



REVIEW OF ZINC REMOVAL PILOT STUDIES

Sturbridge Wastewater Treatment Facility

NEWEA Annual Conference 2020

Ian Catlow, PE
Austin Weidner, PE

PRESENTATION OVERVIEW

- **Regulatory History**
- **Treatment Facility Overview**
- **Metals Removal Approach**
- **Zinc Removal Trials & Performance**



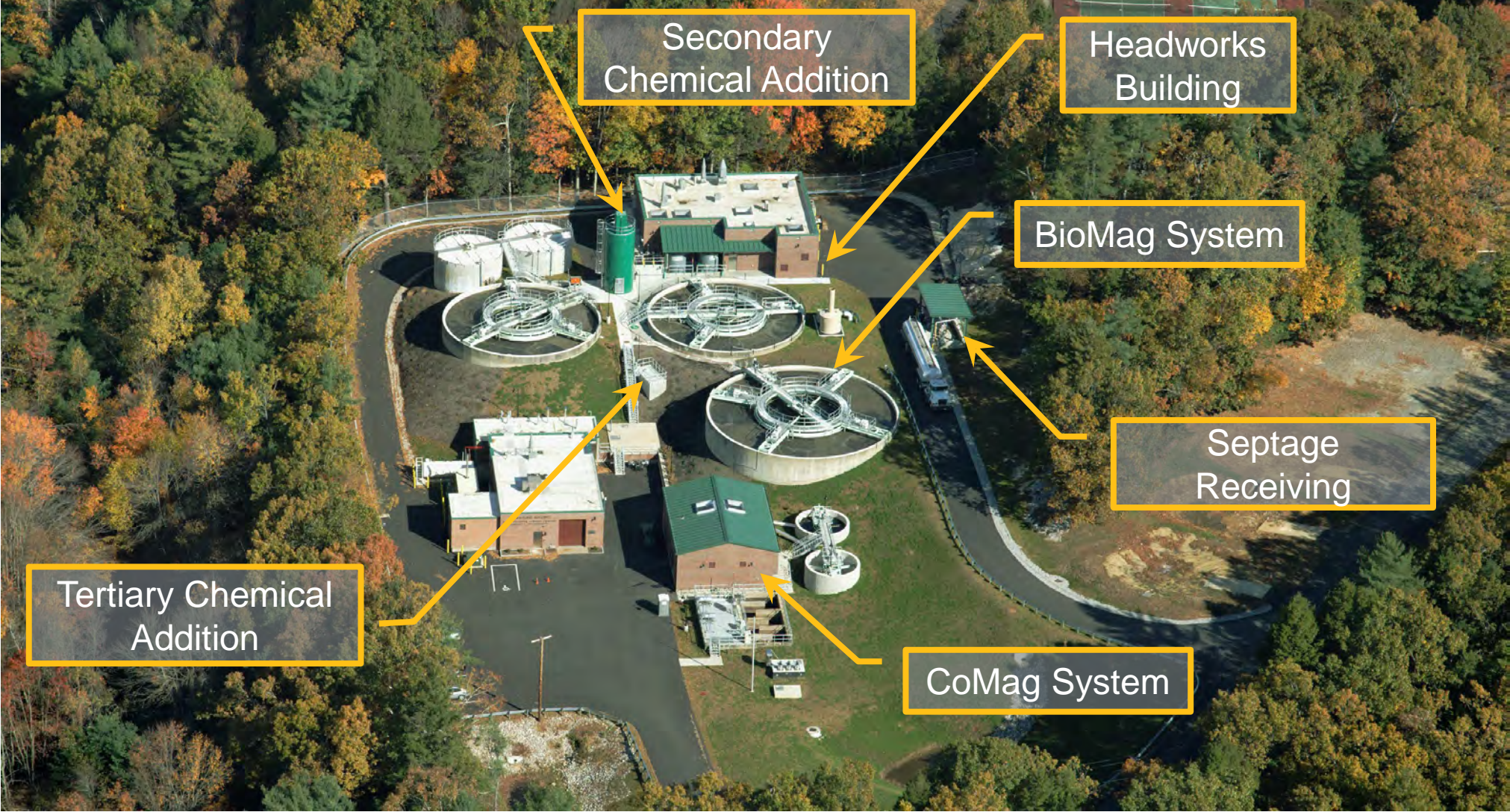
REGULATORY HISTORY

- **2010 Plant Upgrade**
 - Phosphorous Limit & Flow Increase
- **2012 Upgrade Complete**
- **2014 New Total Zinc Limit**
- **Zinc Optimization Work Ongoing**

NPDES PERMIT HISTORY

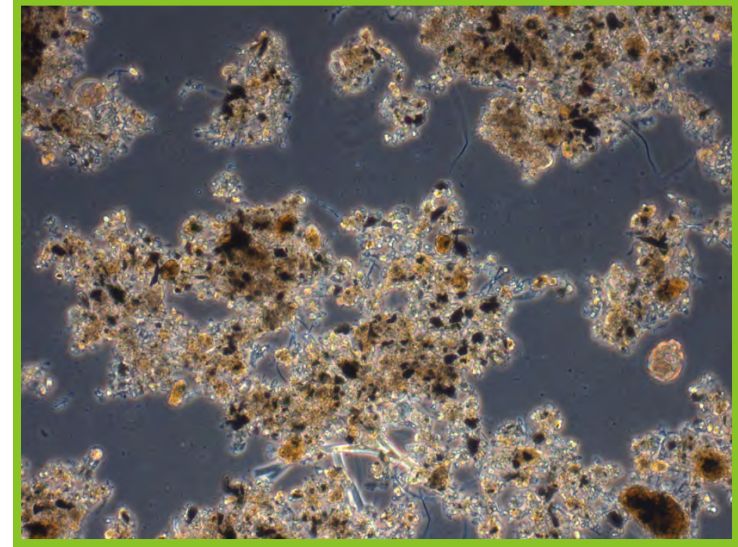
	2006 Permit	2014 Permit
Flow	0.75 MGD	1.3 MGD
Total Phosphorous	0.2 mg/L	0.12 mg/L
Ammonia	1.5 mg/L	0.87 mg/L
Total Zinc	No Limit	46.9 µg/L

STURBRIDGE WWTF OVERVIEW



BIOMAG & COMAG TREATMENT CONCEPT

- **BioMag Incorporates Ballast Into Biological Floc**
- **CoMag Incorporates Ballast Into Chemical Floc**
- **Ballasted Flocculation With Magnetite**
 - SG Magnetite = 5.2
- **Magnetite Is Liberated From WAS By Shear Mill**
- **Magnetite Is Recovered With A Magnet**



METALS REMOVAL APPROACH

Source Reduction

- **Industry**
- **Drinking Water**
 - Source Water
 - Corrosion
- **Accepted Waste**
 - Septage and/or Leachate

Treatment Options

- **Chemical Precipitation**
 - Convert to a Solid → Remove the Solids
 - Adjust pH, coagulant, other
- **Sorption Processes**
 - More Surfaces = More potential for sorption
- **Biological Uptake**

METALS REMOVAL APPROACH

Source Reduction

- **Industry**
- **Drinking Water**
 - Source Water
 - Corrosion
- **Accepted Waste**
 - Septage and/or Leachate

Treatment Options

- **Chemical Precipitation**
 - Convert to a Solid → Remove the Solids
 - Adjust pH, coagulant, other
- **Sorption Processes**
 - More Surfaces = More potential for sorption
- **Biological Uptake**

**Data
Collection**

```
graph TD; DC[Data Collection] --> SR[Source Reduction]; DC --> TO[Treatment Options];
```

PLANT-WIDE ZINC BALANCE

Influent



BioMag
(Secondary System)

Sec Eff

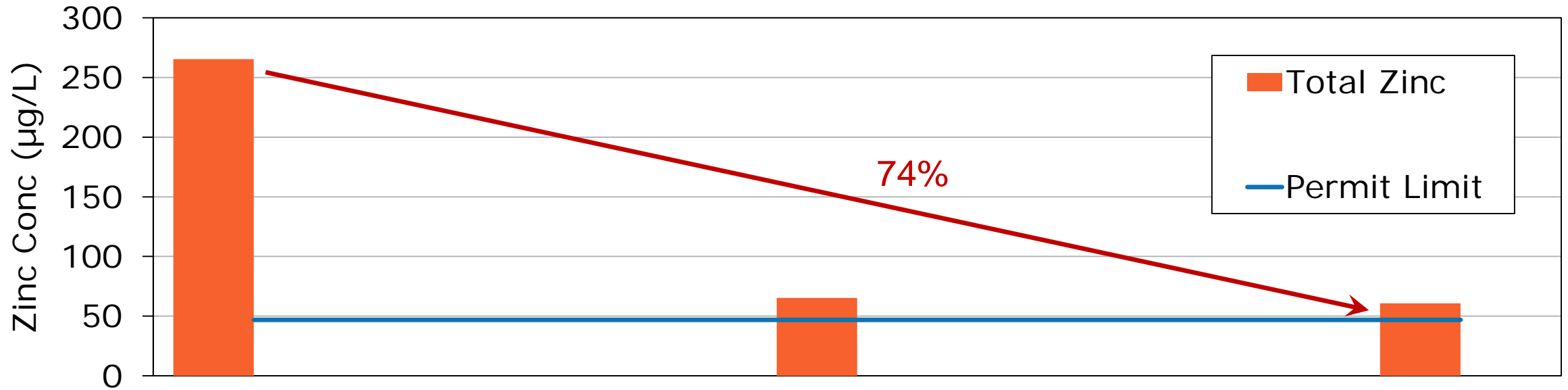


CoMag
(Tertiary System)

Final Effluent



PLANT-WIDE ZINC BALANCE



Influent



BioMag
(Secondary System)

Sec Eff

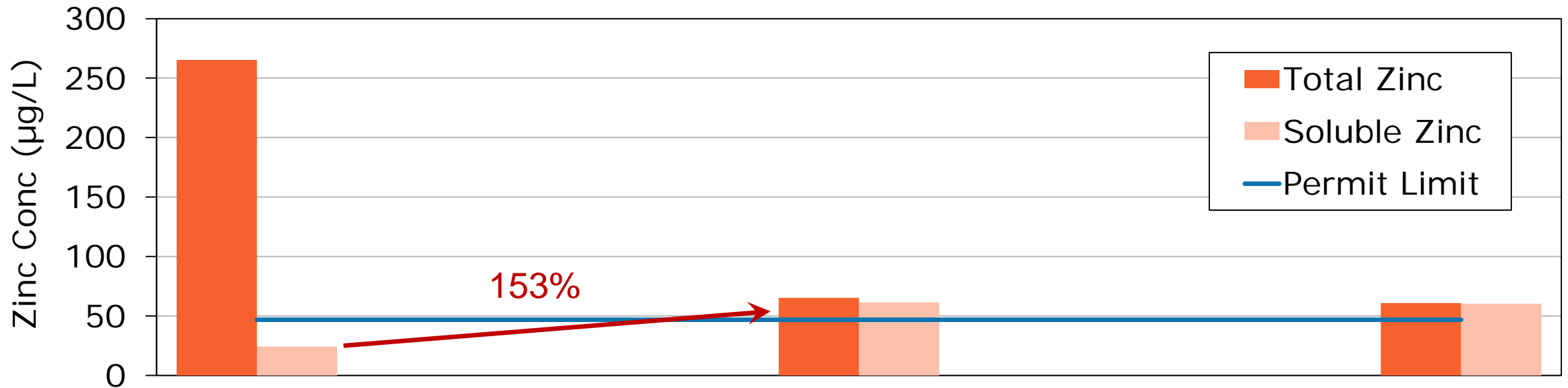


CoMag
(Tertiary System)

Final Effluent



PLANT-WIDE ZINC BALANCE



Influent



BioMag
(Secondary System)

Sec Eff

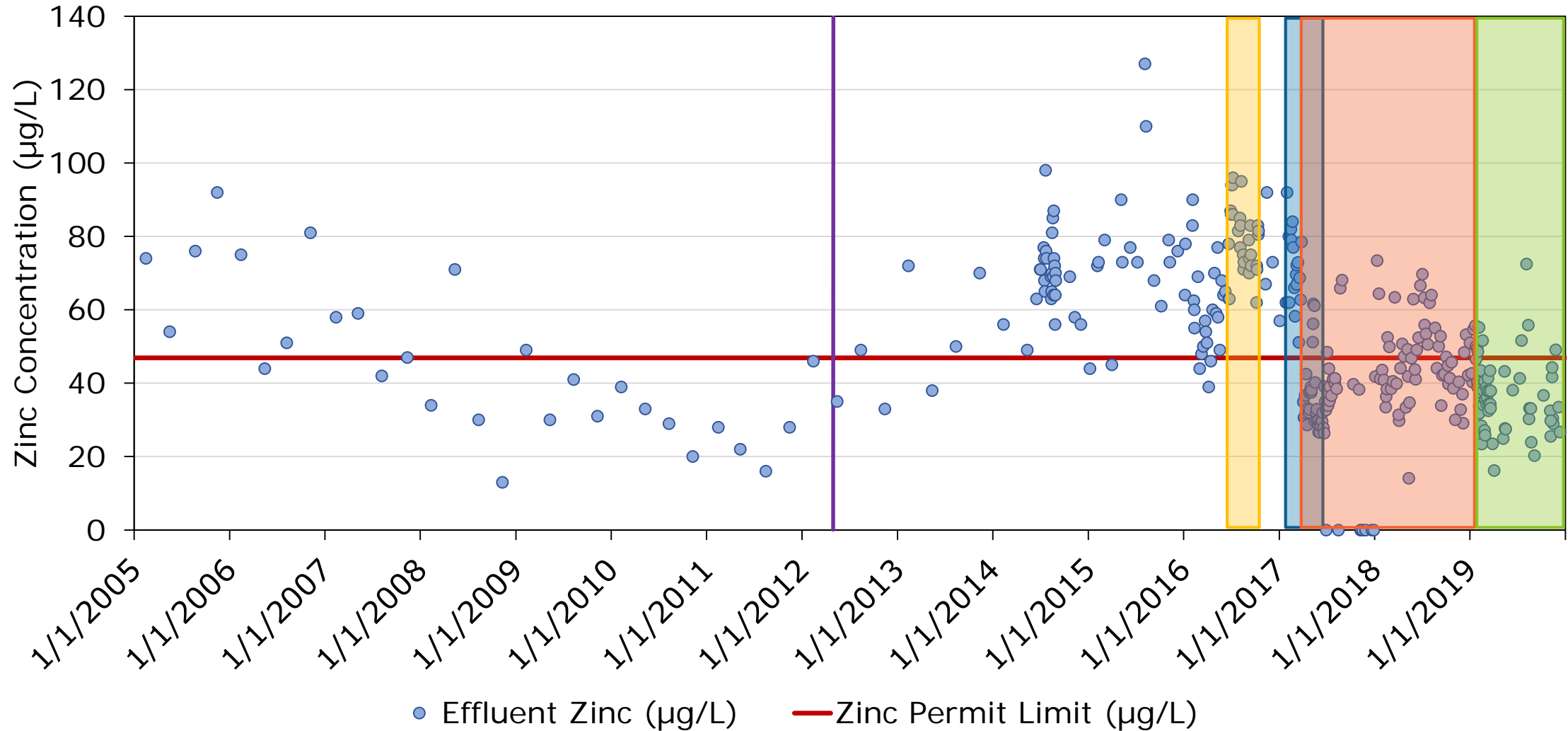


CoMag
(Tertiary System)

Final Effluent

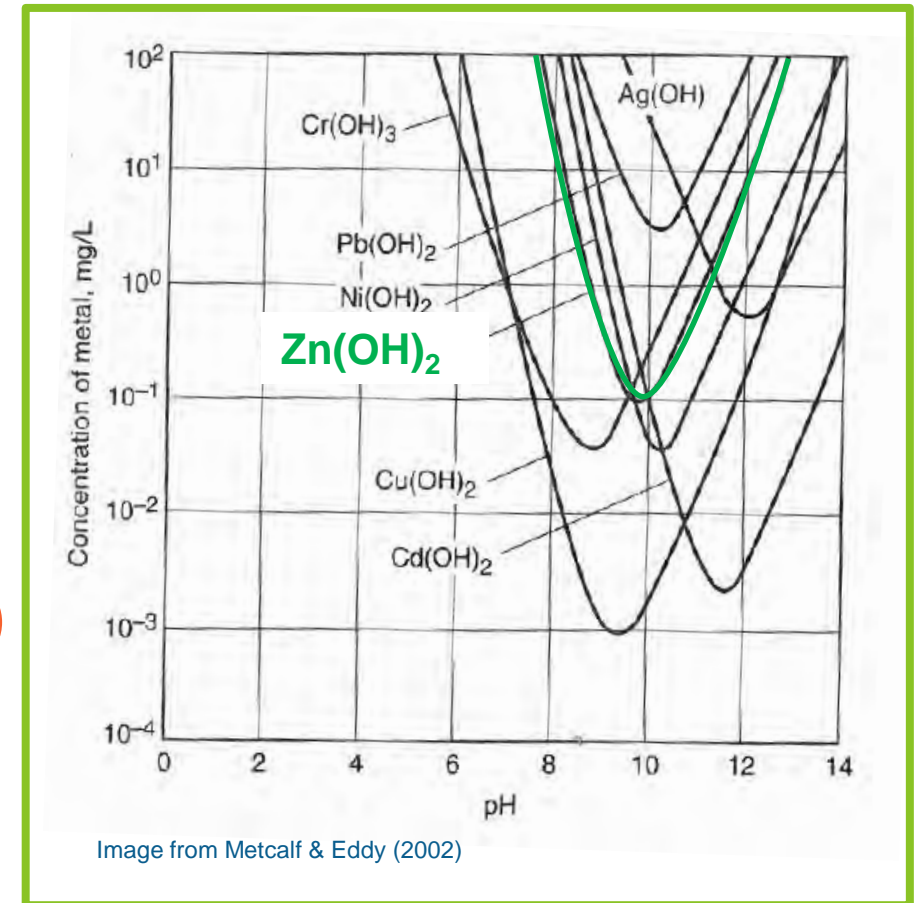


HISTORY OF ZINC REMOVAL AT STURBRIDGE

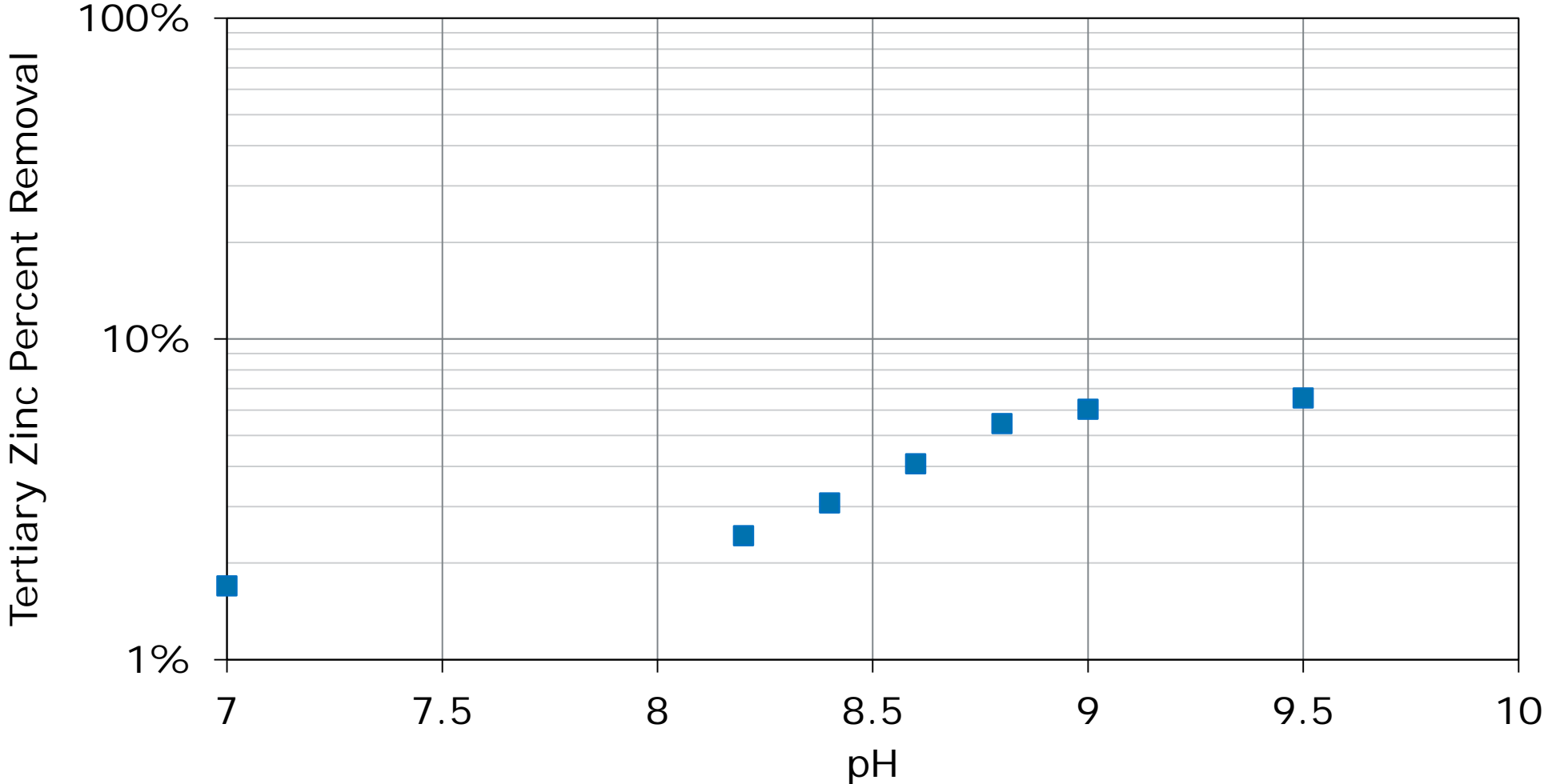


TRIAL 1: TERTIARY PH ADJUSTMENT

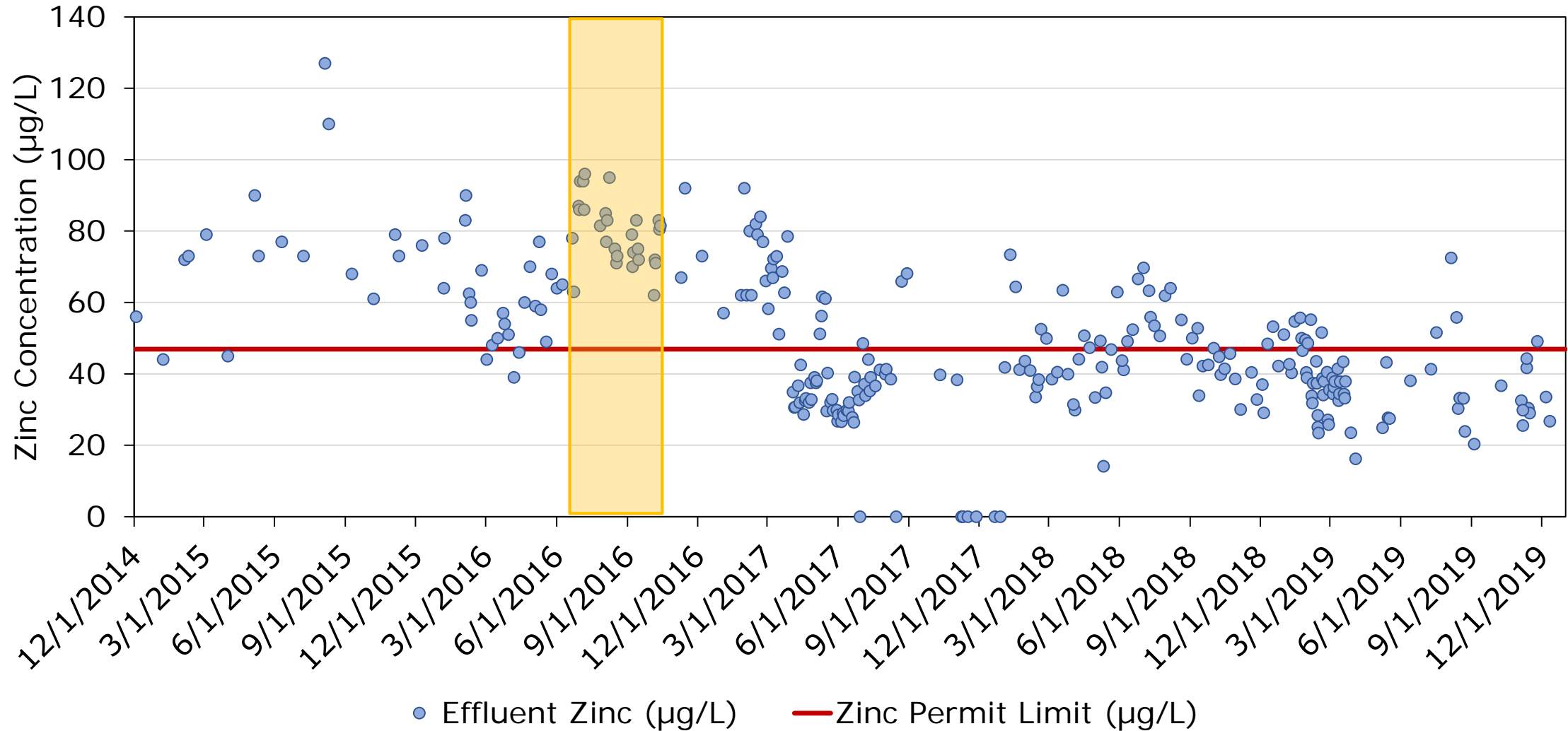
- **Theory: Hydroxide Precipitation**
 - Optimal pH = 9.8
- **Solids Removal within CoMag**
- **Full Scale Pilot Testing (June-Oct 2016)**
 - Adjusted pH in 0.2 SU increments



TRIAL 1: TERTIARY PH ADJUSTMENT RESULTS



TRIAL 1: TERTIARY PH ADJUSTMENT RESULTS



TRIAL 2: SOURCE REDUCTION

- **Point Source Contamination**

- Reviewed Major Water Users

- **Drinking Water**

- Source Water
- Zinc Orthophosphorus

- **Contamination**

- Magnetite
- Defoamer
- Sampling Procedures

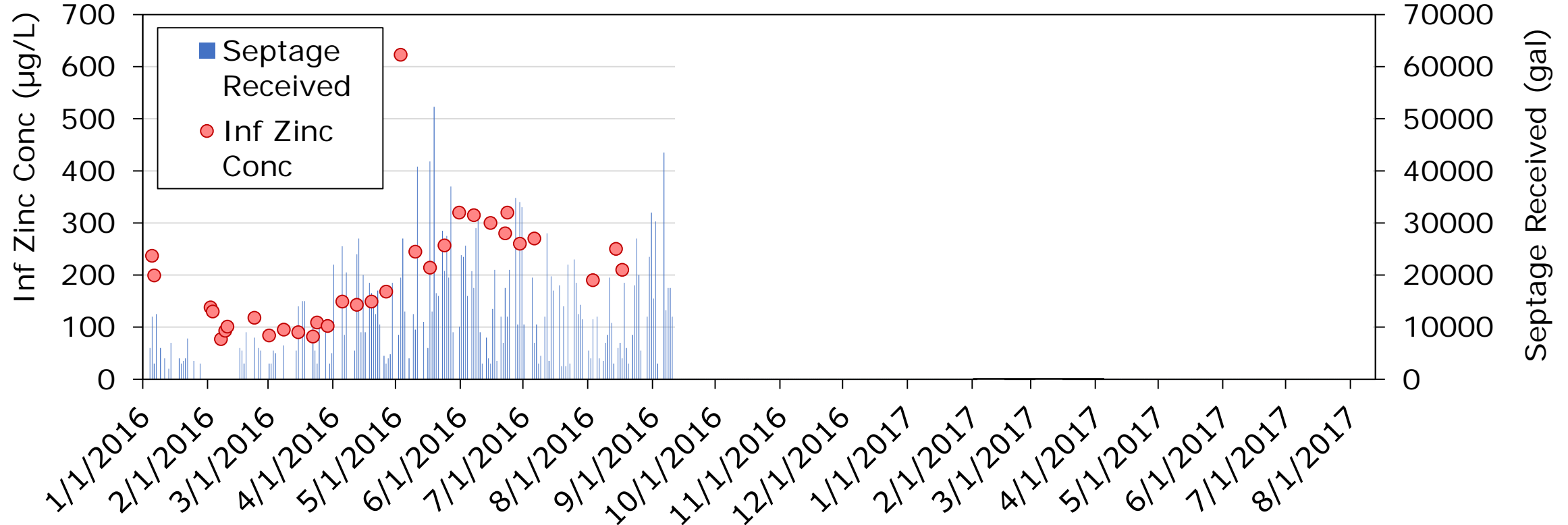


TRIAL 2: SOURCE REDUCTION



- **Accepted Waste Streams**

- Septage & Leachate
- High Strength & Variability

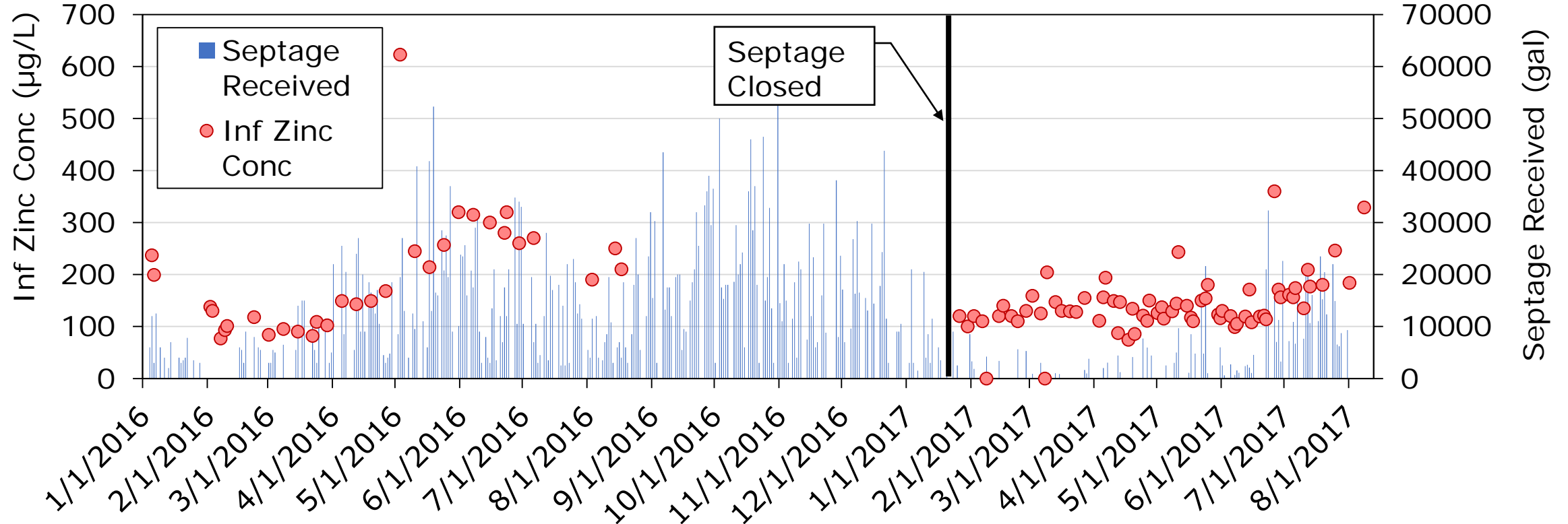


TRIAL 2: SOURCE REDUCTION

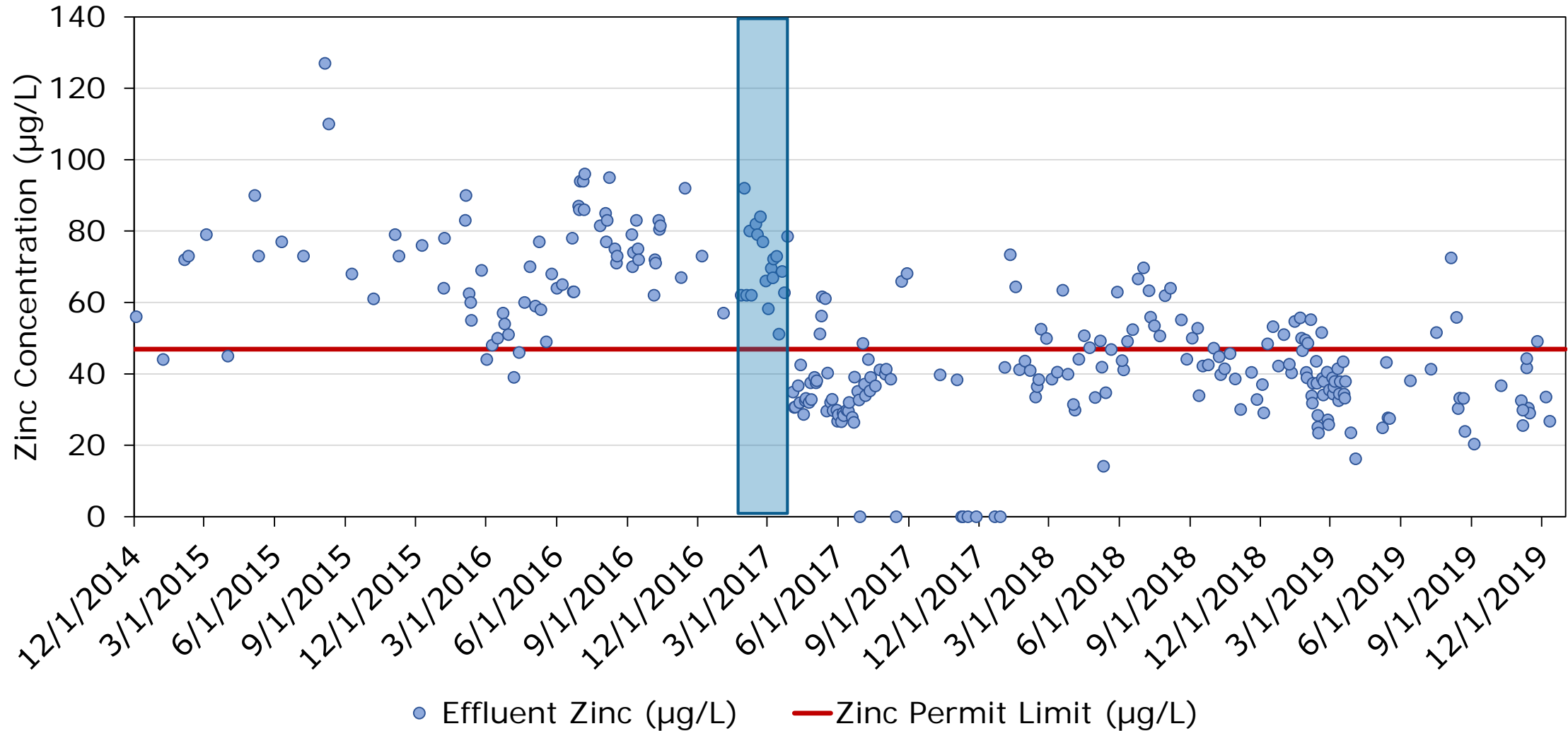


- **Accepted Waste Streams**

- Septage & Leachate
- High Strength & Variability



TRIAL 2: SOURCE REDUCTION RESULTS



TRIAL 3: SECONDARY SYSTEM FERRIC & LIME ADDITION

- **Return to Original Operation Mode**
- **Target Secondary System (BioMag)**
 - Curb Increase in Soluble Zn
- **Theory**
 - Increased pH reduces solubility
 - Iron has a higher affinity for metals than aluminum



TRIAL 3: FERRIC & LIME PILOT TESTING PLAN

BioMag
(Secondary System)



CoMag
(Tertiary System)



INF

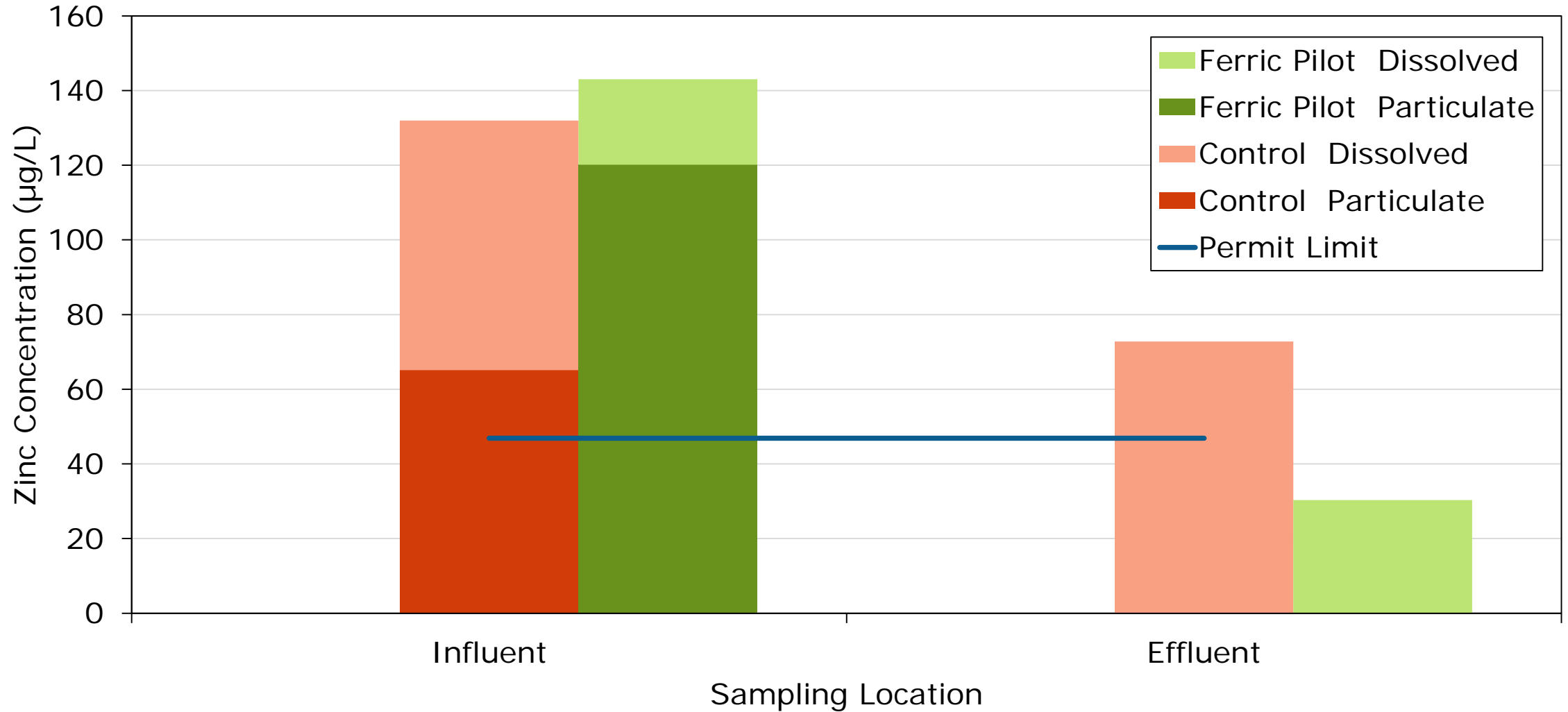
→

EFF

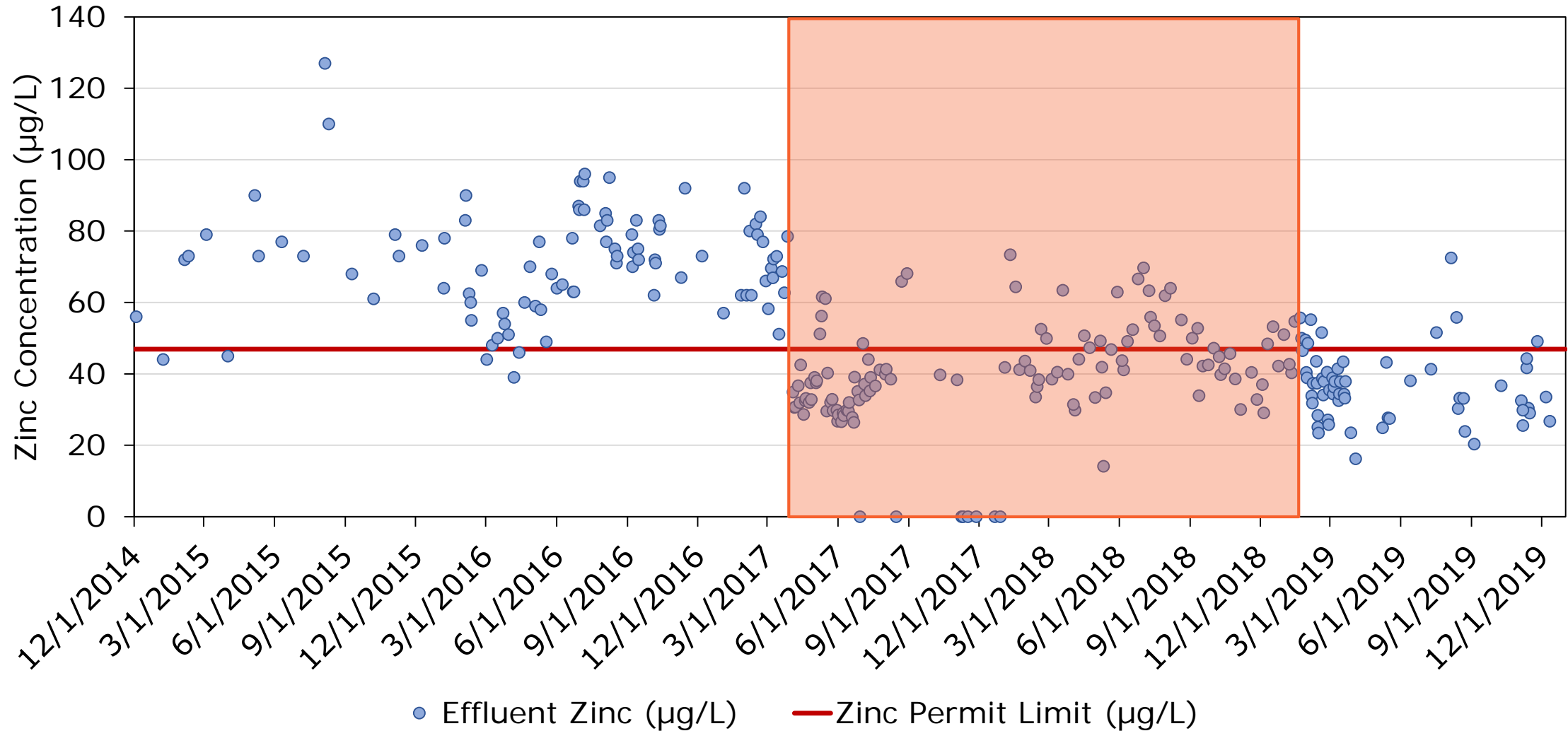
FeCl_3
Lime

FeCl_3
Caustic

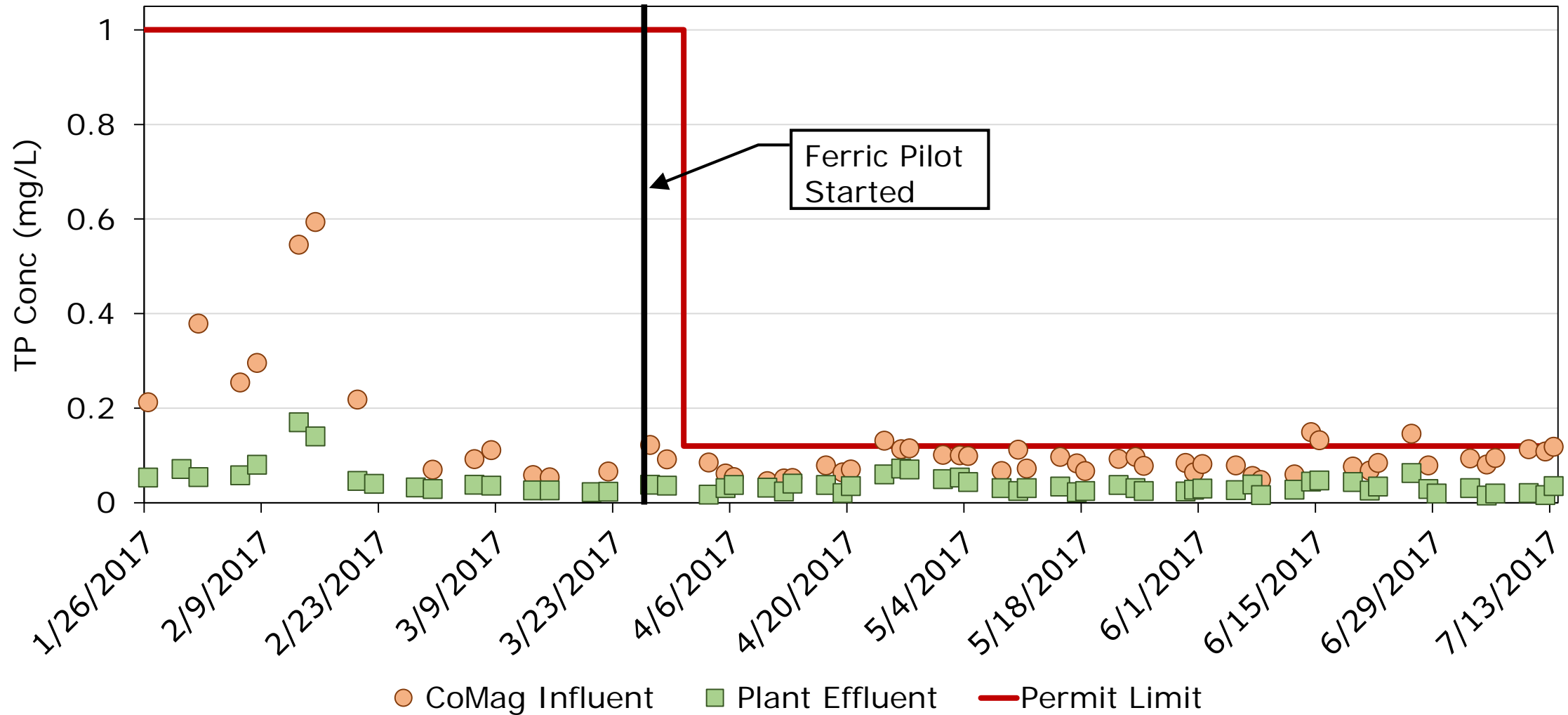
TRIAL 3: FERRIC & LIME PILOT TESTING RESULTS



TRIAL 3: FERRIC & LIME ADDITION RESULTS

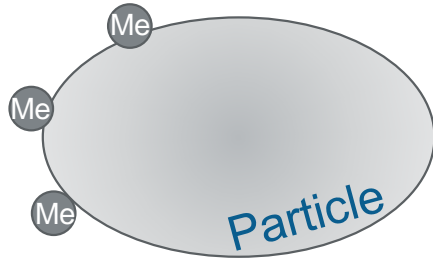


TRIAL 3: TOTAL PHOSPHORUS RESULTS



TRIAL 4: EVOQUA ADVANCED REMOVAL TECHNIQUES

- Sorption Processes

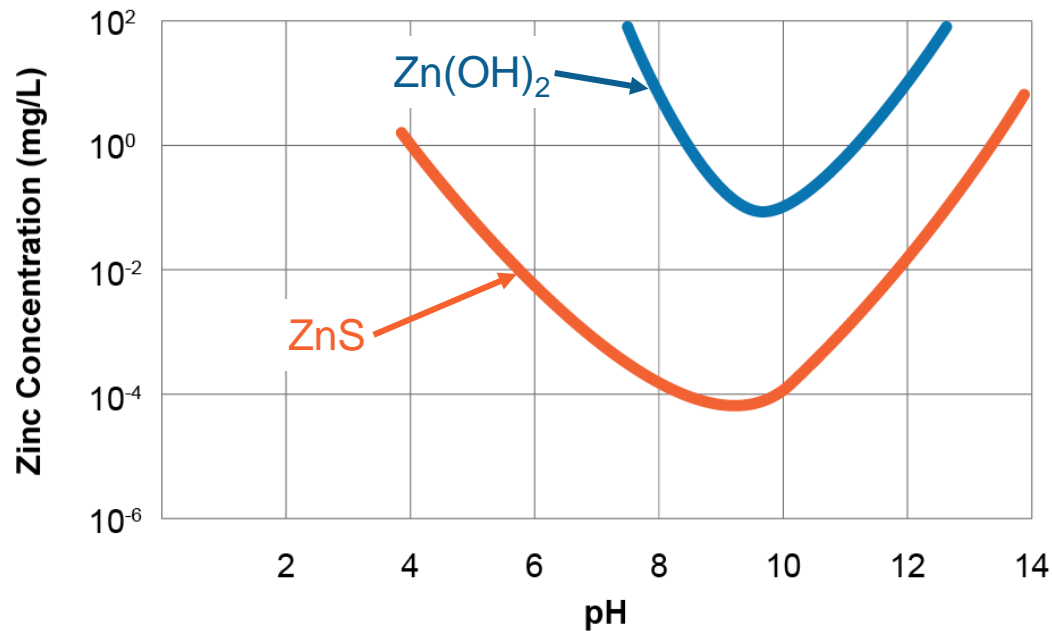


Add MLSS

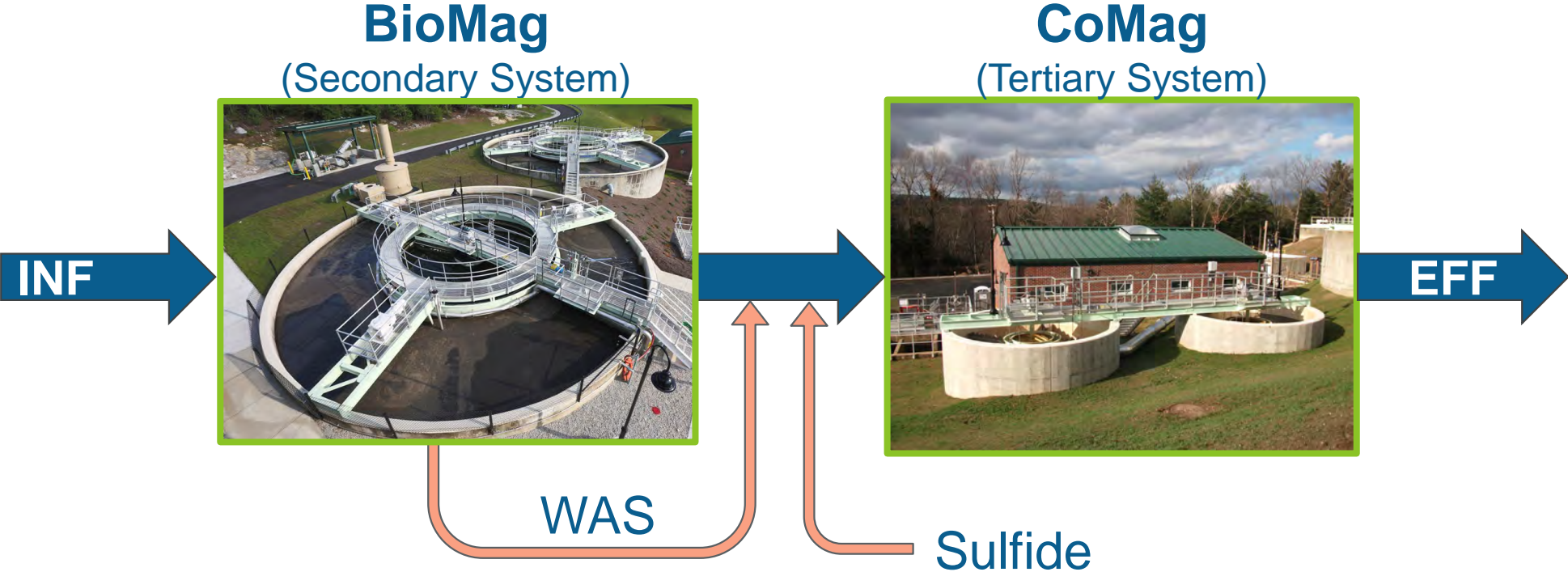
- Sulfide Precipitation



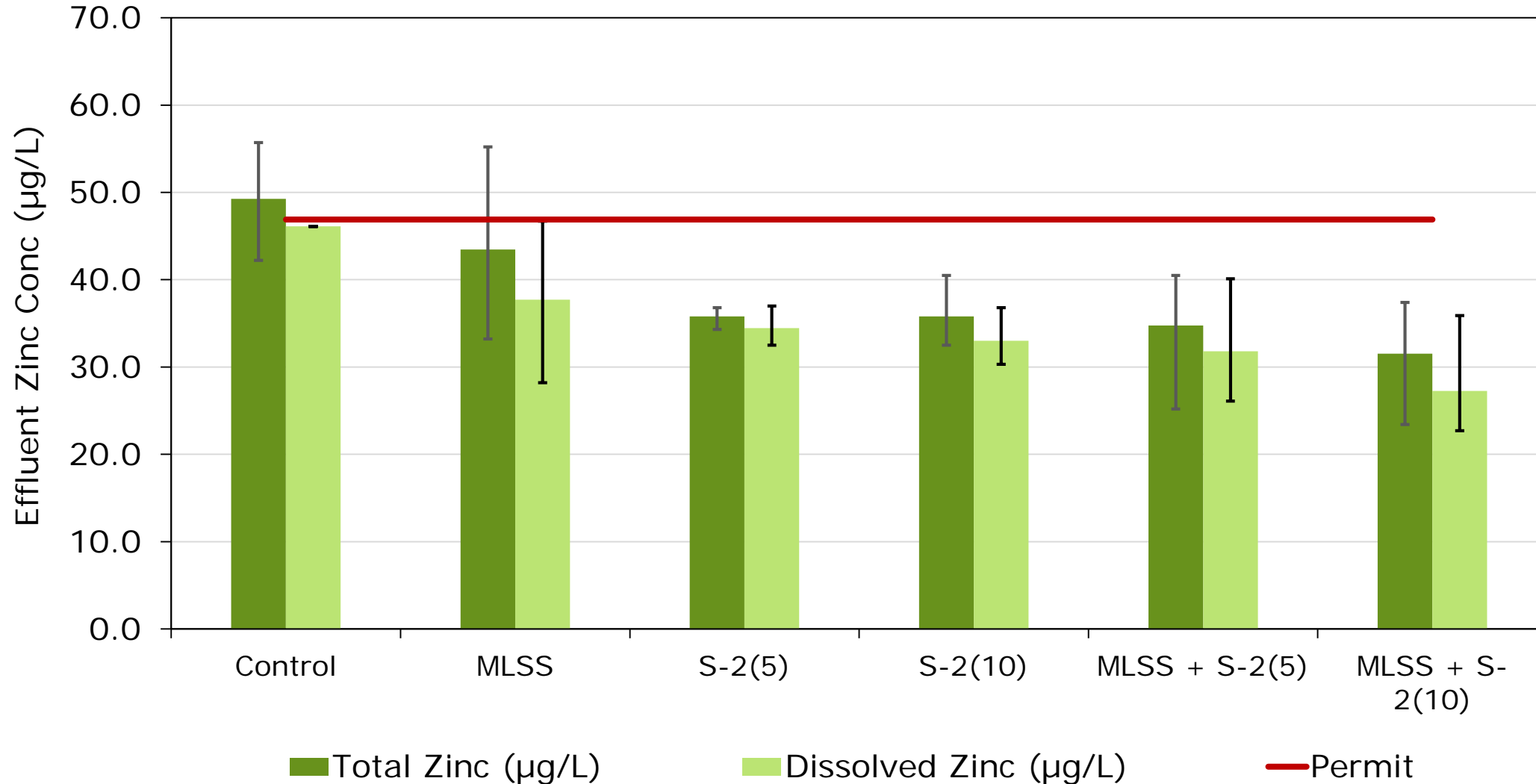
Add Sulfide



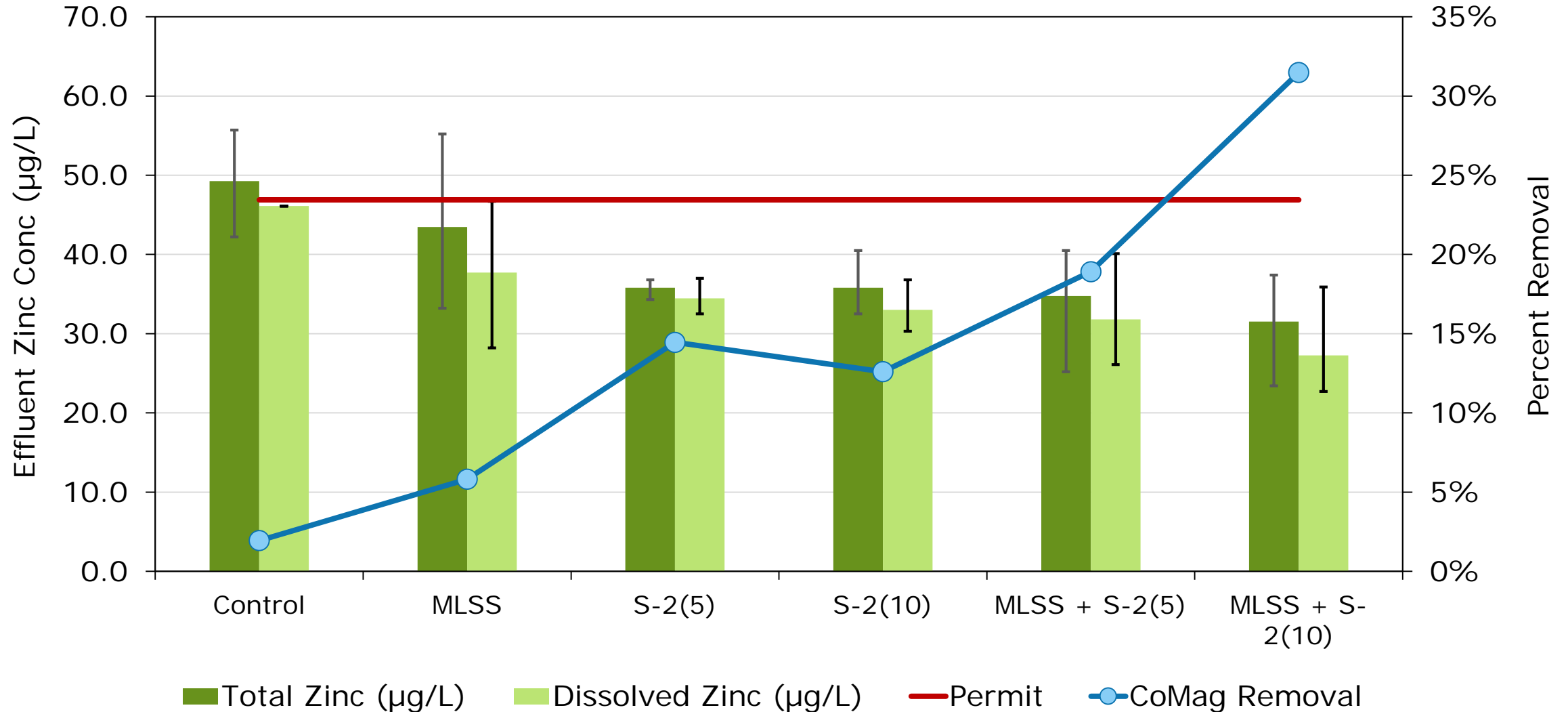
TRIAL 4: EVOQUA MLSS & SULFIDE PILOT TEST PLAN



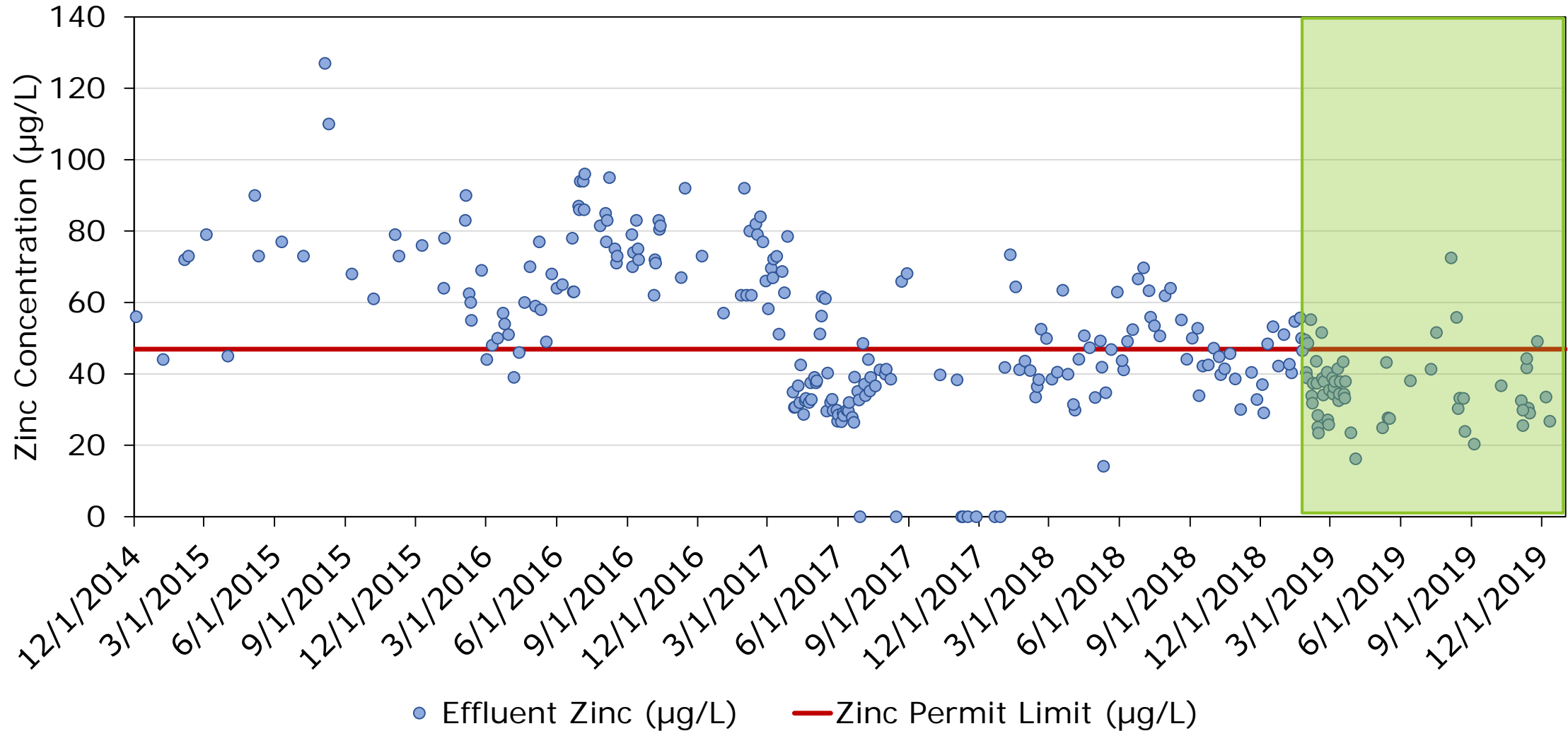
TRIAL 4: EVOQUA MLSS & SULFIDE ADDITION RESULTS



TRIAL 4: EVOQUA MLSS & SULFIDE ADDITION RESULTS



TRIAL 4: MLSS & SULFIDE ADDITION RESULTS



CONCLUSIONS

- **Data collection is essential**
- **Source reduction can be effective**
- **Metals often dissolve during Secondary Treatment**
- **Strategies for metals removal are plant-specific**
- **Combination of strategies may be needed**





SPECIAL THANKS

- **Shane Moody**, Veolia
- **Zach Donahue**, Veolia
- **Ray Pepin**, Evoqua Water Technologies
- **Matt Vareika**, Evoqua Water Technologies
- **Butch Jackson**, Town of Sturbridge



Ian Catlow, PE: IBCatlow@tighebond.com

Austin Weidner, PE: ADWeidner@tighebond.com

