CONTINUING A WATER SERVICE LEGACY

McCarrons Water Treatment Plant– Case Study in Overhaul of Aging Infrastructure

January 26, 2022

SAINT PAUL REGIONAL WATER SERVICES

Jacobs

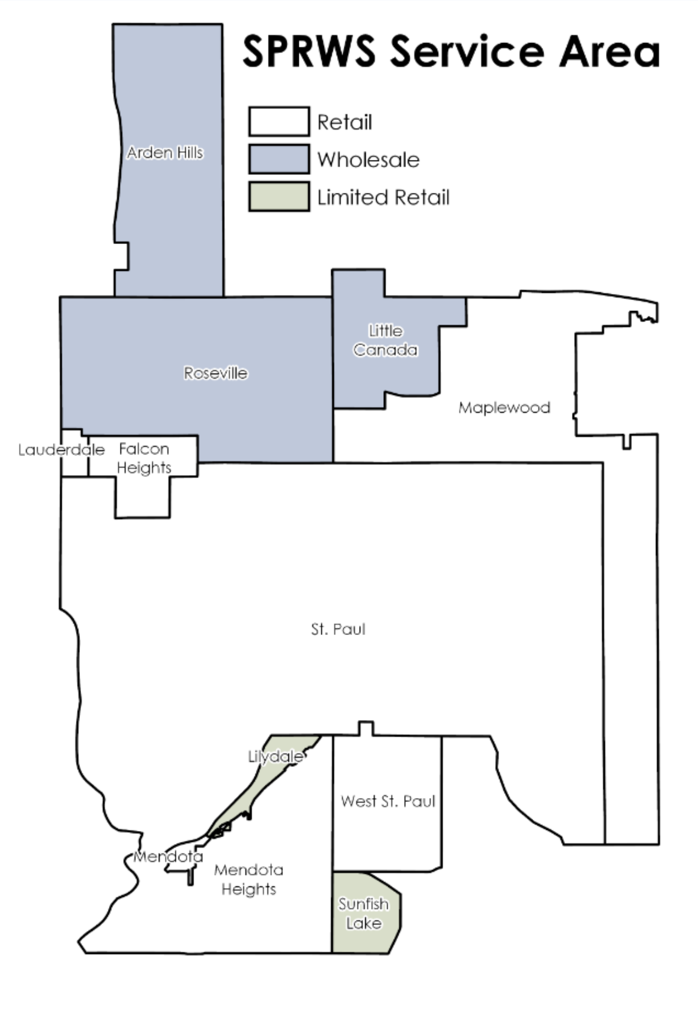
Agenda

- Part One: McCarron's WTP Improvements Project
  - Saint Paul Regional Water Overview
  - McCarron's Water Plant
  - Project Scope
  - Key Project Technical Challenges
  - Pilot Testing Process
  - Project Funding
- Part Two: Design Build Delivery – Will
  - Intro to Progressive Design Build
  - Why SPRWS selected PDB for the McCarron's WTP project
  - Requirements/Recommendations for Successful PDB delivery
  - Procurement Phase Recommendations for PDB
  - Contracting for a PDB Project
- Q&A

Saint Paul Regional Water Overview

Saint Paul Regional Water Services

- 14 Communities Served
- 450,000 Customers
- 40 Million Gallons per Day (Average)
  - Enough to cover a football field with 110 feet of water
- Source water: Mississippi River (via a chain of four lakes)
- McCarron's Treatment Plant is the sole water treatment facility

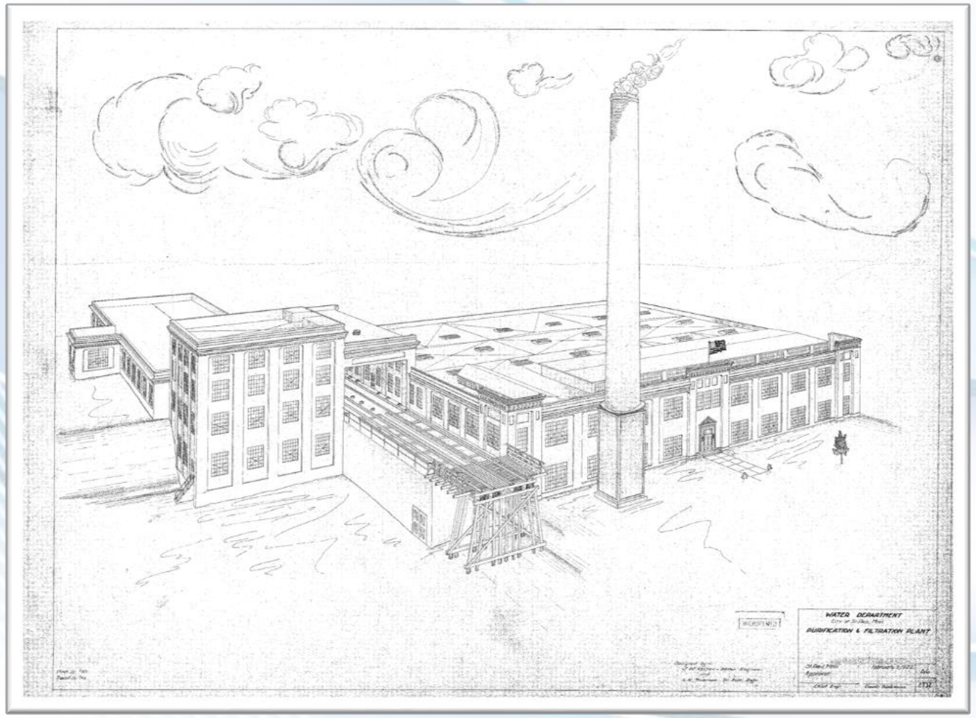


McCarron's Water Treatment Plant

- Construction started in mid-1910s
- Backbone of the facility built by 1925
- Additions in the late 1930s and 1950s
- Much of the infrastructure is nearing 100 years in age
- Water quality remains excellent, but reliability concerns grow with age
  - Partnership for Safe Water Phase IV
  - President's Award for Water Quality

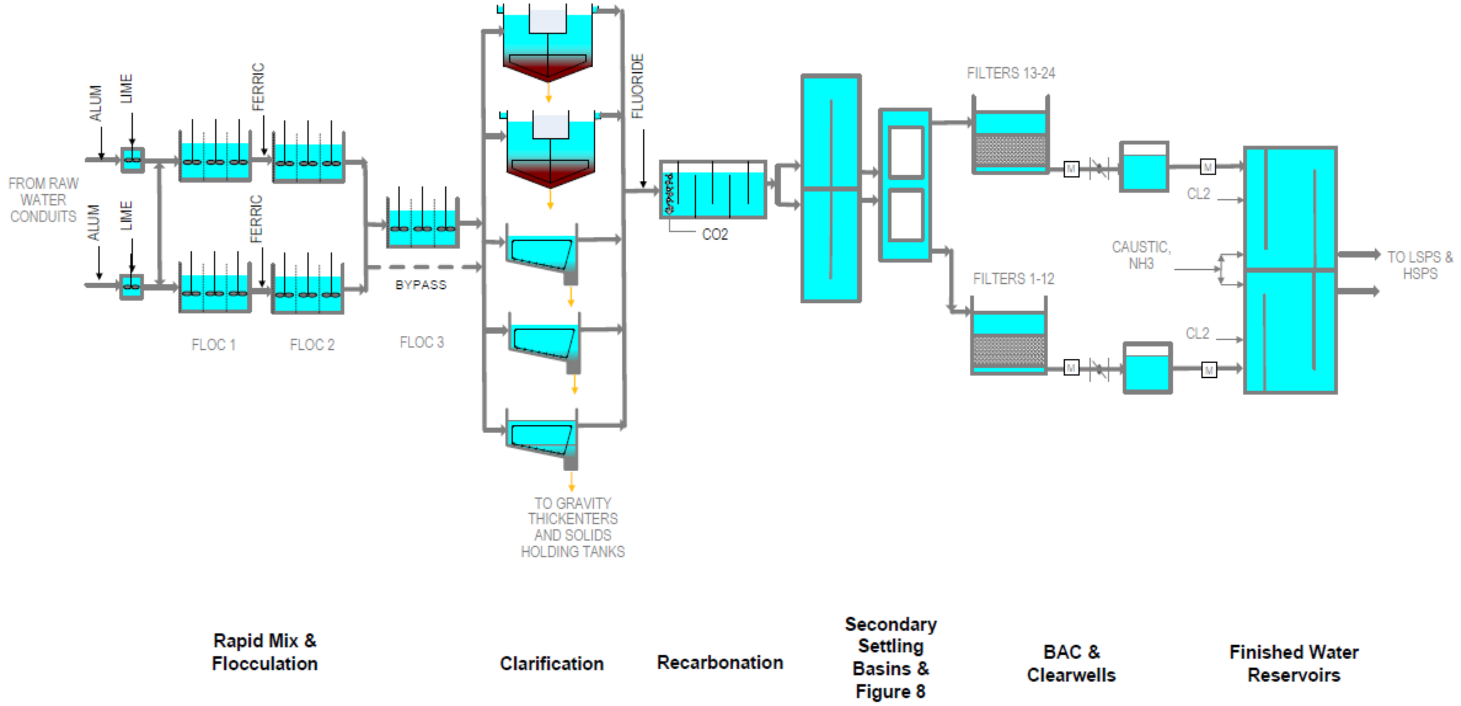
McCarrons Water Treatment Plant

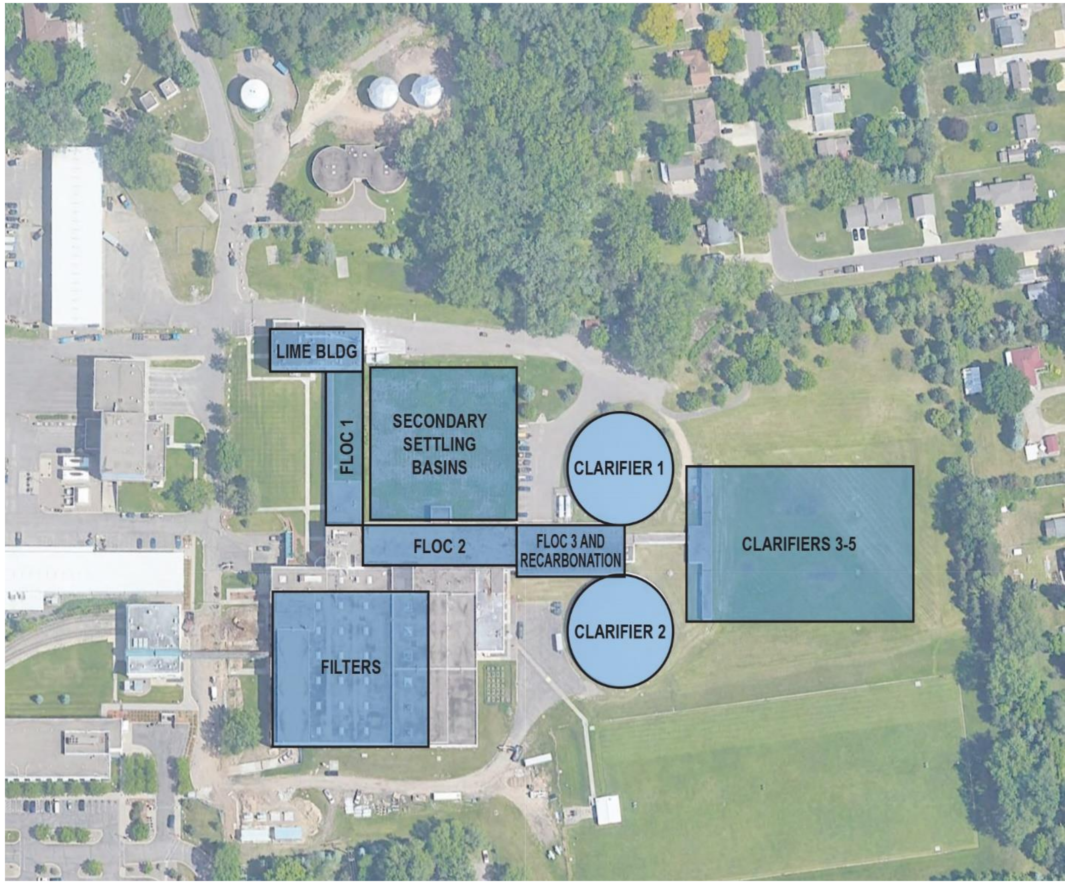
Setting the Stage for the Next 100 Years



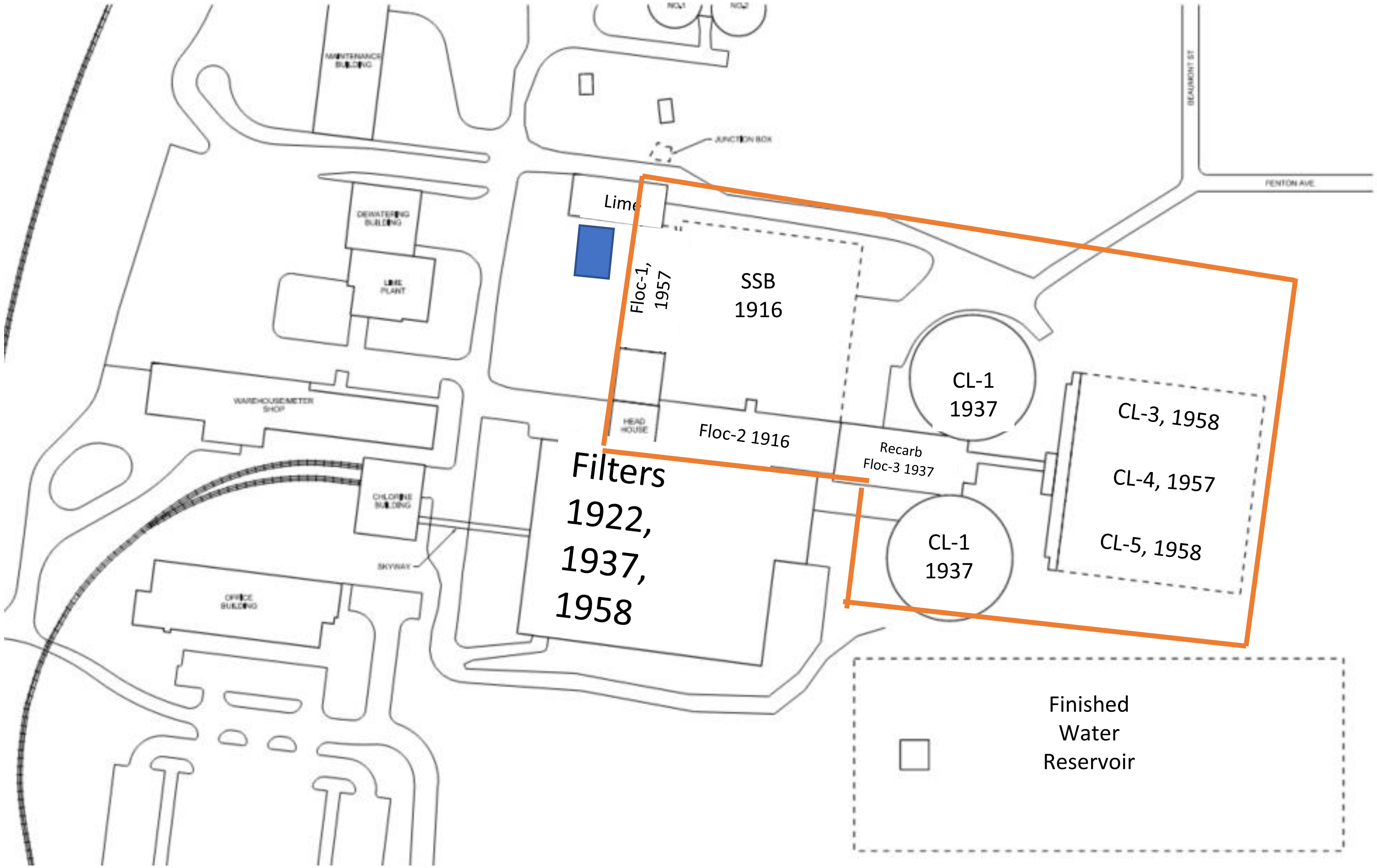
Existing Site

SPRWS Water Treatment Process

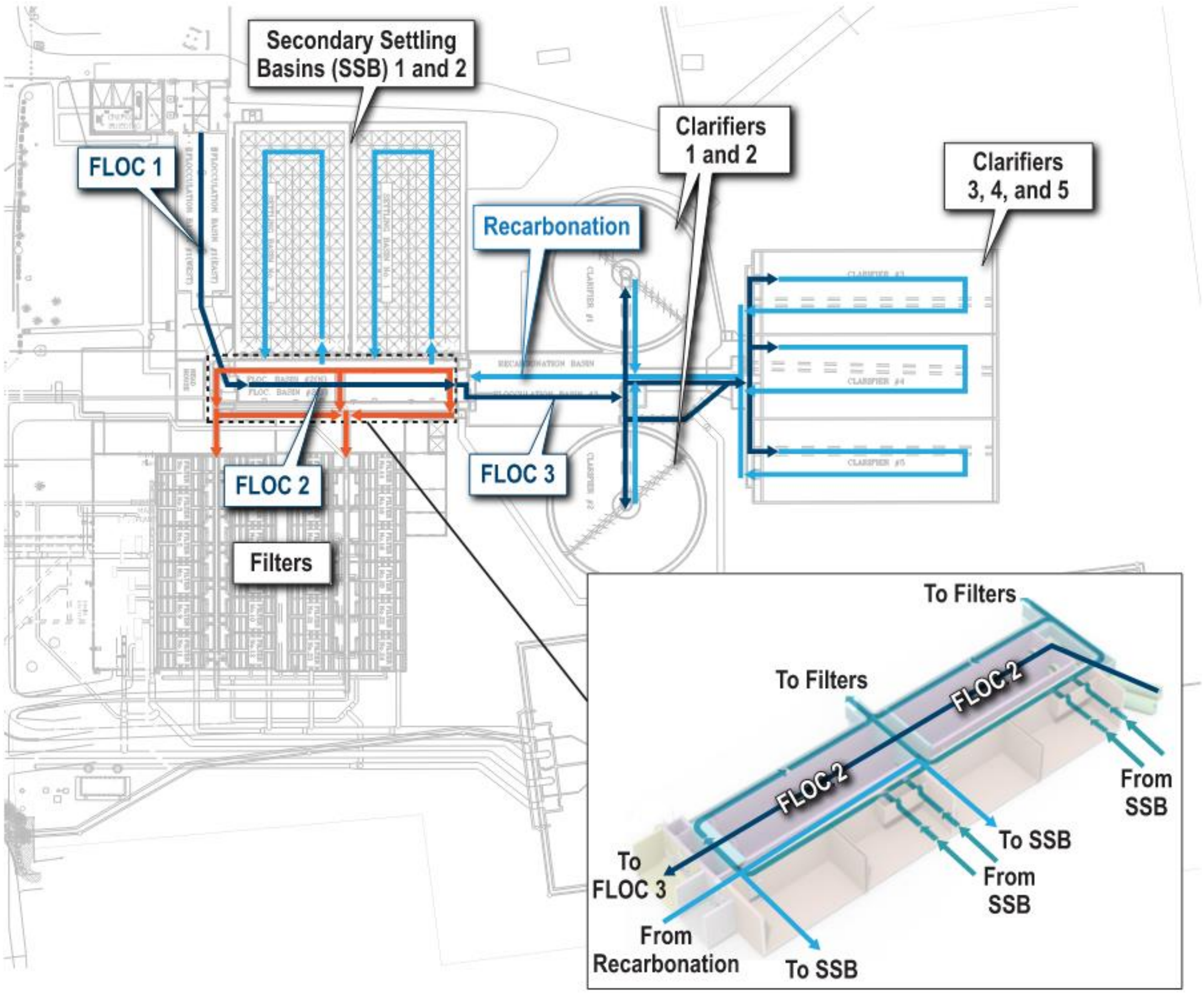




Existing Plant Age

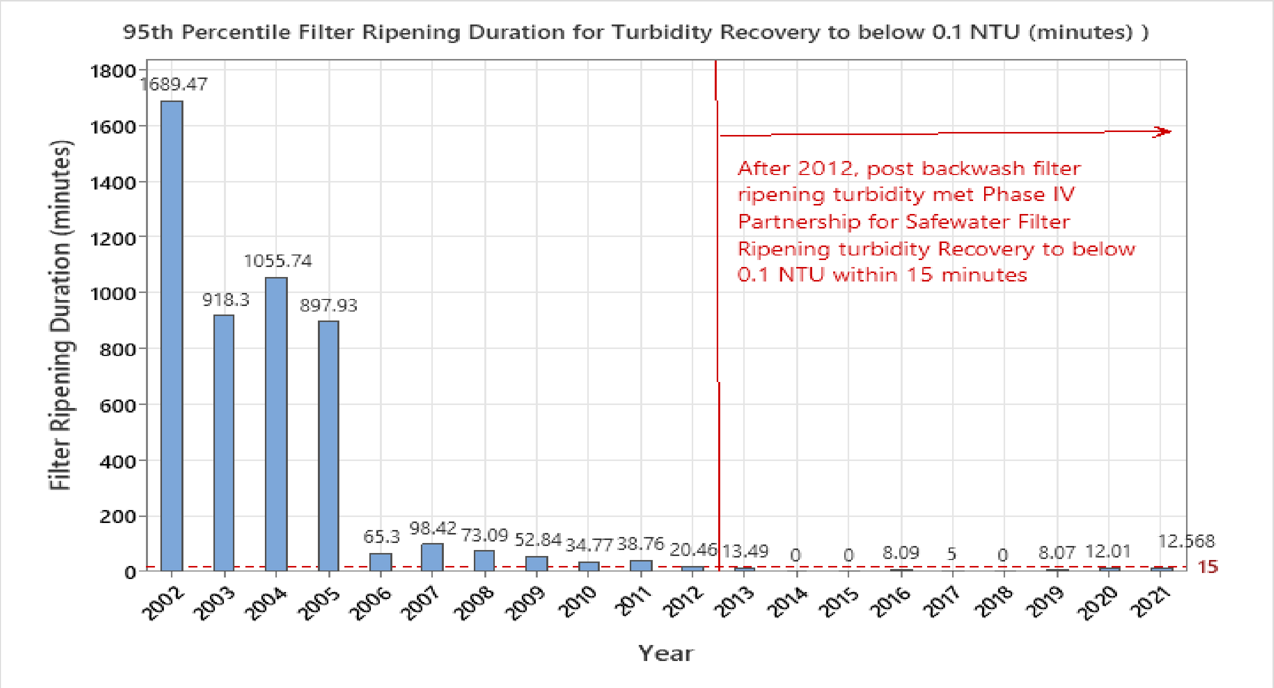


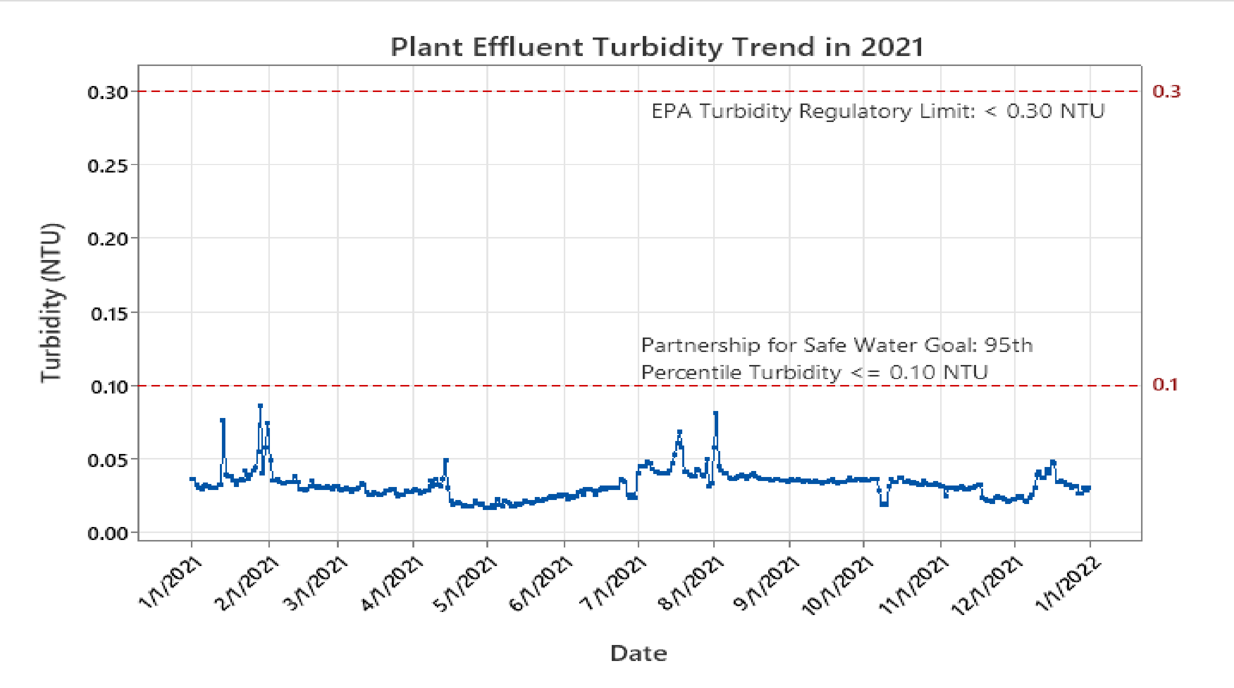
Existing Plant Flow Path



Existing Water Quality

Existing treatment is highly optimized



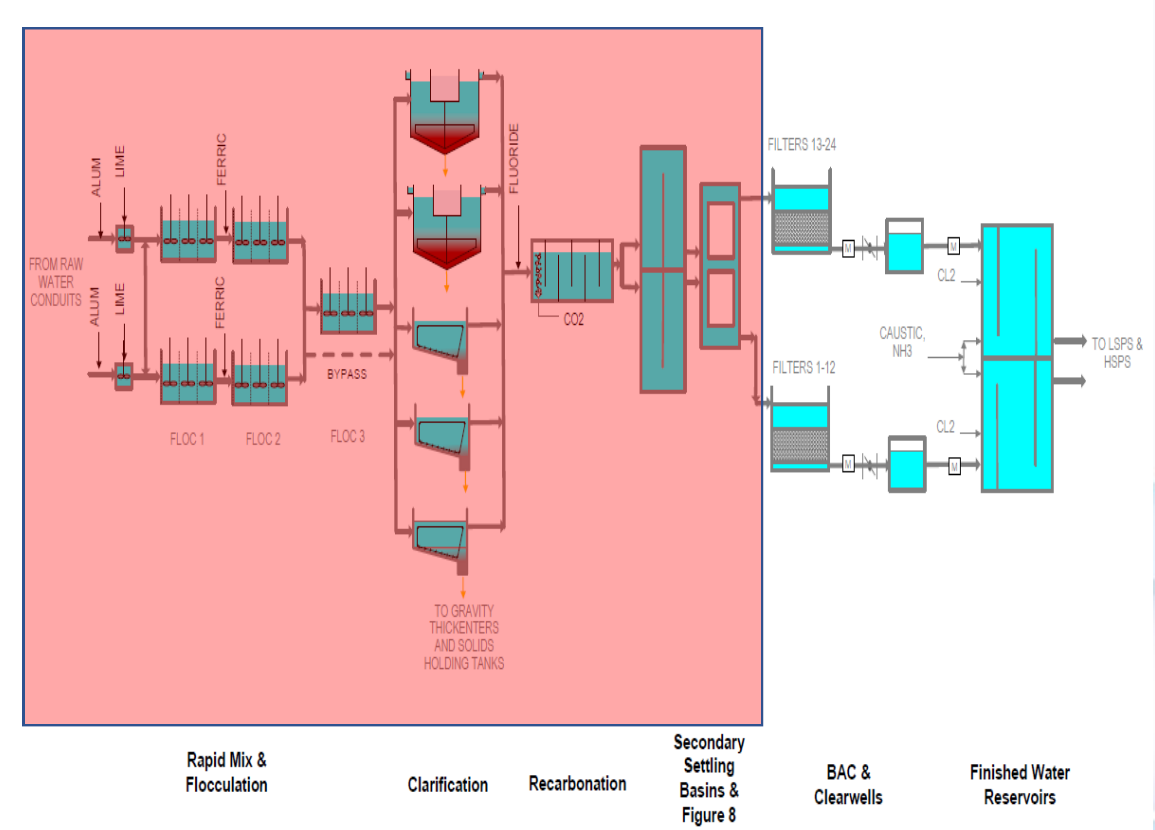


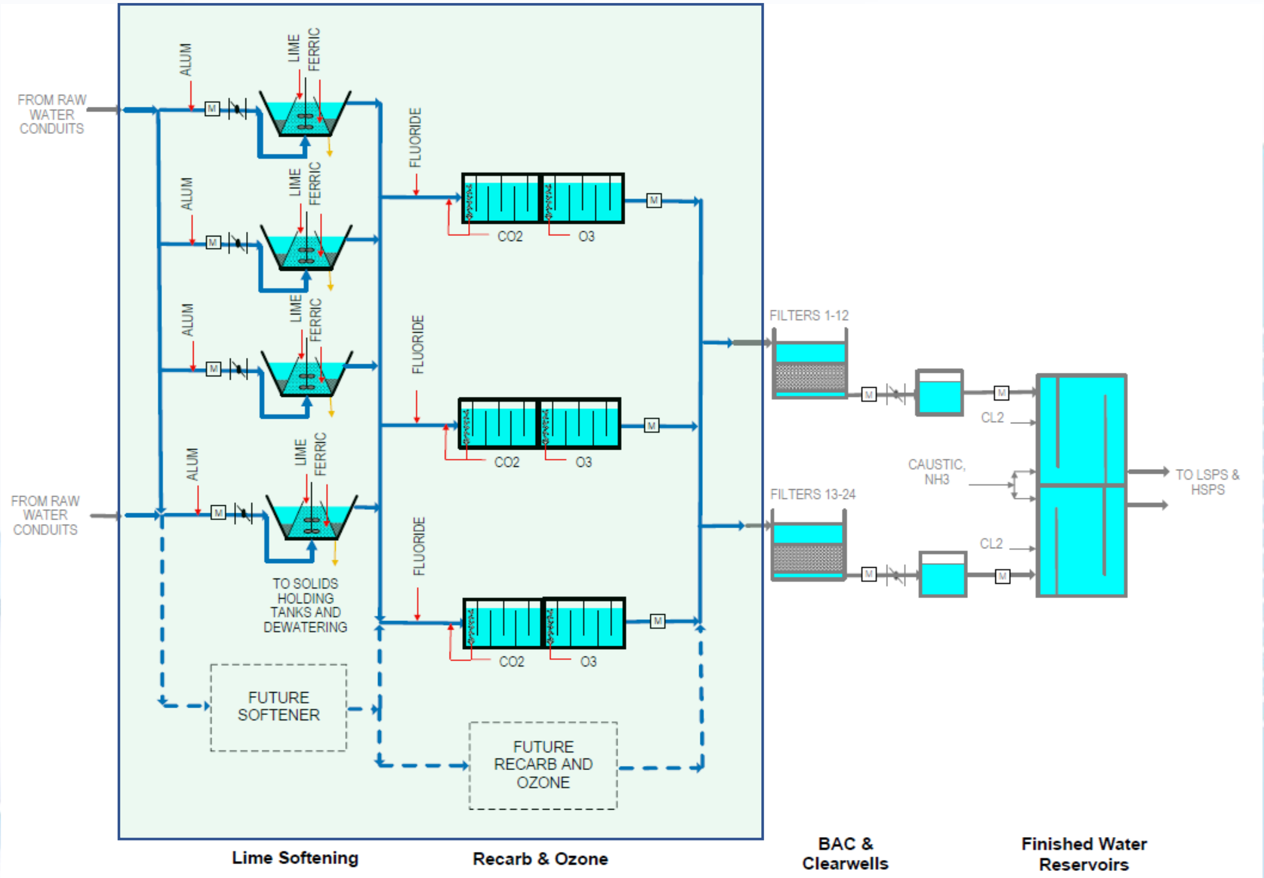
Project Drivers

- Maintain Exceptional Water Quali
- Provide flexibility for future capac and treatment
- Improve plant reliability
- Maintain public trust

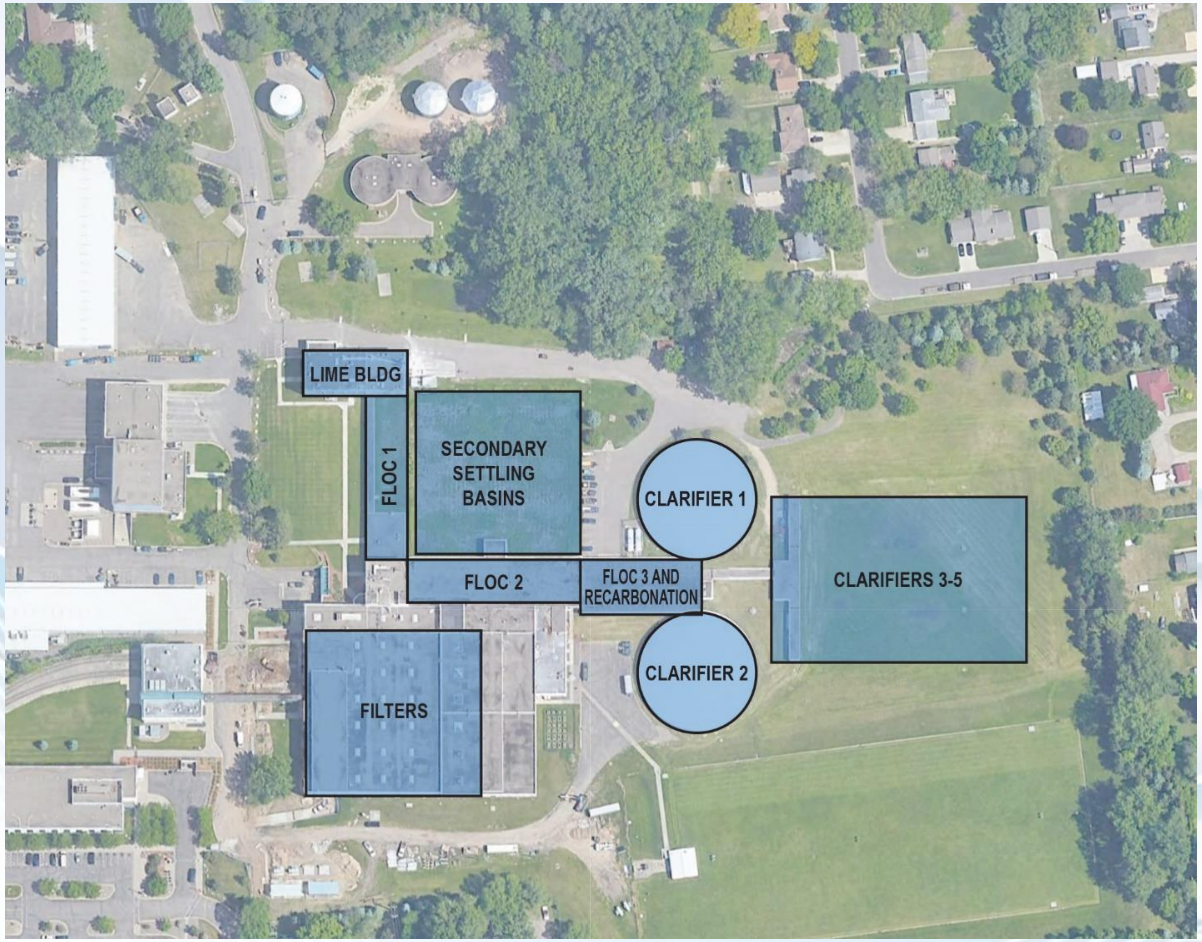
Project Scope

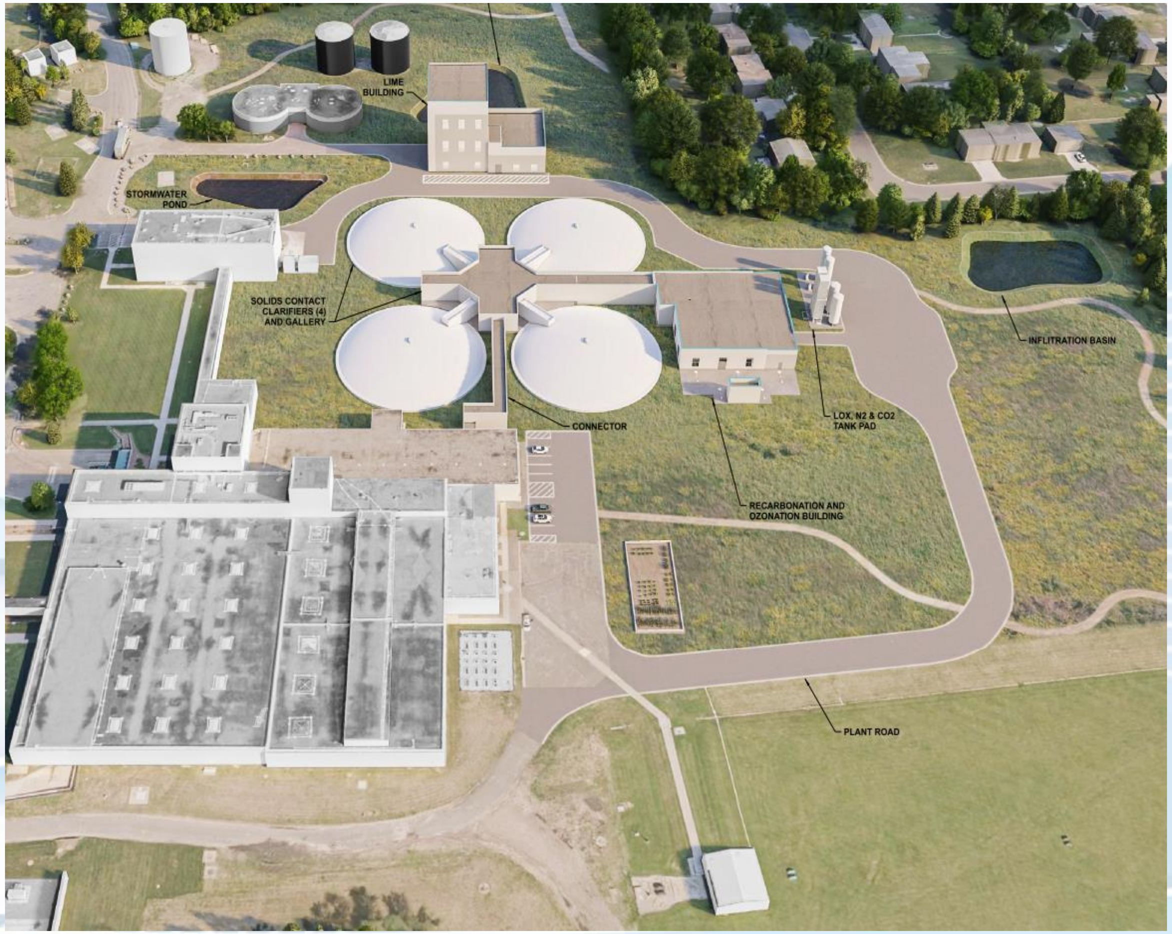
Project Scope





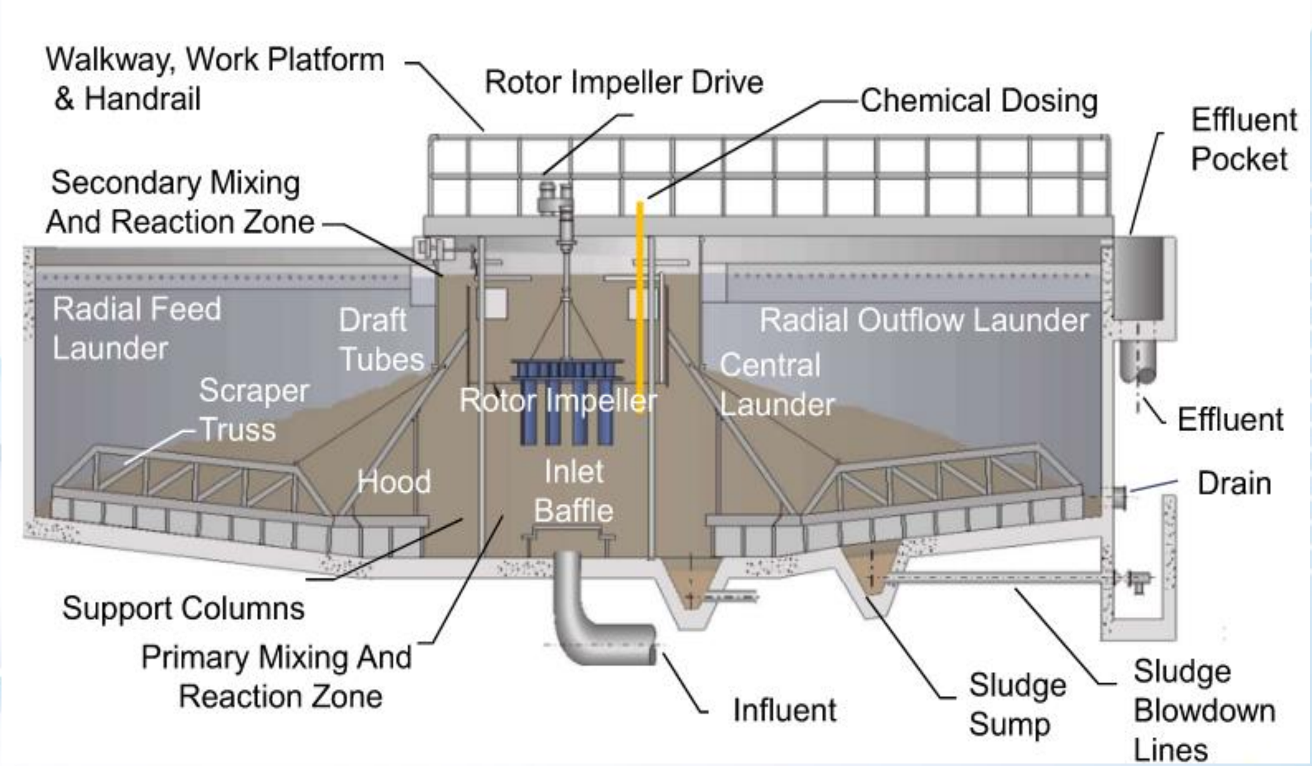
Project Scope



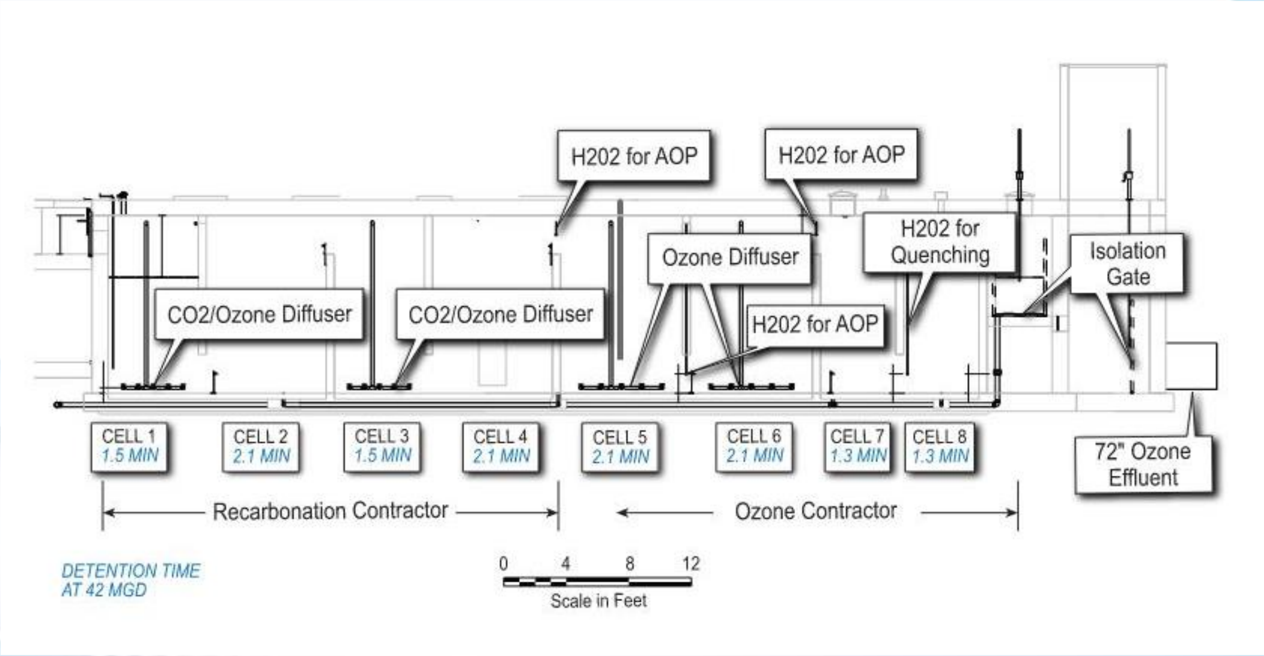


New Lime Feed

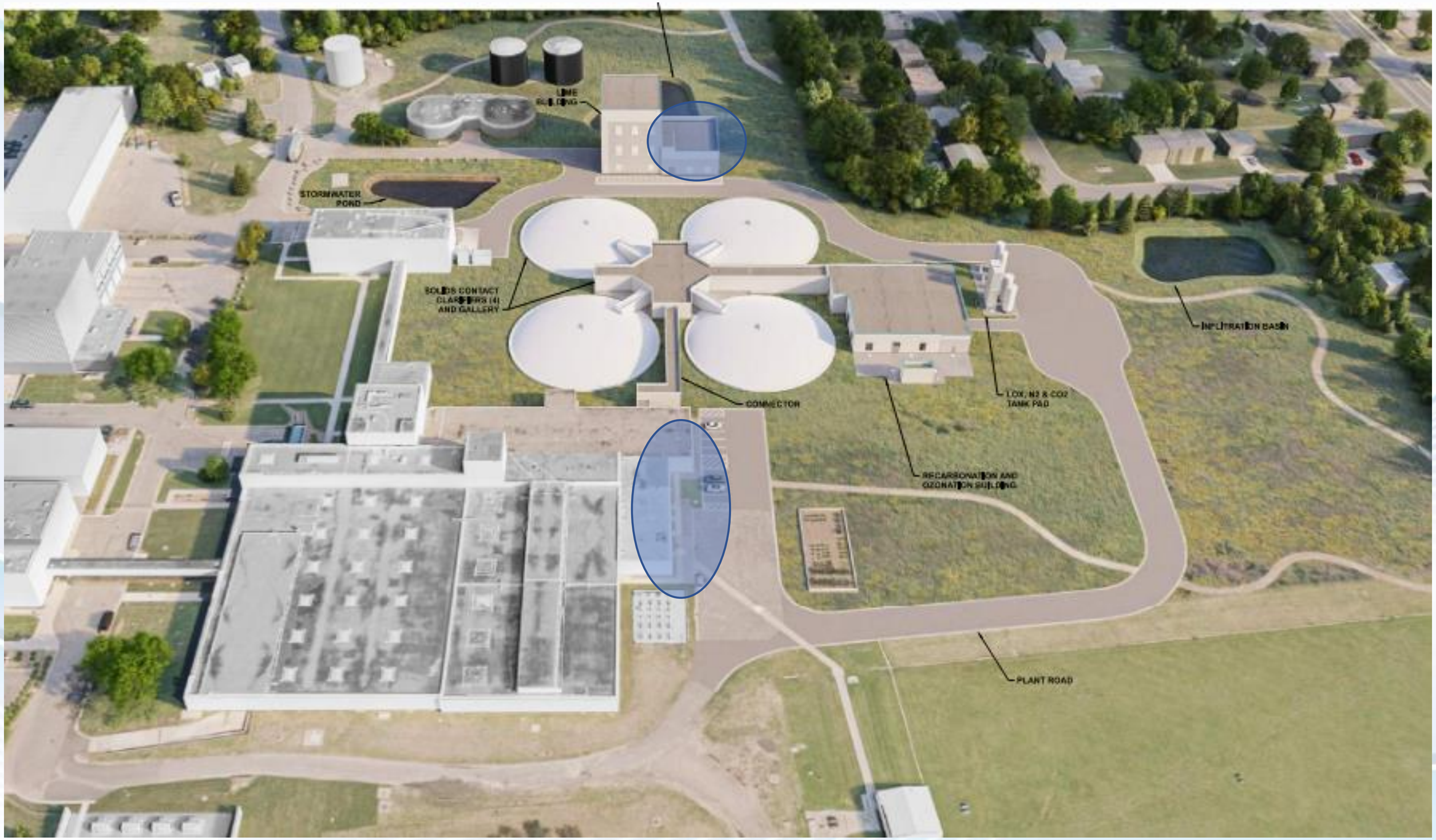
New Solids Contact Clarifiers



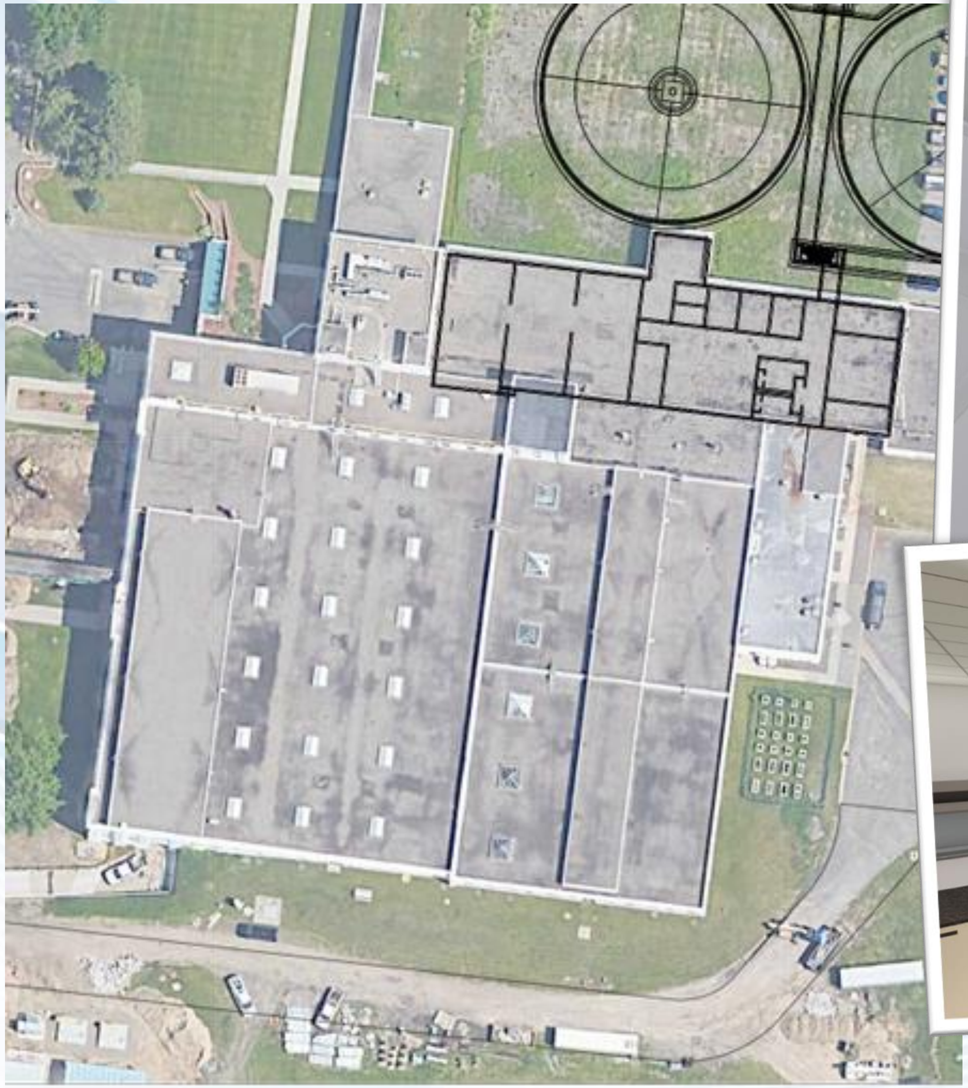
Recarbonation and Ozone



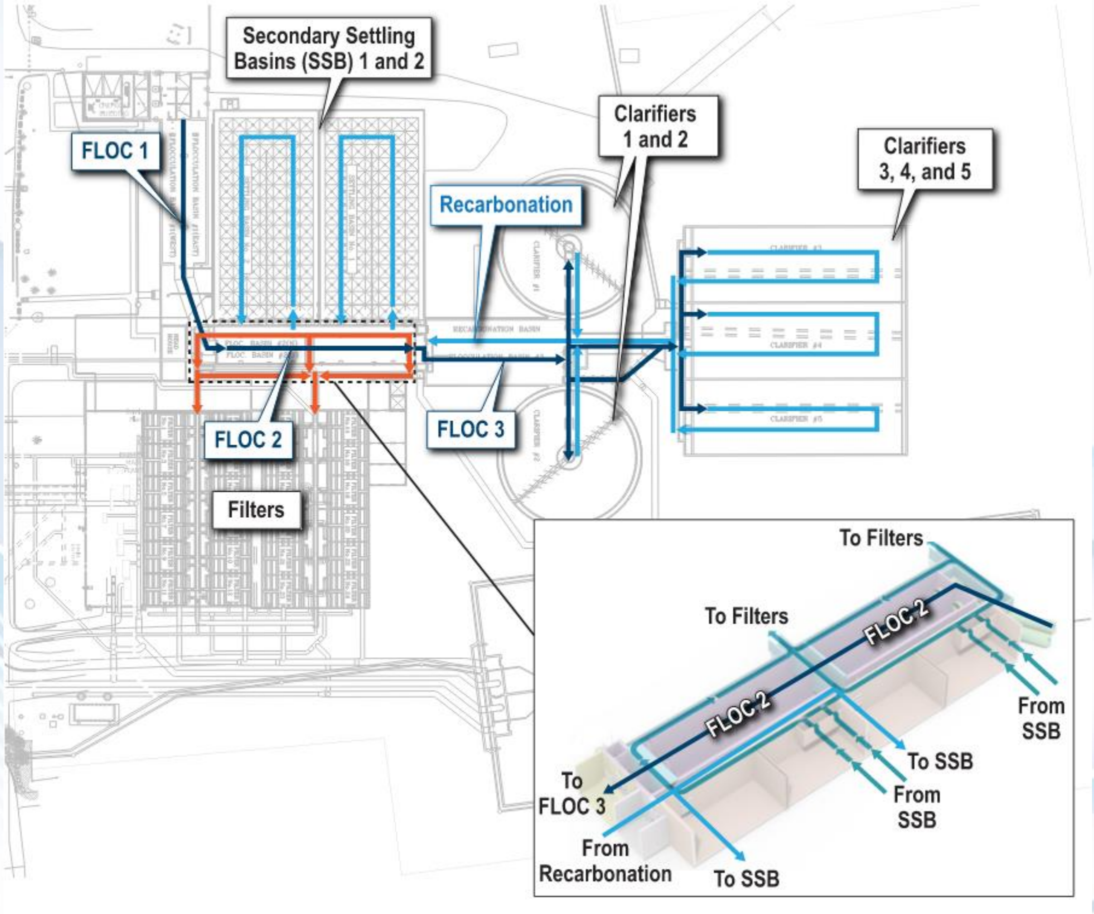
Chemical Systems

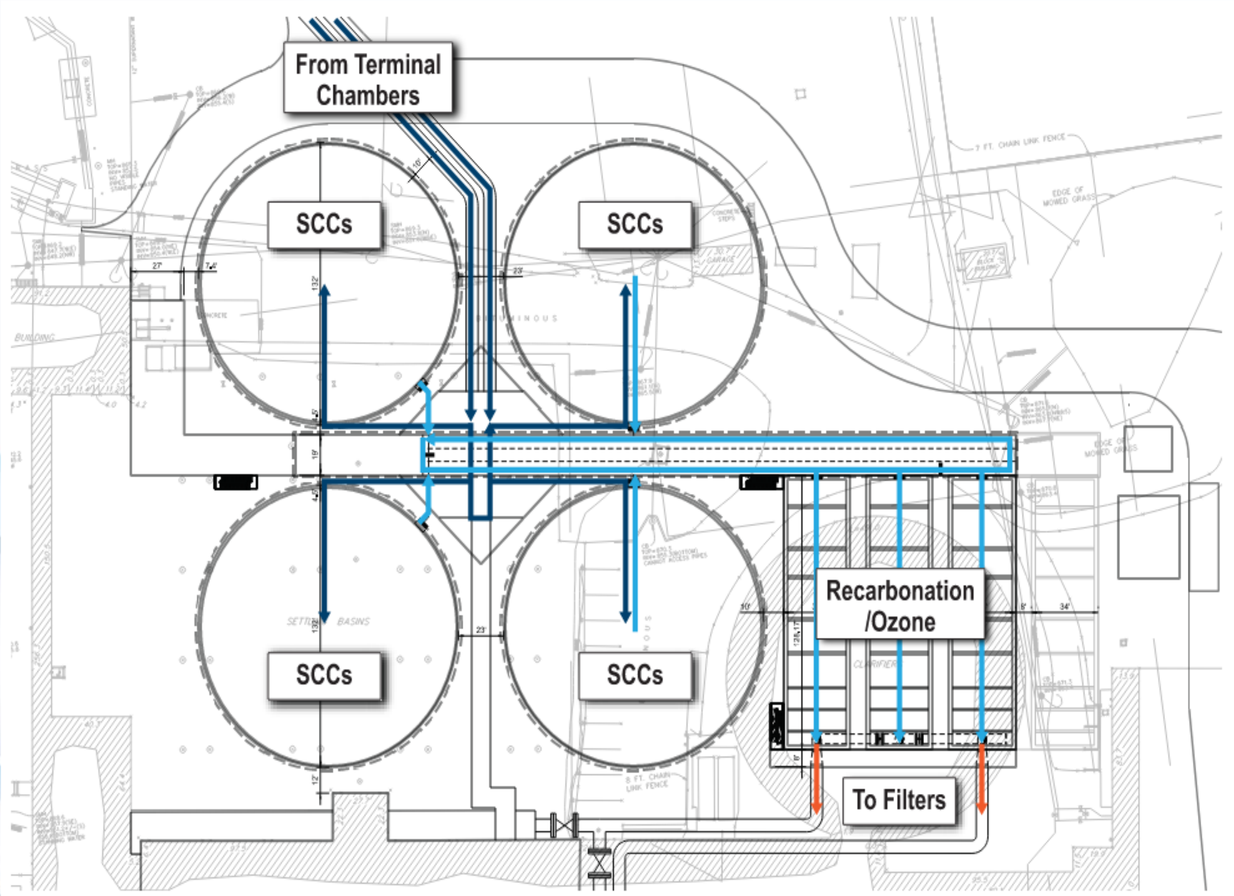


Lab and Operations



New Flow Path





A Legacy of Exceptional Water Quality

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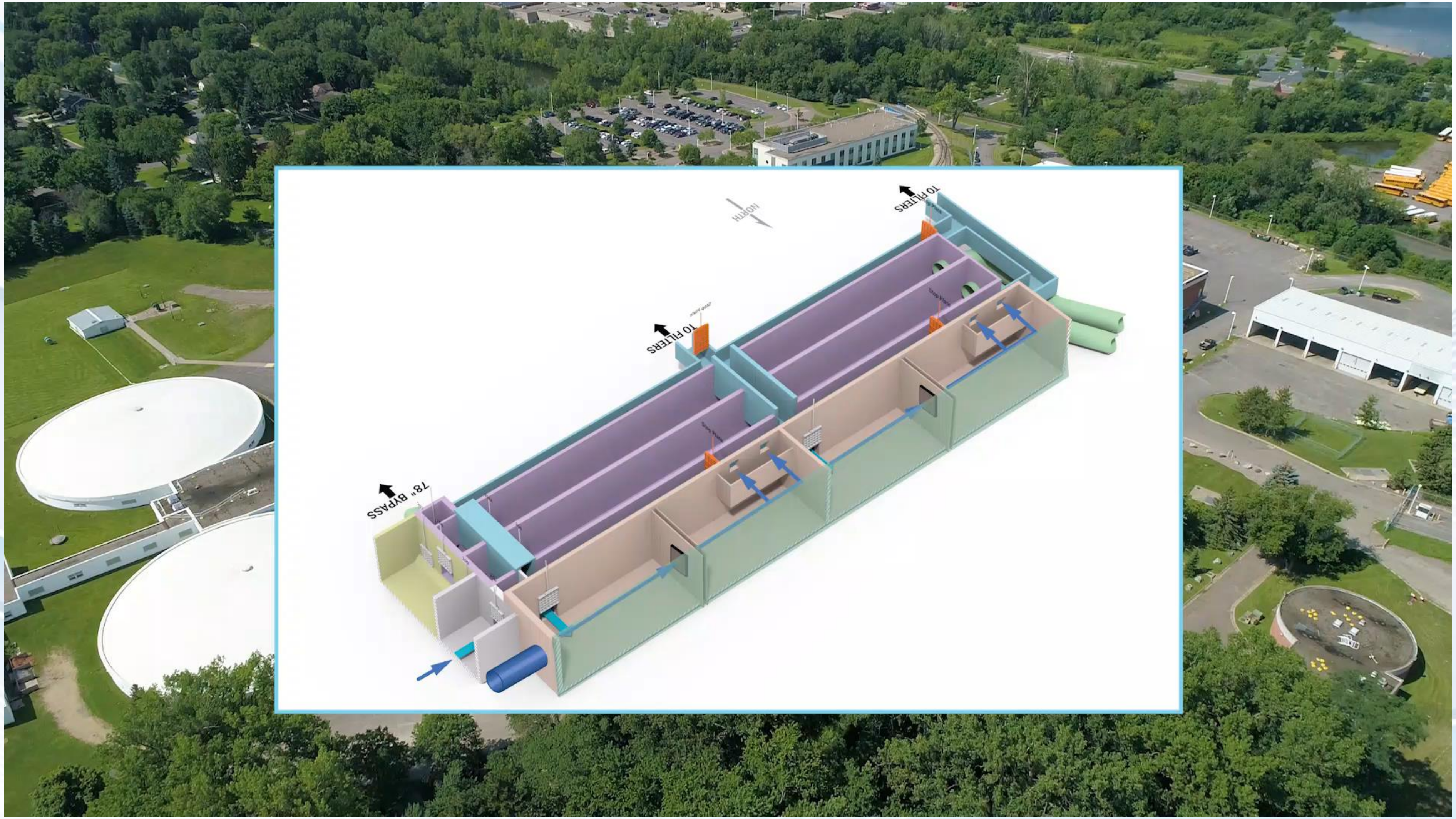
Construction Sequencing

Clarifier 1 & SSB Demo



Softening Clarifiers – Structural Concrete

Softening Clarifiers – Process Mech & Equipment

Softening Clarifiers – Structural Concrete

Recarb/Ozone/Gallery/Lime - Structural Concrete

Recarb/Ozone/Gallery/Lime

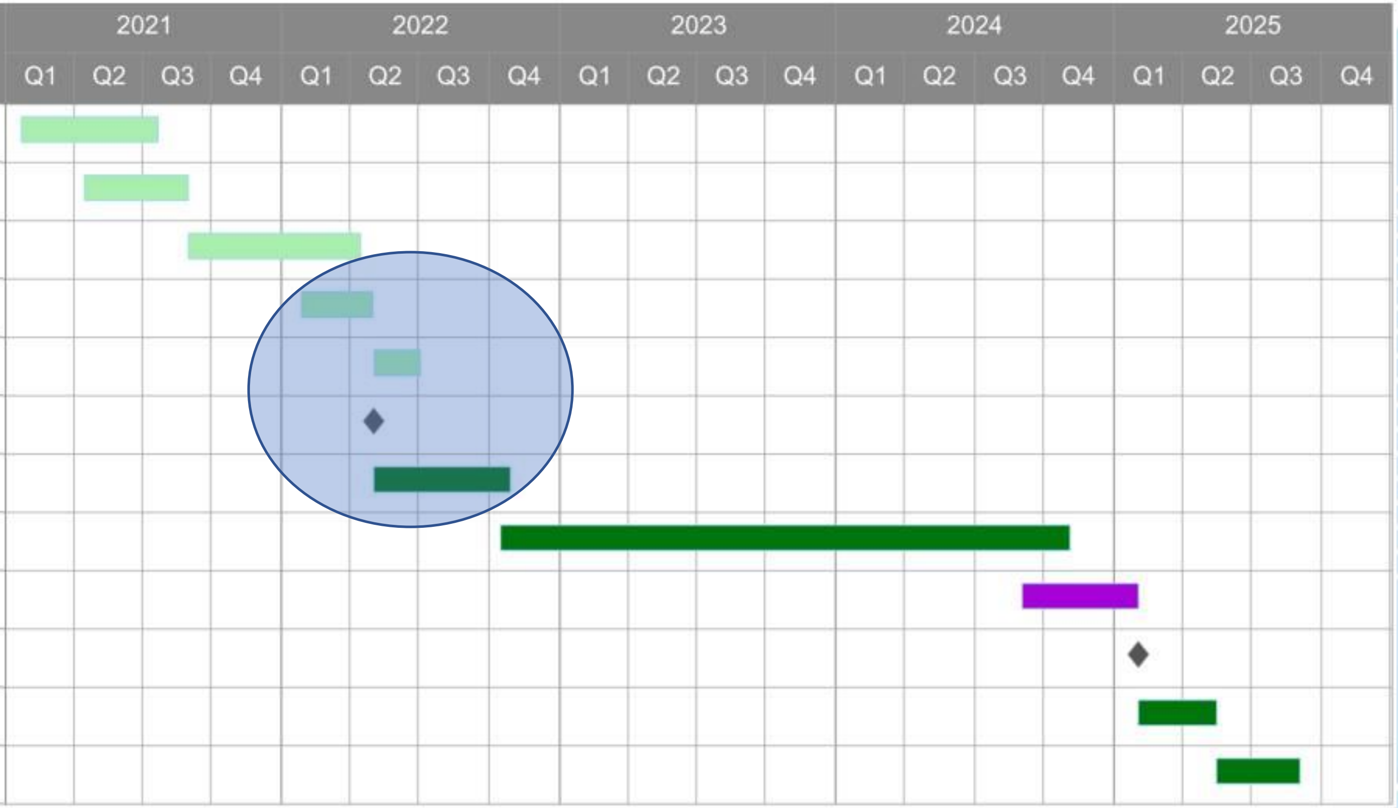
Recarb/Ozone - Process Mechanical & Equipment

Raw Water Lines

Final Site Civil

Project Timeline

Task Name	Duration	Start	Finish
10% Preparatory Design Workshops	129d	01/22/21	07/21/21
30% Schematic Design	97d	04/15/21	08/27/21
60% Design	162d	08/30/21	04/12/22
90% Design	68d	01/26/22	04/29/22
100% Final Design	43d	05/02/22	06/29/22
Construction Start	0	05/01/22	05/01/22
Early Work Package Construction	130d	05/01/22	10/27/22
Main Work Package Construction	536d	10/15/22	11/01/24
Acceptance Testing (Through Figure 8)	110d	09/01/24	01/30/25
New Facilities Online	0	02/01/25	02/01/25
Demolish Existing Facilities	75d	02/01/25	05/15/25
Build New Lab / Office Space	78d	05/15/25	09/01/25



Pilot Plant

Why Pilot Test?

DEPARTMENT OF HEALTH

UNIVERSITY OF MINNESOTA
Driven to Discover℠

Future Regulatory Impacts

Research Collaboration

Operator Training

Customer Water Impacts

Treatment Process Criteria

Major Pilot Components

Solids Contact Clarifier

Lime
Ferric Chloride
Alum

60-140 gpm

Recarbonation (Gas and PSF)

CO2
Hydrofluorosilicic Acid

10-20 gpm

Ozone Contactors (Ozone, AOP)

Air/Oxygen
Hydrogen Peroxide
Calcium Thiosulfite

4-10 gpm/train

BAC Filters (4 trains x 2 each)

0.3-1.0 gpm/filter

Disinfection Contactors (3 Trains)

Sodium Hypochlorite
Liquid Ammonia Sulfate
Caustic

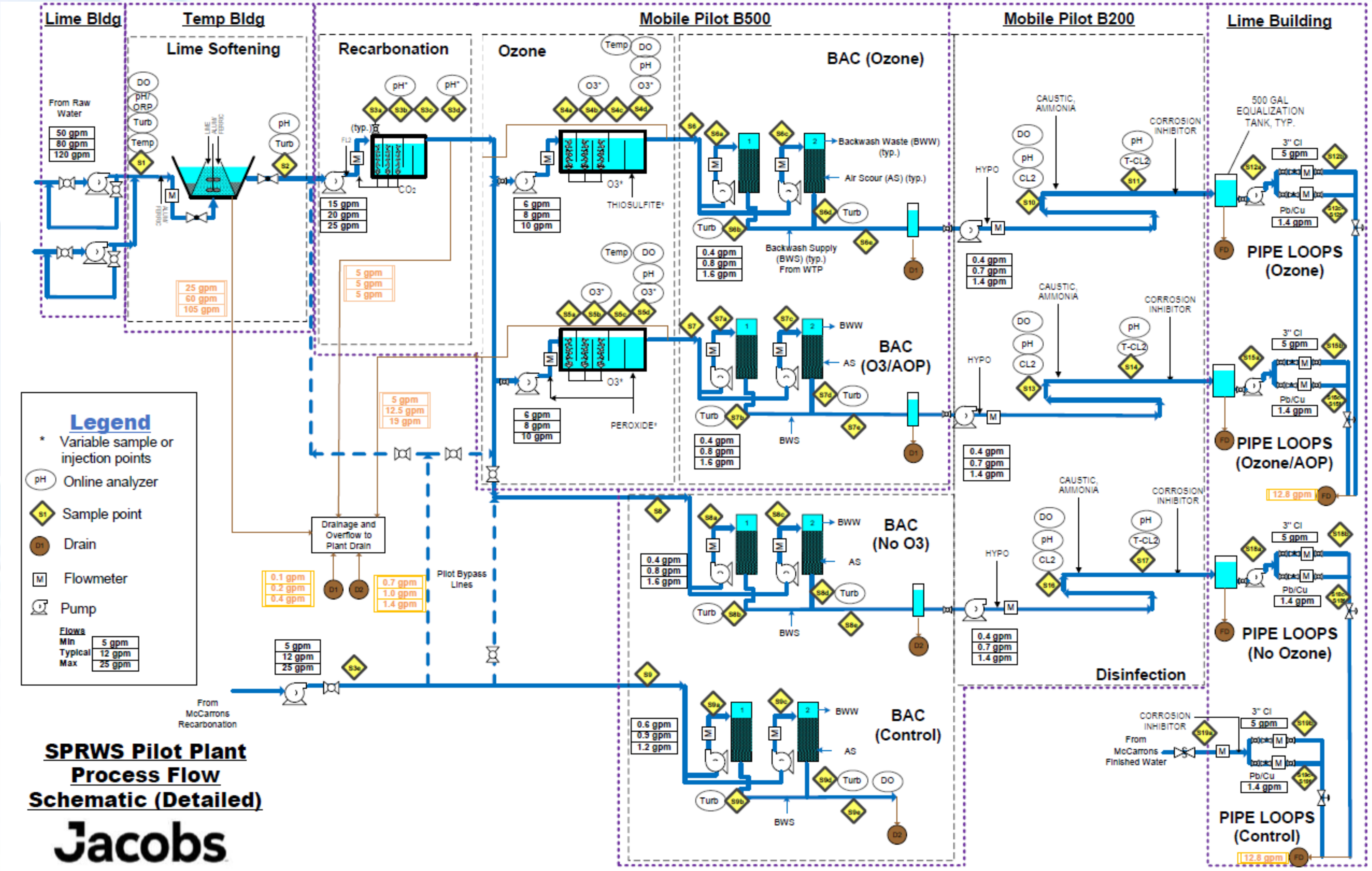
0.5-1.5 gpm/train

Pipe Loops (4 Trains x 2 Loops each)

Dipotassium Phosphate

6.5 gpm total during flushing cycle

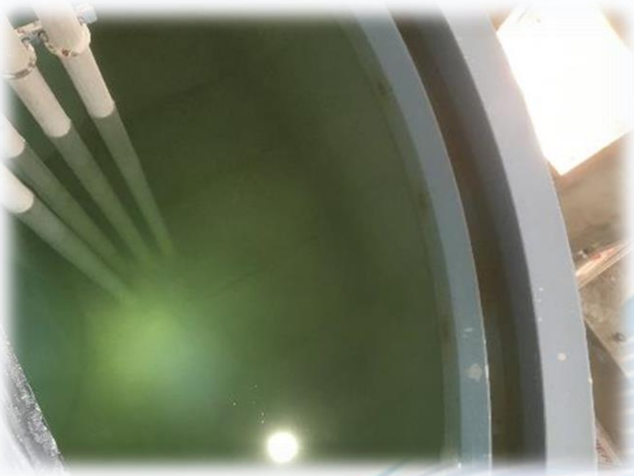
Pilot Process Flow and Details

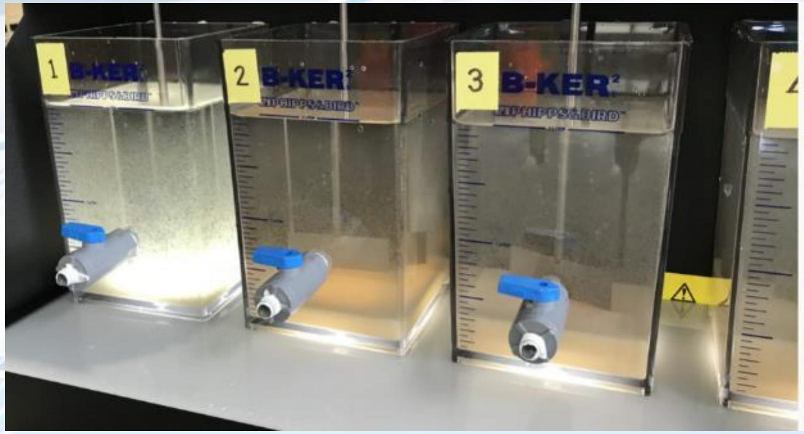


- Flow: 1 Million Gallons Per Week
- Pumps: 20
- Chemical Feed Pumps: 21
- Chemicals Fed: 12
- Meters/sensors: 76
- Online Analyzers: 55
- Sampling ports: 247
- Sample IDs: 70
- Analytes tested for: 60+
- Total number of analyses done:
  - Continuous: 66
  - Daily: 35
  - Weekly: 314
  - Seasonal: 119

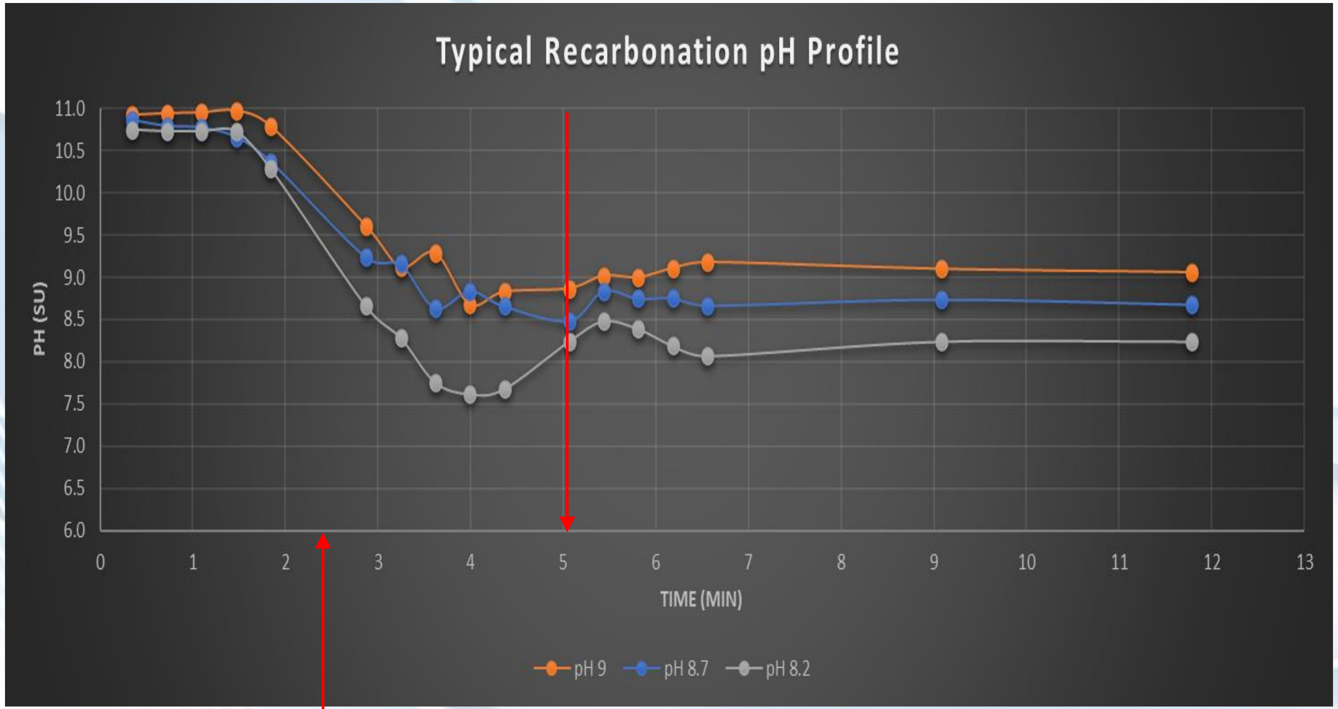
Overall SCC Performance is Good

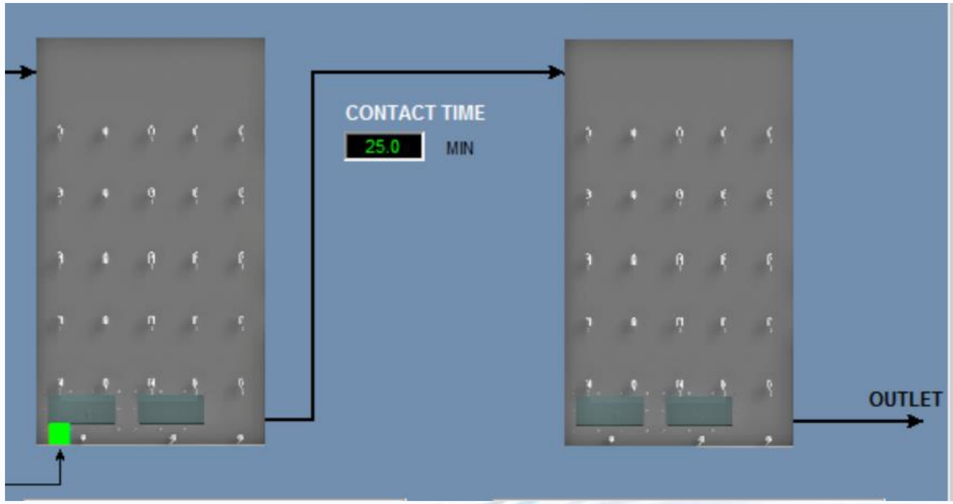
- Typical Performance up to 1.75 gpm/sf @ 75F
  - Turbidity <4 ntu
  - 45-50% TOC removal
  - Hardness closely matches plant water
- Additional Testing
  - Optimize solids thickness
  - Optimize downstream filter performance
  - Trial ferric sulfate and sodium silicate





Stable pH in 5 minutes with gas diffusion



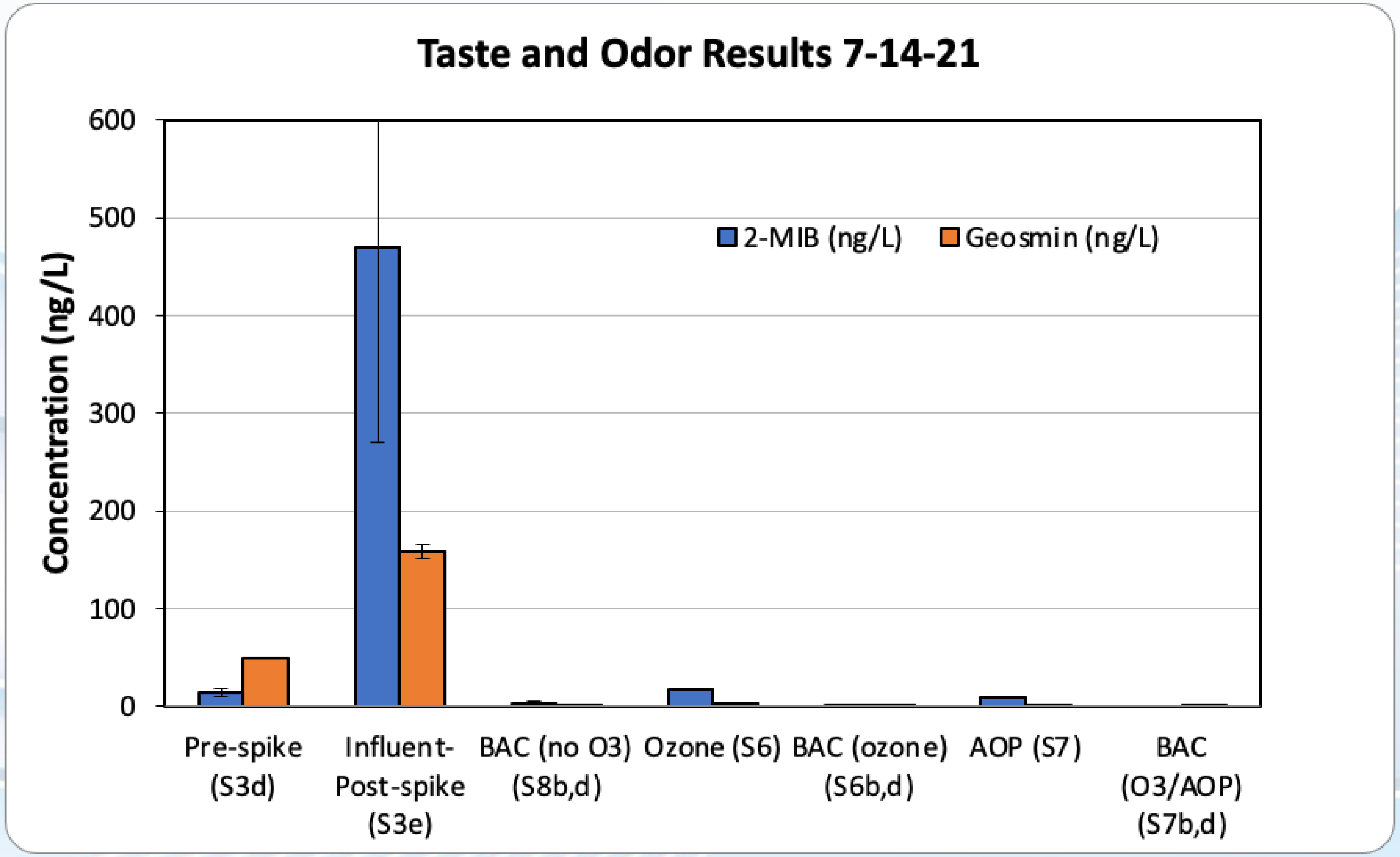


pH at various sample ports										
Flow	16	gpm								
Detention Time per Pass:			2.5 min							
Basin 1						Basin 2				
10.86	8.66	8.49	8.74				8.71		8.75	
10.79	8.84	8.84								
10.77	8.64	8.75								
10.66	9.16	8.76								
10.37	9.24	8.67		8.68		8.65		8.73		8.76

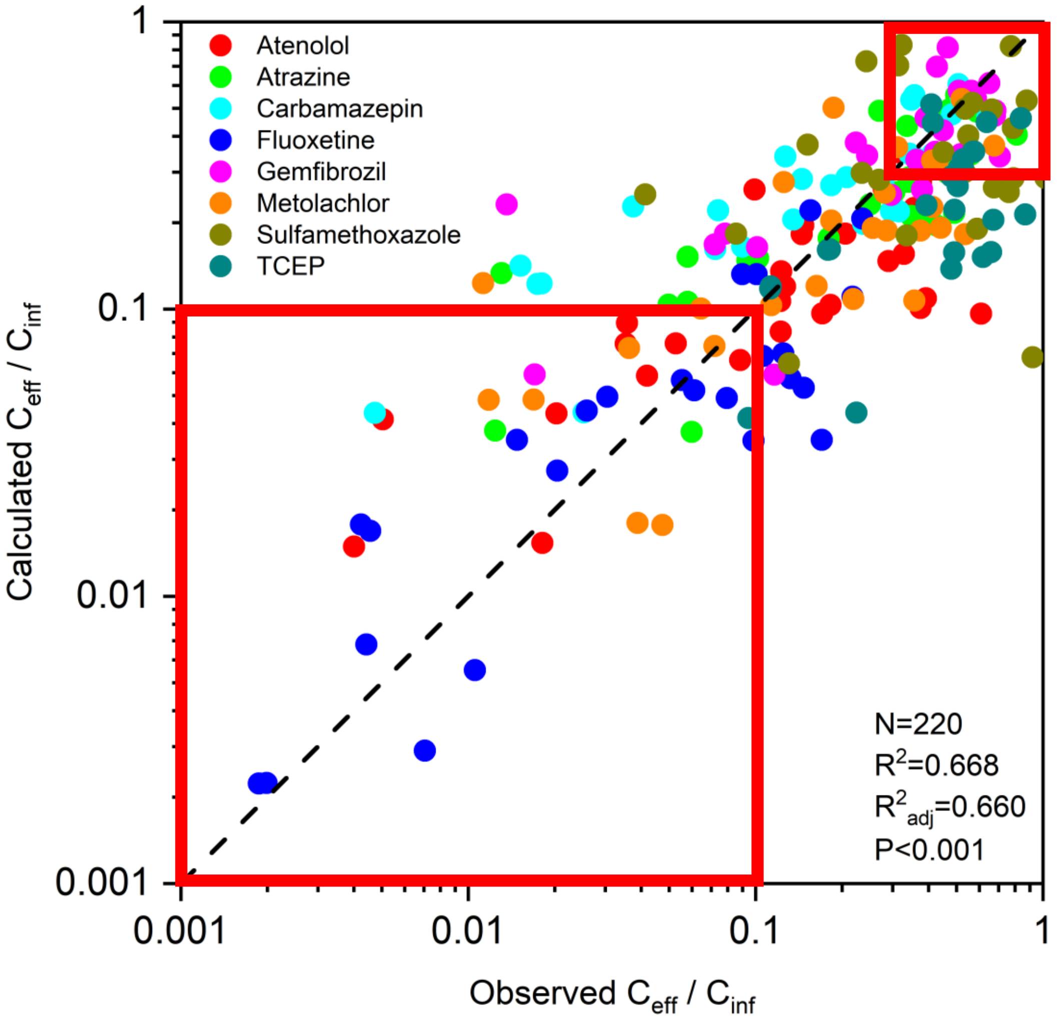
10 States Standards
Recommends 20 Minutes

CO2
Addition

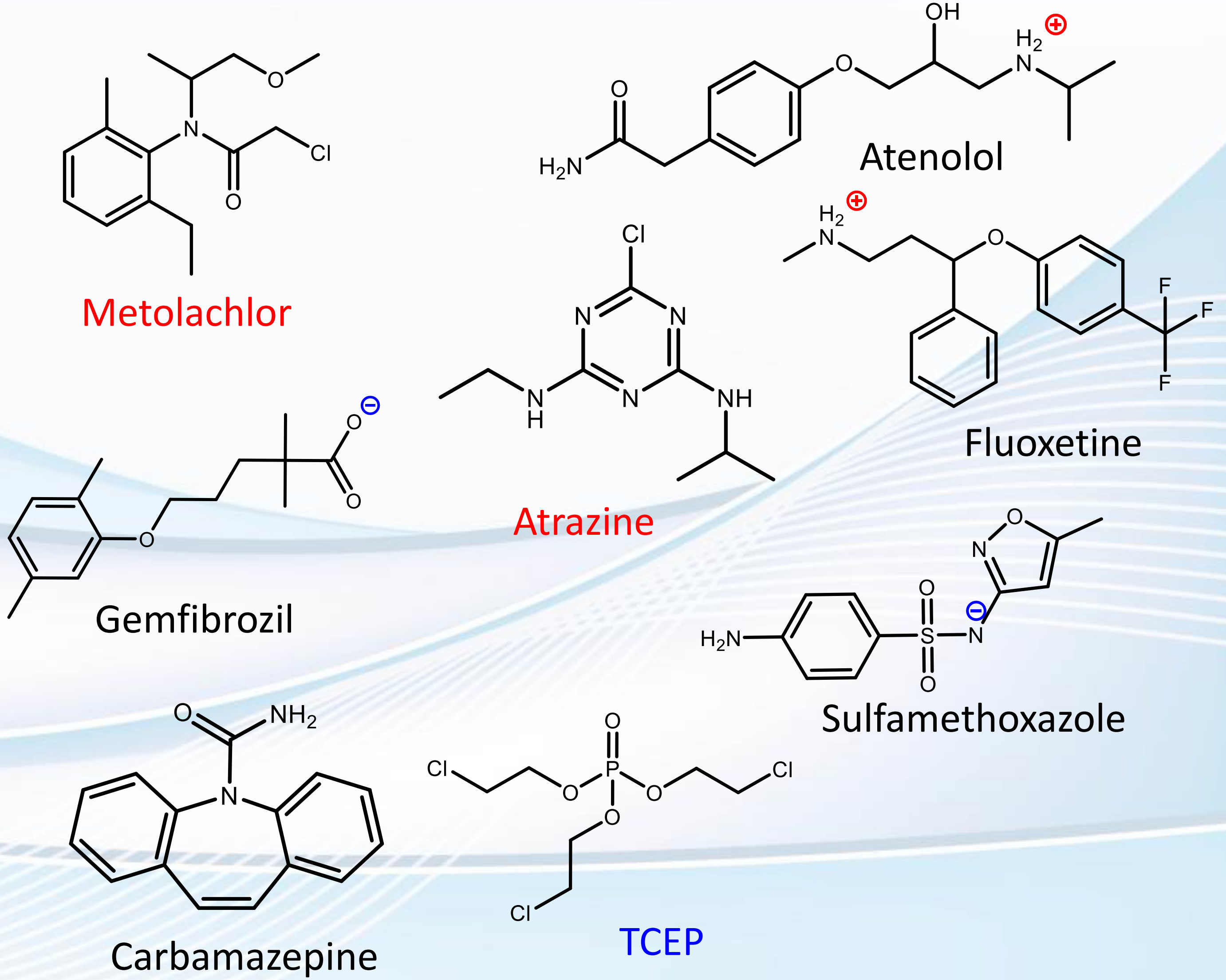
Taste and Odor Spiking



GAC Biofilters Can't Remove all CECs!

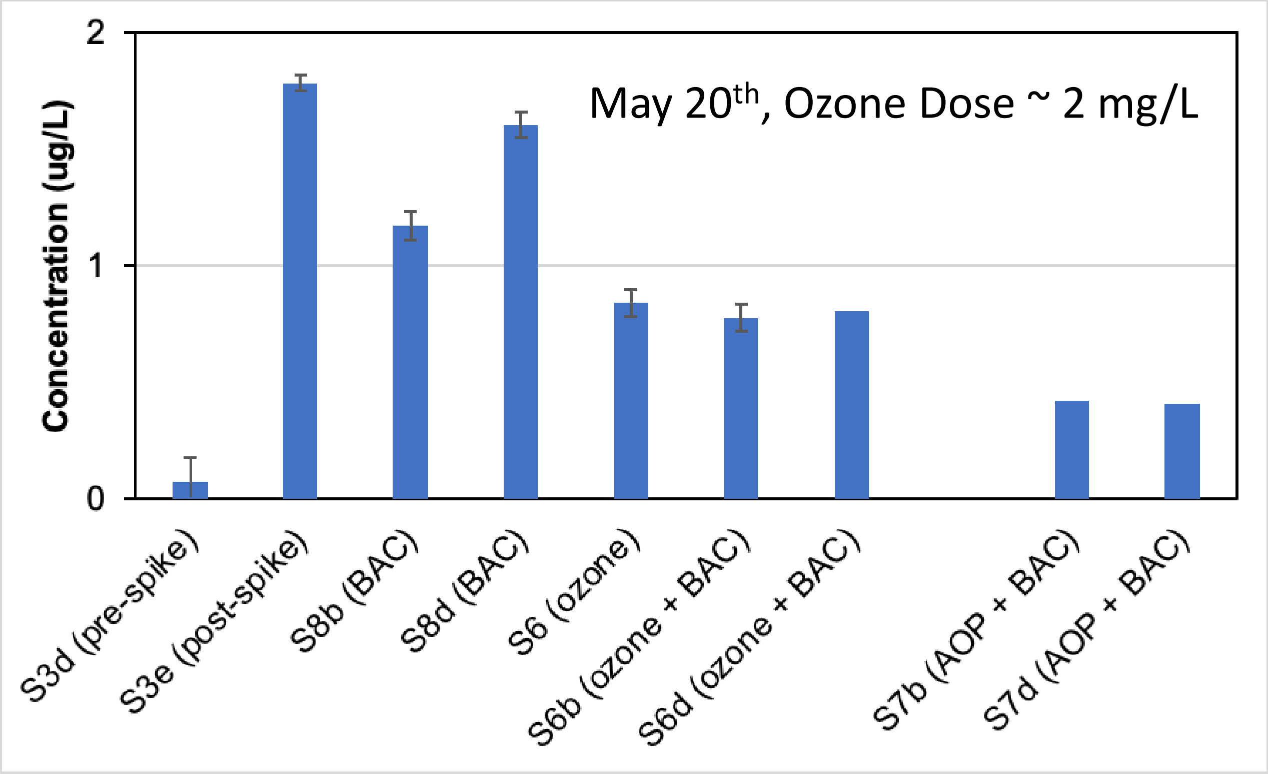


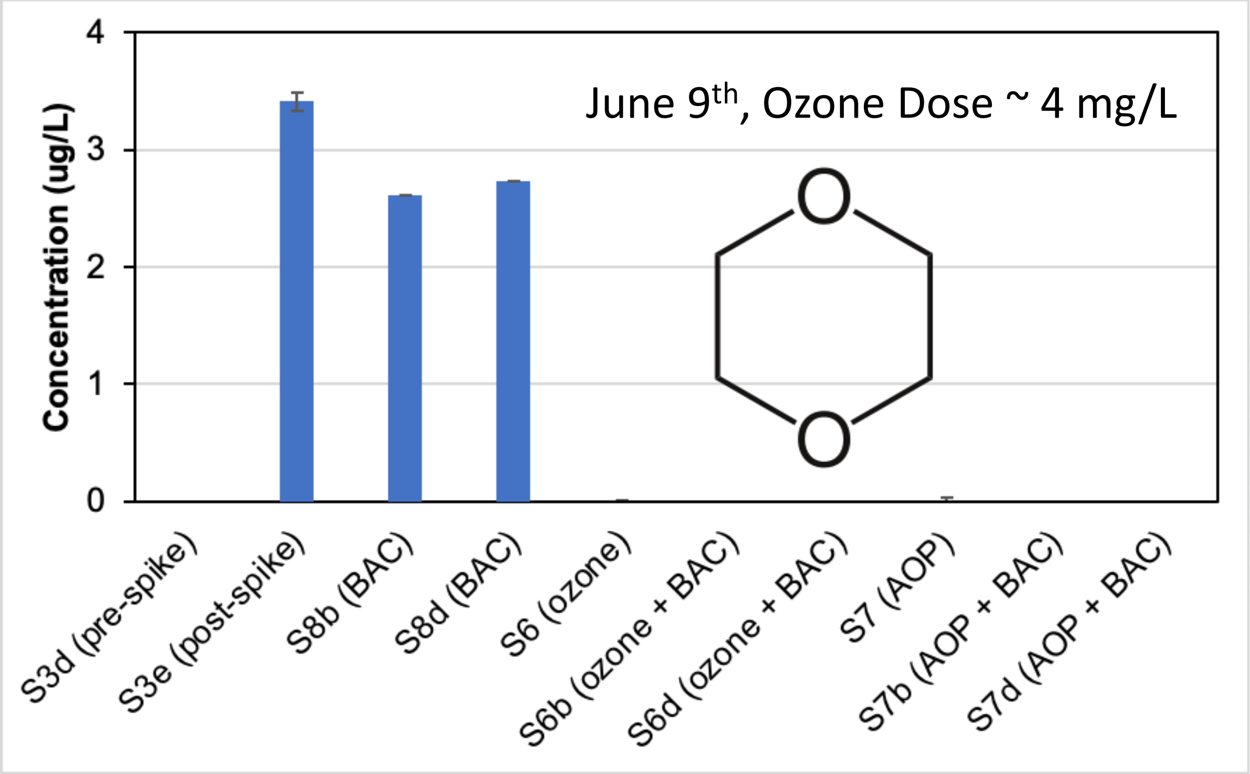
Ma et al. (2018). *Water Research*.

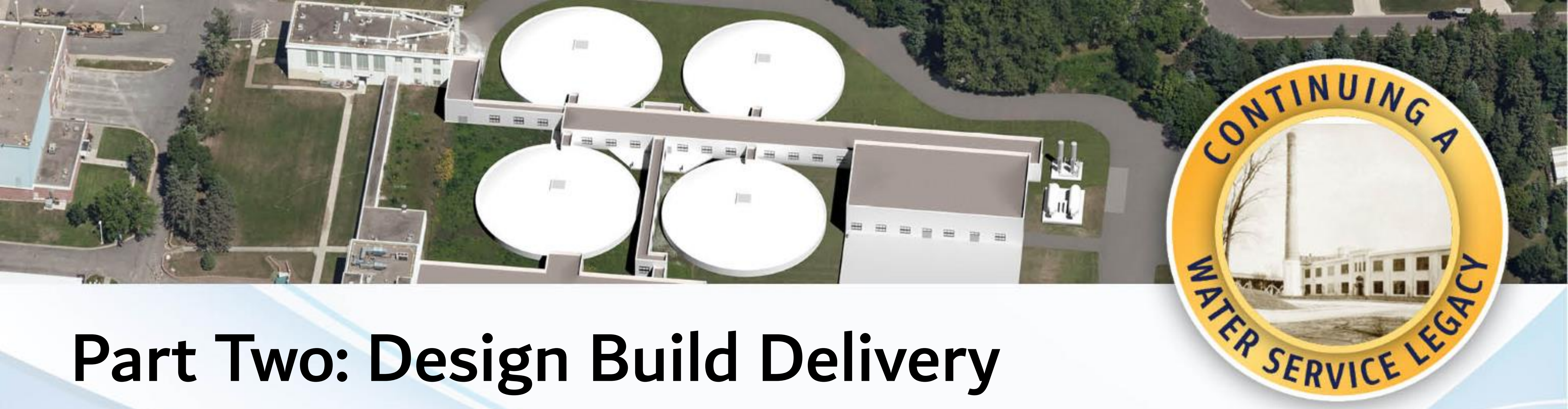


Ozone Provides Enhanced CEC Removal

1,4-Dioxane Spiking







Part Two: Design Build Delivery

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Project Challenges Identified

- Size of Project
- Importance of Final Performance
- Requirement to maintain WTP operation during construction
- All work adjacent to critical, 100-year-old infrastructure
- Countless technologies and layouts available for consideration

The Ideal Delivery Method

- Size of Project
  - Recognize that the design firm will probably make some mistakes. Ensure adaptability.
- Importance of Final Performance
  - Design firm provides performance guarantees to ensure that the facility performs as specified
- Requirement to maintain WTP operation during construction
  - Design and construction professionals collaborate from the start to develop the best project phasing plan
- All work adjacent to critical, 100-year-old infrastructure
  - Design and construction professionals collaborate from the start to find ways to protect infrastructure
- Countless technologies and layouts available for consideration
  - Owner, designer, and construction team all able to provide input to find optimal layout

Enter: Progressive Design Build

- Scenario: Adding a bathroom to your house
- Challenges:
  - Performance required
  - Working around existing infrastructure
  - Need to continue using existing plumbing while building
  - Want to collaborate on layout
- Simple solution: hire one contractor/plumber to do the work
  - A single source of accountability – you know exactly who is at fault if your toilet doesn't flush

What is Progressive Design-Build

Hiring one firm to lead both the design and the construction effort

Advantages of Progressive Design-Build

Design-Bid-Build

- Separate contracts for design and construction = opportunity for finger pointing
- Limited involvement of construction professionals early on = more challenging to plan construction phase
- Construction team selected on low-bid basis = chance that an inexperienced firm does the work
- No construction team under contract = more difficult to get accurate construction estimated

Progressive Design-Build

- One contract for design and construction = clear accountability
- Construction professionals involved from day one = can develop optimal construction plans
- Design-Build team selected on best-value basis = you know what you're getting
- Construction team is on board during design phase = better construction estimate accuracy

Project Challenges Solved by PDB

- Size of Project
  - Design firm remains on board for adjustments during construction phase
- Importance of Final Performance
  - Performance guaranteed by design-build contract
- Requirement to maintain WTP operation during construction
  - Construction team involved from day one
- All work adjacent to critical, 100-year-old infrastructure
  - Construction team involved from day one
- Countless technologies and layouts available for consideration
  - Owner, designer, and construction team develop optimal layout together

Quick Note: Why *Progressive*?

- Fixed Price Design-Build: same single-contract delivery but used when you're pretty certain what you want from the outset
- Progressive Design-Build: used when you want to work with the design and construction team to find the best solution
- Example: Building your dream house.

When is PDB Right for You?

<u>Performance is very important and measurable</u>

A performance-based contract is only a benefit under these circumstances

<u>Your project is technically challenging</u>

The more challenging a project, the more you benefit from the combined design and construction expertise of a design-builder

<u>Your project is fairly large</u>

PDB requires a lot of procurement, contract, and legislative legwork that is only merited on larger projects

What You Need to Succeed

- Get legislative approval from MN state government
- Hire an Owner's Representative (highly recommended)
- Draft a contract that works for you
- Develop a strong procurement strategy

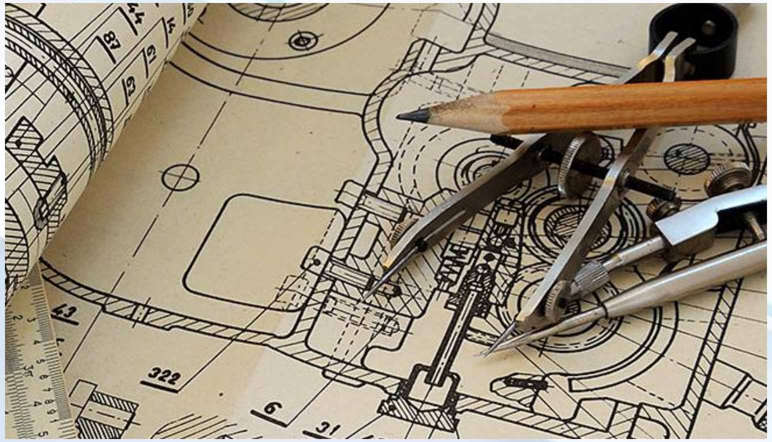
Legislative Approval

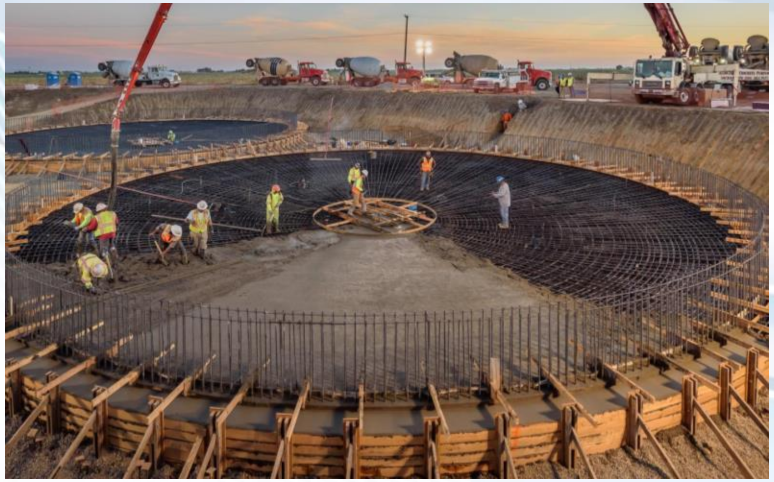
- Progressive Design-Build is not allowed in all contexts in MN
- SPRWS had to obtain legislative authority to deliver this project via PDB
- Legislative process is one reason why PDB isn't ideal for small projects in MN today

Owner's Representative – Procurement Benefits

- Develop a procurement plan (and provide credibility)
- Create procurement documents
- Review facility drawings to identify valuable info
- Identify performance-based technical requirements
- Create a tight scope for design-phase work
- Assist with Evaluation Process
- Answer questions from interested teams
- Assist with Contract Negotiations

Owner's Representative – Design & Construction Benefits





- Assist with reviewing designs, specs, and other technical material
- Provide project management support
- Help understand project cost estimates and confirm validity of DBs assumptions/risk pricing
- Provide third party inspection of critical construction work
- Augment Owner's staff with professionals who deliver these types of projects for a living

Contracting for PDB

- Two phase contract
  - Get commitments on construction phase pricing in a competitive environment
  - Leave an "off-ramp" in case you decide not to proceed with construction as planned
- Start developing a draft contract early
  - We started with a DBIA contract template and modified it for over a year prior to hiring
  - Setting up a performance-based contract is very different. You'll need a while to get used to terminology & concepts and to get buy-in.
- Get comments on the draft contract during the procurement stage

Procurement Process Recommendations

- Two step procurement – RFQ then RFP
  - Will get higher quality proposals if only asking for a few
- One-on-one meetings
  - Teams share proprietary design concepts and see if they fit with Owner's goals
- Ask for useful information. We got:
  - Proposed layouts for new facility
  - Construction sequencing plans to validate feasibility of proposed layout
- Make sure that you provide adequate info.
- Get early buy-in from procurement folks

Getting the best deal

Phase 1 Design Phase Price (Proposed/Known)

+

Phase 2 Estimated Cost of Construction (Estimated by Owner's Rep or budget)

+

Markups on Construction Phase Work (markups are a Proposed/Known percentage of construction phase costs)

=

WHOLE PROJECT COST ESTIMATE

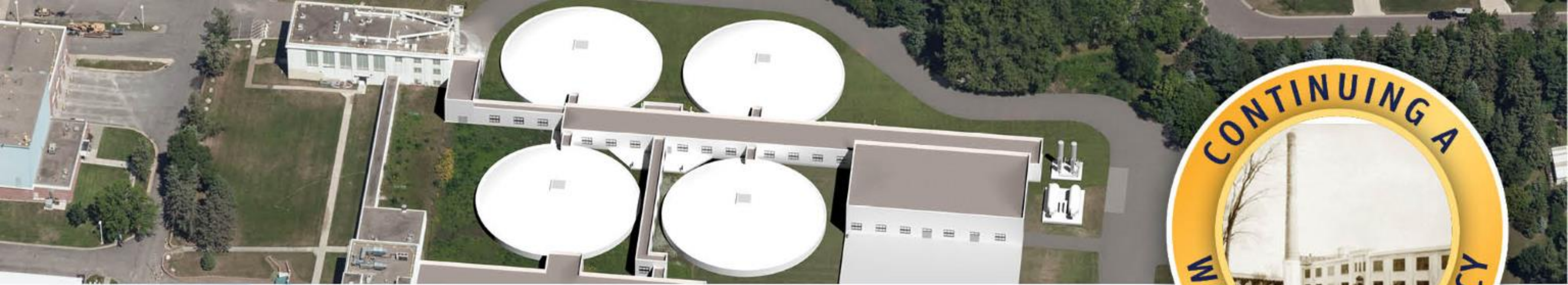
Ask for construction phase markups during procurement!

Wrap-Up

- Progressive Design-Build can be a really useful tool to have available to you
- Delivering a project via PDB when you're used to DBB can be challenging
- For some projects, the benefits of PDB are worth the risks
- In many places, PDB is becoming much more common

Questions?

- Contact Us:
  - Will Menkhaus – William.Menkhaus@ci.stpaul.mn.us
  - Roger Scharf – Roger.Scharf@jacobs.com



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