The Potomac Aquifer Recharge Oversight Committee
Meeting Minutes
May 28, 2020

Electronic Meeting in Accordance with Chapter 1283 of the 2020 Acts of Assembly

In attendance: David Paylor, DEQ; Mark Bennett USGS; David Campbell, USEPA; Adil Godrej, OWML; Whitney Katchmark, HRPDC; William Mann, Governor Appointee; Norman Oliver, VDH; Doug Powell, Governor Appointee; Gary Schafran, PARML; and Mark Widdowson, PARML.

The Chair, David Paylor, called the meeting to order at 1 pm.

Doug Powell made a motion to approve the minutes of the previous meeting; Mark Widdowson seconded the motion; and it carried unanimously.

Mark Widdowson and Gary Schafran, co-directors of the Potomac Aquifer Recharge Monitoring Lab (PARML) made a presentation on the activities of the lab and year-two proposed work plan. Jamie Mitchell responded to a question on testing of phthalates.

Charles Bott (HRSD) made a presentation on continued operations at the SWIFT Research Center.

Jamie Mitchell (HRSD) provided a briefing on the status of the James River Treatment Plant full-scale SWIFT facility individual UIC permitting. Two documents are out for review with comments to be submitted by July 6. She also discussed the differences between the James River Treatment Plant UIC and the SWIFT Research UIC; SWIFT water quality targets key elements; and aquifer monitoring and contingency plan.

Ted Henifin (HRSD) said they have short-listed the design-builders for the James River Treatment Plant full-scale implementation and proposals are being developed. Staff expects to make a selection by the end of the year with construction starting at the beginning of next year. In the interest of time, this topic was deferred to the next meeting.

There were no public comments.

A poll will be sent to members for availability for the next meeting date.

The meeting adjourned at 2:33 pm.

Approved: [signature]
David Paylor, Committee Chair

Date: 9/10/2020

The Potomac Aquifer Recharge Oversight Committee
Draft Meeting Minutes
May 28, 2020

Committee Members:

- David Paylor, Director of Virginia DEQ
- Dr. Norman Oliver, Virginia State Health Commissioner
- Dr. William Mann, Governor Appointee
- Doug Powell, Governor Appointee
- Whitney Katchmark, HRPDC
- Adil N. Godrej, PhD, PE, Co-Director Occoquan Watershed Monitoring Laboratory
- Mark Widdowson, Co-Director of the Potomac Aquifer Recharge Monitoring Lab
- Gary Schafran, Co-Director of the Potomac Aquifer Recharge Monitoring Lab
- Mark Bennett, Director of Virginia and West Virginia Water Science Center
- Dave Campbell, Director of the US EPA Region 3 Laboratory Services and Applied Science Division

Potomac Aquifer Recharge Monitoring Laboratory Update

Gary Schafran and Mark Widdowson
PARML Co-Directors

May 28, 2020

Update:

- Laboratory renovation
- Examination of SWIFT WQ Data to inform development of laboratory analytical capacity
- Groundwater modeling and monitoring
- Travel time analysis in groundwater
- Work plan for 2020-21

PARML Water Quality Laboratory – Renovation Schedule

- Bidding & Contract Awarded – May 2020
- Construction & Inspections – June
- Casework Installed – July/August
- Projected Completion – August

Examining SWIFT Water Quality Relative to Health-Based Reference Points

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

- Analysis of Data from Six Quarterly Reports;
- Parameters of focus had concentrations >25% of a PMCL, health advisory, or reporting value;
- Maximum values (not average) examined;
- Values <LOQ were included as 50% of LOQ value;
- Probability of limit exceedance

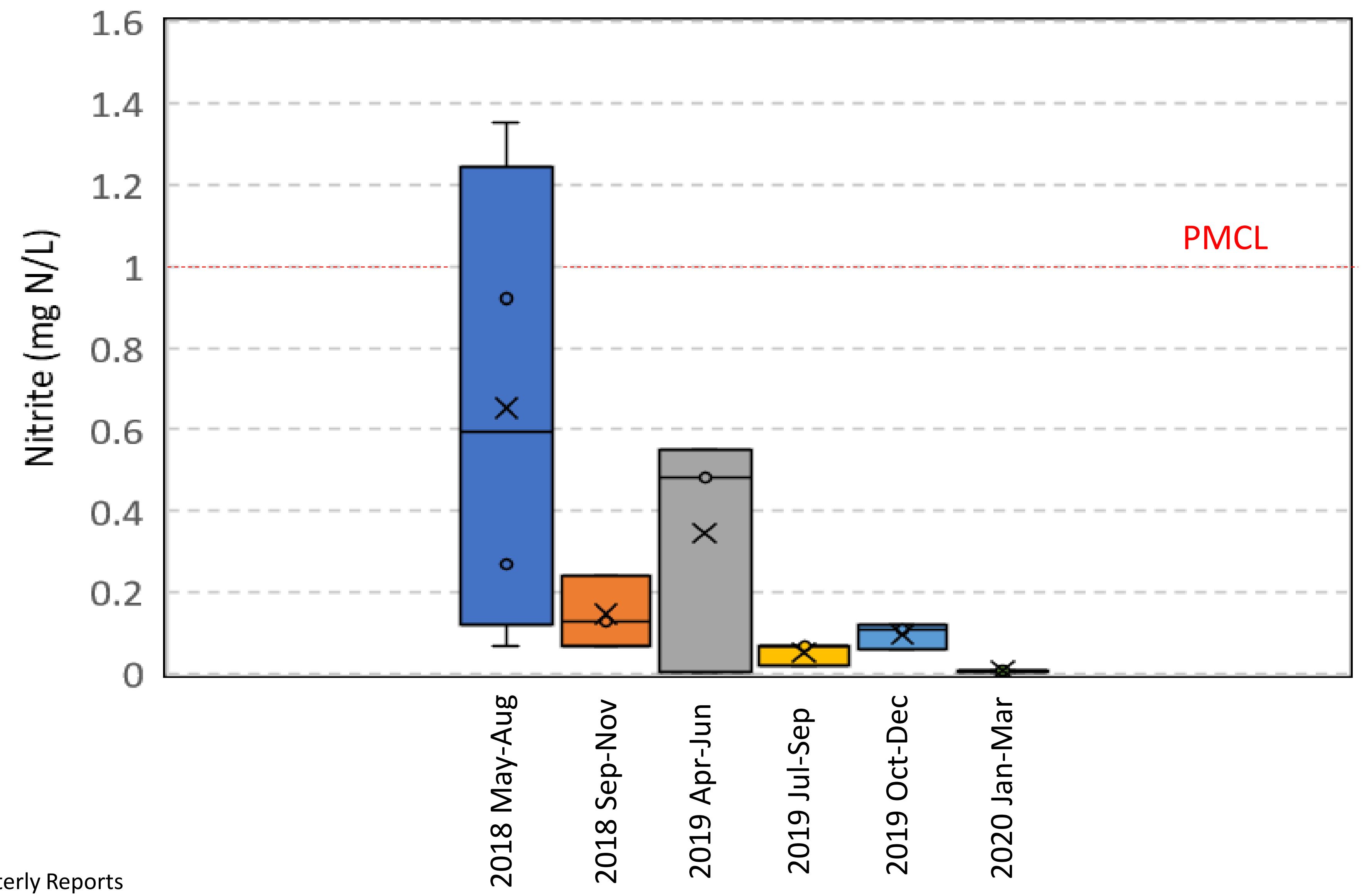
Synthetic Organic Chemicals

- Overwhelmingly below the level of quantitation

- 2020 Jan-Mar Monitoring: 73 of 77 monitored parameters <LOQ (does not include THMs and HAAs)

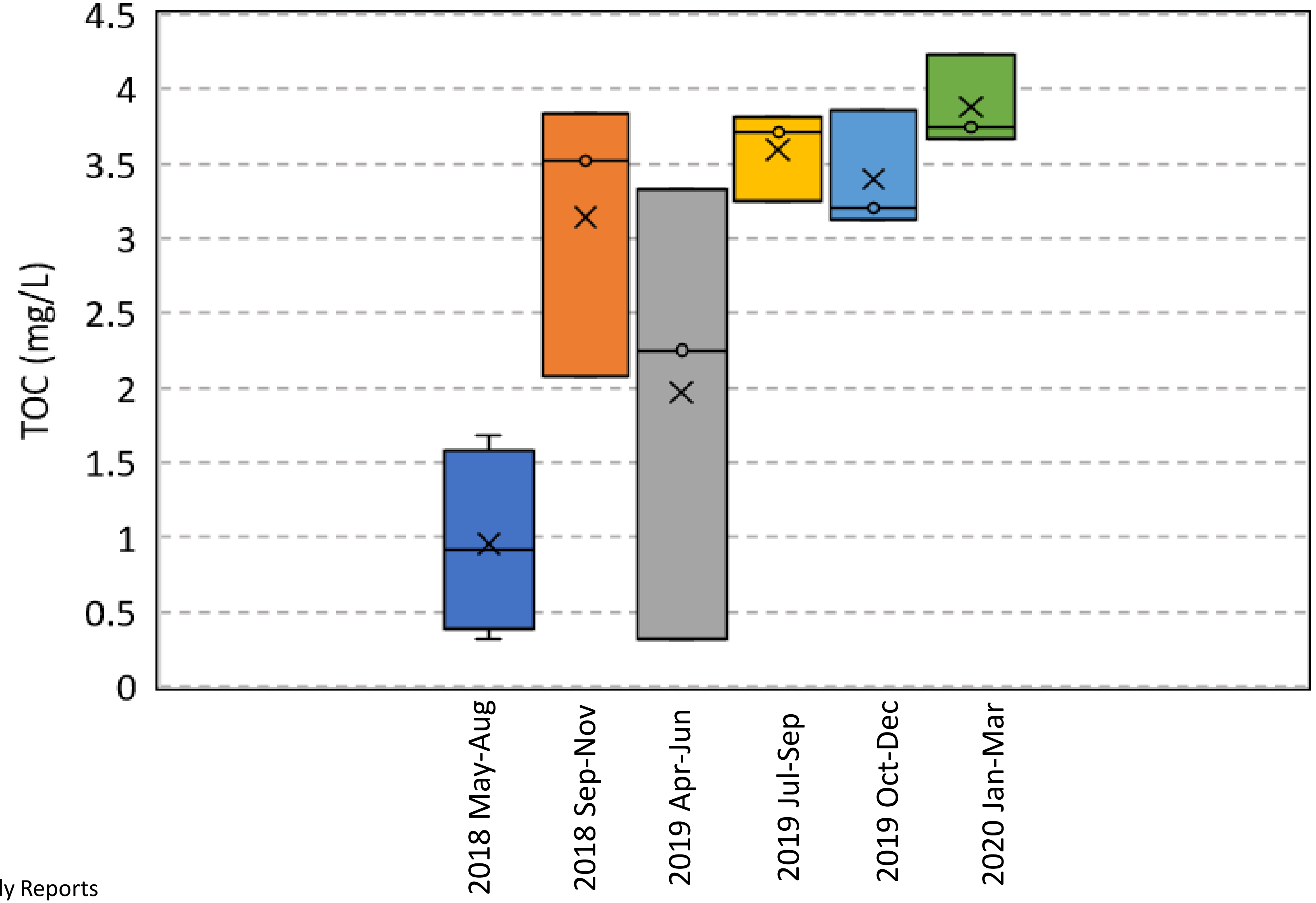
- Sucralose and primidone (treatment efficacy), PFOA and 1,4 dioxane (public health) detected

Variation in SWIFT Water Nitrite Concentrations



All values from Quarterly Reports

Variation in SWIFT Water TOC Concentrations



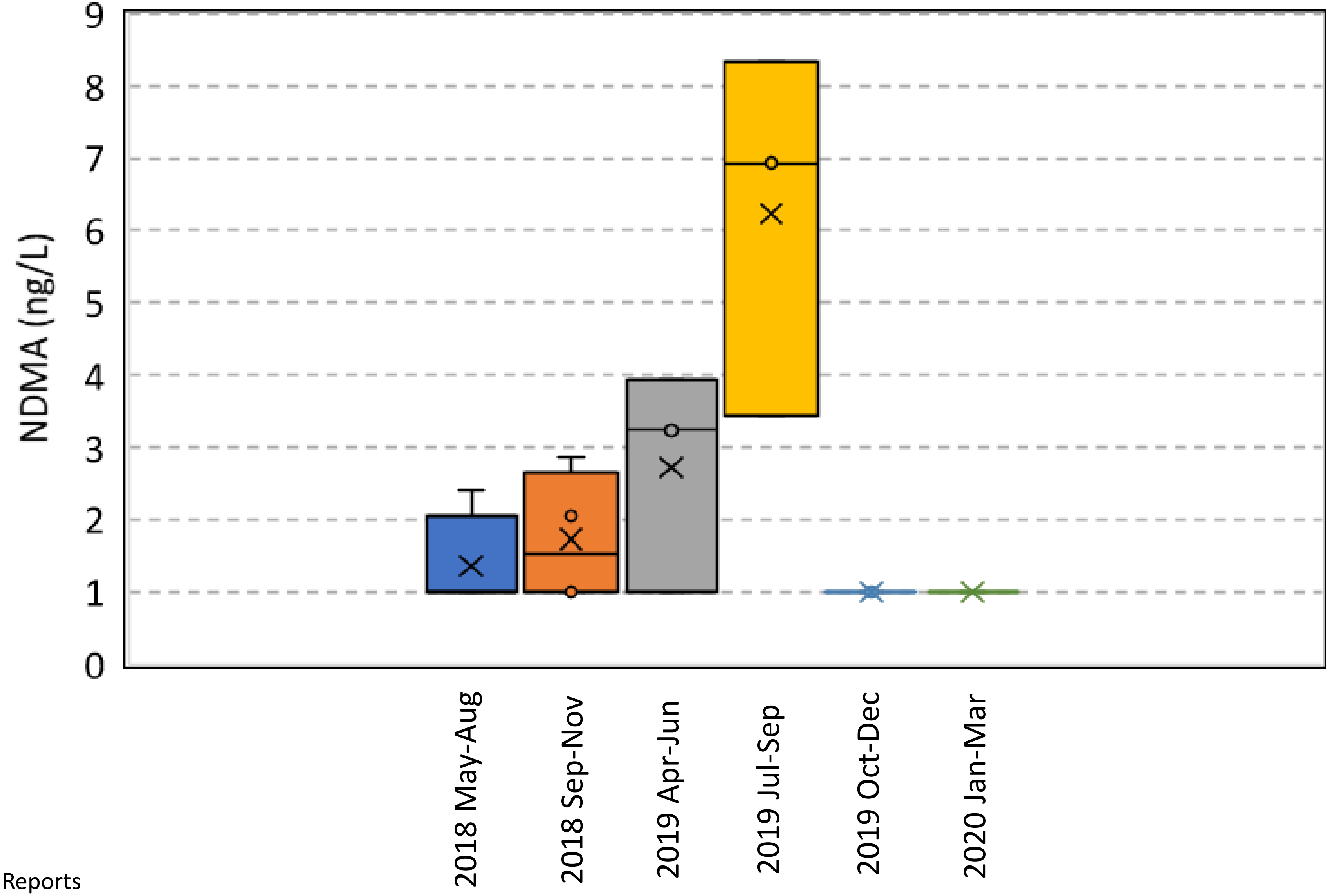
Reference

TOC_{max}: 6 mg/L as C

TOC_{avg}: 4 mg/L as C

All values from Quarterly Reports

Variation in SWIFT Water NDMA Concentrations

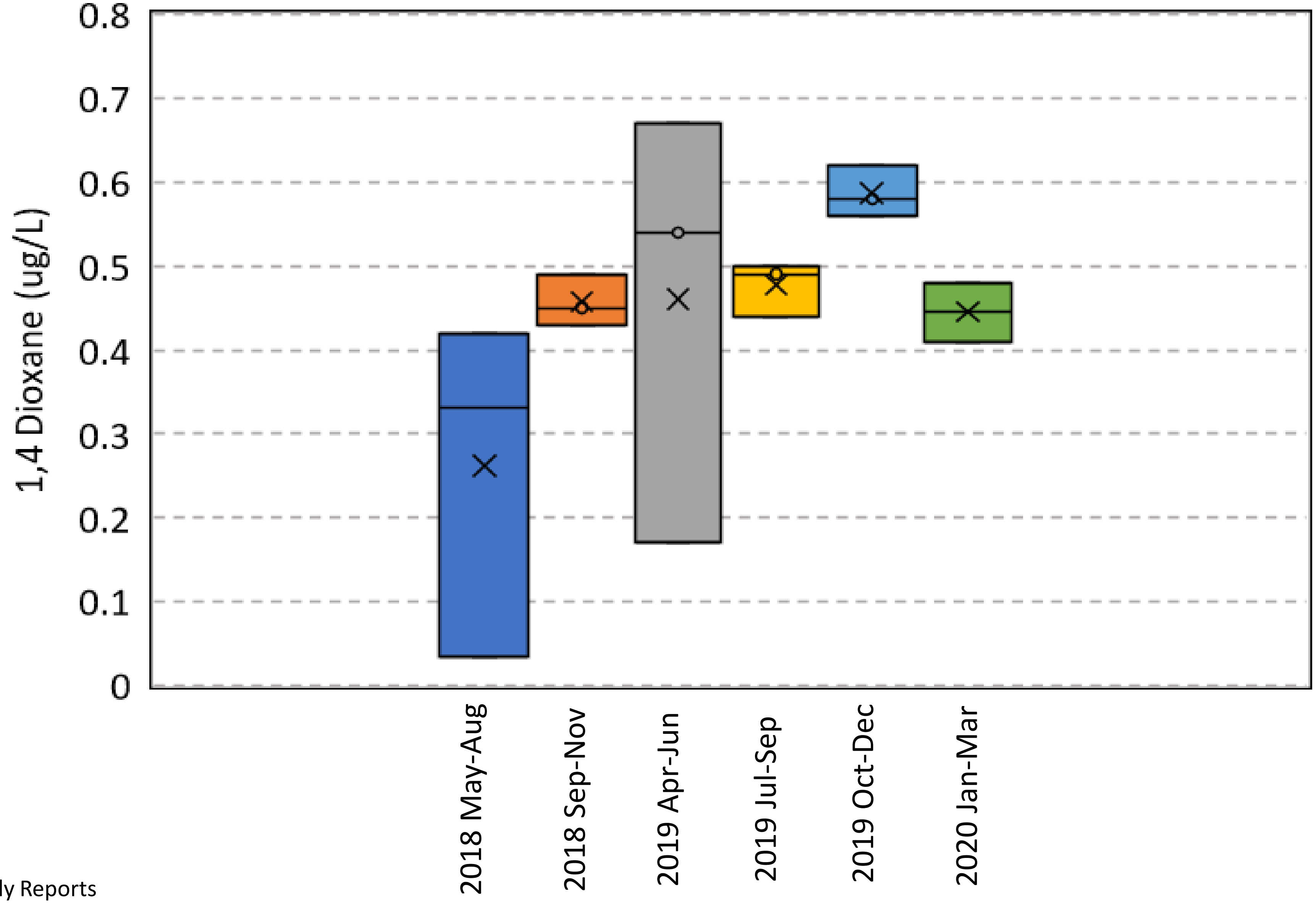


Reference

NDMA: 10 ng/L

All values from Quarterly Reports

Variation in SWIFT Water 1,4 Dioxane Concentrations

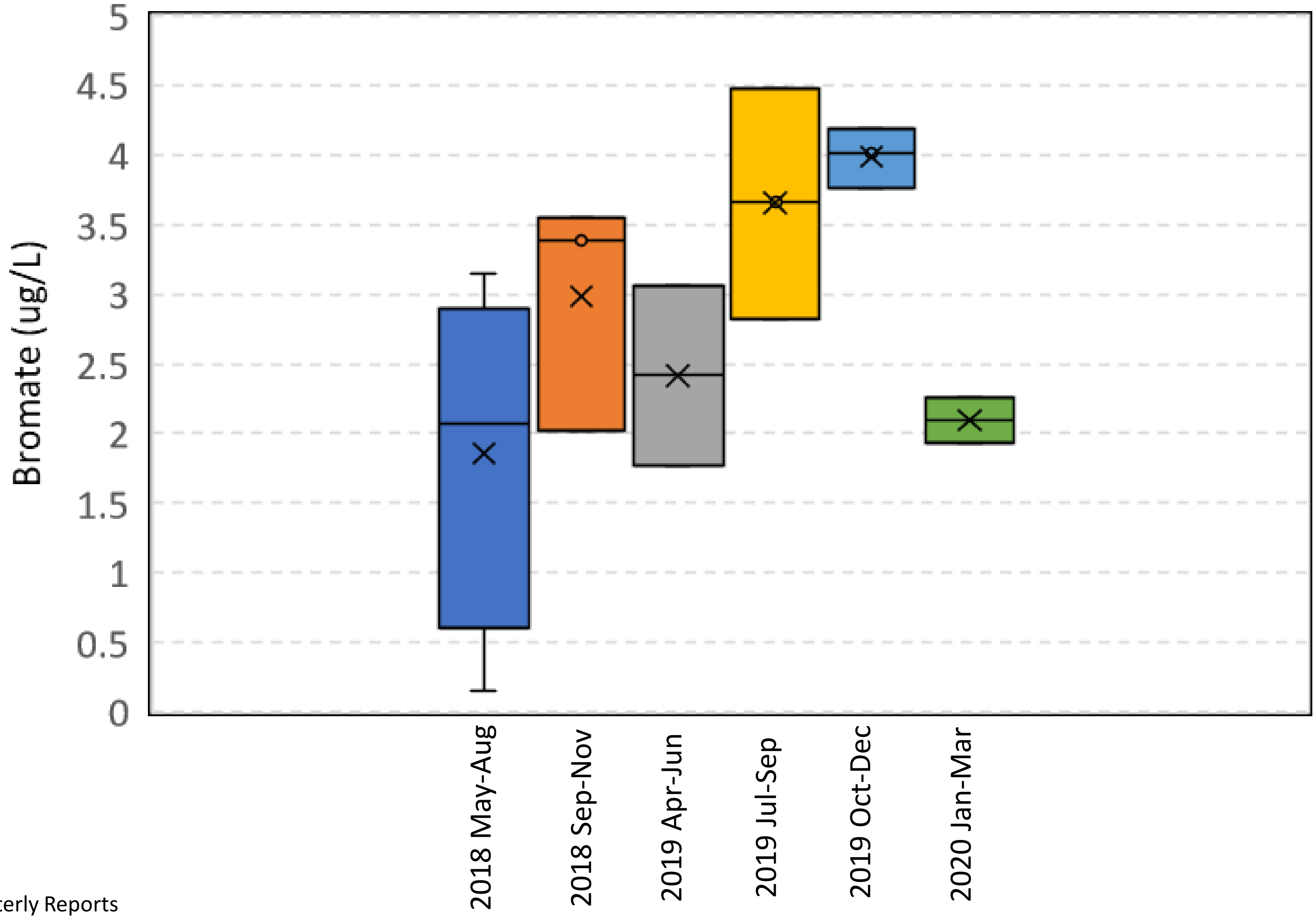


<u>Reference</u>

1,4 dioxane: 1 ug/L

All values from Quarterly Reports

Variation in SWIFT Water Bromate Concentrations

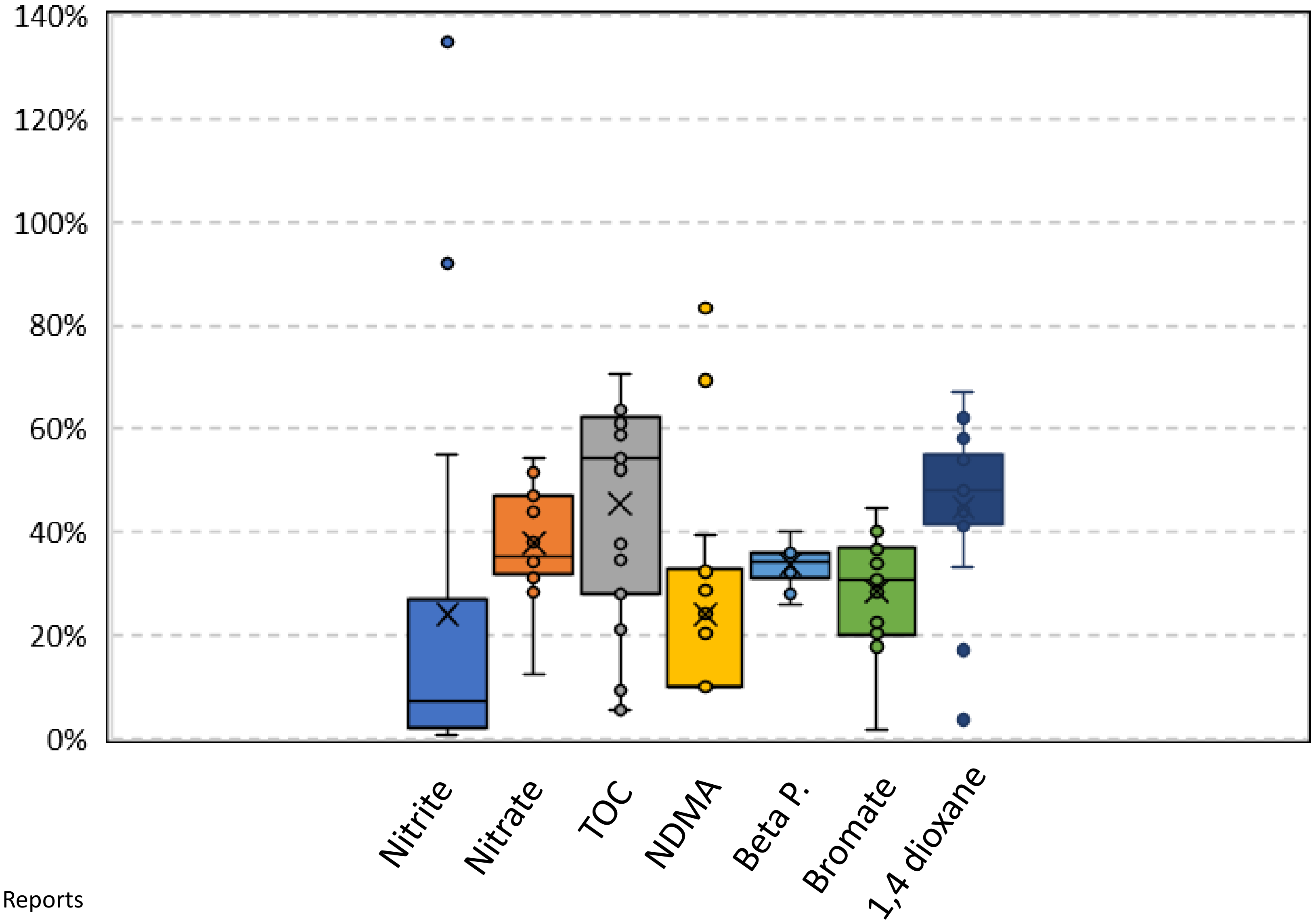


Reference

Bromate: 10 ug/L

All values from Quarterly Reports

Statistical Distributions of Monitored Water Quality Parameters in SWIFT Water: 2018 - 2020



Reference Concentrations

NO_2^-: 1 mg/L as N

NO_3^-: 10 mg/L as N

TOC: 6 mg/L as C

NDMA: 1 ug/L

Beta P. +: 50 pCi/L

Bromate: 10 ug/L

1,4 dioxane: 1 ug/L

All values from Quarterly Reports

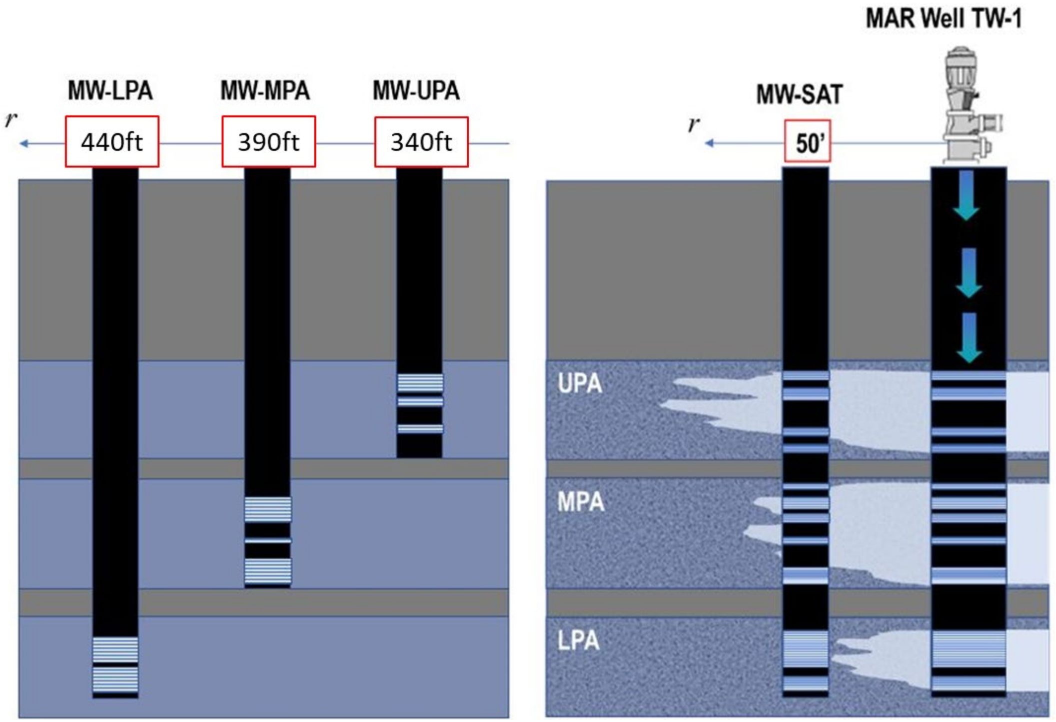
PFAS

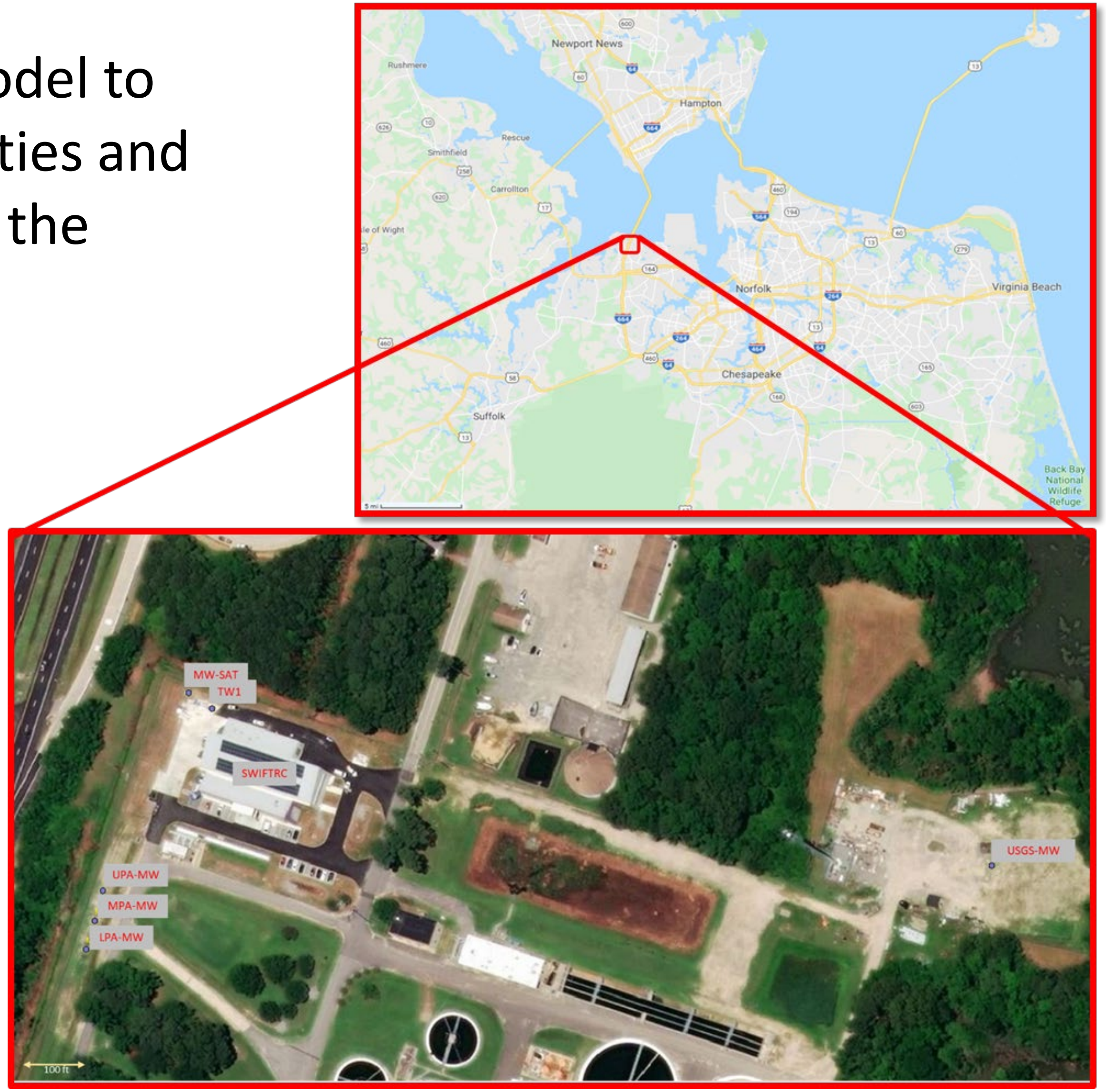
PFOS + PFOA = 70 ng/L EPA Health Advisory

PFOS – All values below LOQ (i.e., not detected)
PFOA – All but one (5.3 ng/L) below LOQ

Groundwater Site Model – SWIFTRC

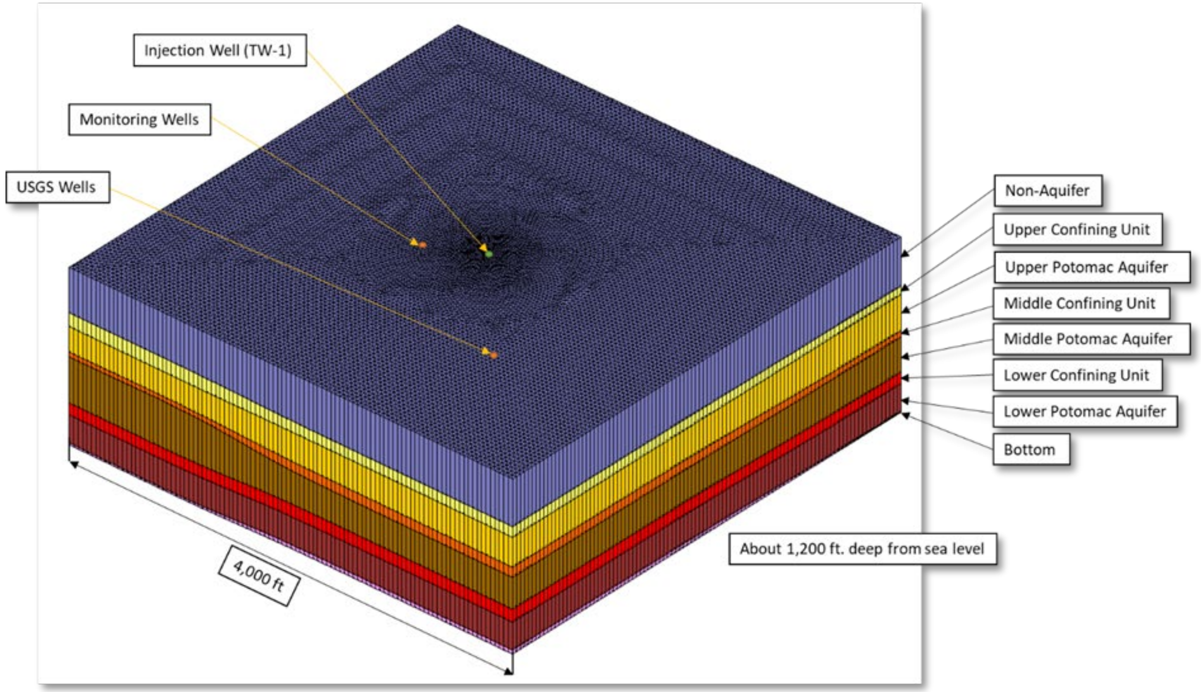
- Objective: Develop and validate math model to quantify aquifer flow and storage properties and replicate groundwater flow conditions in the Potomac Aquifer System at the SWIFTRC





Eric Matynowski

3D Groundwater Model

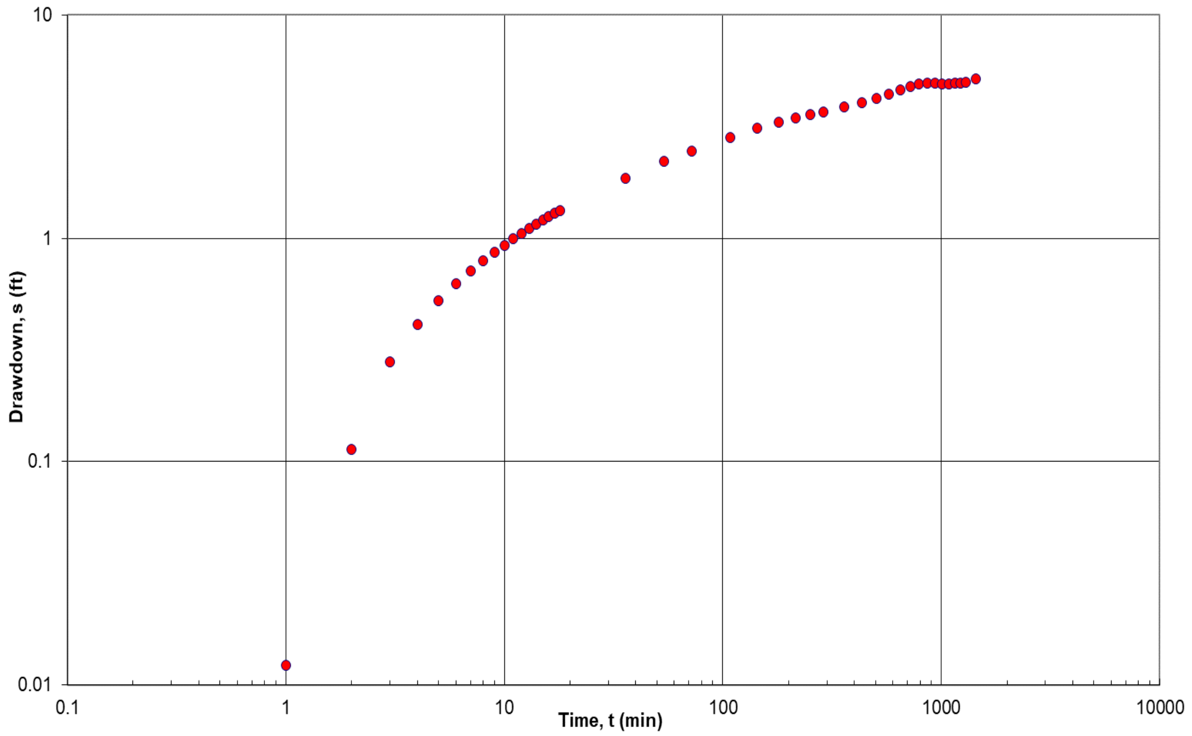


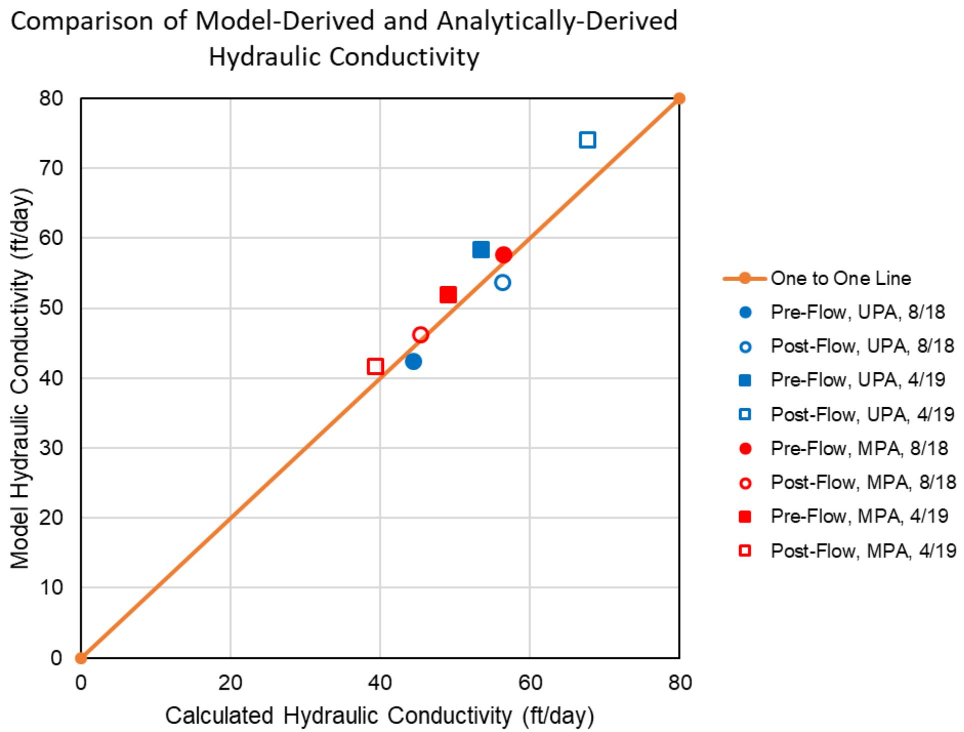
Eric Matynowski

Analysis of Aquifer Properties

- Transmissivity – UPA/MPA
- Storage Coefficients – UPA/MPA

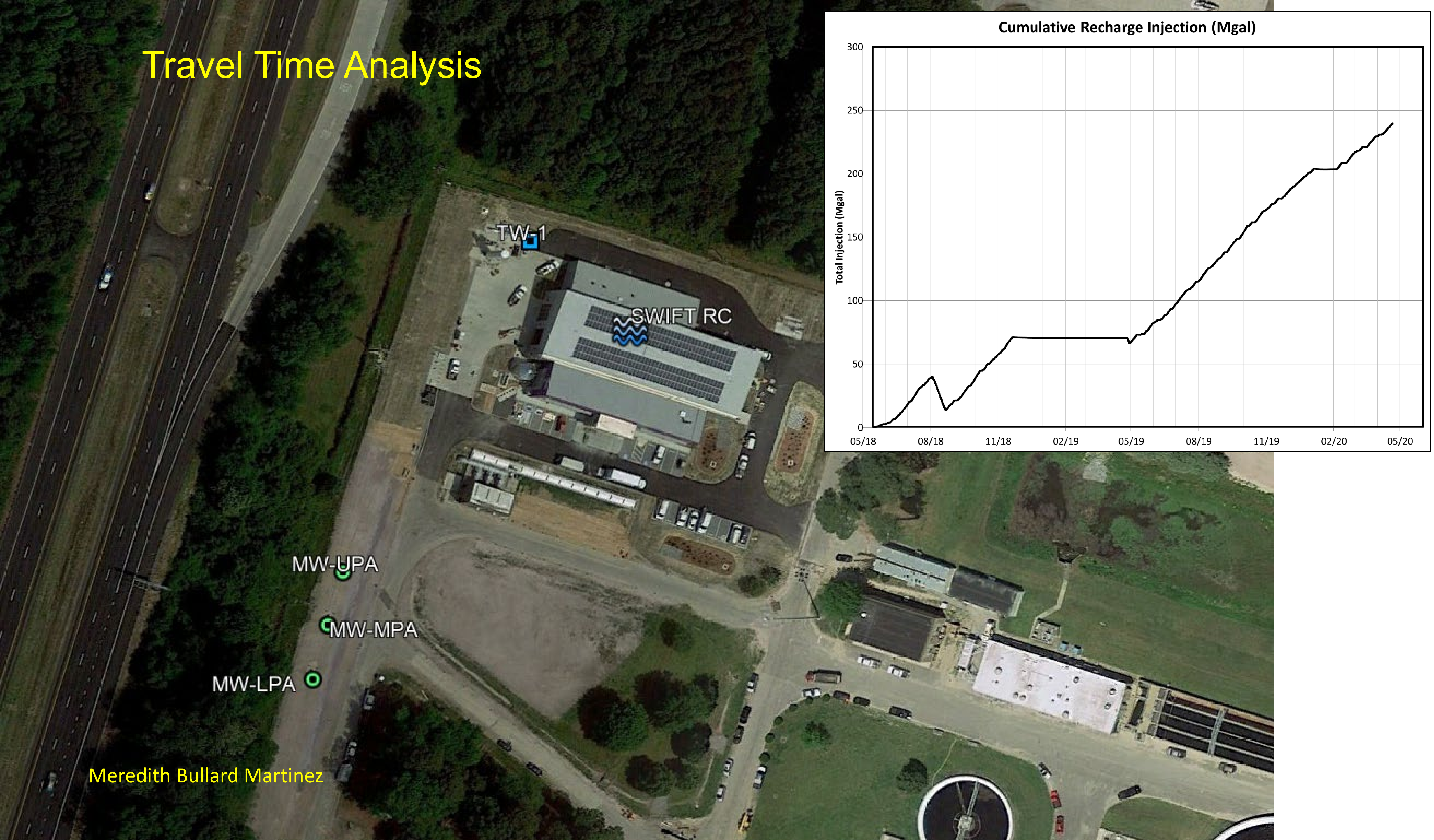
	UPA		MPA	
Parameters	Min	Max	Min	Max
T (ft^2/day)	11,000	17,700	10,600	15,900
K (ft/day)	42	68	37	56
S	6.5E-04	1.0E-03	1.1E-03	1.5E-03
S_s (ft^{-1})	2.5E-06	3.9E-06	3.8E-06	5.1E-06





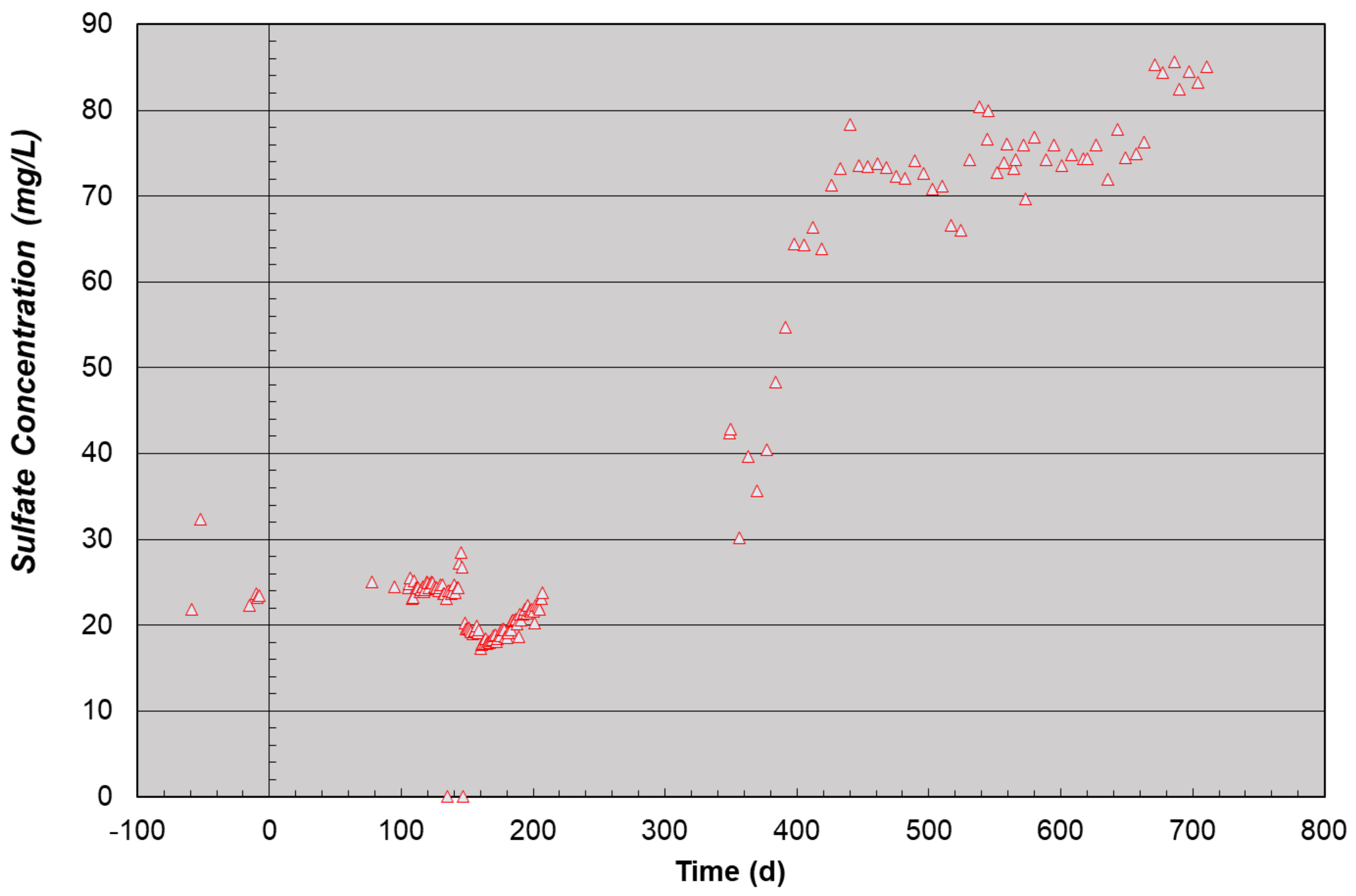
Eric Matynowski

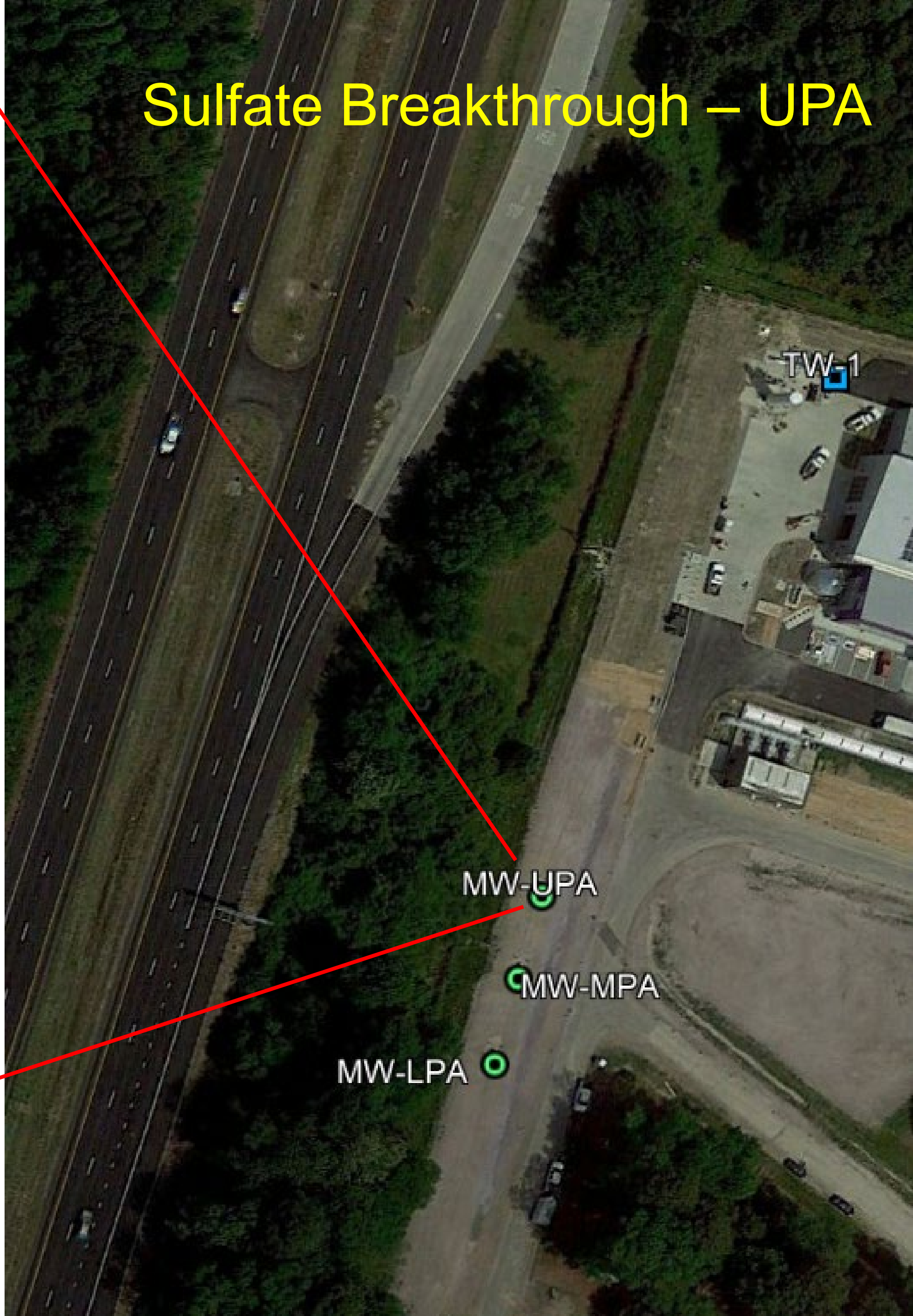
Travel Time Analysis



Meredith Bullard Martinez

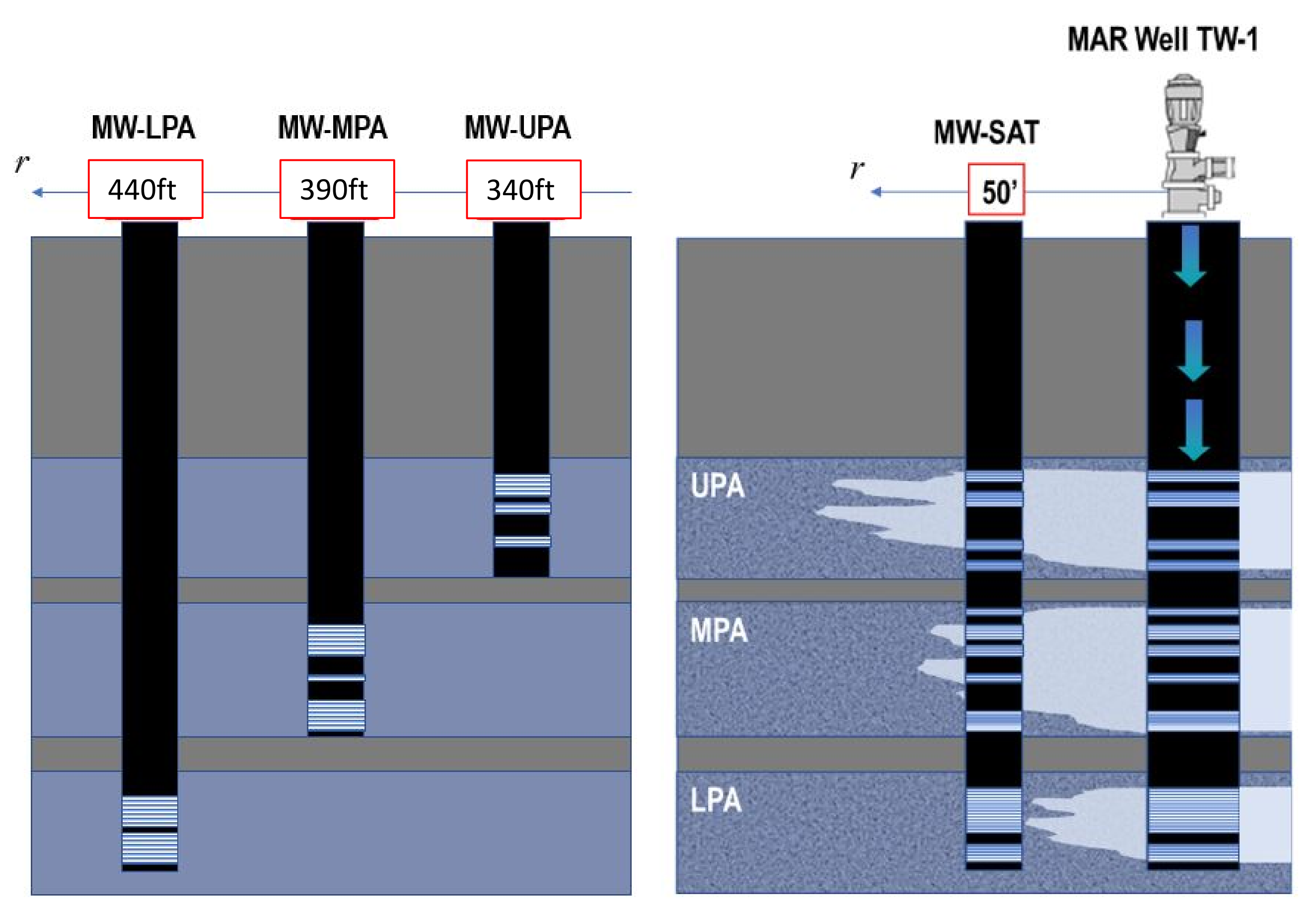
Sulfate Breakthrough – UPA





Thomas Dziura

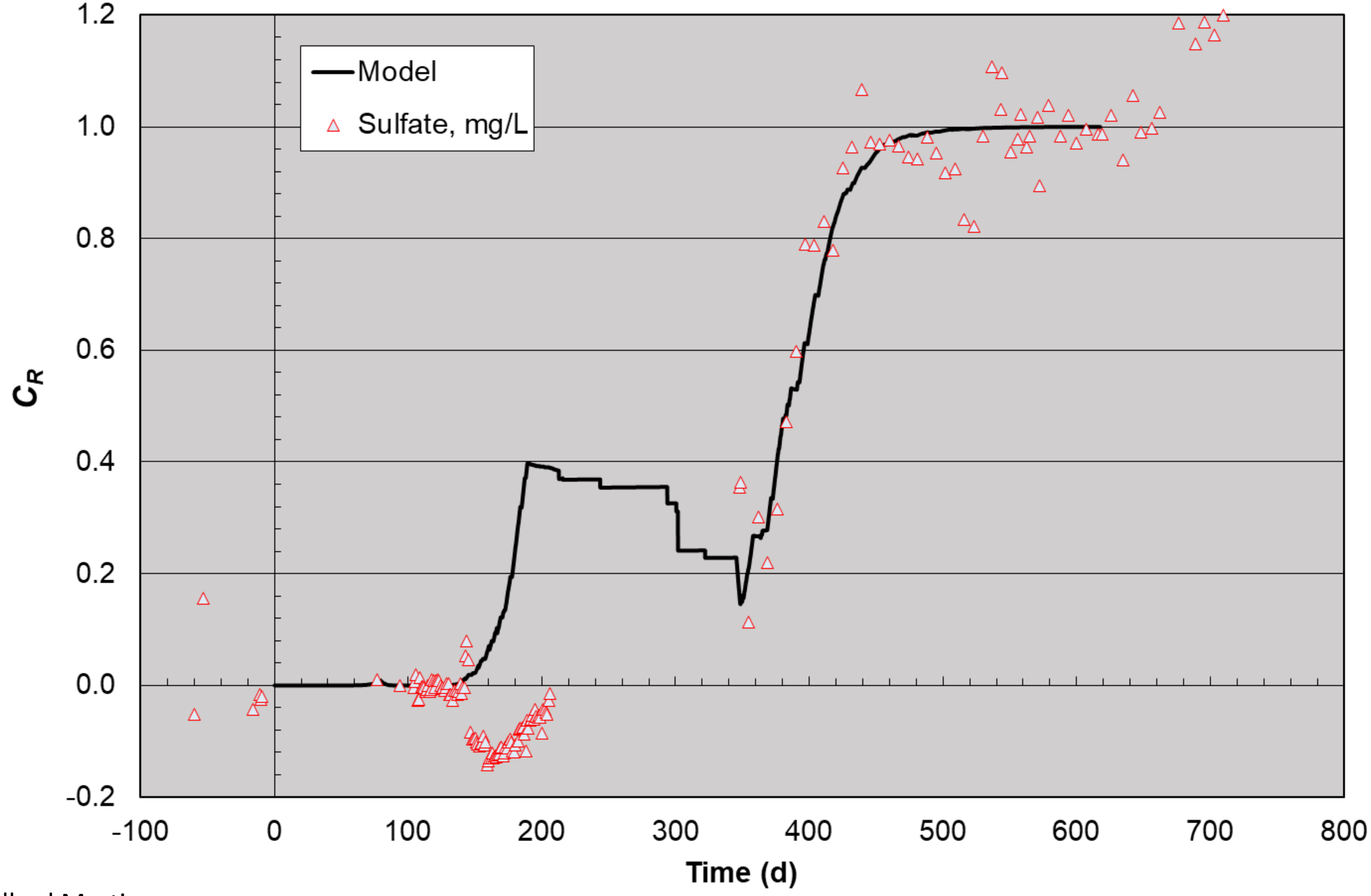
Recharge Distribution and Travel Time



Screen	Flow Distribution Pre-Rehab	Flow Distribution Post-Rehab	Aquifer Unit
1	18%	18%	UPA
2	24%	46%	UPA
3	6%	2%	UPA
4	9%	7%	UPA
5	4%	6%	MPA
6	3%	3%	MPA
7	1%	2%	MPA
8	<1%	2%	MPA
9	31%	11%	MPA
10	2%	1%	LPA
11	<1%	0%	LPA

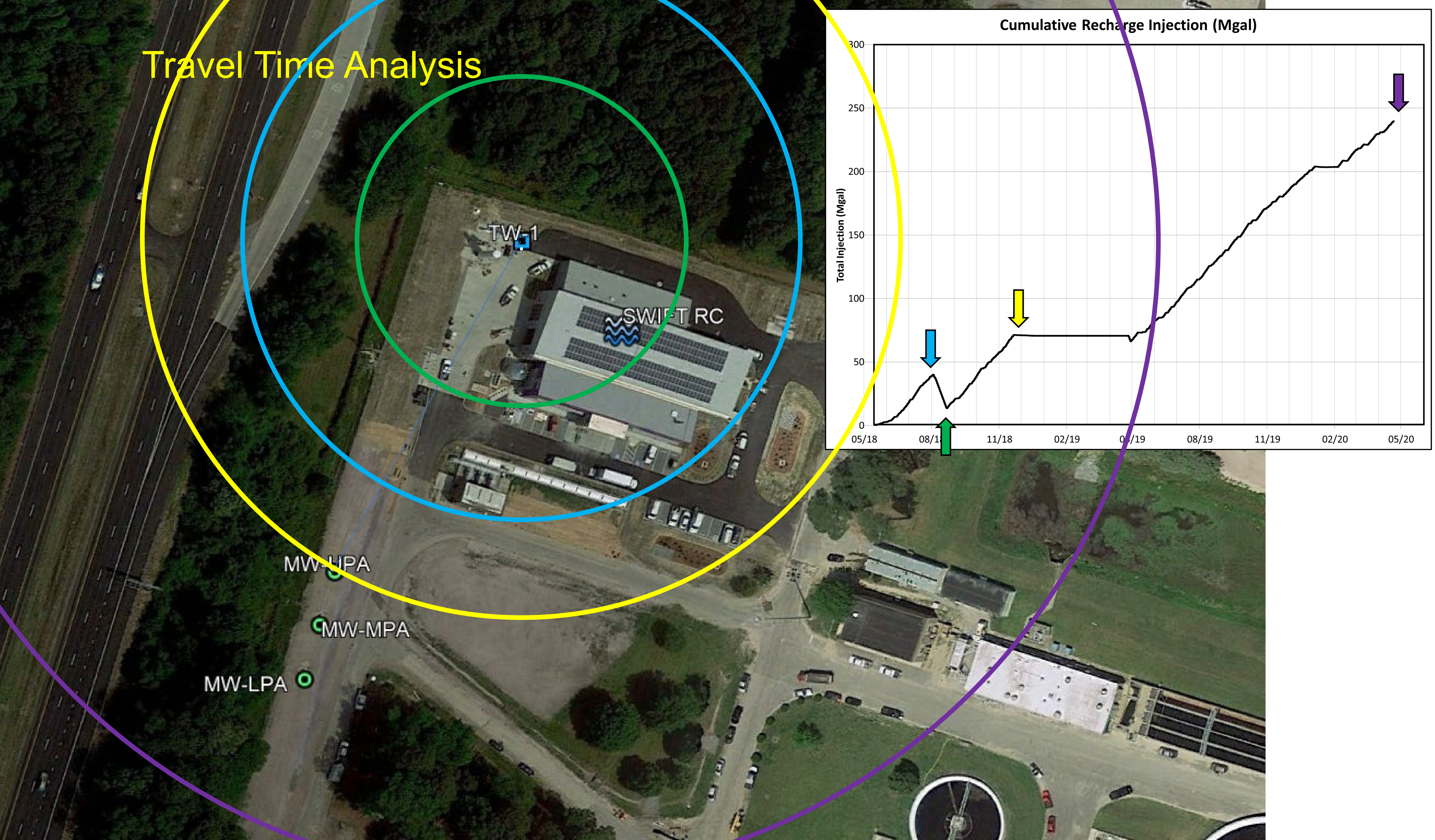
Meredith Bullard Martinez

Sulfate Breakthrough – UPA



Meredith Bullard Martinez

Travel Time Analysis

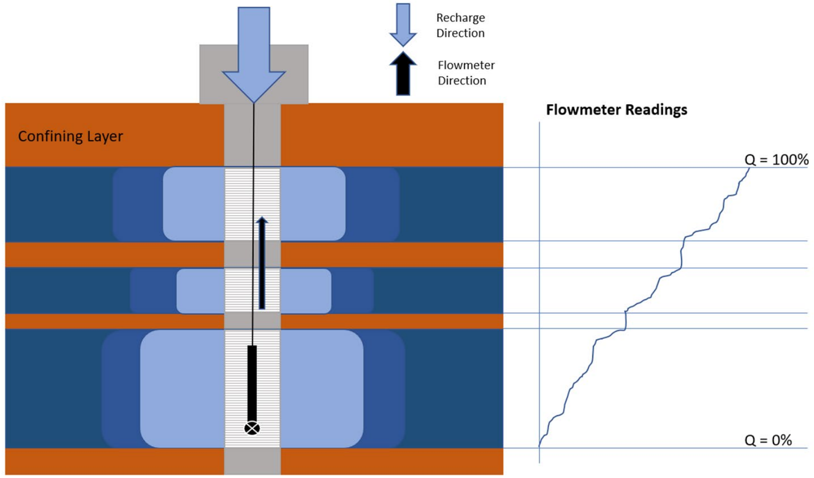


Work Plan 2021

- Develop laboratory analytical capabilities
    - Instrumentation acquisition and method development
- Sampling and analysis of SWIFT WATER and SWIFTRC groundwater
    - Verification of HRSD monitoring data
- Website Development
    - Public outreach
    - Regional groundwater levels
- Develop methodology and capability for archiving water and aquifer samples

Work Plan 2021 (Continued)

- Groundwater Investigations at SWIFTRC
  - Bromide tracer test
  - Analysis of groundwater monitoring data
  - Flowmeter testing



SWIFT Research Center (SRC)

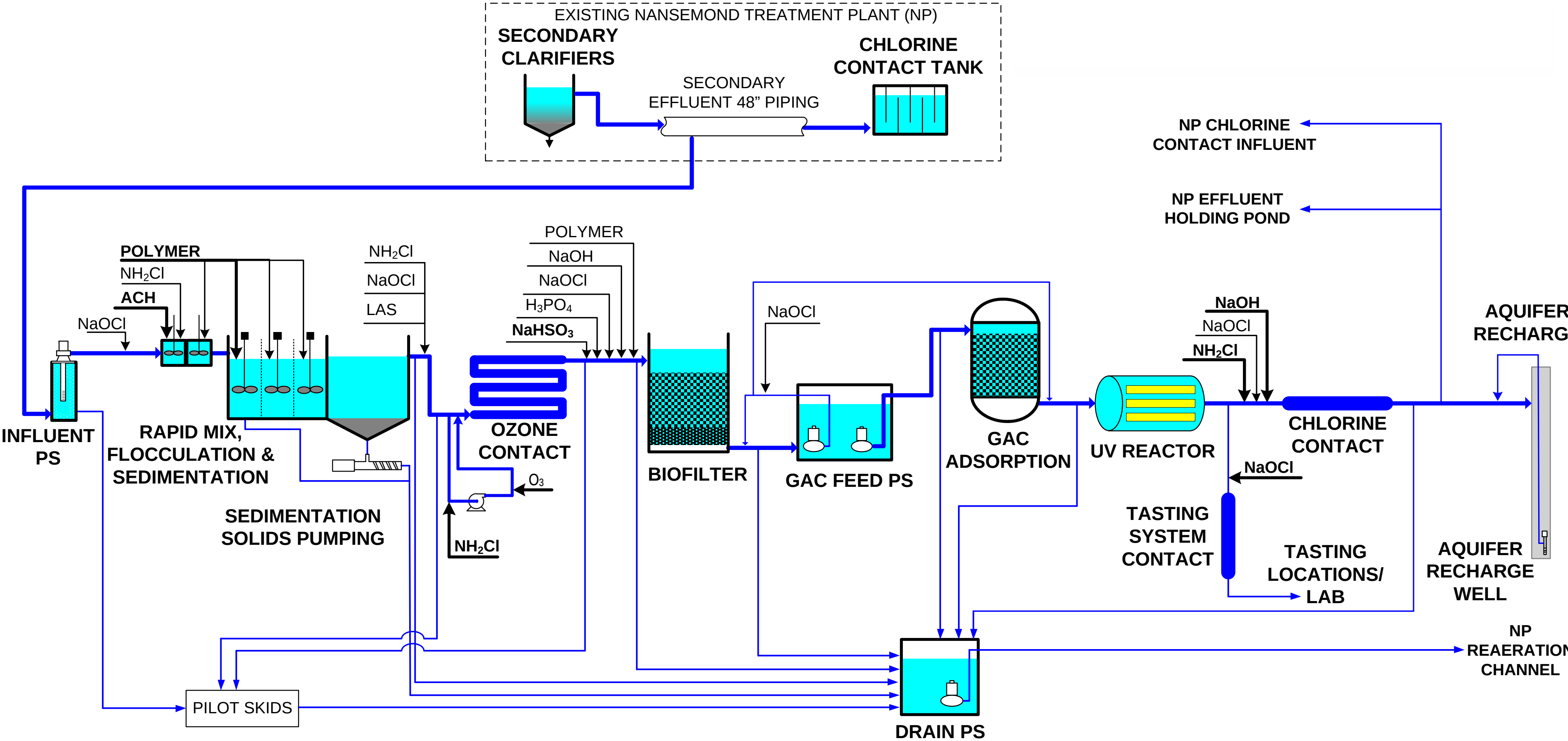
(1.0 MGD AWT + recharge well + monitoring wells + public outreach and education center + research facilities)

Agenda

- SRC Total Coliform issues
- TW-1 injectivity & RW-1 project
- NDMA
- 1,4-Dioxane

SWIFT Research Center – Total Coliform (TC) Issues

<2 CFU/100 mL 95% of daily samples within one calendar month, applied as the 95th percentile of monthly data for all days when recharging



SWIFT RESEARCH CENTER PROCESS FLOW DIAGRAM

Sustainable Water Initiative for Tomorrow

SWIFT Water TC summary (January – March 2020)

- RECHARGE
- OFF-SPEC
- Monochloramine
- Disinfection
- Free Chlorine

January

*Backflush

Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	*29	30	31
TC	3	-	-	1				1			-	4	8		-	2	8			-	-	-	3	2	-	-	-	1	-		-
							4 hrs.			4 hrs.				24 hrs.					24 hrs.		NaOCl			NaOCl $-NH_4$			NaOCl-NH_4-NaOH			24 hrs.	

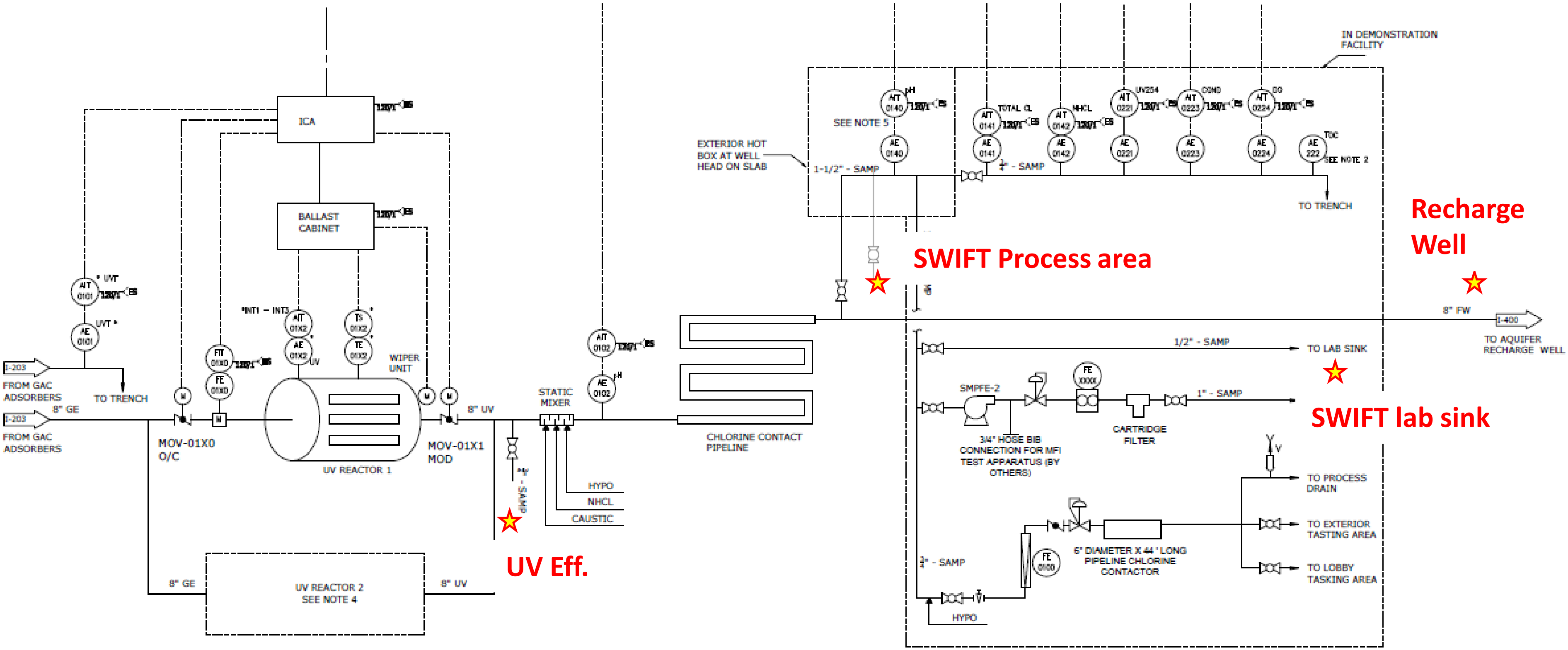
February

Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
TC	-	-	-	-	-	-	1	-	-	2	2	-					-	-	-	-	-	-	-	-	-	-	-	-	-
															DBPs < MCLs														

March

Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
TC	-	-	21	4			-	-	-	-	-						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

T.C. samples location



Disinfection Byproduct Formation in SWIFT Water

TTHMs (MCL: 80 µg/L)

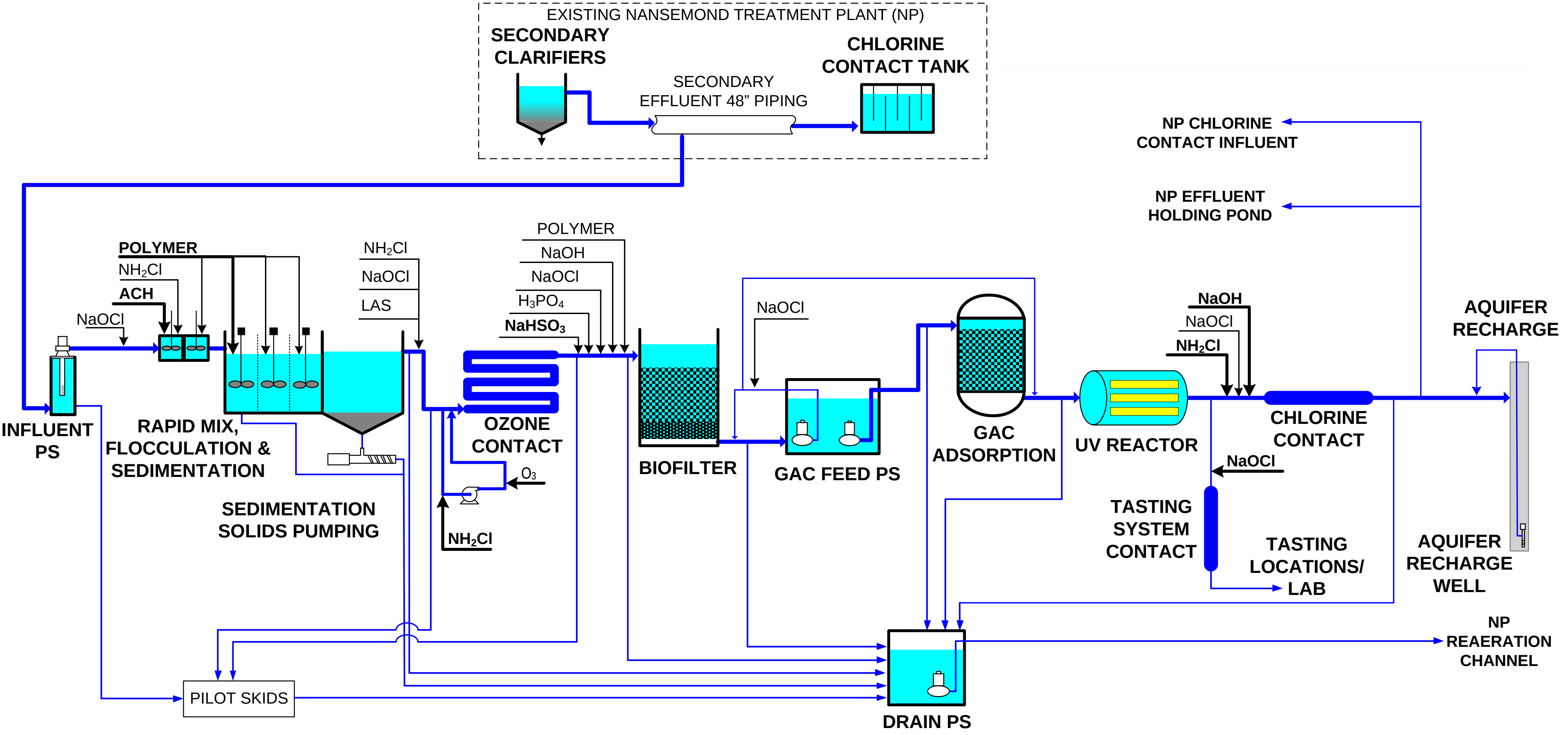
February, 2020	SRC_SWIFT	SRC_SWIFT	SRC_SWIFT	SRC_SWIFT	
	Bromodichloromethane	Bromoform	Chloroform	Dibromochloromethane	
	ug/l	ug/l	ug/l	ug/l	
Fri-07					
Sat-08					
Sun-09					
Monochloramines					
Mon-10					
Tue-11	<1.00	<1.00	<1.00	<1.00	4.0 µg/L
Wed-12					
Thu-13					
Fri-14					
Sat-15					
Sun-16					
Free chlorine					
Mon-17					
Tue-18	<1.00	4.67	<1.00	2.83	9.5 µg/L
Wed-19	<1.00	4.32	<1.00	2.61	8.9 µg/L
Thu-20	<1.00	4.28	<1.00	2.24	8.5 µg/L
Fri-21	<1.00	4.44	<1.00	2.61	9.1 µg/L
Sat-22					
Sun-23					
Mon-24	<1.00	3.67	<1.00	2.46	8.1 µg/L
Tue-25	<1.00	4.03	<1.00	2.66	8.7 µg/L
Wed-26	<1.00	4.38	<1.00	2.60	9.0 µg/L
Thu-27	<1.00	4.38	<1.00	2.62	9.0 µg/L
Fri-28	1.15	5.06	1.02	3.40	10.6 µg/L
Sat-29					

HAA5 (MCL: 60 µg/L)

February, 2020	SRC_SWIFT	SRC_SWIFT	SRC_SWIFT	SRC_SWIFT	SRC_SWIFT	
	Dichloroacetic acid	Trichloroacetic acid	Monochloroacetic acid	Bromoacetic acid	Dibromoacetic acid	
	ug/l	ug/l	ug/l	ug/l	ug/l	
Monochloramines						
Tue-11	2.59	0.64	<0.60	<0.40	0.66	5.5 µg/L
Free chlorine						
Tue-18	1.04	0.41	<0.60	0.80	7.26	13.3 µg/L
Wed-19	0.89	0.47	<0.60	0.72	7.07	9.8 µg/L
Thu-20	1.13	0.61	<0.60	1.12	9.69	13.2 µg/L
Fri-21	1.07	0.60	<0.60	1.00	8.12	11.4 µg/L
Mon-24	1.14	0.54	<0.60	0.81	6.73	9.8 µg/L
Tue-25	1.14	0.46	<0.60	0.79	6.59	9.6 µg/L
Wed-26	1.11	0.57	<0.60	0.77	8.10	11.2 µg/L
Thu-27	0.99	0.54	<0.60	0.63	6.82	9.6 µg/L
Fri-28	1.49	0.70	<0.60	0.68	6.56	10.0 µg/L

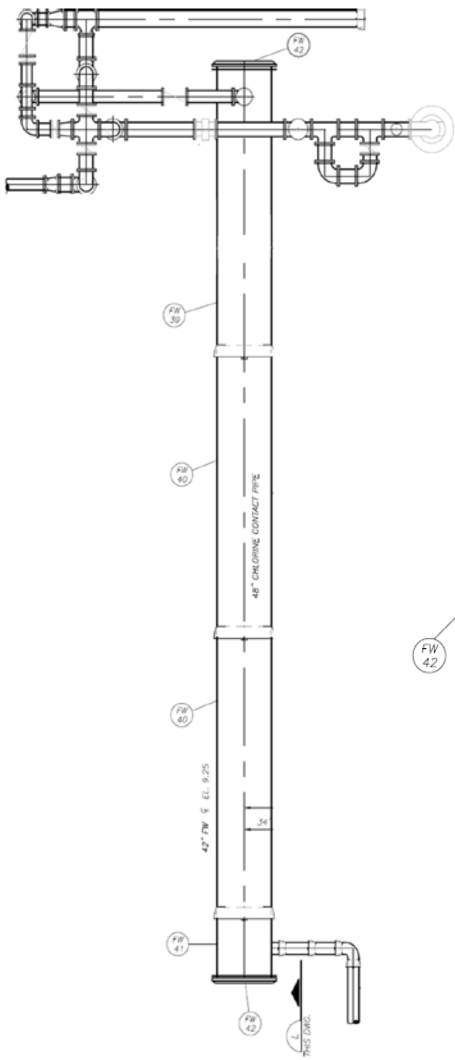
SWIFT Research Center – Total Coliform (TC) Issues

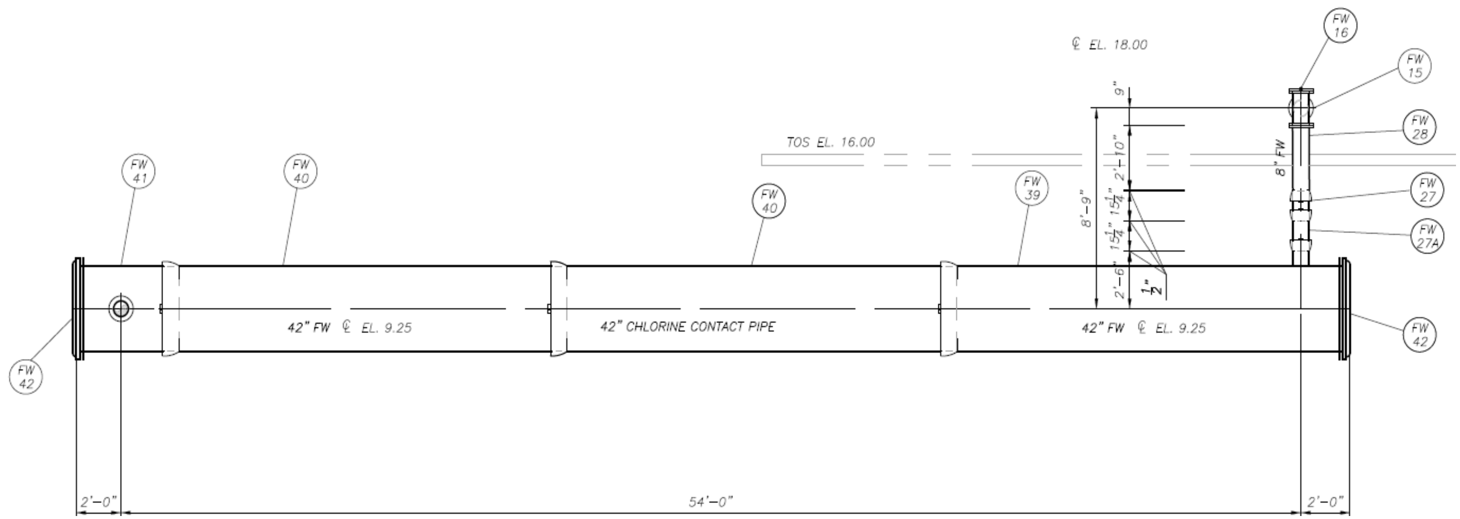
<2 CFU/100 mL 95% of daily samples within one calendar month, applied as the 95th percentile of monthly data for all days when recharging



SWIFT RESEARCH CENTER PROCESS FLOW DIAGRAM

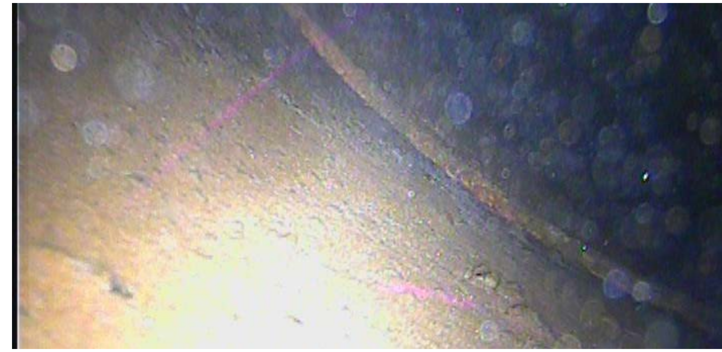
SRC Chlorine Contact Pipeline (5 min)

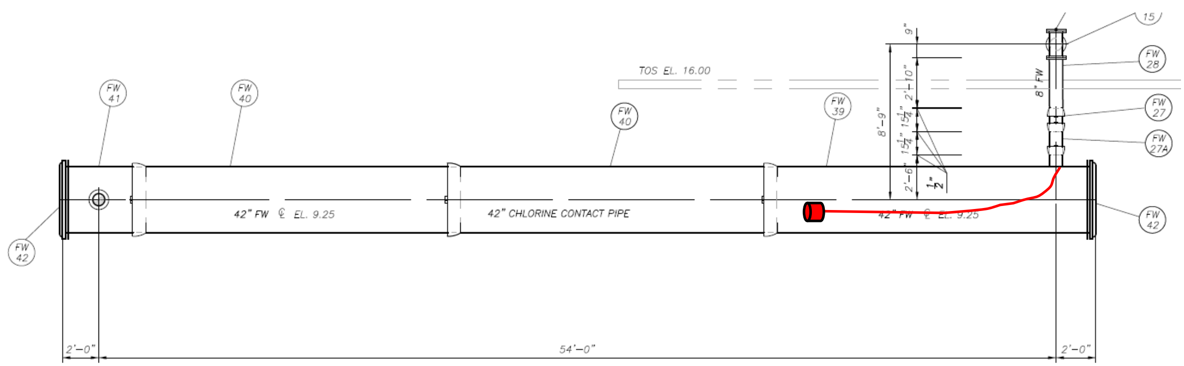




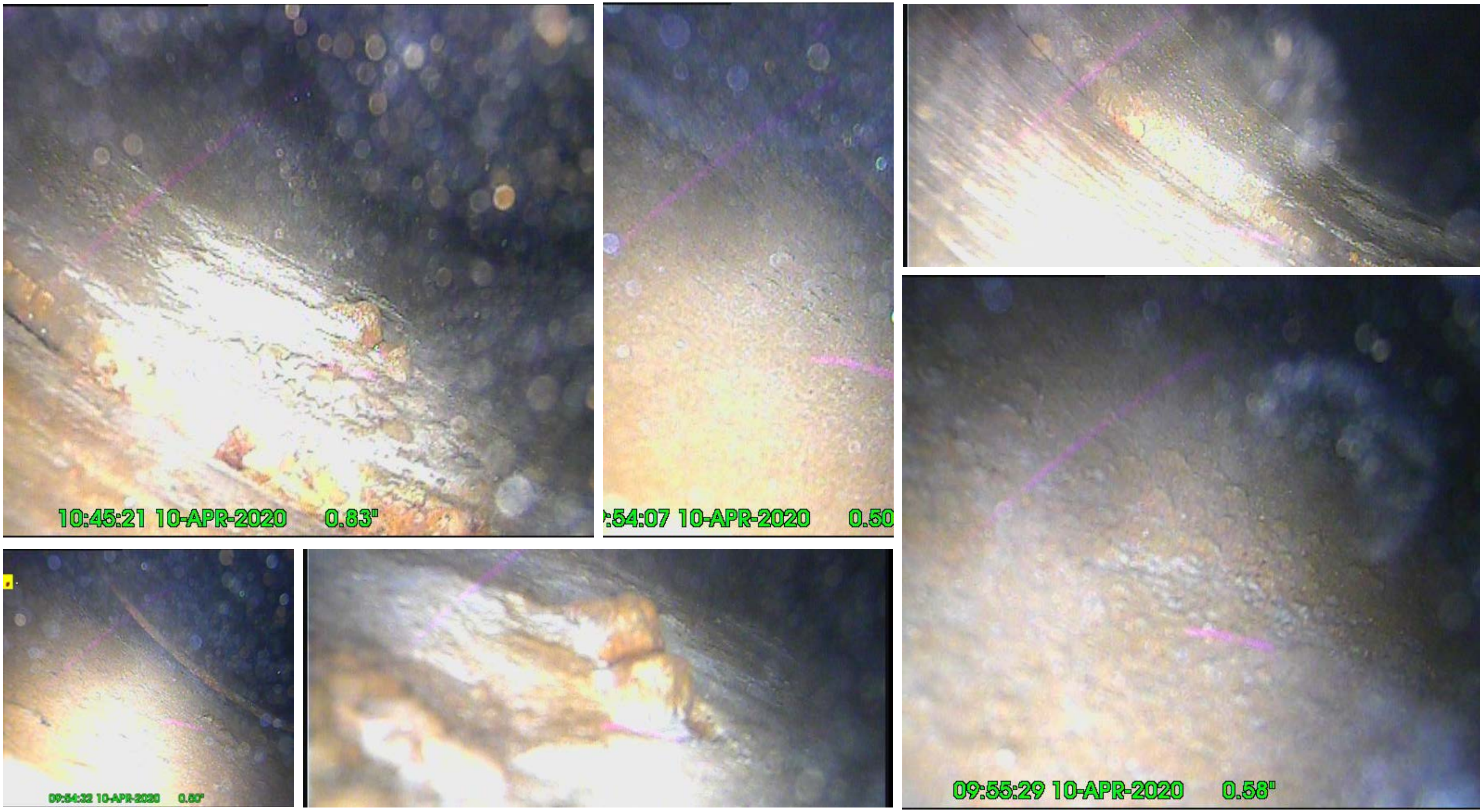

VeriSight


UPRIGHT





TOS EL. 16.00
FW 41
FW 40
FW 40
FW 39
FW 42
FW 42
15
FW 28
FW 27
FW 27A
8" FW
9"
2'-10"
8'-9"
2'-6"
42" FW ℄ EL. 9.25
42" CHLORINE CONTACT PIPE
42" FW ℄ EL. 9.25
2'-0"
54'-0"
2'-0"


10:45:21 10-APR-2020 0.83"
:54:07 10-APR-2020 0.50
09:55:29 10-APR-2020 0.58"

TC investigation…. Next/bigger questions to answer…

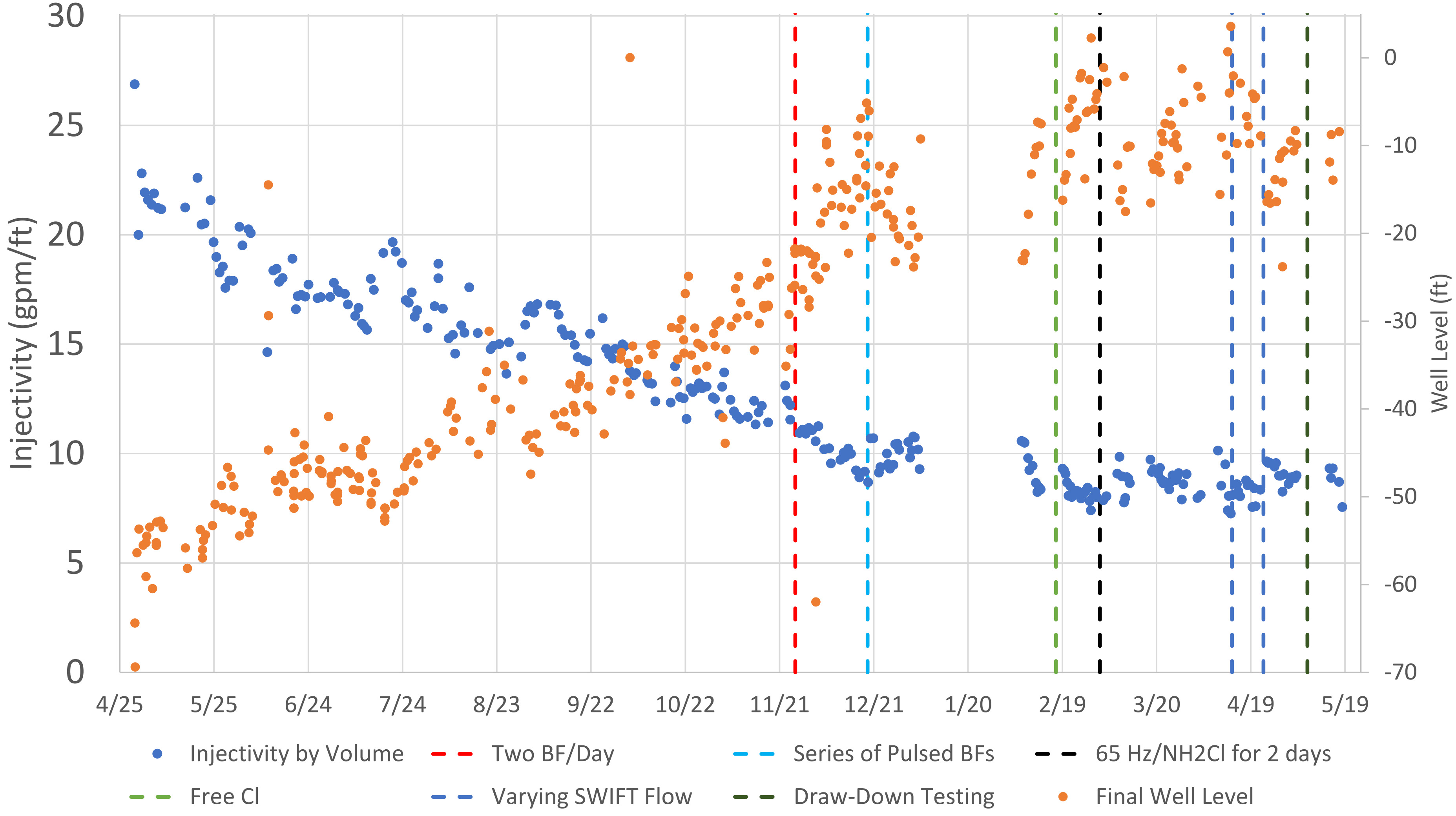
Does the molecular fingerprint of coliform bacteria change before and after the chlorine contact pipeline?

Does the fingerprint change from the baseline in any identifiable way with a switch to monochloramine?

What organisms are responsible for positive TC?

Are the prior positive measurements of TC when operating on monochloramine false positives?

TW-1 (SRC Recharge Well Injectivity)

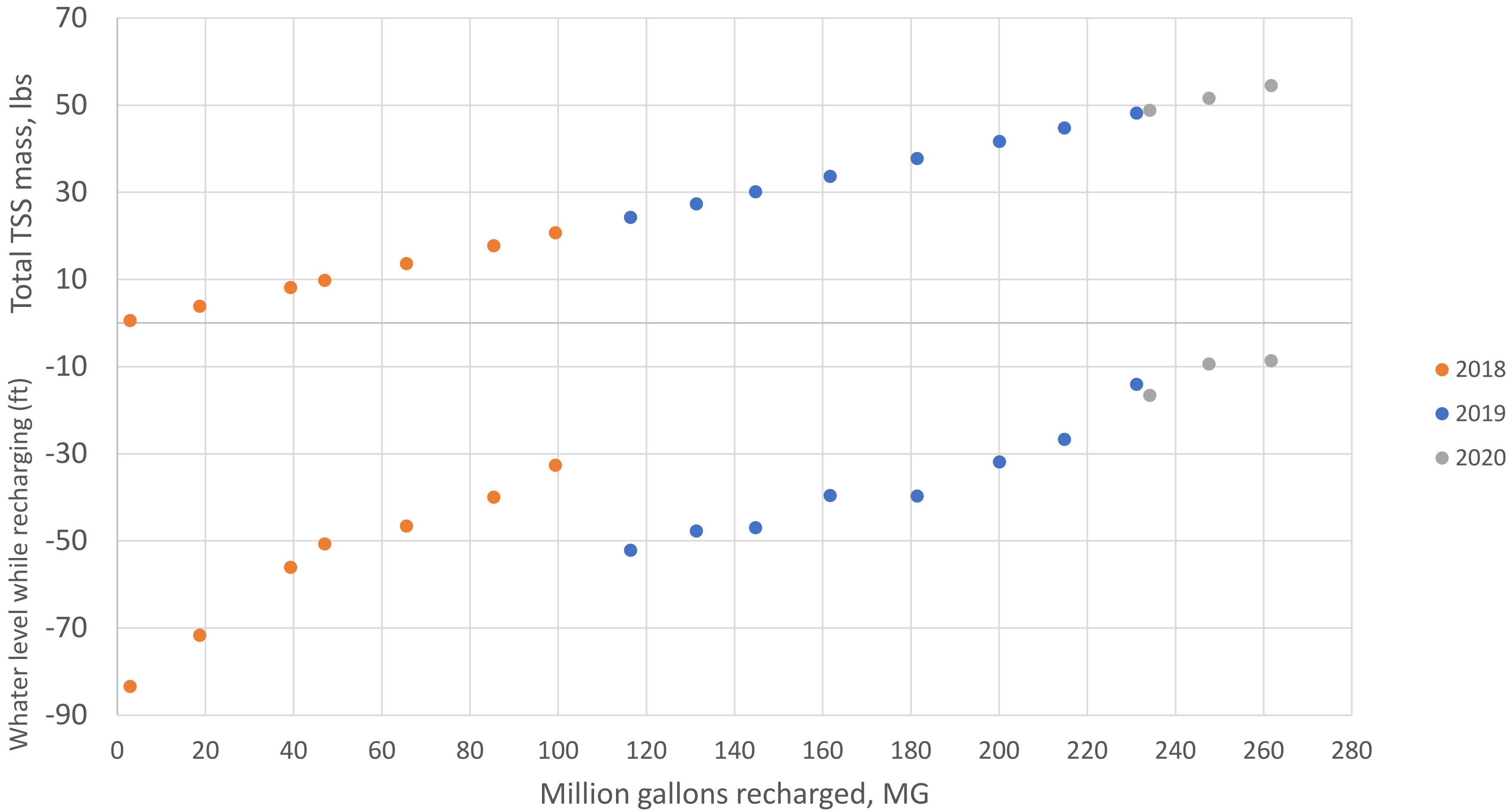


Preliminary conclusions:

- SWIFT Water "TSS or turbidity" is not the cause
- SWIFT Water Fe precipitation is not the cause – instant or delayed
  - There may have been short periods of elevated SWIFT Water Fe in 2018 and 2019 following GAC contactor shutdowns.
- Precipitation of other salts (e.g. $CaCO_3$) from SWIFT Water is unlikely
- Air entrainment in the well is unlikely
- Ineffective backflushing due to low flow rate may be a factor
- Remaining possibilities:
  - Biological fouling
  - Disruption of clay minerals
  - Interaction of SWIFT Water with aquifer materials resulting in precipitation of ?

BFI and MFI are measuring SWIFT Water TSS with very high sensitivity

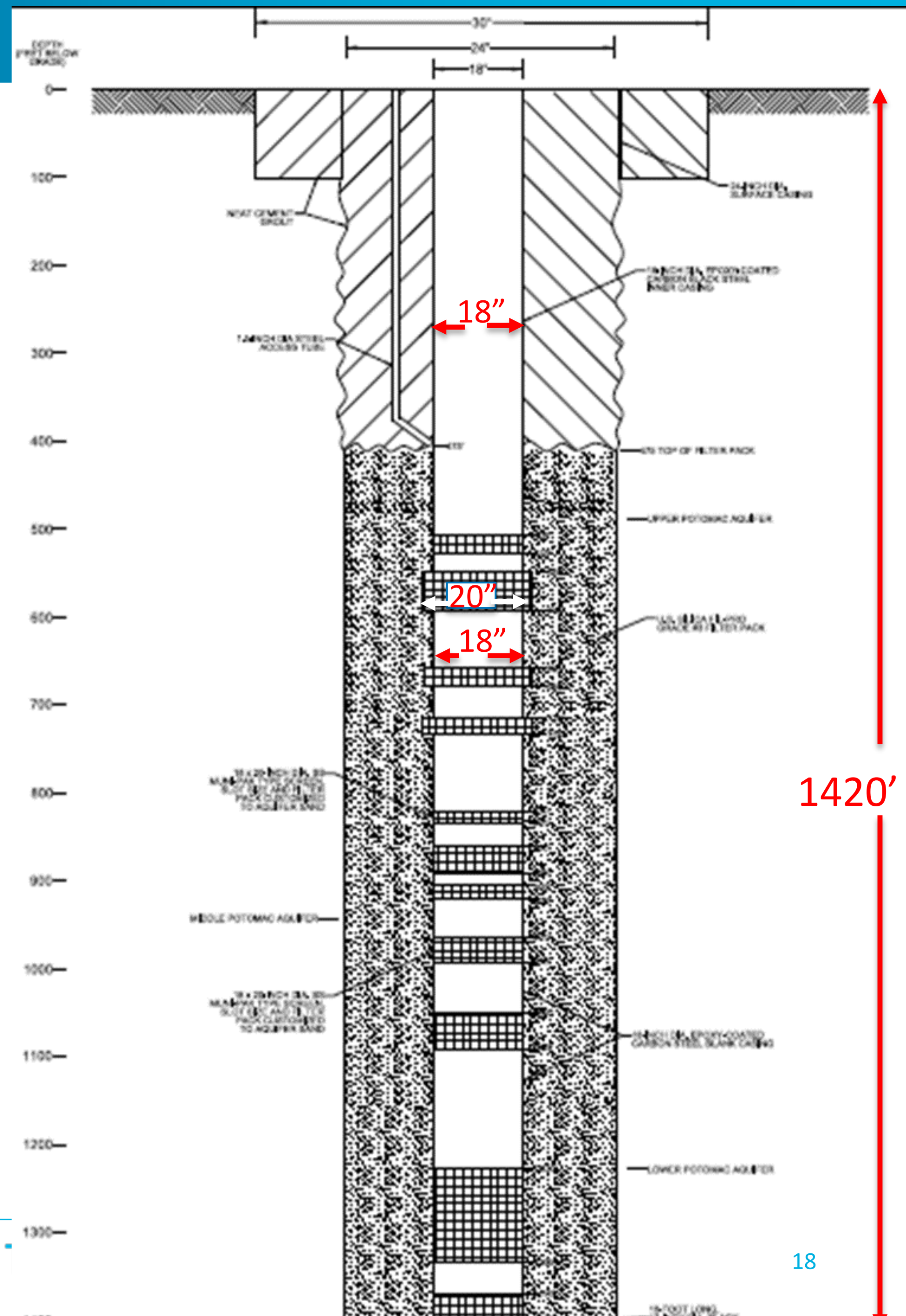
BFI suggests very little TSS in SWIFT Water over the entire period of SRC operation



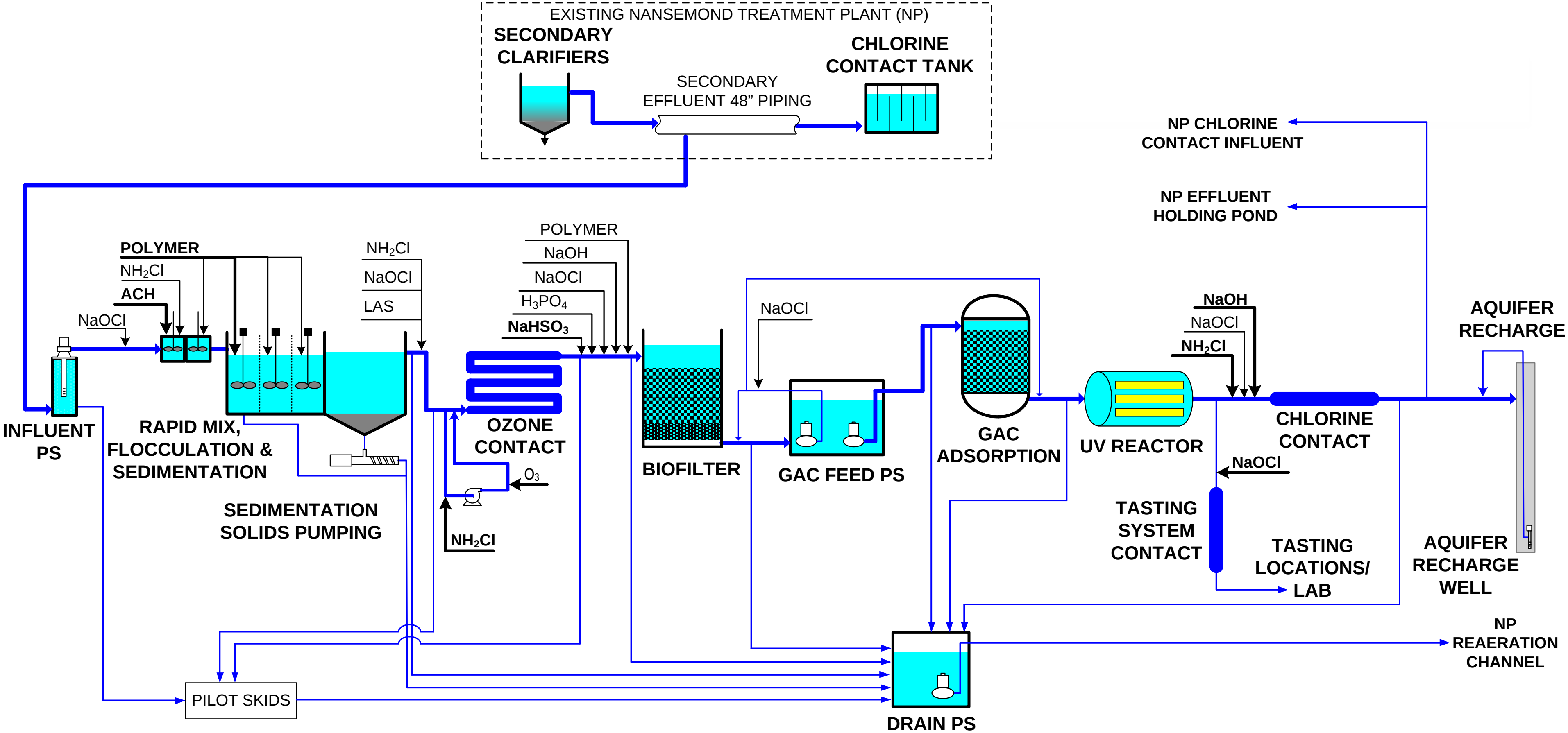
- Seek approval to install new "full-scale" recharge well at Nansemond – RW-1
- Rehabilitate the existing recharge well (TW-1)
- No change in SWIFT Water flow (1 MGD)

Full Scale Screen Design for RW-1

- Casing and screen assembly measures 18-inches in diameter
- Accommodates backflush pump capable of producing 1,800 to 2,100 gpm
- Accommodates 2 to 3 access tubes
- Also, an access tube will extend down outside of casing
- Epoxy coated casing + stainless steel screen/blank
- Muni-Pak type screen instead of conventional screen and filter pack
- RW-1 screens same intervals as TW-1
- Option to use in Full Scale Operation

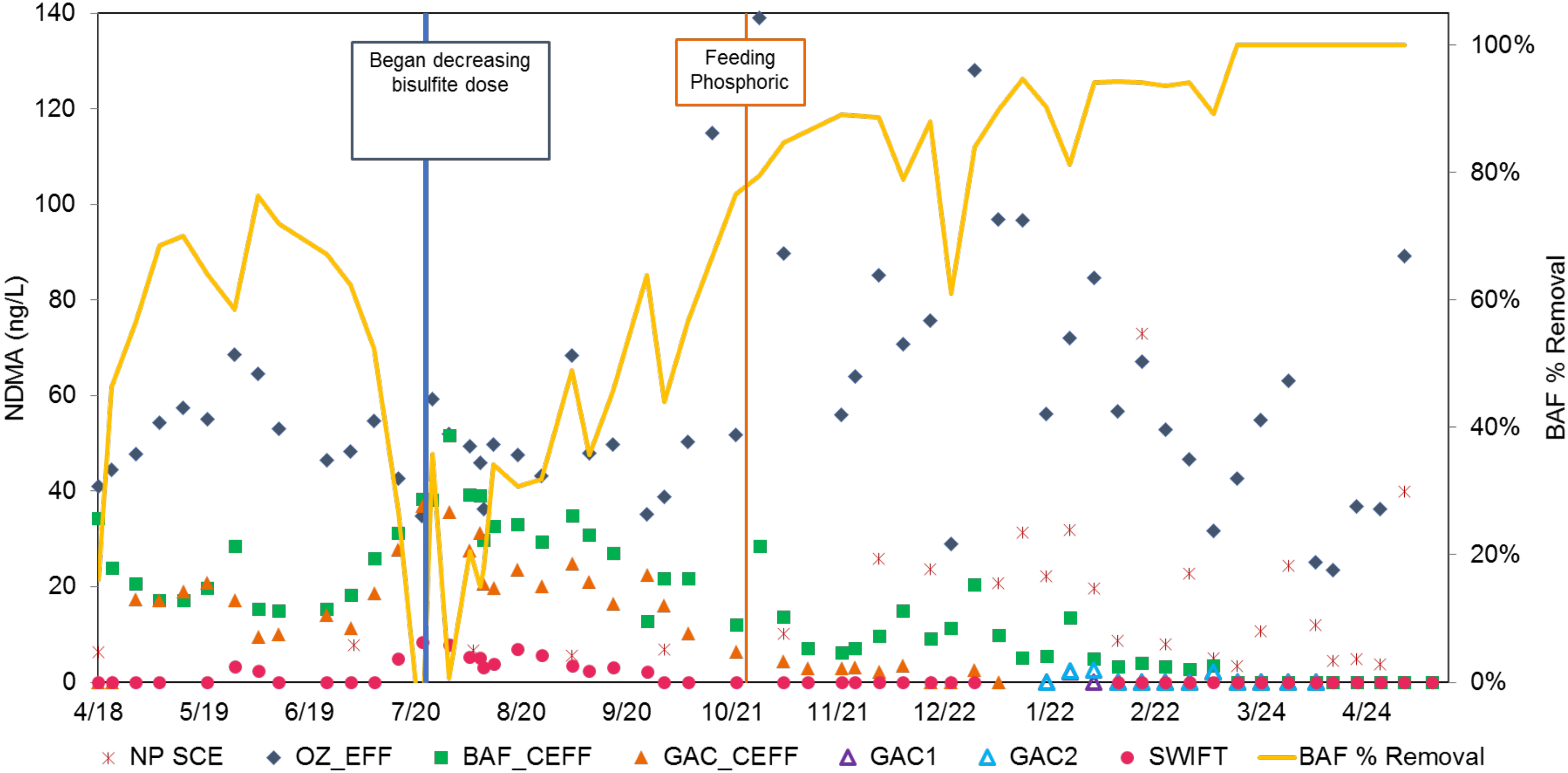


SWIFT Research Center – Topics related to NDMA

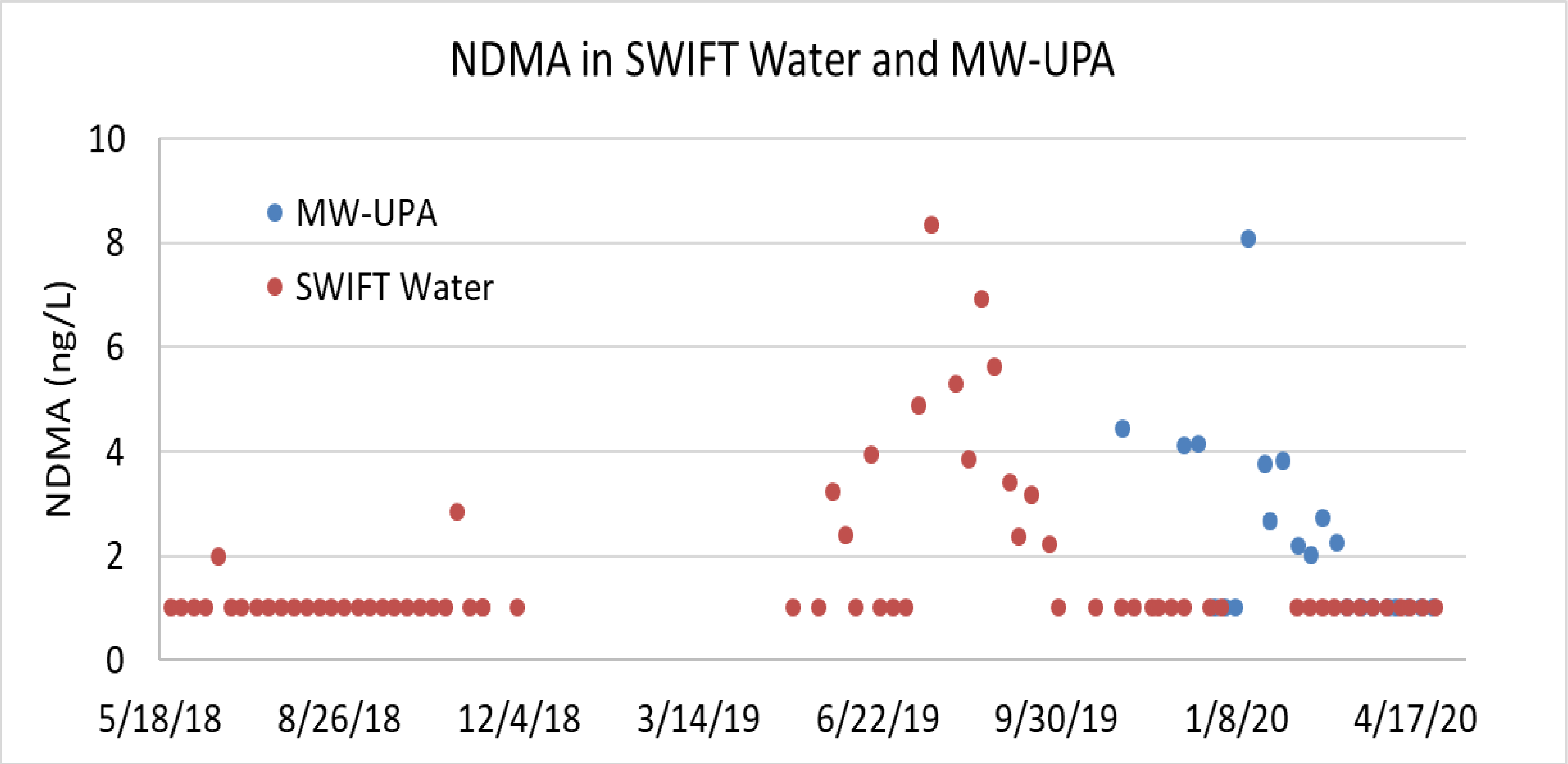


SWIFT RESEARCH CENTER PROCESS FLOW DIAGRAM

SRC NDMA 2019-2020



NDMA – SWIFT Water and MW-UPA

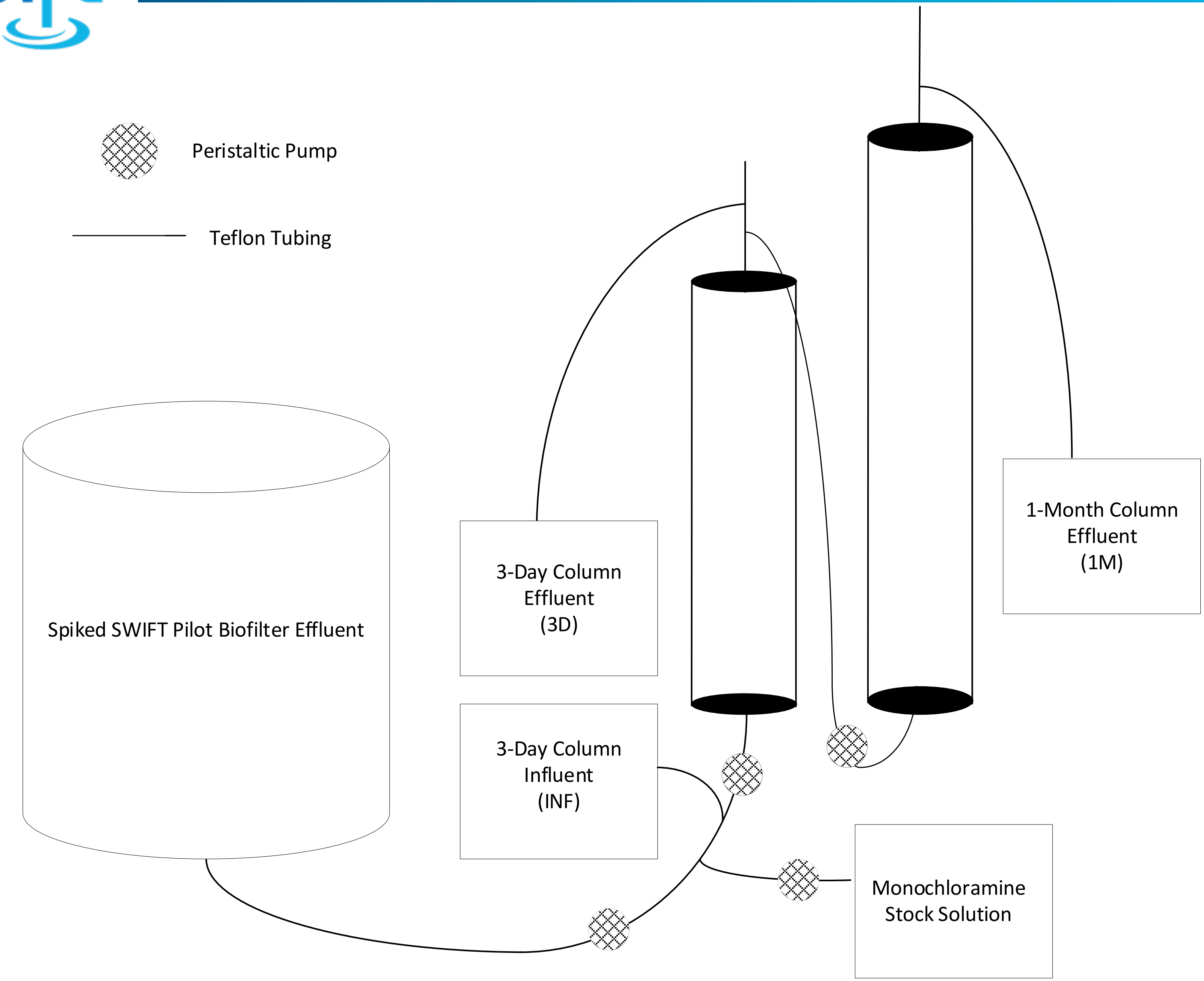


Soil Columns

- Used to model/predict reactive

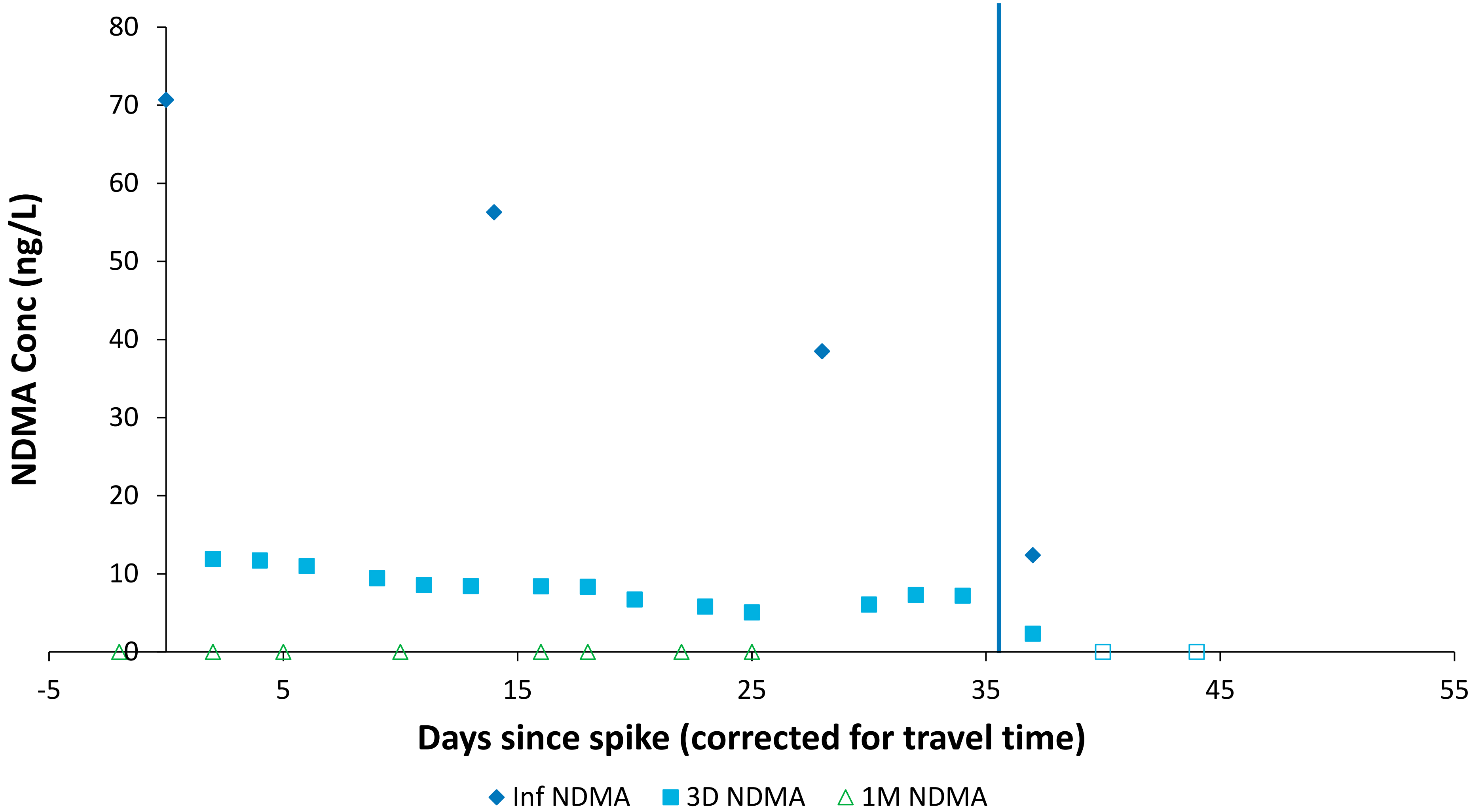
transport of groundwater

- 2 Sets of 2 columns in series
- Column media taken from NP SWIFT test well, washed and screened
- Travel time: 3 days+1 month
- Up-flow to represent saturated conditions



Peristaltic Pump
Teflon Tubing
Spiked SWIFT Pilot Biofilter Effluent
3-Day Column Effluent (3D)
3-Day Column Influent (INF)
1-Month Column Effluent (1M)
Monochloramine Stock Solution

SAT Column – NDMA (complete removal)

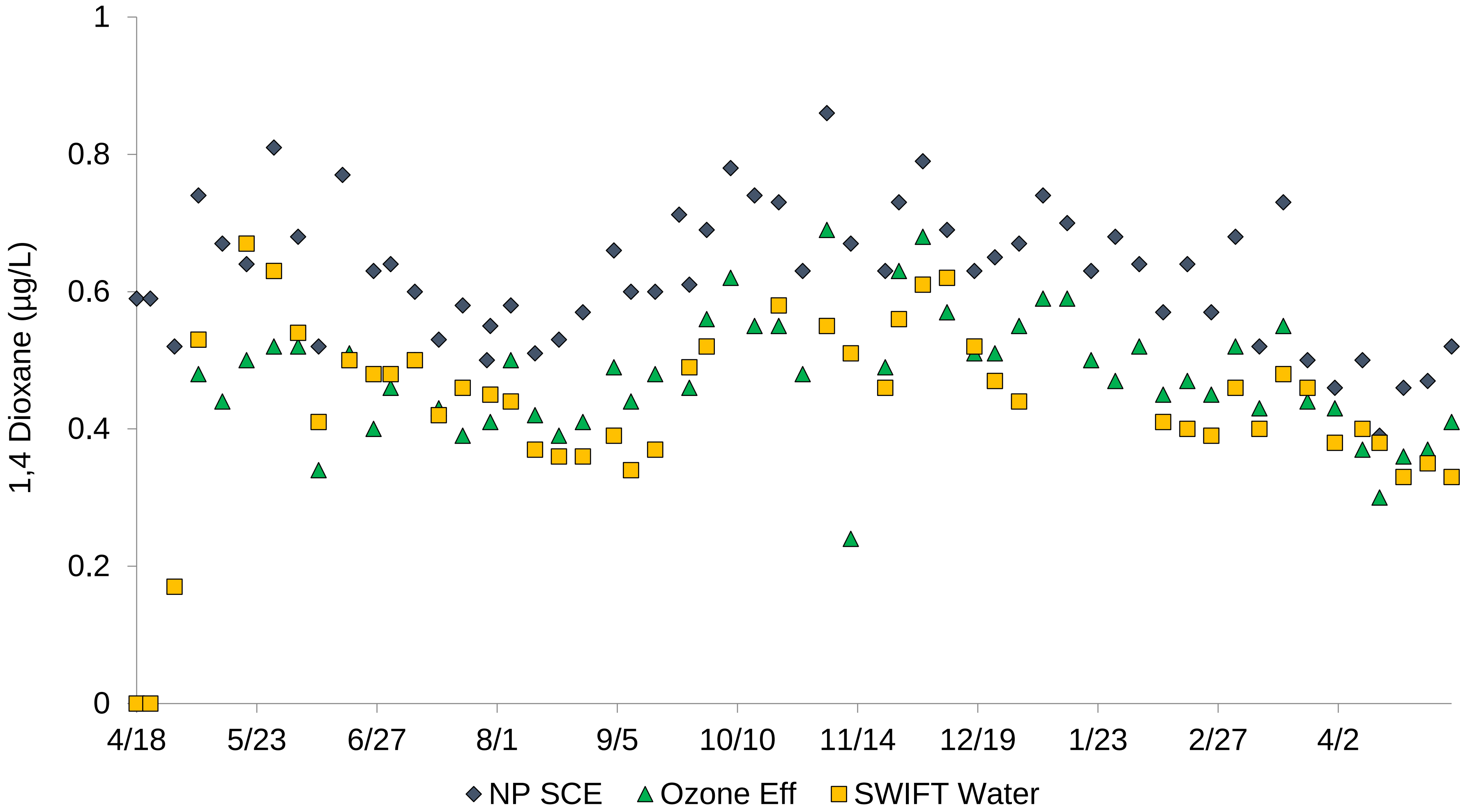


NDMA Formation Potential Measurements (simulating monochloramine added ahead of the recharge well)

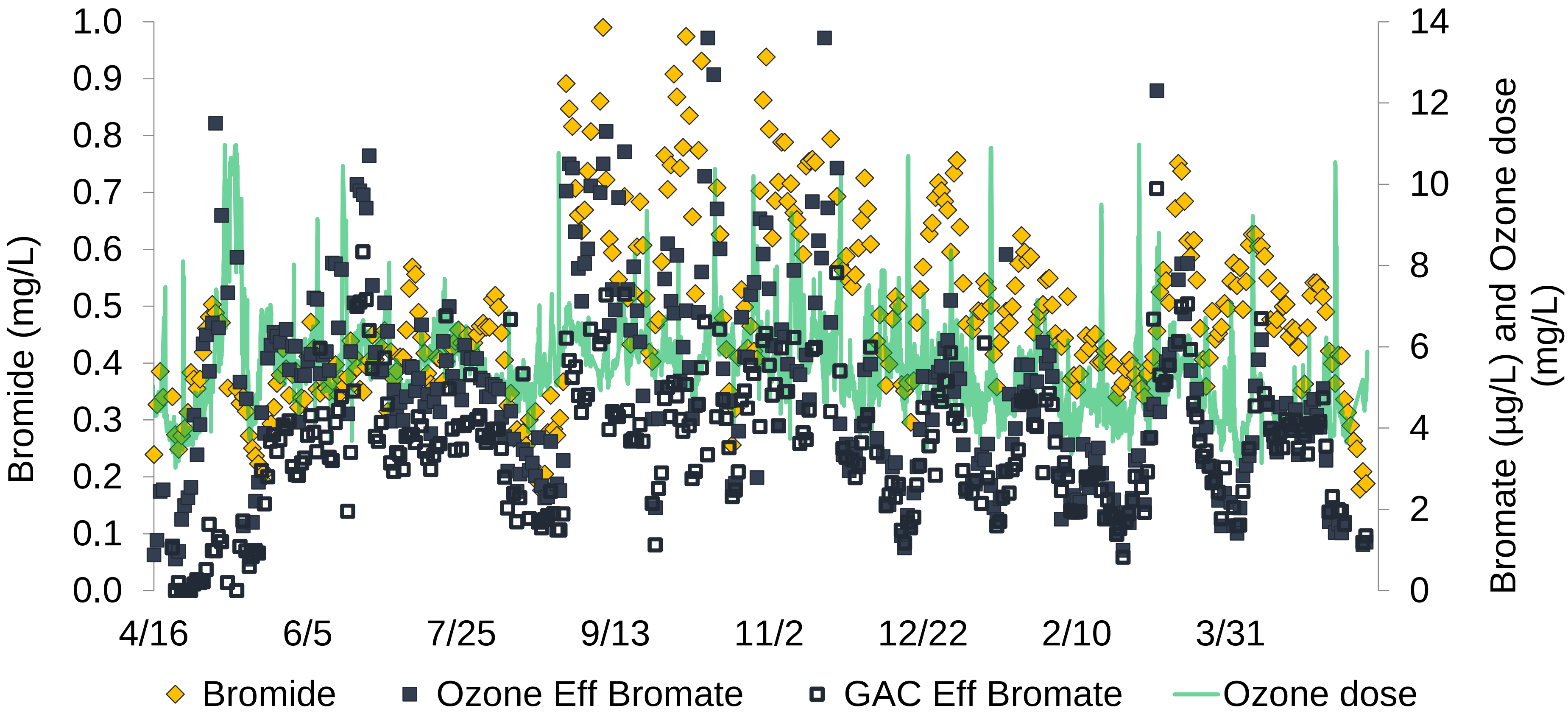
	SWIFT Water		GAC1 Effluent		GAC2 Effluent	
Time (hrs)	NDMA (ng/L)	Total Chlorine (mg/L)	NDMA (ng/L)	Total Chlorine (mg/L)	NDMA (ng/L)	Total Chlorine (mg/L)
0	<2	0.35	<2	0.52	6.83	0.43
4	<2	0.29	<2	0.41	5.03	0.44
24	<2	0.19	<2	0.24	5.37	0.33
48	<2	<0.04	<2	0.14	5.52	0.24
72	2.09	0.10	<2	0.09	5.73	0.17
96	<2	0.06	<2	<0.04	6.69	0.15

Worst case - 2.5 mg/L monochloramine after 3 minutes → 3 day formation potential = 10.1 ng/L @ monochloramine residual = 1.7 mg/L

SRC 1,4-Dioxane Profile (2019-2020)



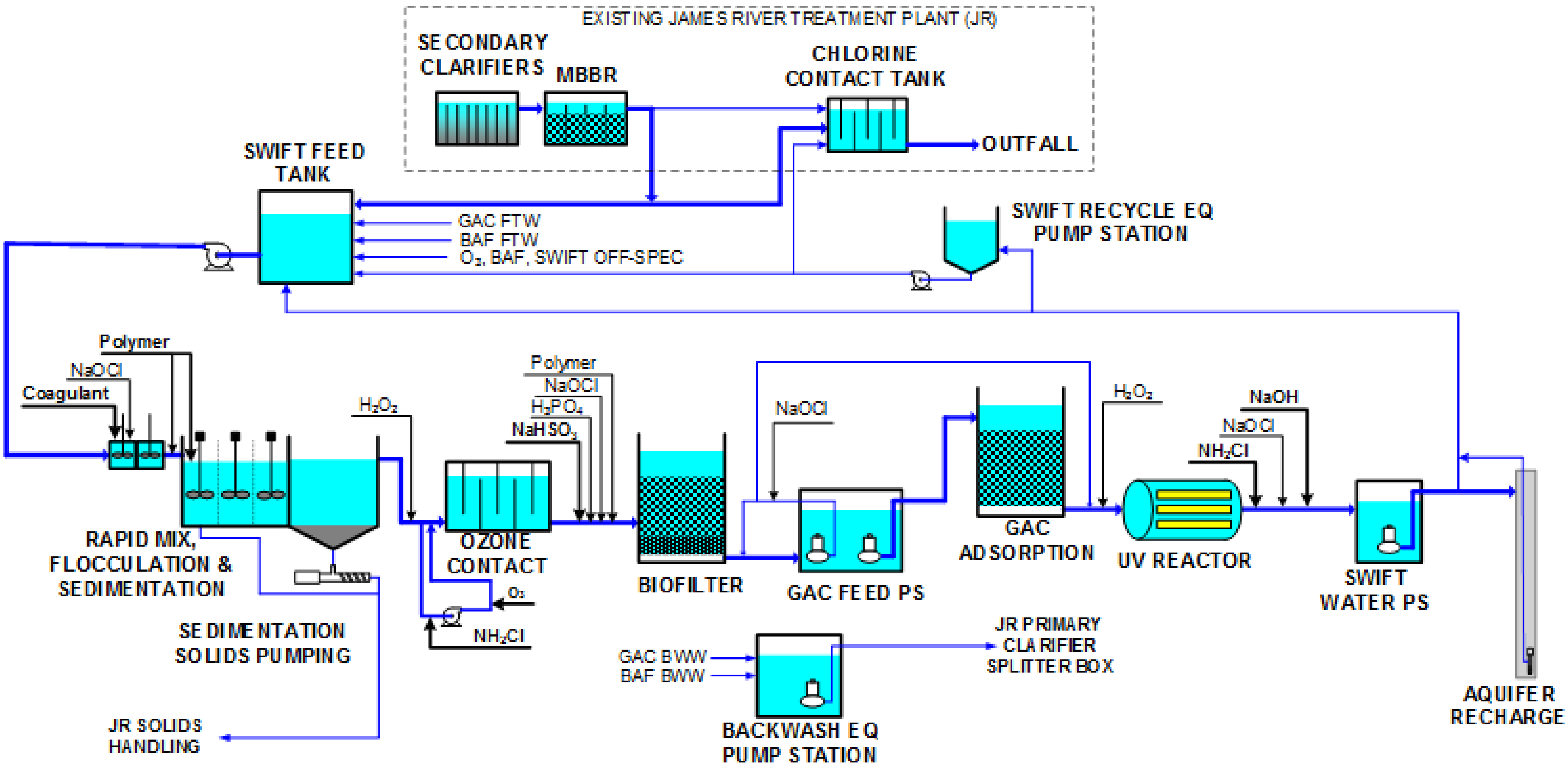
Bromate is well controlled at the SRC by the addition of preformed monochloramine, but this limits 1,4-dioxane removal through ozonation



HRSD 1,4-dioxane (µg/L) SCE data

	ABTP	BHTP	**JRTP**	VIPTP	WBTP	YRTP
Min	0.48	0.55	**0.74**	0.49	0.52	0.34
Max	0.68	0.74	**1.6**	2.2	0.71	0.66
Average	0.56	0.64	**1.12**	0.93	0.61	0.48

James River SWIFT – Improving 1,4-dioxane removal (0.35 µg/L treatment objective)

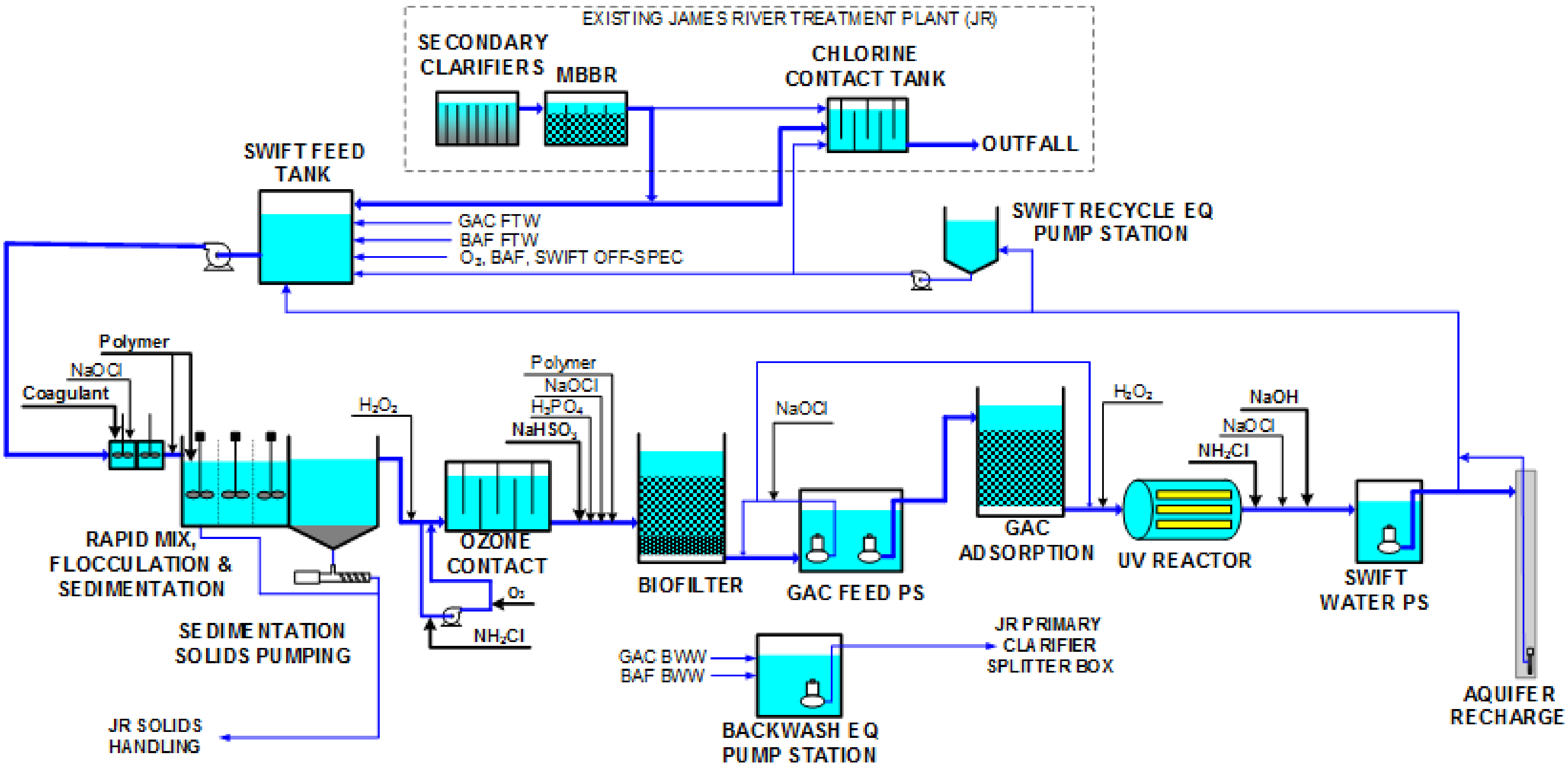


Results demonstrate value of Ozone/H_2O_2 for improving 1,4-dioxane removal while adequately controlling bromate formation. Also multi-point FBD should be considered.

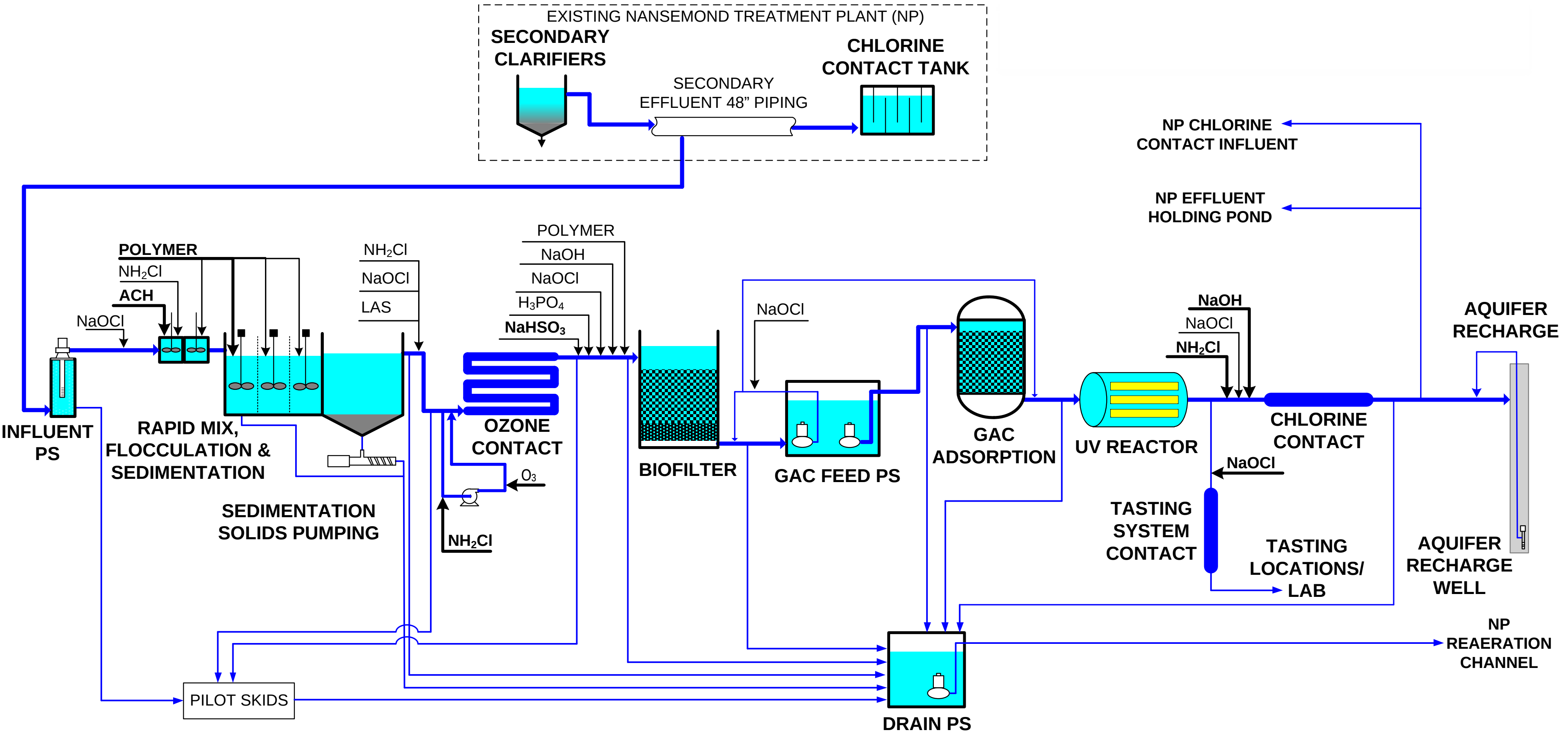
			Bromate Formed (µg/L)			1,4-dioxane % Removed		
		O3:TOC	0.5	0.8	1.1	0.5	0.8	1.1
Day 1- Br: 0.419 mg/L, TOC: 6.2 mg/L, Influent 1,4-dioxane: 2.5 µg/L	No Bromate control	Sidestream	5.84	16.9	42.4	24	48	60
		Fine Bubble	14.8	35.8	68.1	44	60	66.4
	3 mg/L Preformed Monochloramine	Sidestream	1.41	4.14	10.4	28	36	52
		Fine Bubble	1.29	5.82	11.9	28	36	48
	1.5:1 H2O2:O3	Sidestream	2.43	9.53	18.9	36	60	77.6
		1 Diffuser FBD	3.36	6.28	23.8	48	63.6	81.2
		2 Diffuser FBD	1.26	2.38	4.47	61.2	79.6	92.4
Day 2- Br: 0.389 mg/L, TOC: 6.6 mg/L, Inf 1,4-D: 1.36 µg/L	1:1 H2O2:O3	1 Diffuser FBD		*4.88*			51	
		2 Diffuser FBD		*4.56*			82	

Influent 1,4-dioxane spiked in feed tank (YR 1,4-dioxane has been ~0.4 µg/L lately)
YR bromide roughly 2x JR bromide, YR Denite TOC comparable to JR floc-sed effluent TOC
O_3:TOC is NO_2 corrected

James River SWIFT – Improving 1,4-dioxane removal

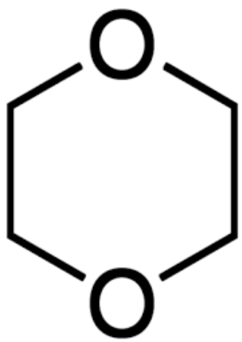


SWIFT Research Center – Improving 1,4-dioxane removal

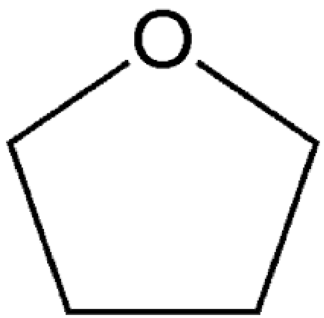


SWIFT RESEARCH CENTER PROCESS FLOW DIAGRAM

BAC/GAC Pilot – Co-metabolic removal of 1,4-dioxane using tetrahydrofuran or propane



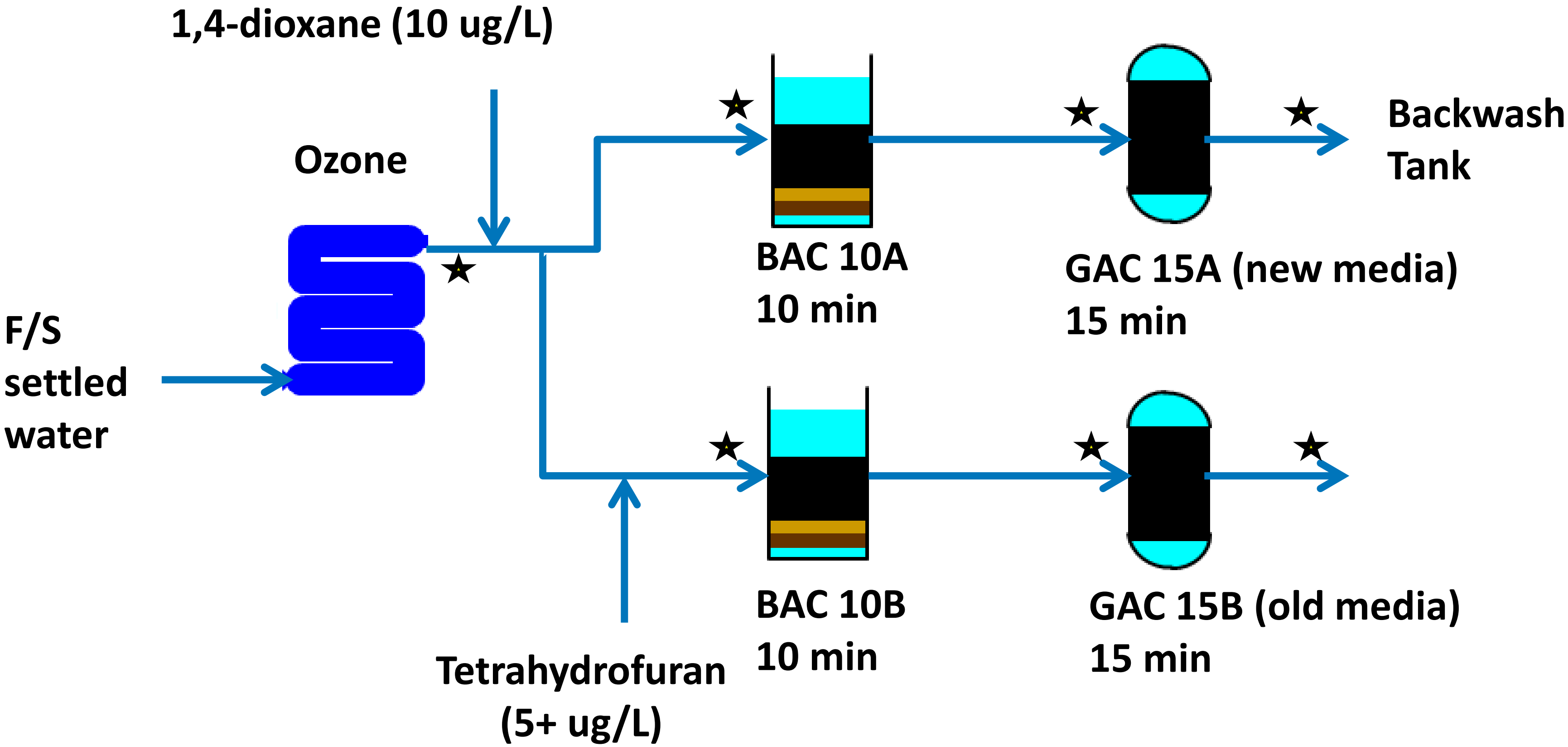
1,4-D



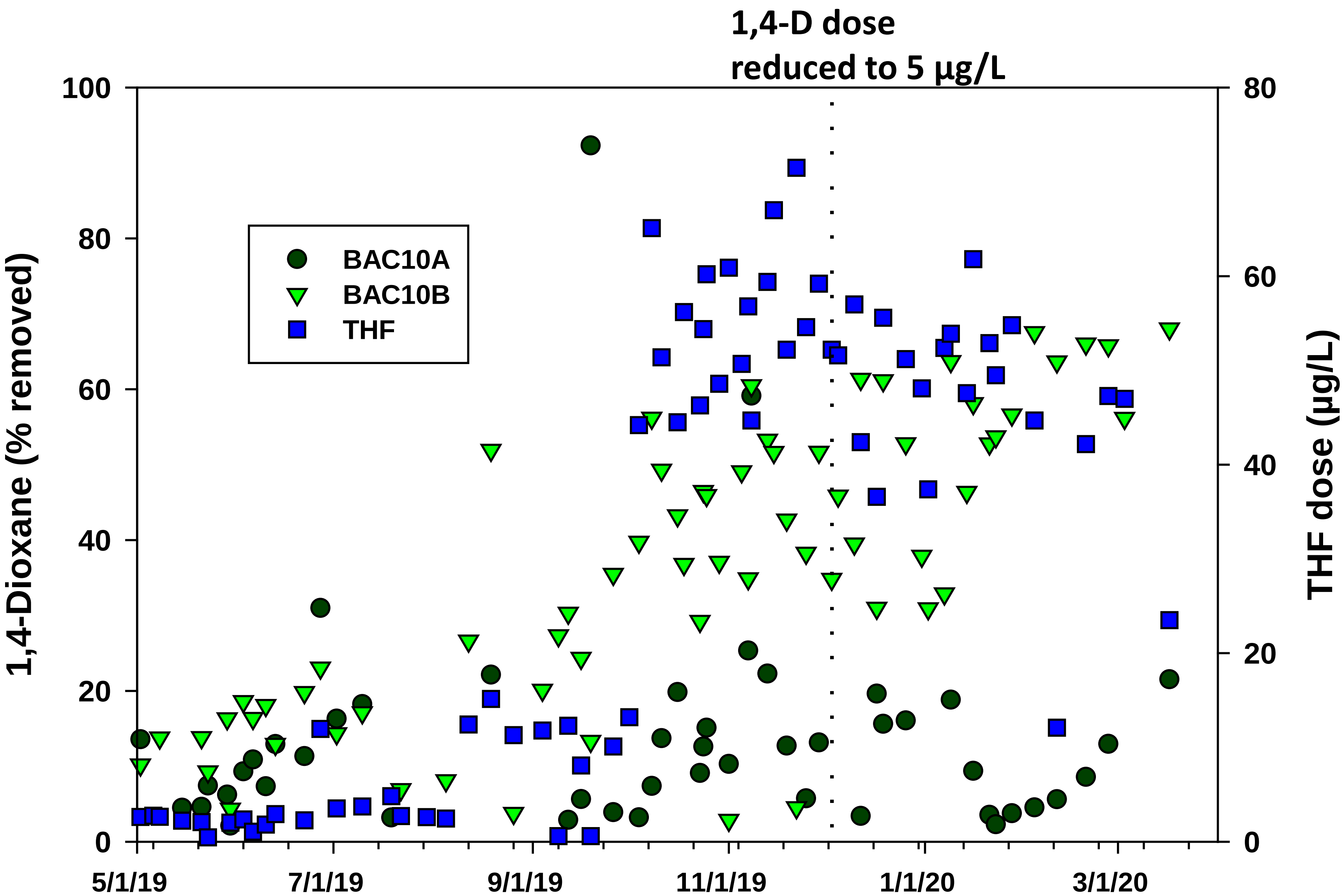
THF

Intuitech™

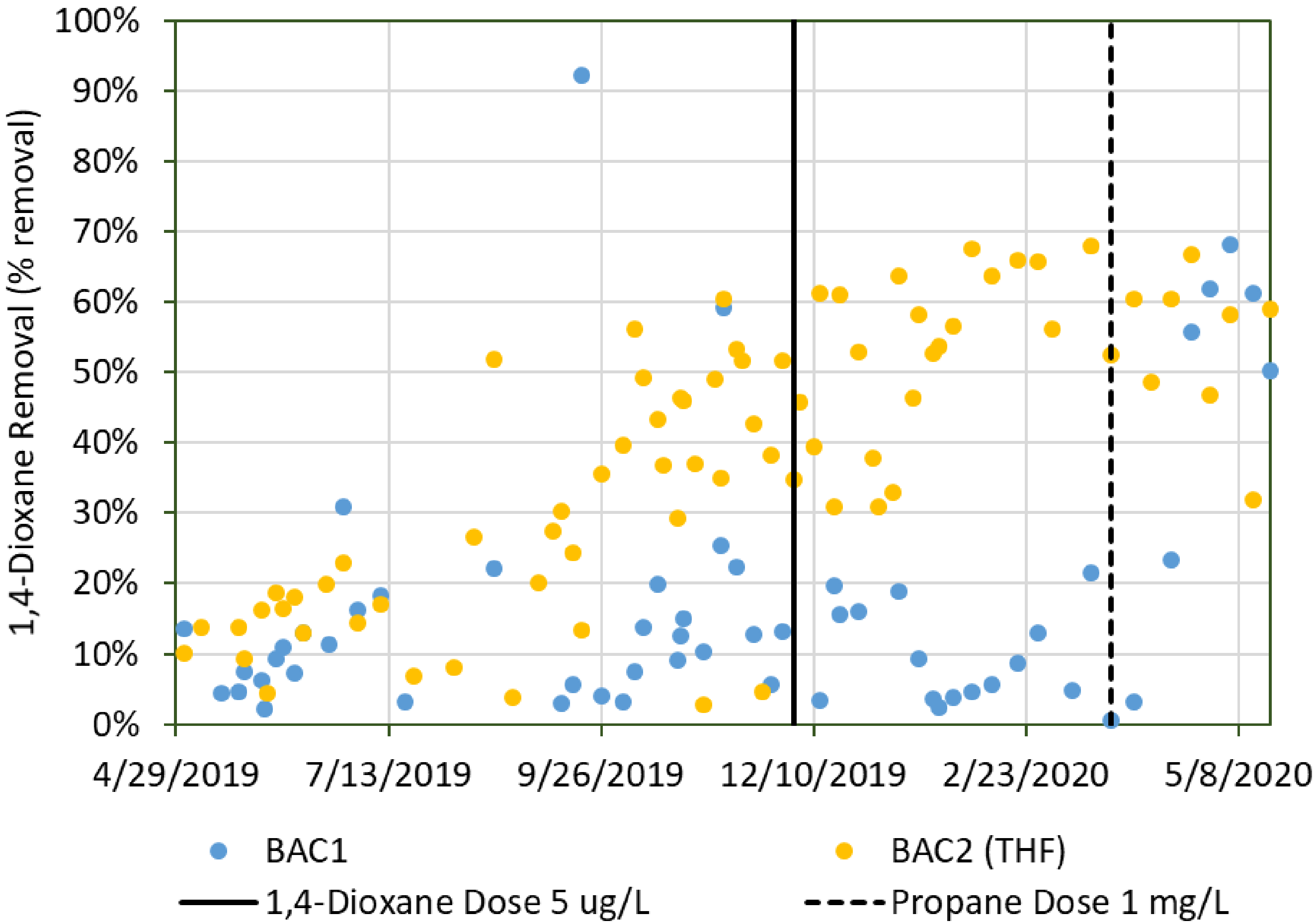
Pilot testing – Enhancing 1,4-dioxane removal with THF addition



1,4-dioxane removal is enhanced by THF



Preliminary propane data are very encouraging



Back to James River – Collaborative project with Waste Management to enhance 1,4-dioxane removal at Bethel Landfill

- Bethel Landfill leachate represents ~40-60% of the 1,4-dioxane load to JR
- Landfill leachate currently treated by aerobic MBBR
  - Sampling and analysis results (n = 4):
  - THF avg 94% removal → about 190 to 10 µg/L
  - 1,4-dioxane avg 38% removal → about 82 to 49 µg/L
- Results suggest 1,4-dioxane removal may be limited by THF availability and THF is very well removed
- Plan moving ahead – Waste Management will install a THF feed system to supplement the MBBR feed up to about 1 mg/L THF
- HRSD supporting with tech support & sampling and analysis
- Future: Evaluate propane

Regulatory Update

Jamie S. Heisig-Mitchell
HRSD Chief of Technical Services

PAROC – May 28, 2020

James River Individual UIC Permitting Update

- Two key documents out for review:
  - SWIFT Water Quality Targets
  - Aquifer Monitoring and Contingency Plan
- These documents will support the completion of the permit application

Att A: Maps & Area of Review
Att B: Geological & Geophysical
Att C: Well Construction
Att D: Injection Operation & Monitoring
Att E: Plugging & Abandonment

Att F: Financial Assurance
Att G: Site Security
Att H: Aquifer Exemption (NA)
Att I: Existing EPA Permits
Att J: Description of Business
Att K: Optional Additional Project Information

Review and Response Timeline

- PAROC
  - Comments from PAROC members appreciated by June 5
  - HRSD response to comments: June 11
  - PAROC response: June 25
- NWRI
  - Comments from NWRI expected May 28
  - HRSD response to comments: June 4
  - NWRI response: June 19
- HRSD will incorporate comments as needed and submit full UIC package by July 6
- Public hearing will be required

How does James River UIC differ from SWIFT RC UIC?

- Research Center authorized by rule, not individually permitted
  - The Research Center is a 1 MGD facility and will not be part of full-scale SWIFT operations at Nansemond
- James River and each full-scale SWIFT facility (including Nansemond) will require an individual UIC permit
  - Regulatory Limits, SWIFT Water and Aquifer Monitoring requirements agreed upon with PAROC will be permitted conditions
  - The Research Center incorporates many elements that address research needs that will not be carried over to full-scale as regulatory requirements (e.g. 50 ft FLUTe monitoring well, analytical parameters of research interest)

SWIFT Water Quality Targets – Key Elements 1/3

- No changes proposed for meeting drinking water standards and total organic carbon, total nitrogen and turbidity limits
- Modified regulatory target and response for Total coliform
  - <2 CFU/100 mL 95% of collected samples within one calendar month, applied as the 95th percentile
  - If TC exceeds 2 CFU/100 mL > 95 % of samples (calculated by the 95th percentile) in one calendar month, HRSD will conduct an additional investigation (e.g., evaluating sample collection and training protocols, possible sample line contamination, etc.) A TC exceedance is not considered a PMCL exceedance unless E. coli is present. The results of the investigation will be included in the next quarterly regulatory report provided to EPA and the PAROC.

SWIFT Water Quality Targets – Key Elements 2/3

- Performance indicator list for the permit will remain the same as that used for the Research Center
- Developing a Hampton Roads-specific list based on our wastewater characteristics
  - This list will be finalized after review with the PAROC prior to the operation of the James River SWIFT facility
  - This Hampton Roads list will be monitored in parallel with the list identified in the UIC permit
  - After obtaining operational experience with the Hampton Roads indicators, the Hampton Roads list will replace the original performance indicator list in permits (new permits, permit renewals and/or permit modifications)
  - All subject to approval by PAROC

SWIFT Water Quality Targets – Key Elements 3/3

- Added in mechanism for evaluating PMCL compliance
  - Working with VDH to identify what is appropriate for SWIFT
  - Modifications to language to ensure recharge is not occurring while waiting for confirmation samples
- Some research-related analytical parameters were removed in draft however, UCMR will be added back in based on feedback from VDH
  - Specific UCMR parameters will not be identified but table of parameters will identify that HRSD will follow the currently effective UCMR and will match the monitoring frequency associated with large drinking water facilities
- Added in NDMA Formation Potential testing with phased reduction in testing frequency based on data evaluation and concurrence with PAROC
  - Still working on details of this language with VDH

Aquifer Monitoring and Contingency Plan

- Early comments have identified the need for clarifications which will be added to document
- VDH expressed interest in understanding travel time to nearest private well user and perhaps incorporating some monitoring
  - Logistical challenges but very much worth exploring
- Removed elements we considered appropriate for operations and maintenance manual but not necessarily permit application
  - Microfouling Filter Index/Bypass Filtering Index
- 4 monitoring wells, 2 each screened in UPA and MPA