The Potomac Aquifer Recharge Oversight Committee
Meeting Minutes
September 4, 2019
SWIFT Research Center, Suffolk, VA

In attendance: David Paylor, DEQ; Dr. Norman Oliver, VDH; Dr. William Mann, Appointee; Doug Powell, Appointee; Whitney Katchmark, HRPDC; Harold Post, OWML; Mark Widdowson, PARML; Gary Schafran, PARML, Kurt McCoy, USGS

The Chair, David Paylor called the meeting to order at 11 am. After introductions the committee reviewed their duties as outlined in the legislation creating the committee and monitoring lab. Committee is to meet quarterly. David Paylor is chair until July 1, 2020 when committee shall select chair from membership.

Mark Widdowson and Gary Schafran, co-directors of the Potomac Aquifer Recharge Monitoring Lab made a presentation on the status of the lab. The PARML will be located at a VT owned facility in Hampton at the National Institute of Aerospace (NIA). Work is on-going to outfit lab. Modeling work will build on current model and existing monitoring network. Work to be done on how dense that network needs to be. The lack of resources for maintenance and replacement of existing groundwater monitoring network was discussed and a future action of providing advisory input to the Governor on resources necessary to maintain and expand the monitoring network was discussed.

HRSD staff (Jamie Mitchell, Chief of Technical Services and Charles Bott, Director of Water Technologies and Research) updated the committee on regulatory reporting and SWIFT performance to date as well as research priorities for the next 12 months.

There were no public comments.

The Chair discussed next meeting dates and location. A poll will be sent to members for availability for a date in late November or early December. Location will be the PARML at NIA in Hampton.

APPROVED:

David K. Paylor
Committee Chair

CHAPTER 54

An Act to amend the Code of Virginia by adding in Title 62.1 a chapter numbered 26, consisting of sections numbered 62.1-271 through 62.1-275, relating to Potomac Aquifer recharge monitoring; laboratory established; SWIFT Project.

[H 2358]

Approved February 19, 2019

Be it enacted by the General Assembly of Virginia:

1. That the Code of Virginia is amended by adding in Title 62.1 a chapter numbered 26, consisting of sections numbered 62.1-271 through 62.1-275, as follows:

CHAPTER 26.

POTOMAC AQUIFER RECHARGE MONITORING.

§ 62.1-271. Definitions.

For the purposes of this chapter:

"Committee" means the Potomac Aquifer Recharge Oversight Committee established pursuant to § 62.1-272.

"Department" means the Department of Environmental Quality.

"HRSD" means the Hampton Roads Sanitation District.

"Laboratory" means the Potomac Aquifer Recharge Monitoring Laboratory established pursuant to § 62.1-274.

"SWIFT Project" means the Sustainable Water Initiative for Tomorrow Project conducted by HRSD.

§ 62.1-272. Potomac Aquifer Recharge Oversight Committee.

A. The Potomac Aquifer Recharge Oversight Committee is established as an advisory board and shall consist of eight voting members and two nonvoting members:

1. The State Health Commissioner or his designee, who shall be a full-time employee of the Virginia Department of Health;

2. The Director of the Department of Environmental Quality or his designee, who shall be a full-time employee of the Department;

3. The Executive Director of the Hampton Roads Planning District Commission or his designee, who shall be a full-time employee of the Hampton Roads Planning District Commission;

4. The two Co-Directors of the Potomac Aquifer Recharge Monitoring Laboratory established pursuant to § 62.1-274;

5. The Director of the Occoquan Watershed Monitoring Laboratory, established pursuant to regulations adopted by the Board;

6. A Virginia citizen who is a full-time employee of a water authority or locality that depends on the Potomac Aquifer as a significant source of public drinking water;

7. A Virginia citizen who is a licensed physician engaged in medical practice within the Eastern Virginia Groundwater Management Area;

8. The Regional Administrator of Region III of the U.S. Environmental Protection Agency (EPA) or his designee, who shall be a full-time employee of EPA Region III and shall serve ex officio without voting privileges; and

9. The Director of the Virginia and West Virginia Water Science Center of the U.S. Geological Survey (USGS) or his designee, who shall be a full-time employee of USGS and shall serve ex officio without voting privileges.

The two Virginia citizen members shall be selected on the basis of merit without regard to political affiliation and shall, by character and reputation, reasonably be expected to inspire the highest degree of cooperation and confidence in the work of the Committee. Each citizen member shall be appointed by the Governor, subject to confirmation by the General Assembly, and shall be appointed for an initial term of two years ending July 1, 2021, and for a term of four years thereafter. Any vacancy of the seat of a citizen member other than by expiration of a term shall be filled by the Governor by appointment for the unexpired term.

B. The Director of the Department shall be the initial chairman of the Committee and shall serve an initial term as chairman until July 1, 2020. The Committee shall elect a chairman to serve thereafter from among any of the eight voting members. The chairman shall be elected to serve a one-year term ending the next July 1 or until his successor is elected. There shall be no limitation on the number of consecutive terms that a committee member may be elected to serve as chairman.

C. The Committee shall convene at least quarterly during the initial three years ending July 1, 2022, and shall convene at least once per calendar year thereafter.

§ 62.1-273. Committee duties and functions.

A. The Committee shall be responsible for ensuring that the SWIFT Project, including its effect on the Potomac Aquifer, is monitored independently.

B. The Committee shall periodically, but not less than every five years, obtain an evaluation of the work of the Potomac Aquifer Recharge Monitoring Laboratory by an independent panel of national experts convened under the auspices of the National Water Research Institute or a similar organization. The evaluation shall address (i) monitoring parameter selection procedures; (ii) analytical methods and screening techniques; (iii) monitoring locations, frequency, results, and interpretation; (iv) modeling activities; and (v) research activities.

C. Additional related activities of the Committee may include:

1. Ensuring that a monitoring program is developed and implemented for monitoring water quality, geological, aquifer pressure, land subsidence, and other SWIFT Project-related impacts;

2. Ensuring independent review of data concerning the quality of the final water produced by the SWIFT Project and upstream process control testing conducted by HRSD in the course of operating the SWIFT Project;

3. Ensuring that a continuous record of monitoring data is maintained and available;

4. Ensuring that projections are made of the effects of the SWIFT Project;

5. Ensuring that the Laboratory operations are separate, distinct, and independent from operations by HRSD;

6. Ensuring that research or modeling on aquifer science, managed aquifer recharge, water reuse treatment, wastewater treatment, and advanced treatment technology is conducted and coordinated with the appropriate stakeholders;

7. Ensuring that data on the status and performance of the SWIFT Project and on any changes in the condition of the aquifer due to the SWIFT Project are synthesized, reported, and submitted at least once a year to the relevant regulatory agencies and made available to localities, water authorities, the general public, and other stakeholders within the Eastern Virginia Groundwater Management Area;

8. Serving as a liaison with stakeholders in the Eastern Virginia Groundwater Management Area;

9. Ensuring that informational material related to the SWIFT Project is readily available to the public;

10. Ensuring that the Laboratory is established to fulfill the above responsibilities;

11. In the event that the Committee finds there to be, related to the SWIFT Project, an imminent danger to the environment, a public water supply, or public health, welfare, or safety, referring such matter to the State Water Control Board for the potential issuance of an emergency order to cease injection or make changes pursuant to subdivisions (8a) and (8b) of § 62.1-44.15 or to the Virginia Department of Health for the potential issuance of an emergency order to cease injection or make changes pursuant to § 32.1-13 or 32.1-175; and

12. In the event that the Committee finds that SWIFT Project water does not meet HRSD standards for tasting events, directing HRSD to discontinue its use of SWIFT Project water in water tasting demonstrations or limited demonstration-scale promotional products.

D. The Committee may establish an advisory council to provide scientific and technical expertise in fields including aquifer science, managed aquifer recharge, wastewater treatment, advanced water treatment technology, water reuse, geology, geochemistry, hydrogeology, and related fields. The Committee may direct the advisory council to synthesize technical information for the Committee, provide recommendations related to monitoring SWIFT Project impacts, and provide other advice and support.

E. The authority granted to the Committee pursuant to this section shall not be construed to prohibit or limit the Department, the State Water Control Board, or the State Health Commissioner from taking any lawful action related to the SWIFT Project.

§ 62.1-274. Potomac Aquifer Recharge Monitoring Laboratory.

A. The Potomac Aquifer Recharge Monitoring Laboratory is established and shall be located at a suitable location in the Hampton Roads region as selected by Old Dominion University (ODU) and Virginia Polytechnic Institute and State University (VPI) and as approved by HRSD.

B. 1. The first Co-Director of the Laboratory (the ODU Director) shall be a member of the faculty of ODU who has appropriate technical and scientific knowledge and shall be appointed by the president of ODU with the concurrence of the Director of the Department and the State Health Commissioner.

2. The ODU Director shall be under the general supervision of the president of ODU and shall carry out specific duties imposed upon him by the president. The ODU Director also shall carry out the duties listed in this section and in so doing shall act at the direction of the Potomac Aquifer Recharge Oversight Committee established by § 62.1-272.

C. 1. The second Co-Director of the Laboratory (the VPI Director) shall be a member of the faculty of VPI who has appropriate technical and scientific knowledge and shall be appointed by the president of VPI with the concurrence of the Director of the Department and the State Health Commissioner.

2. The VPI Director shall be under the general supervision of the president of VPI and shall carry out specific duties imposed upon him by the president. The VPI Director also shall carry out the duties listed in this section and in so doing shall act at the direction of the Committee.

D. The ODU Director and the VPI Director shall coordinate with each other in efficiently and effectively carrying out the duties of the Laboratory.

E. Subject to the approval of the Committee, the Directors may apply for, accept, and expend grants, gifts, donations, and appropriated funds from public or private sources; employ personnel; and enter into contracts to carry out the purposes of this section.

F. The Laboratory shall work cooperatively with relevant technical experts as appropriate and necessary to carry out the purposes of this chapter, including experts at the Virginia Institute of Marine Science, The College of William and Mary in Virginia, Christopher Newport University, the University of Virginia, and other universities, agencies, and departments of the Commonwealth, and the U.S. Geological Survey.

G. The Laboratory shall:

1. Monitor the impact of the SWIFT Project on the Potomac Aquifer by reviewing and synthesizing relevant water quality data;

2. Identify needs and recommend options for filling gaps in the monitoring of the Potomac Aquifer, such as by recommending changes to monitoring locations and protocols;

3. Conduct sampling and analysis of SWIFT Project water and groundwater on a local scale near SWIFT Project injections to verify monitoring data reported by HRSD, and transmit the results of such analyses to the Director of the Department, the State Health Commissioner, and HRSD;

4. Generate, assimilate, interpret, manage, and consolidate data to help inform decision making related to the impact of the SWIFT Project on the Potomac Aquifer. These actions may include the creation of a clearinghouse for aquifer and SWIFT Project data and the synthesis and dissemination of information to various audiences, including the public and the scientific community; and

5. Advance understanding of the Potomac Aquifer, aquifer science, managed aquifer recharge, water reuse treatment technology, and advanced water treatment, through research, analysis, or modeling.

H. The Laboratory shall focus initially on meeting the demonstration-phase needs of the SWIFT Project; however, development of the Laboratory shall be planned in a manner to support its timely and cost-effective expansion to meet the increased needs associated with the phased full-scale implementation of the SWIFT Project.

§ 62.1-275. Cessation of injection.

A. HRSD shall operate and monitor the SWIFT Project advanced treatment process and recharge operations in accordance with any applicable permit or authorization issued by the U.S. Environmental Protection Agency at all times, including during the cessation of injection and the implementation of other required measures, when applicable, in accordance with the terms and conditions of the permitted contingency plan.

B. If HRSD fails to comply with the requirements of any applicable permit or authorization issued by the U.S. Environmental Protection Agency, the State Water Control Board may issue to HRSD a special order or emergency special order pursuant to subdivisions (8a) and (8b) of § 62.1-44.15, or the State Health Commissioner may issue to HRSD an emergency order pursuant to § 32.1-13 or 32.1-175, directing HRSD to cease injections or make necessary corrections to the SWIFT Project's advanced treatment processes or recharge operations. This subsection shall not be construed to prohibit or limit the Department, the State Water Control Board, or the State Health Commissioner from taking any lawful action related to the SWIFT Project.

2. That the Potomac Aquifer Recharge Oversight Committee established by § 62.1-272 of the Code of Virginia, as created by this act, shall request from the Hampton Roads Sanitation District funding sufficient to conduct its activities, including the monitoring of the recharge of the Potomac Aquifer, until July 1, 2022. No later than July 1, 2021, the Committee shall develop a plan for funding such activities beginning July 1, 2022.

Potomac Aquifer Recharge Monitoring Laboratory (PARML): Year 1 - Startup

September 4, 2019

Overview

Legislative Directive - PARML's Roadmap

Co-Directors

Laboratory Setting

Laboratory Start-Up

Sampling/Monitoring/Data Management

Groundwater Modeling

Data Assessment, Availability and Reporting

Outreach and Communication

Legislative Directive to PARML

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Background and Experience of the Co-Directors

Gary Schafran –

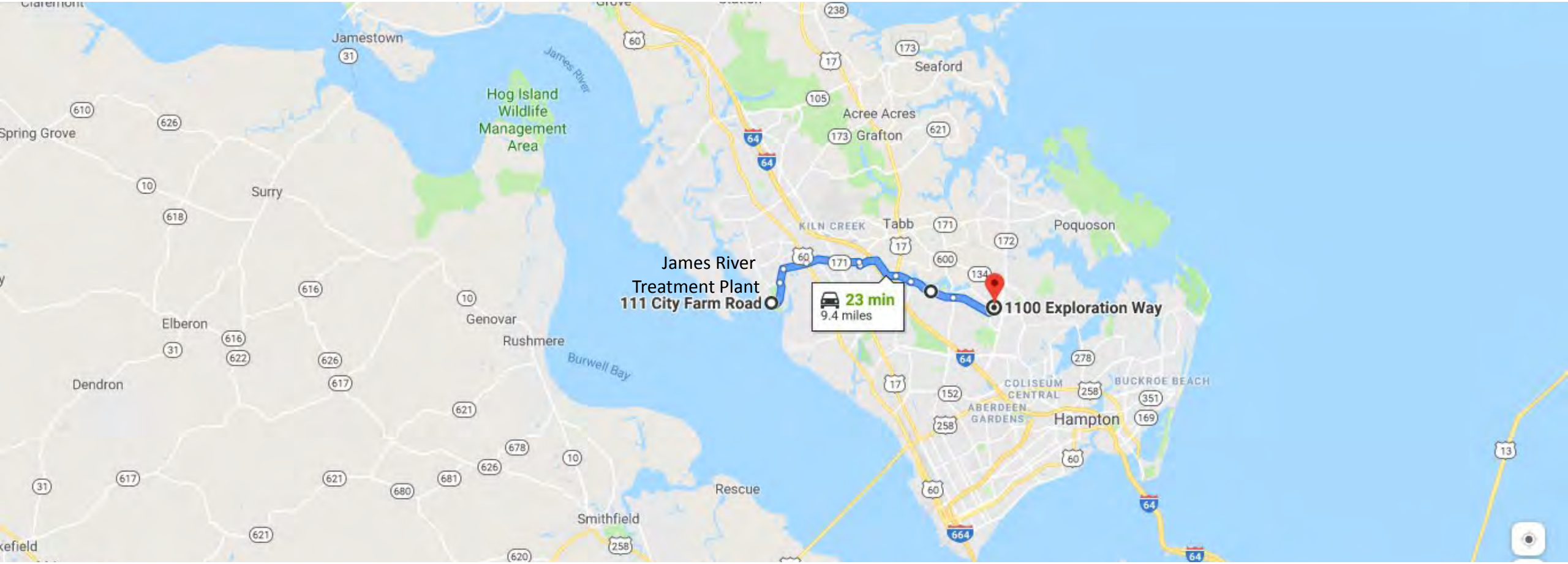
- Professor, Civil and Environmental Engineering Department, ODU (ODU since 1987)
- Research and teaching in water quality, physicochemical processes, aquatic chemistry
- Laboratory/analytical-focused research over the past 40 years
- Analytical method development and QA/QC
- Rebuilt “abandoned” ODU environmental engineering laboratories

Mark Widdowson –

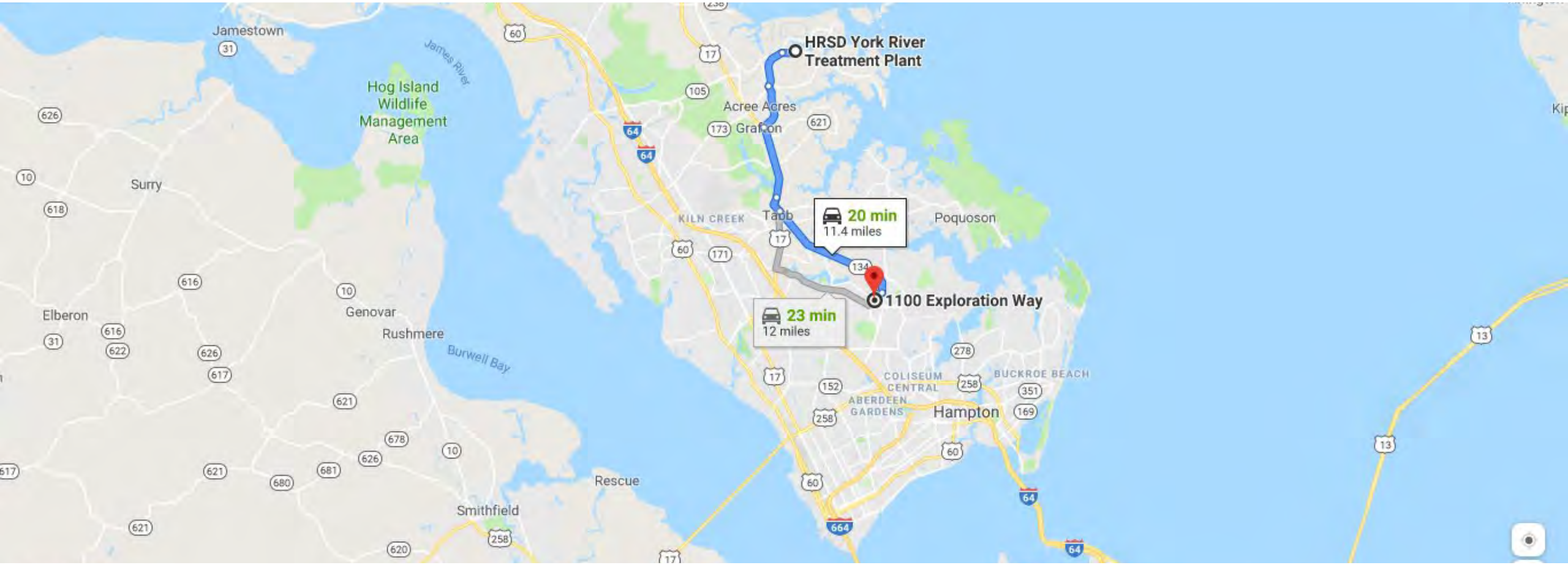
- Professor, Civil and Environmental Engineering Department, VT (VT since 1992)
- Research and teaching in groundwater resources, contaminant fate and transport
- Computational and field-based research over the past 35 years
- Computer models and development laboratory methods – bioavailable organic carbon
- Authored groundwater computational tools: SEAM3D, Natural Attenuation Software (NAS)

PARML Location: 1100 Exploration Way, Hampton, VA
National Institute of Aerospace (NIA) Building

PARML is Centrally Located to Future SWIFT Facilities



PARML is Centrally Located to Future SWIFT Facilities



PARML Facilities:

Access to an Existing Wet Chemistry Laboratory with Six Fume Hoods

PARML Facilities:

Office Suite for Laboratory Personnel

Eight offices

PARML Facilities:

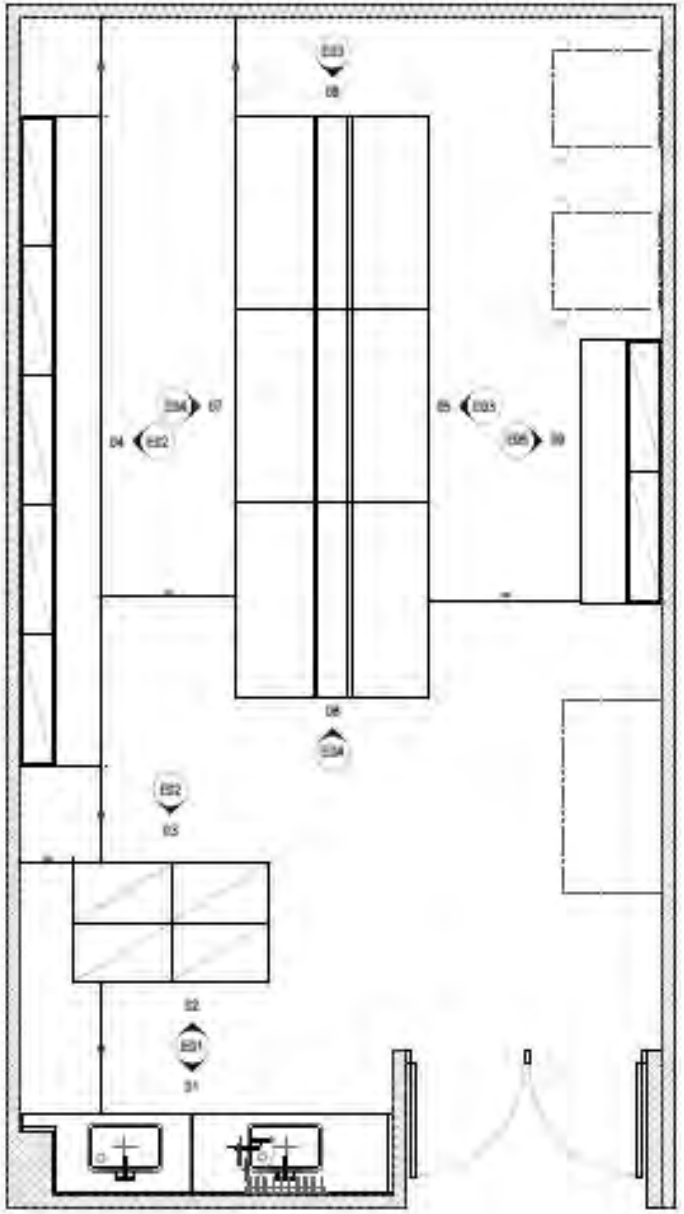
Reconfigurable Conference Room/Classroom Space Set Up for Video Conferencing

PARML Facilities:
Developing the Wet Chemistry Laboratory

120, 208, and 460 V Electrical Service

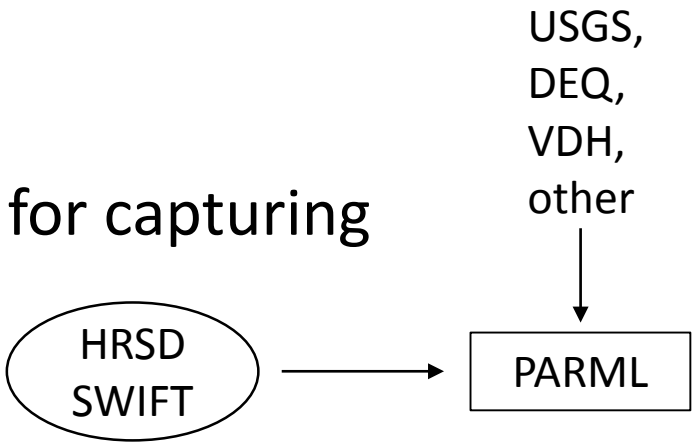
Exhaust Venting

Layout of New PARML Laboratory (750 sq ft)



Aquifer and SWIFT Process Monitoring

- Extensive regulatory water quality monitoring required of HRSD under UIC permit
- PARML to replicate analyses and provide independent assessment and interpretation
- Year 1: acquisition of key analytical instrumentation, laboratory equipment and supplies
- Hiring of laboratory personnel and beginning of sampling and analytical analyses
- Aquifer/well monitoring network
- Develop procedures and data management system for capturing data generated by HRSD, PARML, and others



Developing a Data Quality Management Plan

- Quality Assurance Project Plan (QAPP)
- Standard operating procedures
- Data quality objectives
- QA/QC
- Data management system

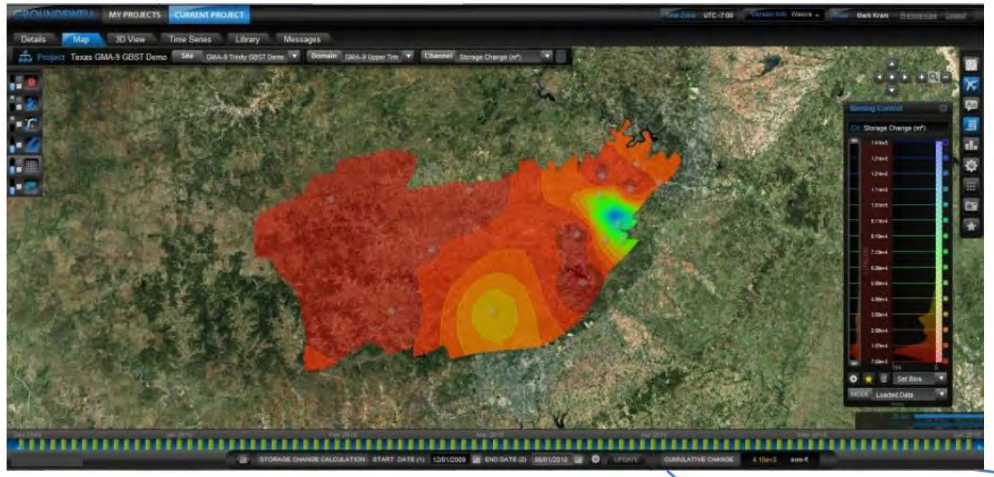
Laboratory Instruments, Equipment and Supplies

- Ramp up laboratory capability through instrument acquisition and equipment needed to begin analysis of the higher priority and more frequently monitored constituents.

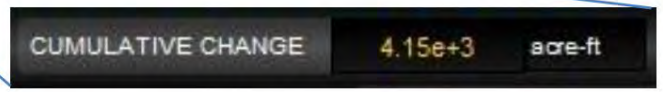
Item #	Item Description
1	Carbon Analyzer with Total N & Auto Sampl.
2	Ion Chromatograph w/ Auto Sampl
3	Laboratory DI water system
4	UV-Vis Spectrophotometer
5	Analytical Balances - high precision
6	Hach UV-VIS spectrophotometer
7	Drying Ovens
8	Top Loading Balance
9	Volumetric Glassware
10	Flasks and Beakers
11	Pipettes (0-50, 50-250, 250-1000, 1000-5000 uL)
12	Cold Storage
13	pH meter + electrode
14	Conductivity meter + probe
15	Nephelometer/tubidimeter
16	Vacuum pump
17	Chemical storage cabinet
18	Assort. Lab supplies (kimwipes, parafilm, gloves, etc.)
19	Sample containers
20	Laboratory chemicals (incl. analytical stnds, gases)

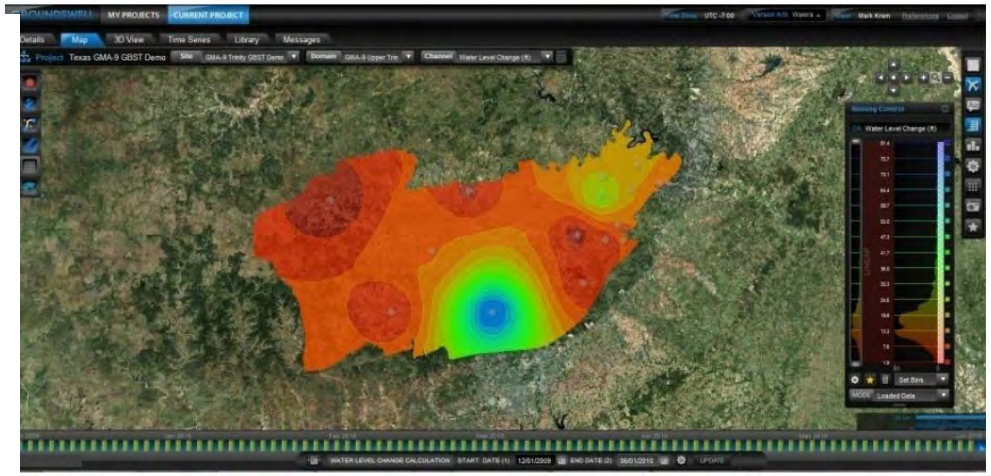
Groundwater Monitoring: Web-Enabled Output

- Aim – Real-time monitoring of groundwater levels including web-enabled output of
  - Water level change over spatial regionals of the Potomac Aquifer System
  - Storage change (distribution/cumulative)



Storage Change
Distribution/Cumulative

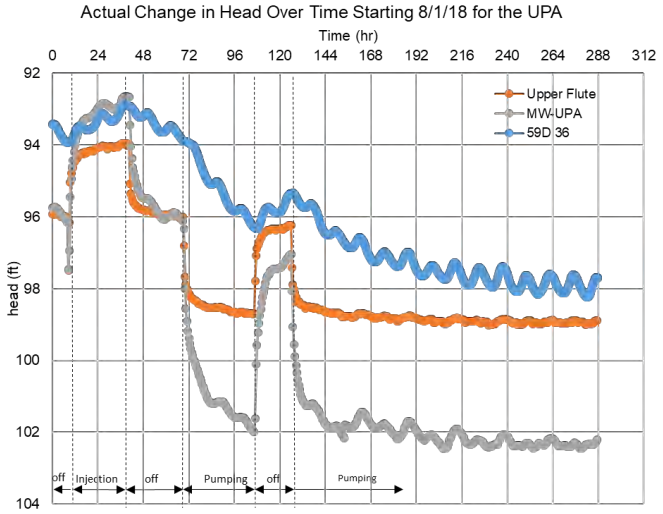


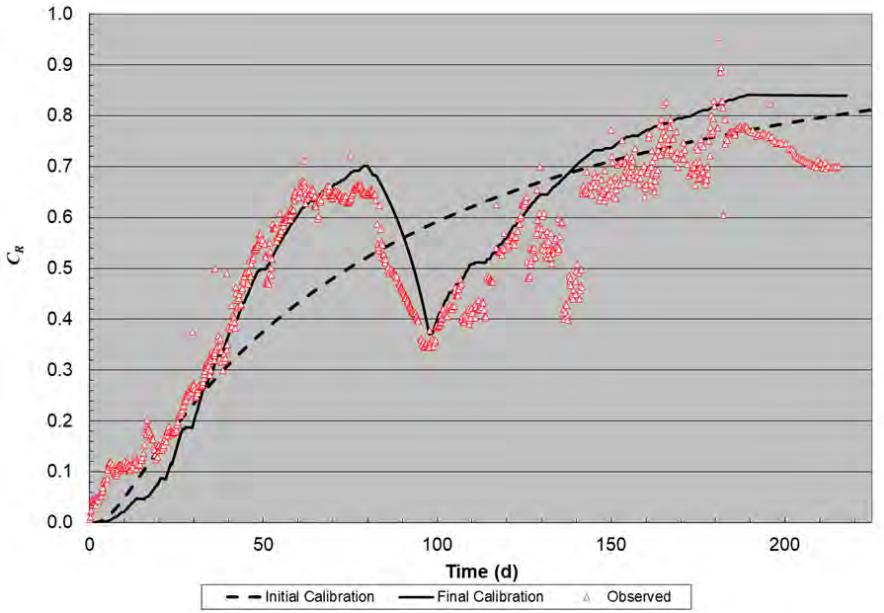


Water Level Change

Groundwater Modeling

- Initial focus – Site model of the SWIFT RC
  - Water level changes in response to recharge and back-flushing
  - Changes in water quality parameters resulting from recharge





Data Assessment, Availability and Reporting

- PARML identified as a clearinghouse for information related to the Potomac Aquifer and the influence of recharge on PAS
- Dissemination of information – passive via web site; actively through response to inquiries
- Archive for all reports and data after QA/QC
- PARML to provide annual report of PAS related to SWIFT operations. Report will include interpretation of information from all relevant sources that relate to groundwater recharge, geochemistry and groundwater modeling.

Outreach and Communication

- Primary Aims:
  - Educate the public on the scientific merit and engineering challenges associated with water reuse
  - Inform the public on PARML oversight outcomes
- Engage stakeholders
  - Local/regional entities
  - Public
  - Scientific community

Regulatory Update

Regulatory Structure

- SWIFT Research Center authorization received
  - Permitted under EPA's Region 3 Underground Injection Control Program as a Class V well- Technical documents for authorization reviewed by
    - Virginia Department of Environmental Quality
    - Virginia Department of Health
    - National Water Research Institute (NWRI) independent review panel of experts
    - Parallel Virginia academic review
- Applying for permit for full-scale implementation 2019
  - Information gathered from SWIFT Research Center will help inform permitting

Protecting the Underground Sources of Drinking Water

- Meet all primary Maximum Contaminant Levels (MCLs) regulated by the USEPA in the SDWA
- Provide multiple barriers to pathogens and organics (including chemicals of emerging concern)
- Ensure aquifer compatibility
  - Minimum pH target = 7.6
  - No TDS removal + aquifer conditioning with $AlCl_3$
  - Site-specific geochemical evaluation
- Conduct hazard analysis and establish critical control points (HACCP) for treatment processes
  - Action level exceedance will prevent water from entering the recharge well

Additional Protective Measures

- Source control program
  - Stringent pretreatment requirements
  - Zero discharge parameters
  - Track down studies
- Working with VDH to identify well owners in close proximity to SWIFT sites
- Modeled travel time indicates >180 years for 1 mile of travel
  - Data from SWIFTRC will be used to refine estimate

SWIFT Water Quality Targets

Parameter	Proposed Regulatory Limit	Non-regulatory Action/Goal
MCLs	Meet all primary MCLs	N/A
TN	5 mg/L monthly average; 8 mg/L max daily	Secondary Effluent CCP Action Limit for TIN = 5 mg/L
Turbidity	IFE <0.15 NTU 95% of time & never > 0.3 NTU in two consecutive measurements	CCP Action Limit at 0.10 NTU to initiate backwash or place filter in standby
TOC	4 mg/L monthly average 6 mg/L maximum	COP Action Limit at 4 mg/L, laboratory 10 day average
Total coliform	< 2 CFU / 100 mL; 95% of time; Not to exceed geometric mean of 3 CFU/100 mL, based on a running calculation of 20 days of daily samples for total coliforms	CCPs to achieve 12 LRV for viruses and 10 LRV for Crypto & Giardia
E. Coli	Non-detect	
Unreg Chemicals (CECs)	None	Monitor suite of chemicals and address as necessary
Total Dissolved Solids	None	Monitor aquifer compatibility

Regulatory Reporting

- Required reporting includes quarterly reports regarding performance relative to previously agreed upon regulatory targets
- Reports are also produced in the event there is a violation of a PMCL
  - These initially established as single point exceedances
  - Full-scale permitting will establish PMCL compliance consistent with Virginia Waterworks Regulation
    - e.g., averaging periods associated with radionuclides, many inorganic and organic parameters when monitoring frequently based on running annual averages

SWIFT Water Quality (April - June)

Parameter	April	May	June	SWIFT Water Target
Total Nitrogen, mg/L	2.11 Avg; 2.17 Max	2.90 Avg; 3.53 Max	2.90 Avg; 3.68 Max	5 mg/L Monthly Average; 8 mg/L Daily Maximum
Nitrate, mg/L	1.24 Avg; 1.24 Max	2.03 Avg; 3.06 Max	2.34 Avg; 3.10 Max	10
Nitrite, mg/L	<0.01 Avg; <0.01 Max	0.26 Avg; 0.48 Max	0.12 Avg; 0.55 Max	1
Total Organic Carbon (TOC), mg/L	0.32 Avg; 0.32 Max	1.23 Avg; 2.25 Max	2.73 Avg; 3.33 Max	4 mg/L Monthly Average; 6 mg/L Maximum
Bromate, µg/L	NS	1.77	3.06	10
Bromoform, µg/L	NS	<1	3.16	10
Dibromochloromethane, µg/L	NS	<1	1.33	80 (Total Trihalomethanes)
Dibromoacetic acid, µg/L	NS	<0.2	3.10	60 (Haloacetic acids)
Arsenic, µg/L	NS	0.61	<1	10
Barium, mg/L	NS	0.008	0.005	2
Fluoride, mg/L	0.78 Avg; 0.88 Max	0.93 Avg; 1.1 Max	0.96 Avg; 1.2 Max	4
Beta particles and photon emitters, pCi/L	NS	17	15	4 mrem/yr (50 pCi/L screening)
Radium 226, pCi/L	NS	3.4	<1	Radium 226+228 = 5
TDS, mg/L	NS	546	630	NA

PMCL detections only; NS – not sampled – only two days recharge in April

Unregulated Chemical Constituents that are of Public Health Interest (*Final Report of an NWRI Independent Advisory Panel: Recommended DPR General Guidelines and Operational Requirements for New Mexico, 2016*)

Chemical	Screening Value	SWIFTRC May 2018-June 2019	Notes
1,4-Dioxane	1 µg/L	<0.07-0.67 µg/L	CCL4; CA Notification limit
17-B-estradiol	TBD (ng/L range)	<0.4 ng/L	CCL4
DEET	200 µg/L	<10 ng/L	Minnesota Health guidance value
Ethinyl Estradiol	TBD (ng/L range)	<5 ng/L	CCL4
NDMA	10 ng/L	<2 – 3.9 ng/L	CCL4; CA Notification limit
Perchlorate	6 µg/L	< 0.74-1.7 µg/L	CA MCL
PFOA +PFOS	70 ng/L	<2 – <60 ng/L	USEPA Health Advisory
TCEP	5 µg/L	<10 ng/L	Minnesota Health guidance value

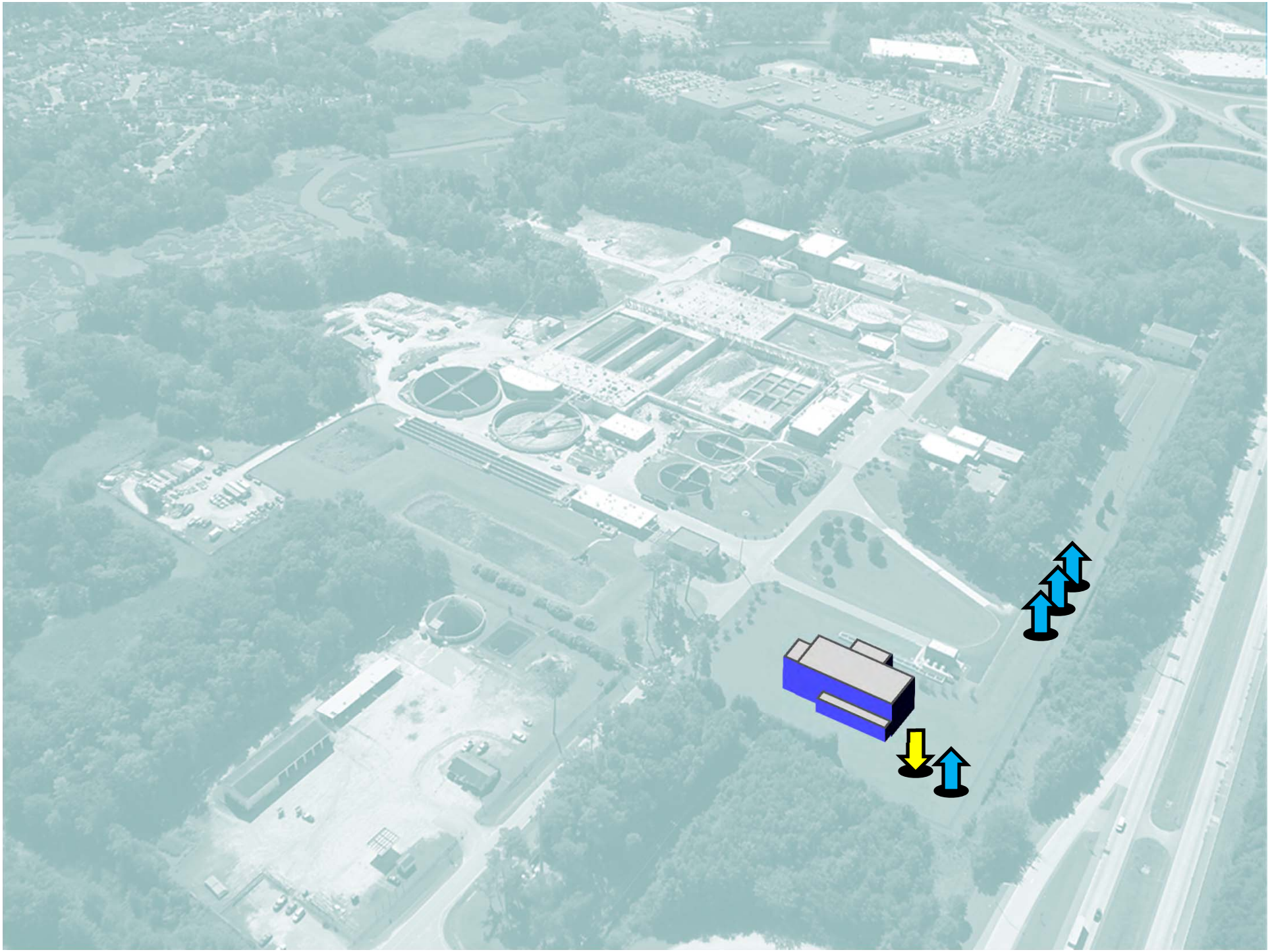
Unregulated chemical constituents that provide information on the effectiveness of treatment (*Final Report of an NWRI Independent Advisory Panel: Recommended DPR General Guidelines and Operational Requirements for New Mexico, 2016*)

Chemical	Screening Value[1]	SWIFTRC May 2018-June 2019	Notes
Cotinine	1,000 ng/L	<10 ng/L	Surrogate for low MW, partially charged cyclics
Primidone	10,000 ng/L	<10 ng/L	
Phenytoin	2,000 ng/L	<20 ng/L	
Meprobamate	200,000 ng/L	<5 ng/L	High occurrence in WWTP effluent
Atenolol	4,000 ng/L	<5 ng/L	
Carbamazepine	10,000 ng/L	<5 ng/L	Unique structure
Estrone	320,000 ng/L	<5 ng/L	Surrogate for steroids
Sucralose	150,000,000 ng/L	<100 ng/L	Surrogate for water soluble, uncharged chemicals, moderate MW
Triclosan	2,100,000 µg/L	<10 ng/L	Chemical of interest

1. In most cases, screening value is based on drinking water equivalent concentration for lowest therapeutic dose divided by 1,000 or 10,000 to provide a safety factor.

SWIFT James River UIC Permit will be modeled after SWIFT RC authorization

- Regulatory parameters in Underground Injection Control (UIC) permit will be similar with some adjustments
  - Adjustments to Critical Control Points and Critical Operating Parameters as needed based on James River operations and learning from SWIFT RC
- A second set of indicator compounds will be proposed to better reflect HRSD source waters
- All proposals will be provided to the VDH and DEQ as well as an independent advisory panel for review and input before submission to EPA
- Will apply for permit in 2019
- Permit will be subject to public hearing




VENT
PRESSURE
1
2
3
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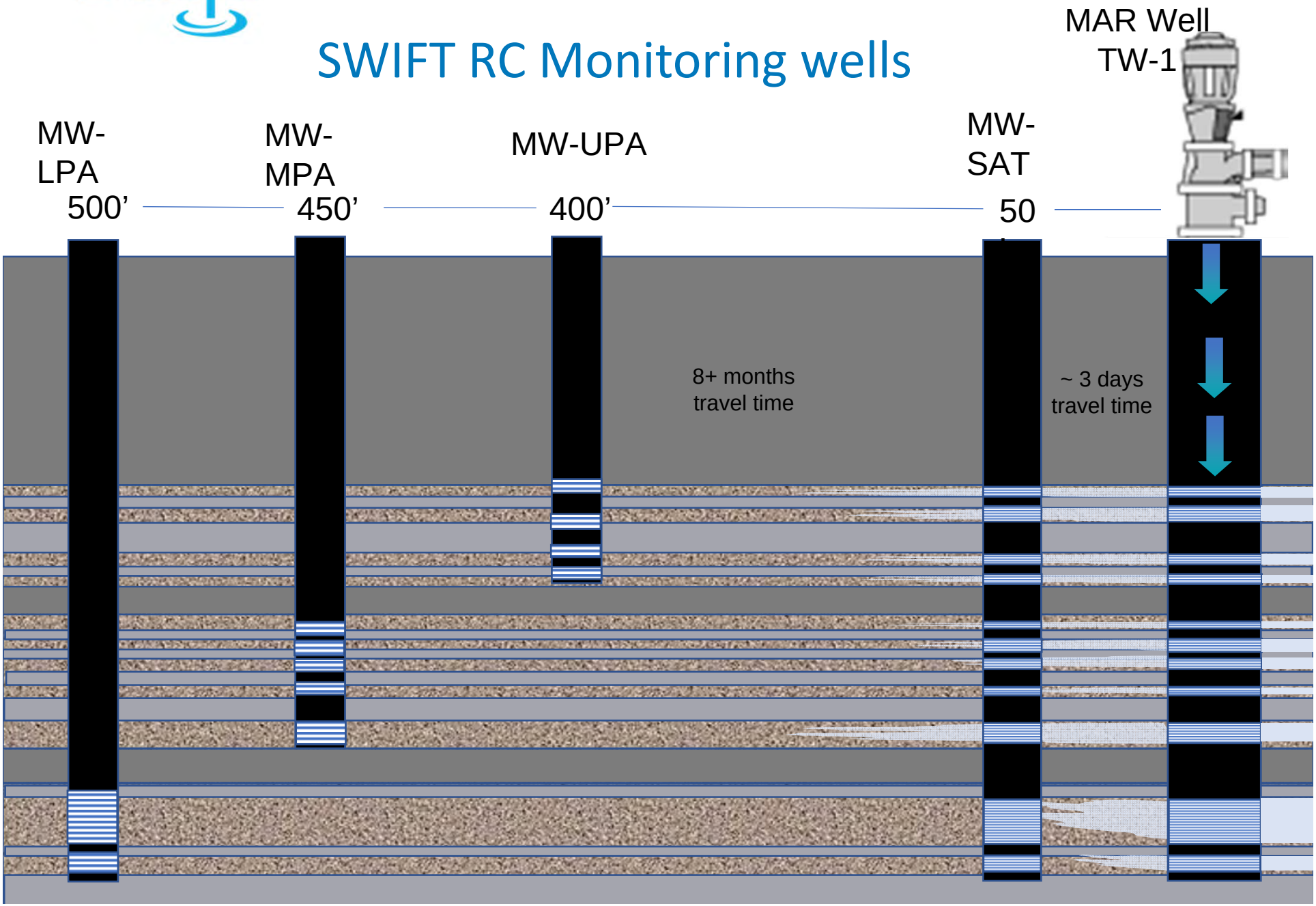
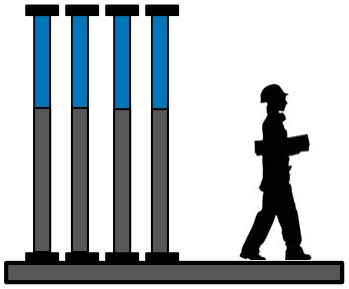
UPPER POTOMAC
MIDDLE POTOMAC
LOWER POTOMAC

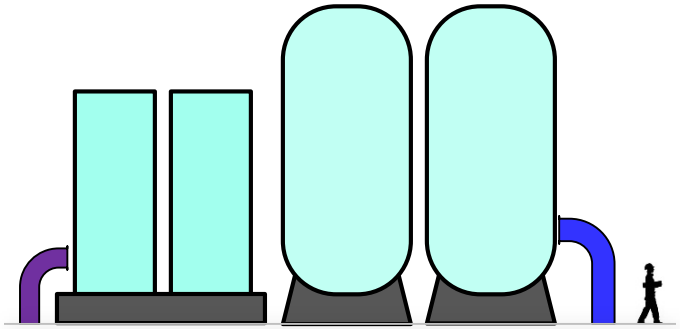
SWIFT RC Monitoring wells



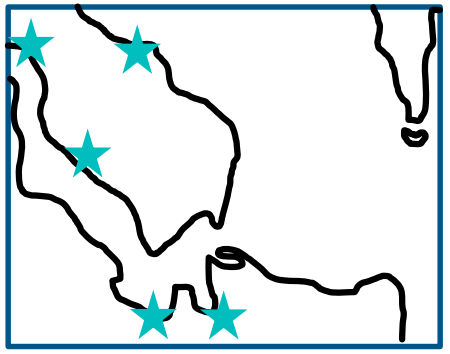
SWIFT is being implemented in a phased approach



ca. 1:2,000 scale
Pilot Facility



ca. 1:15 scale
Research Center



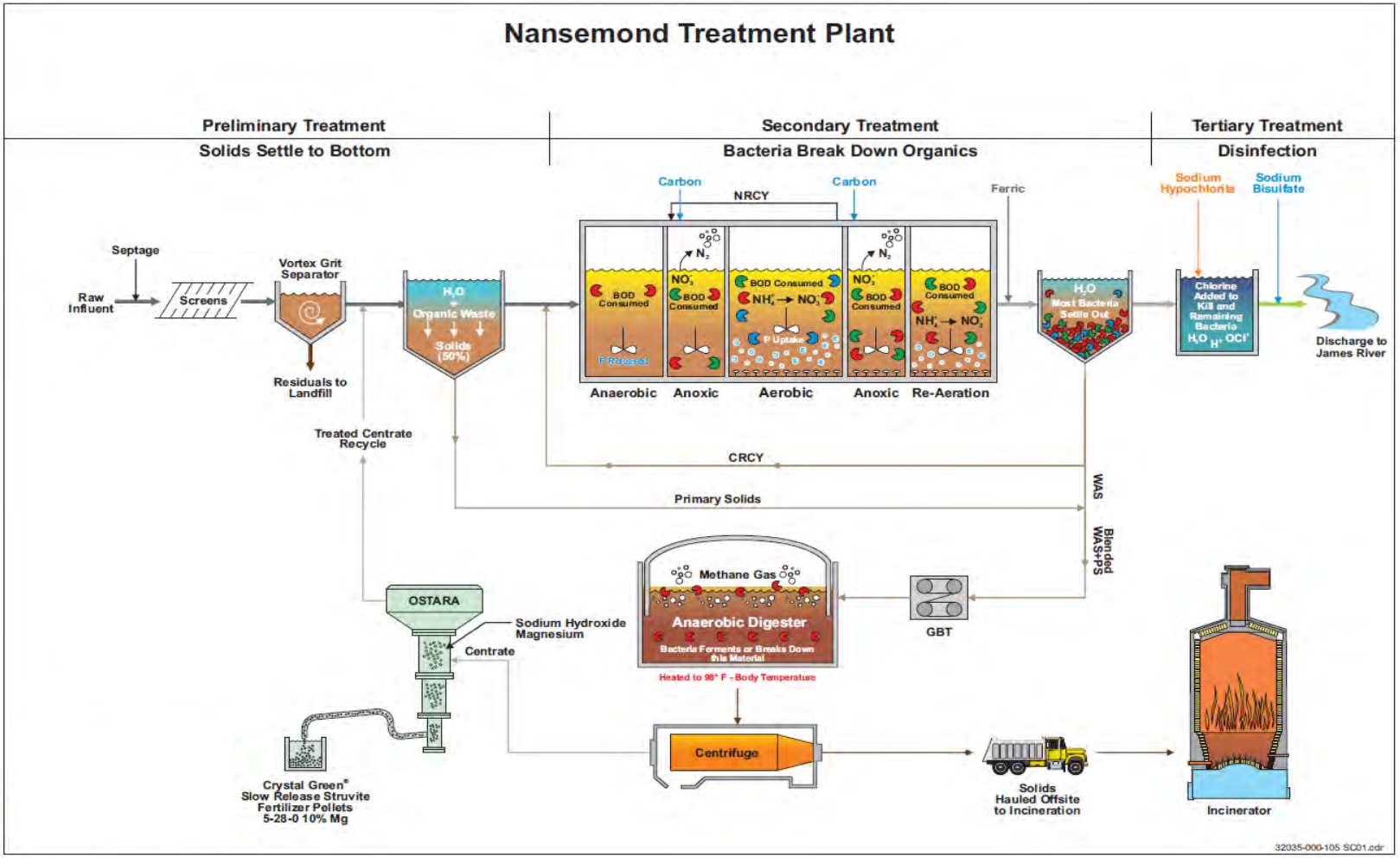
> 100 MGD
SWIFT Build Out

SWIFT Research Center

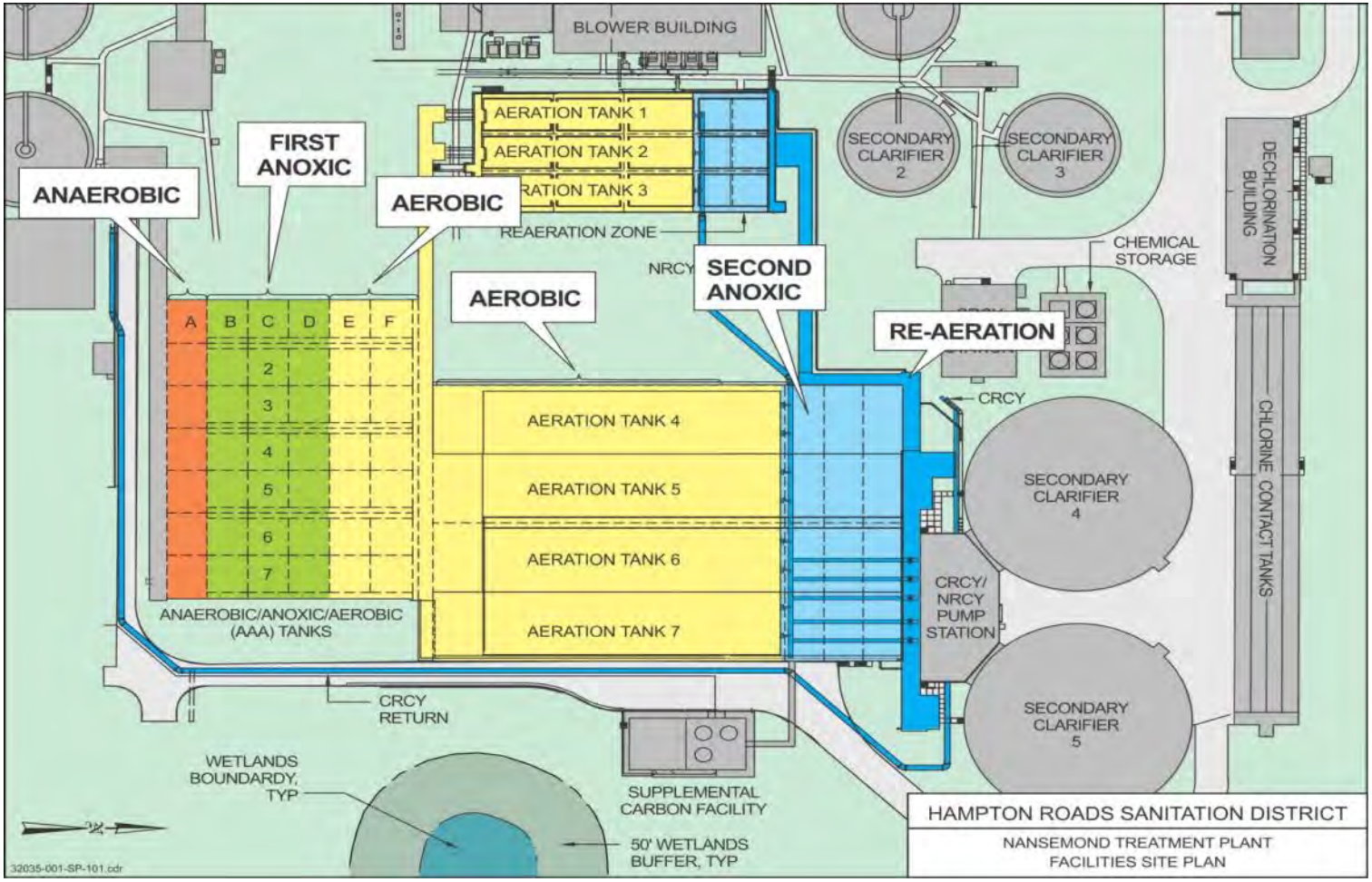
(1.0 MGD AWT + recharge well + monitoring wells + public outreach and education center + research facilities)

SWIFT Research Center at HRSD Nansemond Treatment Plant (30 MGD)

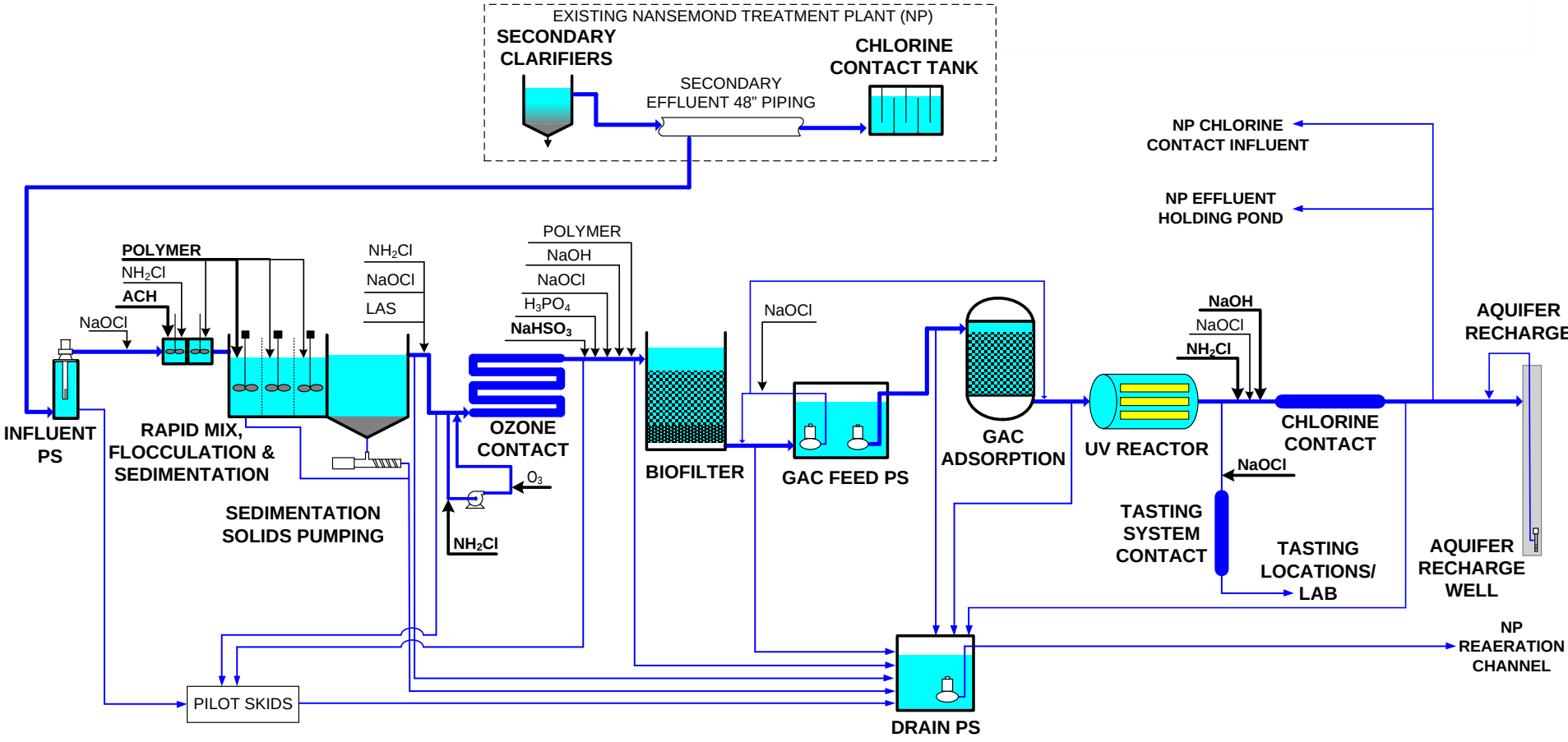
Nansemond Plant Schematic



5-Stage Bardenpho Configuration – Stable and reliable TN removal is a must!



Process Flow Diagram for SWIFT Research Center



SWIFT RESEARCH CENTER PROCESS FLOW DIAGRAM

SWIFT Research Center – Pathogen LRVs

- Design – 12/10/10 (NWRI recommendation, but include SAT)
- Operate to achieve 12/10/10 using CCPs
- Tasting demands virus and giardia reduction by ozone & additional free chlorination (4 LRV virus)

Parameter	Log Reduction Credits								
	Coag/Sed (+BAC)	Ozone	BAC	GAC	UV (186 mJ/cm^2)	Cl_2	**Total AWT**	SAT	Total
Enteric Viruses	2	0-3	0	0	4	0-4	**6-13**	6	12-19
Cryptosporidium	4	0	0	0	6	0	**10**	6	16
Giardia	2.5	0-1.5	0	0	6	0	**8.5-10**	6	14.5-16

Instrument Lineups (typical)

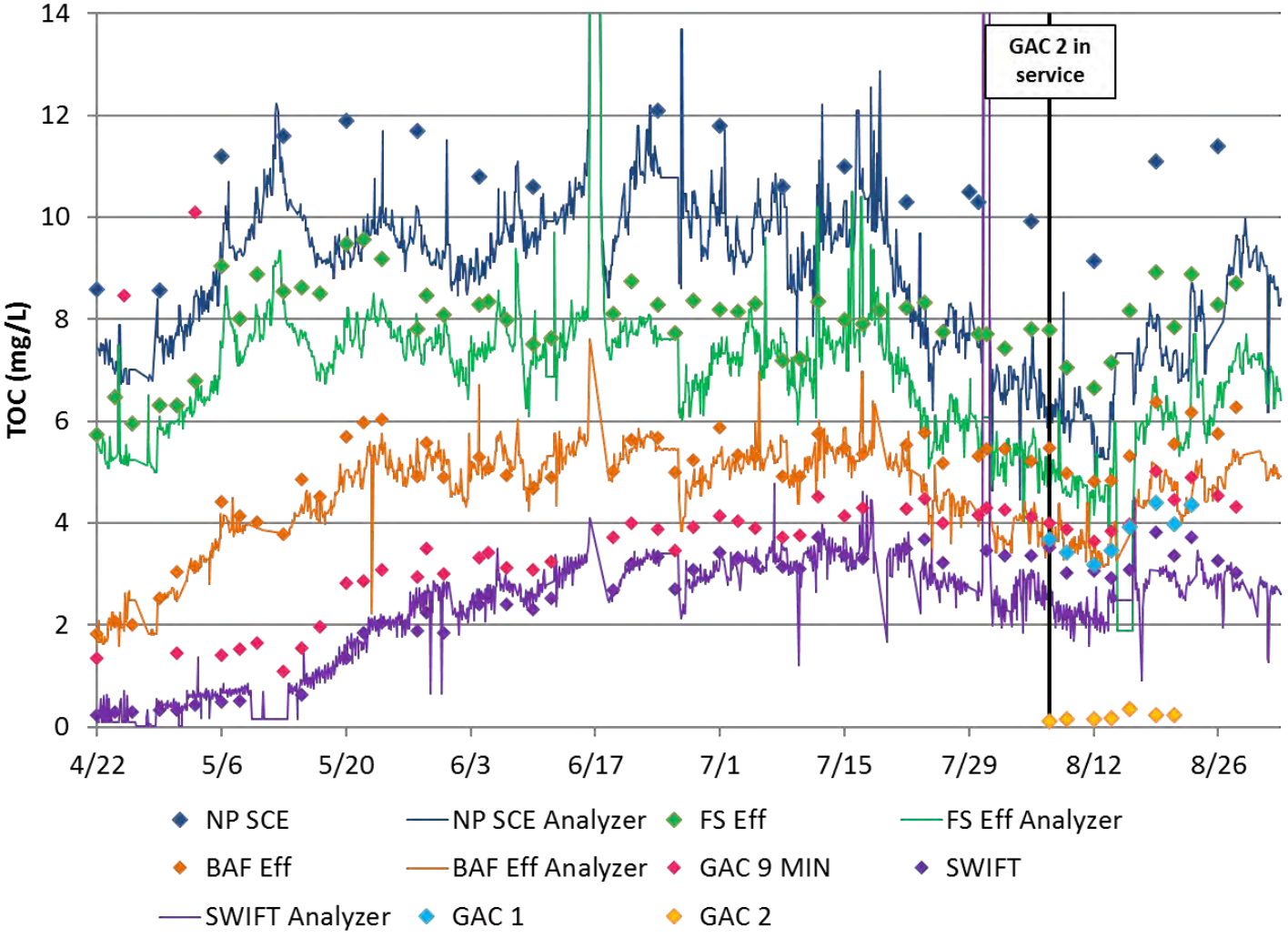
Hazard Analysis and Critical Control Points

SWIFT AWT Process Concerns and Problems

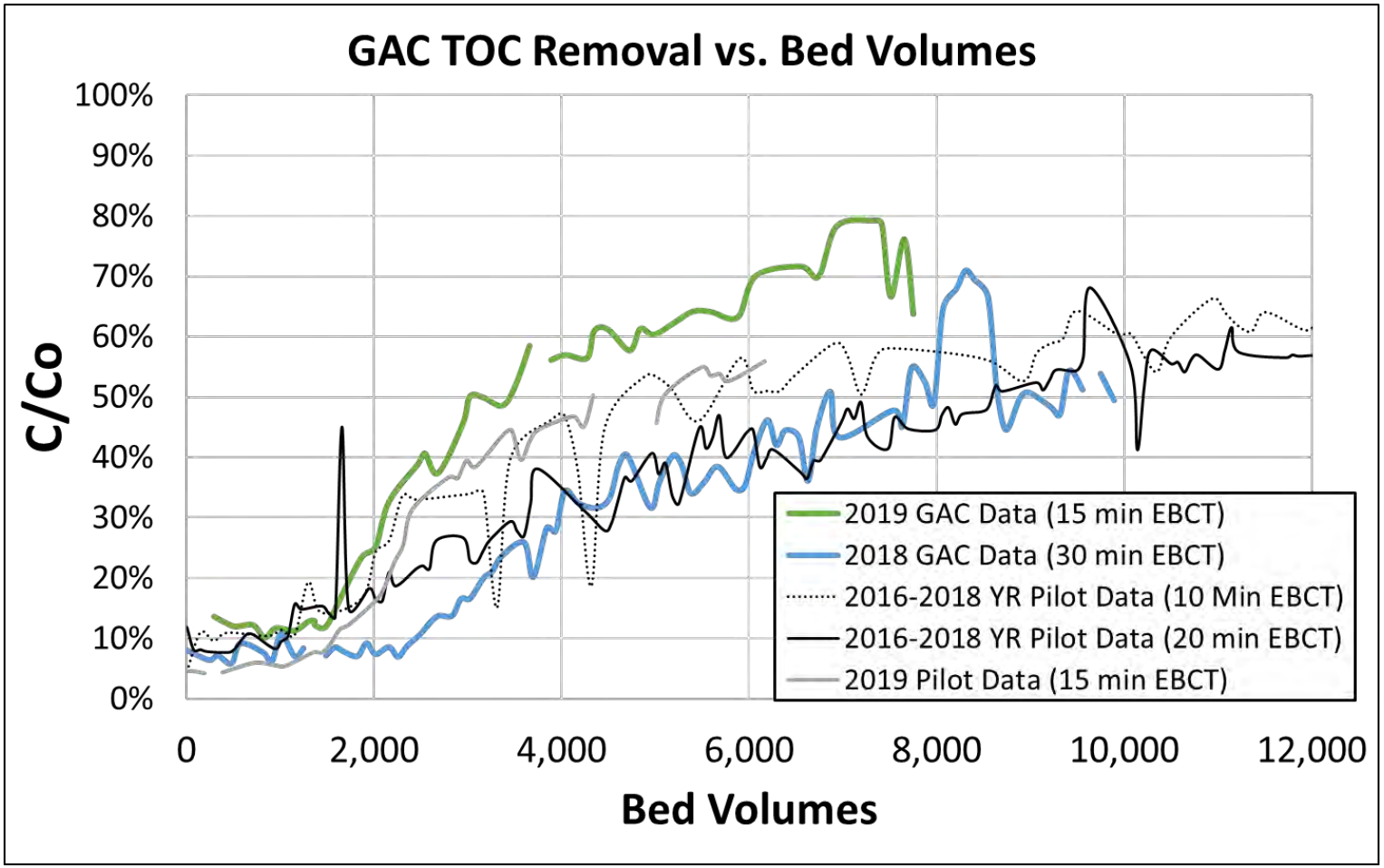
- TOC removal (item of interest)
- WWTP N removal, SWIFT influent TIN
- Establishment of nitrification in biofilters
  - short term nitrite formation
  - control with free chlorine during startup
- Bromate control
- 1,4-dioxane
- NDMA
- Mn
- Acrylamide (issue solved)
- Low molecular weight PFAS
- Perchlorate and chlorate
- Recharge well operation
- Tasting system

Shimadzu TOC/TN Analyzer – 6 sample points

Total Organic Carbon (TOC)



GAC TOC Breakthrough

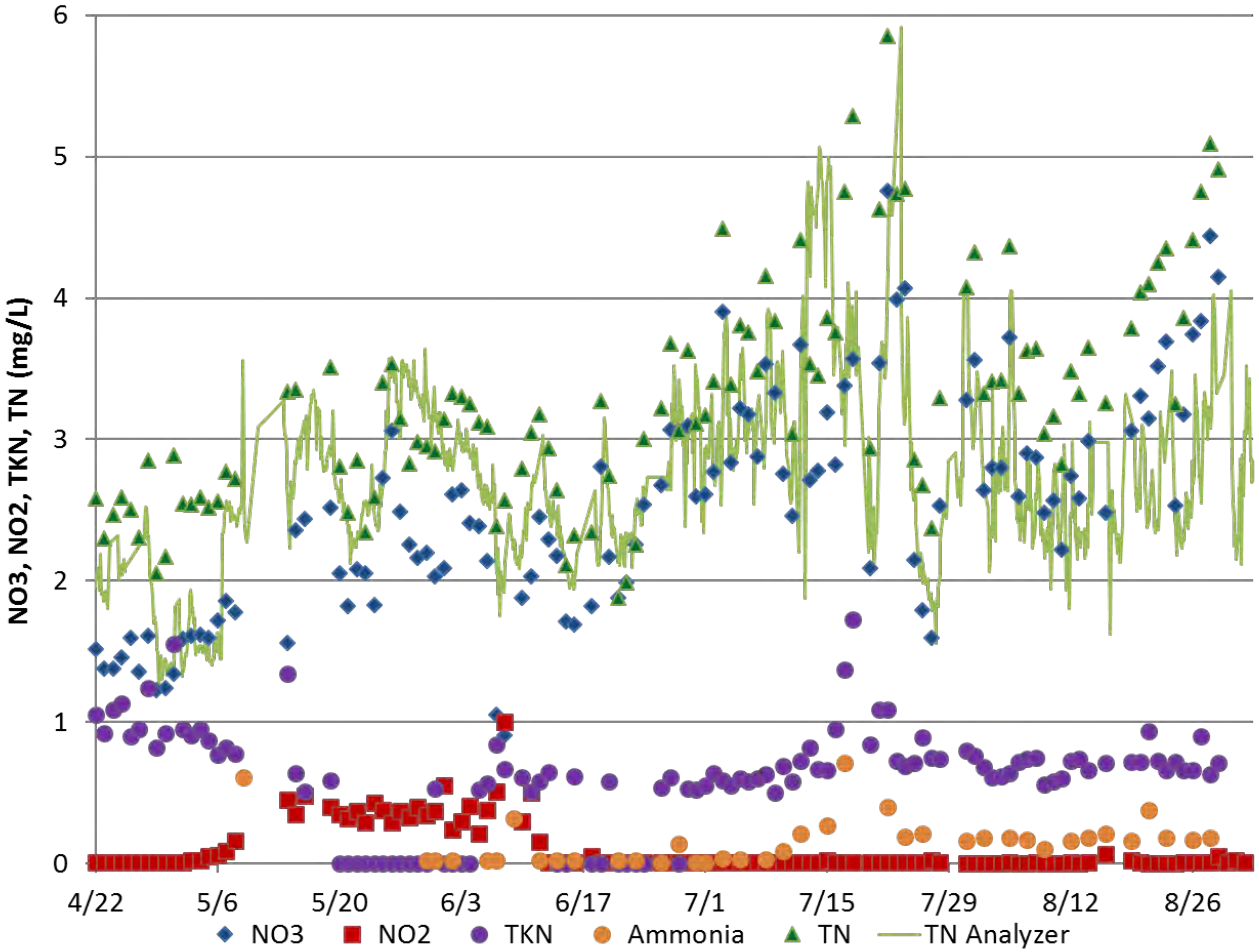


Indicator Review

- Perchlorate and sucralose are only indicators to appear in SWIFT Water
  - A few other CEC detections in ng/L range (quinoline, iohexal, caffeine, acetaminophen)
- Appears that SWIFT organics will be driven by 4 mg/L TOC regulation, not by breakthrough of indicators

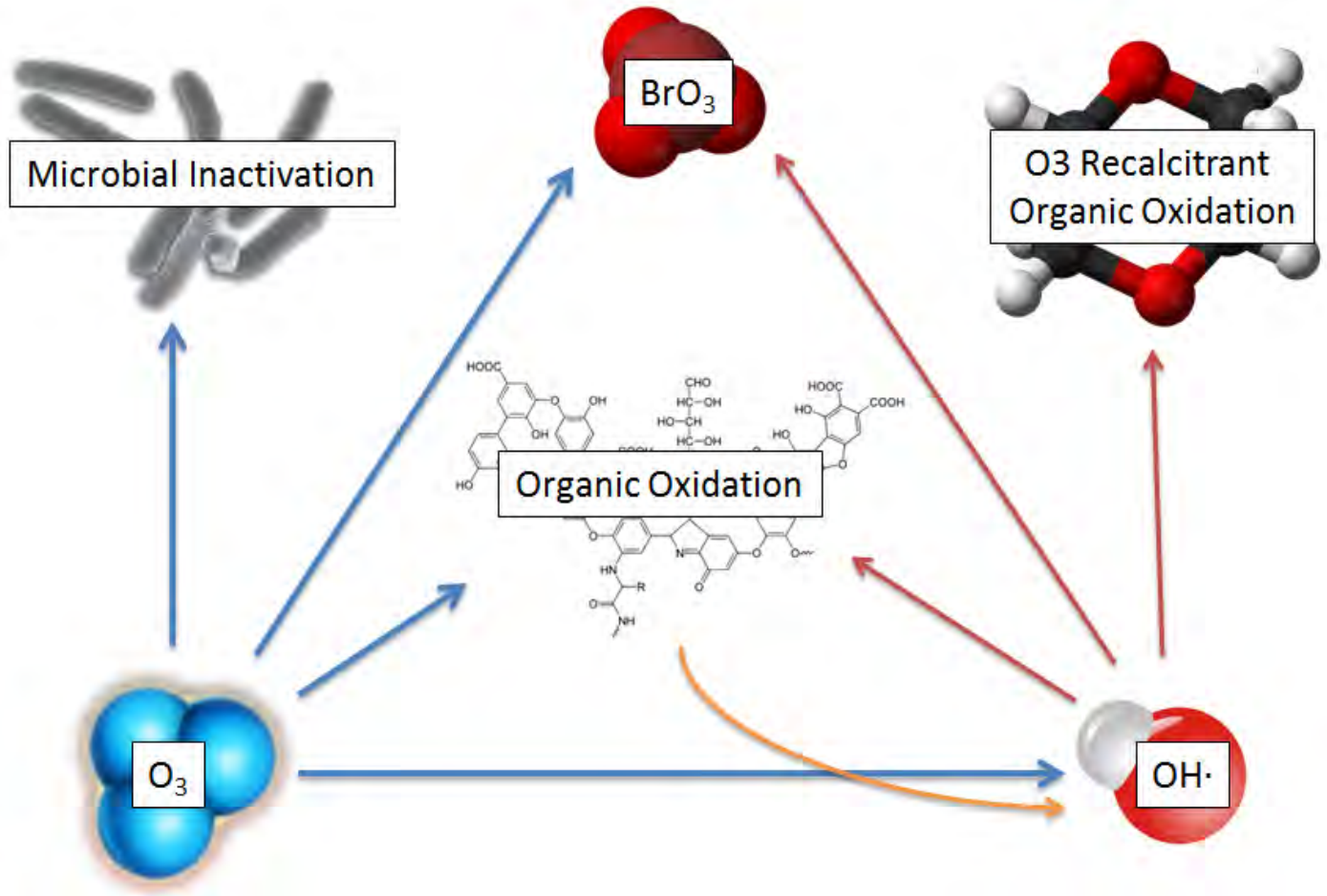
Parameter	Trigger	Units	4/19/2018	7/10/2018	10/2/2018	5/7/2019	6/4/2019	7/2/2019
Atenolol	4,000	ng/L	<5	<5	<5	<5.0	<5.0	<5.0
Carbamazepine	10,000	ng/L	<5	<5	<5	<5.0	<5.0	<5.0
Cotinine	1,000	ng/L	<50	<10	<10	<10	<10	<10
DEET	200,000	ng/L	<10	<10	<10	<10	<10	<10
Phenytoin	2,000	ng/L	<20	<20	<20	<20	<20	<20
Estrone	320	ug/L	<5	<5	<5	<5	<10	<10
Meprobamate	200,000	ng/L	<5	<5	<5	<5	<5.0	<5.0
Perchlorate	6	ug/L	<0.5	0.74	0.84	<0.5	<0.50	0.52
Perfluorooctanesulfonic Acid (PFOS)	70	ng/L	<0.04	<0.04	<0.04	<0.0020	<0.0020	<0.0020
Perfluorooctanoic Acid (PFOA)	70	ng/L	<0.02	<0.02	<0.02	<0.0020	<0.0020	<0.0020
Primidone	10,000	ng/L	<20	<10	<25	<5.0	<5.0	<5.0
Sucralose	150,000,000	ng/L	<100	<100	<100	<100	<100	270
TCEP	5,000	ng/L	<10	<10	<10	<10	<10	<10
Triclosan	2,100,000	ng/L	<10	<10	<100	<20	<20	<20

SWIFT Water Total Nitrogen (TN)



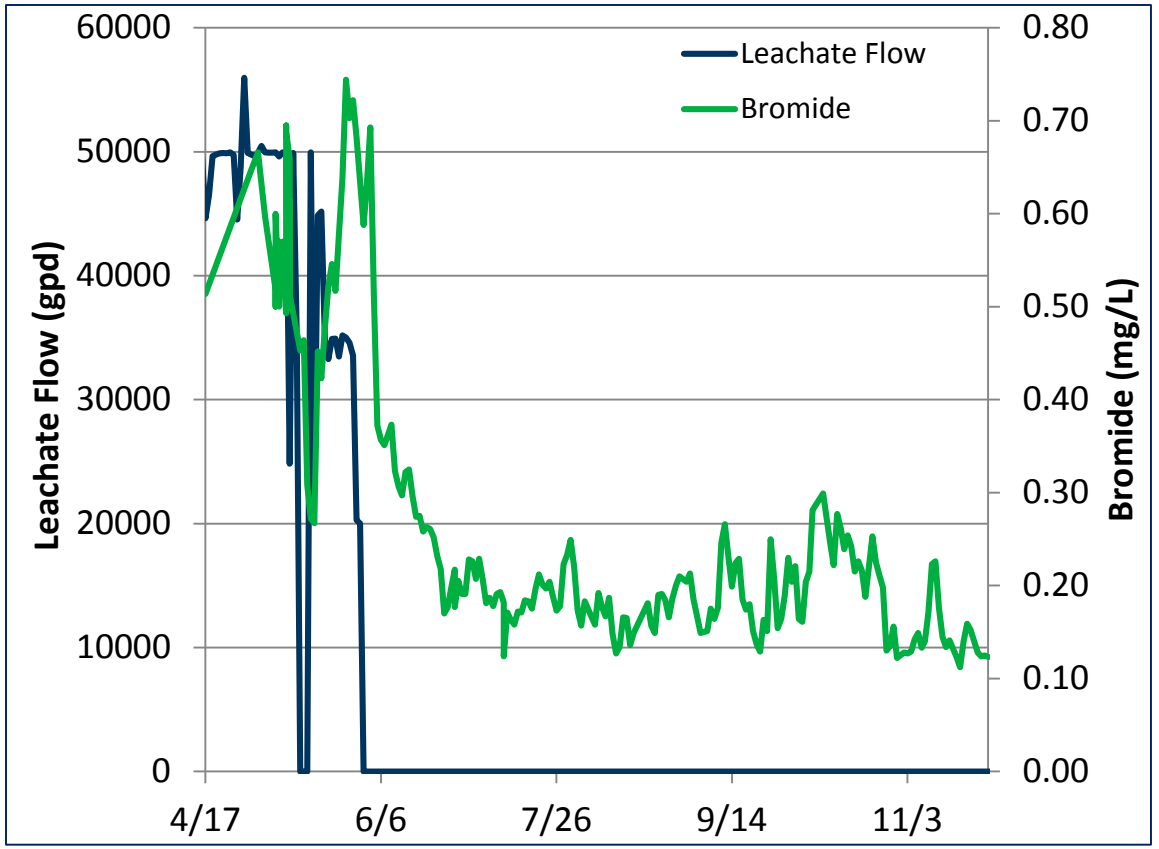
- TN Limits
  - 5 mg/L Monthly Average
  - 8 mg/L Daily Max
- SWIFT Water TN consistently below limits
- NO_2 increased and subsequently decreased after filters began to nitrify

Ozone Reactions in Water



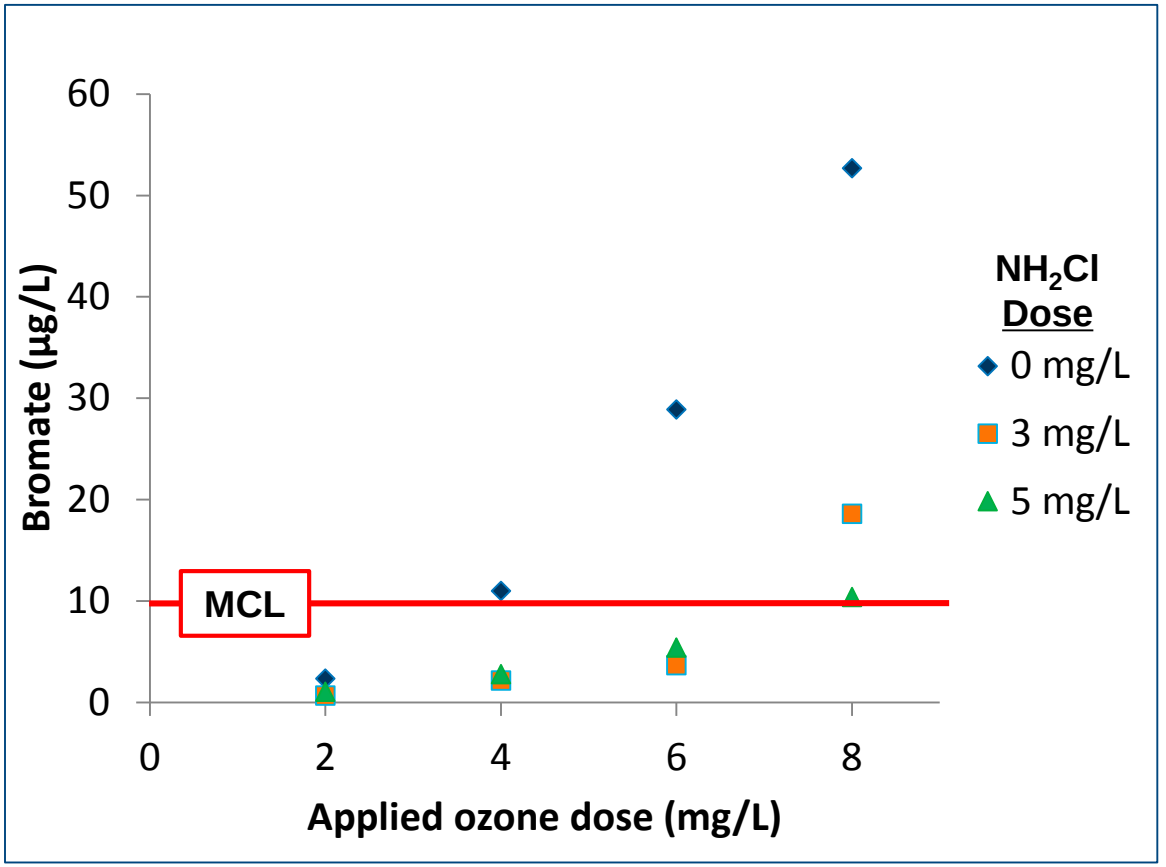
Elevated Bromide at SWIFTRC

- Elevated bromide concentration **> 0.7 mg/L!**
- Source of bromide determined to be landfill leachate



Bromate Formation at SWIFTRC

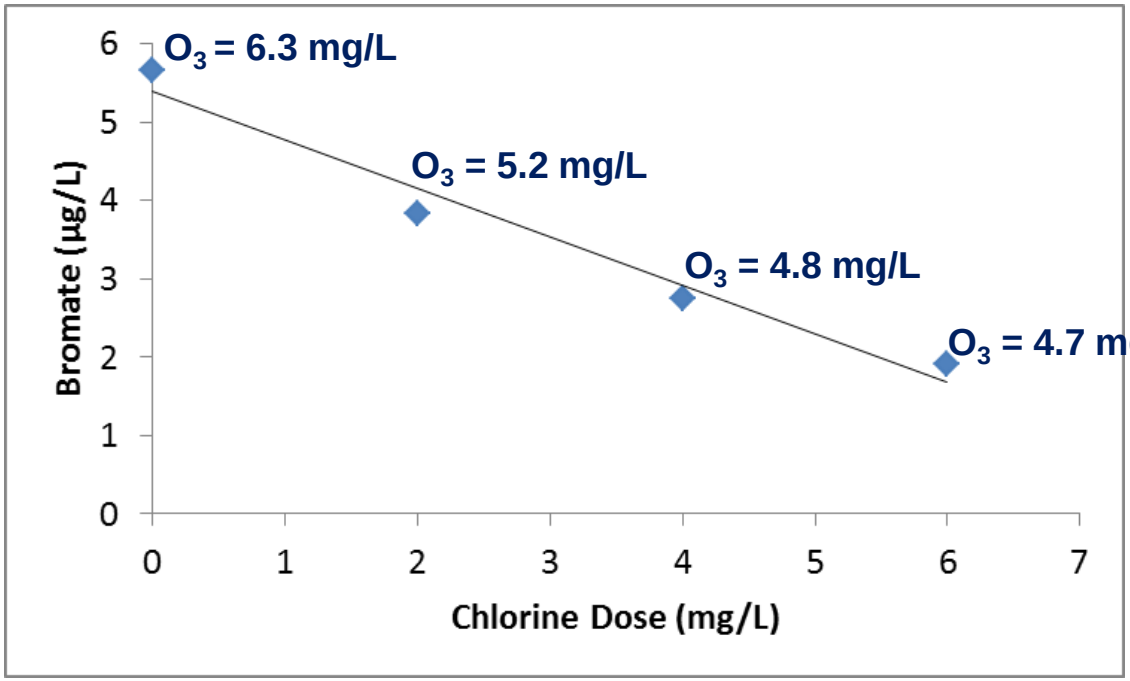
- NH_2Cl used to control bromate by limiting hydroxyl radical exposure and masking bromide



Bromide = 0.38 mg/L

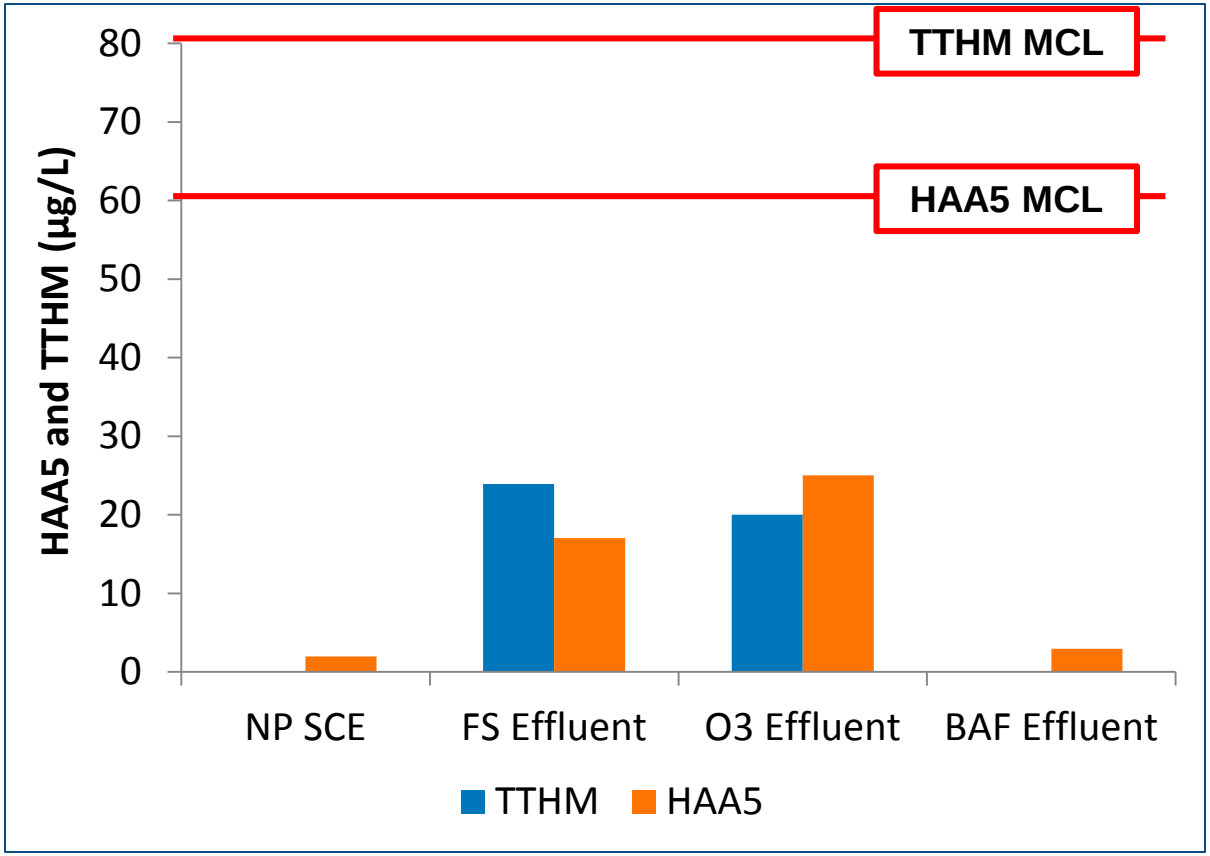
Bromate Control by Free Chlorination

- Chlorine was fed to rapid mix at doses of 2, 4 and 6 mg/L resulting in decreased ozone demand and decreased bromate formation



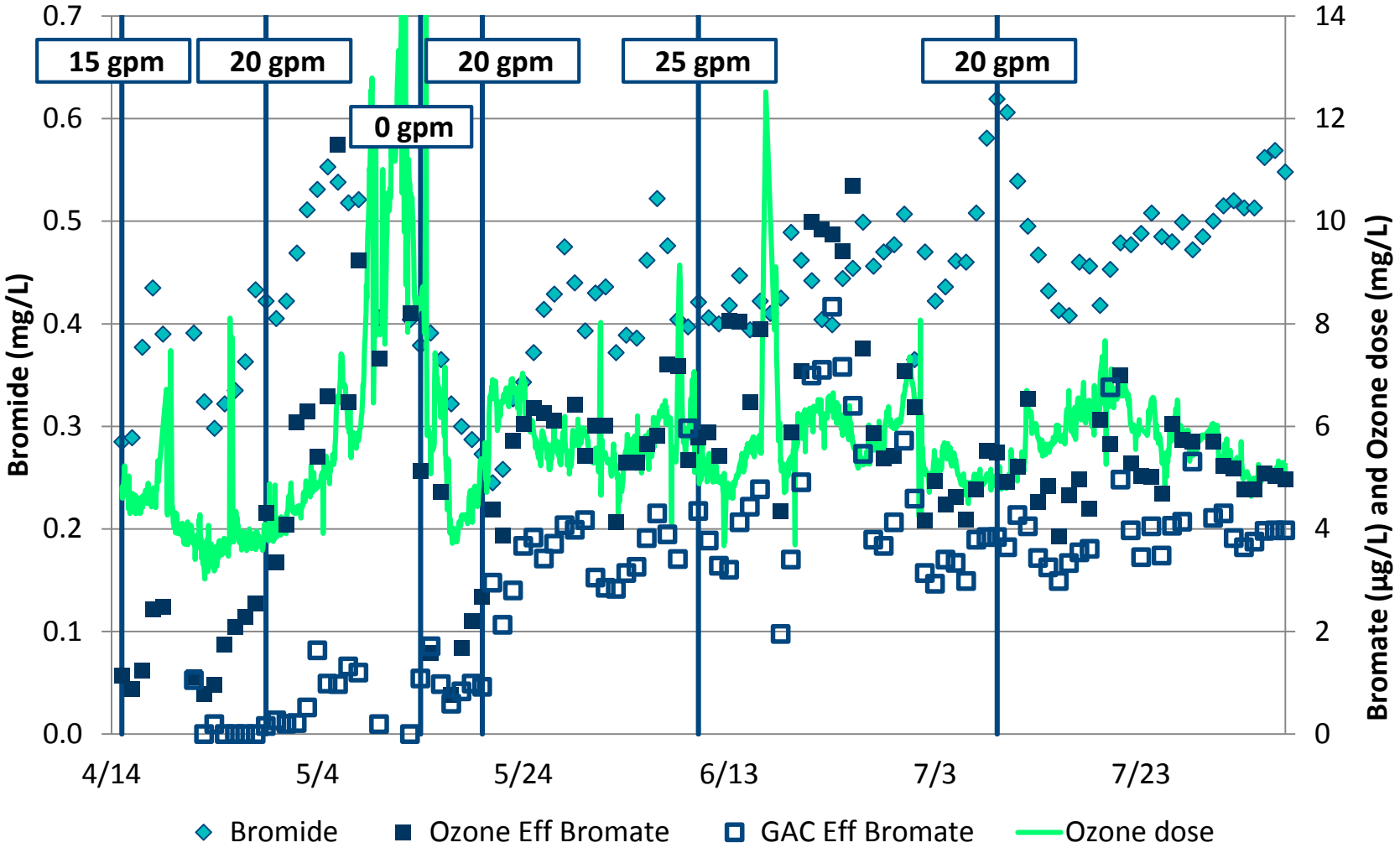
Bromide = 0.17 mg/L

Formation and Removal of DBPs During Prechlorination

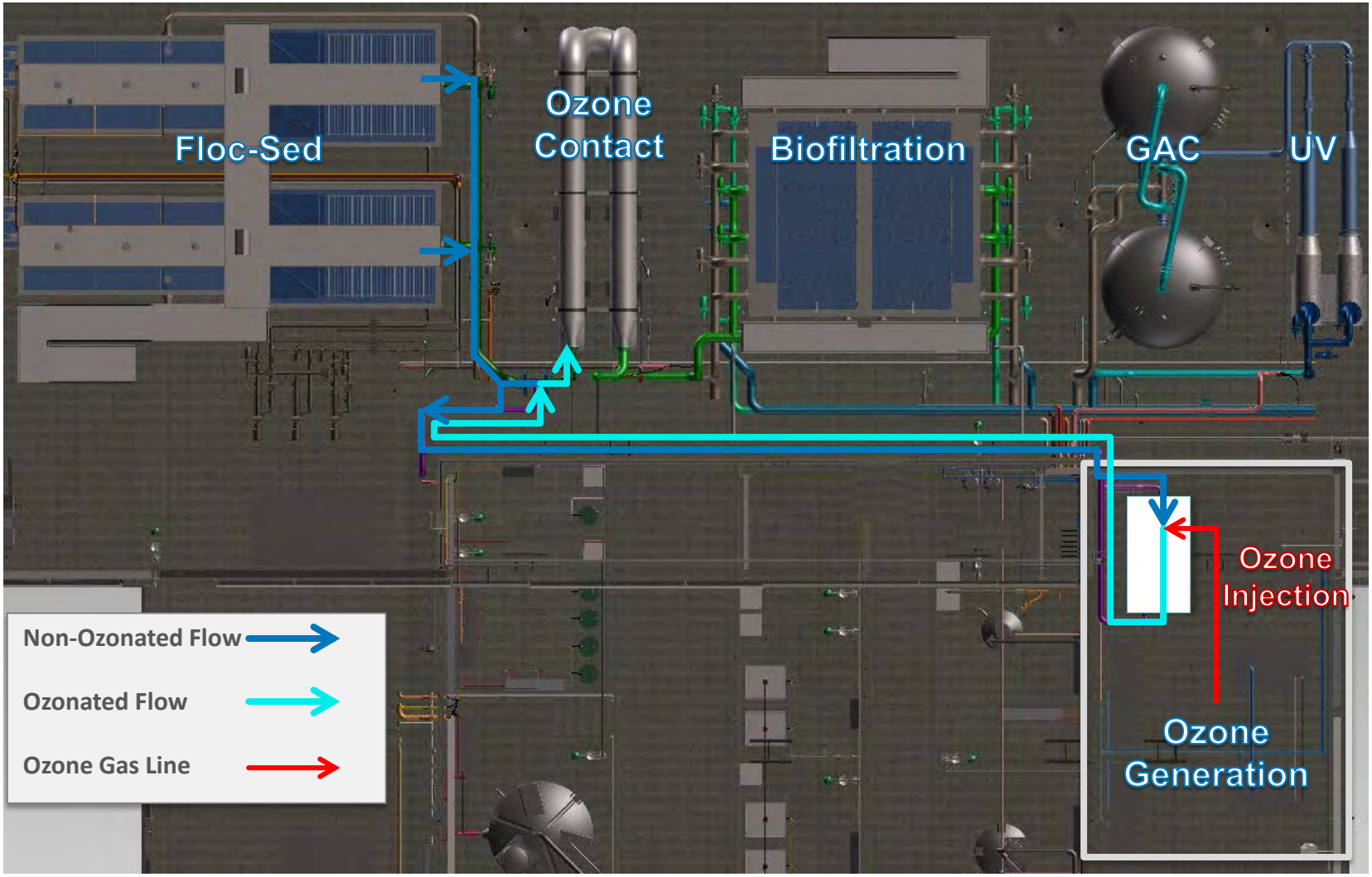


Chlorine dose = 4 mg/L

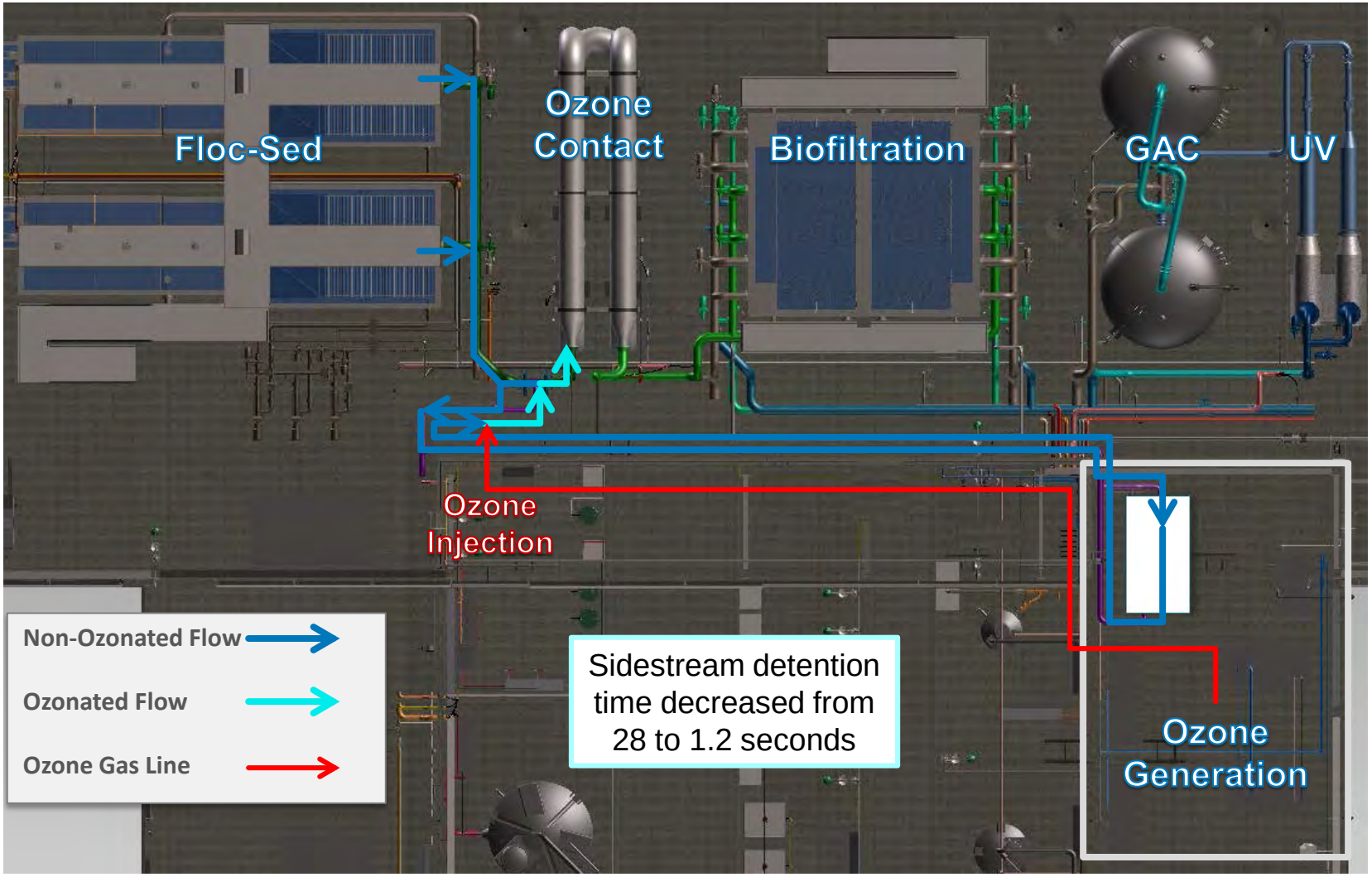
Leachate Flowrate Influence on Bromide/Bromate



Original Sidestream Injection Design

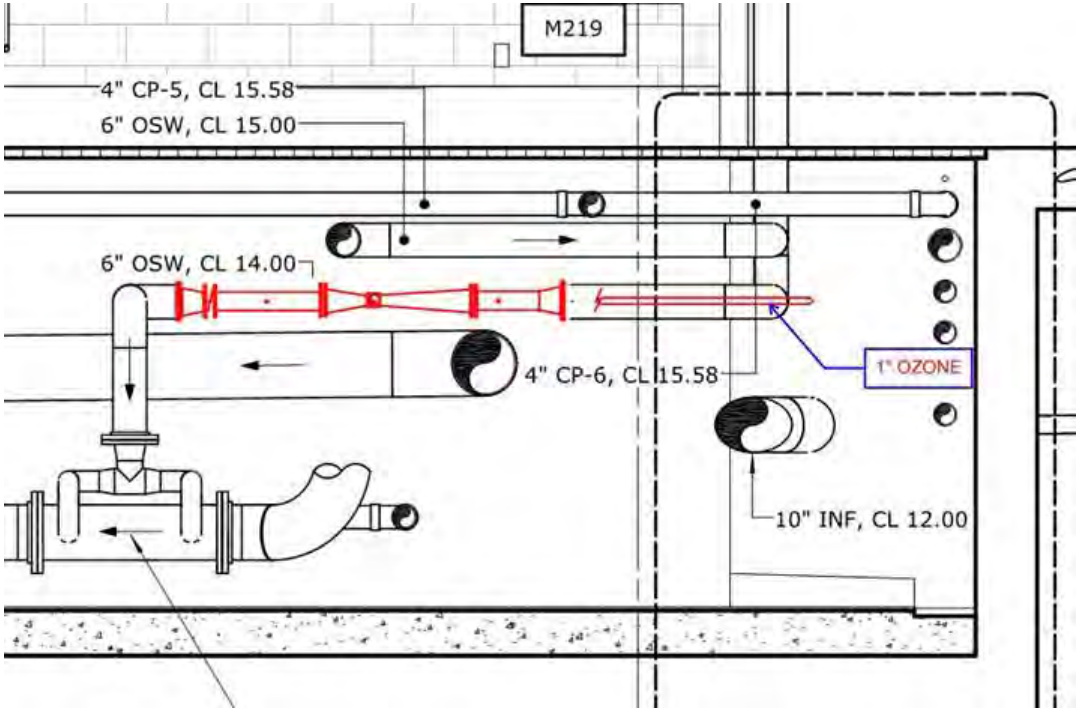


Modified Sidestream Injection Design

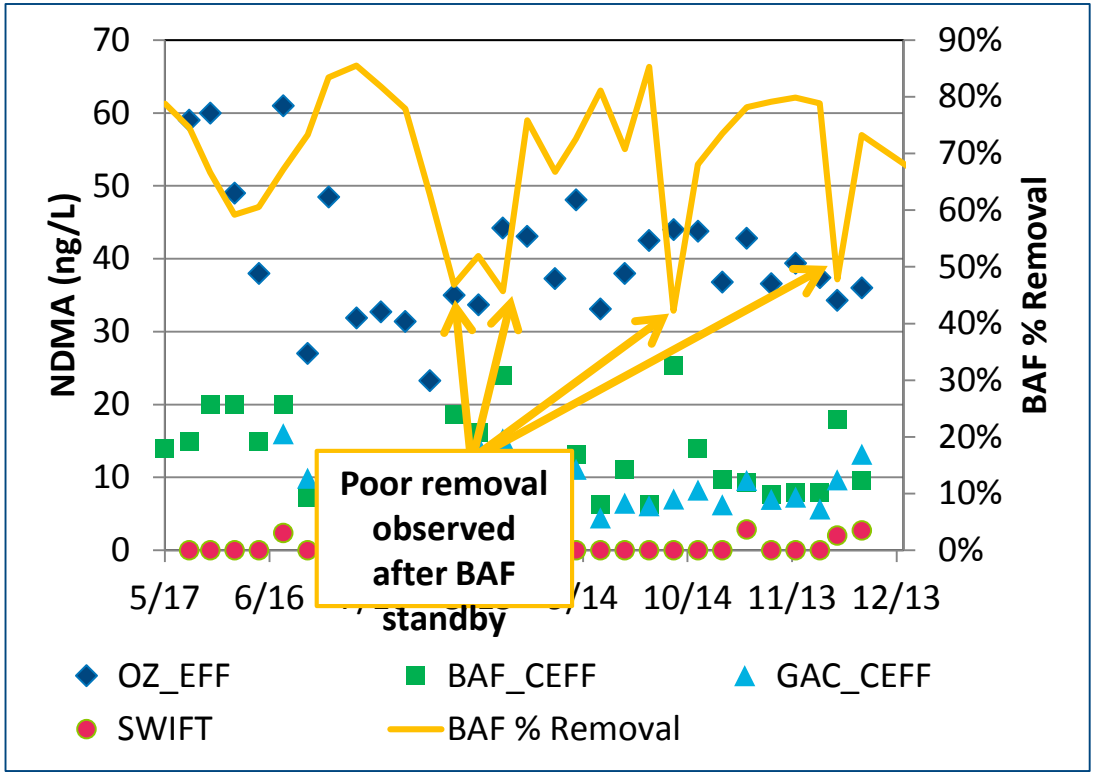


Improved Ozone Performance

- Before injector move:
  - Average Ozone Dose: **6.7 mg/L**
  - Average TOC: 7.4 mg/L
- After injector move:
  - Average Ozone Dose **5.4 mg/L**
  - Average TOC: 8.1 mg/L
  - Bromate controlled with >50%higher bromide



N-nitrosodimethylamine (NDMA)



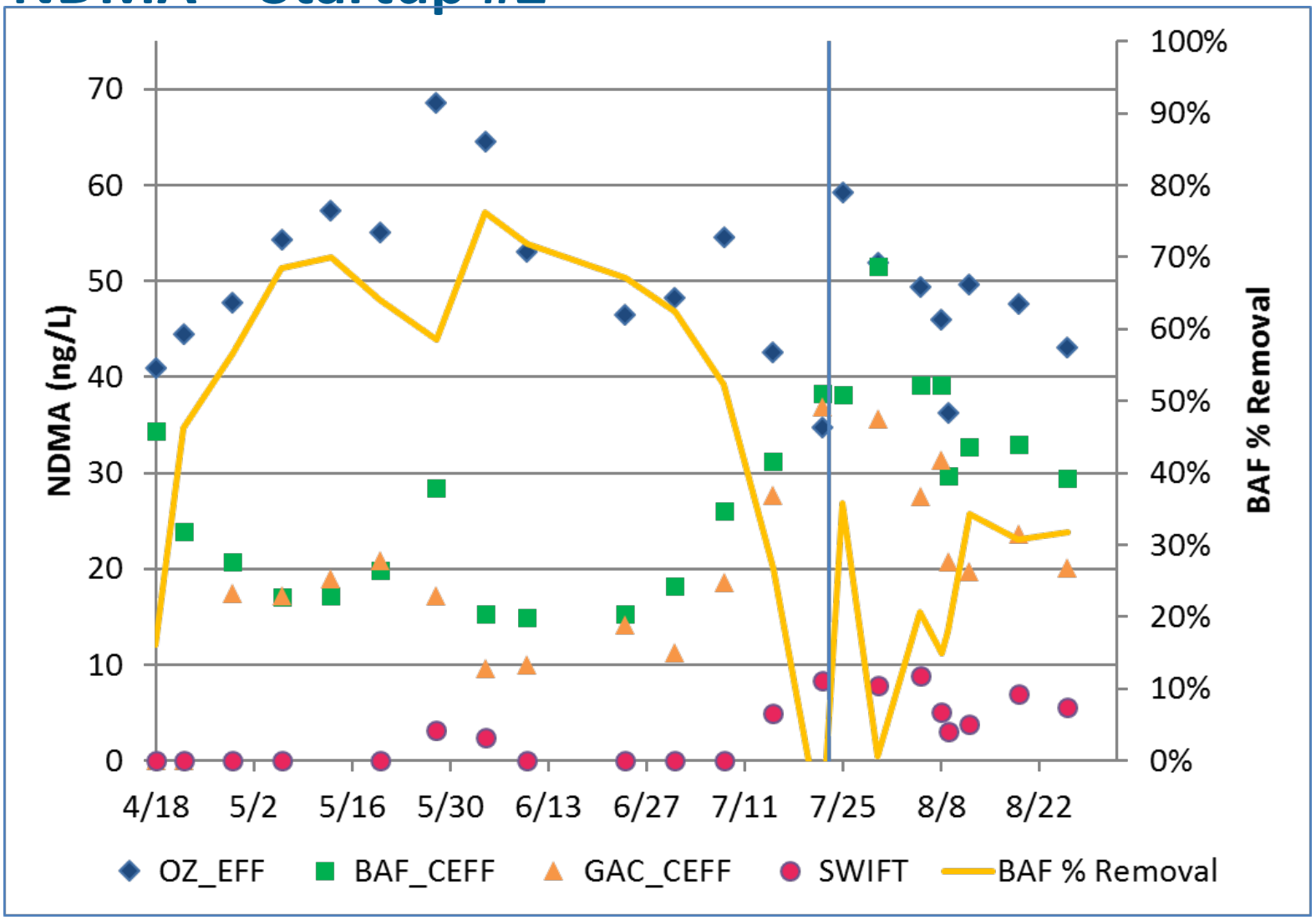
- NDMA is a byproduct of chloramination/ozonation
  - Included on the EPA Contaminant Candidate List 3
  - CA Health Advisory Limit = 10 ng/L
- Primary removal mechanism is biodegradation in the biofilters
- NDMA is consistently below the detection limit on SWIFT Water
  - Adsorption on virgin GAC
  - Direct Photolysis

NDMA detection limit = 2 ng/L

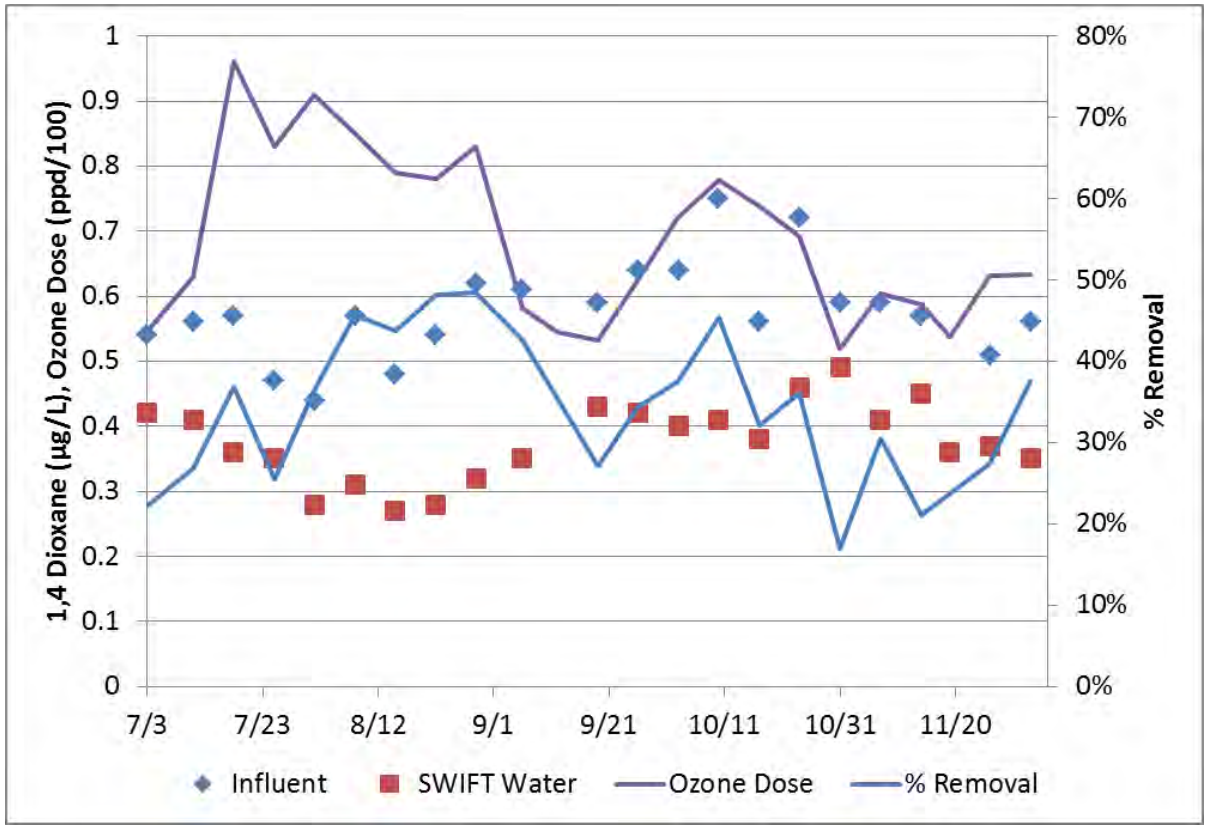
NDMA Removal by Direct Photolysis in UV:

- As long as >97% UVT, expect 97.5% NDMA removal (1.6 log) @ 100% power,1 MGD, both reactors in service with 50/50 flow split
- 200 ng/L to 10 ng/L requires 95% removal

NDMA – Startup #2

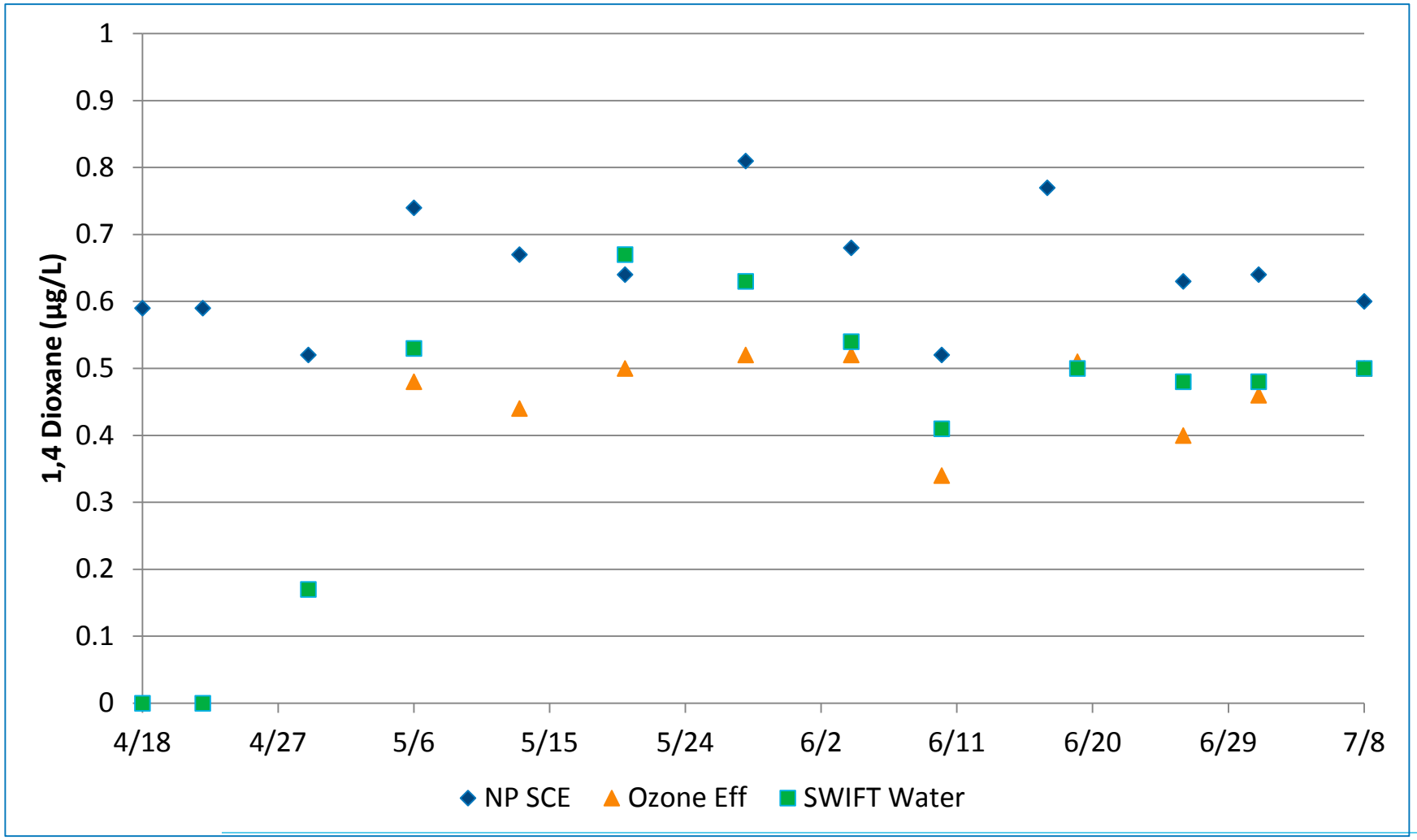


1,4-Dioxane

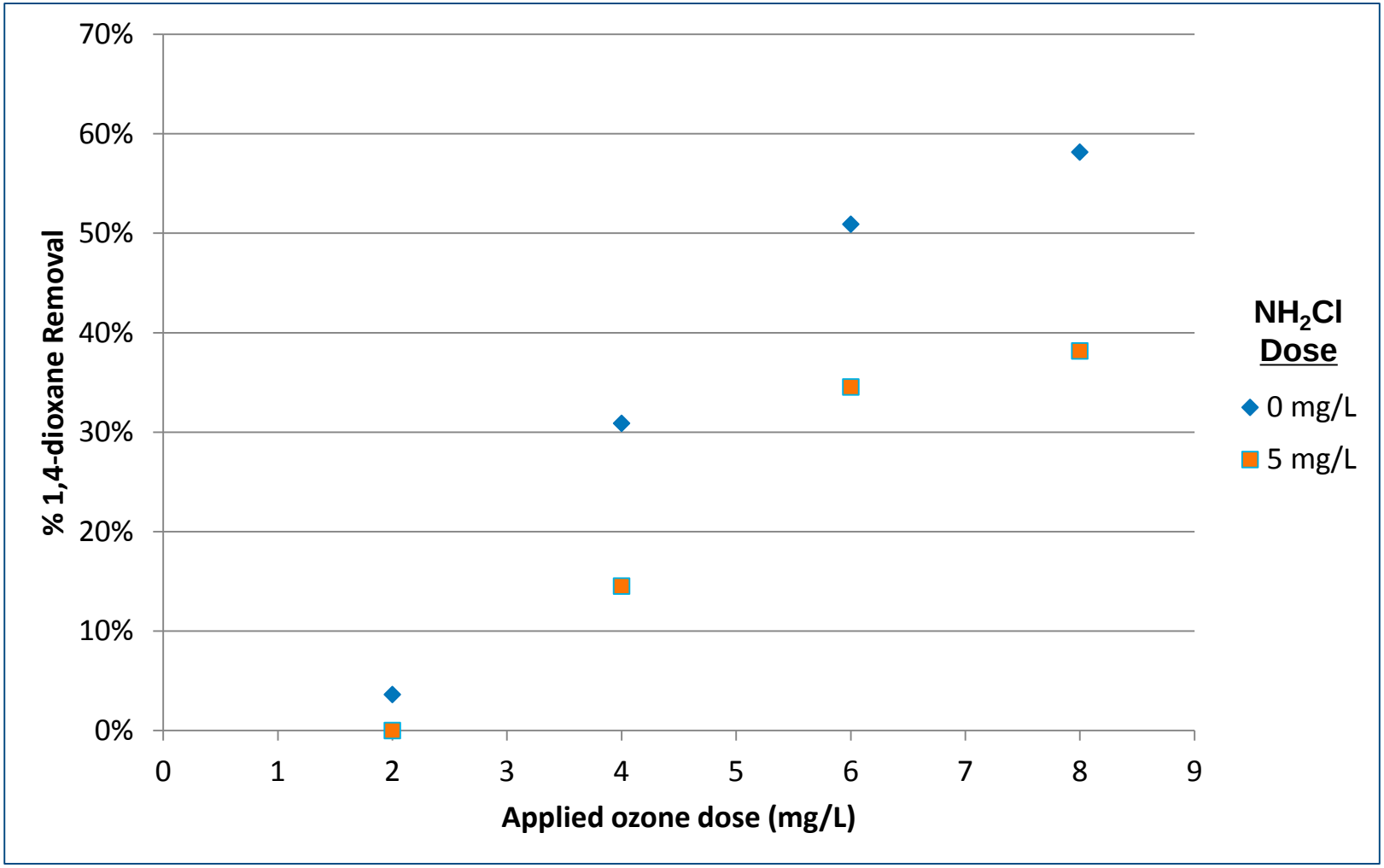


- Trace organic included on the EPA Contaminant Candidate List 3
- CA Drinking Water Notification Limit = 1 µg/L
  - Partial removal by hydroxyl radical through ozonation
  - Biodegraded in biologically active filters (some)
  - Adsorption on virgin GAC

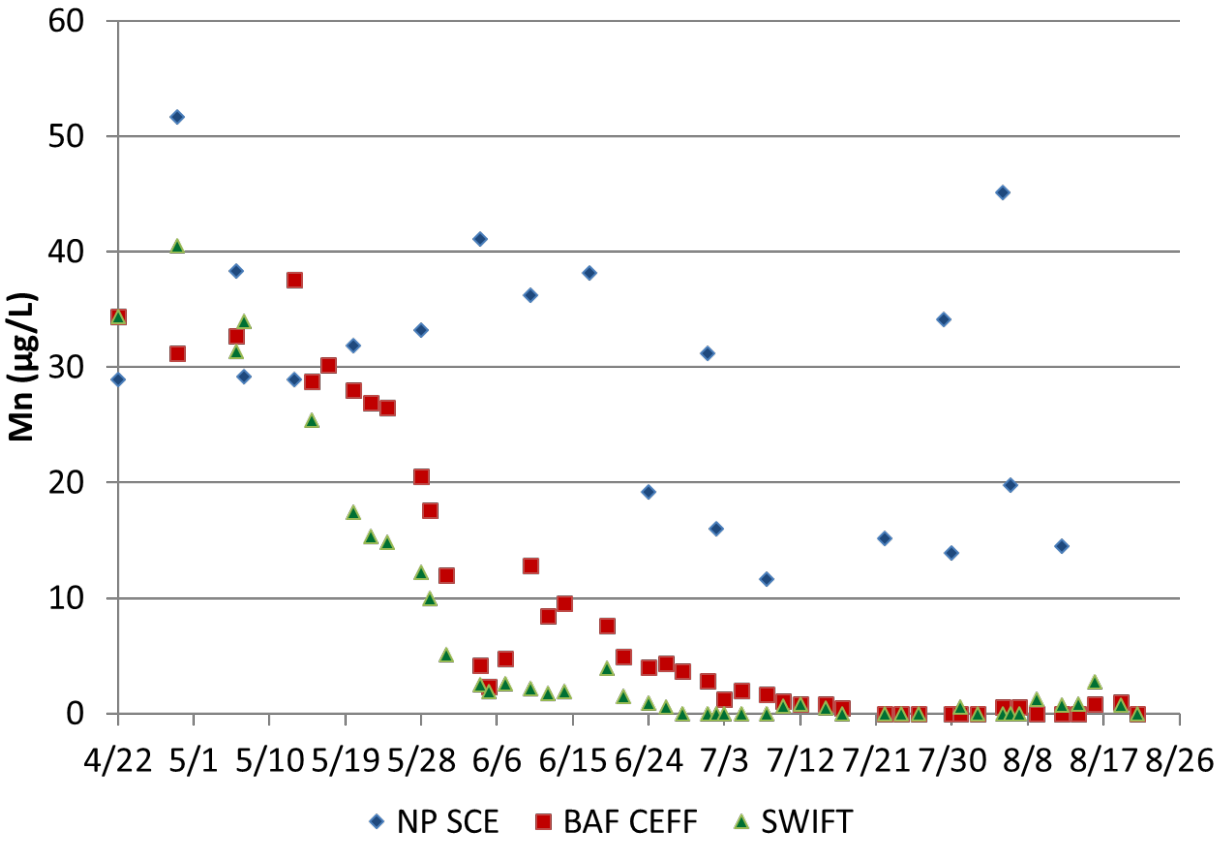
1,4-Dioxane Removal During RC Startup-2



1,4-Dioxane Removal by Ozone



Manganese



Mn Secondary MCL = 50 µg/L

Bypass Filtering Index (BFI)

SWIFT Research Center and Pilot Activities:

- Research and Development Activities
  - **Improving 1,4-dioxane removal**
  - **Direct filtration (potential for YR SWIFT)**
  - **SAT Column Testing**
  - **NP, JR, WB Ozone Testing**
  - **NP, JR, WB Residuals**

Largely pilot scale

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