Keeping the aeration train rolling through turbulent times: Hampton's WWTP upgrades

NEWEA Annual Conference

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Welcome to Hampton, NH

Source: Google Earth

- Hampton Beach
  - Popular Tourist Destination
- Year-round population: ~16,000
- Seasonal Population Swings
  - Holiday Surges
    (Memorial Day, July 4th, Labor Day)
  - Seafood Festival (150,000 people!)
- Seasonal Wastewater Flows and Loads

Hampton Wastewater Treatment Plant (WWTP)

Source: Google Earth

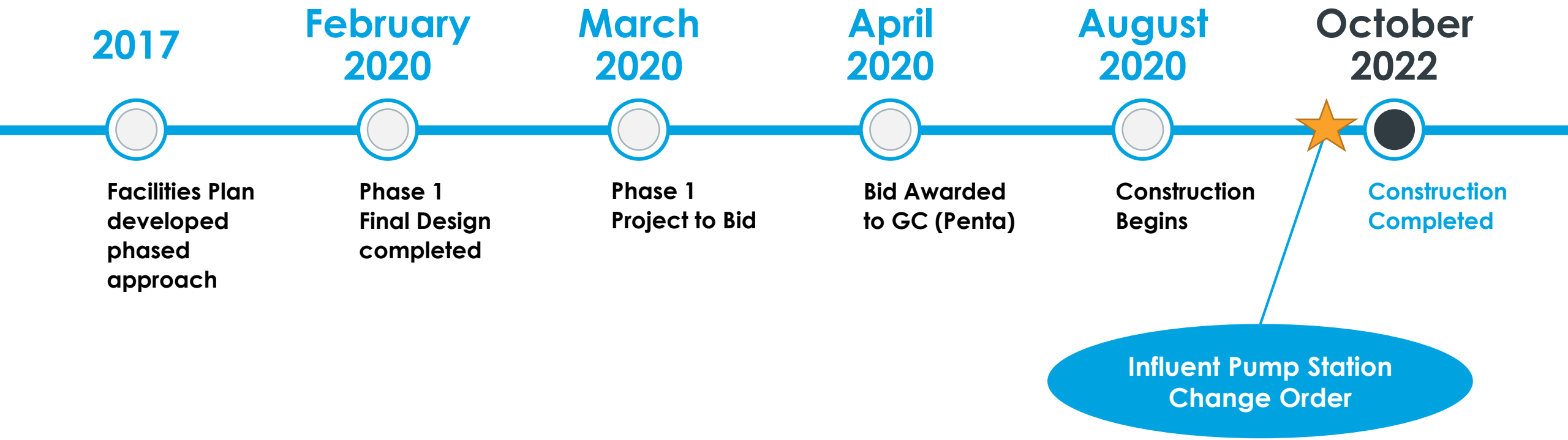
- Originally constructed in the 1920s
  - Major upgrades in the 1960s and '70s
- 2.5 MGD average daily flow
  - 4.7 MGD design flow
- 12 MGD + peak flow conditions
- Discharges to tidal tributary
- Significant recreational resources…
  - Shellfishing beds
  - Popular beach
  - Recreational/commercial fishing
  - Boating

Need for WWTP Upgrades

Source: Google Earth

- No comprehensive upgrade in 45+ years!
  - Existing Structures date from 1960s and ‘70s
- Equipment in critical condition/obsolete
  - Clarifier/thickener mechanisms
  - Influent pumps
  - Grit System
- Aeration System
  - Approaching loading limits
  - Diffuser grid failures
  - Ageing blowers
  - Limited process control & automation
  - Gates & valves inoperable
  - No flexibility for seasonal load swings

Project Timeline



Phase 1 – Scope of Work

- Aeration System Upgrades
- New SCADA System
- Comprehensive PLC/Control Panel Upgrades
- Headworks Upgrades
- Influent Pump Station Upgrades
- Mixed Sludge Pump Station Upgrades
- Plant Water Pump Upgrades
- Primary Clarifier & Gravity Thickener Rehab
- Plant-wide Electrical & HVAC Upgrades

Aeration System Upgrades

Aeration Tanks

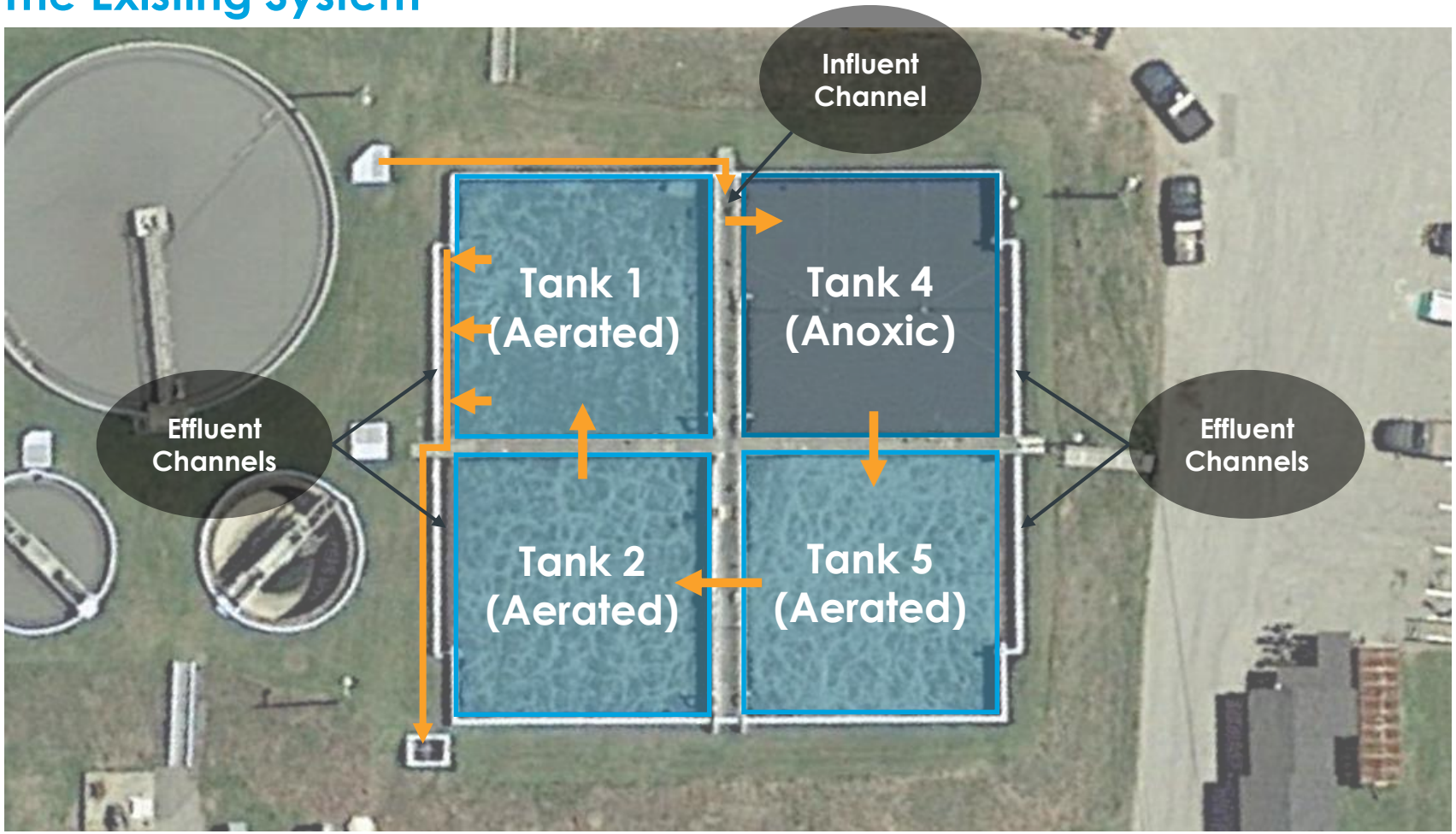
- Tank modifications & baffle walls
  - Single train to Two trains, operational flexibility
- Submersible mixers & internal recycle pumps
- New fine bubble diffusers, gates, & valves
- Instrumentation & controls
  - Enhanced process automation & efficiency

Blower Building

- Aeration blowers
  - Improved efficiency & energy savings
- Blower building control panel
- Ventilation improvements
- Emergency standby power generator

The Aeration Train

The Existing System

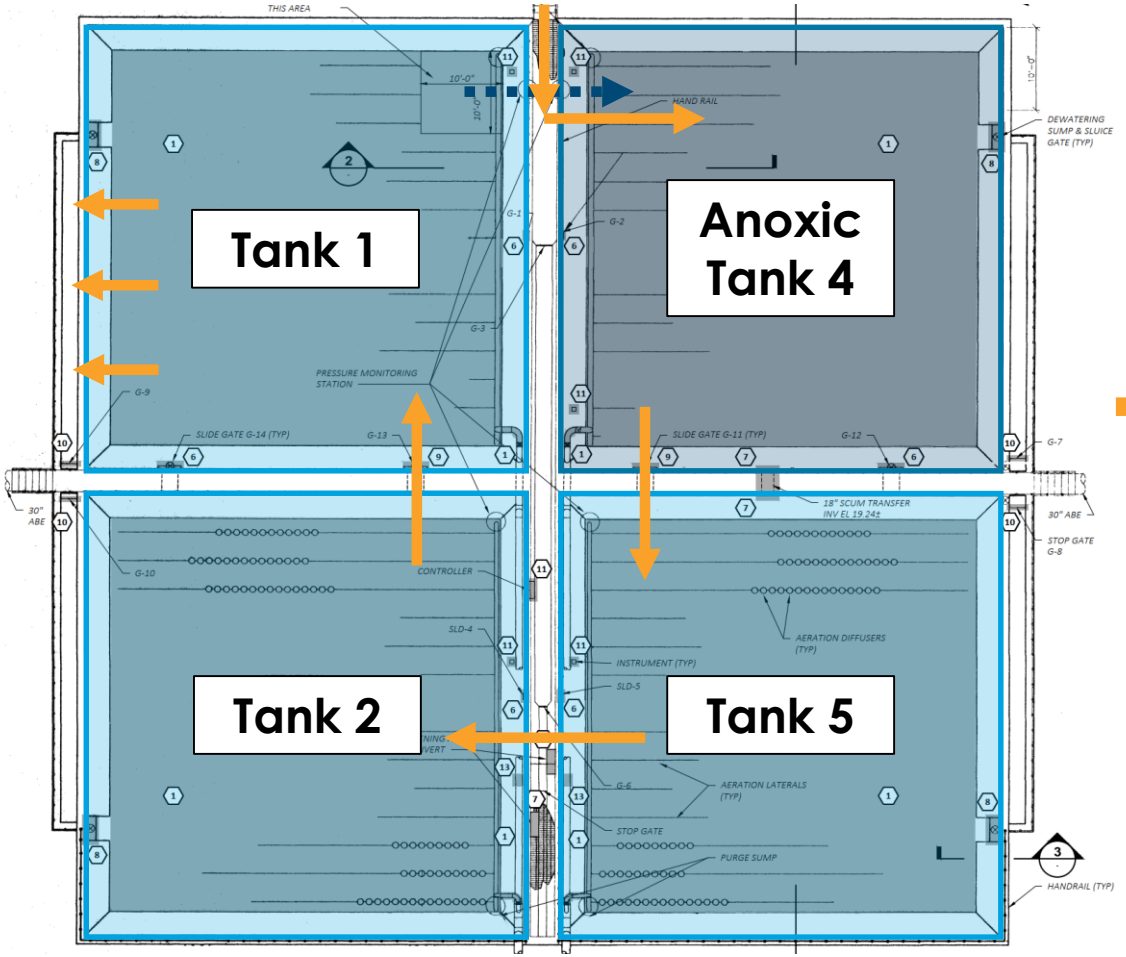


Source: Google Earth

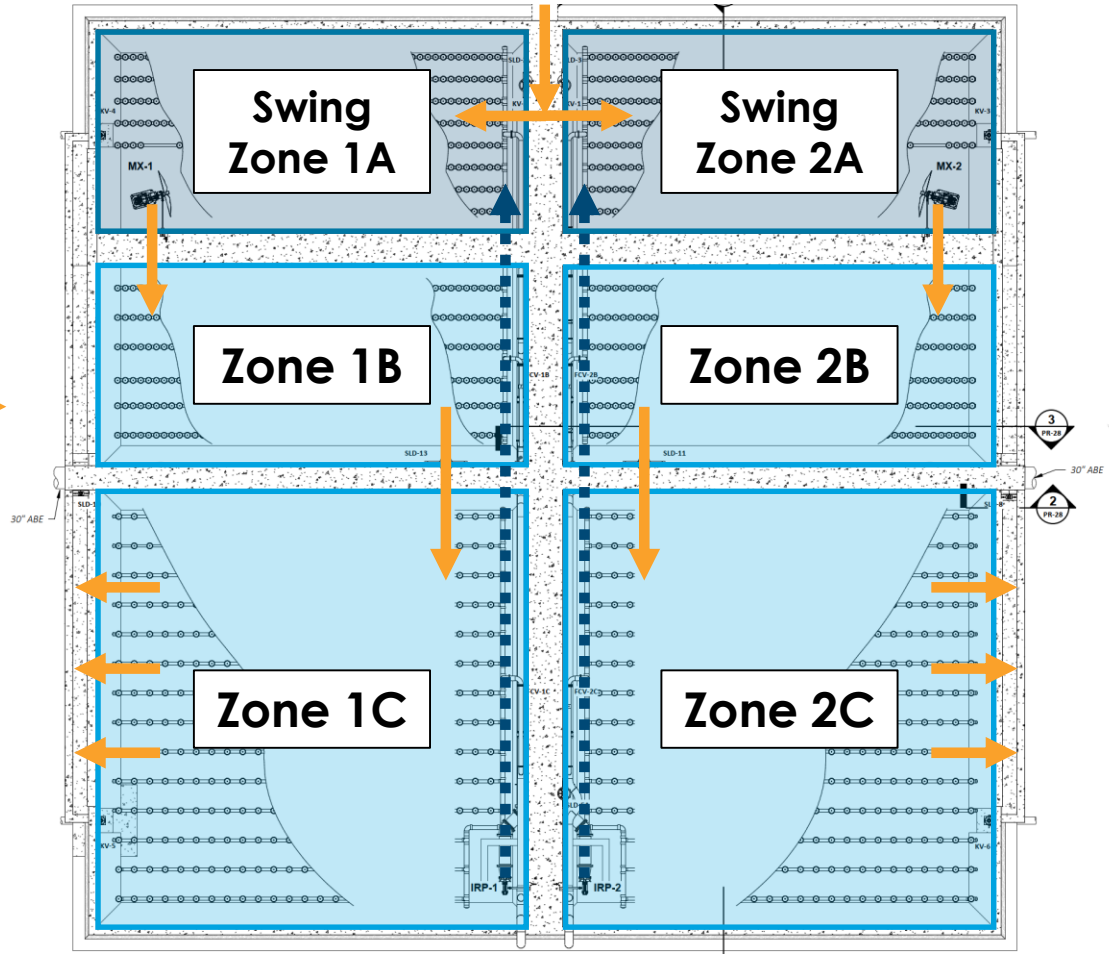
- Originally Designed as Activated Sludge Process (Nitrification)
- Retrofitted to MLE Process (Denitrification)
- Single Train, 4 Tanks
  - Configured for MLE
- Limited Operational Flexibility
  - Gates between tanks no longer functional
  - No way to take any single tank offline

The Aeration Train Design

Existing – One Train



New – Two Trains



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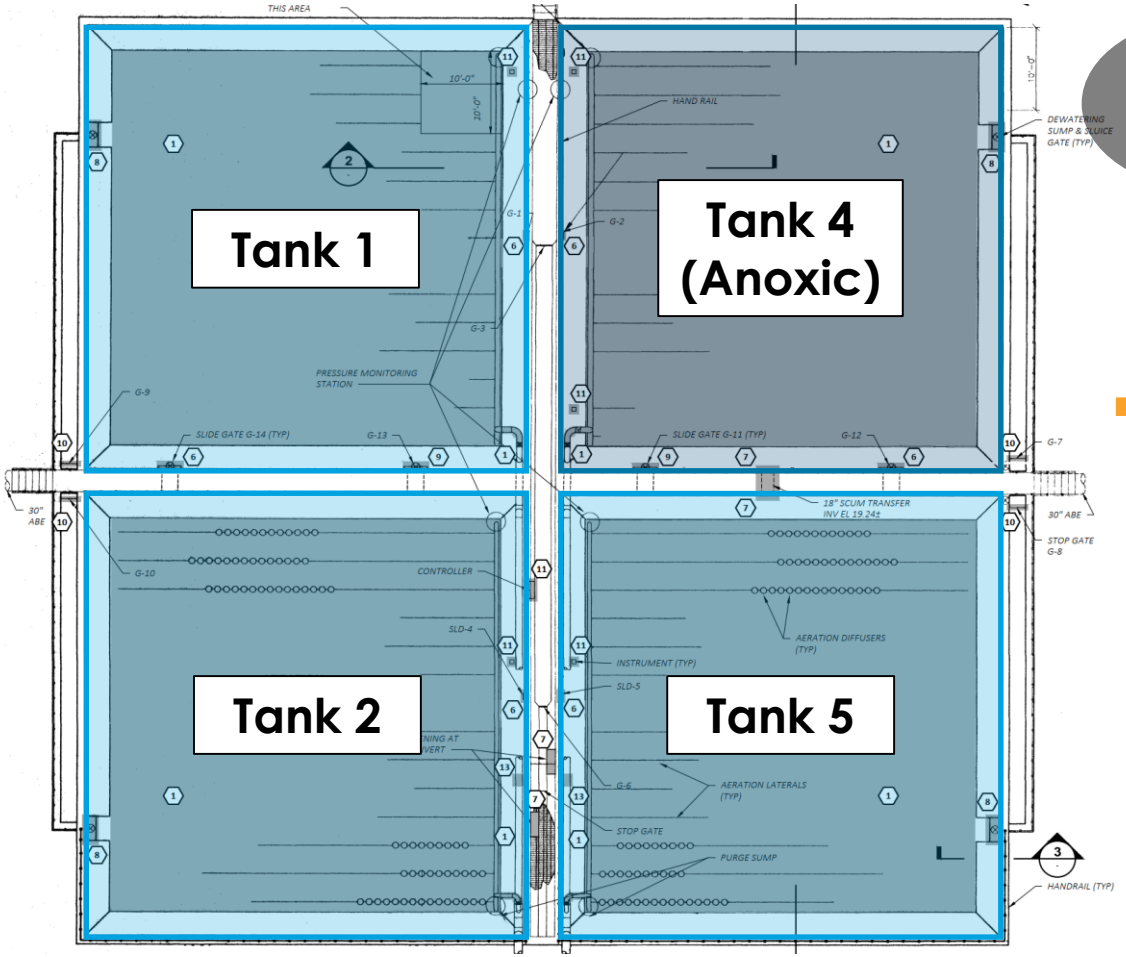
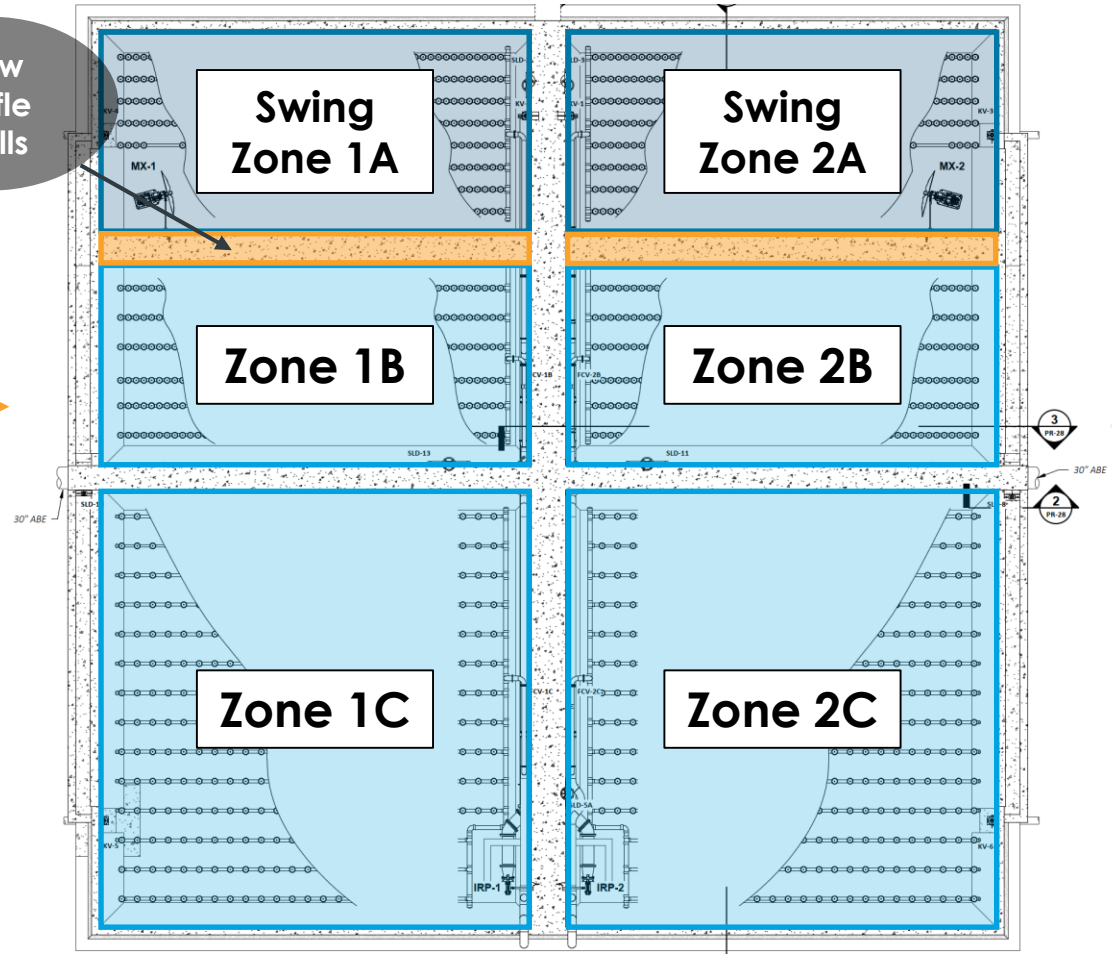
The Aeration Train Design

Existing Tanks



Tank Modifications



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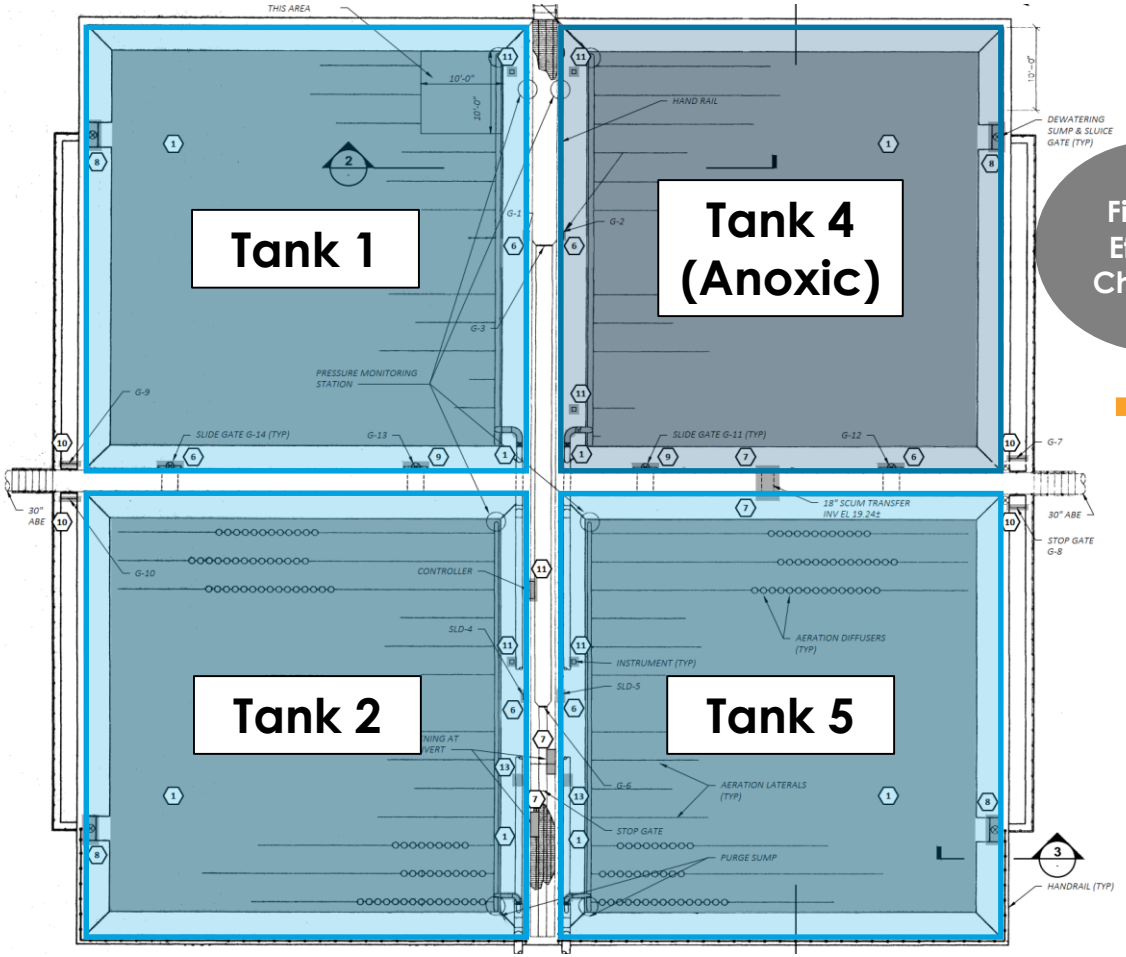
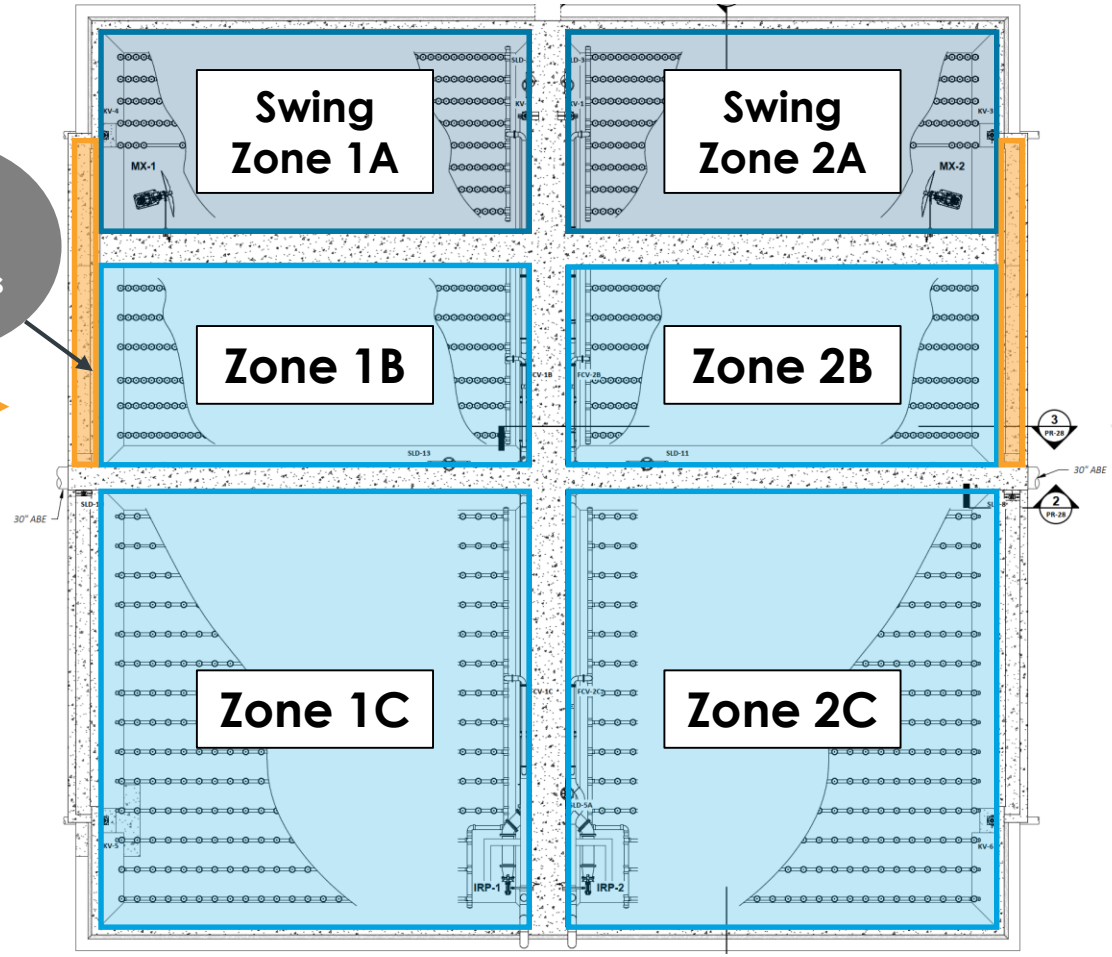
The Aeration Train Design

Existing Tanks



Filled in Effluent Channels

Tank Modifications



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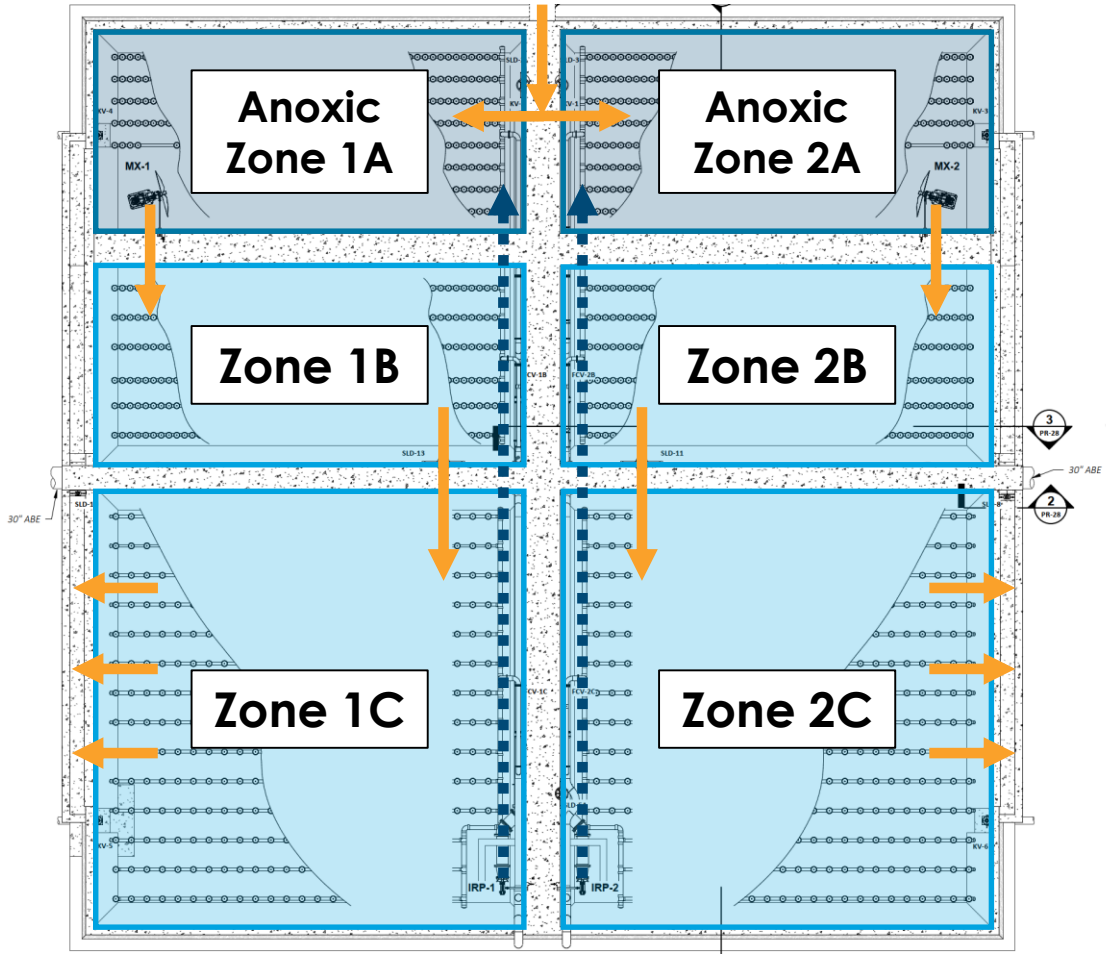
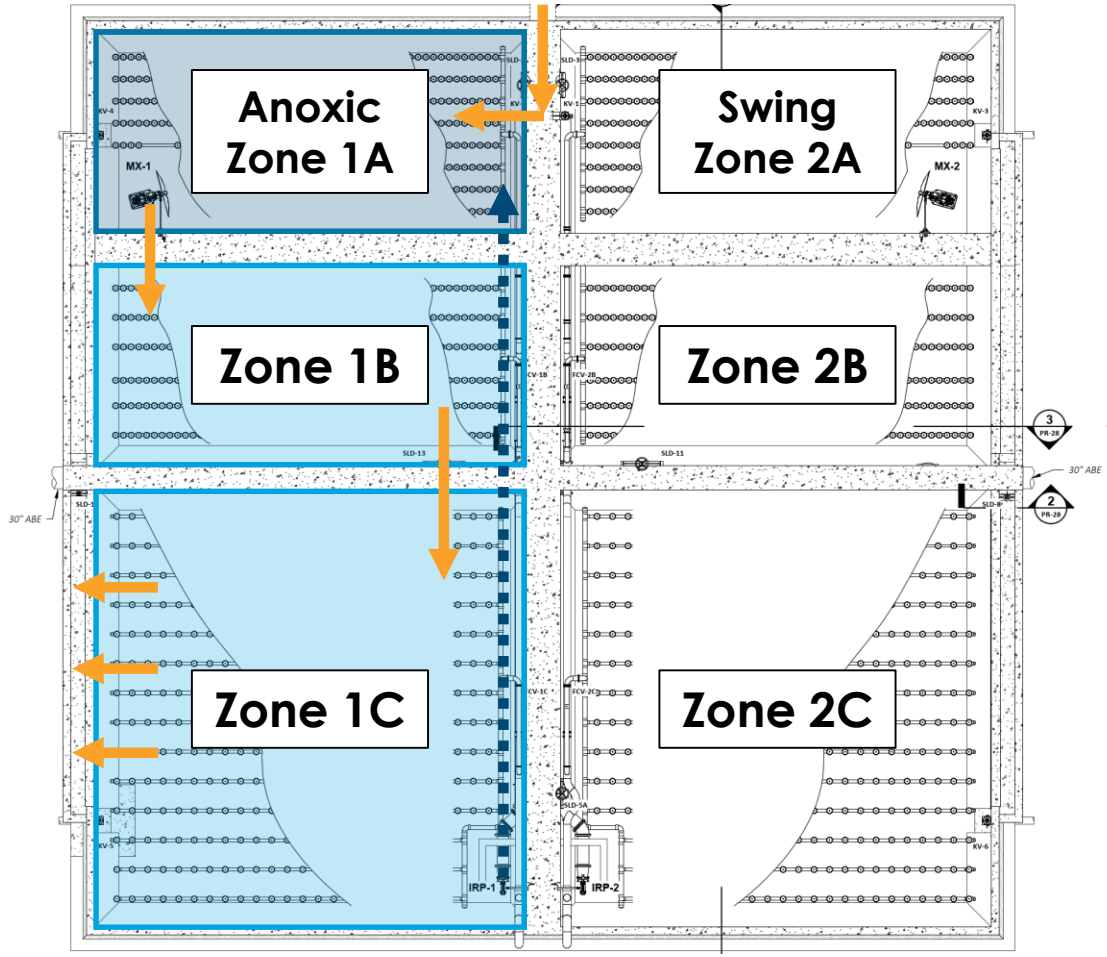
The Aeration Train Design

Summer Configuration – MLE



Winter Configuration – MLE



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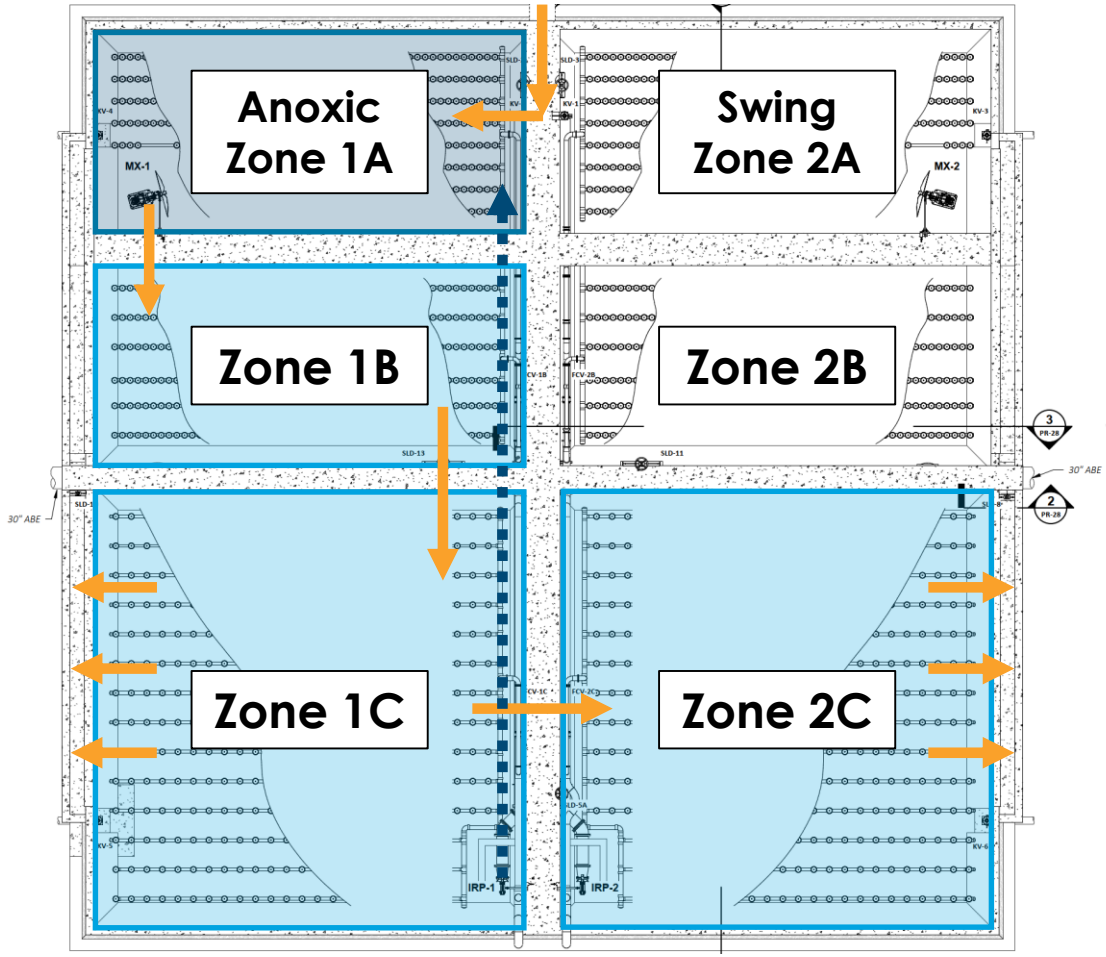
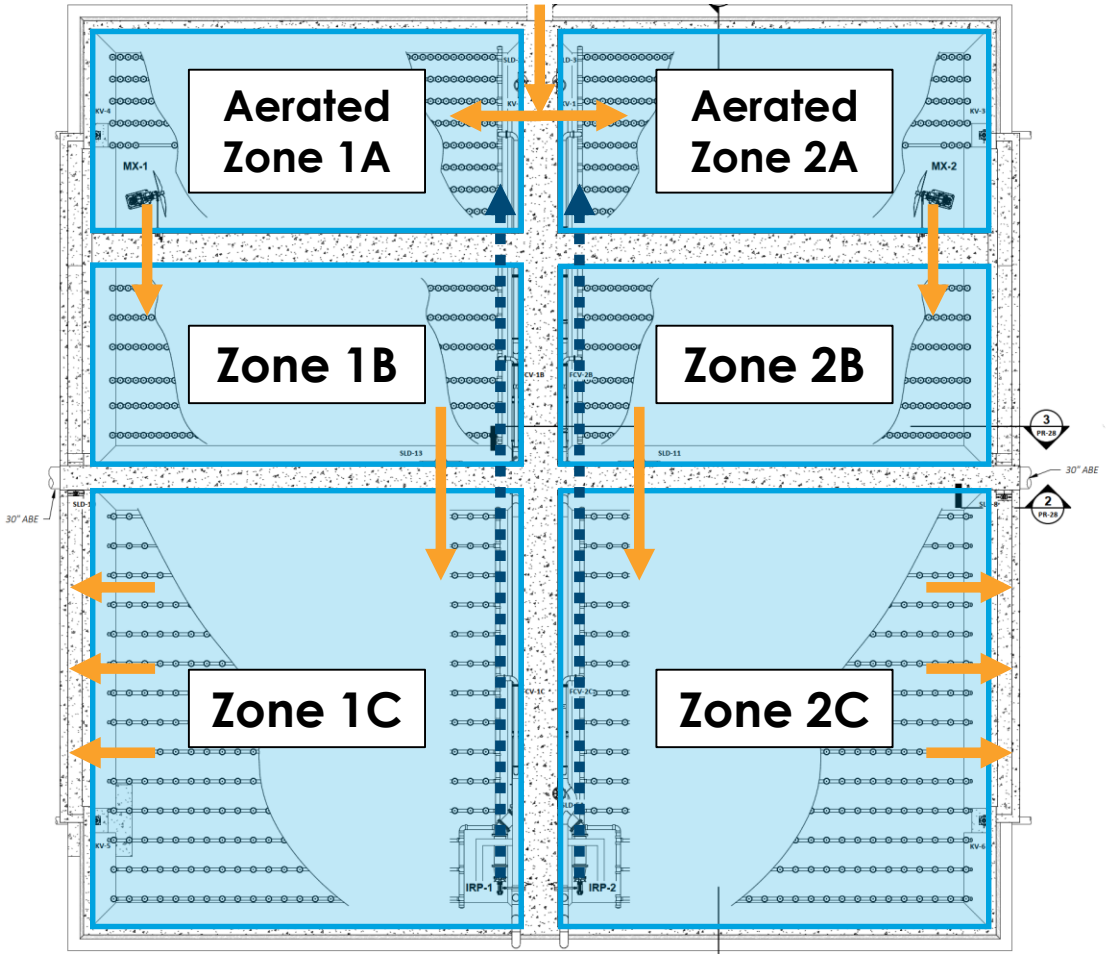
The Aeration Train Design

The ¾ Configuration – MLE



Additional Capacity – Full Nitrification



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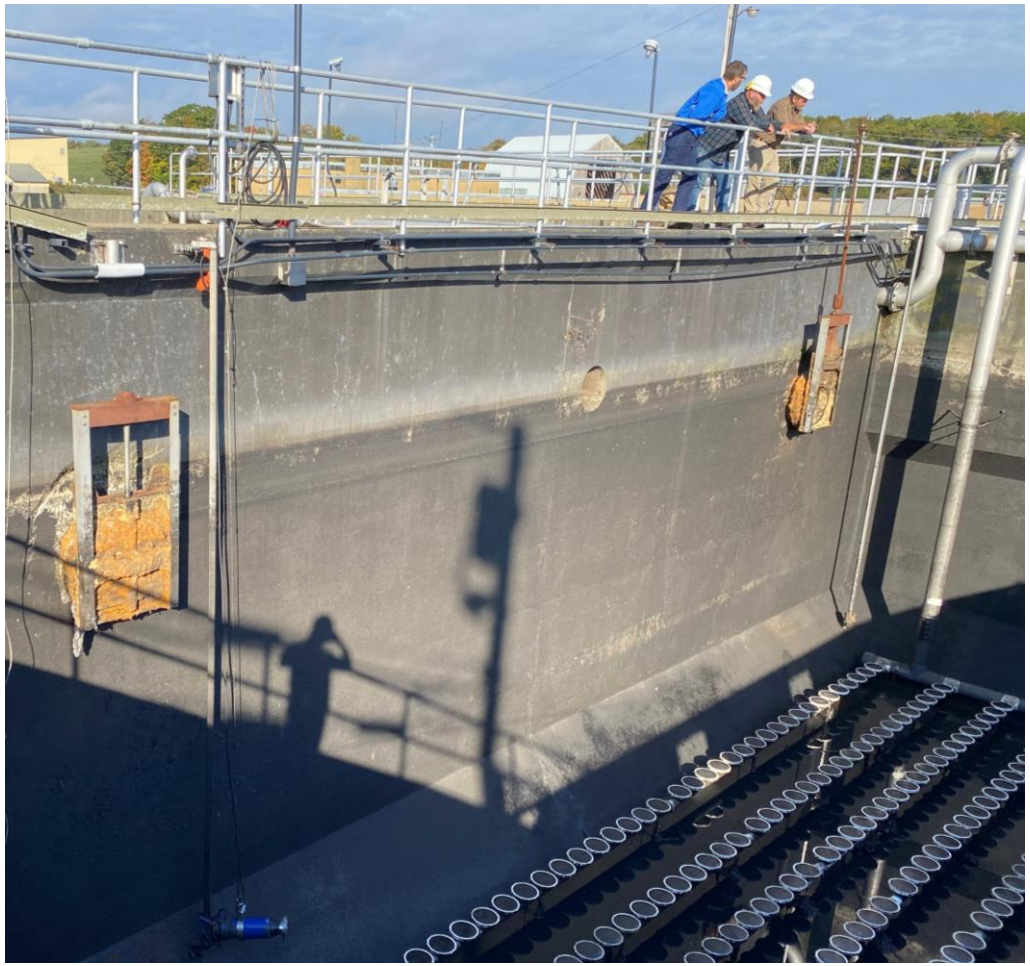
Challenges: Construction Sequencing



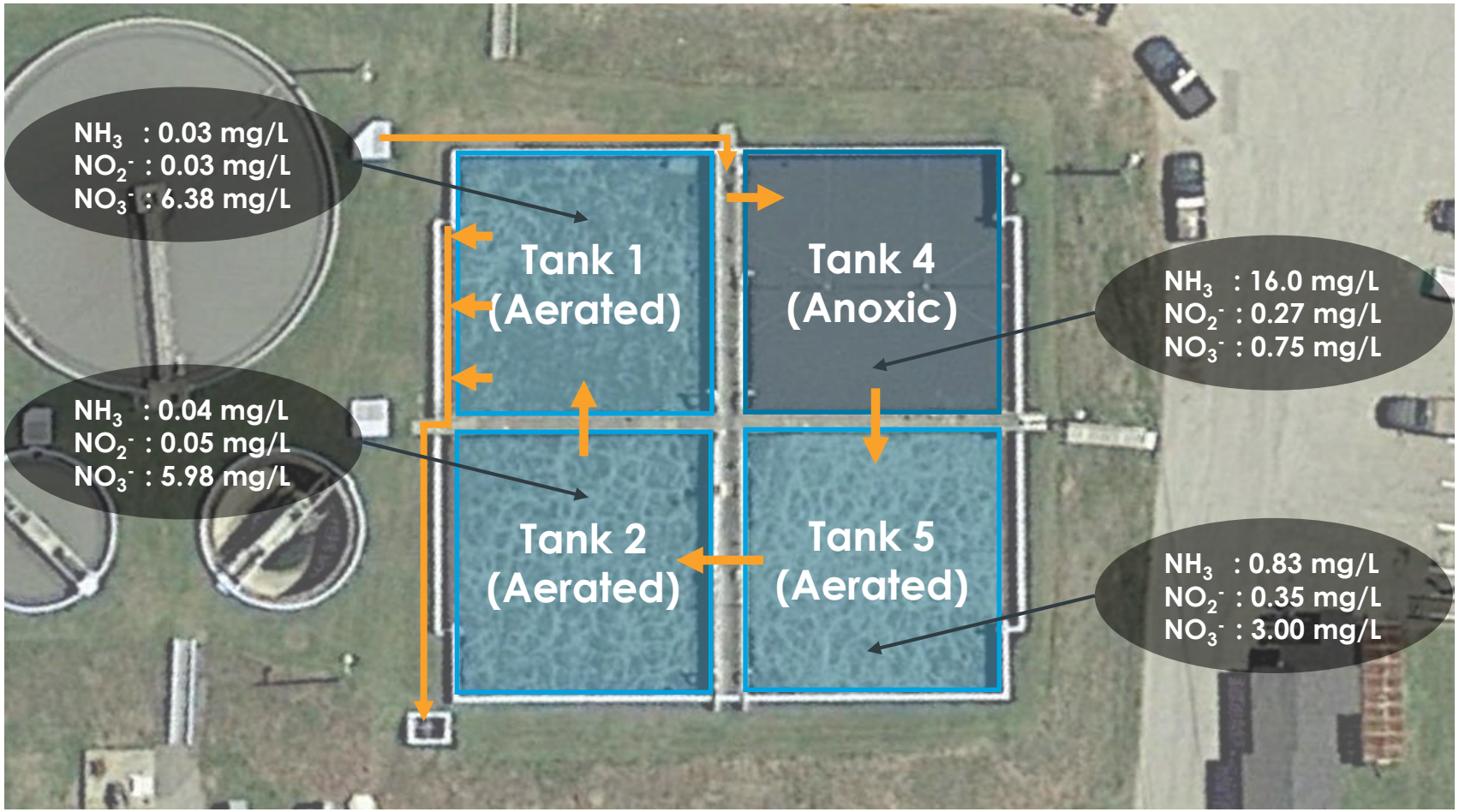
- Getting into the Tanks
  - Isolating Tanks from the flow
- Working around the Treatment Process
  - Managing flow, maintaining capacity
  - Bypass Pumping required? ($$$)
- Unknowns
  - What happens when we take 2 tanks offline? (50% capacity)
  - How long can we run at reduced capacity?
  - How will the process react?
  - What's under the water (i.e., cracks?)
- Blower Building Sequencing
  - Replacing blowers & aeration piping
  - …while Continuously Providing Air

Challenges: Plant Operations

- How will the process react?
  - What happens when we take 2 tanks offline?
  - How long can we run at reduced capacity?
  - How will the bugs perform? (WWBD?)
  - Need to continue to meet permit limits
- MLE to Full Nitrification Process
  - Without denitrification, low alkalinity, pH…
- Reduced Capacity
  - Maintaining Biomass and Sludge Retention Time (SRT) to treat Influent Loading
  - How many tanks do we *really* need?

Understanding The Aeration Train

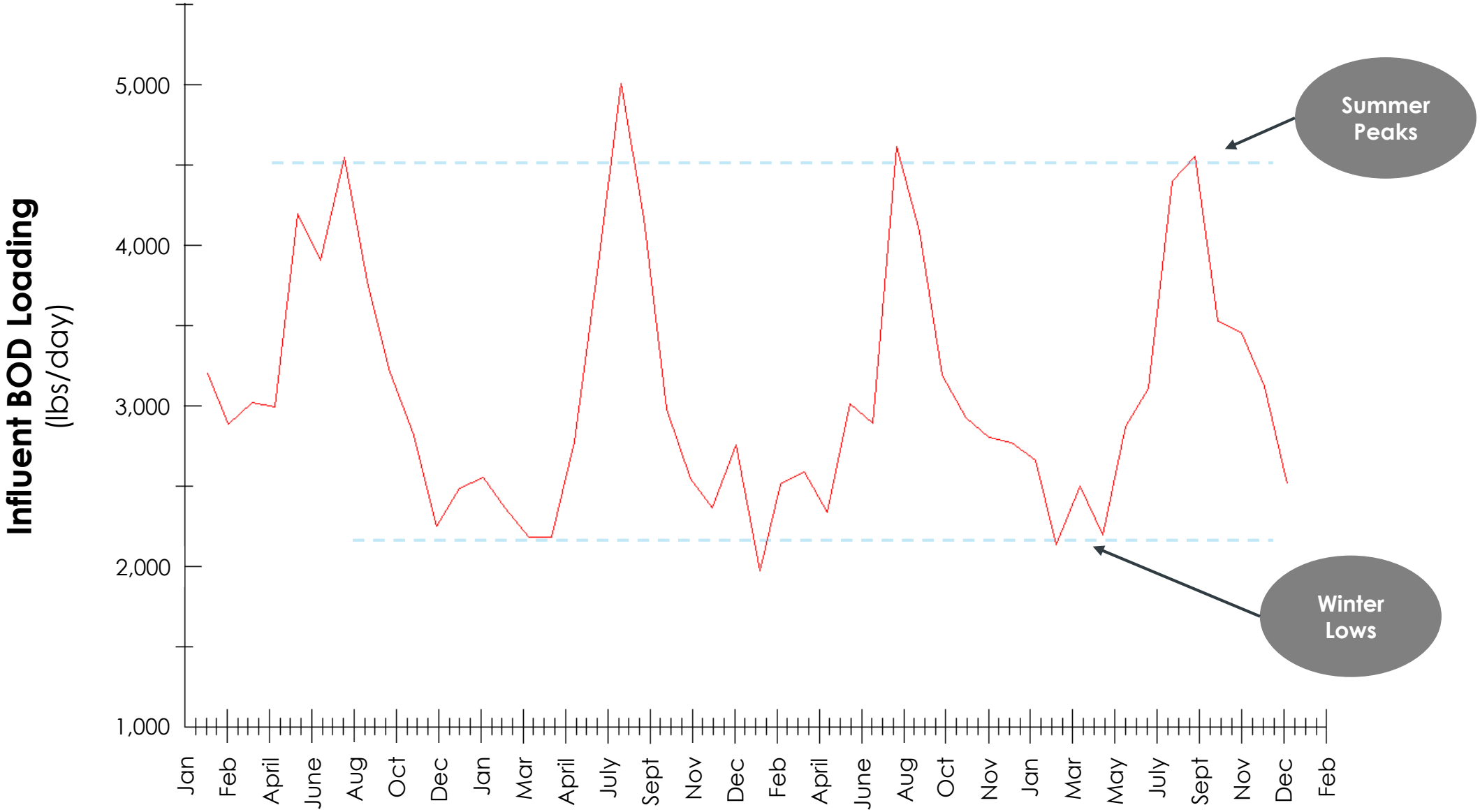
Follow the Nitrogen



Source: Google Earth

- How many tanks do we *really* need *now*?
  - Look to the data!
  - Follow the Nitrogen through the process
- Years of data from each of the four tanks
  - Ammonia (NH_3)
  - Nitrite (NO_2^-)
  - Nitrate (NO_3^-)
- When loading is low, most of the Ammonia & BOD is consumed in Tanks 5 and 2

Influent BOD Loading (Biochemical Oxygen Demand)



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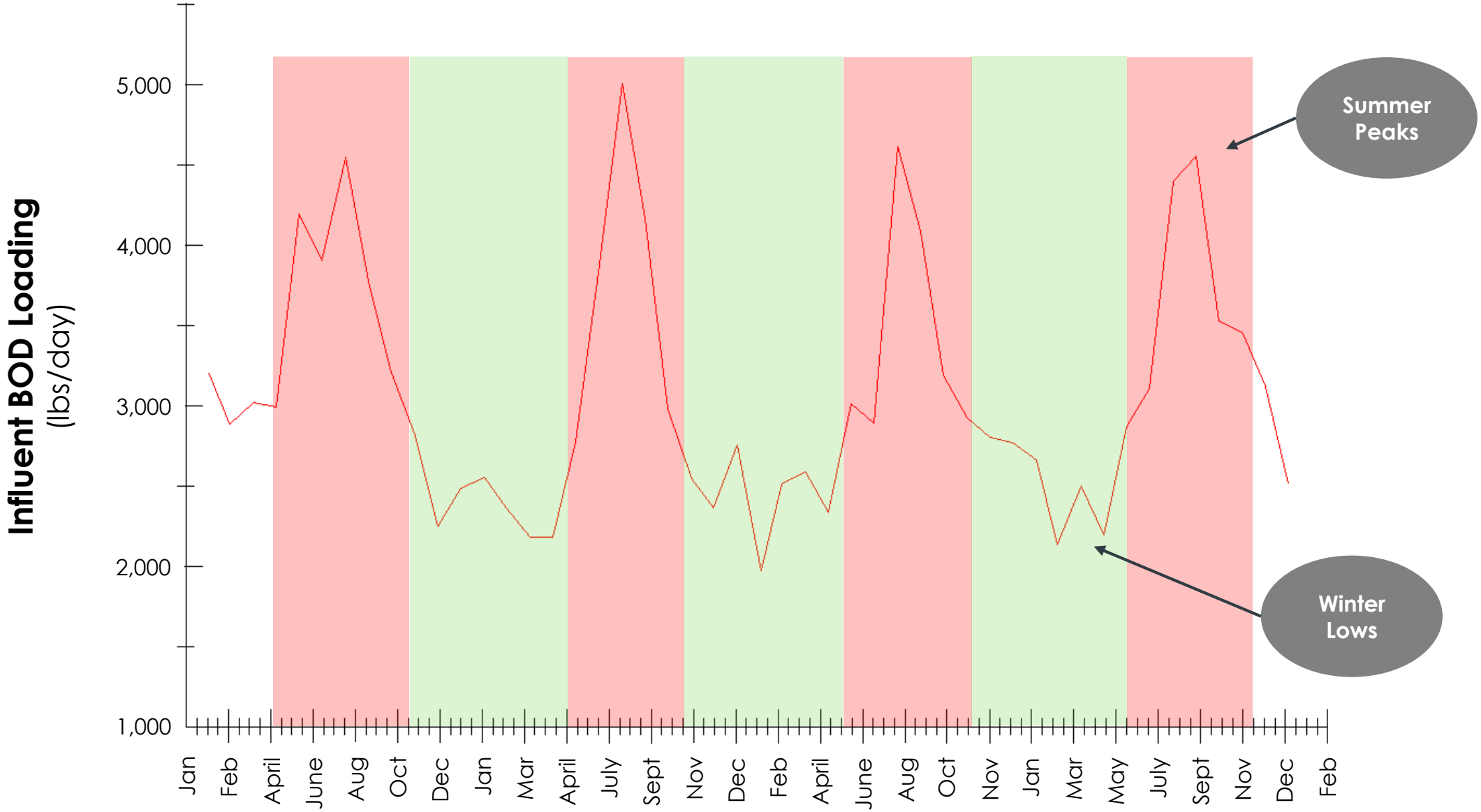
Influent BOD Loading (Biochemical Oxygen Demand)



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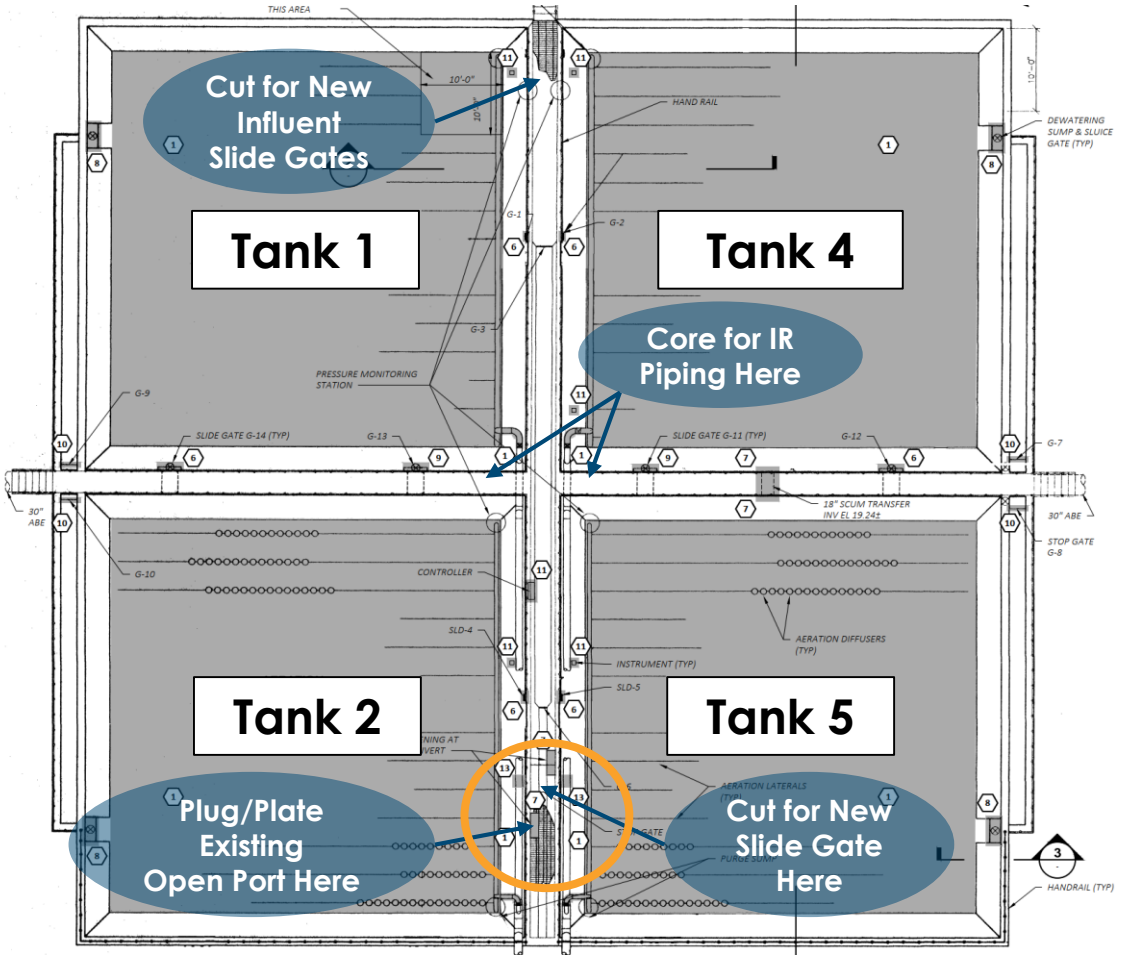
Construction Challenges



Obstacles to Isolating the Tanks

- Existing Slide Gates
  - Inoperable, leaking
- Existing Ports between Tanks
  - Always Open Port between Tanks 2 & 5
- Cutting through Walls into Active Tanks
  - Slide Gates in the Influent Chanel
  - Internal Recycle (IR) Piping between Tanks 1-2 and Tanks 4-5
  - New Slide Gate between Tanks 2-5

- How do you cut through a wall, without draining the water on the other side?

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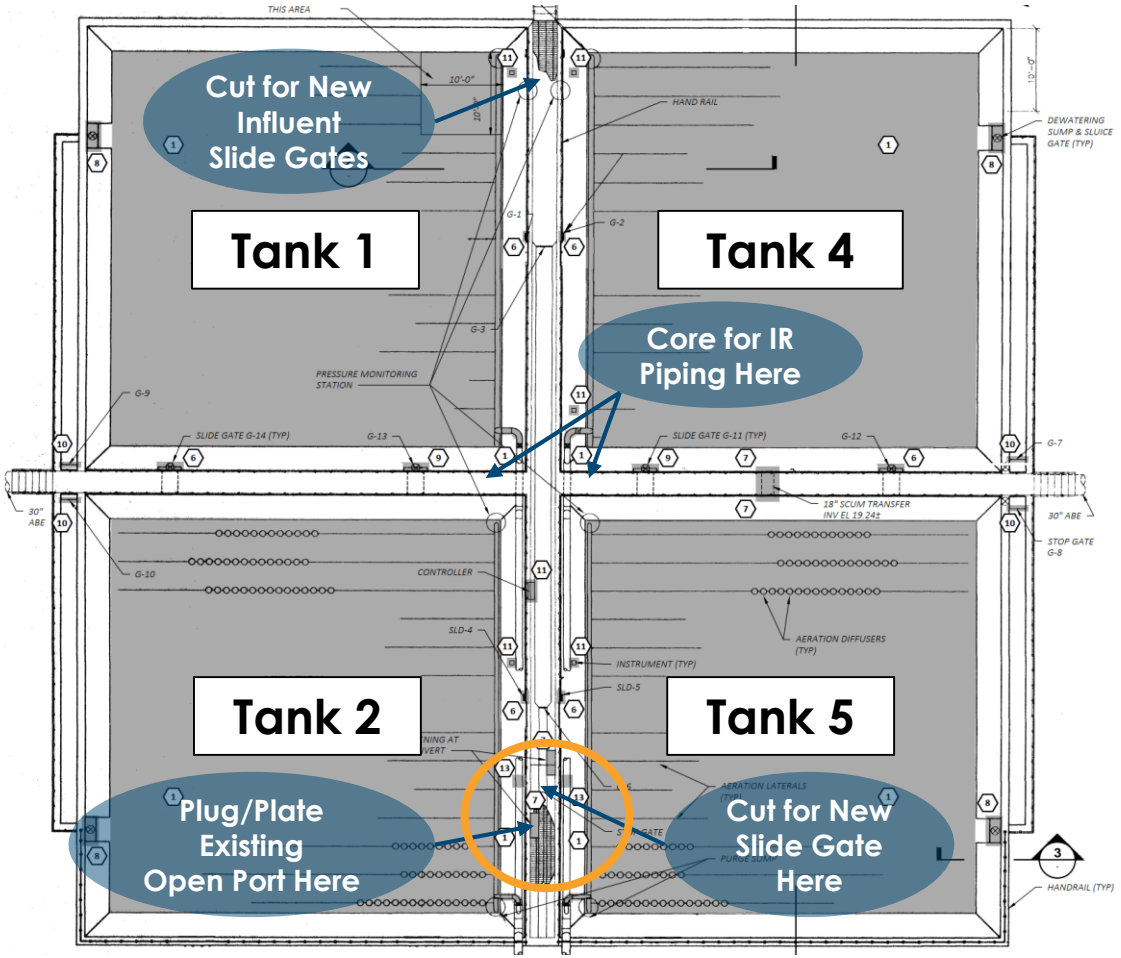
The Original Sequencing Plan



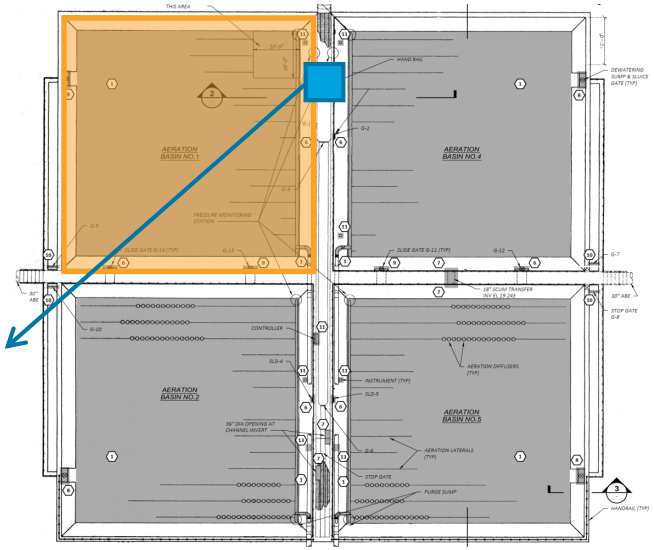
The original plan entailed…

- Working in One Tank at a time
- Bypass Pumping the Influent Channel to Install Slide Gates
- Work in Tank 1
- Work in Tank 4
- Drain Tanks 1 & 2 *briefly* to core IR Piping
- Drain Tanks 4 & 5 *briefly* to core IR Piping
- Bypass Pumping to *briefly* Drain Tanks 2 & 5 to install new Slide Gate
- Work in Tank 2
- Work in Tank 5

… A fair amount of process juggling and bypass pumping!

Construction – Fall 2020

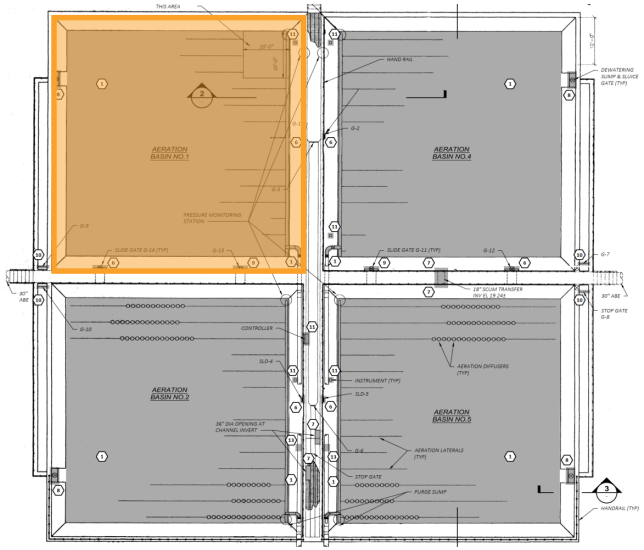
Tank 1



- **Block Flow to Tank 1**
  - **Flow briefly diverted to Primary Clarifier**
- **Temporary Cofferdam in Influent Channel**
  - **Enabled Slide Gate Installation w/o Bypass**

Construction – Fall 2020

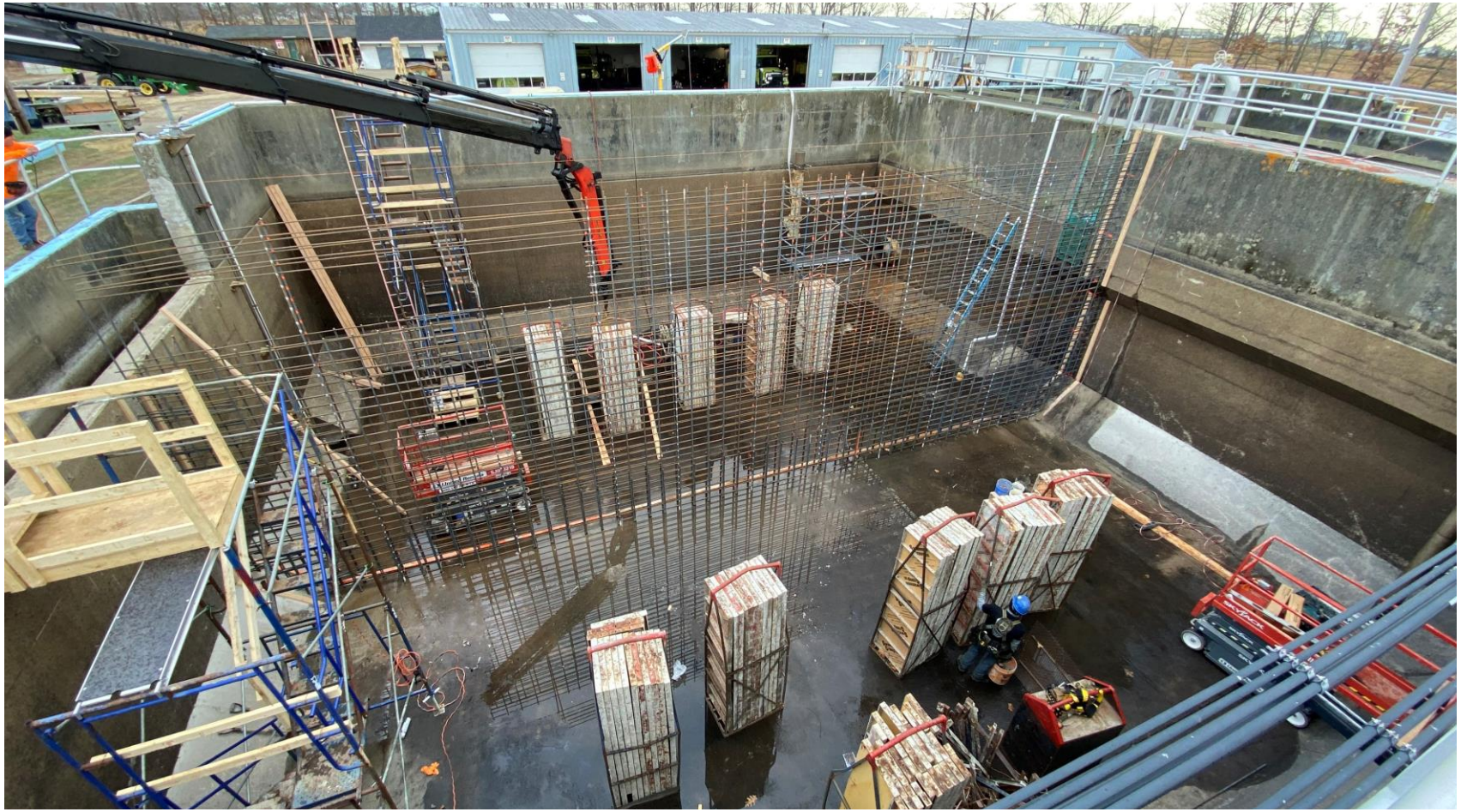
Tank 1

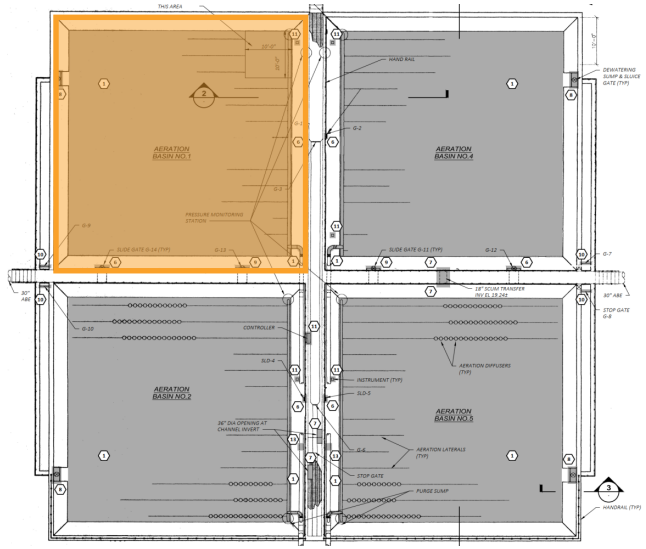


- **Isolate and Drain Tank 1**
  - **Plug Openings to Online Tanks**
  - **Seal leaking Cracks & Construction Joints**
- **Clean Up and Demolish**

Construction – Fall 2020

Tank 1

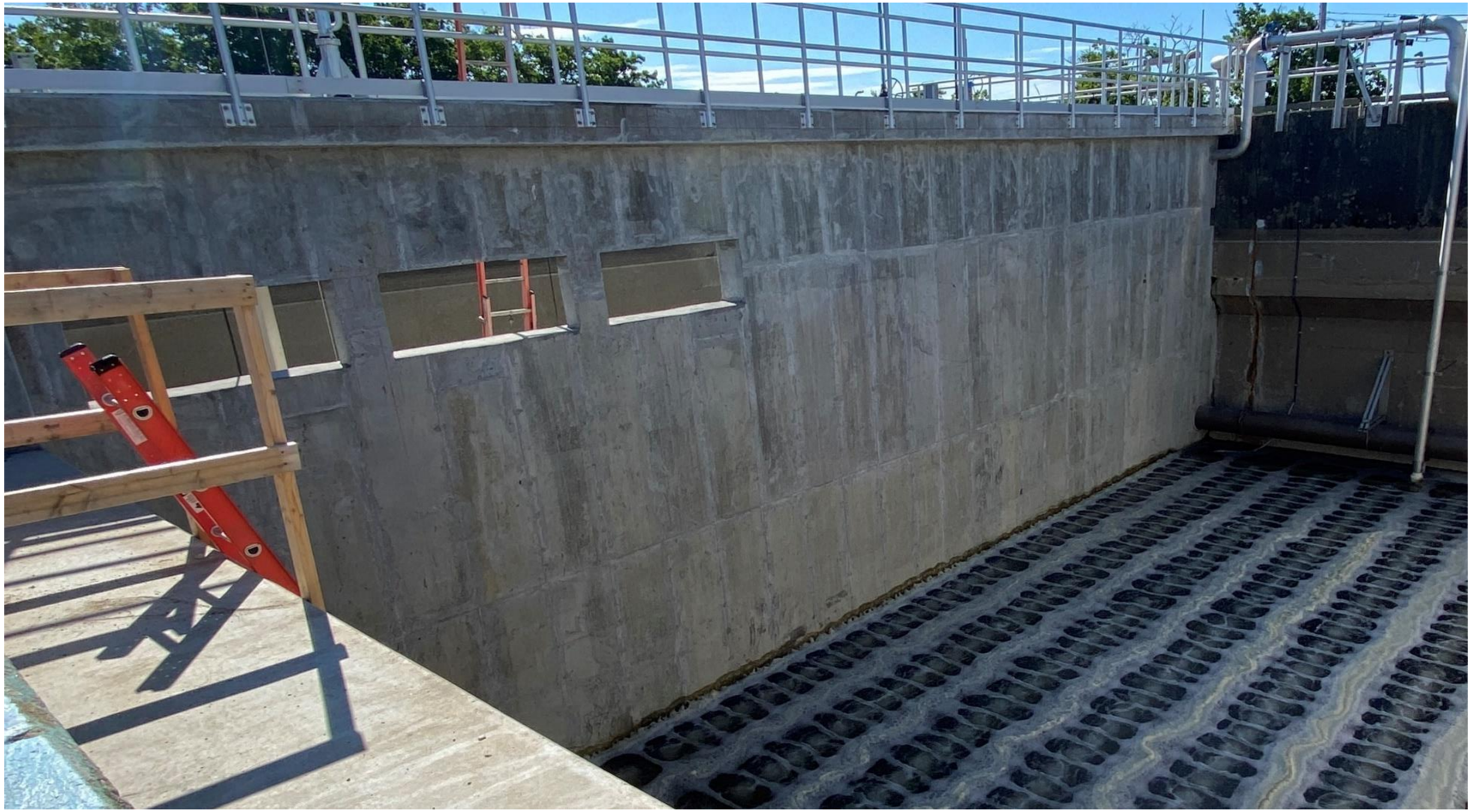


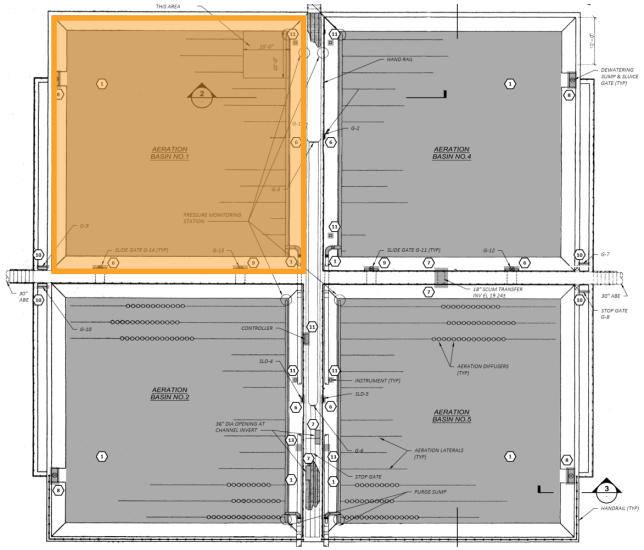


- Concrete Work
  - Construct Baffle Wall
  - Fill Effluent Channel

Construction – Fall 2020

Tank 1

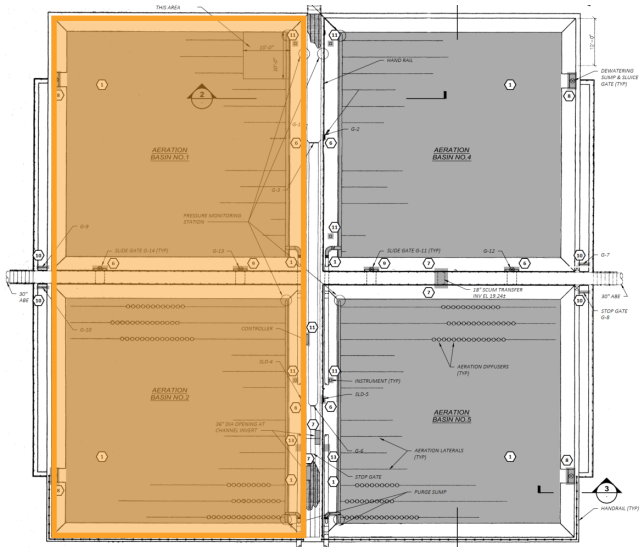




- Submersible Mixer
- IR Piping
- Valves
- Diffusers & Air Piping
- Electrical Work

Construction – Winter 2020-21

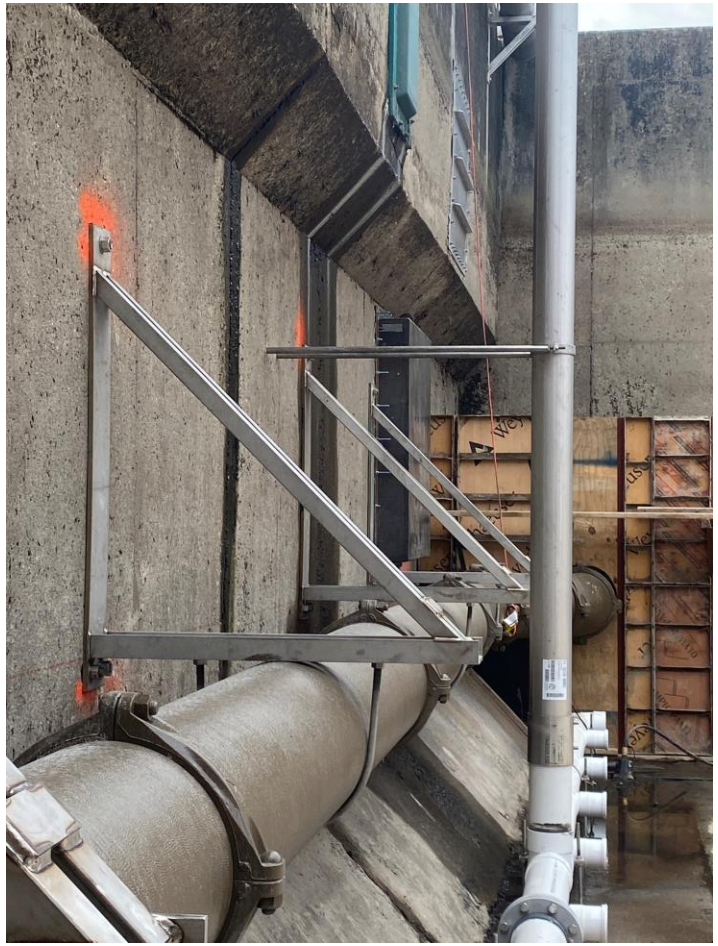
Tanks 2

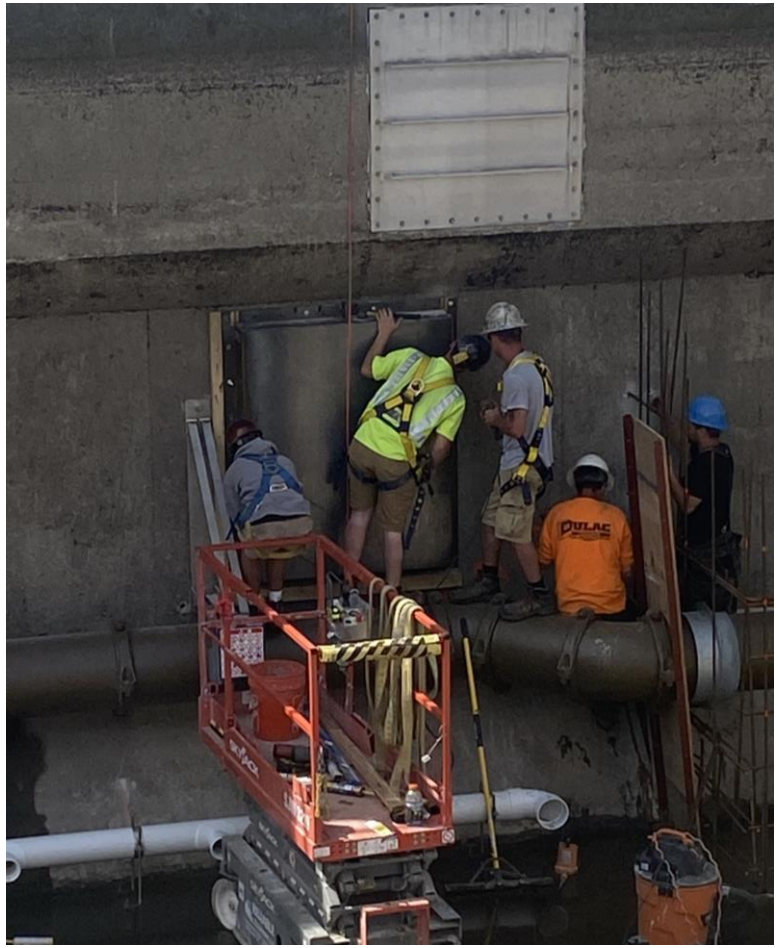


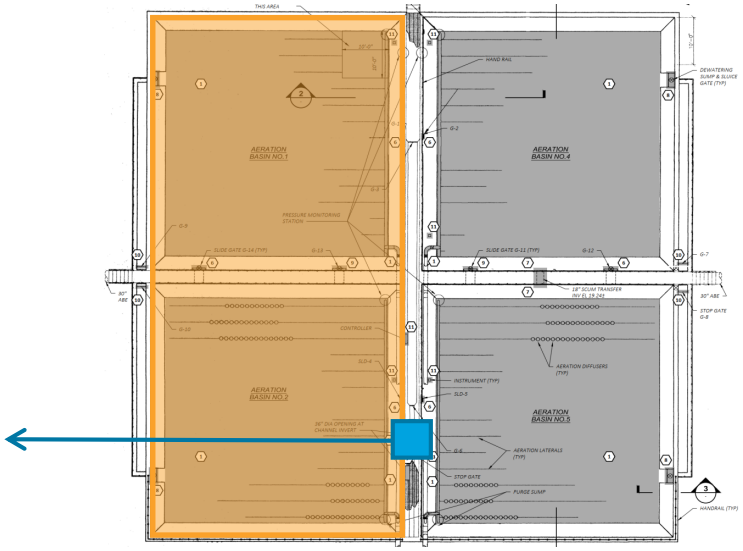
- Town gives Penta Tank 2
  - Need to Core IR Piping between Tanks
- With only ½ of the train
  - Process doing surprisingly well
  - Need to blow off excess air

Construction – Winter 2020-21

Tank 2



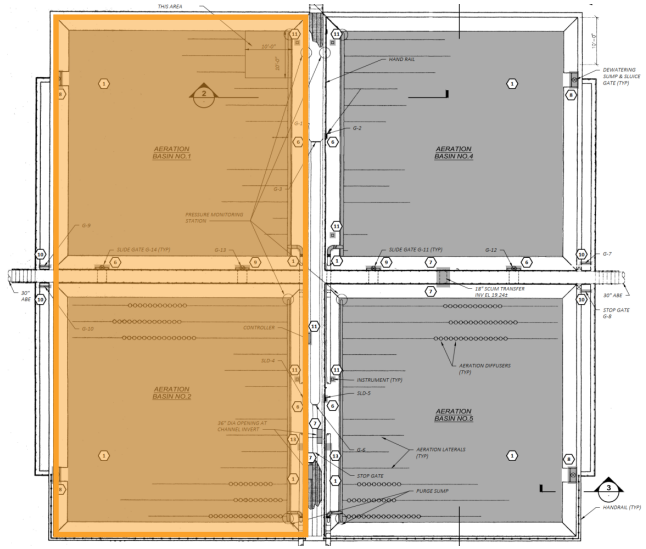




- **Plug & Plate Opening to Tank 5**
  - **No gate here – always open!**
- **IR Piping & IR Pump**
- **Install Cofferdam**
  - **Enabled future installation of Slide Gate, without draining Tanks 2 & 5 simultaneously**

Construction – Spring 2021

Tank 2

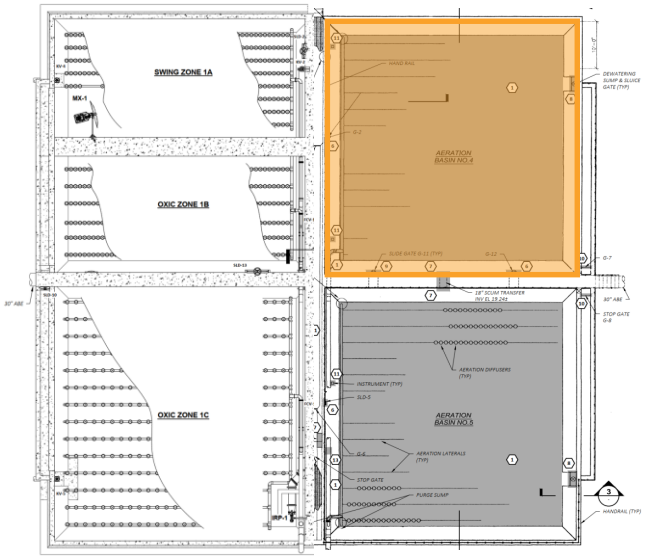


- Gates & Valves
- Diffusers & Air Piping
- Electrical Work
- Working against the clock into springtime
  - Loads on the rise…

Temporary Blower Building

Construction – Fall 2021

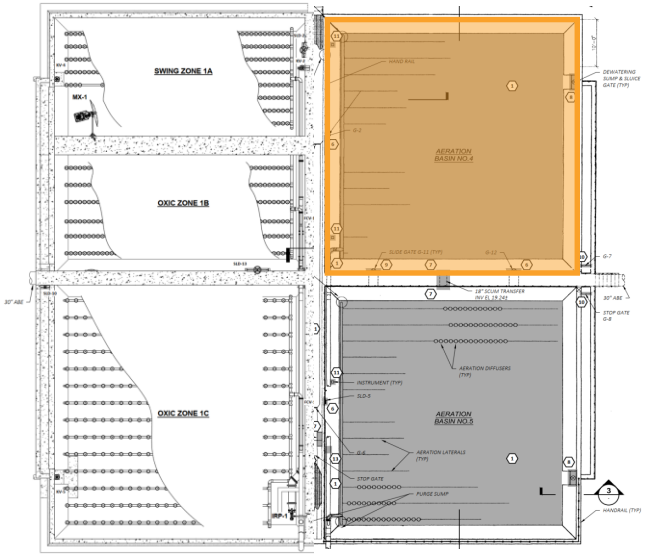
Tank 3



- Repeat for Train 2
- Switch Cofferdam to other side of Influent Channel
- Treatment Process now operating the new Train 1

Construction – Fall 2021

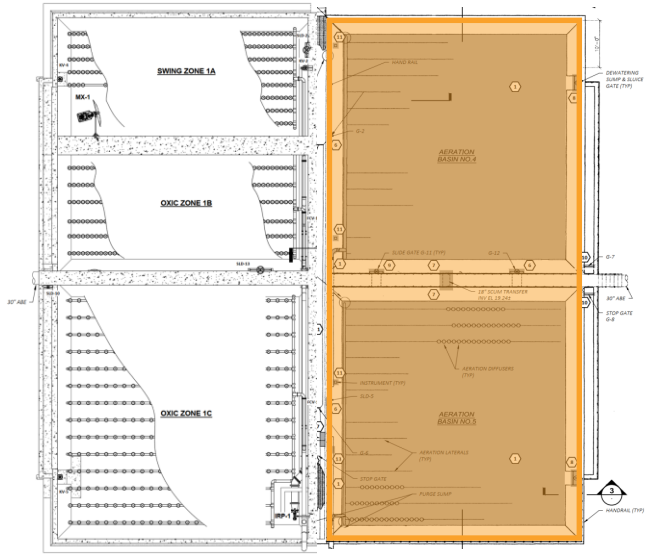
Tank 3



- **The next wall goes up**

Construction – Winter 2021-22

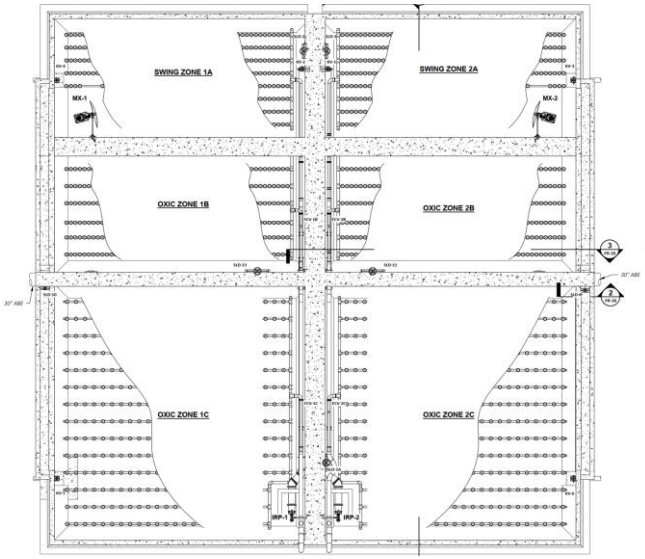
Tank 4



- Cracks in Concrete
  - Construction Joints
  - Foam Injections
- Ice Buildup in Tanks

Construction – Spring 2022

All Aboard the Aeration Train!



- **Both Trains Completed Spring 2022**
  - **Several months ahead of Planned Completion**

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Lessons Learned

- Be flexible
- Maintain close communication and cooperation between Town, Contractor, and Engineer
  - Enabled greater flexibility and creativity in sequencing approach
- Understand the WWTP and process needs
  - Enabled us to reevaluate plant capabilities and process requirements in real time
- … and consider using cofferdams to avoid bypass pumping!

The next Phase of improvements is underway… See you next year!

Acknowledgements

- Jennifer Hale
- Michael Dube
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- Joseph Lynch

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- Carlin Berger
- Dave Spaulding

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- Paul Denis
- Kyle Allcroft
- Steve Soule

THANK YOU

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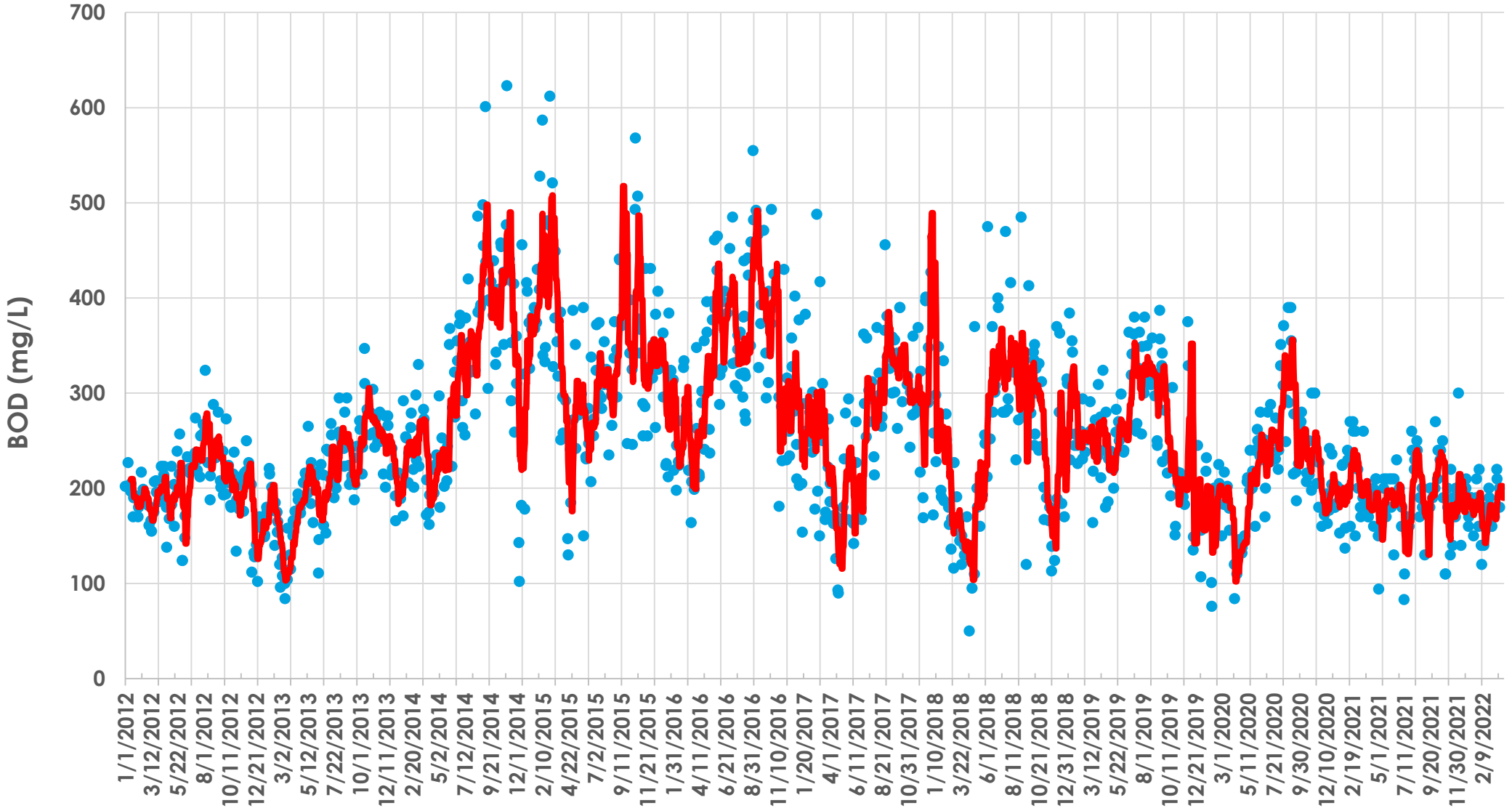
Influent BOD 2012-2022



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