Well water quality in Orleans region and the effect of road salt on plumbing corrosion

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Fisher's Landing Fire Hall

United States Department of Agriculture
National Institute of Food and Agriculture

Exposure to lead

- Affects mental and physical development
  - Learning disabilities and behavioral problems

- No safe level of exposure
  - Even small amounts can cause serious health problems

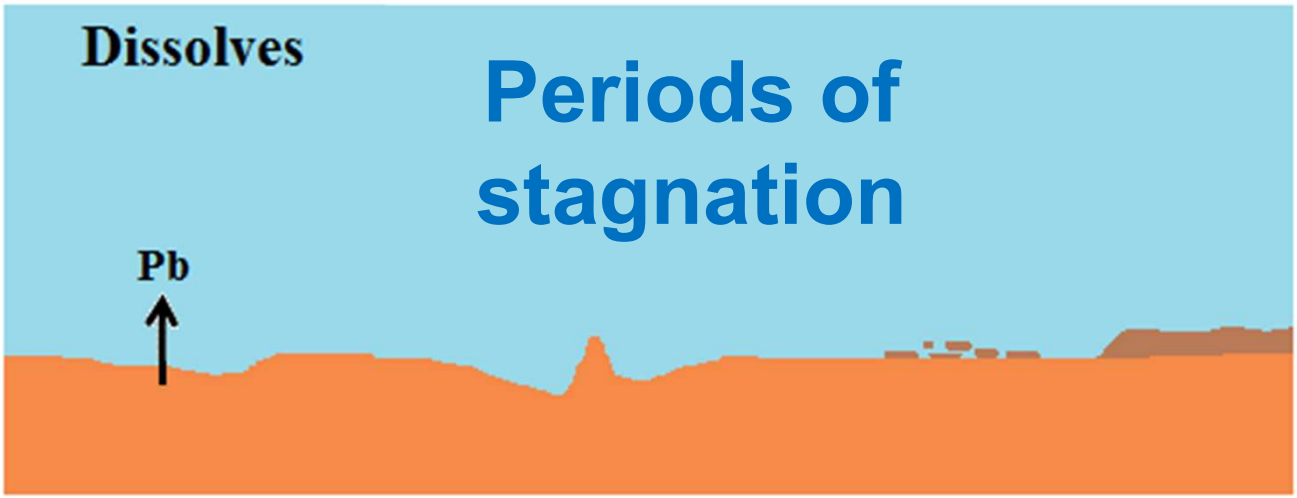
Efforts to eliminate levels of elevated blood lead in children

Lead is common additive in plumbing

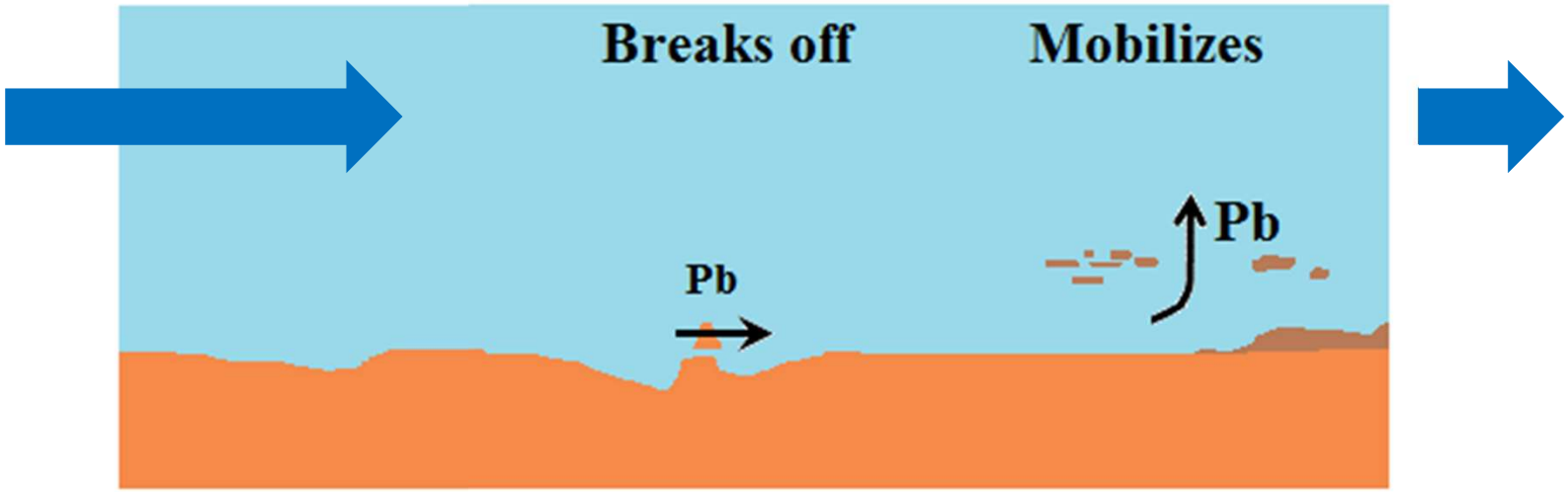
Solder Brass Brass Galvanized iron

Lead-bearing materials can be present in both the home plumbing and well system

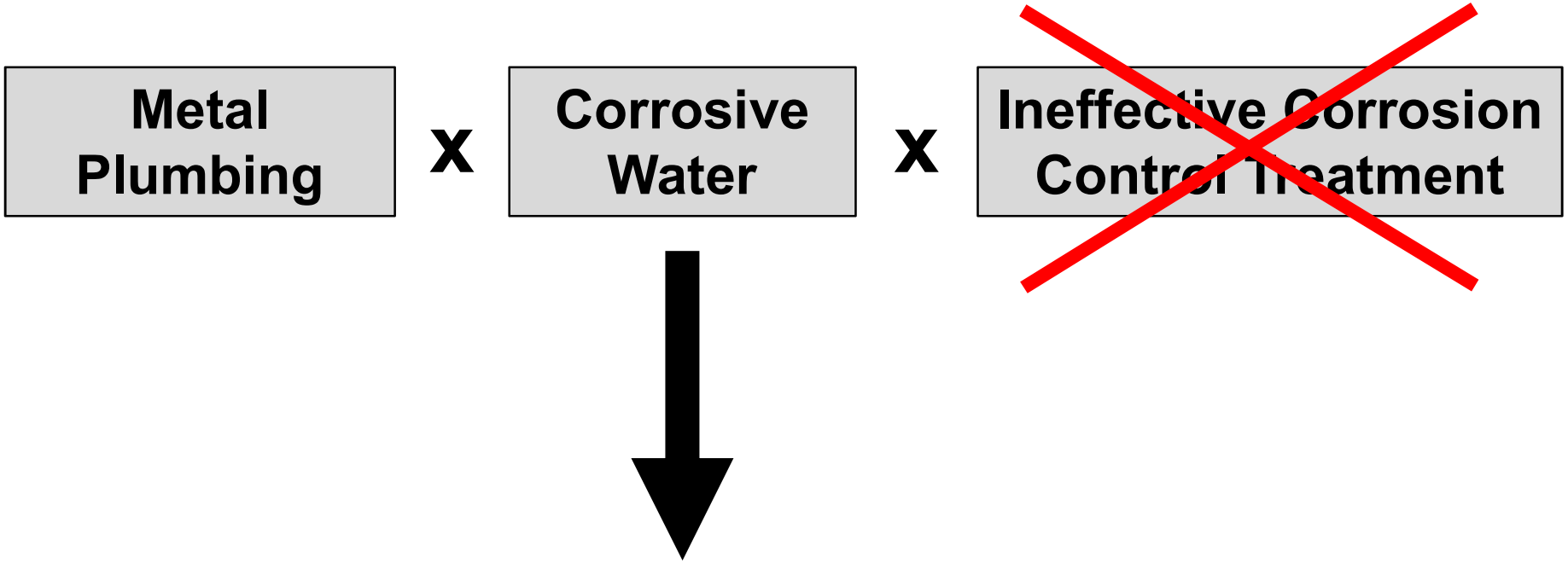
Lead is common additive in plumbing



Lead is common additive in plumbing



Presence of metal in drinking water



Exploring how **elevated chloride** levels and **road salt** contamination can influence **corrosivity of the water**

Chloride to sulfate relationship

$$\frac{\boldsymbol{Chloride}}{\boldsymbol{Sulfate}}$$

Impacts corrosion when different types of metals are in direct contact

Chloride to sulfate relationship

$$\frac{Chloride}{Sulfate}$$

Will **increase** corrosion and **breakdown** protective scale layers for connection of dissimilar metals

Will **decrease** corrosion and **form** protective scale layers

$$\frac{Chloride}{Sulfate} > 0.5$$

Potential of corrosion of dissimilar metals when in direct contact

Link between chlorides in drinking water and use of road salt

- NaCl is a primary deicer for many DOTs
  - Dissolves into Na^+ and Cl^-
- According to USGS, per capita salt use=137 lbs/person

Photo source: https://www.pca.state.mn.us/water/salt-and-water-quality

Increasing

$$\frac{Chloride}{Sulfate}$$

Not influenced

Salt barn on Route 12

Orleans homeowners blame NY DOT for water issues

Greig aims to fix decades-old water pollution from road salt

Frustrated with inaction, Orleans will try to hold DOT accountable for salt contamination

WRVO PUBLIC MEDIA

Watertown Daily Times

Serving the communities of Jefferson, St. Lawrence and Lewis counties, New York

In print daily. Online always.

Major Questions:

1. What are the levels of chloride and corrosion-related metals in well water in the Orleans area?

2. Does increasing chloride levels impact the corrosion of plumbing materials?

Well sampling in Orleans area

Offered free testing between April and June 2016

6+ hour stagnation → 

250 mL
First draw

Flush for 1 minute → 

250 mL
1 min flush

1. Analyzed for corrosion metals (lead, iron, copper), chloride and sulfate

2. Well user survey about systems, usage, and perception

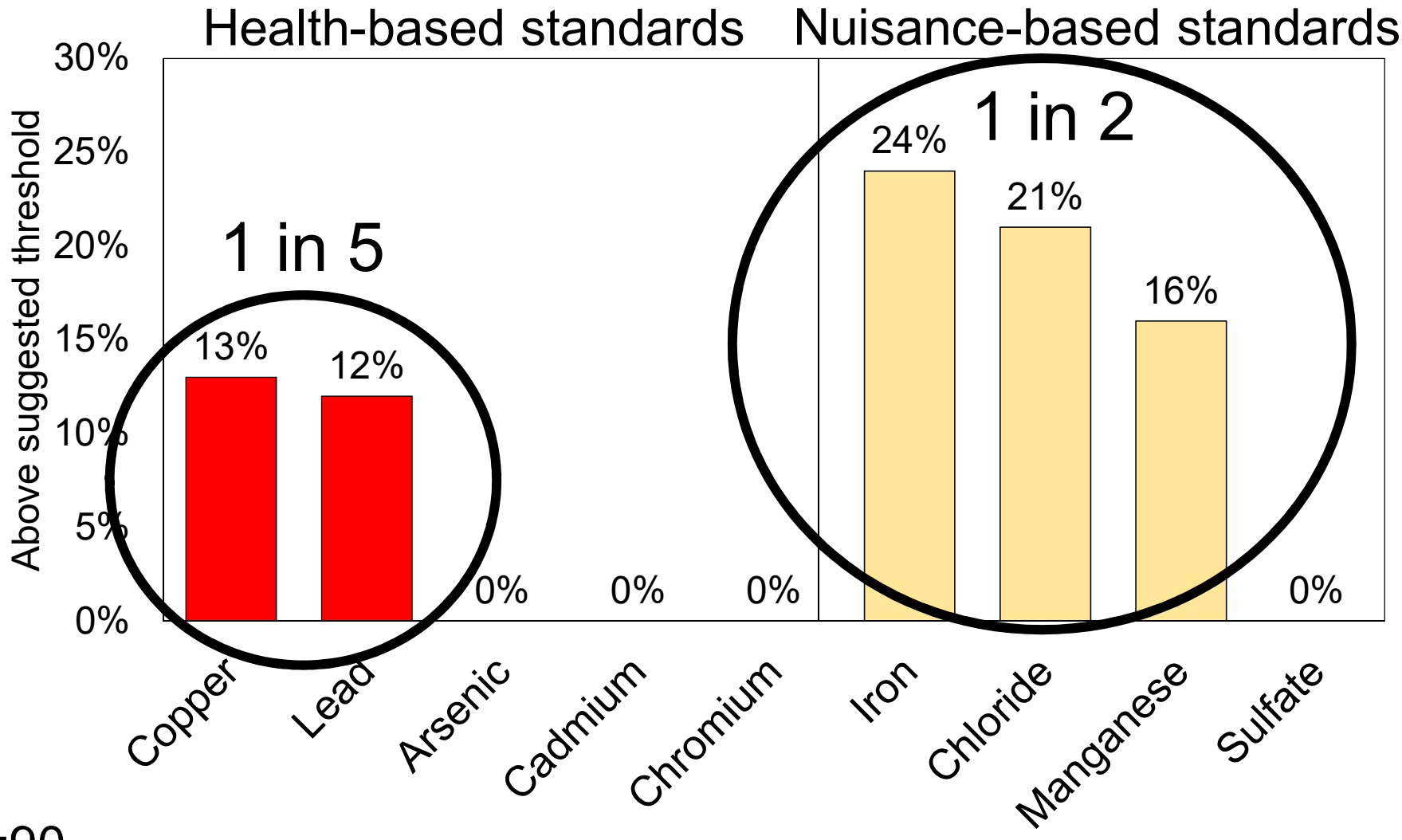
Distributed free water sampling kits at the Gal's Place

95 homeowners submitted samples (76% return rate)

5 were outside the study boundaries

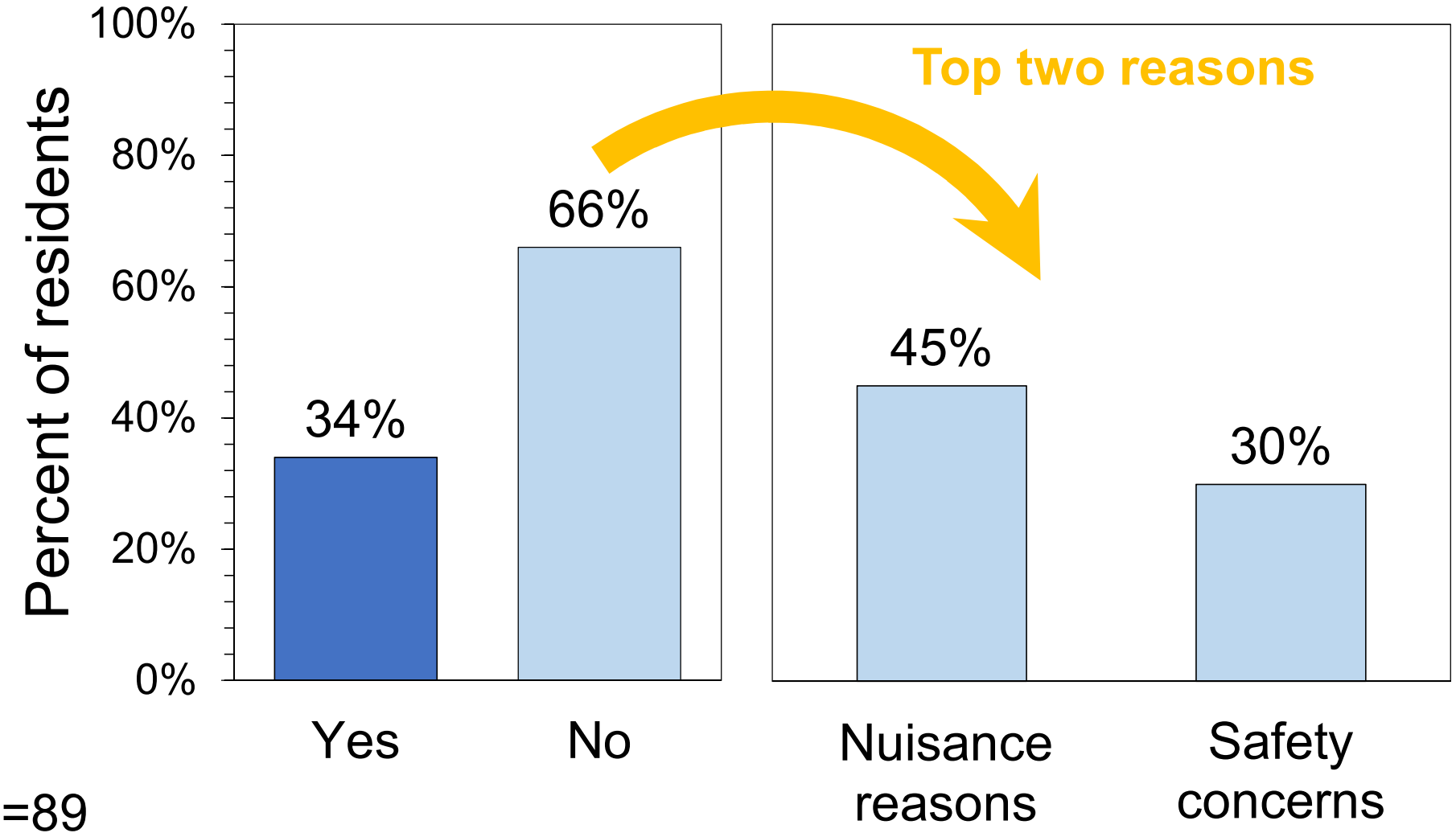
Overall, **<u>90 residents</u>** submitted samples and 89 surveys.

Comparison to EPA drinking water standards for municipal systems



n=90

Is your well water a primary source of drinking water?

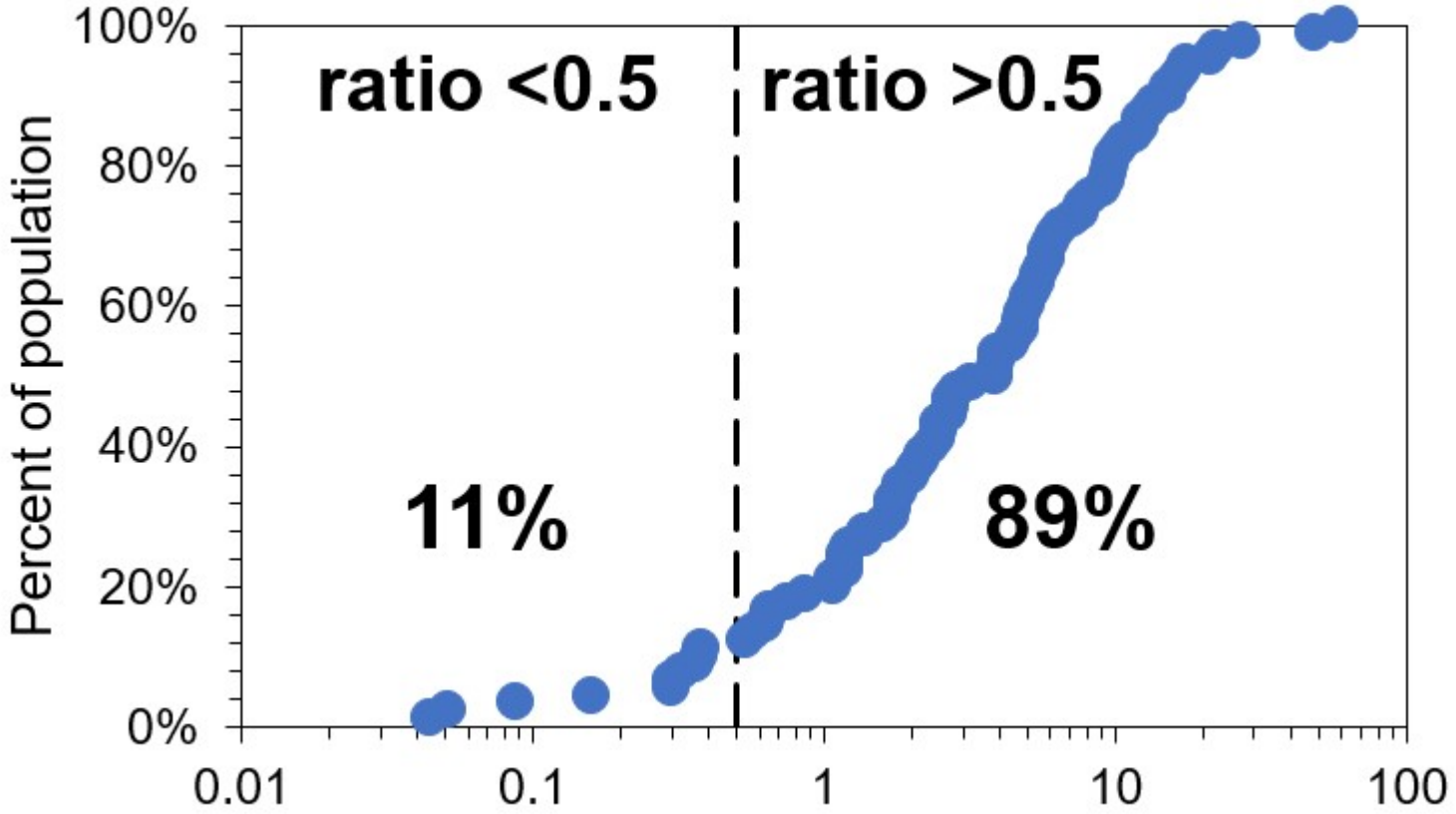


n=89

Chloride to sulfate relationship

$$\frac{Chloride}{Sulfate} > 0.5$$

Potential of corrosion of dissimilar metals when in direct contact



Potential Sources of Chloride in Water

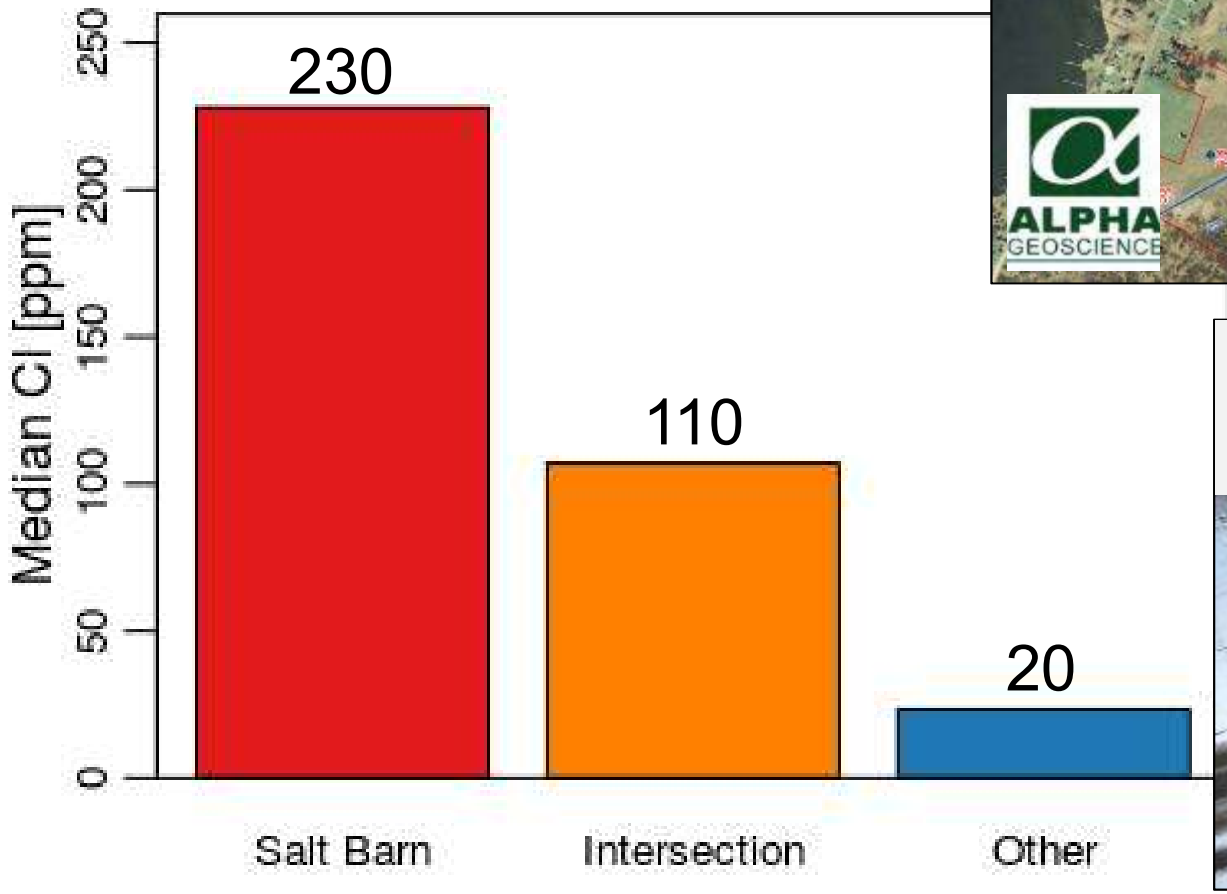


Photo source: Wikimedia commons

Alpha Geoscience 2012 "Analysis of the occurrence and source of elevated chloride in ground water in the vicinity of the Thousand Island Winery, Town of Orleans, Jefferson County, New York

Key Findings:

1. Drinking water in Orleans homes with wells pose health and nuisance-based concerns.

2. Residents have stopped drinking their water

3. Higher levels of chloride levels were observed downstream of the salt barn and near major intersections.

Major Questions:

1. What are the levels of chloride and corrosion-related metals in well water in the Orleans area?

2. **Does increasing chloride levels impact the corrosion of plumbing materials?**

Corrosion of Plumbing Overview

Uniform corrosion

Non-uniform corrosion

Measure of corrosion

- **Metal leaching**
- Weight loss
- Rust formation

http://www.mathisplumbingheatingair.com/pin-hole-leaks-greenwood-sc.php

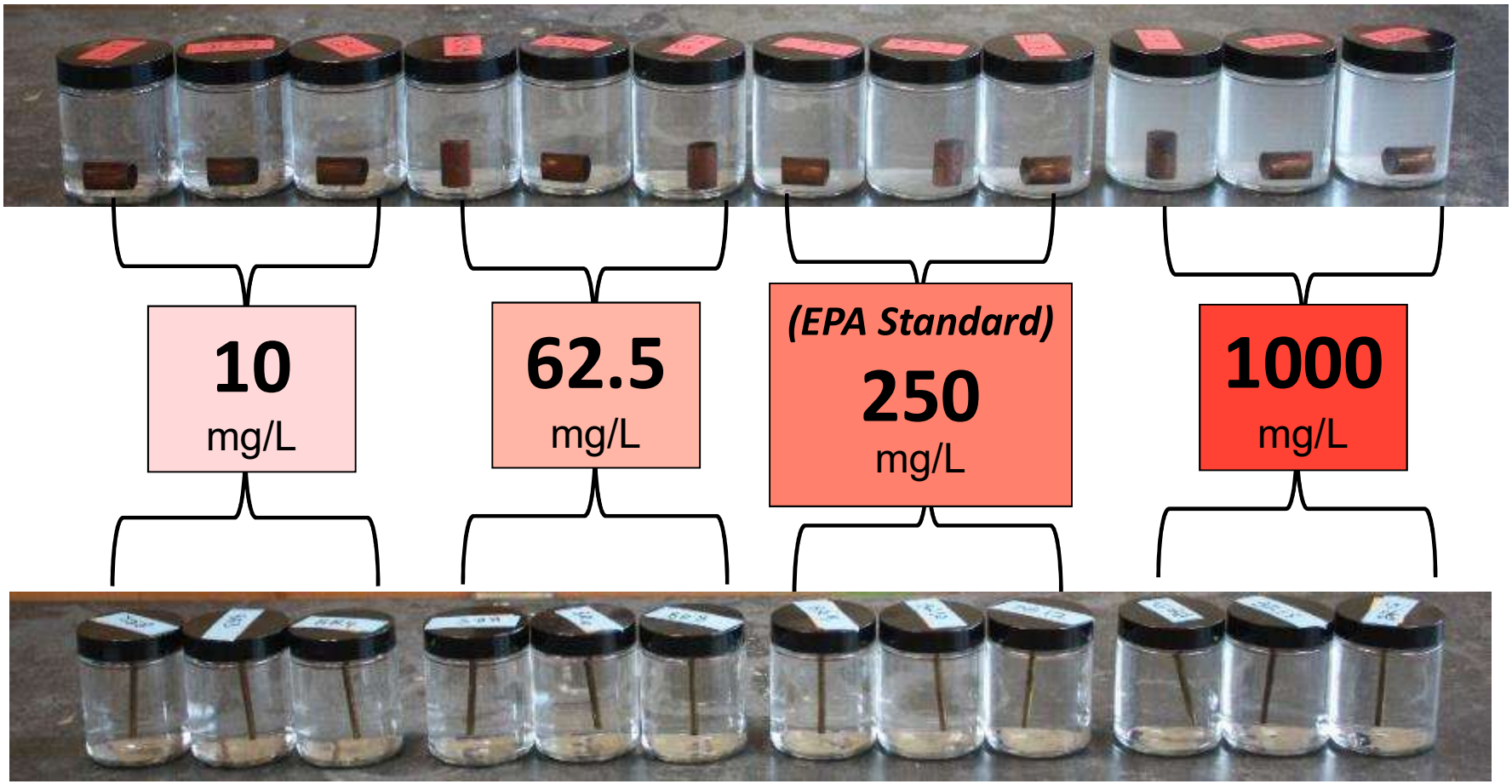
http://www.gocarwarranty.co.uk/news/preventing-rust-know-where-it-forms/333984#.WiDB7kqnHSE
http://www.instructables.com/id/How-to-prevent-rust-on-your-car/

Simulating Well Water conditions

Isolate the impact of increasing chloride levels on metal leaching plumbing materials

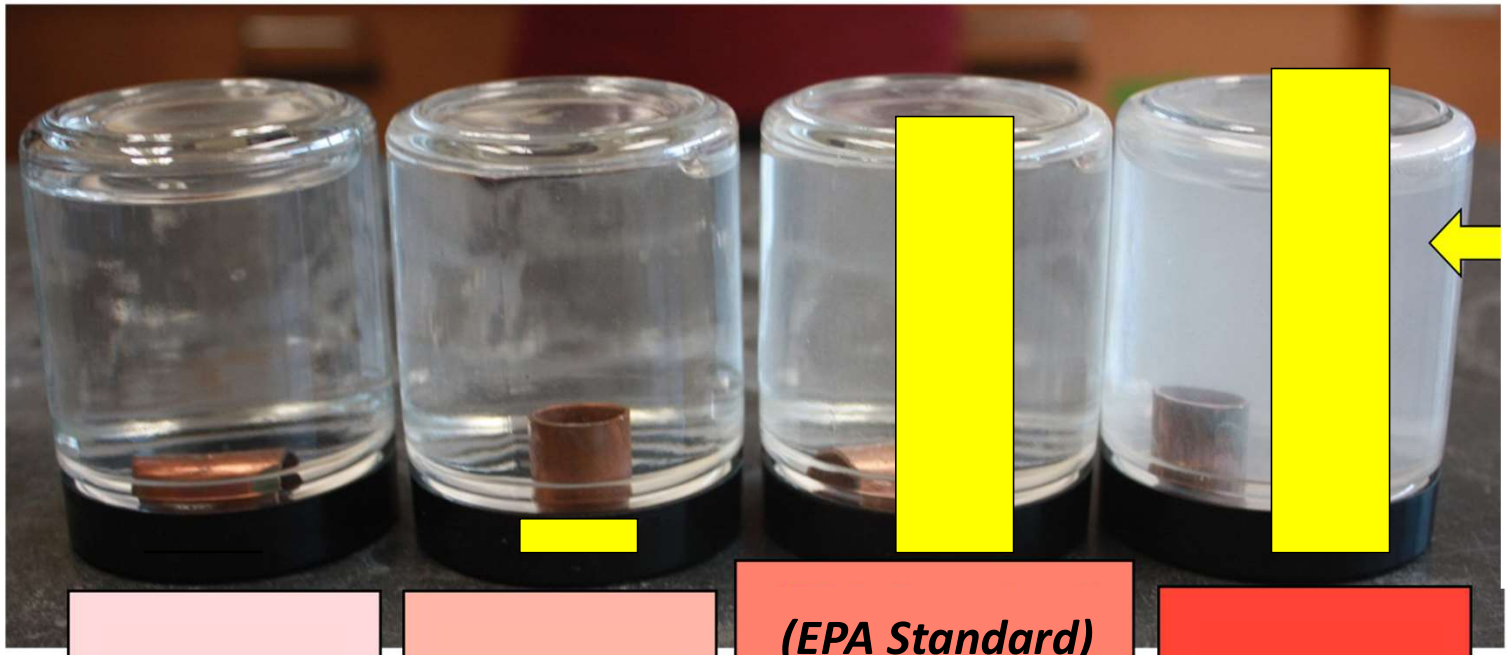
Brass Iron Zinc Stainless Steel Lead-solder

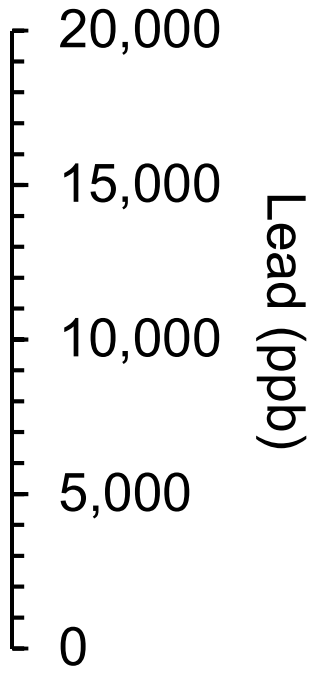
Exposing materials to varying levels of chloride in water



Lead Leaching from Lead Solder

After 2 weeks of exposure

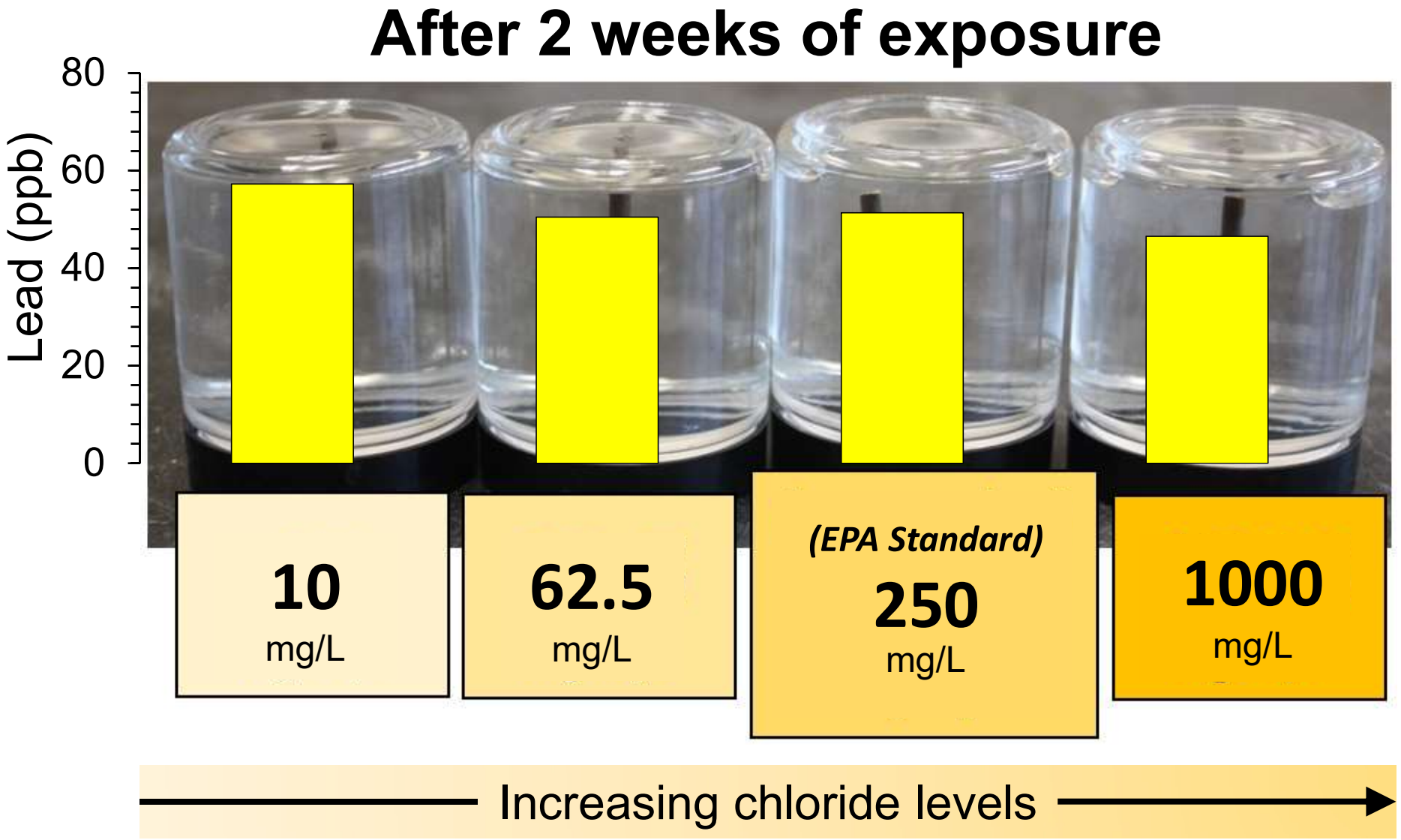




10 mg/L	62.5 mg/L	*(EPA Standard)* 250 mg/L	1000 mg/L

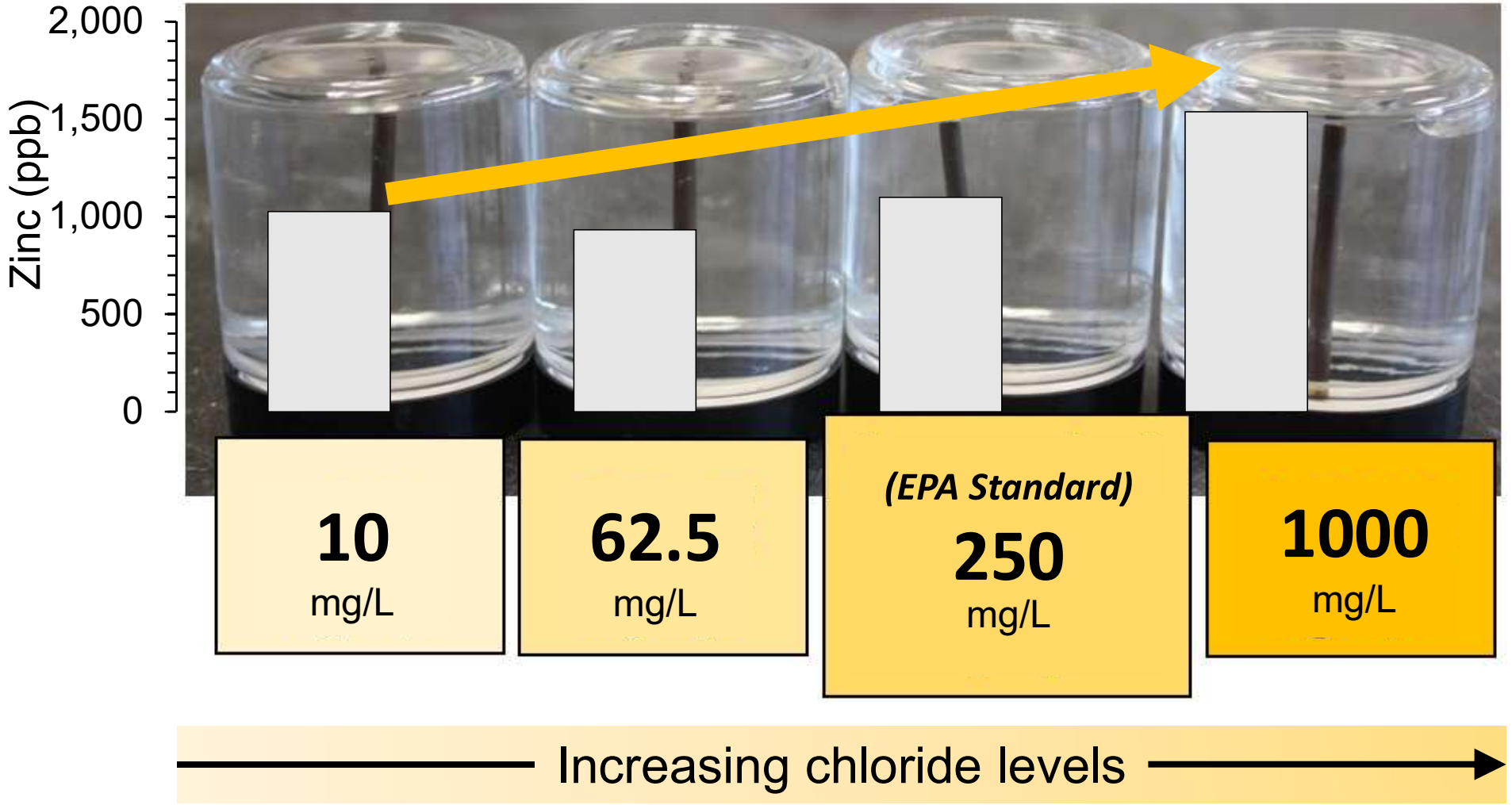
Increasing chloride levels →

Lead Leaching from Brass



Zinc Leaching from Brass

After 2 weeks of exposure



Key findings

- Higher chloride levels influenced lead release from lead solder joints

- Higher chloride levels did not impact lead release from brass
  - Higher chloride levels impacted zinc release from brass

Next steps for our team

1. Citizen sampling campaign: Working to understand source of elevated chlorides using spatial analysis

2. Laboratory study: Working to determine weight loss and rust formation associated with road salt

USWaterStudy.org

Thank you to all the residents that participated in our study!

United States Department of Agriculture
National Institute of Food and Agriculture

Virginia Tech
Invent the Future