Total Residual Chlorine (TRC) Evolution, Alternatives and Progress at OCDWEP Facilities

2017 Environmental Symposium – Emerging Issues and Challenges

October 12, 2017

WATER ENVIRONMENT PROTECTION

David Snyder, P.E., Sanitary Engineer II

Jeanne Powers, Sanitary Engineer III

Onondaga County Department of WATER ENVIRONMENT PROTECTION

Save the Rain

www.savetherain.us

ONONDAGA COUNTY SEAL

1. Approaches for compliance at multiple facilities (project drivers),
2. Basis for selection of disinfection and/or dechlorination technology, and
3. Design and construction challenges (lessons learned).

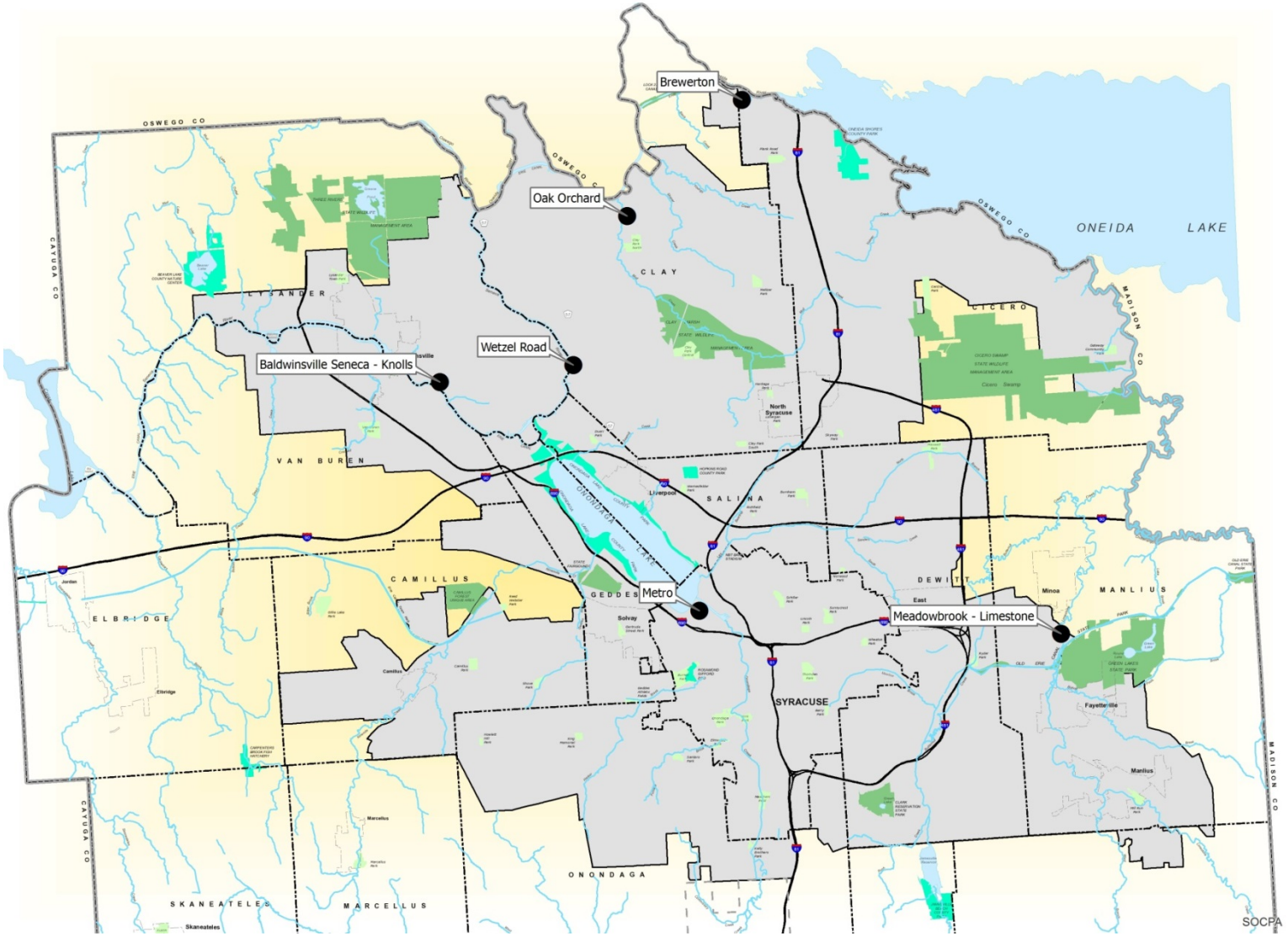
Learning Objectives

Onondaga County Department of WATER ENVIRONMENT PROTECTION

Save the Rain
www.savetherain.us

ONONDAGA COUNTY SEAL

Water Environment Protection's WWTP Facilities



SPDES Permit Negotiations

- SPDES Permits for Five County WWTPs opened in 2010- 2012 to include modifications for seasonal Total Residual Chlorine (TRC) based on a Water Quality Standard (NYS TOGS 1.3.3, 1.1.1)
- Permits included TRC limits and Compliance Schedules
- County Negotiated SPDES permits through formal comment process and informal meetings over the course of two years
- DEC did revise limits based on stream flows and extended compliance dates to allow for budgeting and construction.

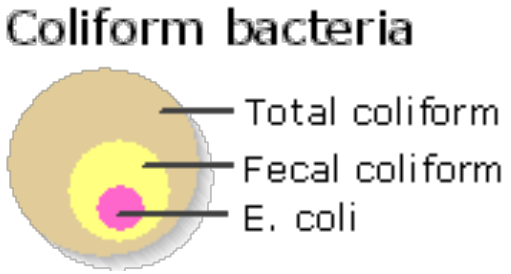
NYSDEC Basis for TRC Limitation – Seasonal Water Quality Based Effluent Limit (WQBEL)

- Environmental Driver: Elimination of chlorination disinfection byproducts

- Regulatory Driver: Compliance with Water Quality Standard – 5 µg/l
- Draft permits established Dilution Ratios
  - Utilized 7Q10 – 7 day low flow conditions and design flow to determine dilution ratio: (7Q10 + Design flow)/(Design flow).
  - Some flow monitoring records dating back to the 30's and 40's.
  - Long term data set affected by Climate Change (contemporary data use requested).

Technical Negotiations with NYSDEC

- Baldwinsville WWTP
  - EPA Commented on use of Total Coliform rather than Fecal Coliform.
  - NYSDEC justified continued use of Fecal Coliform.



- Brewerton WWTP
  - OCDWEP requested use of “modern” data for 7Q10 flows.
  - Revised calculations yielded an increase of TRC from 0.12 mg/L proposed to 0.14 mg/L final seasonal limit.
- Meadowbrook Limestone WWTP
  - Draft Permit required monitoring Enterococci, later removed (applicable only for coastal recreational waters).

Technical Negotiations with NYSDEC (Continued)

- Meadowbrook-Limestone cont.
  - Stream Flow Monitoring added to draft permit to monitor diversions from Limestone Creek (affect on assimilative capacity).
  - OCDWEP provided information and photos to prove no diversions possible so full stream flow available.

  - NYSDEC eliminated monitoring requirement, TRC limit still low due to low stream flows.

- Take-away Message
  - Receiving water flow has an impact on TRC permit limits due to effect on the dilution ratio. Those permits with low receiving stream flows have very low TRC limits. This affects the choice of technology used.

Modifications to WEP Facility SPDES Permits –Previous Permit Limits

Facility	Disinfection Season	Design Flow (MGD)	Peak Flow (MGD)	Disinfection Method at Time of Permit Renewal	Permit Limit
Metro - 001 outfall	April 1 - October 15	84.2	126.3	UV	Fecal Coli 200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)
Metro - 002 outfall	April 1 - October 15	Up to 114		Chlorination - Sodium Hypochlorite Dechlorination - Sodium Bisulfite	Fecal Coli Reported Daily Maximum, TRC Monitor Only
Oak Orchard	May 15 - October 15	10.0	24.0	Chlorination - Sodium Hypochlorite	Fecal Coli 200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)
Baldwinsville Seneca Knolls	May 15 - October 15	9.0	18.0	Chlorination - Sodium Hypochlorite	Fecal Coli 200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)
Wetzel Road	May 15 - October 15	7.0	15.7	UV	Fecal Coli 200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)
Meadowbrook Limestone	May 15 - October 15	6.5	16.0	Chlorination - Sodium Hypochlorite	Fecal Coli 200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)
Brewerton	May 15 - October 15	3.0	7.5	Chlorination - Sodium Hypochlorite	Fecal Coli 200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)

Disinfection Project Schedules

- Five out of six County permit under renewal at the same time, each requiring a disinfection upgrade.
- OCDWEP concerned over both financial capability and schedule.
- Draft permits issued by NYSDEC without consideration given to other County efforts.
- Example: 2013 draft for Oak Orchard WWTP included an effective date of EDP + one year for final TRC limit.
- OCDWEP proposed schedule to DEC coordinating the needs of the County owned treatment plants.
- Permits were resolved with County time frames suggested.

Multiple Facilities Requiring Capital Improvement Planning

- WEP Rule of Thumb – 5 Years from Permit Requirement to Construction
- Budgeting and Approvals (County Executive and Legislature)
  - CIP Development - Spreading out the Capital Expense
- RFP Development, Advertising and Award.
- Design (25% thru Final)
  - County team hands on in design review and comments
  - Plan for complex geotechnical issues or Site Management Plan (Soils)
- Construction Budgeting
  - Firm construction estimate by 95% Design
  - Timing in County budget cycle
- NYSDEC and EFC Reviews and Approvals
- Construction Advertising and Award
- Construction Schedules (9 to 18 Months).

SCHEDULE NEGOTIATION S WITH NYSDEC

Disinfection Project Planning Schedules

Project Name	RFP Process (months)	Design/Evaluation Start	Preliminary Design / Evaluation Complete	Final Design	DEC Approval	Construction Start	Construction End	Timeframe - RFP Process Start to Construction End (months)
Baldwinsville WWTP: Disinfection	12	Dec-14	Jul-15	Jun-16	Oct-16	Mar-17	Sep-18	58
Brewerton WWTP Disinfection and Baffles	0	Jul-13	Dec-13	Jun-14	Oct-14	Mar-15	Jan-16	30
Meadowbrook-Limestone WWTP Disinfection	12	Dec-14	Aug-15	Jul-16	Nov-16	May-17	Oct-18	59
Metro WWTP 002 Bypass Treatment - Disinfection	0	Sep-13	tbd	tbd	tbd	tbd	Nov-17	50
Oak Orchard WWTP Disinfection	12	Dec-14	Aug-15	Jul-16	Nov-16	May-17	Oct-18	59

SCHEDULE NEGOTIATION WITH NYSDEC

Modifications to WEP Facility SPDES Permits – New Permit

Facility	Disinfection Season	Permit Effective Date	Compliance Date	Permit Limit	
				Fecal Coli	TRC
Metro - 01A	April 1 - October 15	March 21, 2012	Original April 1, 2016, Extended - April 1, 2017	200 cells/100 ml (30 day Geomean)	0.1 mg/l
Metro - 002 outfall	April 1 - October 15	March 21, 2012	Original April 1, 2016, Extended - April 1, 2017	200 cells/100 ml (30 day Geomean)	0.1 mg/l
Oak Orchard	May 15 - October 15	July 1, 2014	November 1, 2018, effectively May 15, 2019	200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)	0.045 mg/l
Baldwinsville Seneca Knolls	May 15 - October 15	July 1, 2014	May 15, 2018	200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)	0.8 mg/l
Meadowbrook Limestone	May 15 - October 15	July 1, 2014	May 18, 2018	200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)	0.02 mg/l
Brewerton	May 15 - October 15	January 1, 2011	May 15, 2016	200 cells/100 ml (30 day Geomean), 400 cells/100 ml (7 day Geomean)	0.14 mg/l

"NEW" TRC LIMITATIONS

Possible Approaches for Disinfection Permit Compliance

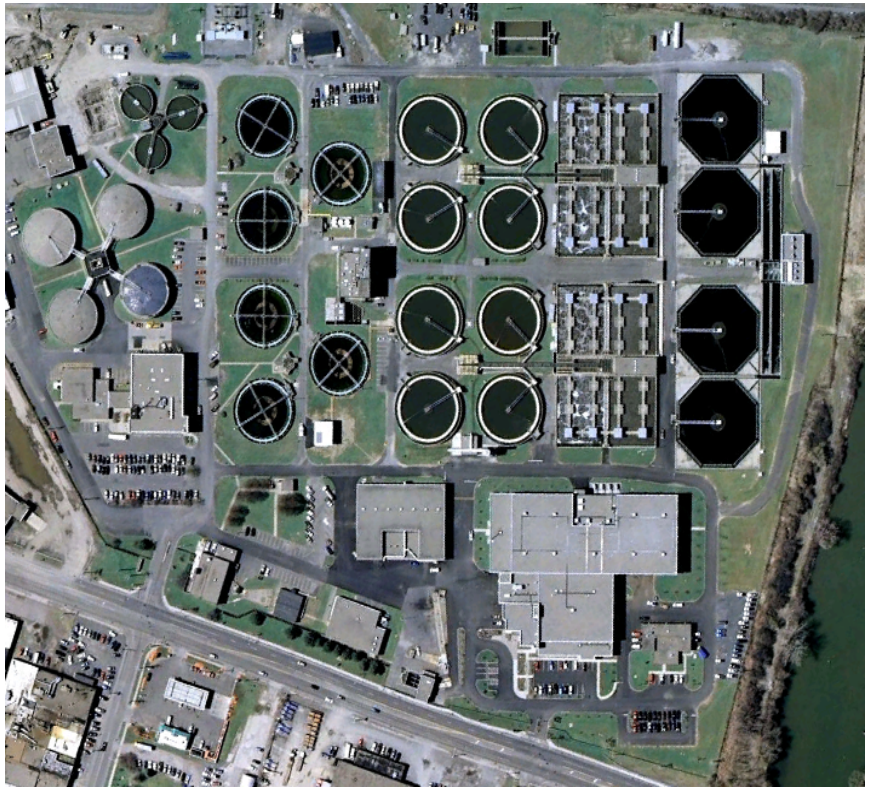
- Dechlorination – Historically used sodium hypochlorite for disinfection at five (5) County WWTPs.
- Peracetic Acid (PAA) – Short contact times with no disinfection by-products.
  - Jar Testing, Pilot testing, Compliance Schedule, vendor support and DEC acceptance.
- Ozone – No first hand experience and high capital cost.
- Ultraviolet Disinfection – Used at Metro 001 and Wetzel Road WWTP
  - Mixed success based on technology (medium pressure, high intensity lamps vs. low pressure, high intensity lamps.
  - Coagulant type (iron vs aluminum).
  - Transmissivity.
  - Electrical (available power and annual O&M).
- Site Constraints – Flood Zone and Flood Plain (New Mapping effective November 2016).
- Consideration for future E. Coli limitations.

Ultimately, the selection was plant specific, and we'll go over each in detail……..

Metro Secondary Bypass

Project Drivers:

- Treat flows between 126 mgd and 240 mgd
- History of ineffective disinfection due to lack of contact time
- Existing Infrastructure circa 1970's
- New Limit for TRC



Challenges:

- Variable flow conditions due to wet weather
- Site conditions (Former MGP Site, Solvay Waste, and Seismic Class F).
- Aggressive Compliance Schedule

Technical Memorandum – Evaluate Compliance Alternatives

Goals

- Determine process tankage requirements.
- Evaluate reusing existing abandoned tertiary tanks.
- Consider geotechnical issues and other construction challenges.
- Develop recommendation, cost estimate and schedule.

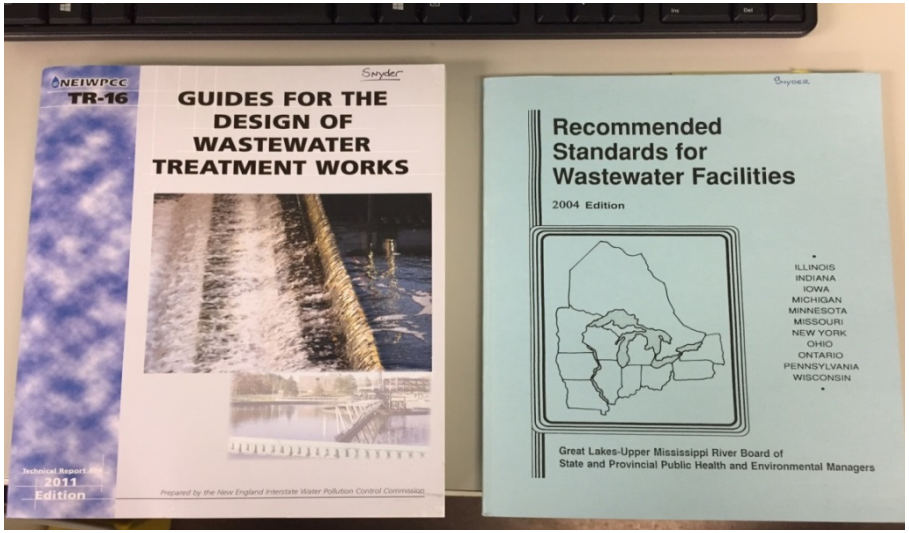
Options

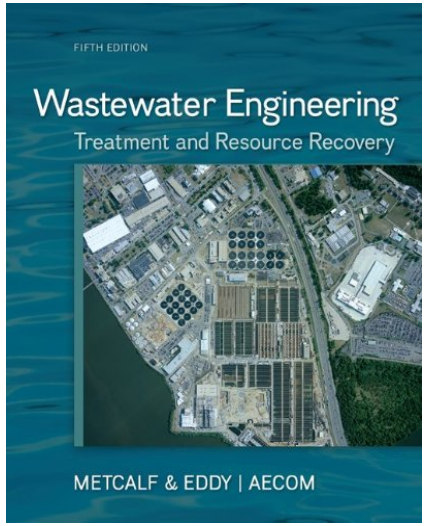
1. Construct New Process Tankage
   - Provides greater operational flexibility
   - Design challenges identified:
     - Proximity to railroad.
     - Proximity to OCWA 24" main.
     - Proximity of overhead electrical.

2. Reuse of Abandoned Tertiary Treatment Tanks
   - Numerous risks identified
     - High risk of extra costs associated with unknown conditions.
     - Geotechnical issues/uneven settling of existing tanks (not on piles).
     - Structural integrity – shorter life expectancy.
     - Tank penetrations and wire wound tanks limit piping connections.
     - Conveyance issues to final discharge point.

Design Standards/Guidance For Chlorination/Dechlorination

- Design standards: Disinfection and dechlorination contact times of 15 and 0.5 minutes, respectively at peak hourly flow (Recommended by Ten State Standards) and 2 minutes at average flow per TR-16.
- Conservatively designed using 30 minutes of chlorination contact time and 5 minutes for dechlorination.
- With peak flows of 114 mgd, a total process tankage volume of approximately 2.8 million gallons (MG) is required.





Design Approach

1. Addition of approximately 2.0 MG of new process tankage to be connected in series with the existing bypass chlorine contact tank to achieve disinfection and dechlorination compliance – this will provide approximately 2.8 MG total for disinfection/dechlorination.

2. Added benefit of capturing additional phosphorus containing wastewater from secondary bypasses; reducing on average 670 lbs./year of phosphorus from this location.

Objective is to achieve both disinfection TRC compliance and assistance with Phosphorus Total Maximum Daily Load (TMDL) waste load allocation compliance, specifically the aggregate limit for Metro's discharges (001, 01A and 002).

Metro 002 Bypass Improvements

$20 million Project to Achieve SPDES compliance by April 2017

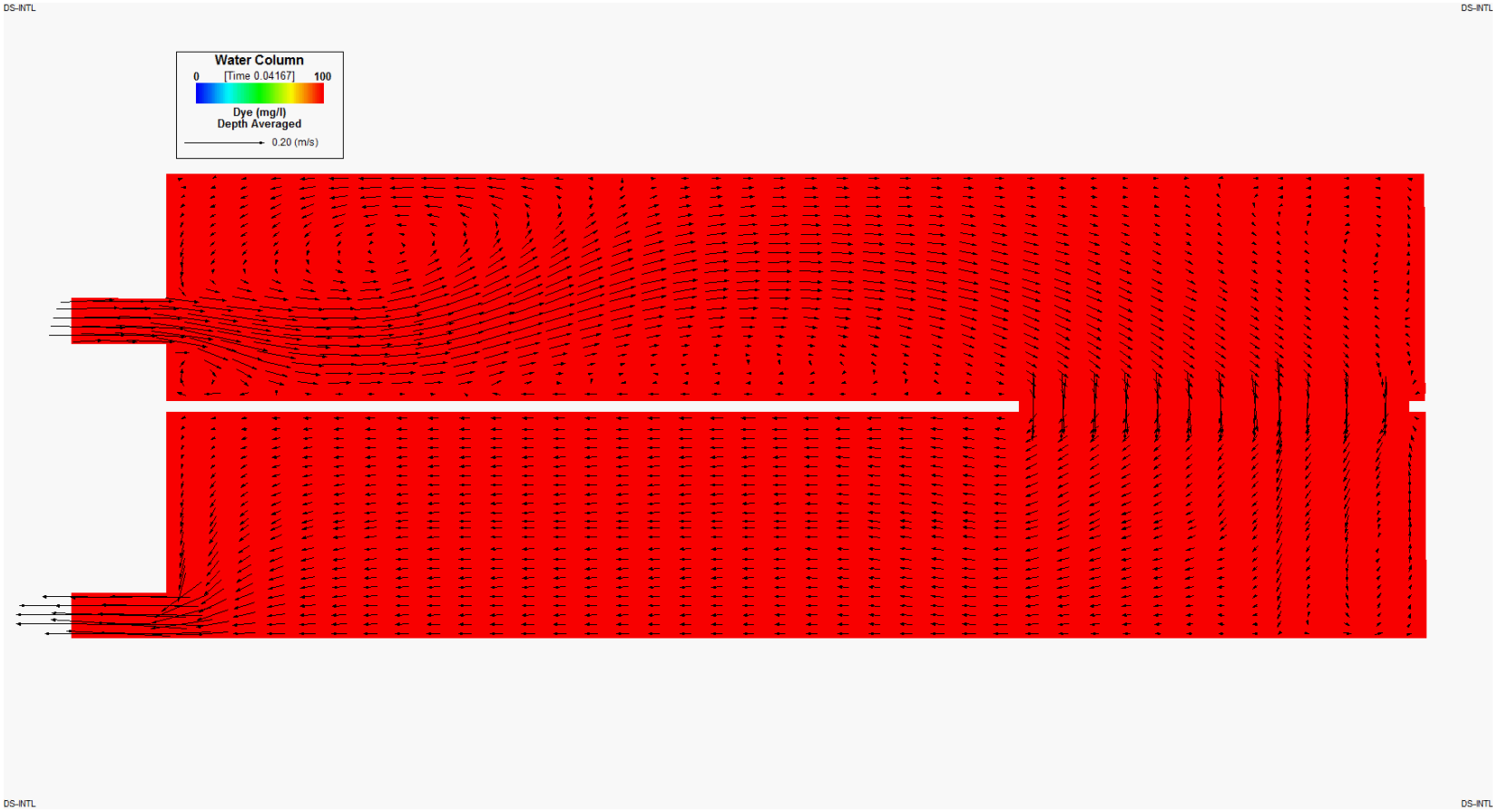
- Upgrades to disinfection system.
- New process tankage (Increased volume).
- Improvements to flow monitoring system.
- Improvements to chlorination feed system.
- Tertiary bypass avoidance.
- Essential to meeting revised fecal coli. And total residual chlorine (TRC) limits.

Secondary Bypass Disinfection Improvements Project

Road To Construction - RFP June 2013

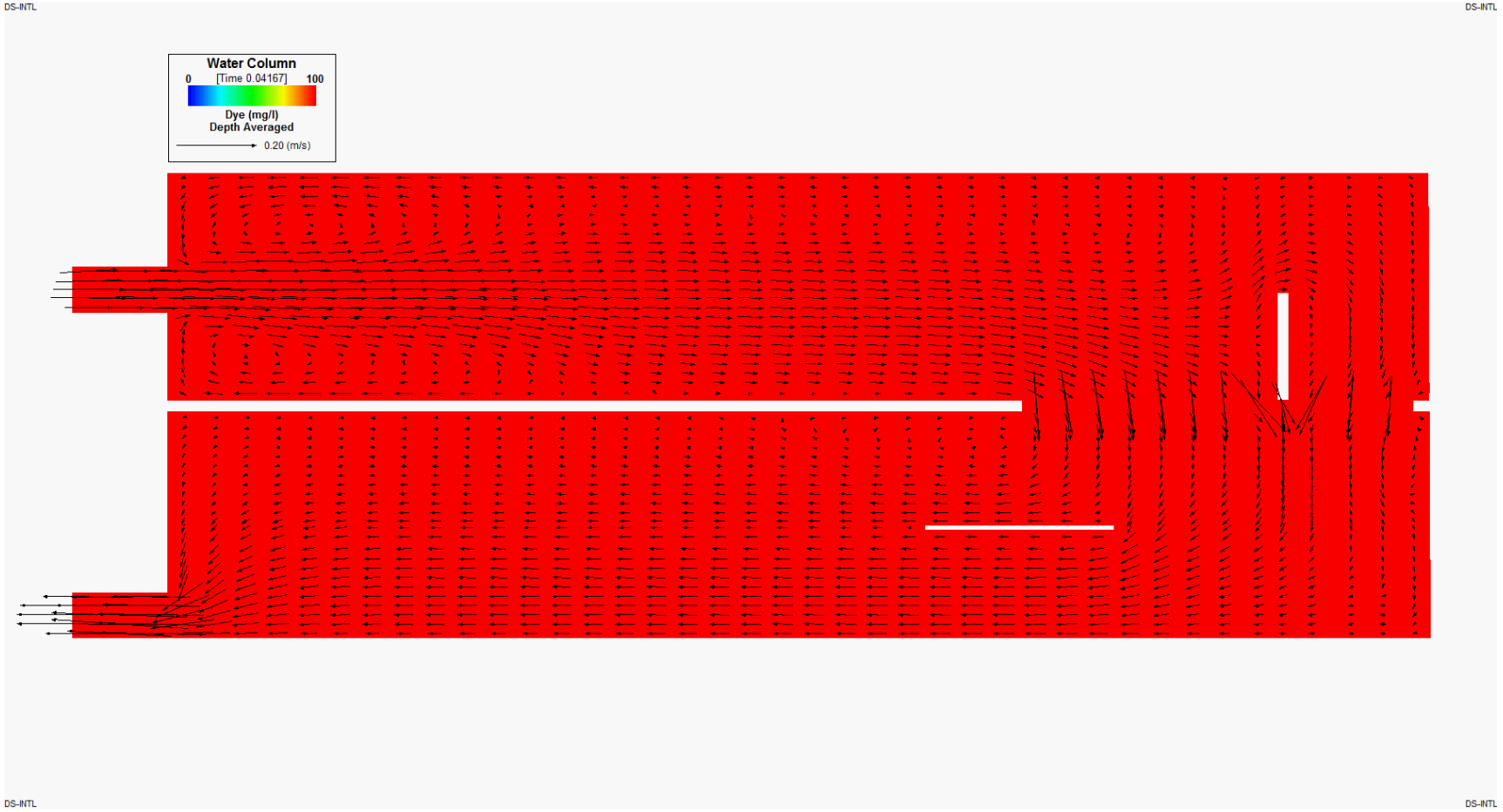
- Basis of Design, 50% Design, and Final Design
  - Roughly 1 year
- Regulatory Review and Approval (NYSDEC and EFC)
  - 45 days
- Bidding – Advertising thru Award
  - 3 months
- Notice to Proceed - 9/30/15
  - Construction Duration 671 Days
- Factors affecting schedule
  - Contracts
  - Insurance
  - Submittals
  - MWBE Requirements
- First day onsite was the end of November 2015
- In service starting April 1, 2017.

Dispersion Model – Baffle Design (No Baffle)



Environmental Fluid Dynamics Code (EFDC) Model

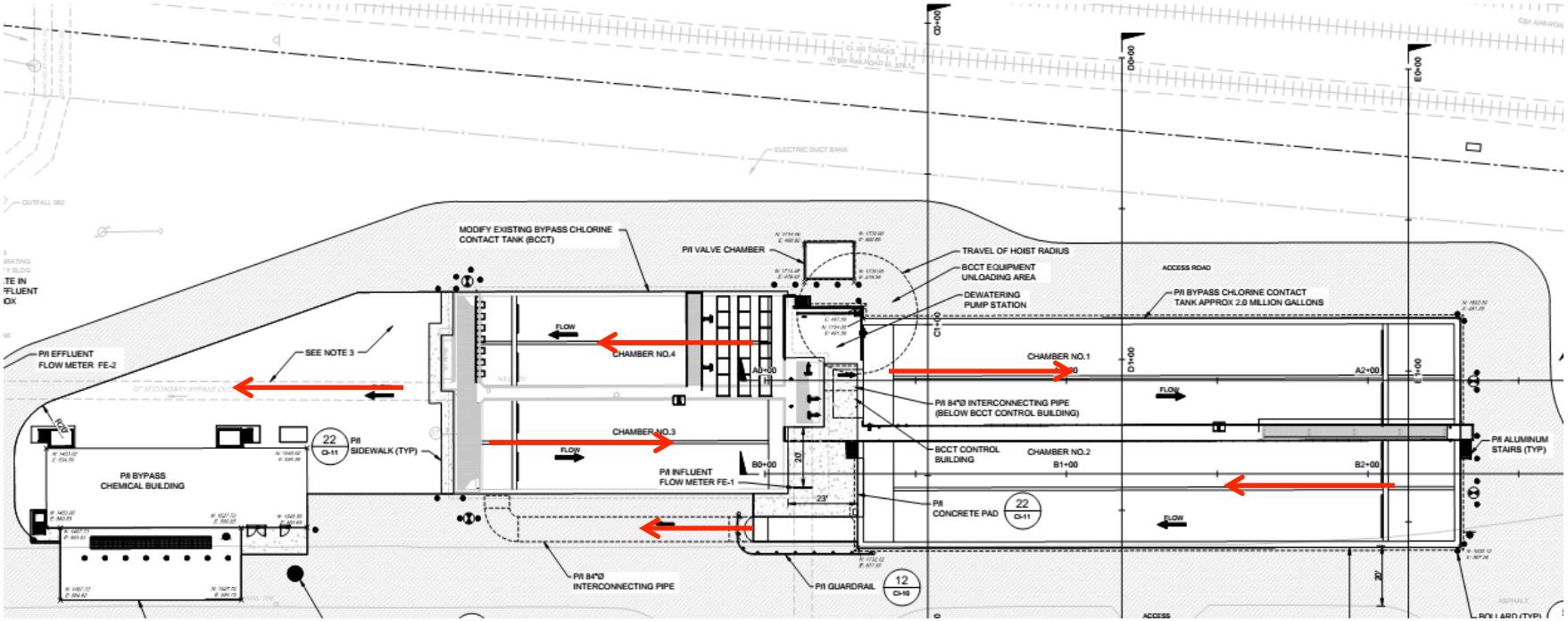
Dispersion Model – Baffle Design (Two Baffle)



Minimizing short circuiting, reducing hydraulic impact and facilitate O&M.

Environmental Fluid Dynamics Code (EFDC) Model

Final Design – Site Plan



From Secondary Bypass Structure

Secondary Bypass Disinfection Improvements Project

Construction and Design Features

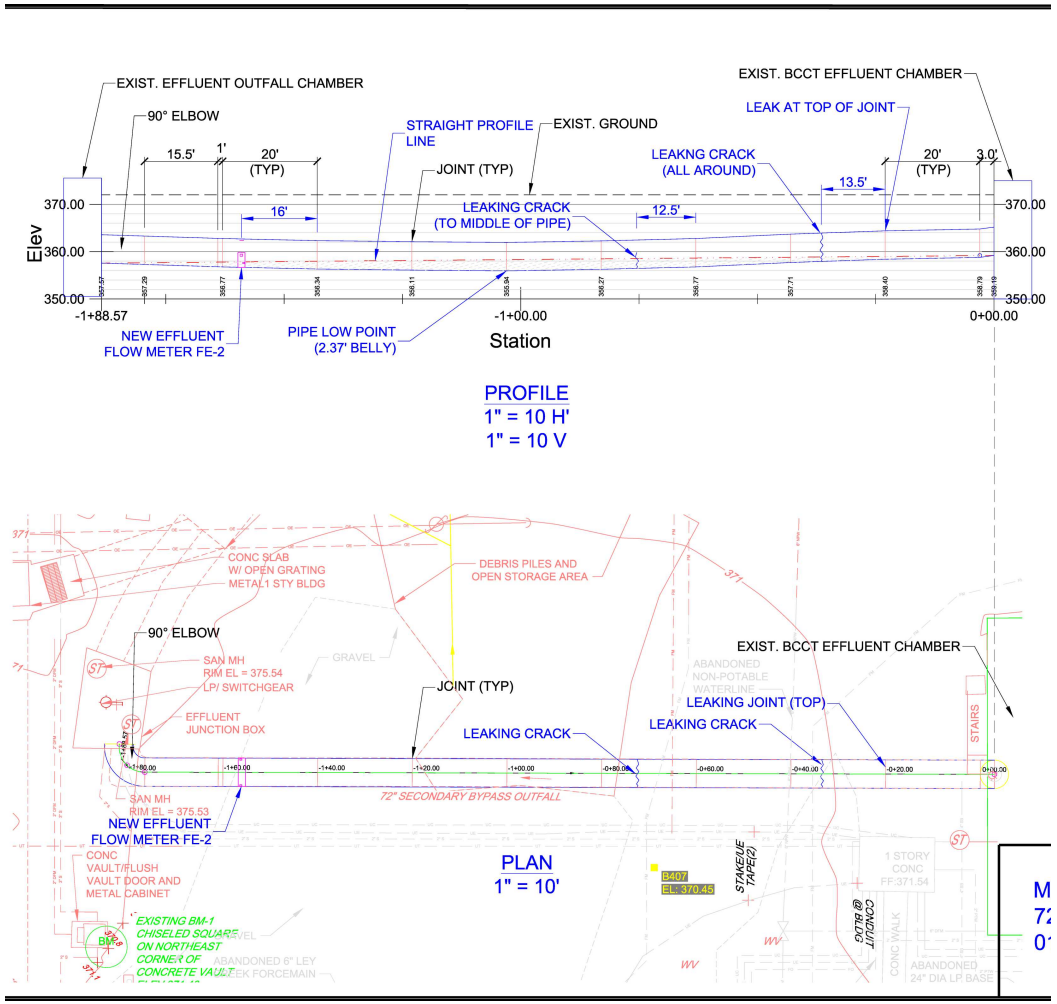
Piles, Sheeting, Pre-cast Building, Chemical Tank Access

Geotechnical Issue No. 1 - Wall Failure in Existing BCCT

Design Features

CURB, FLUSHING GATES, BAFFLES AND TESTING

Geotechnical Issue No. 2 - Effluent Pipe Settlement



NEW CHANNEL AND FLOW METER

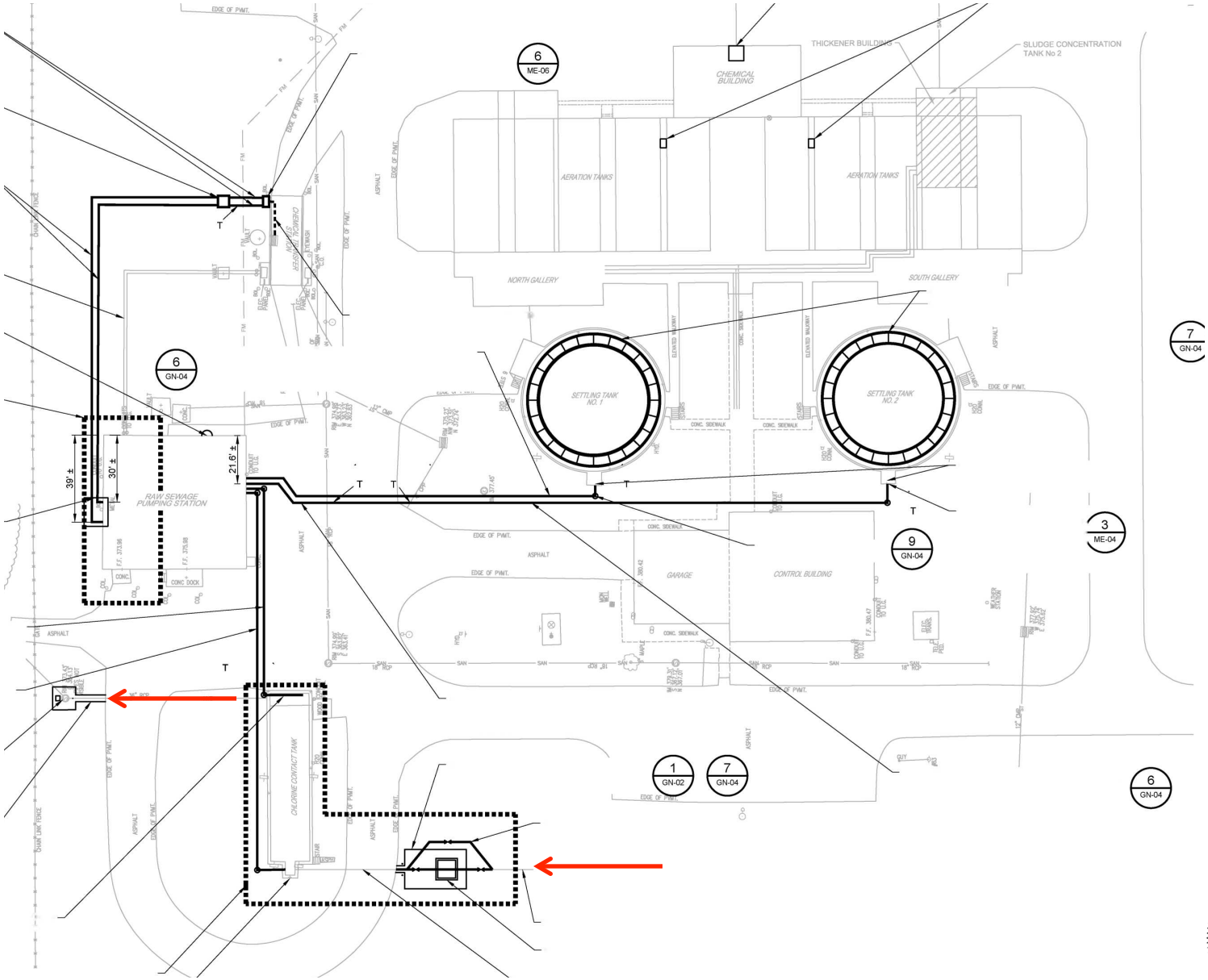
Final Product and Lessons Learned

- Geotechnical Issues
- Flow Monitoring
- SCADA Programming by Consultant rather than Contractor (Coordination).
- Pre-cast Building

Brewerton WPCP – Disinfection Project (Chlor/Dechlor)

- First Permit with TRC Addition (0.14 mg/l).
- Included general asset renewal for disinfection (tanks, chemical pumps, feed lines, etc.).
- Utilize available space in CBS room.
  - Geotechnical Issue.
- Effluent mag-meter (reporting and flow pacing).
- Hydraulic restriction in CCT Distribution Structure.
- Sodium Bisulfite diffuser in CCT effluent outfall (mixing).
- Dechlor in submerged effluent pipe.
- Down-stream Monitoring manhole.

Final Design – Site Plan



Brewerton WPCP Chlor/Dechlor

Brewerton WPCP – Disinfection Project

From Permit to Start-up

- Days/Years – 5 year, 5 Months
- Engineering $382.7K (Total Contract) ($220K Disinfection only)
- Construction $ 1.147M

General Contractor – Blue Heron Construction

Electrical – O'Connell Electric Co.

<u>Lesson's Learned</u>

- Simple diffusers
- Platform arrangement/clearance
- Equipment lead times
- Accountability – submittals and schedule
- No feed-back or on-line analyzers.

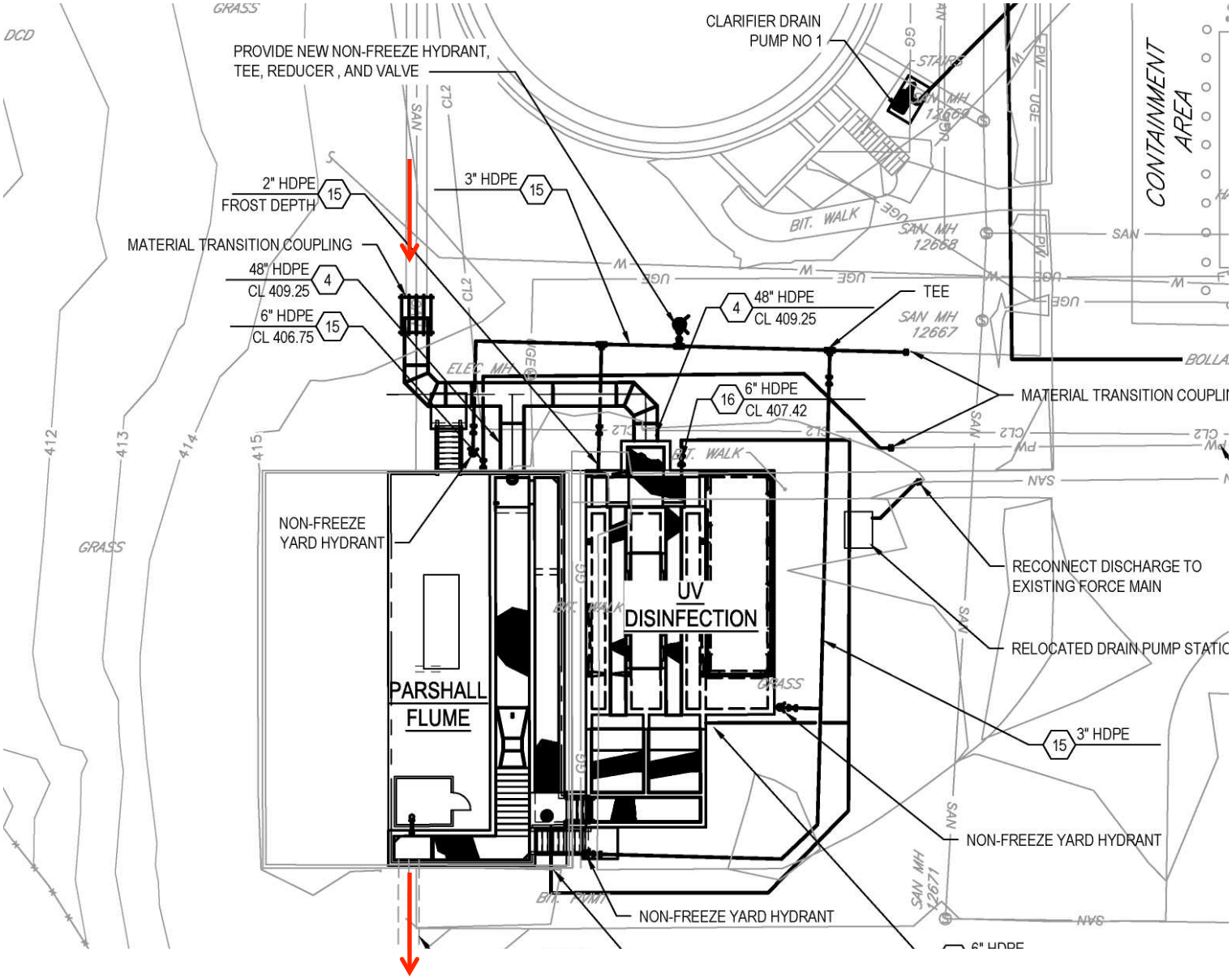
POST-CONSTRUCTION

MBLS WWTP Disinfection and Clarifier Improvements (UV)

- Only facility selected for UV disinfection - stream flow, trout stream, highly visible, good transmittance (>65%) and lowest TRC limit.
- Pre-selection of UV Equipment (Wedeco).
- Coagulant switch from Ferrous Chloride to Alum.
- Polymer Addition.
- Effluent Parshall Flume (reporting).
- Floodway and Flood Plain Issues (LOMA).
- Included as part of larger asset renewal (substation, clarifiers, coagulant, influent mag meter, roofing, etc).

DESIGN

Final Design – Site Plan



MBLS WWTP UV Facility

MBLS WWTP Disinfection and Clarifier Improvements (Current Status)

From Permit to Start-up

- Days/Years – < 4 years for disinfection
- Engineering $1.119M (Total Contract)
- Construction $ 9.266M

General Contractor – MA Bongiovanni

Electrical – Patricia Electric

HVAC – Advanced Sheet Metal

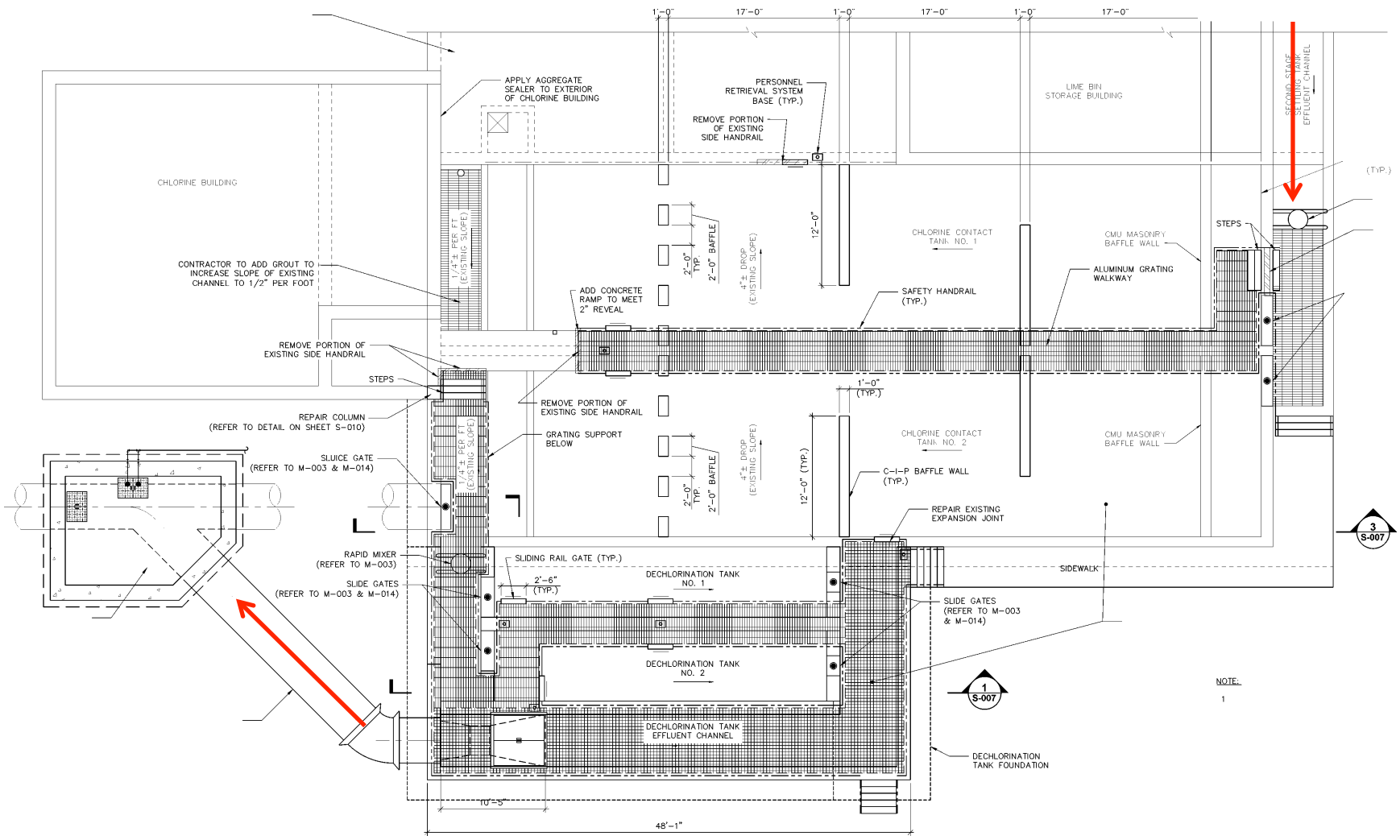
<u>Lesson's Learned</u>

- Schedule Impacts - Internal County and LOMA process.
- Pre-selection Process - Internal acceptance, impact on design, and cost-tipping point.

BSK WWTP Disinfection Project (Chlor/Dechlor)

- Add Dechlor Process Tanks.
- Baffle walls in CCT.
- Effluent Parshall Flume (reporting and flow pacing).
- Feedback control with analyzers.
- Ease of maintenance (walkways, grating, and hose bibs, scum troughs, etc.).
- Sampling Shed.
- Chemical unloading station.
- Available inside storage for bisulfite tanks.
- Included general asset renewal for disinfection (tanks, chemical pumps, feed lines, slide gates, etc.).

Final Design – Site Plan



BSK WWTP Chlor/Dechlor

BSK WWTP Disinfection Project – Construction Started Fall 2017

From Permit to Start-up

- Days/Years - < 4 Years
- Engineering $262K
- Construction $2.641M

General Contractor – MA Bongiovanni

Electrical – O'Connell Electric

<u>Lessons Learned</u>

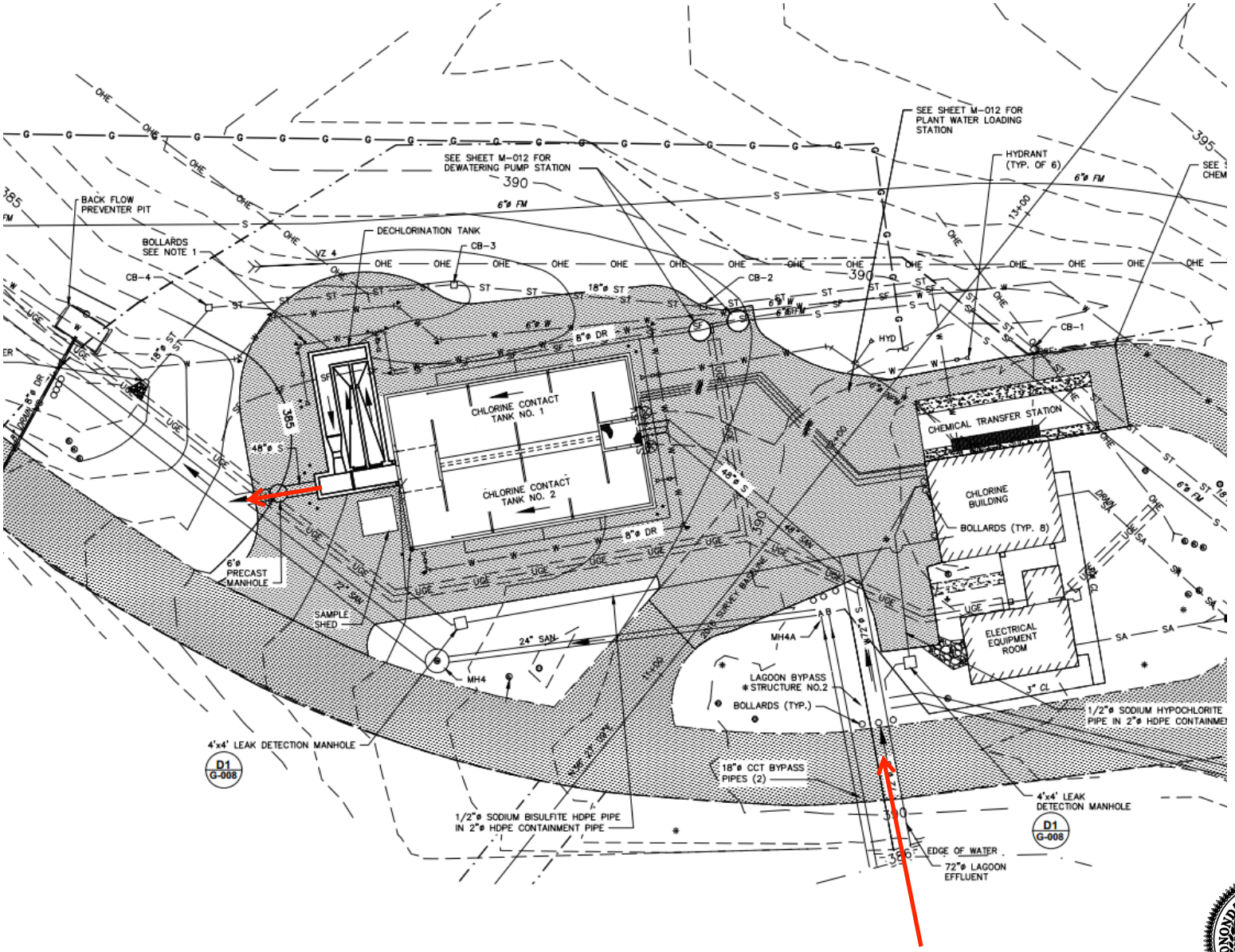
- Engineers Estimate and multiple County Projects out-to-bid (delay).
- Pre-cast vs Cast-in-Place

Oak Orchard WWTP – Disinfection Project (Chlor/Dechlor)

Similar design to Approach to BSK.

- Add Dechlor Process Tanks.
- CCT tank rehab (concrete degradation).
- Effluent Parshall Flume (reporting and flow pacing).
- Feedback control with analyzers.
- Ease of maintenance (dewatering, mud valves, and access for vac trucks).
- New Chemical unloading station.
- Available inside storage for bisulfite tanks.
- Included general asset renewal for disinfection (tanks, chemical pumps, feed lines, slide gates, etc.).

Final Design – Site Plan



Oak Orchard WWTP Chlor/Dechlor

Oak Orchard WWTP – Disinfection Project

From Permit to Start-up (estimates)

- To be advertised in the 1st quarter of 2018.
- Days/Years - 4 Years, 10 months.
- Engineering $762K (Combined with Lagoon Cleaning Project).
- Construction $2.2M at 50% Design.

<u>Lessons Learned</u>

- Residual Bisulfite meters.

Still In Design

1. PAA is a proven and accepted practice/standard for effluent disinfection in NYS (True or False).

2. What is the minimum contact time for chlorine based disinfection per approved standards?

PDH Required Questions

Onondaga County Department of WATER ENVIRONMENT PROTECTION

Save the Rain
www.savetherain.us

ONONDAGA COUNTY SEAL

1. PAA is a proven and accepted practice/standard for effluent disinfection in NYS (True or False).

   False, in pilot testing approach.

2. What is the minimum contact time for chlorine based disinfection per approved standards?

PDH Required Questions

1. PAA is a proven and accepted practice/standard for effluent disinfection in NYS (True or False).

   False, in pilot testing approach.

2. What is the minimum contact time for chlorine based disinfection per approved standards?

   15 minutes at design peak hourly flow (10 State Standards), and 30 minutes per TR-16.

PDH Required Questions

3. What is the minimum contact time for dechlorination per approved standards?

4. What is the minimum transmittance required for UV Disinfection?

PDH Required Questions (Continued)

3. What is the minimum contact time for dechlorination per approved standards? 30 seconds of mixing and contact time at design peak hourly flow (10 State Standards), and 2 minutes at average flow per TR-16.

4. What is the minimum transmittance required for UV Disinfection?

PDH Required Questions (Continued)

3. What is the minimum contact time for dechlorination per approved standards? 30 seconds of mixing and contact time at design peak hourly flow (10 State Standards), and 2 minutes at average flow per TR-16.

4. What is the minimum transmittance required for UV Disinfection? At least 65%.

PDH Required Questions (Continued)

Review of the Learning Objectives

1. Approaches for compliance at multiple facilities (project drivers); coordination with the DEC, Chlor/ Dechlor, UV and design standards.
2. Basis for selection of disinfection and/or dechlorination technology; cost, receiving stream, and past performance and experience.
3. Design and construction challenges (lessons learned); geotechnical, SCADA Programming and Integration, and on-line analyzers.
4. The value of good consultants and contractors.

THANK YOU! ANY QUESTIONS?

Onondaga County Department of WATER ENVIRONMENT PROTECTION

Save the Rain

ONONDAGA COUNTY SEAL