



## Corrosion Studies

**Ashley Pifer, PhD, PE**

Water Quality Practice Leader

October 12, 2023

1

## OUR AGENDA

- 01.** When corrosion studies are needed
- 02.** Types and applications of corrosion studies
- 03.** Other water quality considerations and resources

2

1

## When corrosion studies are needed

3

## Corrosion studies inform CCT and can be undertaken proactively or to meet regulatory requirements



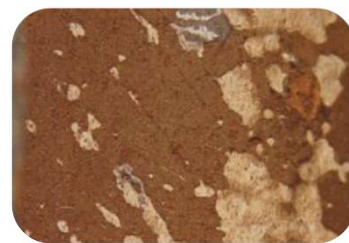
### Oxides

- Lead(IV) oxide (Plattnerite) occurs in high-ORP systems



### Carbonates

- Lead(II) carbonates
  - Cerussite
  - Hydrocerussite



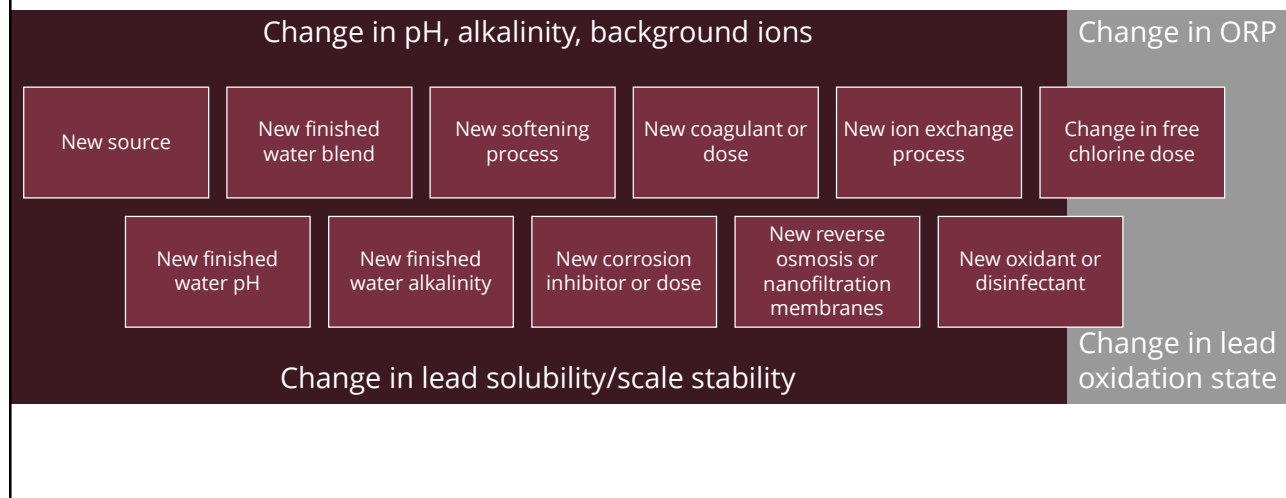
### Phosphates

- Lead(II) phosphate (Hydroxypyromorphite)
- Requires orthophosphate

Image References: Plattnerite, hydroxypyromorphite: De Santis et al 2020: [https://cfpub.epa.gov/si/si\\_public\\_file\\_download.cfm?p\\_download\\_id=540968&Lab=CESER](https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=540968&Lab=CESER)  
Lead(II) Carbonates: Harmon et al. 2022. <https://awwa.onlinelibrary.wiley.com/doi/full/10.1002/aww2.1278>

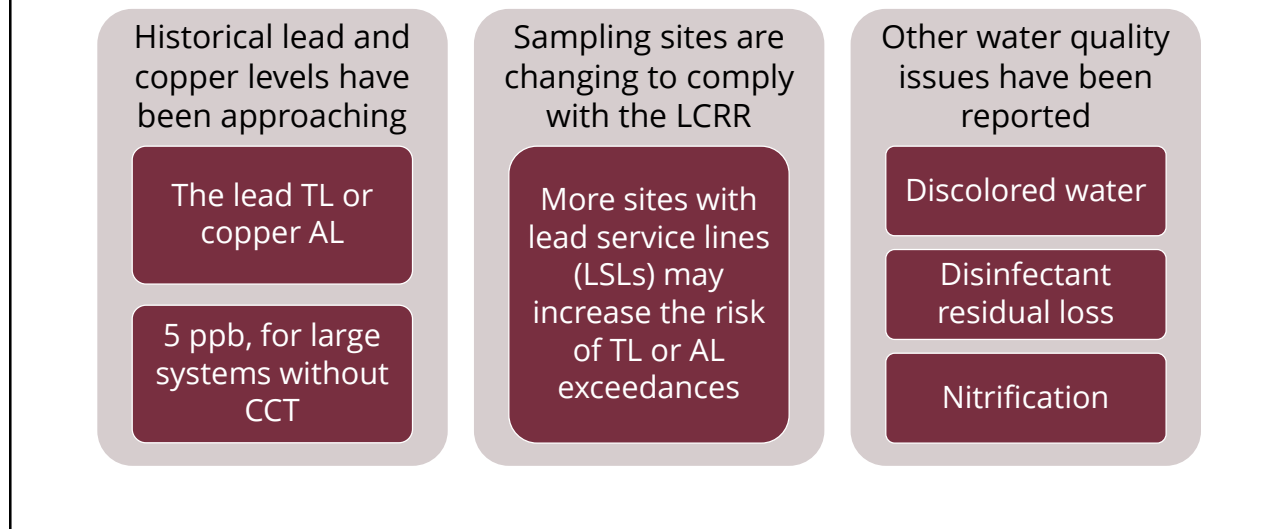
4

## Corrosion studies may be needed when a source or treatment change is proposed



5

## Consider initiating a corrosion study prior to the LCRR compliance date if:



6

# 2

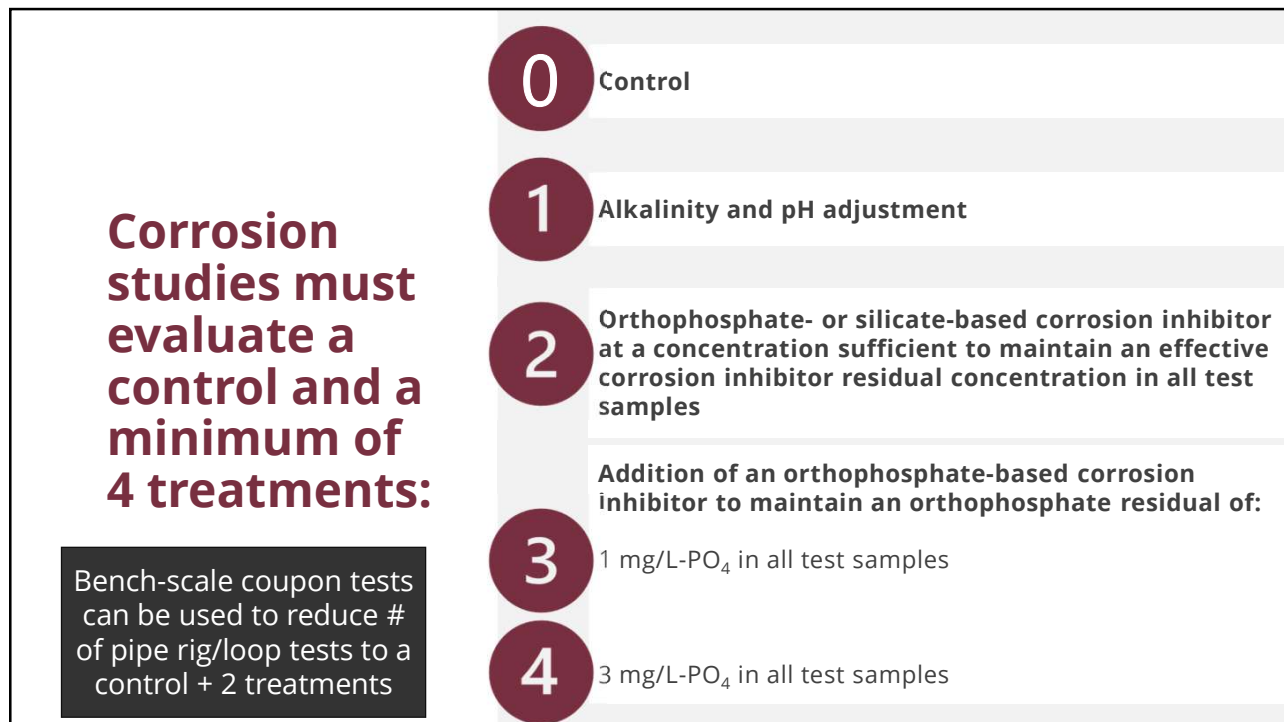
## Types of corrosion studies and their applications

7

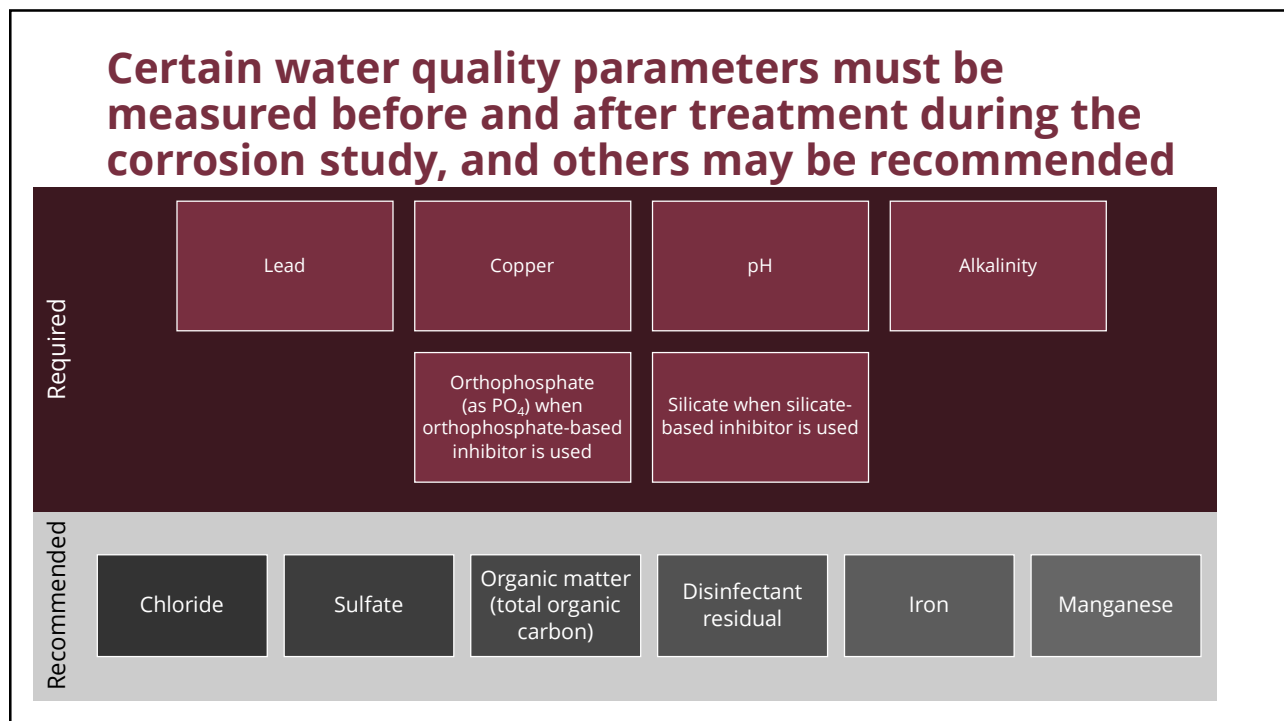
### Corrosion studies can take several forms:

Test	Description	Purpose	Considerations
Existing system evaluation	Desktop study evaluates historical source to tap water quality data. Includes assessment of CCT applied to similar systems. May use theoretical solubility models, network hydraulic models.	Assess existing and proposed CCT, identify potential for metals release; identify CCT that has negatively impacted a drinking water treatment process at another system with similar water quality	Data may be limited; equilibrium-based models may not match actual conditions.
Bench-scale study – metal coupons, immersion study, or static pipe test	Benchtop tests using new or harvested materials, conducted with static or flowing water over weeks to months	Assess metals release under multiple conditions – may be used as a screening tool for systems with LSLs	Static tests do not capture impacts of hydraulics; these tests do not represent distribution system lead levels; may not capture impacts of scales
Pilot-scale study – pipe loop/rig, recirculating or once-through	Pilot tests using multiple new or harvested pipes over months to years	Assess CCT under multiple conditions, and represent impacts of flow	Results may not represent full-scale distribution system; cost and effort
Full-scale testing	Test is run in parts of the full-scale distribution system	Assess CCT in full-scale system to understand actual impacts	May have unintended consequences; long duration

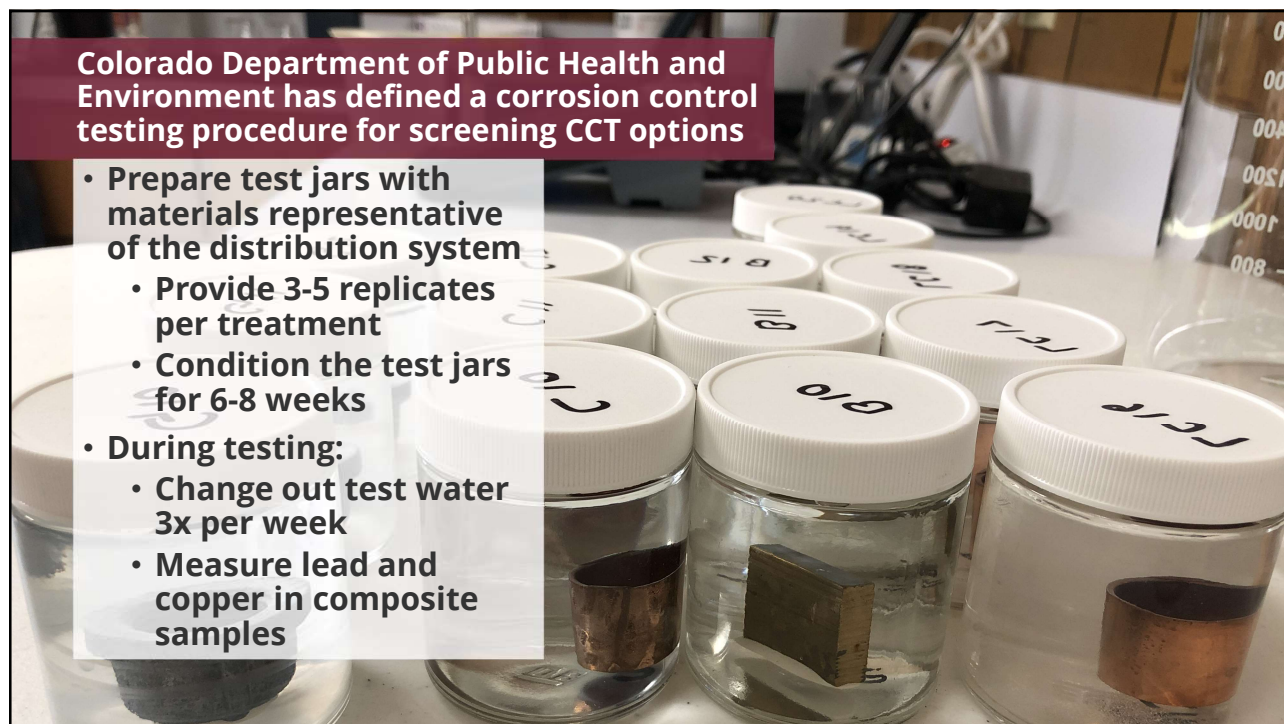
8



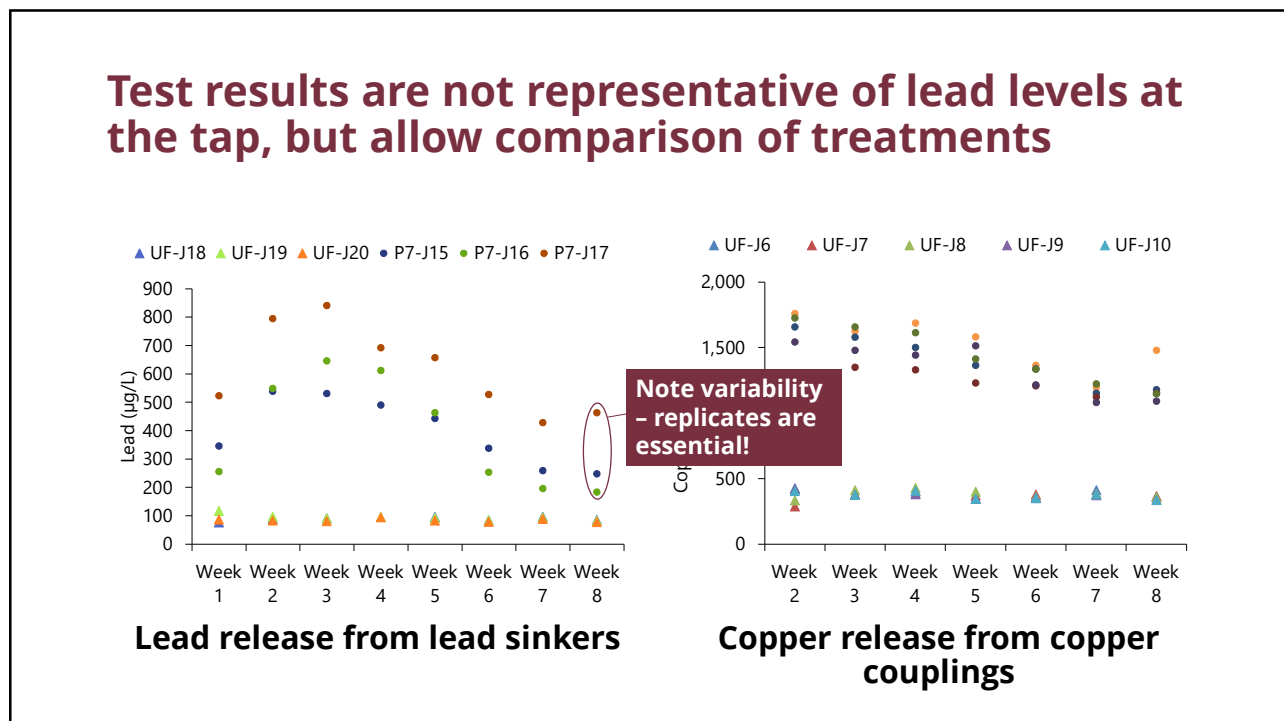
9



10

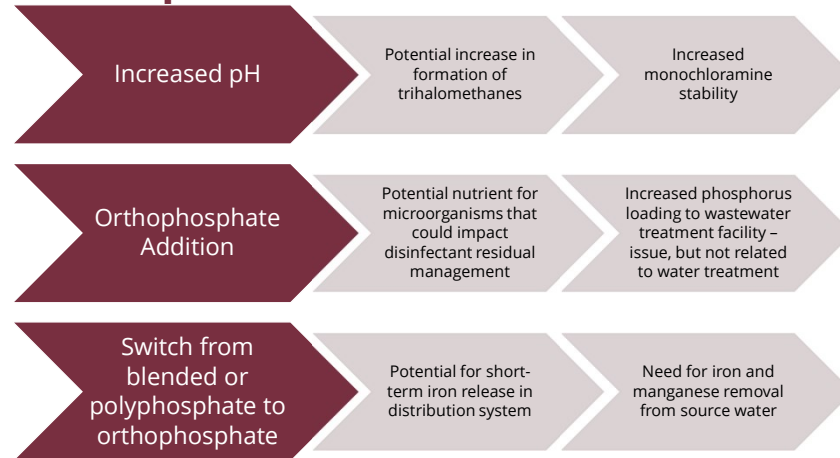


11



12

## Corrosion studies must evaluate and document impacts of the CCT options on other water treatment processes and should consider other potential impacts



13

3

## Resources

14

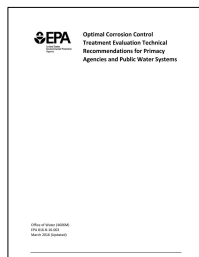
## The EPA provided possible outlines for corrosion study reports in 2016 guidance document

## Bench/Pilot/Partial Distribution System Reports

### Desktop Reports

#### Executive Summary

- I. Introduction
- II. Project Background
- III. Review of Existing Information
  - A. Water System Information (provide a system schematic)
  - B. Water Quality Data
    1. Raw water
    2. Entry Point
    3. Distribution system
    4. Tap
  - C. Pipeline and Plumbing Materials
  - D. Summary of Water Quality Complaints
  - E. Analogous System Information
- IV. Potential Causes of Elevated Lead and/or Copper Levels in the System
- V. Identification and Assessment of Corrosion Control Alternatives
- VI. Evaluation of Corrosion Control Alternatives
  - A. Performance
  - B. Constraints
  - C. Recommended OCCT



#### Executive Summary

- I. Introduction
- II. Project Background
- III. Review of Existing Information
  - A. Water System Information (provide a system schematic)
  - B. Water Quality Data
    1. Raw Water
    2. Entry Point
    3. Distribution System
    4. Tap
  - C. Pipeline and Plumbing Materials
  - D. Summary of Water Quality Complaints
  - E. Analogous System Information
- IV. Special Studies
  - A. Bench Scale Studies
    1. Methods and Materials
    2. Results
  - B. Pipe Loop Studies
    1. Methods and Materials
    2. Results
  - C. Partial System Testing
    1. Methods and Materials
    2. Results
- V. Potential Causes of Elevated Lead and/or Copper Levels in the System
- VI. Identification and Assessment of Corrosion Control Alternatives
- VII. Evaluation of Corrosion Control Alternatives
  - A. Performance
  - B. Constraints
  - C. Recommended OCCT

15

## Resources for corrosion studies



Ongoing Water Research Foundation projects will produce additional resources:

Project #5081

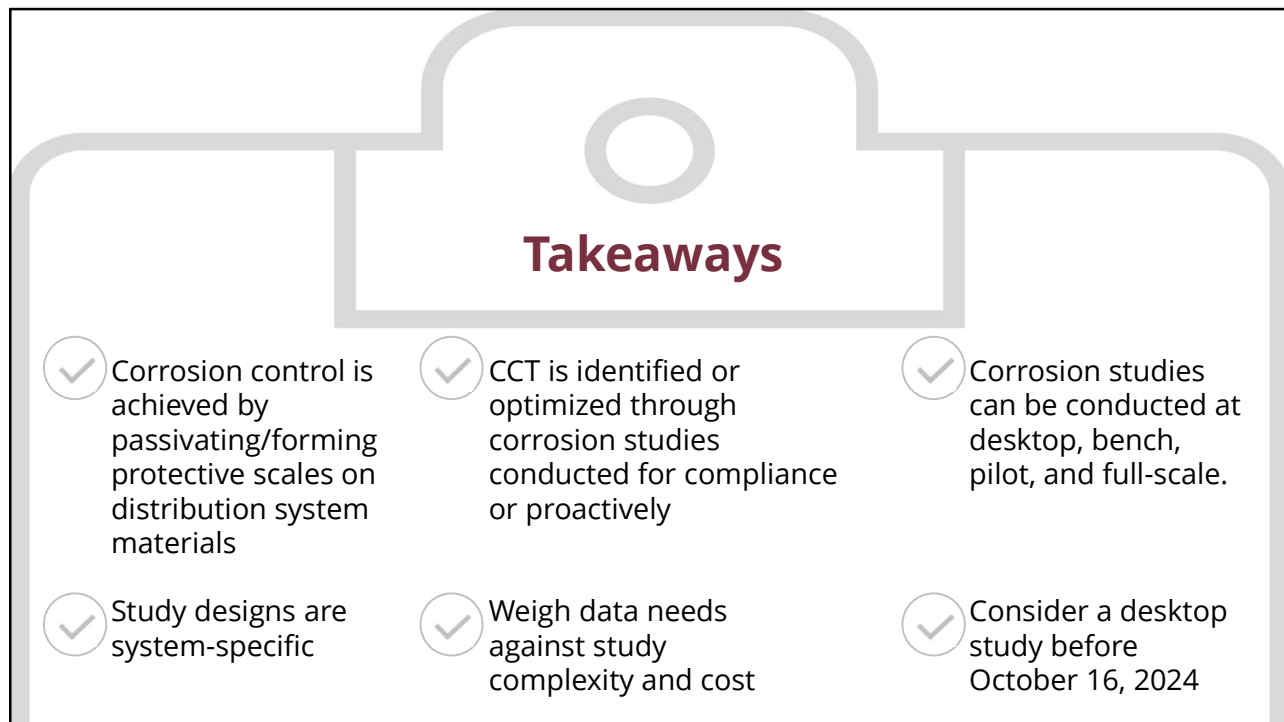
Guidance for Using Pipe Loops to Inform Lead and Copper Corrosion Control Treatment Decisions

Project #5119

Using Phosphate-Based Corrosion Inhibitors and Sequestrants to Meet Multiple Water Treatment Objectives

16

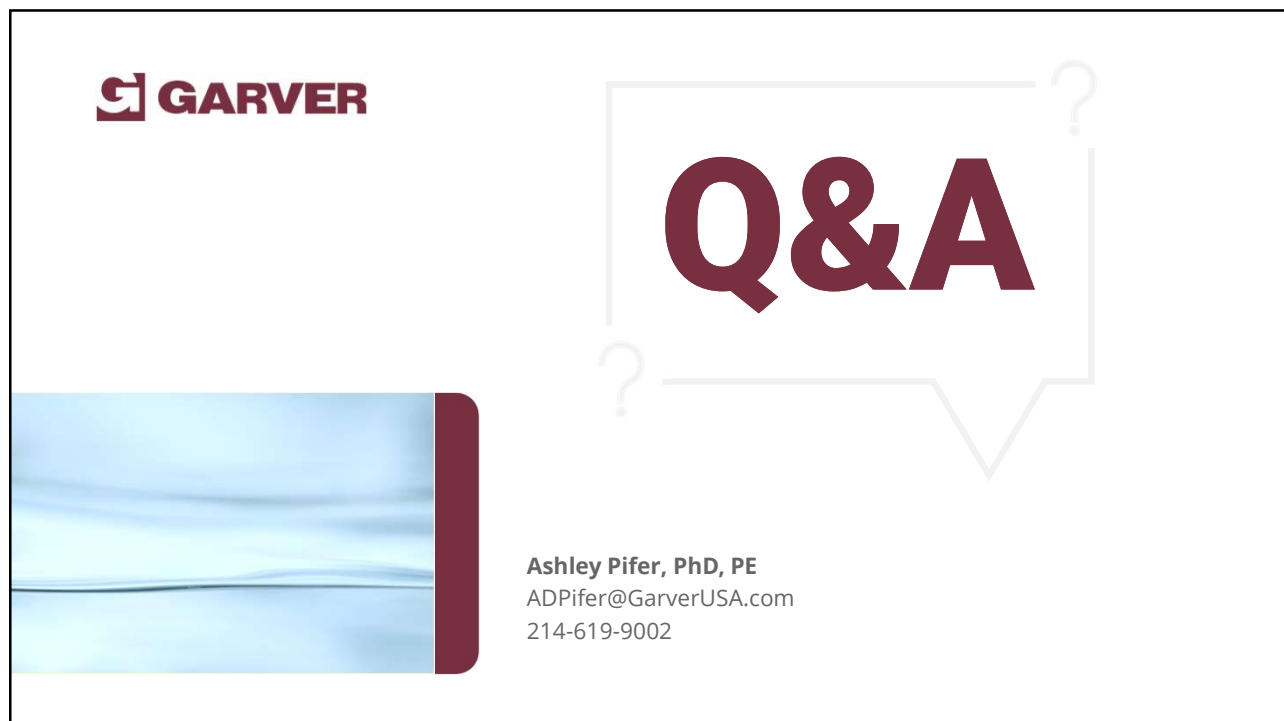


A graphic designed to look like a clipboard with a silver clip at the top. The word "Takeaways" is written in a bold, dark red font in the center of the clipboard. Below the title, there are six bullet points, each preceded by a checkmark inside a circle. The bullet points are arranged in two rows of three.

## Takeaways

- ✓ Corrosion control is achieved by passivating/forming protective scales on distribution system materials
- ✓ CCT is identified or optimized through corrosion studies conducted for compliance or proactively
- ✓ Corrosion studies can be conducted at desktop, bench, pilot, and full-scale.
- ✓ Study designs are system-specific
- ✓ Weigh data needs against study complexity and cost
- ✓ Consider a desktop study before October 16, 2024

17

A graphic for a Q&A session. In the top left corner is the Garver logo, which consists of a stylized 'G' icon followed by the word "GARVER" in a bold, dark red font. In the center, the text "Q&A" is written in a large, bold, dark red font, enclosed within a light gray speech bubble shape that has question marks at its top and bottom. In the bottom left corner, there is a rectangular image showing a blue, wavy liquid surface. To the right of this image, the name "Ashley Pifer, PhD, PE" is written in a bold, dark red font, followed by the email address "ADPifer@GarverUSA.com" and the phone number "214-619-9002" in a smaller, dark red font.

**GARVER**

# Q&A

**Ashley Pifer, PhD, PE**  
ADPifer@GarverUSA.com  
214-619-9002

18