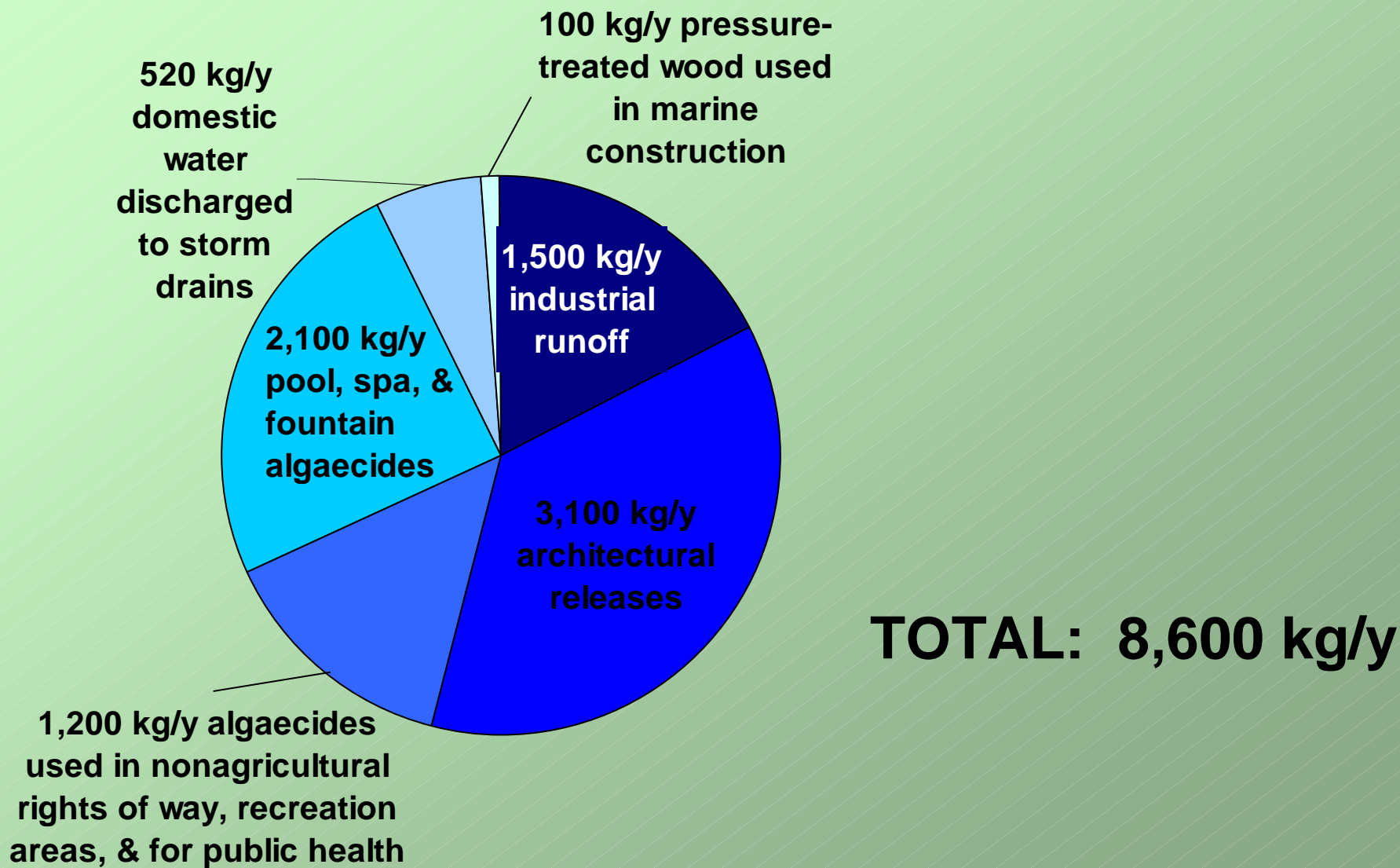
TOTAL: 80,000 kg/y

Releases from aftermarket pads are a substantial amount of the total

More than half of copper released from brakes is transported through air

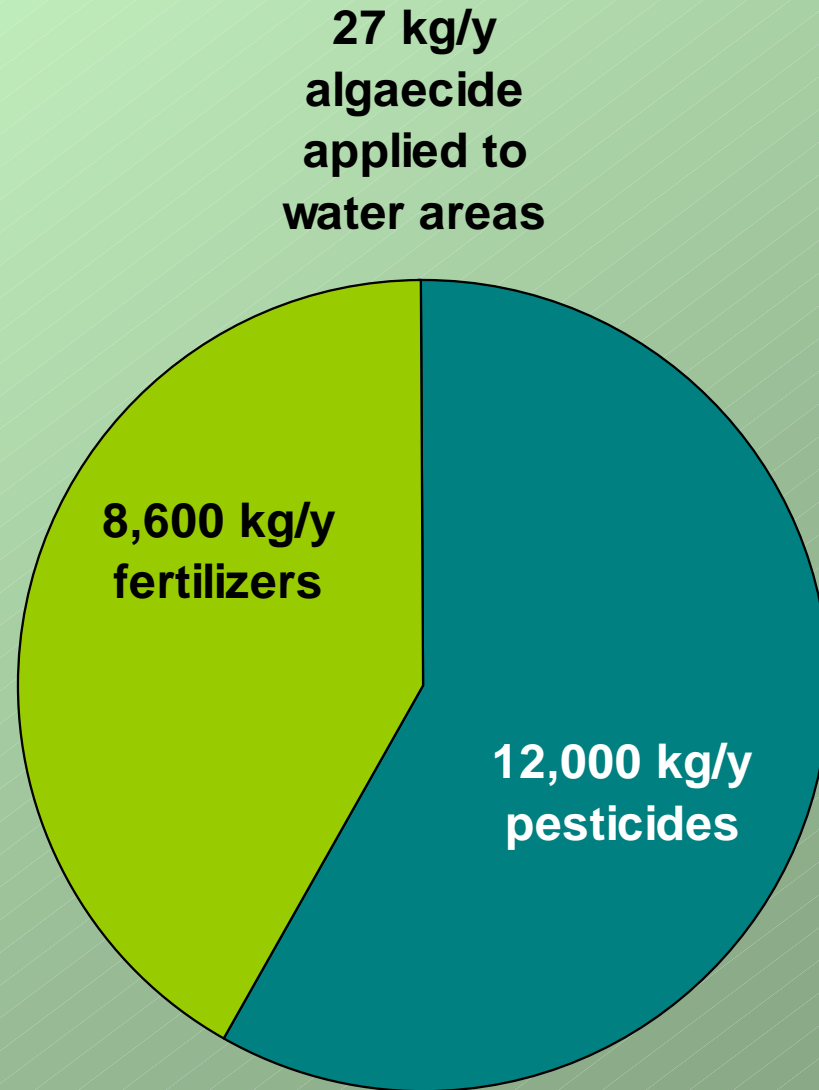


Releases of Copper to Storm Drains and Surface Waters



Copper Released to Agricultural Land

TOTAL: 20,000 kg/y



Copper Released to Developed Land

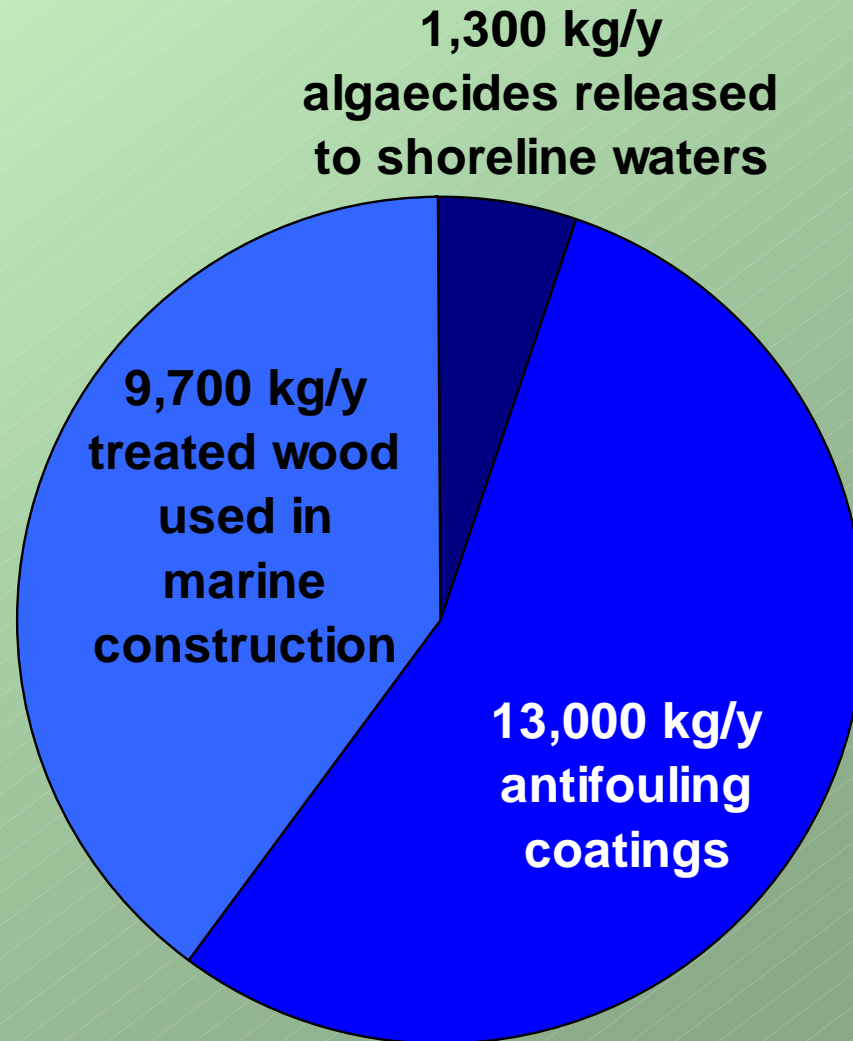


TOTAL: 110,000 kg/y

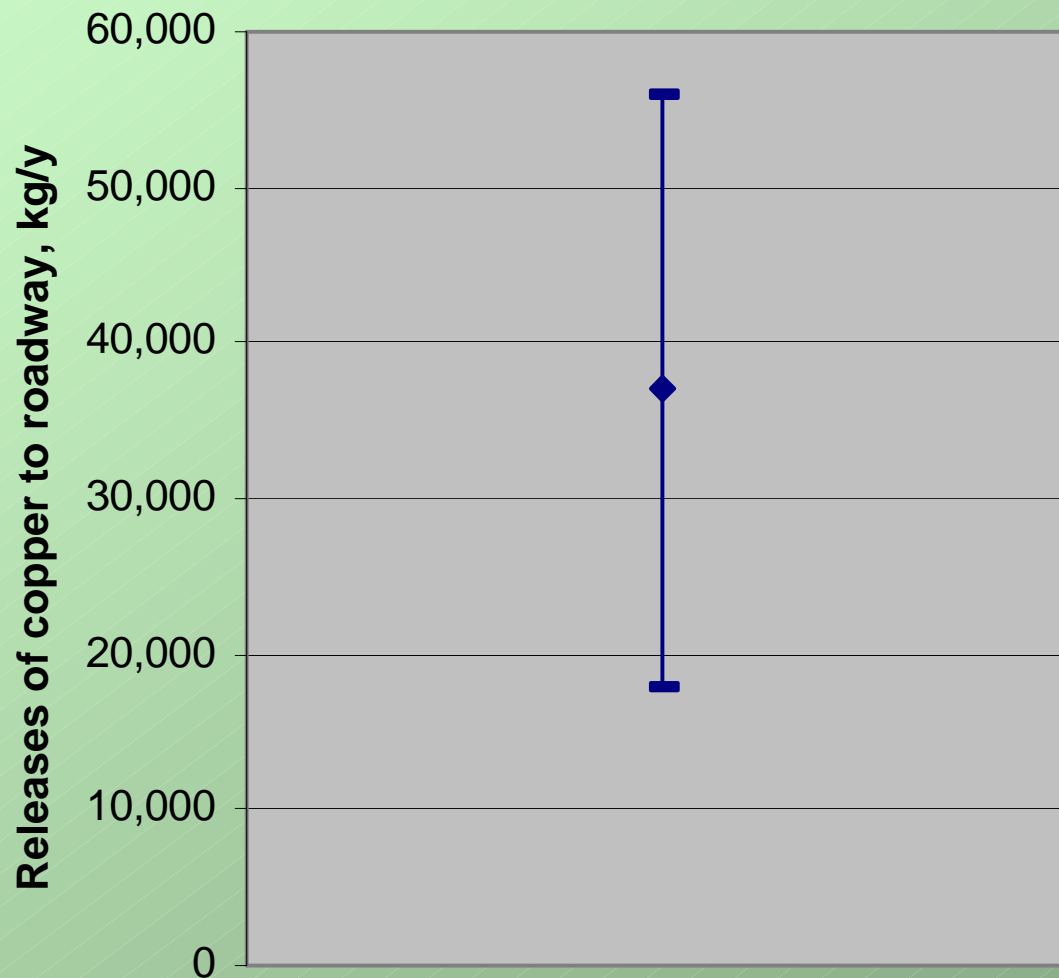
Pesticides applied to urban land are the single largest source of copper releases to the environment in the San Francisco Bay watershed.

Copper Released Directly to Bay Waters

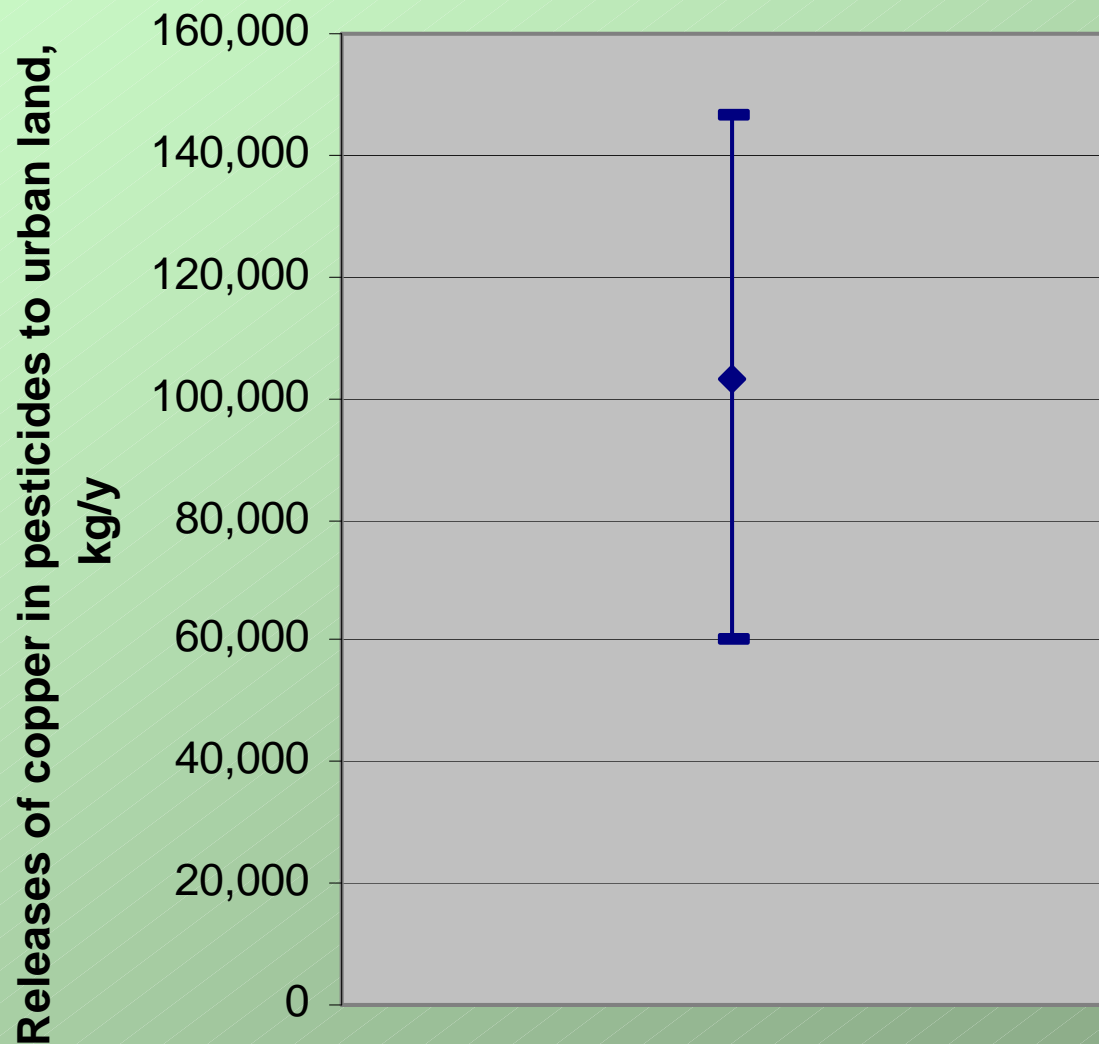
TOTAL: 24,000 kg/y



Exploring Uncertainty in Relative Contribution of Releases from Brake Pads



Exploring Uncertainty in Relative Contribution of Releases from Brake Pads



Summary

- **A little more than half of the copper releases from brake pads in the San Francisco Bay watershed are to air**
- **A substantial amount of the anthropogenic copper releases in the watershed are from non-brake sources**
- **Copper is released directly to bay waters and to surface streams and storm drains as well as to air, soil, and impervious surfaces; the models tell us how much of the releases to the different environmental compartments wind up in runoff**

