

# How Tire Particles and Chemicals Reach California's Aquatic Environments

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A photograph of a coastal wetland. In the foreground, a group of seals is resting on a muddy bank. The background shows a vast expanse of green grass and a clear blue sky with some clouds. In the distance, there are hills and power lines.

# Tire tread wears off during use



US tire wear particle release estimate:  
3.0 - 5.5 kg/y per capita

Particles are tiny (nm - 100  $\mu\text{m}$ )



Release estimate sources: Baensch-Baltruschat et al., 2020;  
Cuncell et al., 2004; Kole et al., 2017; Wagner et al., 2018

# Tires contain more than rubber

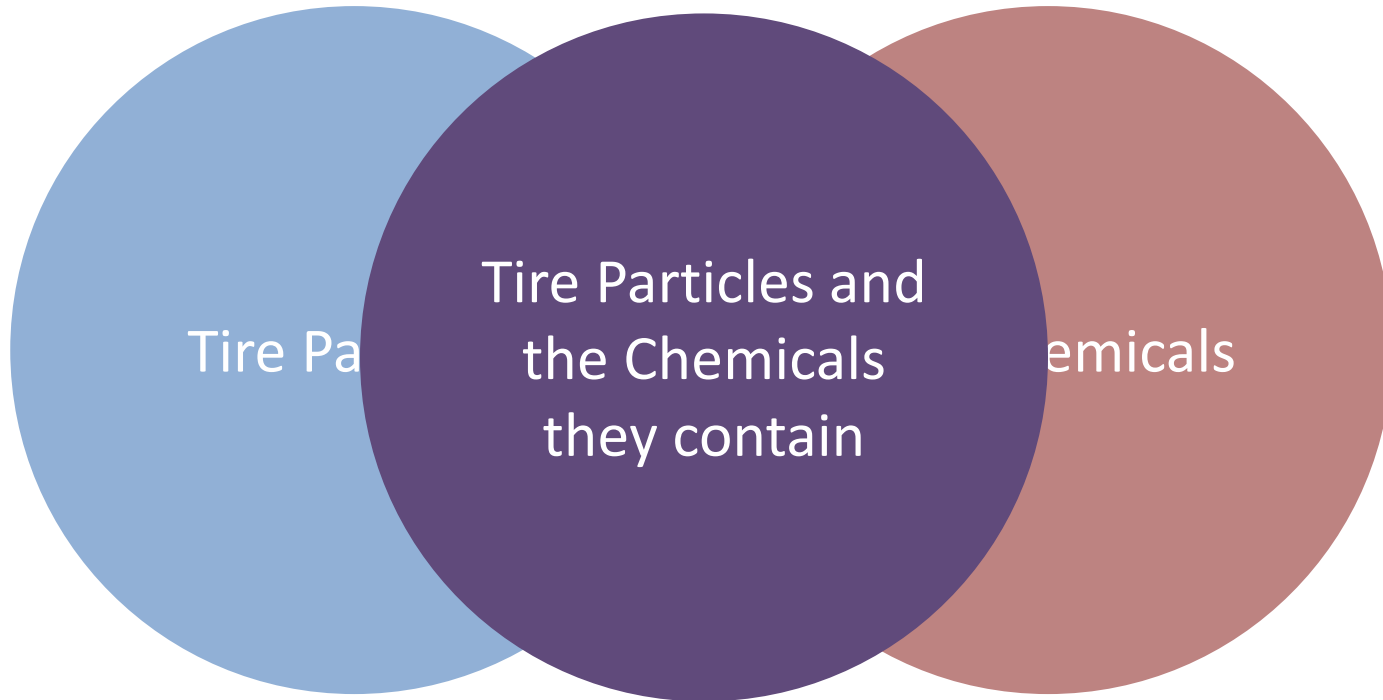
<b>Compound Type</b>	<b>Content</b>
Rubber	40-60%
Fillers/reinforcing agents	20-35%
Process/extender oils	12-15%
Additives (preservatives, plasticizers, etc.)	5-10%
Vulcanization agents	1-2%



Tire Particles

Tire Chemicals

# Tire particles carry chemicals into the environment



# Why care?

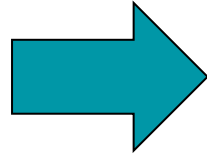
- Tire pollutants and tire wear particles wash into storm drains
- Flow directly to surface water without treatment
- Particles and leachate both toxic to aquatic organisms
- Potential to harm fish and ecosystems



Particle toxicity: Baensch-Baltruschat et al., 2020; Camponelli et al., 2009; Chibwe et al., 2021; Halle et al., 2020; Khan et al., 2019; Panko et al., 2013; Redondo Hasselerharm et al., 2018; Wagner et al., 2018; Wik and Dave, 2009

Leachate toxicity: Capolupo et al., 2020; Gualtieri et al., 2005; Halle et al., 2020; Halsband et al., 2020; Kolomijeca et al., 2020; Wik and Dave, 2009

Most California stormwater flows directly to surface water without any treatment



# Tire particles are the most common microplastic flowing into San Francisco Bay

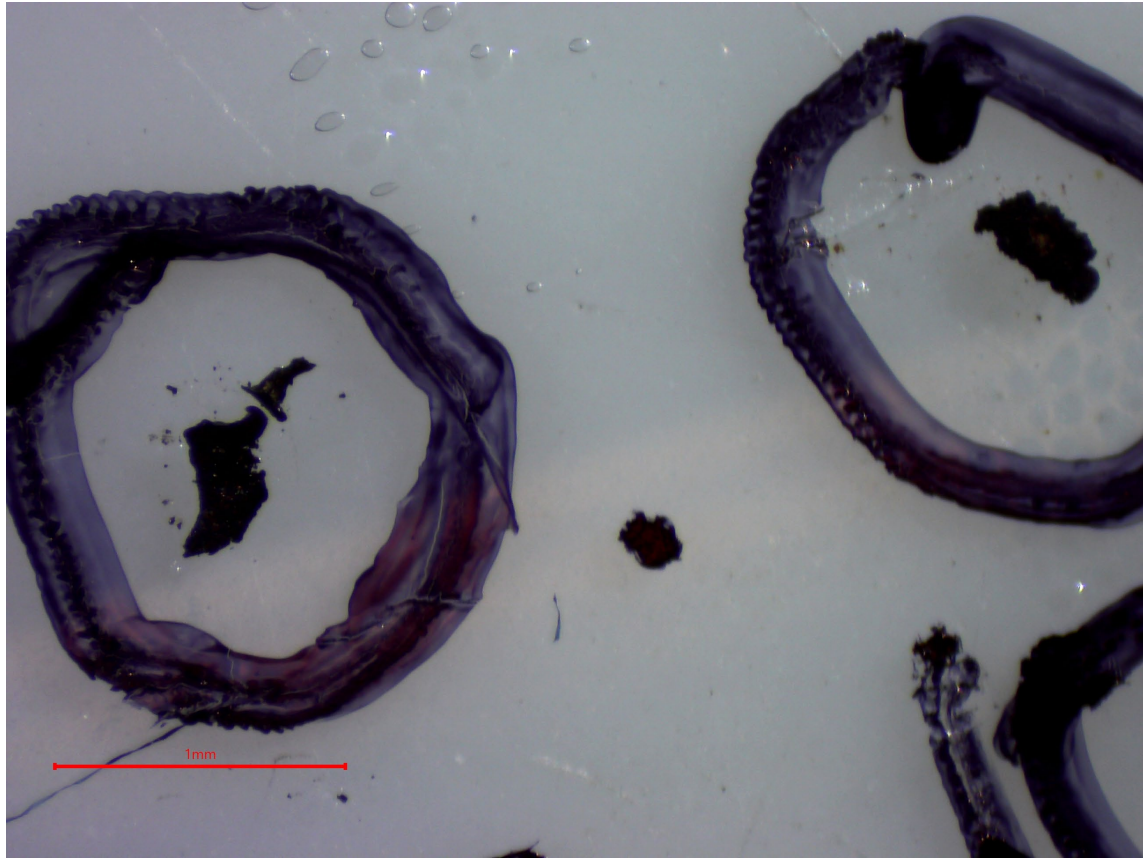
SFEI 2019 study:

- Common in stormwater and sediment
- Not detected in Bay water, wastewater, prey fish or bivalves
- Study design likely undercounted tire particles





Black rubbery fragments were abundant in stormwater and constituted 48% of all microparticles in samples



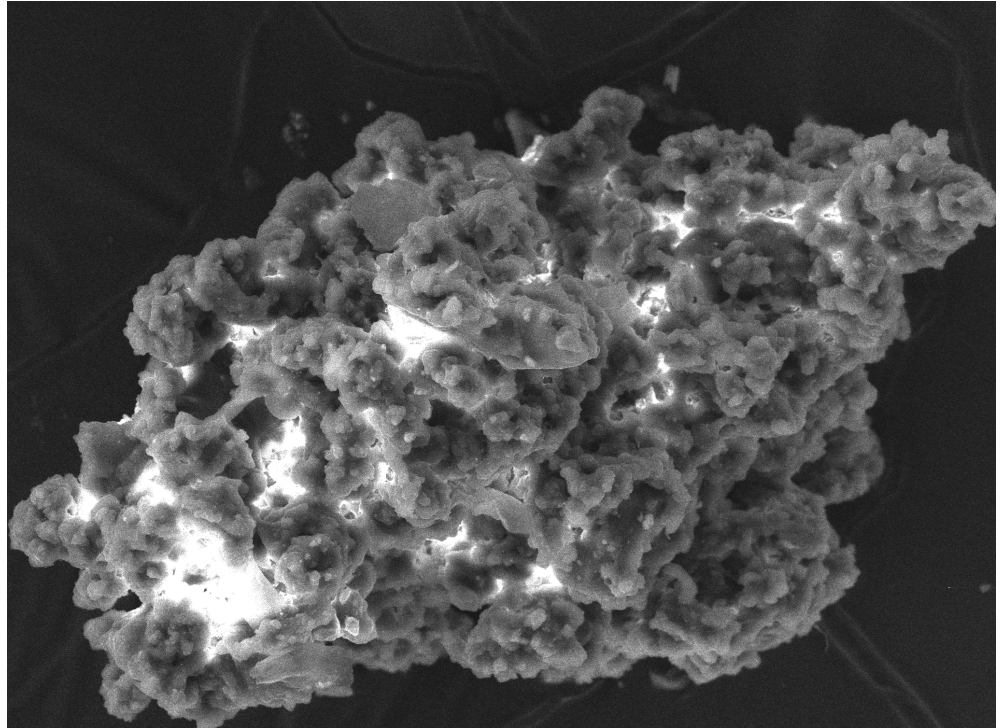
Surface area = leaching potential



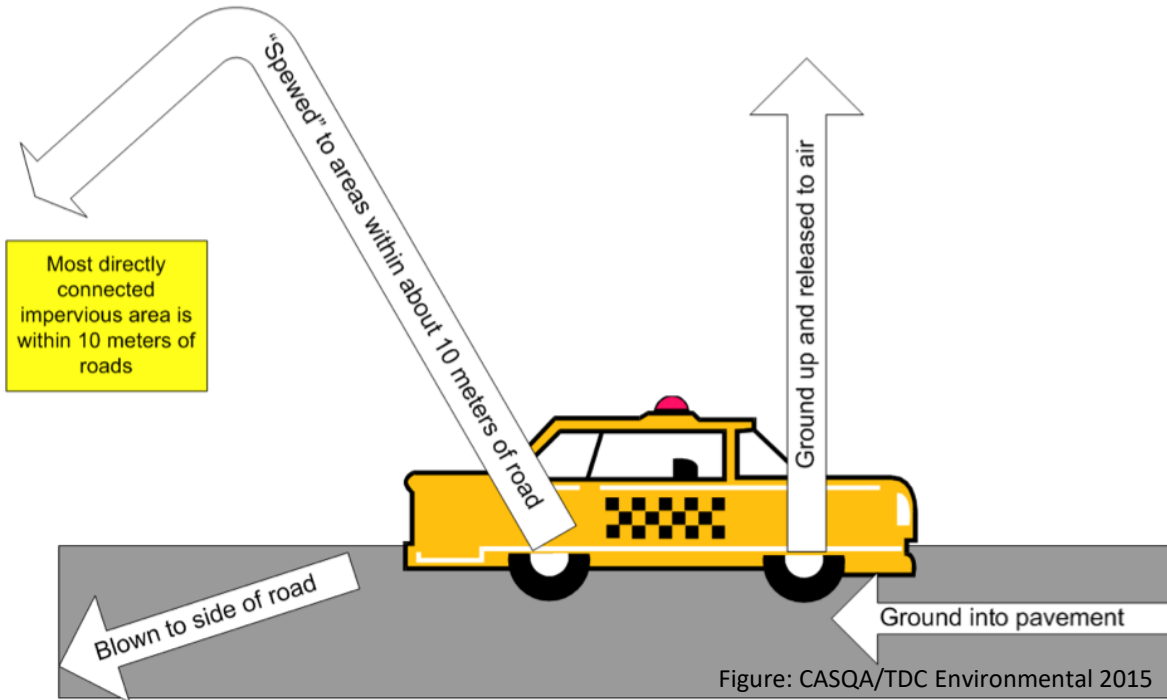
Wear particles have much greater surface area than powders

# Tire particles appear to have large surface areas

Scanning electron microscope image of laboratory-generated tire wear particle



# Most tire wear particle mass winds up near roads – but small particles can fly far away



Still unknown: how important are the smallest particles (ones that fall throughout cities) for water quality?

# Tire-related chemicals released everywhere

- Tire particles found in air, stormwater, aquatic environments, and organisms (Baensch-Baltruschat et al., 2020; Leads and Weinstein, 2019; Siegfried et al., 2017; Tian et al., 2017; Werbowski et al., 2021; Wik and Dave, 2009)
- Tire-related chemicals found in stormwater, creeks (Huang et al., 2021; Peter et al., 2020, 2018; Tian et al., 2021)
- Likely to be released in aquatic sediments & organisms

# Many potential mitigation options exist

Potential actors include tire manufacturers, vehicle manufacturers, government, and general public

*Prevention*

*Remediation*



Eliminate tire wear particles/  
Remove toxic ingredients

Reduce wear debris formation

Reduce wear debris emissions

Collect (portion of) wear debris

Remove wear debris/tire contaminants from runoff

# Thank you to our funders



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