

A photograph of a large, white, spherical water tower with a yellow support structure. The tower is set against a clear blue sky. The words "GRAND RAPIDS" are written in large, dark letters across the top of the sphere, and "IT'S IN MINNESOTA'S NATURE" is written in smaller letters below it.

Utility Success in Overcoming *Legionella* with Treatment and Operations Improvements

Alex Mofidi, PE



American Water Works Association

Pacific Northwest Section

PNWS Annual Conference

May 7-9, 2025, Boise, ID



confluence
ENGINEERING GROUP LLC

Project Team

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Agenda

- 1 Background & Setting
- 2 Outbreak Timeline & Response
- 3 Current Status & Lessons Learned

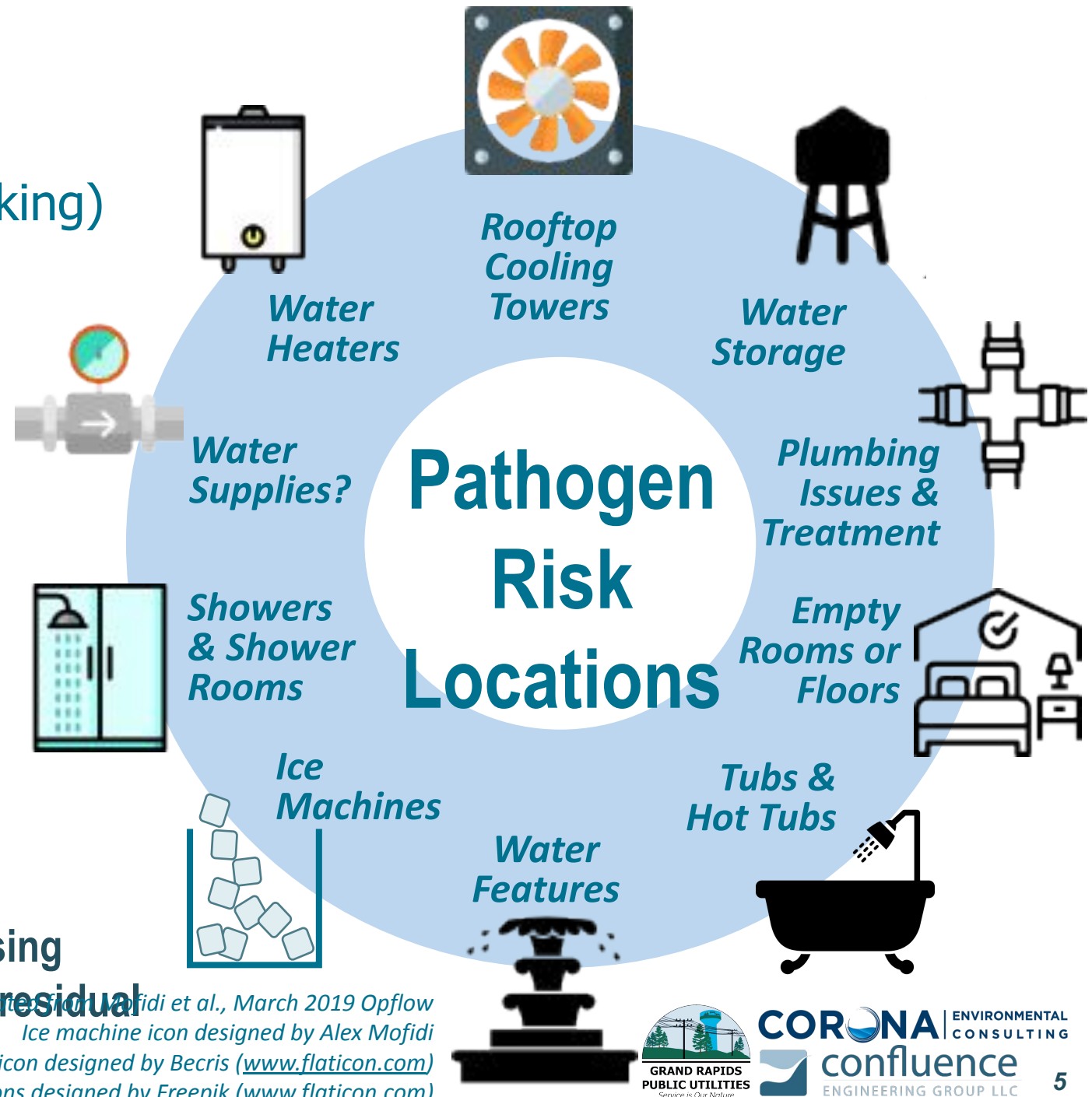




1 Background & Setting

Legionella Risk Locations

- Inhalation Hazard (not from Drinking)
- Building Water Systems
 - ❑ Healthcare Facilities
 - ❑ Large/Aging Infrastructure
 - ❑ Cooling Towers
 - ❑ Re-Purposed Facilities
- Water Conditions
 - ❑ Cooling of hot water plumbing
 - ❑ Warming of cold water plumbing
- Utility Distribution System?
 - ❑ Not typical: Risk increases w/increasing temperature or decreasing chlorine residual

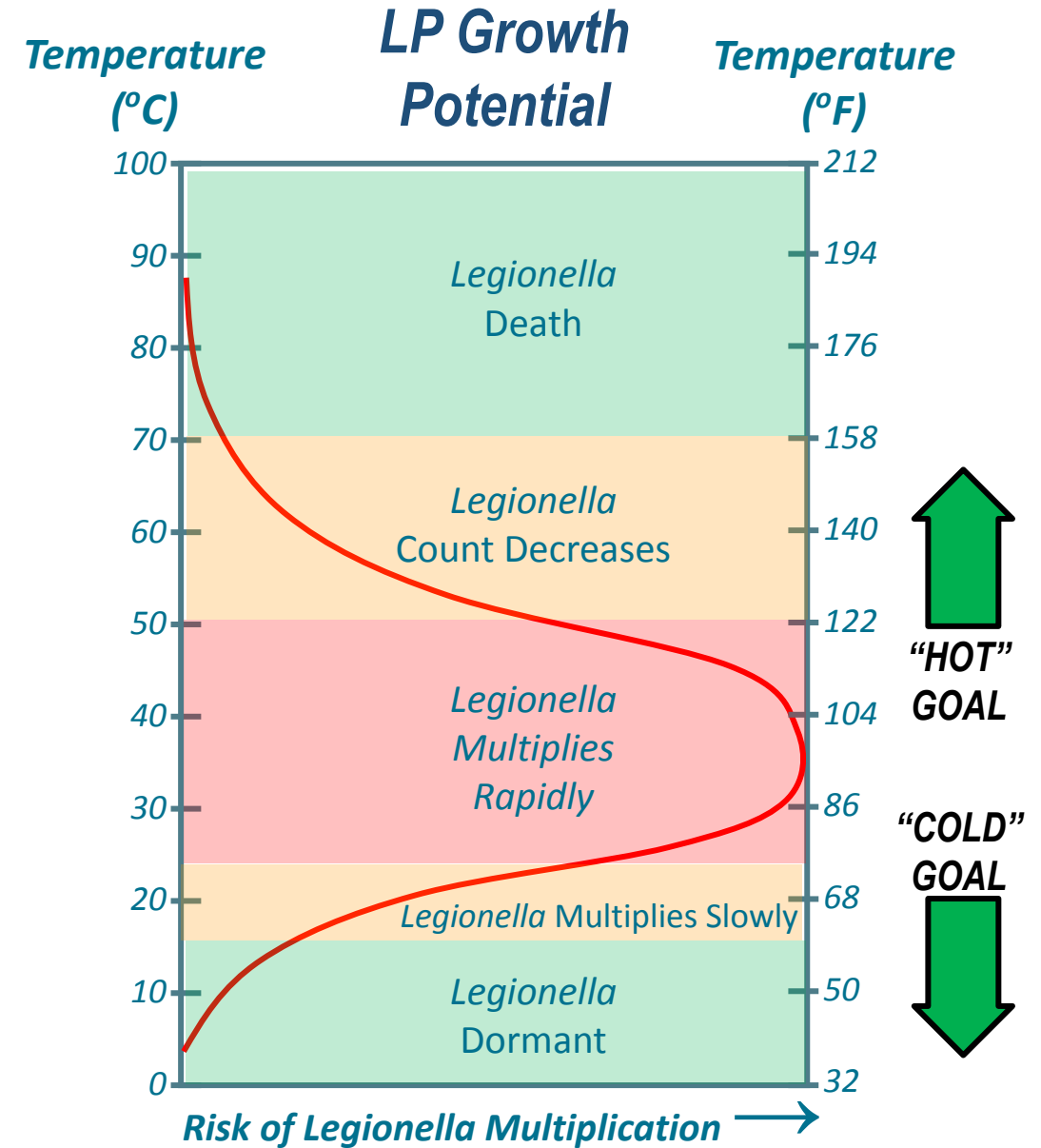


Legionella Risk Conditions

Example Building LP Levels vs. Concern/Action

<i>L. pneumophila</i> (MPN/100mL)	Concern level	Corrective action
Not-detected (<10)	Baseline or normal	Keep maintaining best management practices.
<100	Potential for growth	Repeat monitoring. Measure and document incoming water quality.
100 – 1,000	Level 1: Possible growth	Investigate and mitigate risks of growth, system-wide assessment.
>1,000	Level 2: Indicates growth	Investigate, mitigate risks of growth, and enhance control measures.

GOAL

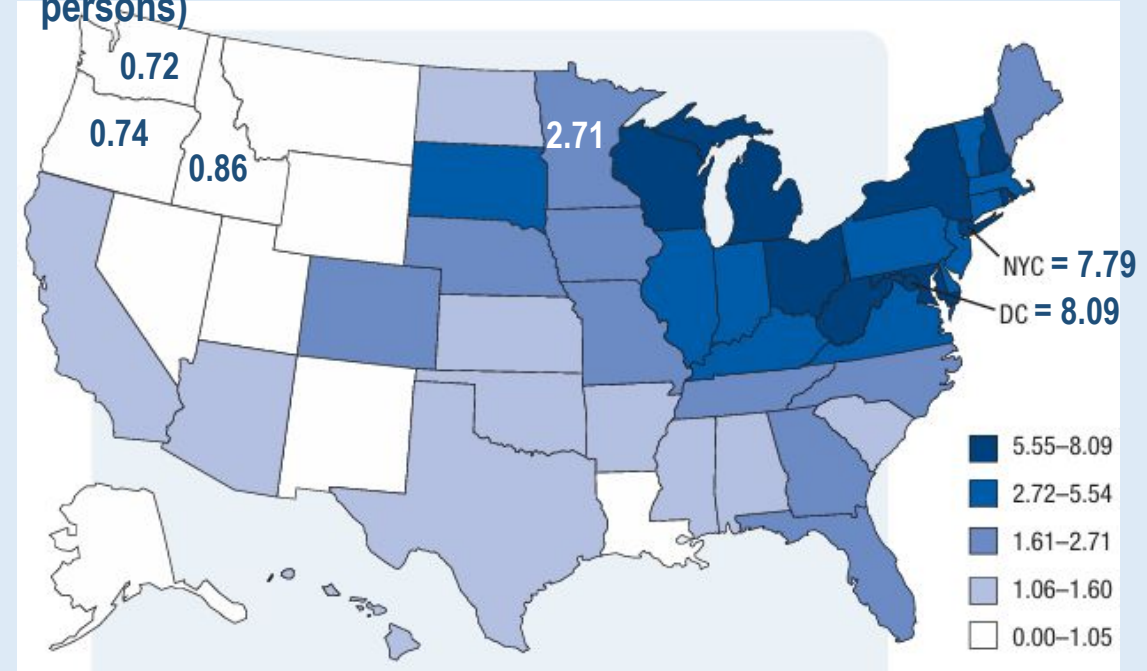


Legionnaires' Disease Review

“For 2010-2022, *Legionella* bacteria are the most frequently reported cause of disease outbreaks associated with drinking water.”



2018 Legionnaires' Disease Incidence (Cases /100,000 persons)



Area	2018 Cases	2019 Cases
Washington	54 persons	76 persons
Oregon	31	55
Idaho	15	25
New York City	654	446
Minnesota	152	118

Grand Rapids Public Utilities (GRPU), MN

- Rural, Northern Minnesota
- GRPU Serves 11,126
 - ❑ 3,250 water / wastewater connections
 - ❑ 37 employees
 - ❑ Mostly residential and commercial, with a few small industrial customers
- Groundwater Source W/ Treatment Plant (~1987)
 - ❑ 5 Wells from 2 aquifers blended prior to treatment
 - ❑ Aeration + KMnO_4 + Filtration + Partial Softening + Fluoride
 - ❑ No disinfection





GRPU team providing Town Hall update meeting to residents

2 Outbreak Timeline & Response

Outbreak Timeline



- Minnesota Department of Health (MDH) Investigation Begins
 - ❑ Cooling towers investigated in GRPU community
 - ❑ One tower *Legionella* positive, different isolate/remediated
 - ❑ No potential 'point source' locations identified in area
- MDH Engaged GRPU
 - ❑ Request of information from GRPU (system operations)
 - ❑ Anticipated testing in GRPU system
- MDH Collected Initial Samples

The Investigation Begins, Cont'd.

- MDH Outbreak Investigation

- ❑ No common point sources found

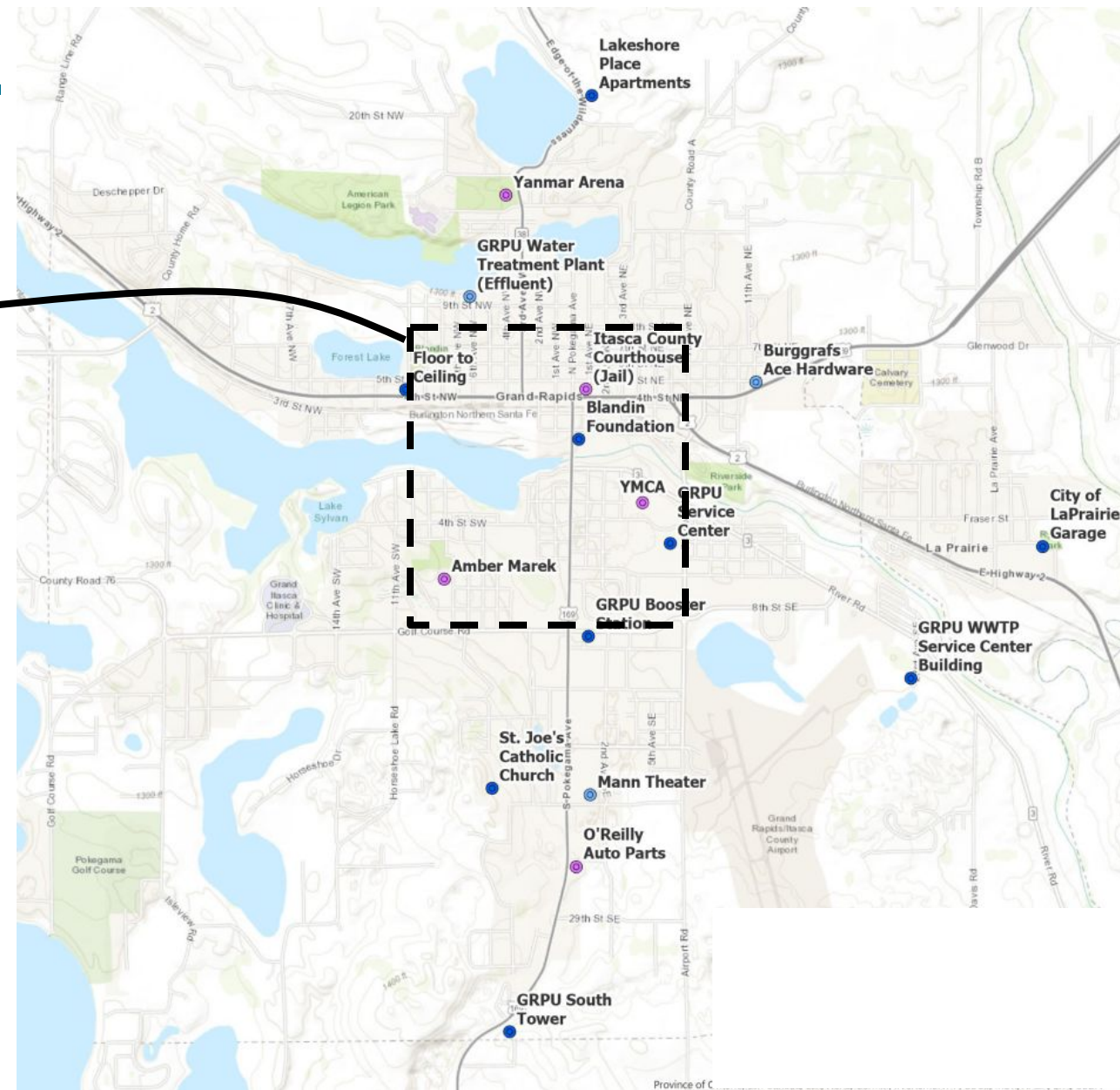
- ❑ All cases (Up to Dec 2023) were inside this 1.6 square mile MDH-defined area

- ❑ Only commonality: All in GRPU area

- ❑ MDH Sampled five GRPU locations

- Zero culturable detections at GRPU locations (no *L. pneumophila*)
 - Sampled two building water systems; both *L. pneumophila* culture positive

- MDH asks GRPU to investigate



Investigation By Monitoring

- Questions to Answer:

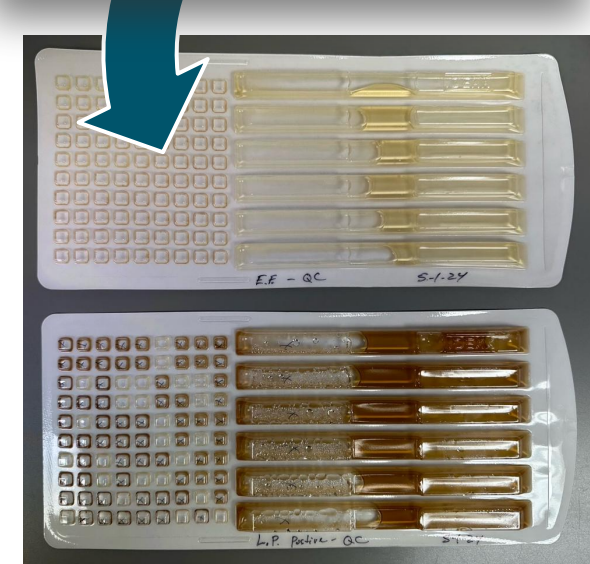
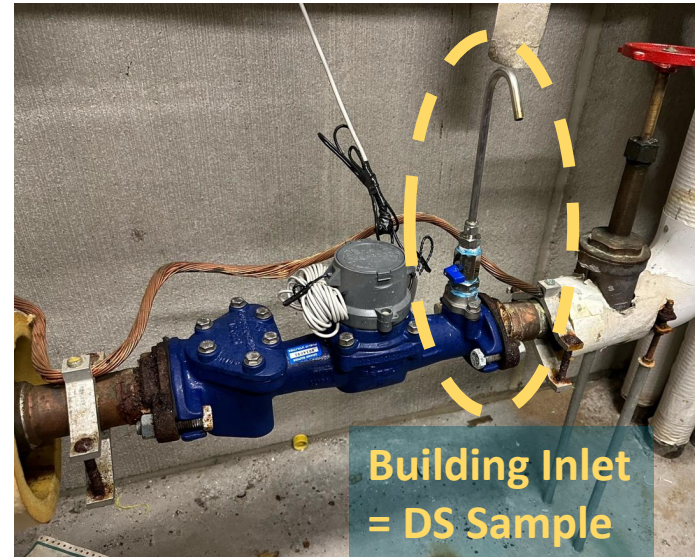
- ☐ Is Legionella in detectable in the DS?
- ☐ Is Legionella detectable in building plumbing systems?

- Started 20-24 locations/week (utility staff)

- ☐ Started April 2024 (GRPU staff)
- ☐ Public and private buildings (no single family homes)
- ☐ Entry point to building
- ☐ Cold water inside building
- ☐ Hot water inside building

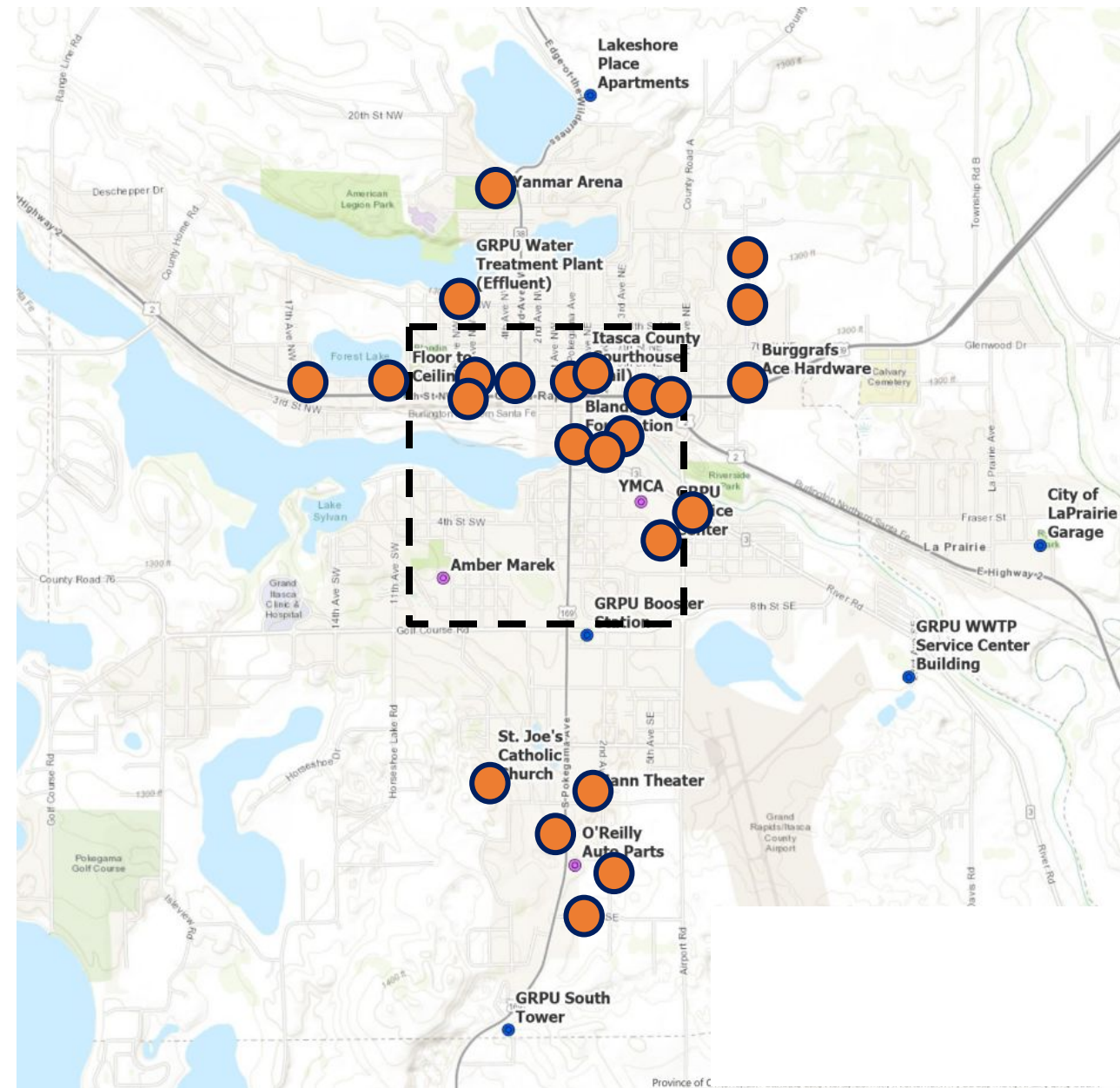
- Analyses:

- ☐ GRPU: Legiolert, ATP, other parameters
- ☐ MDH: PCR and culture methods for Legionella, LP sg1 and non sg1

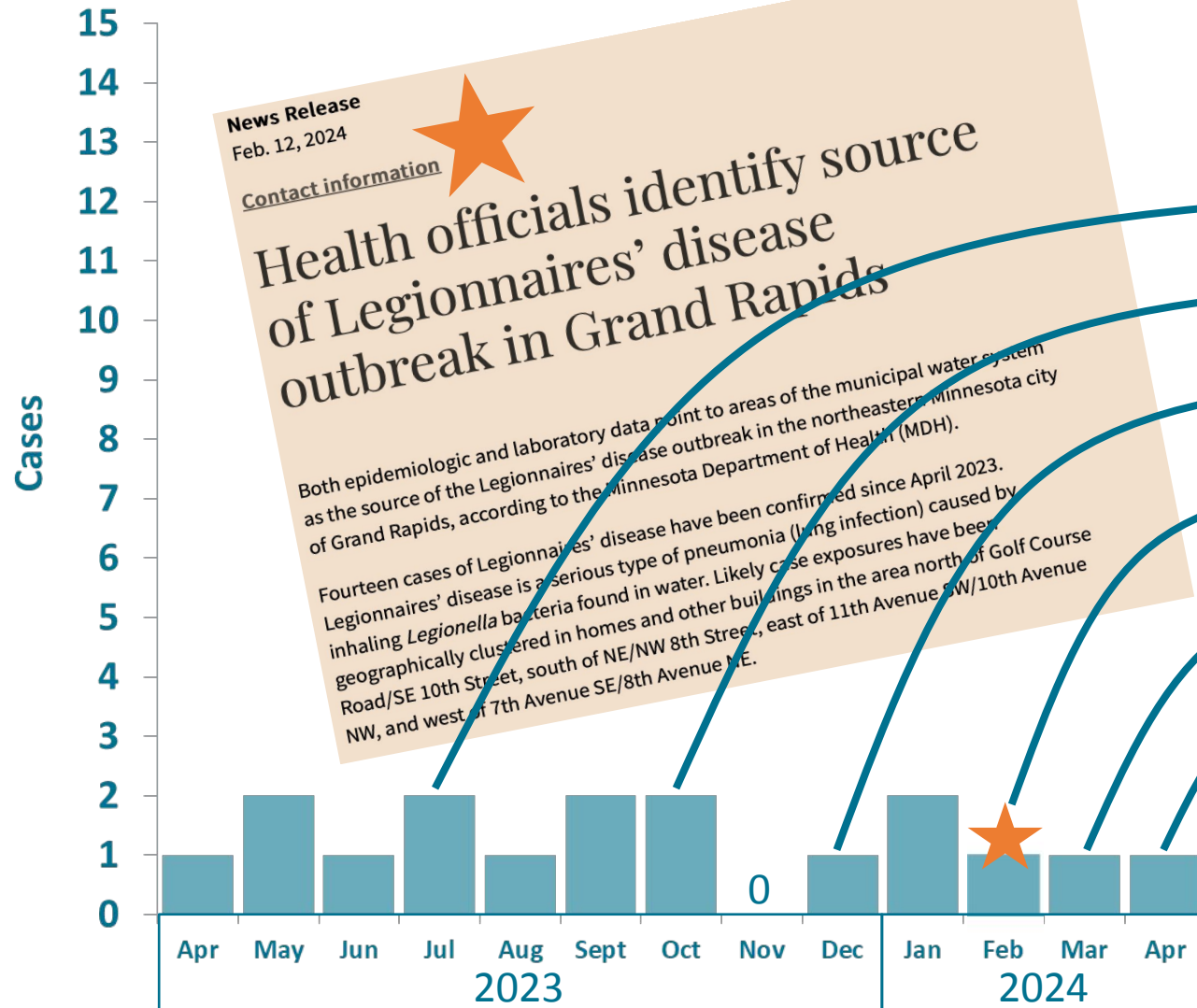


Monitoring Locations

- GRPU Sampling (●) Across System
- Several Building Types
 - ❑ WTP point of entry (POE) to the system
 - ❑ GRPU facilities
 - ❑ Apartment complex
 - ❑ YMCA
 - ❑ County courthouse and jail
 - ❑ Sports arena
 - ❑ Aged care facilities
 - ❑ Church
 - ❑ Gas station
 - ❑ Water storage tower
 - ❑ Other businesses



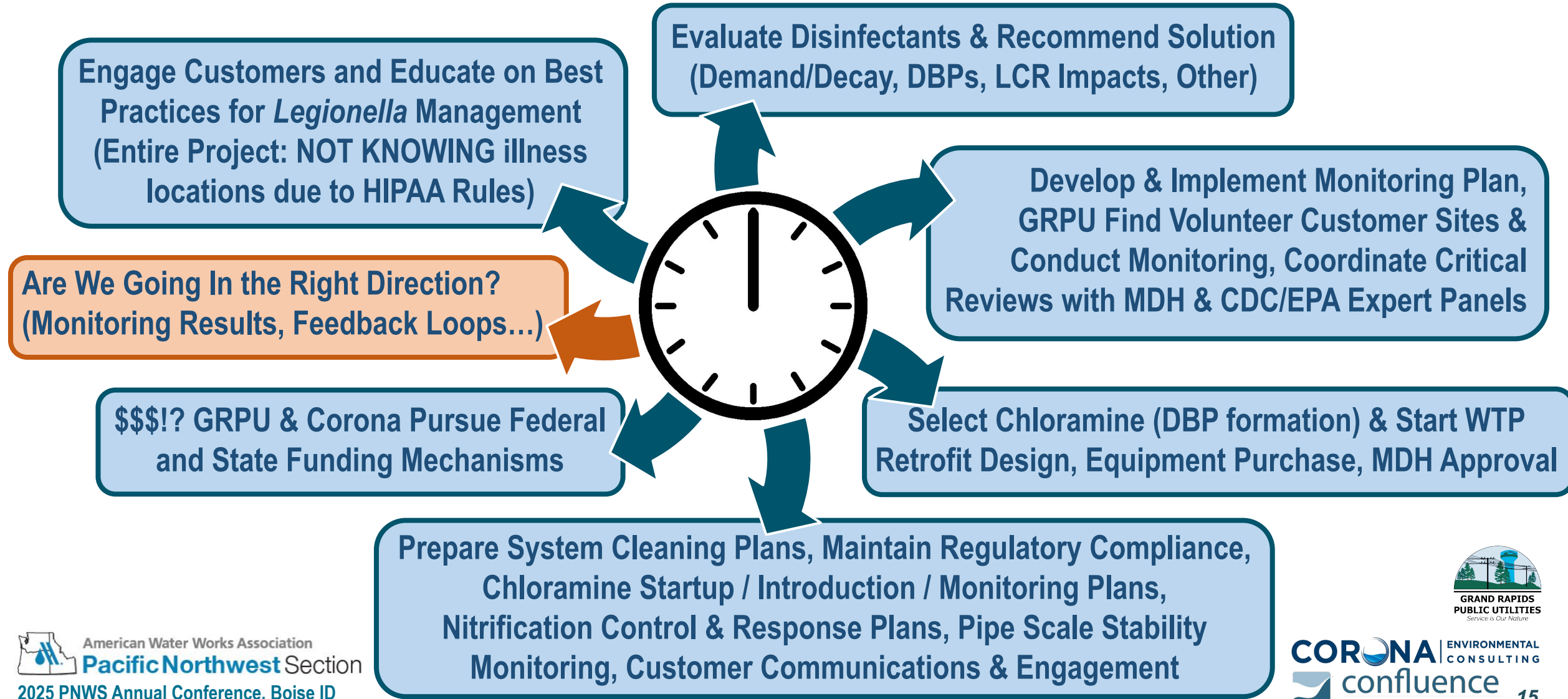
Outbreak Timeline



- MDH Investigation Begins
- MDH Engaged GRPU
- MDH Collected Initial Samples
- Consultants Engaged
 - ❑ Sampling plans developed
 - ❑ Water system and building monitoring begins
- Up To Now: MDH Lab Culture Samples from Distribution System and Storage Facilities are all at Non-Detect Levels

RAPID Response Activities

- Time is of the Essence: Needed to Start Work Without Contracts In Place!



Monitoring: *Legionella*

- 253 Samples / 3 Mo. (30%+)

- Undisinfected System



- Zero DS *LP* Detections (0%+)



- Cold Premise *LP* (36%+)

- ☐ >2273 MPN/100 at 20°C / 67°F

- ☐ ≤10 MPN/100 mL at <15°C / 60°F

- ☐ Zero detections <14°C / 56°F

- ☐ Cold water up to 24°C / 75°F

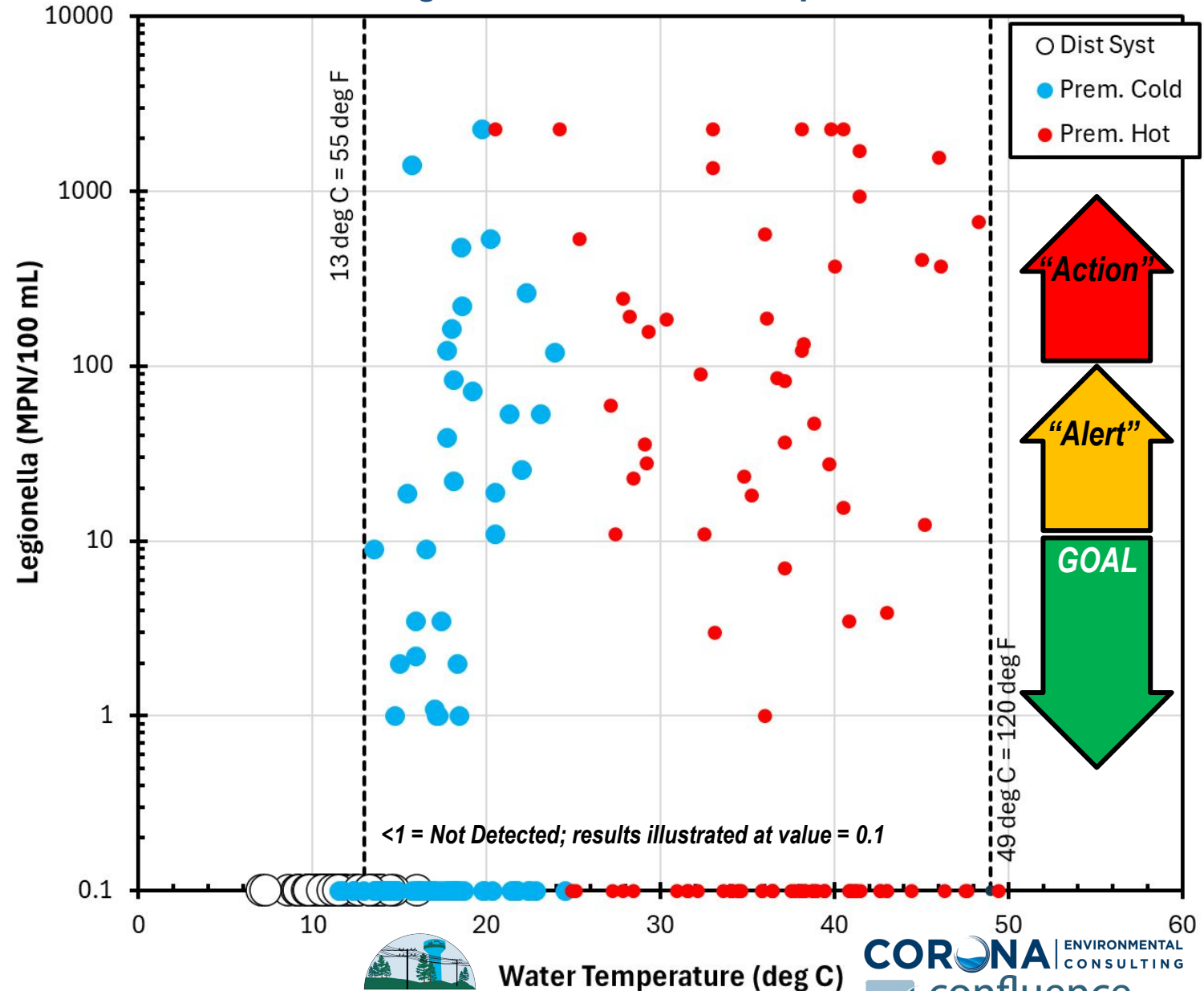


- Hot Premise *LP* (49%+)

- ☐ Zero detections >48°C / 118°F

- ☐ Hot water down to 21°C / 69°F

Legionella Count vs. Temperature



Monitoring: *Legionella*, Cont'd.

- Same Data as Previous Slide

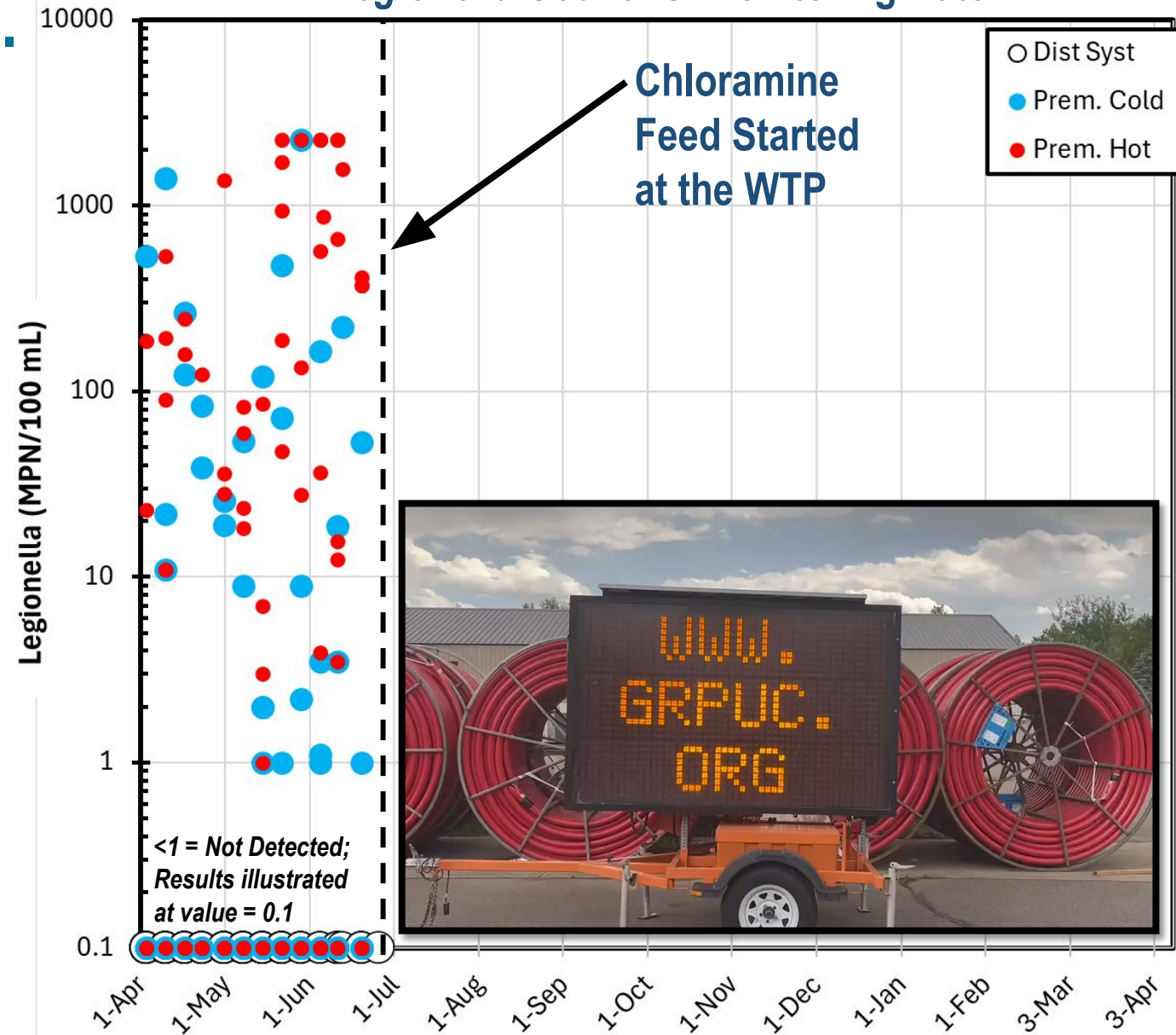
- All Results Apr-Jun 2024

- ☐ Building Inlet (DS) LP
- ☒ Cold water premise LP
- ☒ Hot water premise LP

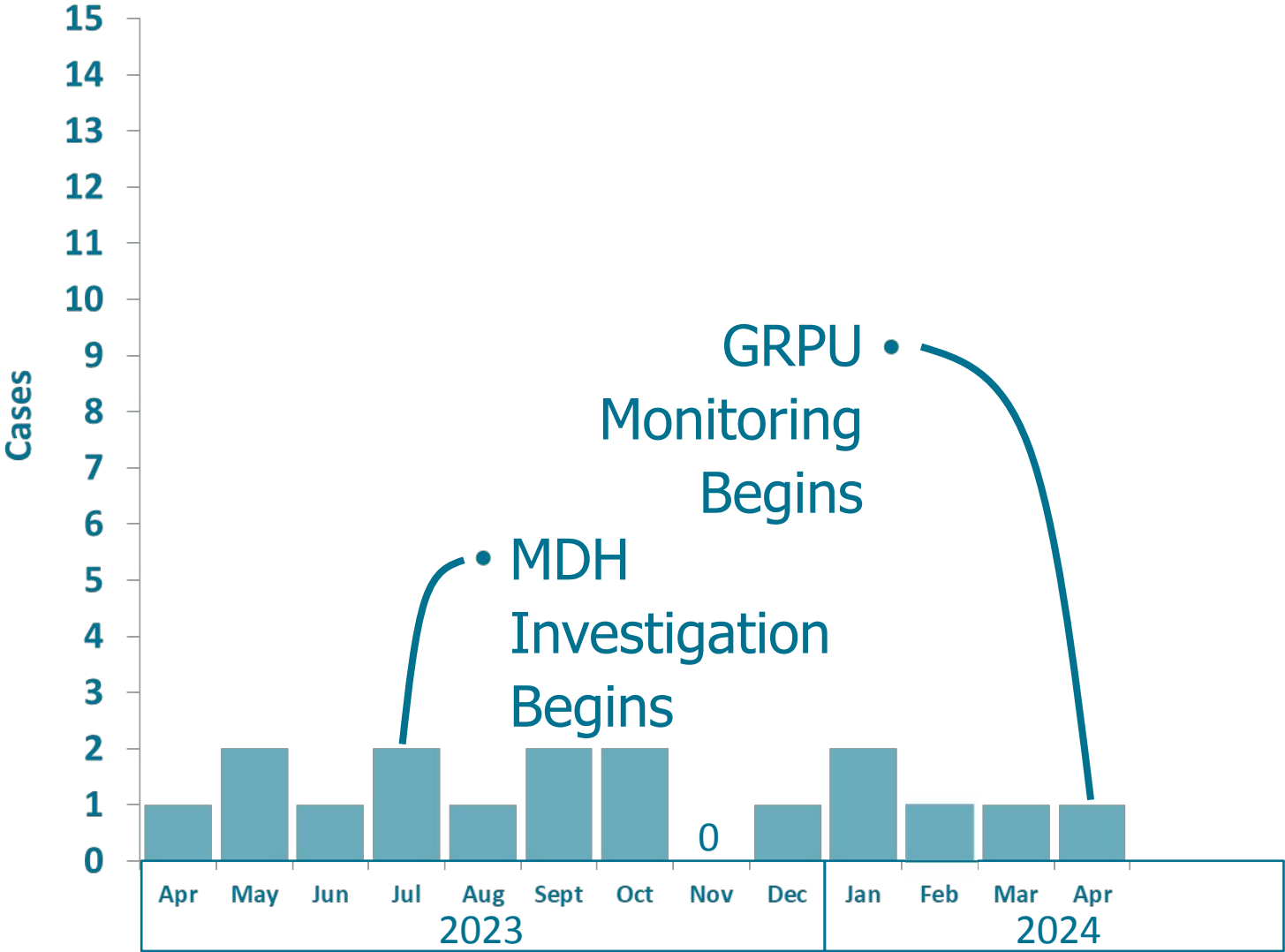
- Chloramine Startup at WTP

- ☐ June 24, 2024
- ☐ Between 4.5:1 to 5.0:1 $\text{Cl}_2:\text{NH}_3\text{-N}$ Ratio
- ☐ 2 mg/L total Cl_2 target through the DS
- ☐ Nitrification monitoring started
- ☐ Pipe scale stability monitoring started

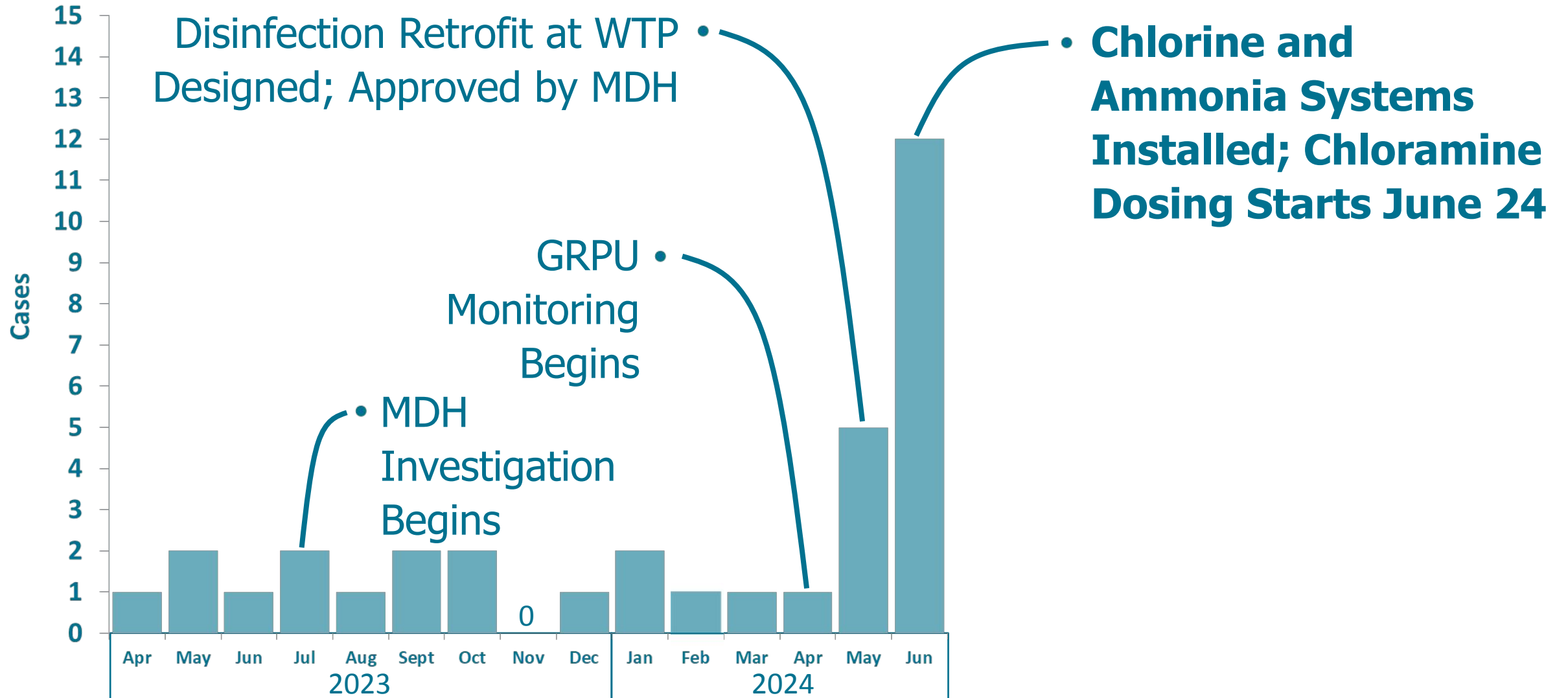
Legionella Count vs. Monitoring Date



Outbreak Timeline



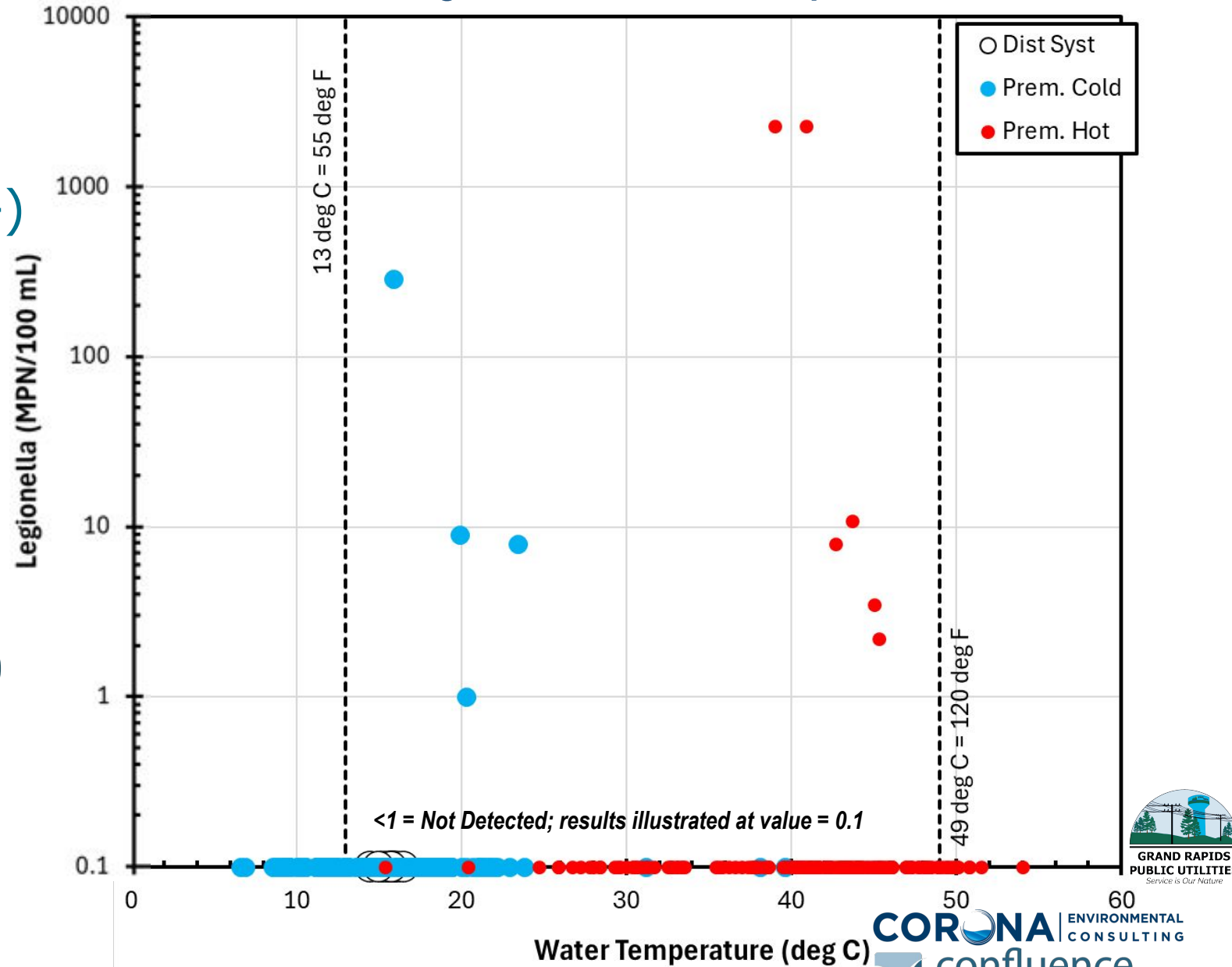
Outbreak Timeline: Bad News



Chloramine vs. *Legionella*

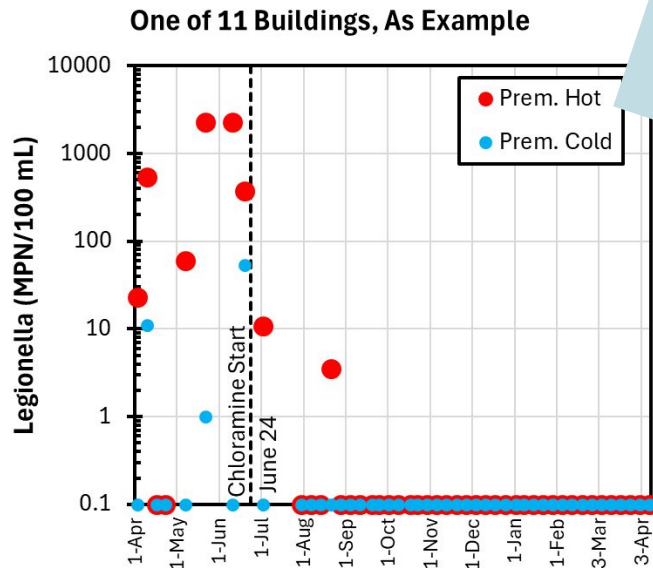
- 366 Samples / 9 Mo. (3%+)
- Zero *LP* DS Detections (0%+)
- Cold Premise *LP* (2%+)
 - ❑ Only one result >10 MPN/100
 - ❑ Max count = 287 MPN/100
 - ❑ Zero detections <16°C / 61°F
- Hot Premise *LP* (3%+)
 - ❑ Only three results >10 MPN/100
 - ❑ Zero detections >45°C / 113°F

Legionella Count vs. Temperature

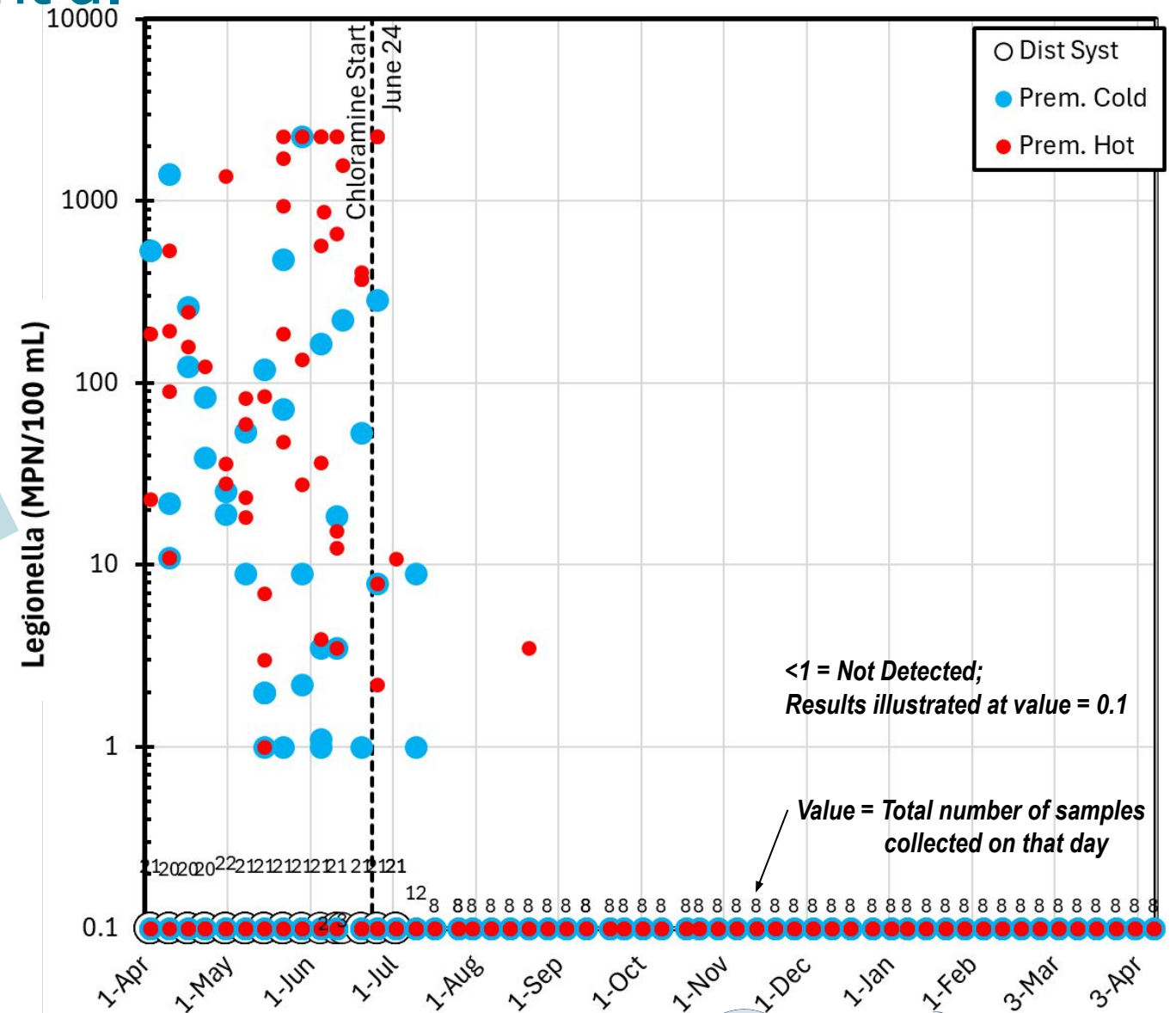


Chloramine vs. *Legionella*, Cont'd.

- Chloramine Started Jun 24
- No Cold-Water Premise Detections Since Jul 10
- No Hot-Water Premise Detections Since Aug 21



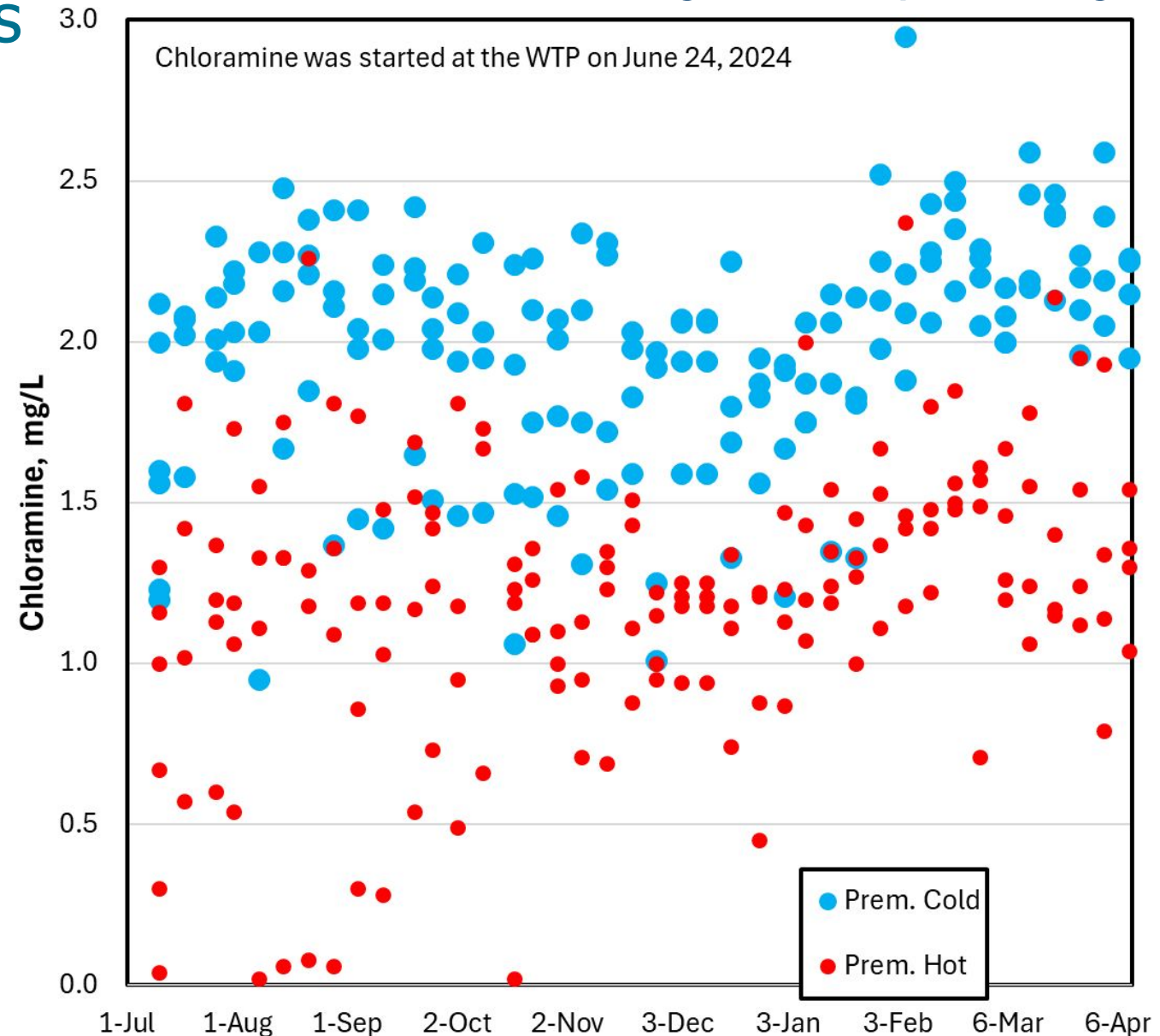
Legionella Count vs. Monitoring Date



Chloramine Stability in Buildings

- Ability to Push Through the System Rapidly (Within a Week)
- Cold Water Taps
 - ❑ All cold >1.0 mg/L since Aug 7
 - ❑ Now: Typical cold from 2.0-2.5 mg/L
- Hot Water Taps
 - ❑ All hot >0.5 mg/L since Jan 2
 - ❑ Now: Typical hot from 1.0-2.0 mg/L

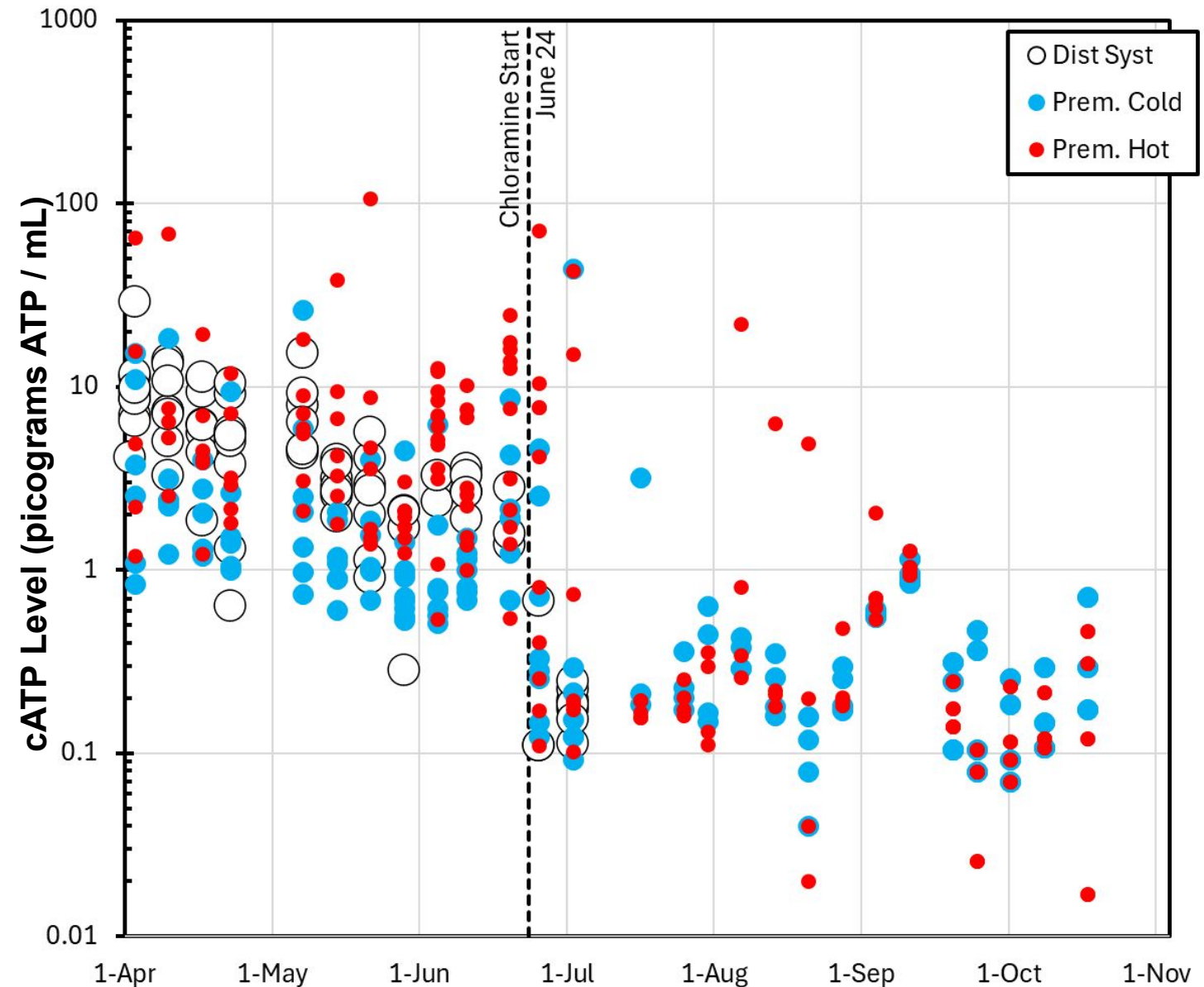
Chloramine Level vs. Monitoring Date, Multiple Buildings



Chloramine vs cATP

- cATP Monitored Apr to Oct
- Drinking Water cATP Levels:
 - ❑ Recommended: <1 pg cATP/mL
 - ❑ Preventative Action: 1-10 pg/mL
 - ❑ Corrective Action: >10 pg/mL
- Chloramine Addition
 - ❑ Without: It was 1 to 100 pg/mL
 - ❑ With: Now, typically <1 cATP/mL

cATP Level vs. Monitoring Date, Multiple Buildings



Chloramine vs. cATP, Cont'd.

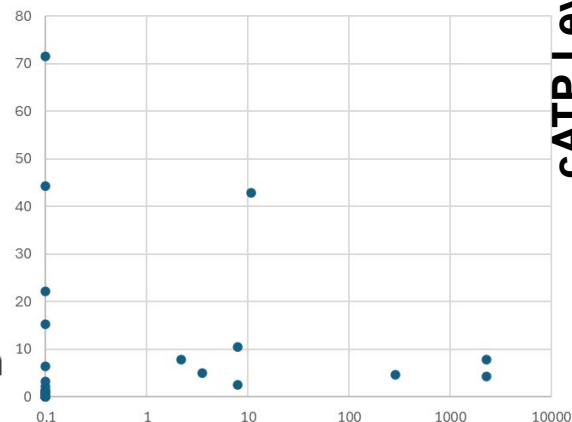
- 220 cATP & Legiolert Data Pairs Before Chlorination Started

- ❑ DS: 63 pairs
- ❑ Cold taps: 75 pairs
- ❑ Hot taps: 82 pairs

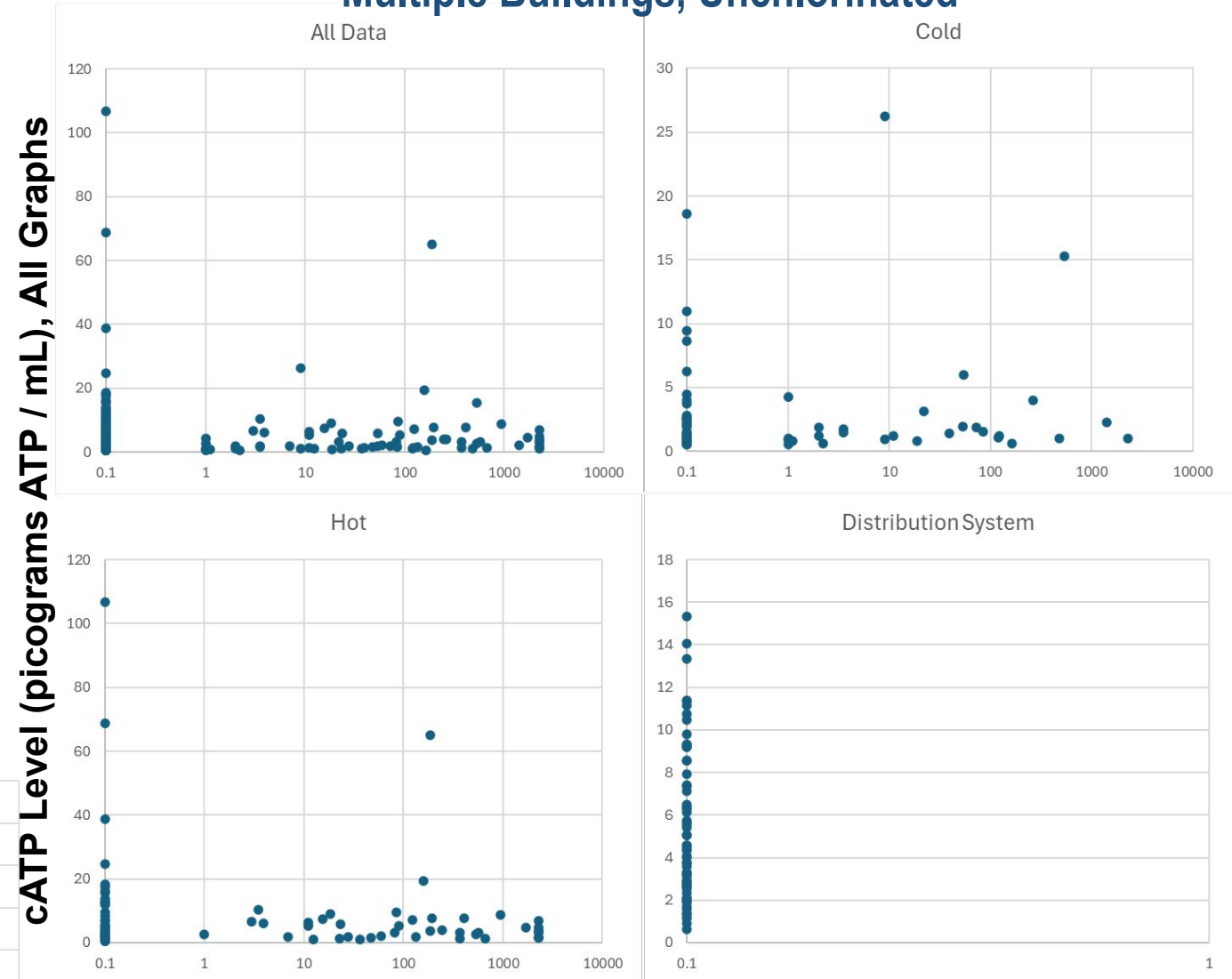
- No Correlation

- After Chlorination, Still Looks Bad

All Chlorinated Data



cATP Level vs. *Legionella* Count, Multiple Buildings, Unchlorinated



Legionella Count (MPN/100 mL), All Graphs

Grand Rapids Public Utilities Town Hall Meeting Chlorination & Drinking Water

**Tuesday, June 4, 2024
4 to 6 p.m.**

**Upstairs Meeting Room
Yanmar Arena**

1401 NW 3rd Ave., Grand Rapids, MN

Agenda

Welcome

- Dale Adams, City Councilor & GRPU Commissioner

Presentations

Julie Kennedy, General Manager of GRPU

- GRPU Response Activities Update
 - Legionella Monitoring Results Update
 - Disinfection Implementation Plan and Schedule

Chad Seidel, President of Corona Environmental Consulting, LLC

- What Does Implementing Chloramine Disinfection Mean?
 - What Does It Mean for GRPU?
 - What Does It Mean for Customers?
- Building Water Quality Management Recommendations

Public Question & Answer Session



Grand Rapids Public Utilities (GRPU) is a municipal utility established by the City of Grand Rapids, Minnesota. Utilities under the jurisdiction of the GRPU include electric distribution, water treatment and distribution, and wastewater collection and treatment.

GRAND RAPIDS PUBLIC UTILITIES 224-326-7024 • Website: cityofgrandrapidsmn.com/utilities
Facebook: [grpucom](https://www.facebook.com/grpucom)



Local News

Stay up to date on news, weather, and sports in north and central Minnesota.



Grand Rapids Set to Chlorinate Water Supply After Legionnaires' Outbreak

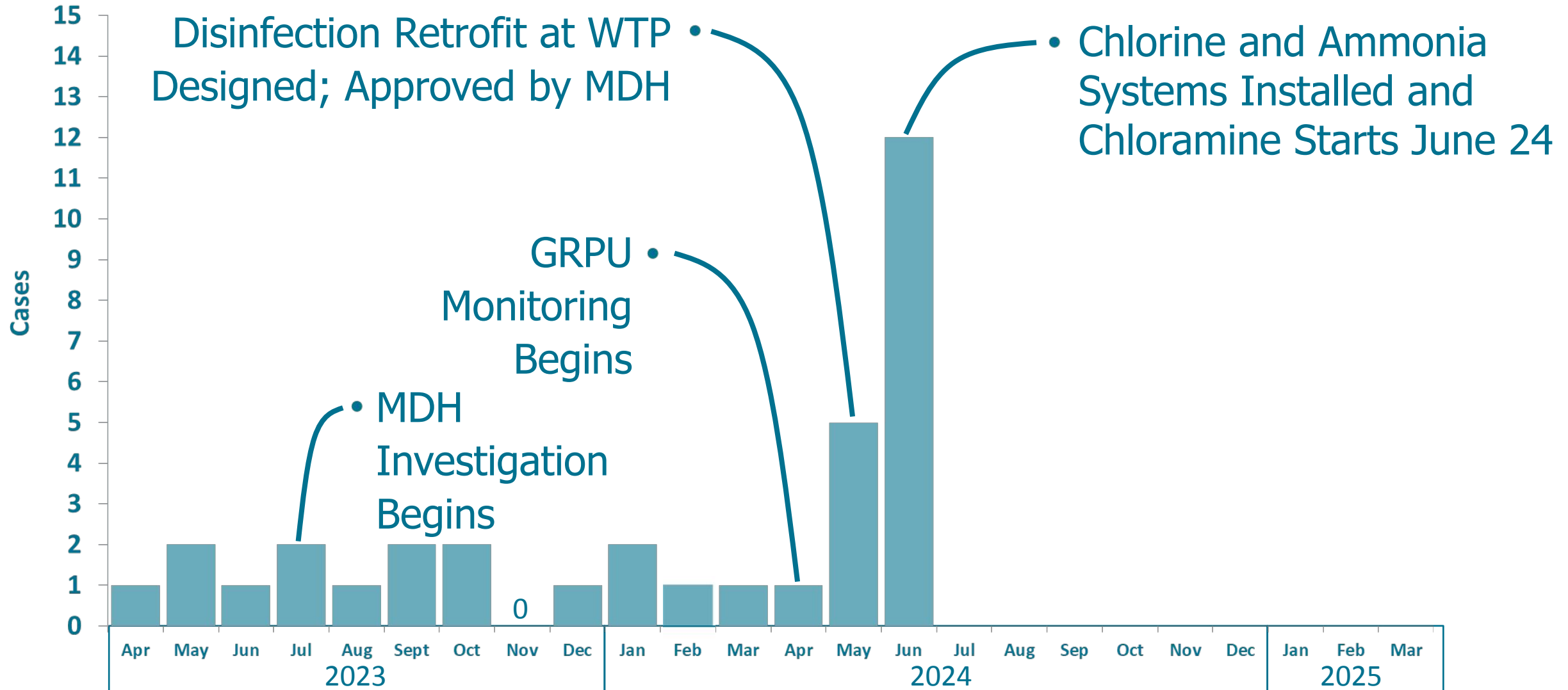
Education & Government - June 23, 2024

Over the last several months, the city of Grand Rapids has seen a Legionnaires' disease outbreak, and the Public Utilities Center has now made the decision to chlorinate the water system to kill off the Legionella bacteria starting this week. According to the Minnesota Department of Health, Grand Rapids has had 14 official cases of...

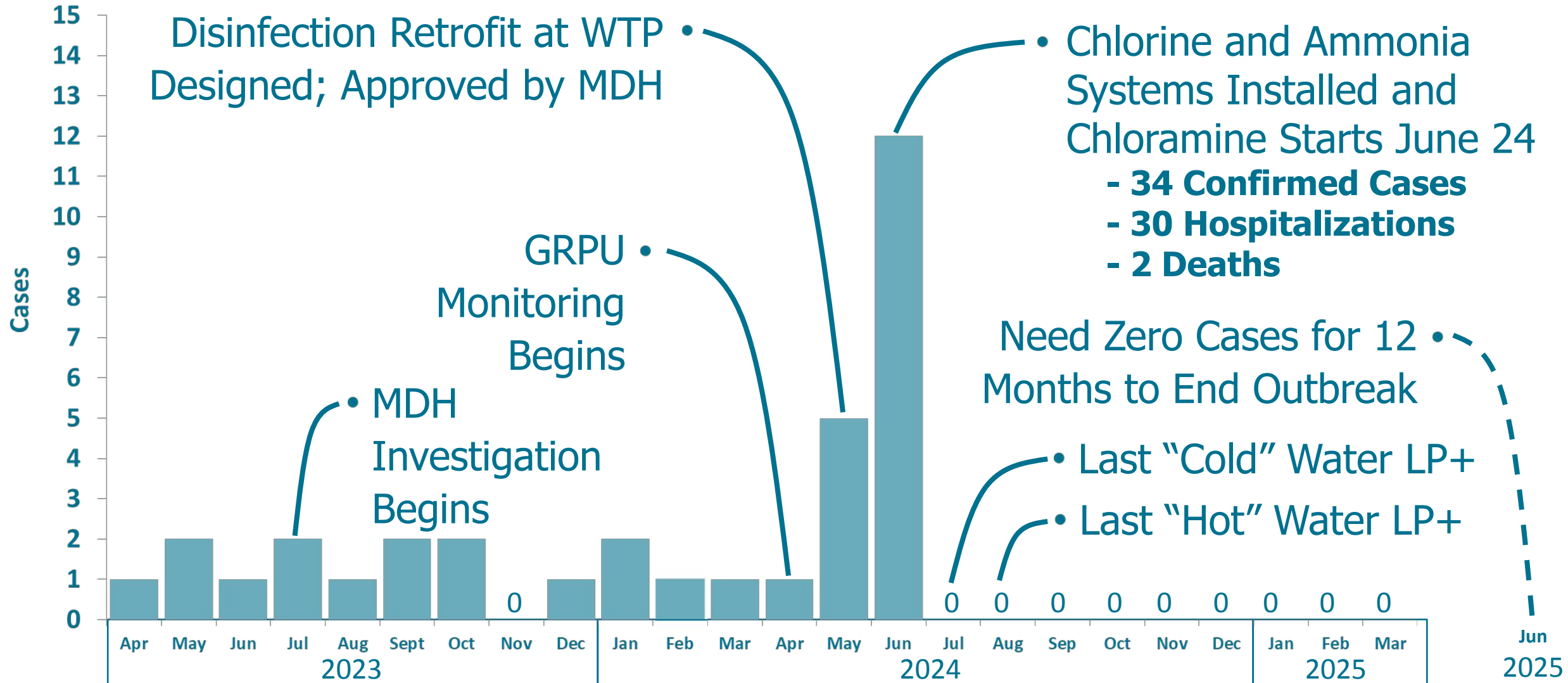
[Read More](#)

3 Current Status & Lessons Learned

Outbreak Timeline: 34 Cases Through March 2025

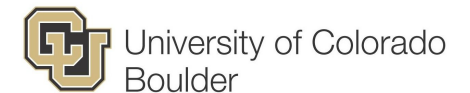


Outbreak Timeline: 34 Cases Through March 2025



Lessons Learned

- A Committed, Engaged Team Can Accomplish A lot Quickly!
- Communication With Customers
 - ❑ Optimize private water systems
 - ❑ Discourage whole-facility / whole-house GAC cartridges
 - ❑ Keep water flowing (especially when disinfection starts)
- Communication With Health Department
 - ❑ Outbreak information is difficult to convey (HIPAA protections)
 - ❑ Education goes both ways (state epidemiologists do not necessarily understand how water systems work)
- Surprise: An Ongoing Valve Maintenance Program is Crucial!
- *Legionella* Outbreak ≠ Violation: Emergency Funding Difficult
- Chlorine/Chloramine Saves Lives (M/DBPR Revisions?)



THANK YOU!

source
treatment
distribution
tap



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