WATER FIRST
WATERCON 2025

ELGIN CASE STUDY: SYSTEM COMPLEXITIES REQUIRES MULTIPLE CHANGES TO OPTIMIZE CCT

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City of Elgin

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American Water Works Association
Illinois Section

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IEPA #21542

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ELGIN CASE STUDY: SYSTEM COMPLEXITIES REQUIRES MULTIPLE CHANGES TO OPTIMIZE CCT

Stephen Dennison, PE
Vice President, EEI

Nora Bertram, PE
Director of Water/Utilities

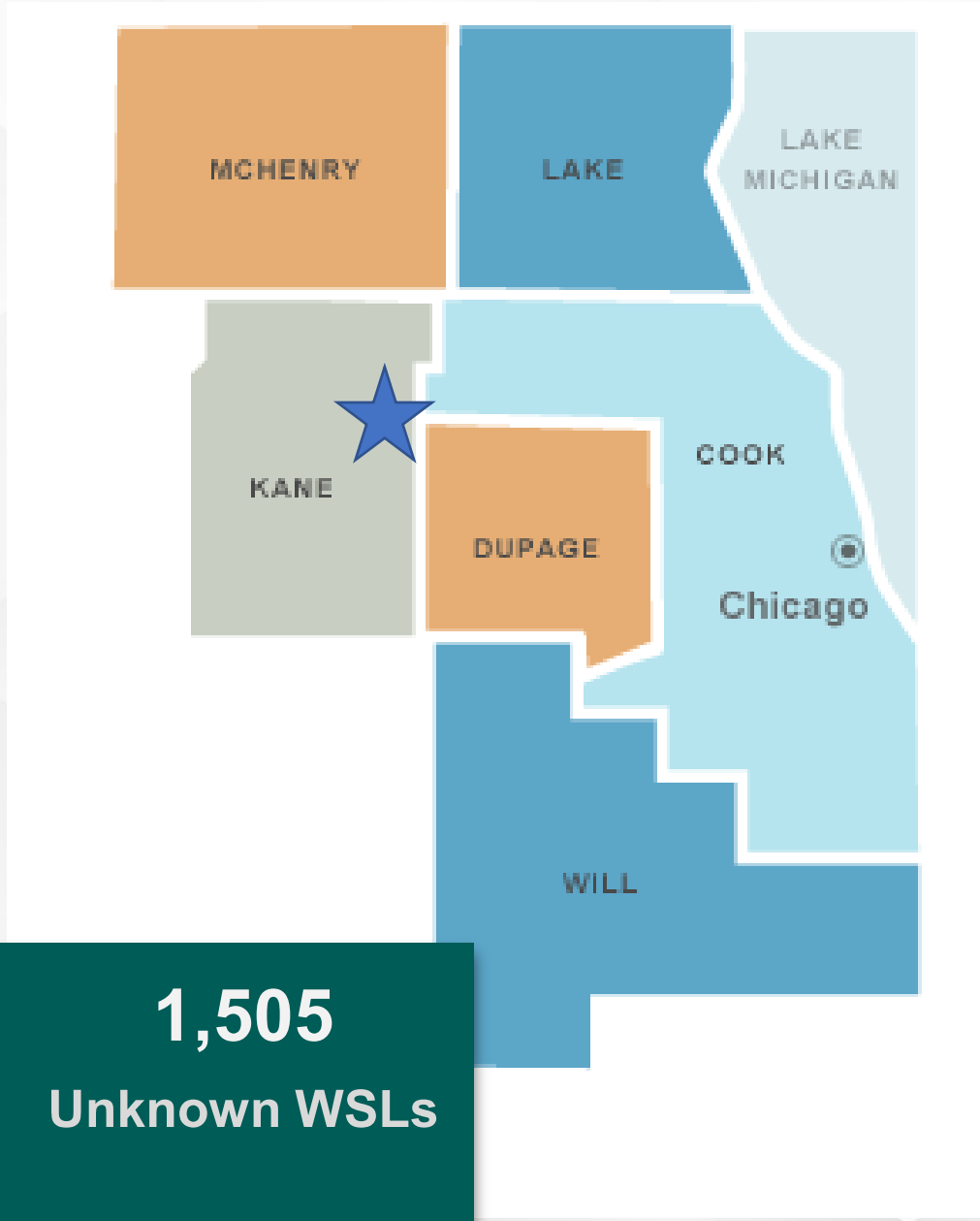
Agenda

1. Elgin's Lead Management Program History
2. Overview of Elgin's Water Supply and Treatment
3. Review of Elgin's Corrosion Control Study
4. Findings and Additional Considerations
5. Q&A

GENERAL INFORMATION

City of Elgin, Illinois

- Founded in 1835
- Sixth largest city in IL by population
- ~32% of water services were suspected LSLs in 2022
- Currently ~27% of water services are suspected LSLs



116,780	34,515	9,222	1,505
Population	Total Services	Suspected LSLs	Unknown WSLs

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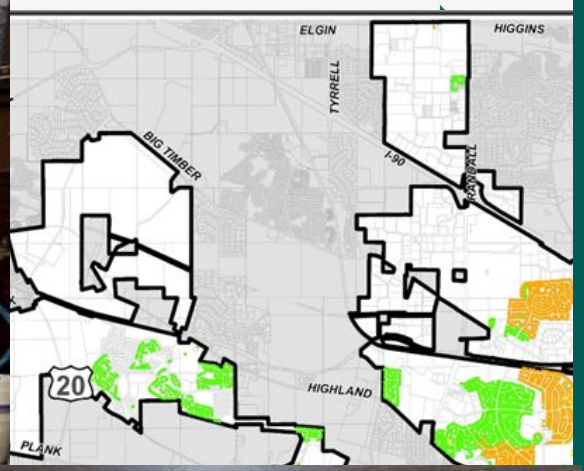
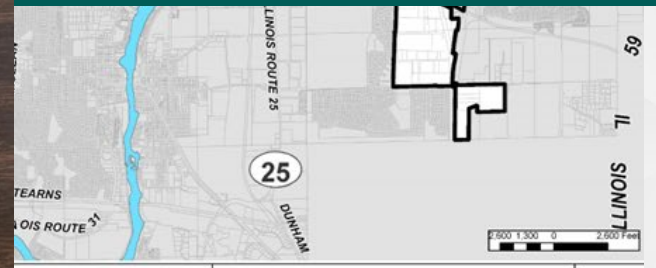
ELGIN'S HISTORY OF LSL MANAGEMENT



- Desktop Study
- Scale Analysis
- Demonstration Studies:
  - ✓ Bench Solubility
  - ✓ Harvested Pipe Flow-Through

Awarded Year 1 LSLR Improvements ($4M PF)



ARPA Funding

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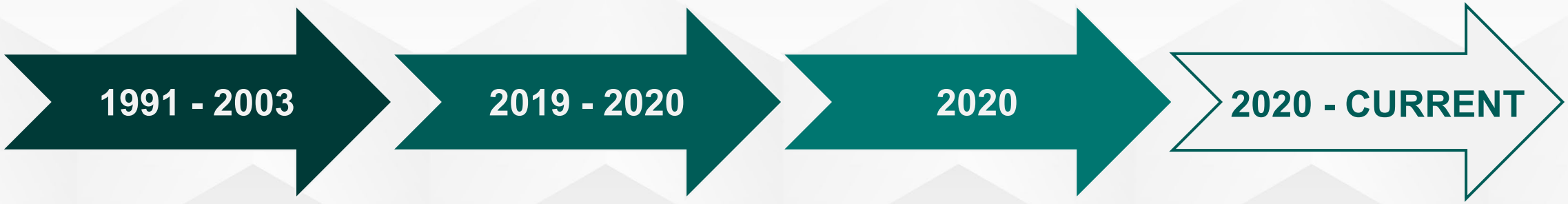
- Goal is to be lead free
- Cannot be accomplished overnight
- What do communities do until all lead is removed?
- Corrosion control – managing water chemistry to minimize the corrosivity of water
- Corrosion control helps after lead services replaced – lead solder and/or lead in premise plumbing

ELGIN'S CORROSION CONTROL HISTORY



PREVIOUS CCS

Lead and Copper Rule (LCR) requirements instituted in 1991 for corrosion control

Elgin's last Optimal Corrosion Control Treatment parameters modified/approved in 2003 (current)

LEAD PROFILE SAMPLING REQUEST FROM IEPA

Requested for all Illinois Large Water Systems to better understand lead concentrations from full service line and premise plumbing

CCS REQUIREMENT FROM IEPA

Although City's water had been compliant, results from lead profile sampling resulted in IEPA requesting a CCS

CCS & COMPLIANCE

CCS started in 2020

OCCT Submitted to IEPA in July 2023 – Approved; Implementation is Ongoing

LCR Action Level exceedances for lead in recent years

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EXISTING WATER QUALITY PARAMETERS

Riverside WTP

Parameter	Range
pH (Units)	No less than 8.5
Alkalinity (mg/L)	No less than 30

Airlite WTP

Parameter	Range
pH (Units)	No less than 8.5
Alkalinity (mg/L)	No less than 50

Took Effect: January 2004

- Letter from IL EPA 12/1/03 also states all distribution samples must be above pH 7.0
- No Corrosion Control Inhibitors (Orthophosphate, etc.) are utilized

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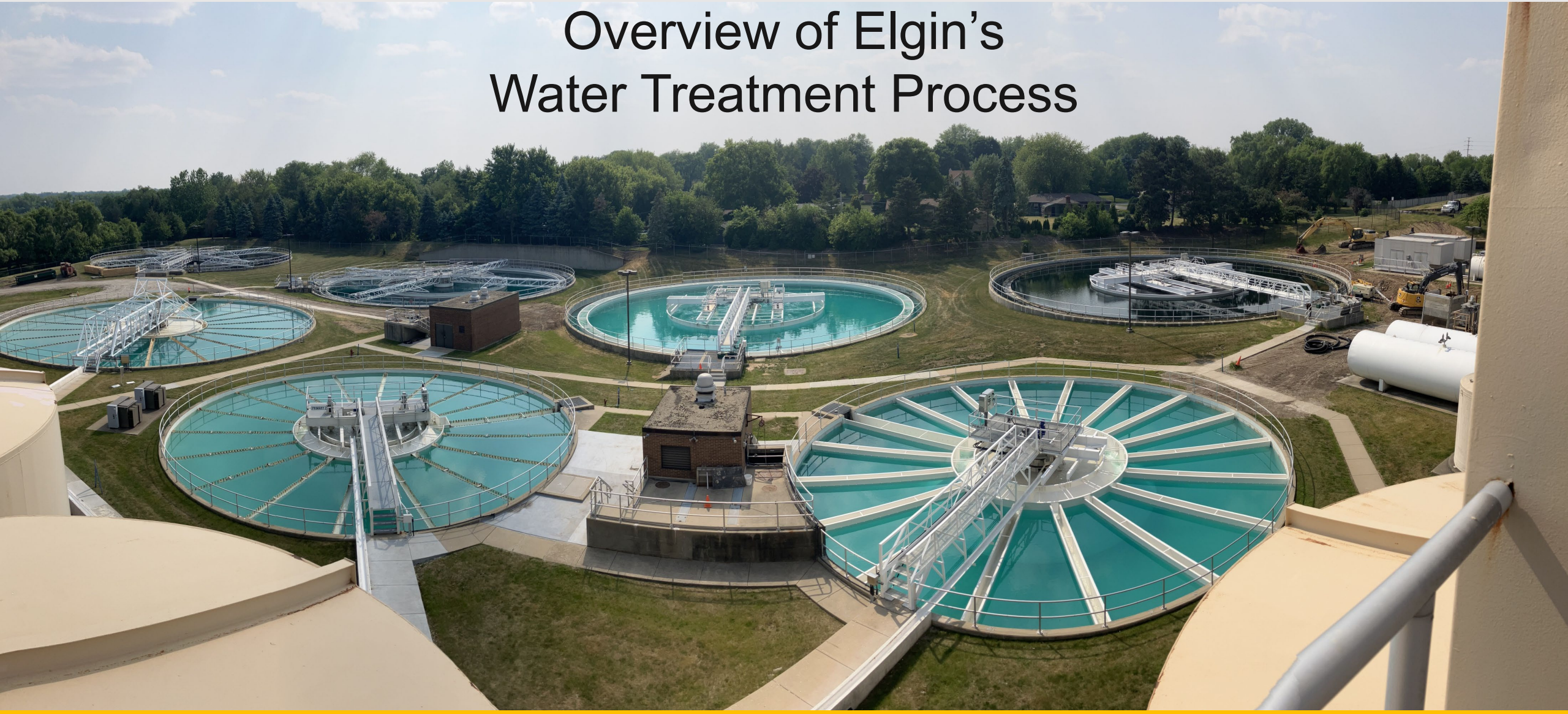
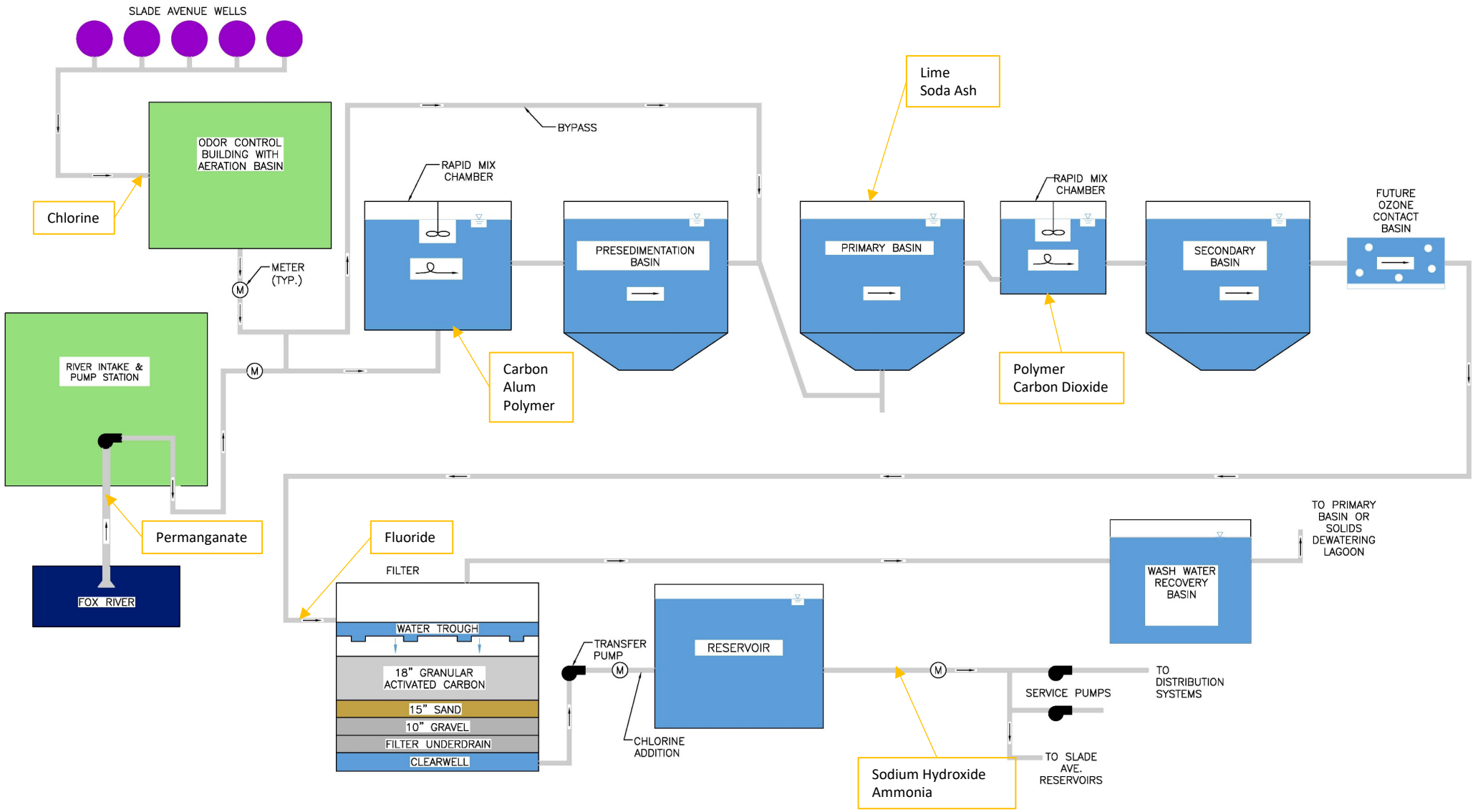
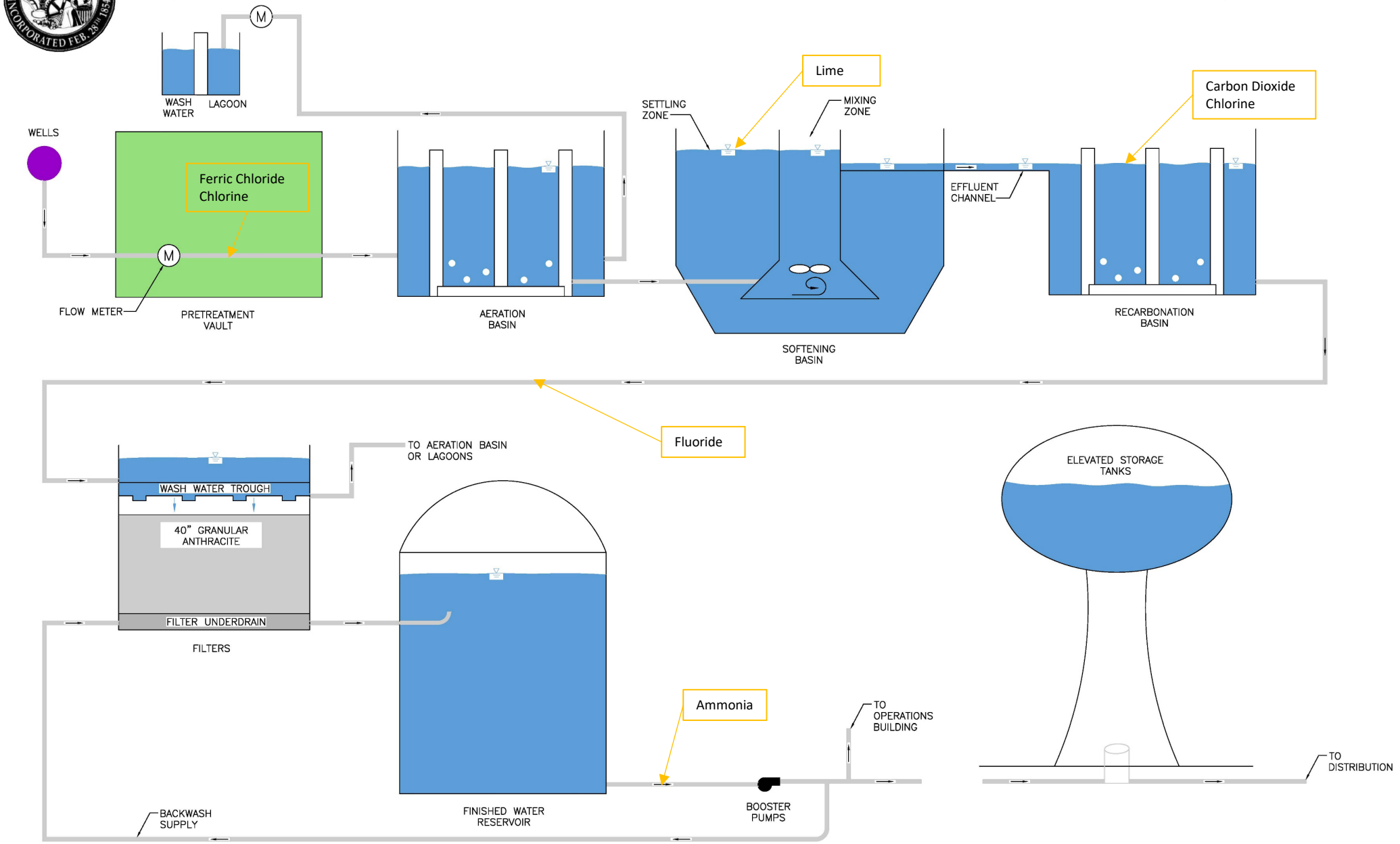
Overview of Elgin's Water Treatment Process



RIVERSIDE WATER TREATMENT PLANT



AIRLITE WATER TREATMENT PLANT



PROJECT TEAM FOR THE CORROSION CONTROL STUDY

COMPONENTS OF A CORROSION CONTROL STUDY

DESKTOP STUDY

REPORT

SCALE ANALYSIS

SOLUBILITY STUDY

DEMON-STRATION STUDIES

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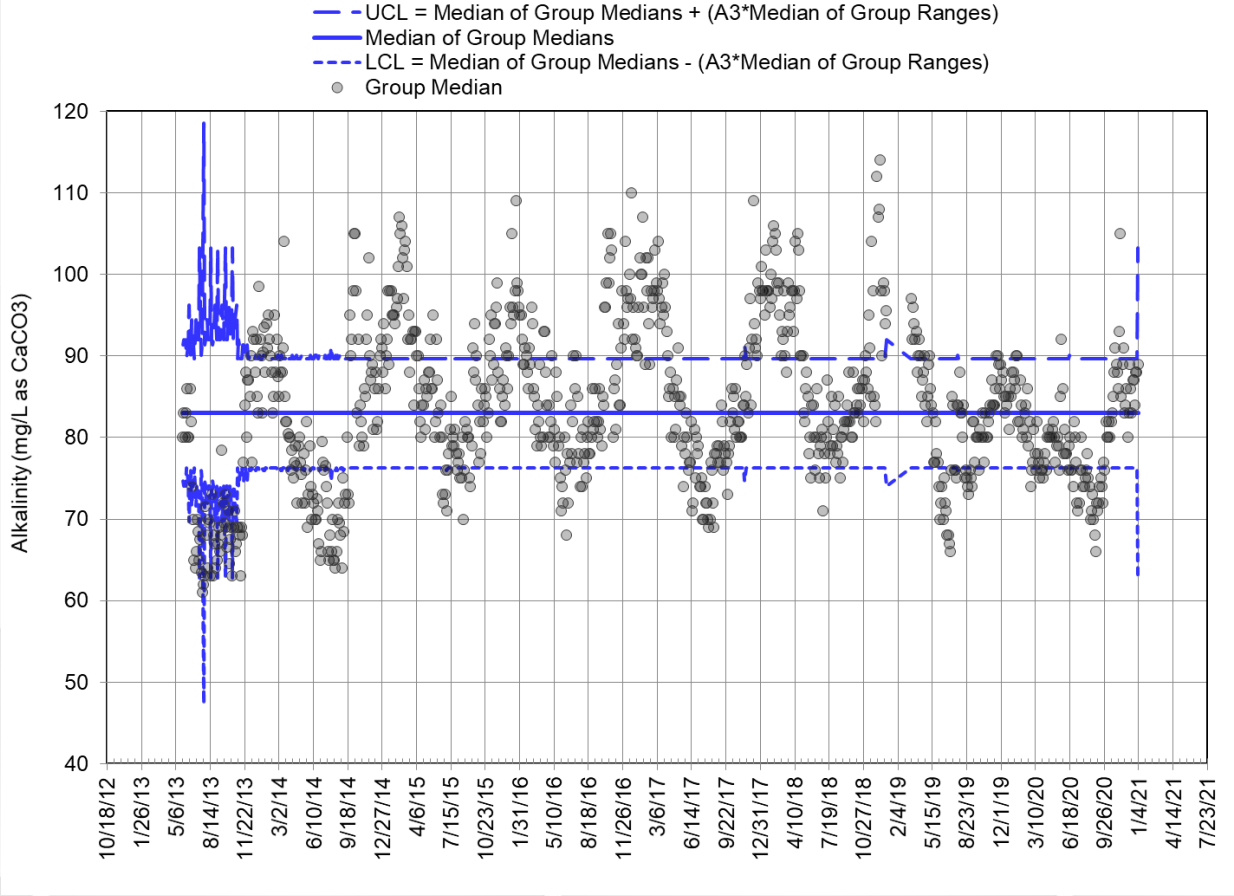
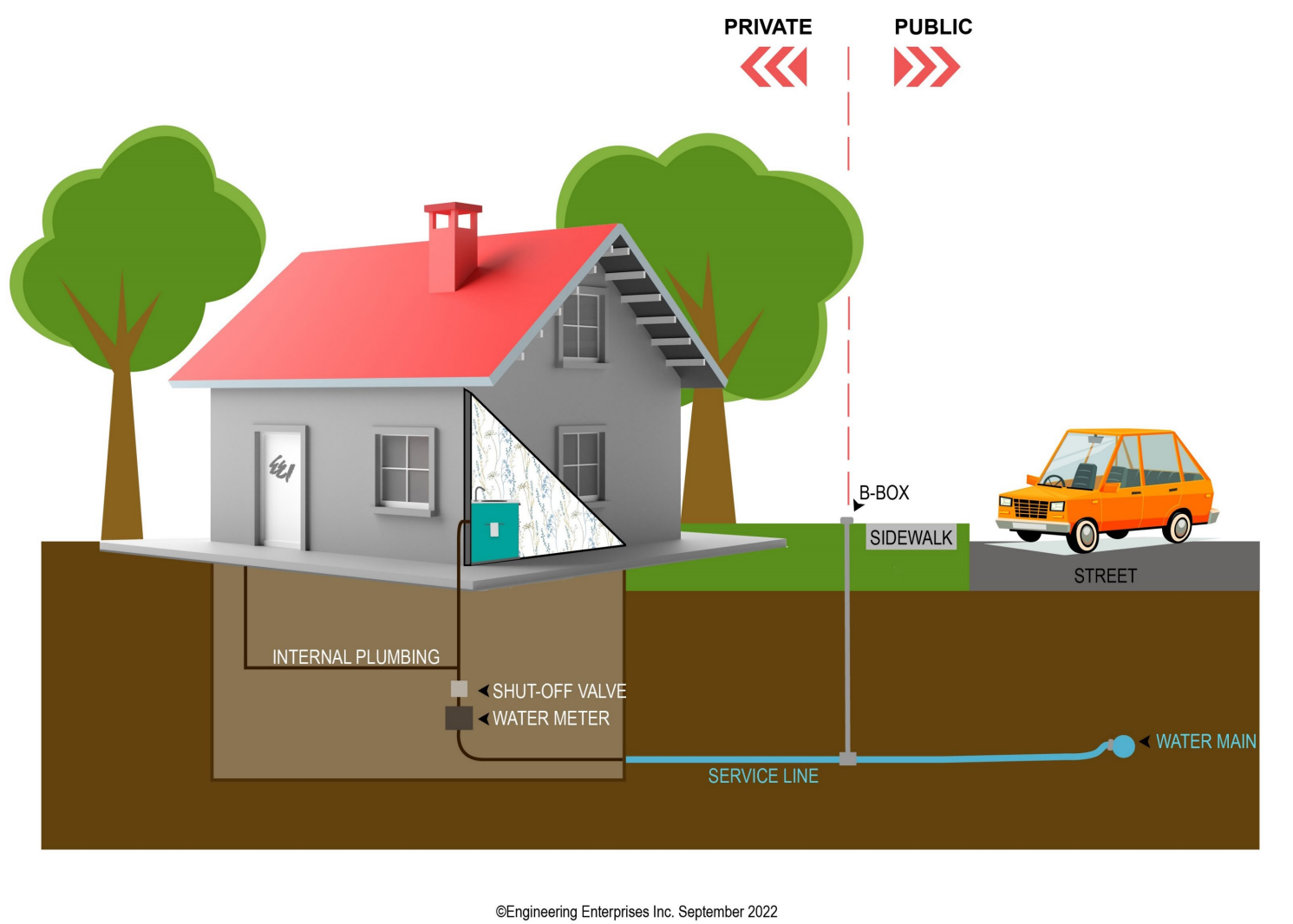
DESKTOP STUDY ANALYSIS – SYSTEM COMPLEXITIES

- pH and alkalinity are variable
  - Alkalinity is seasonally variable
  - Variability in alkalinity could influence scale formation and dissolution
  - Operational stability beneficial
- Unique system (no analogous systems)
  - Mix and variability of surface and groundwater sources
  - Mix of water from different treatment plants in system

Riverside WTP Alkalinity

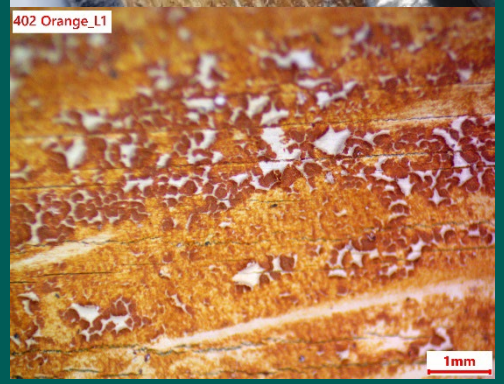


LEAD PIPES FROM ELGIN

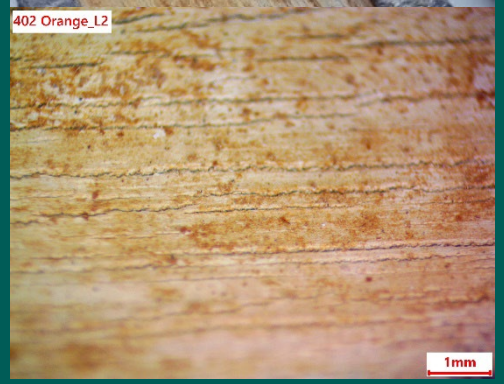


HARVESTED PIPE SCALES

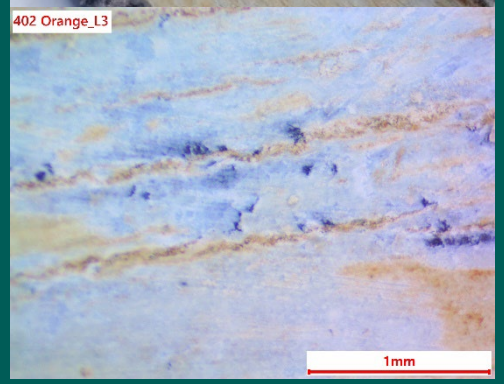
Layer 1



Layer 2



Layer 3



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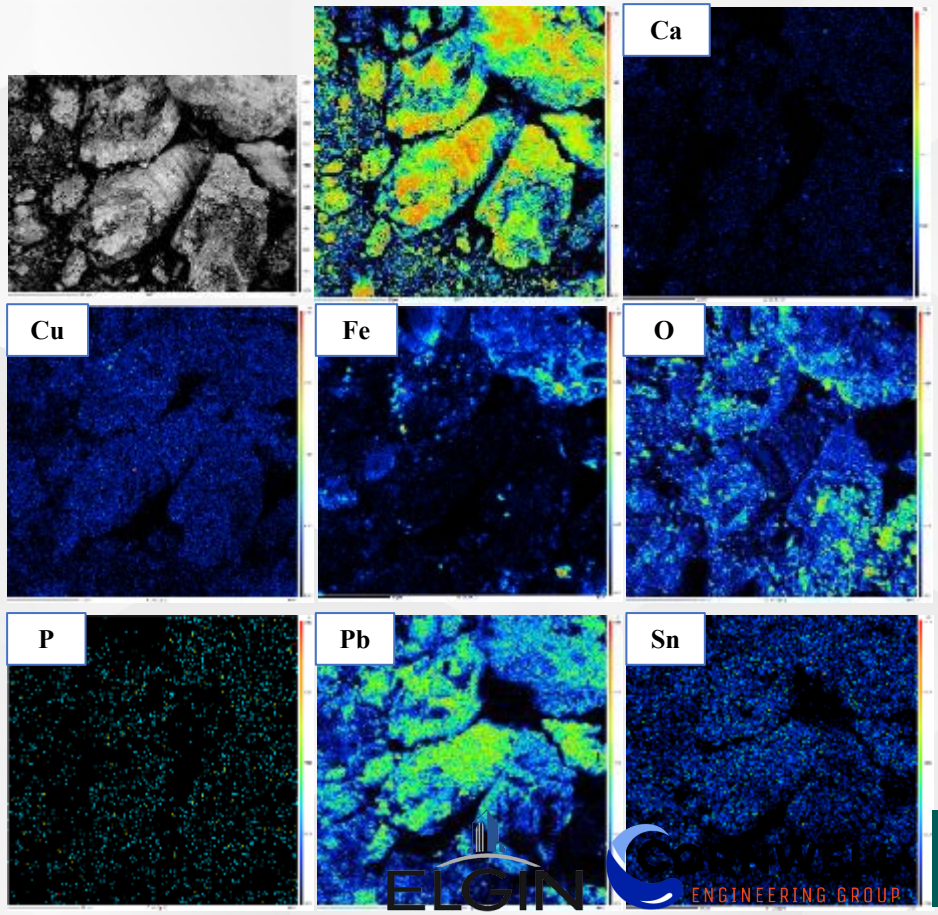
SCALE ANALYSIS CONCLUSIONS

- Scales have a majority of lead (II) carbonate species
  - Cerussite in layers closest to water not protected by amorphous scales surrounding it
- Variability in alkalinity could influence different scale compounds to form and dissolve at different points in the year

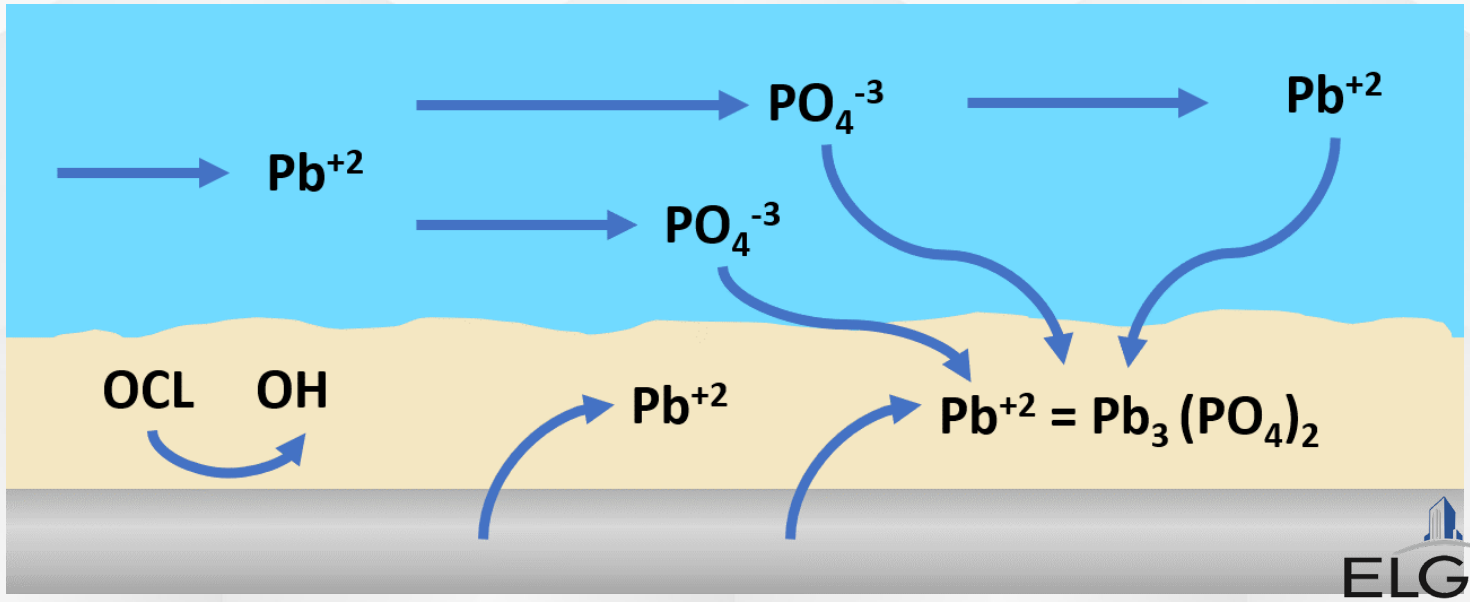
WDS Heatmaps
159 Porter L1

200x200 Scan

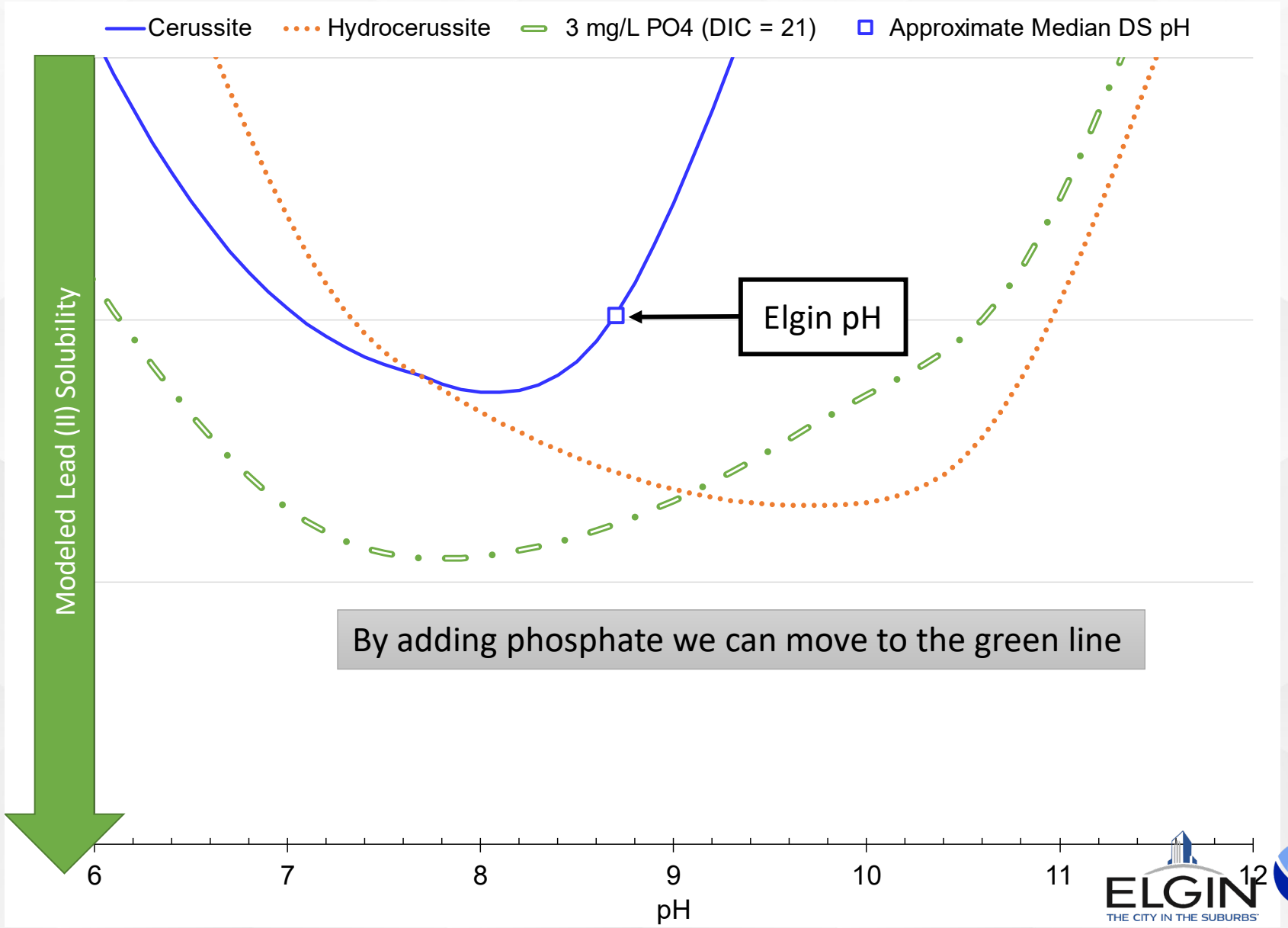


ALTERING THE CHEMISTRY

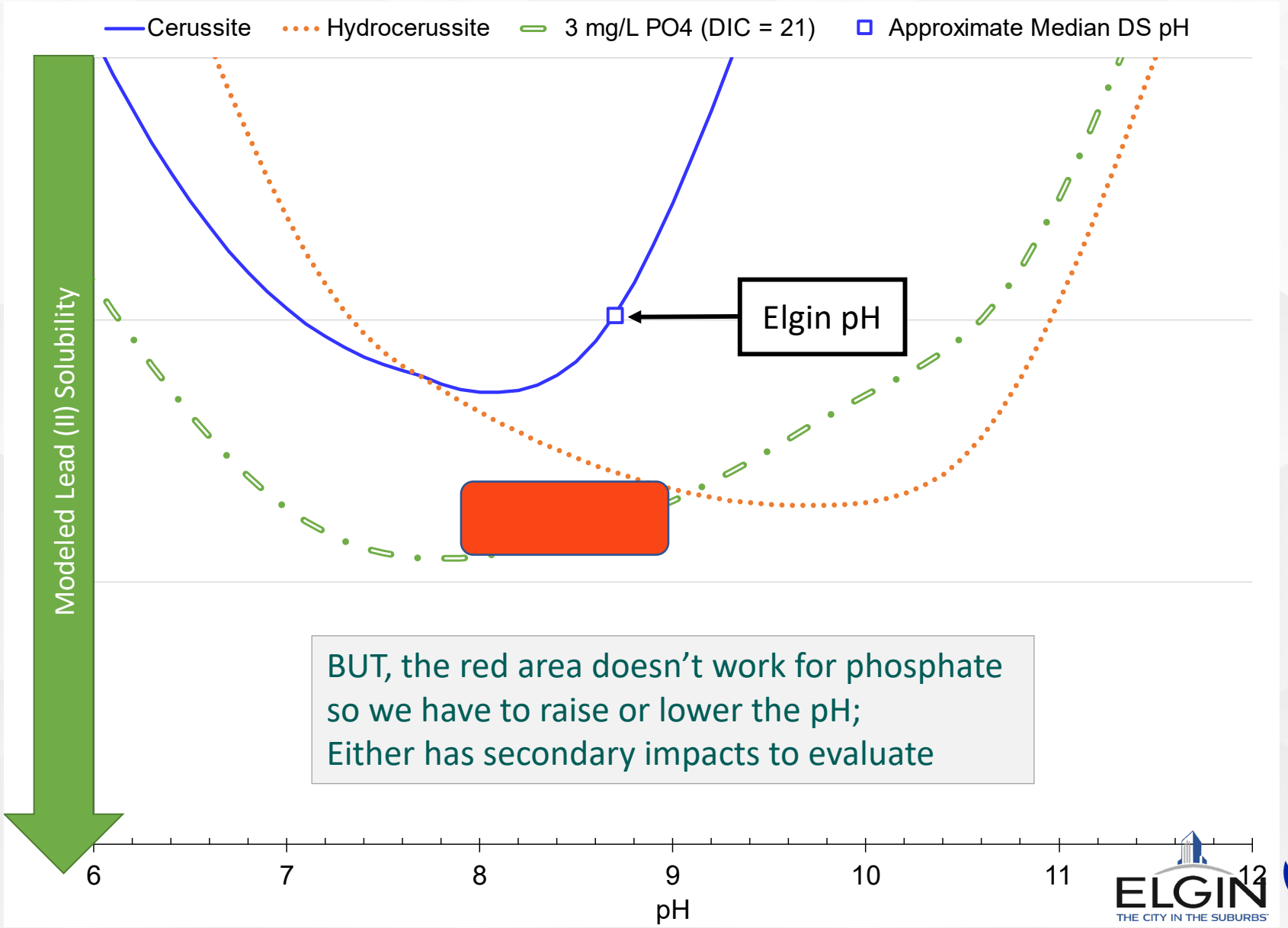
- One common way to produce lower lead is to add orthophosphate
- Orthophosphate is commonly used in water treatment
- It is approved for use in water by EPA
- Also approved for use in food by FDA and it is natural in many foods



ORTHOPHOSPHATE CURVES



ORTHOPHOSPHATE CURVES



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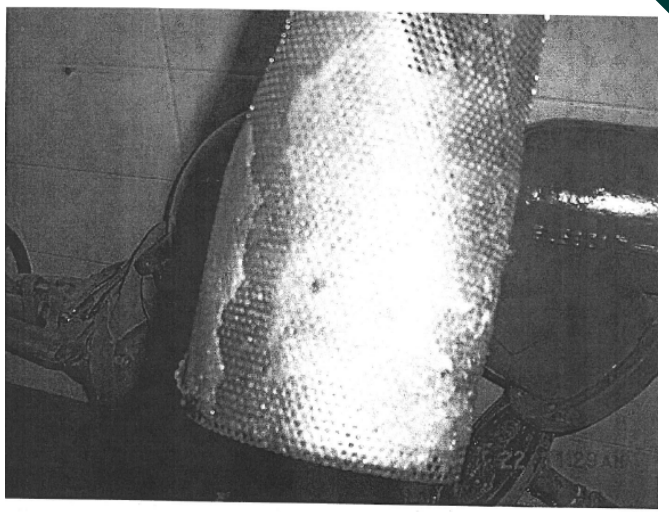
POTENTIAL SECONDARY IMPACTS OF pH ADJUSTMENT

Excessive Precipitation/ Scaling



6-inch y-strainer, with screen removed, showing excessive scaling and build-up, photo taken during November 2003.

RAISE pH

LOWER pH

Reaction with Iron in Distribution Water Main (Discolored Water)

Disinfection Changes

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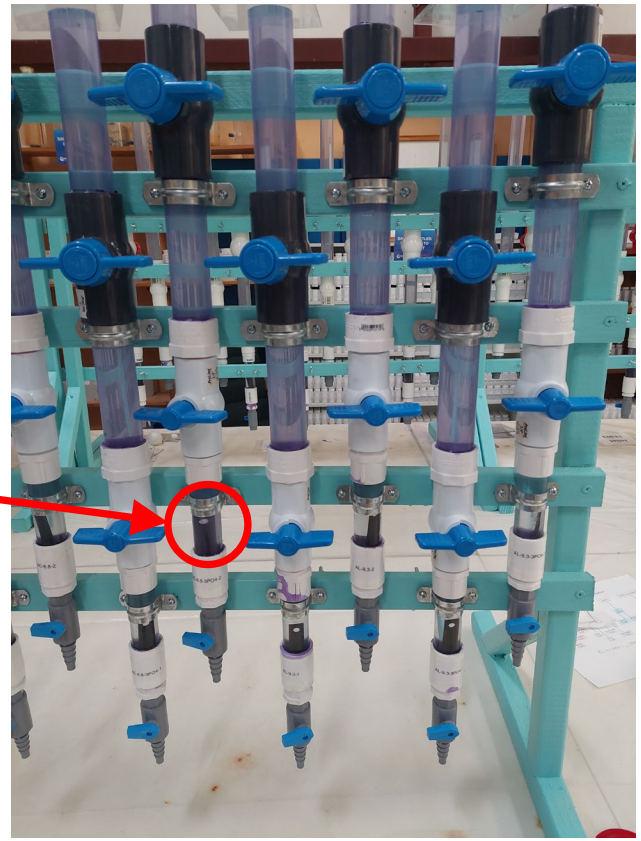
LEAD SOLUBILITY TESTING

- New methodology for coupon testing
  - Eliminates headspace
  - Coupons always submerged
  - Minimal disruption
- Lead coupons
- Water prepared 2x/week
  - WQPs adjusted
    - H_3PO_4 dosed (SLI-PHOS 36)
    - Disinfectant dosed and verified
    - pH adjusted
  - Samples taken post-immersion
    - pH measured
    - Lead measured



SOLUBILITY STUDY GOALS FOR ELGIN

- Can we just raise the pH?
- Does DIC affect pH and alkalinity considerations?
- What does orthophosphate do?
- What pH to use for orthophosphate?
- Are Riverside and Airlite different?
- What conditions do we use for harvested pipe studies?

Label	Source	pH	Alkalinity (mg/L as CaCO3)	DIC (mg/L as C)	O-PO4 (mg/L as PO4)
No orthophosphate					
R1	Riverside	8.8	85	20	0
R2	Riverside	9.0	70	16	0
R3	Riverside	8.8	60	14	0
R4	Riverside	9.3	65	14	0
A5	Airlite	8.8	103	24	0
A6	Airlite	9.3	65	14	0
With orthophosphate					
R11	Riverside	8.8	69	16	3
R12	Riverside	7.8	65	16	3
R13	Riverside	9.3	65	14	3
R14	Riverside	9.3	65	14	1
A15	Airlite	8.8	103	24	3
A16	Airlite	9.3	65	14	3

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SOLUBILITY STUDY SUMMARY FINDINGS

Orthophosphate

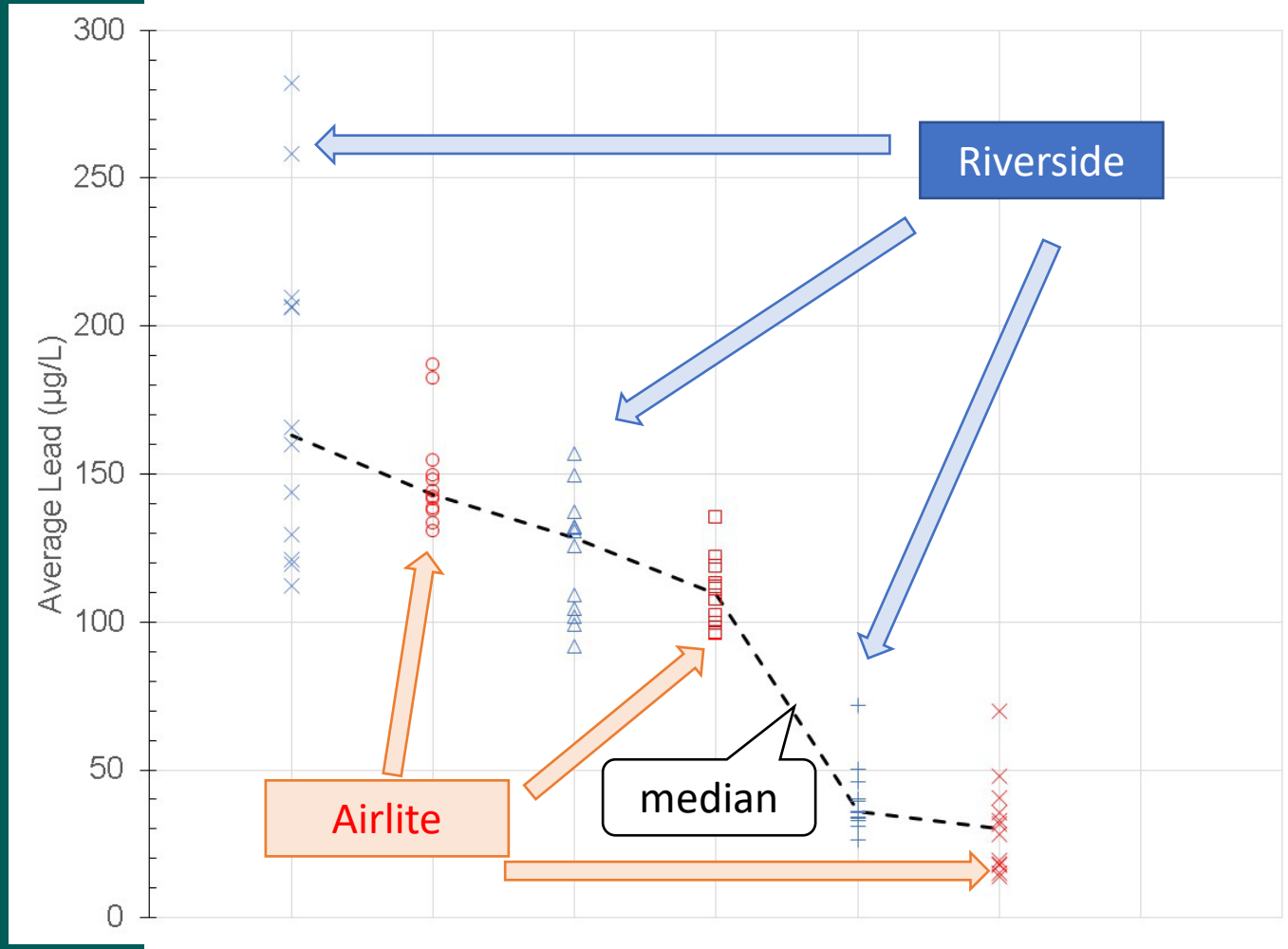
- 3 mg/L-PO_4 lowered Pb release under all conditions
- 1 mg/L-PO_4 showed minimal to no improvement in Pb release under low alkalinity conditions for Riverside water
- Possible a lower PO_4 dose (between 1 and 3 mg/L) would give similar results to 3 mg/L
- pH 7.8 and 9.3 similar
- pH 8.8 is not a viable solution
- In the ranges tested, DIC did not have a big impact

pH and Alkalinity

- Increasing pH to 9.3 reduced Pb by roughly 20%. Requires low alkalinity.

Riverside Compared to Airlite

- Essentially the same



pH	8.8	8.8	9.3	9.3	9.3	9.3
DIC	20	24	14	14	14	14
PO4	0	0	0	0	3	3

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ELGIN HARVESTED PIPE STUDY

- City sent Cornwell Engineering Group (CEG) lead pipes removed from service lines
- City sent CEG water from the two treatment plants
- CEG altered the water chemistry to test options to lower the lead

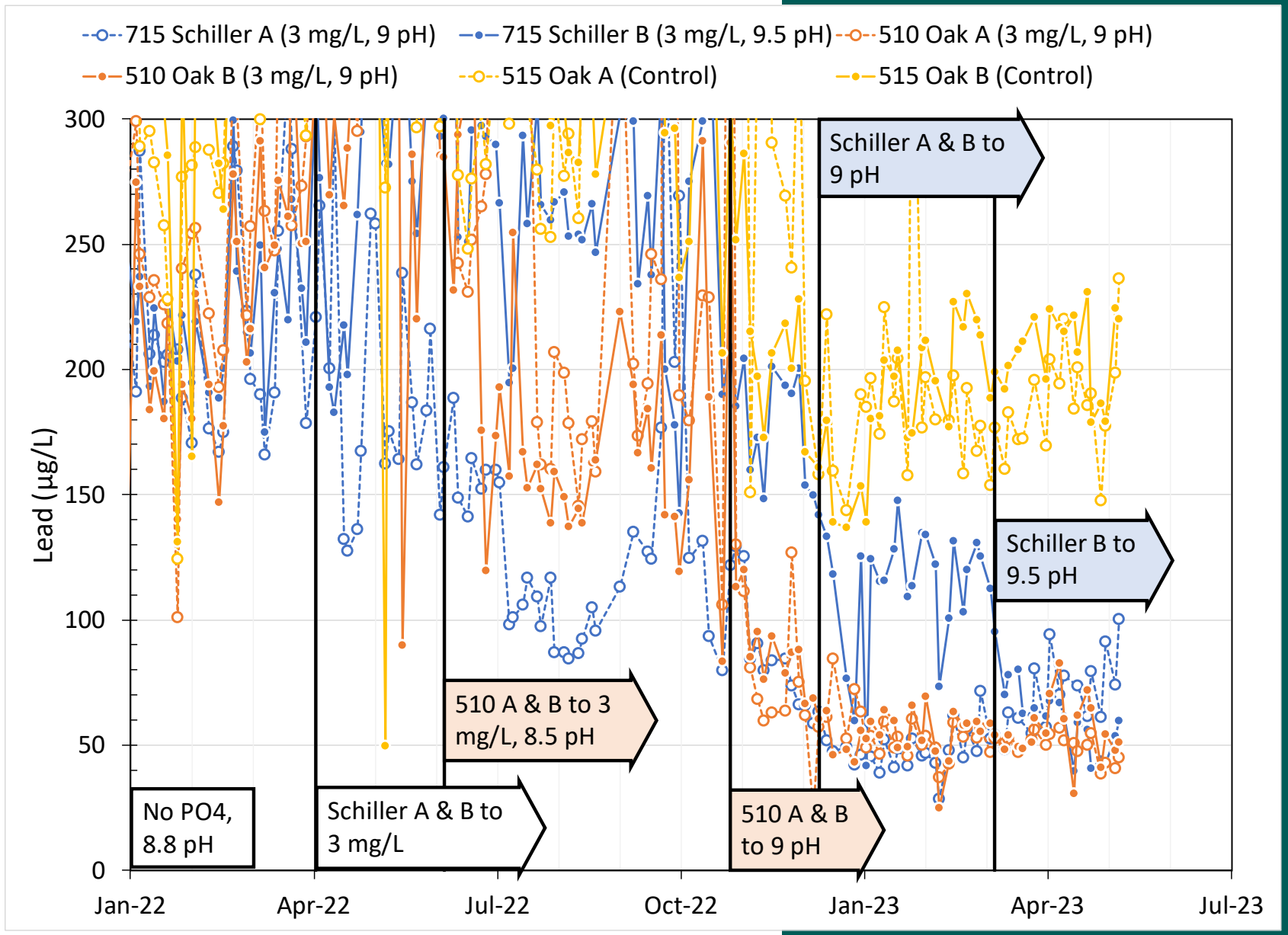
HARVESTED PIP FLOWTHROUGH STUDY OVERVIEW

- Total of 12 lead pipes harvested from 7 separate addresses
  - 8 pipes from 4 addresses in areas served primarily by Riverside WTP
  - 4 pipes from 3 addresses in areas served primarily by Airlite WTP
- Pipes started to become conditioned around April 2022
  - Over 6 months after start
- 3 pipes with duplicates dosed with o-PO4 starting April 2022
  - 2 on Riverside, 1 on Airlite (no duplicate)
  - 1 Riverside also adjusted to 7.8 pH
- 2 pipes with duplicates dosed with o-PO4 starting June 2022
  - 1 on Riverside, 1 on Airlite
  - Airlite also adjusted to 7.8 pH
- 2 pipes with duplicates remain as control (1 Riverside, 1 Airlite)

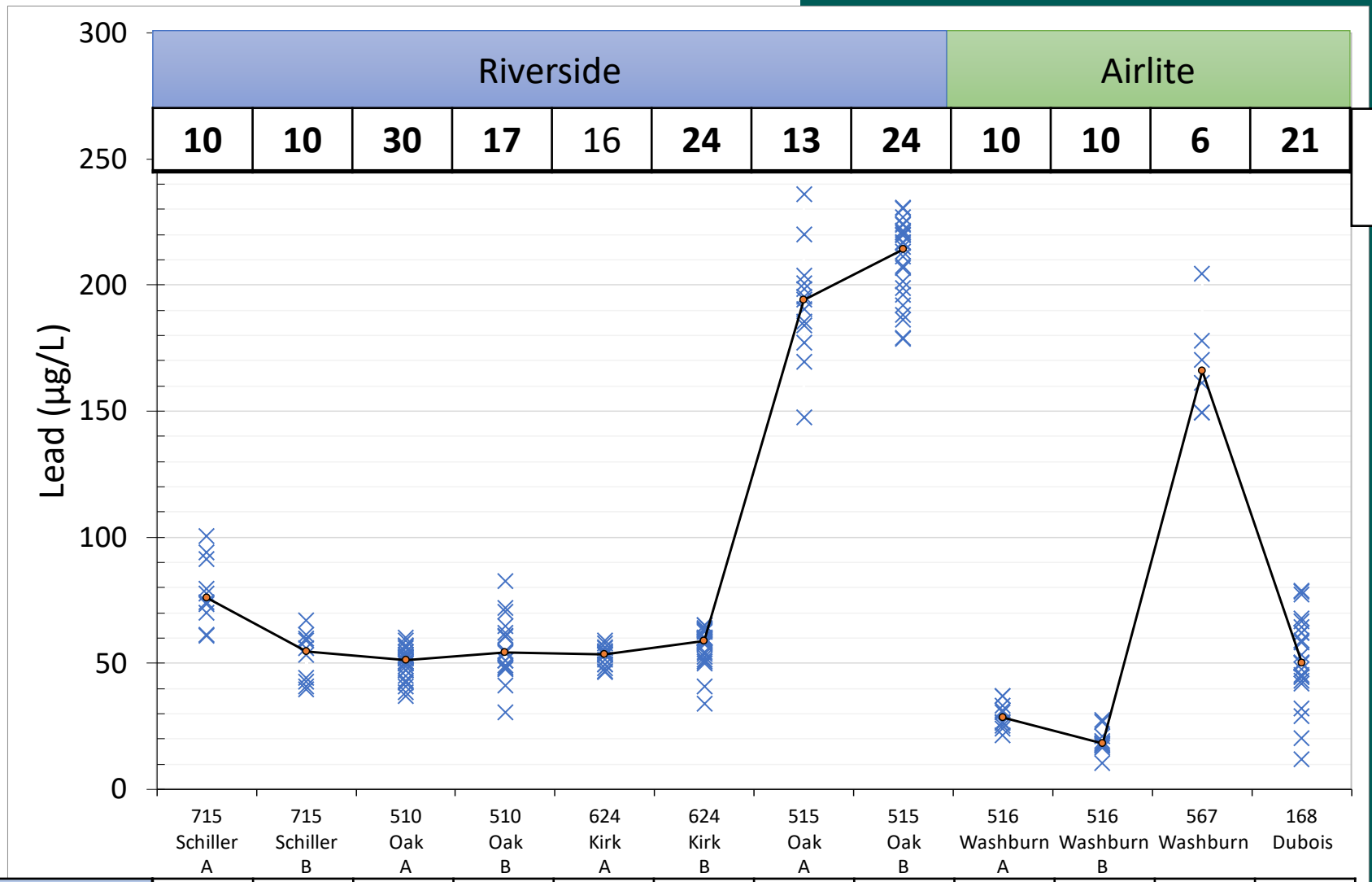
<table>
<tr><th rowspan="2">Water Source</th><th rowspan="2">Address</th><th rowspan="2">Acclimation</th><th colspan="4">CCT Test Conditions</th></tr>
<tr><th>Test 1</th><th>Test 2</th><th>Test 3</th><th>Test 4</th></tr>
<tr><td rowspan="10">Riverside</td><td>715 Schiller A</td><td rowspan="15">0 mg/L PO_4 at 8.8 pH</td><td rowspan="2">3 mg/L PO_4 at 8.8 pH</td><td rowspan="2">3 mg/L PO_4 at 9 pH</td><td colspan="2">N/A</td></tr>
<tr><td>715 Schiller B</td><td>3 mg/L PO_4 at 9.5 pH</td><td rowspan="2">N/A</td></tr>
<tr><td>510 Oak A</td><td rowspan="2">3 mg/L PO_4 at 8.5 pH</td><td rowspan="2">3 mg/L PO_4 at 9 pH</td><td>2.5 mg/L PO_4 at 9 pH</td></tr>
<tr><td>510 Oak B</td><td colspan="2">N/A</td></tr>
<tr><td>624 Kirk A</td><td rowspan="2">3 mg/L PO_4 at 7.8 pH</td><td>4 mg/L PO_4 at 7.8 pH</td><td>3 mg/L PO_4 at 7.8 pH</td><td>2.5 mg/L PO_4 at 7.8 pH</td></tr>
<tr><td>624 Kirk B</td><td colspan="3">N/A</td></tr>
<tr><td>515 Oak A</td><td colspan="4" rowspan="2">N/A</td></tr>
<tr><td>515 Oak B</td></tr>
<tr><td rowspan="5">Airlite</td><td>561 Washburn A</td><td rowspan="2">3 mg/L PO_4 at 7.8 pH</td><td>4 mg/L PO_4 at 7.8 pH</td><td>3 mg/L PO_4 at 7.8 pH</td><td>2.5 mg/L PO_4 at 7.8 pH</td></tr>
<tr><td>561 Washburn B</td><td colspan="3" rowspan="2">N/A</td></tr>
<tr><td>567 Washburn</td><td>3 mg/L PO_4 at 9 pH</td></tr>
<tr><td>186 N Du Bois</td><td>3 mg/L PO_4 at 8.8 pH</td><td colspan="3">N/A</td></tr>
</table>

HARVESTED PIPE STUDY

Riverside 9.0-9.5 pH Pipe Example



HARVESTED PIPE RESULTS



Dose (mg/L)	3	3	3	3	4	3	0	0	4	3	0	3
pH	9	9	9	9	7.8	7.8	8.8	8.8	7.8	7.8	8.8	8.8

OPTIMAL CORROSION CONTROL TREATMENT (OCCT)

- Submitted report to IEPA in July 2023
- Over one year of testing Corrosion Control Treatment options
- Target pH of 9.3 and o-PO4 dosage of 3.0 mg/L at both WTPs
- If precipitation an issue for operations at pH 9.3, the system will gradually switch to pH 7.8
- IEPA approved OCCT in December 2023
  - Asked for additional testing for DBPs and Copper Pitting
    - DBPs – Two Rounds of Testing to Date; Ongoing
      - HAA5 not impacted; Small increase in TTHM formation
    - Copper Pitting – Six copper pipes examined – No significant pitting – Will do more testing after OCCT implementation

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ADDITIONAL CONSIDERATIONS FOR OCCT

- Previous studies showed that 3 mg/L o-PO4 was as good as 4 mg/L
- Both pH 7.8 and 9.1+ performed similarly
- Iron pipe analysis performed for pH 7.8 – no significant impacts
- Full scale testing at Riverside demonstrated that by adjusting the softening chemistry that alkalinity could be lowered to drop CCPP below a precipitation potential
- Implementation will begin at pH 9.3 and 3 mg/L o-PO4
- Additional testing was conducted to see if a lower orthophosphate dose would perform as well
- Three pipes (2 Riverside and 1 Airlite) were switched to 2.5 mg/L o-PO4 in June 2023

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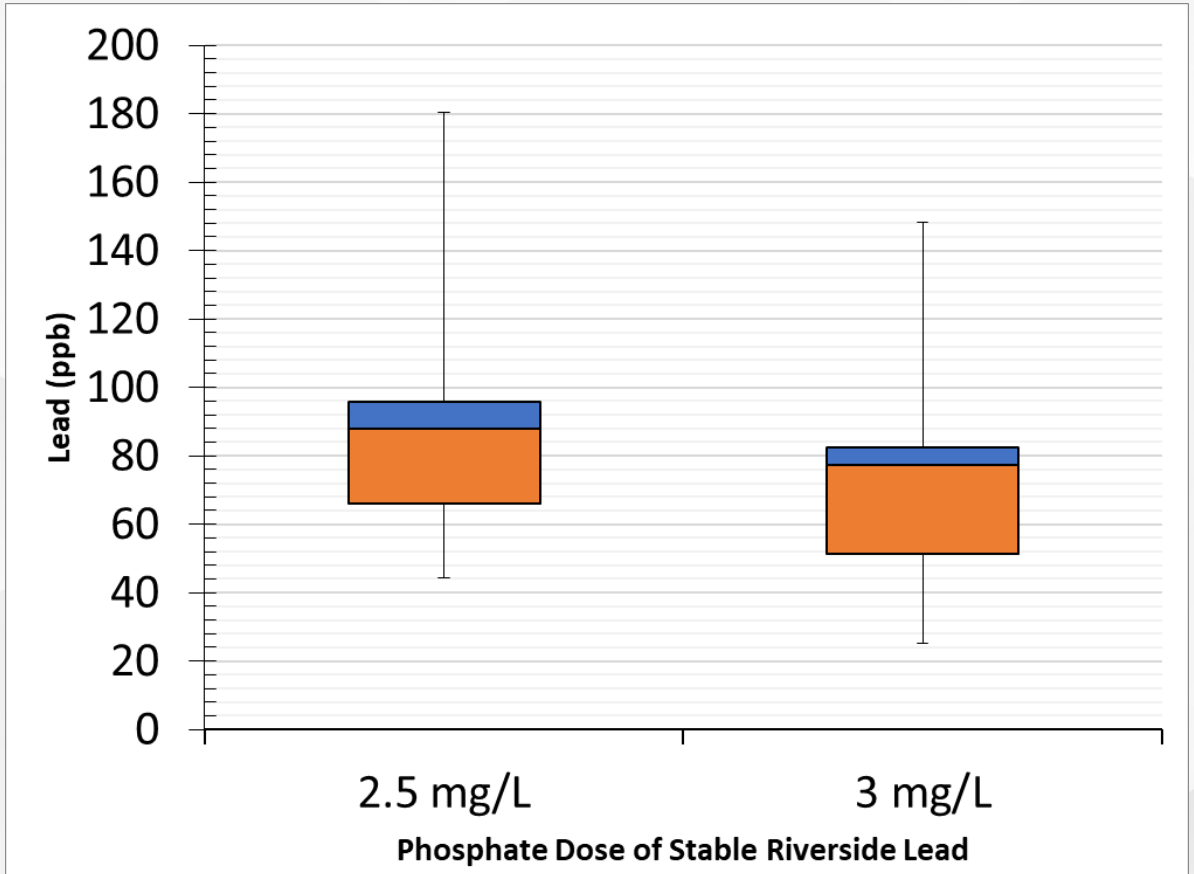
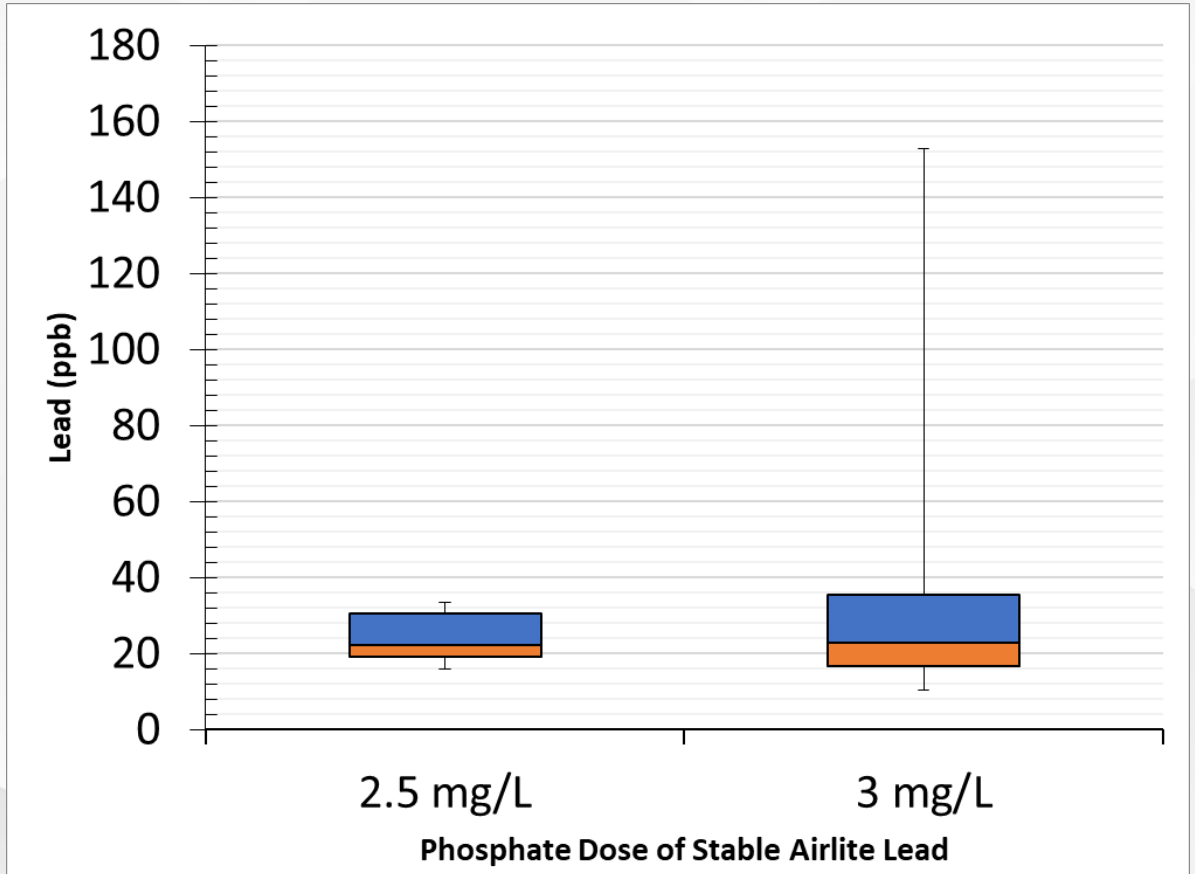
Aggregated data included did not discriminate pH.

2.5 vs 3.0 o-PO4 – Aggregated Data



- **2.5 mg/L:** includes data from Oak A at 9.1 pH and Kirk A at 7.8 pH
- **3 mg/L:** includes data from Schiller A at 9.1 pH, Schiller B at 9.1 pH, 510 Oak A at 9.1 pH 510 Oak B at 9.1 pH, Kirk A at 7.8 pH, and Kirk B at 7.8 pH.



- **2.5 mg/L:** includes 561 Washburn B at 7.8 pH
- **3 mg/L:** includes data from 561 Washburn A at 7.8 pH, 561 Washburn B at 7.8 pH, and 567 Washburn at 9.1 pH

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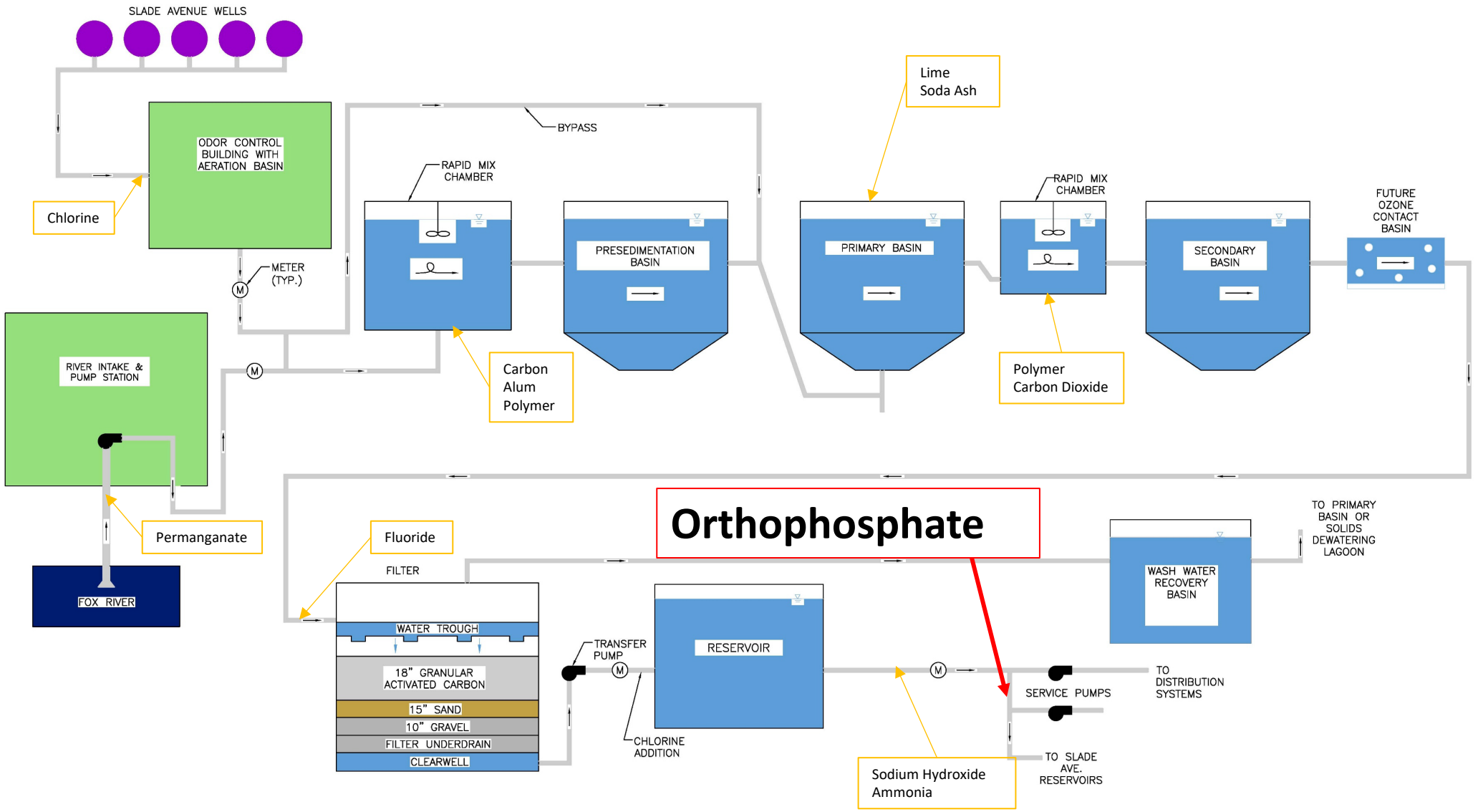
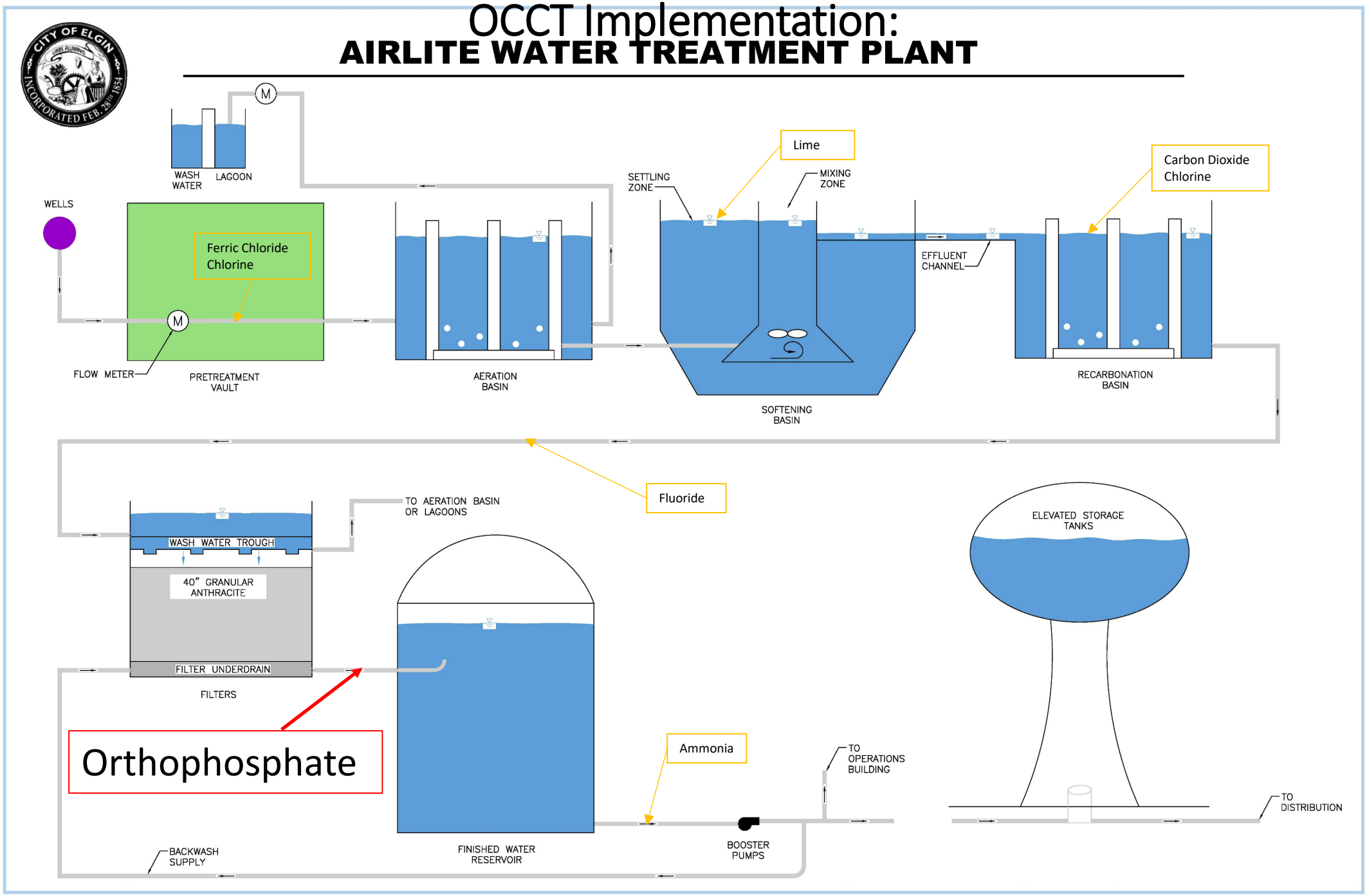
LOWER ORTHOPHOSPHATE DOSE FINDINGS

- It appears that 2.5 mg/L o-PO4 will not perform as well as 3.0 mg/L on Riverside WTP water
- Likely stay on a 3.0 mg/L o-PO4 at least until all LSLs are gone
- Perhaps at that time there would be another study on Copper with Lead Solder (CuLS)

OCCT Implementation:
RIVERSIDE WATER TREATMENT PLANT



OCCT Implementation:
AIRLITE WATER TREATMENT PLANT



OCCT IMPLEMENTATION OVERVIEW

- Design and permitting for o-PO4 (phosphoric acid) feed systems at each WTP in 2024
  - Riverside WTP: Convert existing/unused Ferric Chloride system area into o-PO4 system area – Repurpose Ferric Storage Tanks for o-PO4
  - Airlite WTP: Convert portion of existing Fluoride system area into o-PO4 system area – New Tanks
  - New pump skids, carrier water and chemical piping to injection points
  - o-PO4 Online Analyzers with SCADA/Controls Modifications for Dosing
- Construction started January 2025
- Startup: anticipated by end of July 2025
- Operational Changes required prior to feeding o-PO4
  - Increase pH to 9.3 by decreasing Carbon Dioxide feed
  - Lower and stabilize Alkalinity by adjusting Lime feed
- Ongoing coordination with IEPA and FRWRD

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SUMMARY

- THE CORROSION CONTROL STUDY IS ONE PART OF A LEAD MANAGEMENT PLAN
- CCS MAY STILL BE REQUIRED, AND WILL BE BENEFICIAL, EVEN IF NO LEAD SERVICES
- CCS RESULTS MUST BE FULLY UNDERSTOOD BEFORE MAKING TREATMENT CHANGES – MAY REQUIRE TIME EXTENSIONS WITH IEPA AND EXTENDED TESTING
- CONSIDER EXISTING WATER TREATMENT LIMITATIONS AND ALTERNATIVES, PARTICULARLY WITH SOFTENING
- MAY NEED TO CONSIDER MULTIPLE TEST CONDITIONS AND ITERATIONS FOR DEMONSTRATION STUDIES, PARTICULARLY HARVESTED PIPE FLOWTHROUGH STUDY
- MAINTAIN CONSTANT COMMUNICATION WITH REGULATORY AGENCIES THROUGHOUT THE STUDY

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THANK YOU

We value your time and appreciate the opportunity to present. Please let us know if you have any questions.

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