The Potomac Aquifer Recharge Oversight Committee
Meeting Minutes
June 30, 2021

Electronic Meeting in Accordance with Chapter 1289 of the 2020 Acts of Assembly

In attendance: David Paylor, DEQ; Adil N. Godrej, Co-Director Occoquan Watershed Monitoring Laboratory; Whitney Katchmark, HRPDC; William Mann, Governor Appointee; Norman Oliver, Virginia State Health Commissioner; Doug Powell, Governor Appointee; Gary Schafran, Co-Director of the Potomac Aquifer Recharge Monitoring Lab; Mark Widdowson, Co-Director of the Potomac Aquifer Recharge Monitoring Lab.

The Committee Chair, David Paylor, called the meeting to order at noon.

Gary Schafran made a motion to approve the minutes of the previous meeting as distributed; Adil Godrej seconded the motion; and the minutes were approved without objection.

Jamie Mitchell (HRSD) discussed the recent Tribal Consultation which occurred in early June. At that consultation, HRSD and AECOM provided a briefing on the SWIFT program and on the archeological survey. The information was very well received, and the archeological survey did not identify any impacts to cultural resources. The EPA received a letter of concurrence from Virginia's Department of Historic Resources that the wells will not cause an adverse impact to historical property. She also discussed recommendations from the Tribal Consultation meeting on the plan for unanticipated discoveries during the construction of the wells.

The EPA is actively engaged in drafting the permit. They plan to incorporate the indicator and groundwater monitoring as an appendix to the permit for informational purposes. Once the draft is complete, it will be provided to DEQ and VDH for input prior to advertising for public comment. A hearing will only occur if deemed necessary on any public comments. Public comment is anticipated in September.

Ryder Bunce (VDH) provided an update on the development of a SWIFT monitoring plan.

Mark Widdowson and Gary Schafran of the Potomac Aquifer Recharge Monitoring Lab (PARML), provided updates on the following: SWIFT treatment performance; groundwater impact assessment; communication, reporting and coordination; the Groundwater Advisory Workgroup activities; groundwater impacts lessons learned; lines of evidence - groundwater impacts; travel time analysis; continuing development of laboratory analytical capabilities; recent SWIFT monitoring efforts; and recent and next laboratory acquisitions.

Mr. Henifin introduced Dana Gonzalez (HRSD) who discussed ongoing PFAS research at HRSD including PFAS dynamics at SWIFT.

Dan Holloway (HRSD) presented updates on well rehabilitation and the installation of the new full-scale recharge well at the SWIFT Research Center.

The Potomac Aquifer Recharge Oversight Committee
Meeting Minutes
June 30, 2021

The Committee and HRSD staff discussed clogging issues with well 9.

There were no registered public comments.

A poll will be sent to members for availability and location of the next meeting to be held in-person in September.

The meeting adjourned at 2:02 p.m.

Approved:

David K Paylor

David Paylor, Committee Chair

Date:

10/27/2021

Committee Members:

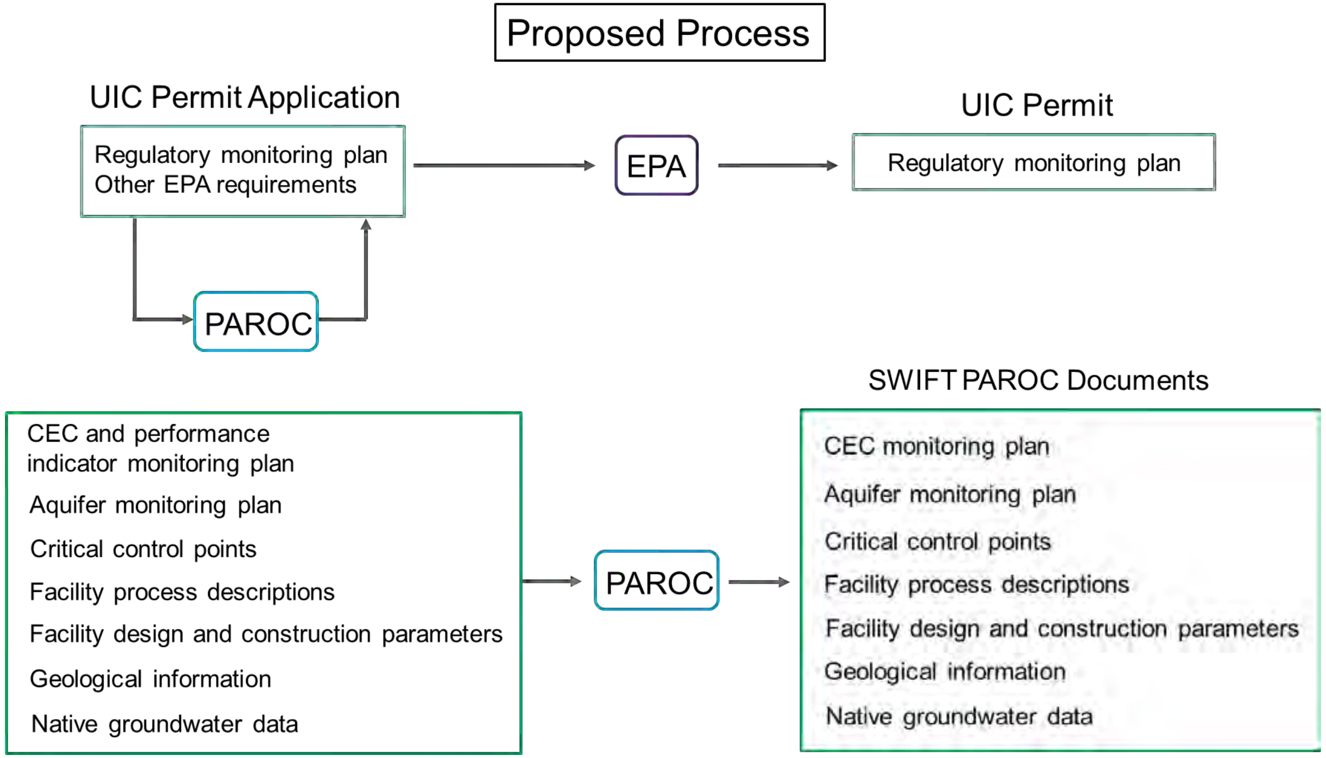
- Mark Bennett, Director of Virginia and West Virginia Water Science Center
- Dave Campbell, Director of the US EPA Region 3 Laboratory Services and Applied Science Division
- Adil N. Godrej, Co-Director Occoquan Watershed Monitoring Laboratory
- Whitney Katchmark, HRPDC
- William Mann, Governor Appointee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

PAROC Oversight of Non-Regulatory Items

June 30th, 2021

At the last PAROC meeting on April 30th

- EPA will omit most reference documents and non-regulated items from UIC permits for full-scale facilities
- PAROC directed staff to evaluate options for vehicle to provide oversight



Proposed Process

UIC Permit Application

Regulatory monitoring plan
Other EPA requirements

PAROC

EPA

UIC Permit

Regulatory monitoring plan

CEC and performance indicator monitoring plan
Aquifer monitoring plan
Critical control points
Facility process descriptions
Facility design and construction parameters
Geological information
Native groundwater data

PAROC

SWIFT PAROC Documents

CEC monitoring plan
Aquifer monitoring plan
Critical control points
Facility process descriptions
Facility design and construction parameters
Geological information
Native groundwater data

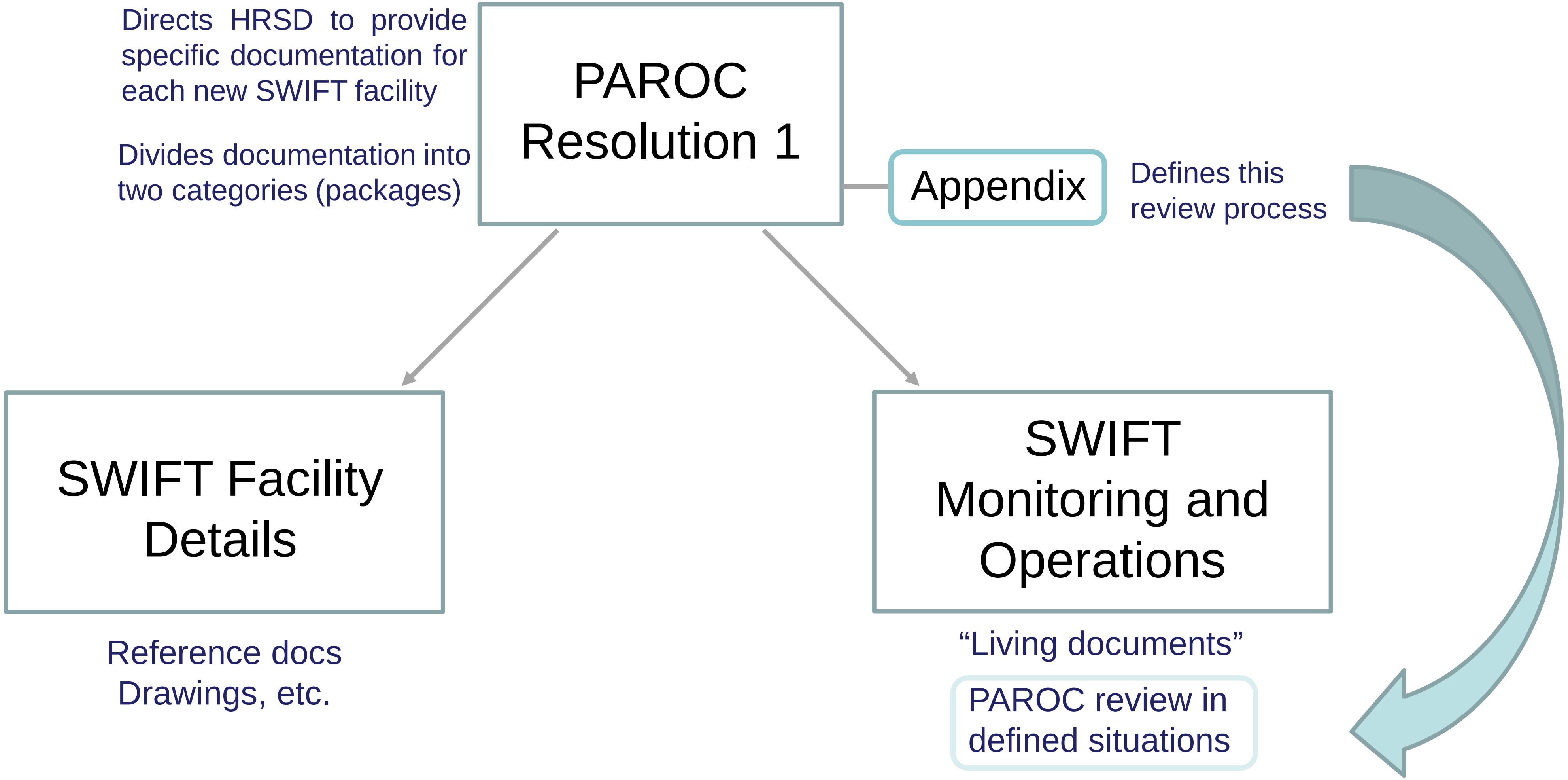
Vehicle Options

Signed by PAROC and HRSD

Memorandum of Agreement VS PAROC Resolution

Issued by PAROC, formally acknowledged by HRSD

- Decision affects the language and format of the document, and may have different legal implications, but essential contents will remain the same for each option.
- Group discussion – VDH, DEQ, HRSD, and PARML
- VDH and HRSD consulted legal counsel – advantages and disadvantages to each
- Group agreed on Resolution



Directs HRSD to provide specific documentation for each new SWIFT facility

Divides documentation into two categories (packages)

PAROC Resolution 1

Appendix

Defines this review process

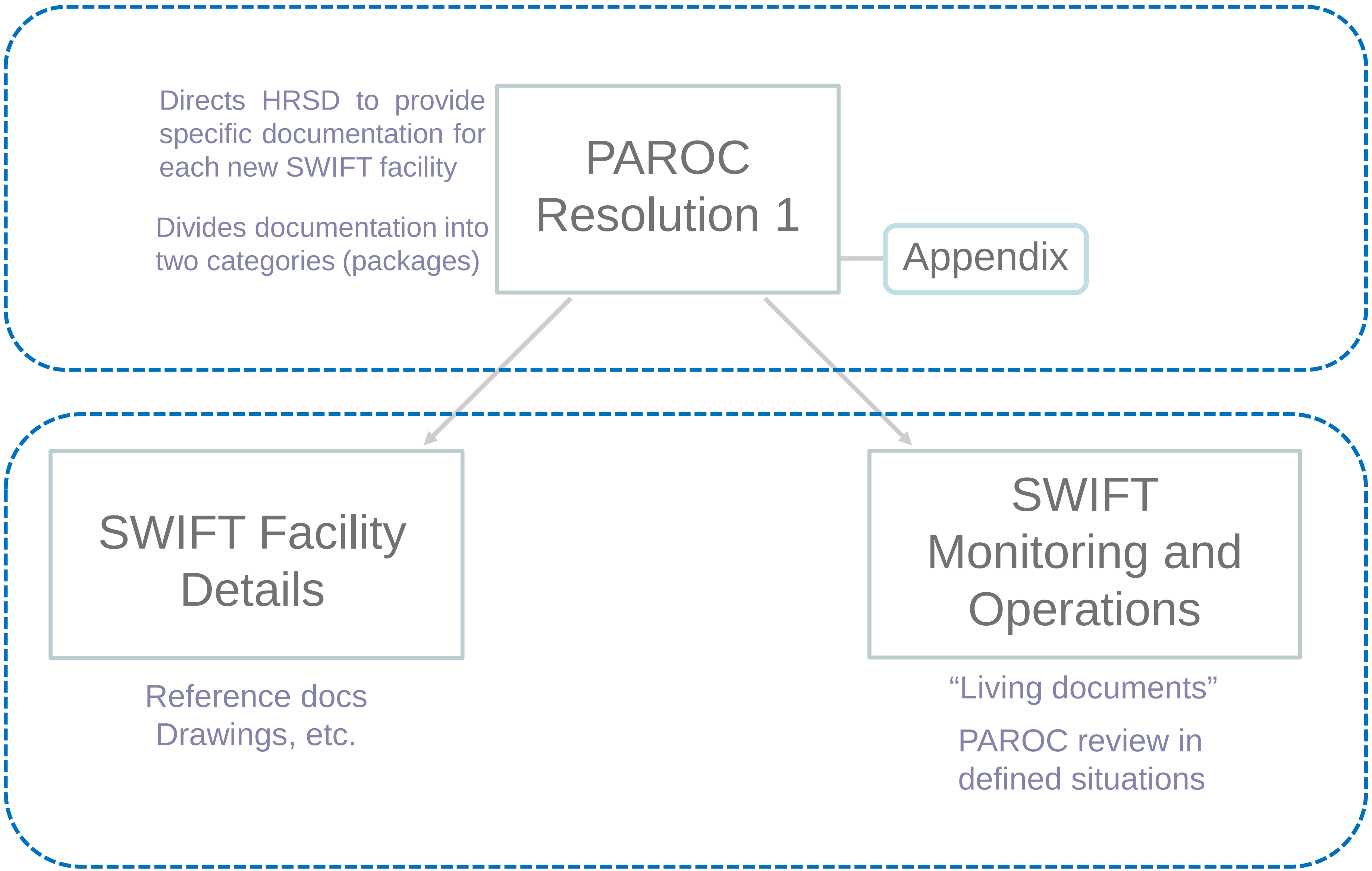
SWIFT Facility Details

Reference docs
Drawings, etc.

SWIFT Monitoring and Operations

“Living documents”

PAROC review in defined situations



One Document

Directs HRSD to provide specific documentation for each new SWIFT facility

Divides documentation into two categories (packages)

PAROC Resolution 1

Appendix

One Set for Each Facility

x …

SWIFT Facility Details

Reference docs
Drawings, etc.

SWIFT Monitoring and Operations

“Living documents”

PAROC review in defined situations

Resolution Outline

- Introduction
- Declaration
  - Instructs HRSD to provide two documentation packages to PAROC for each new UIC permit application
  - States the purpose of each documentation package
    - Provide a set of core reference documents for each facility
      - Physical and operational reference documents
      - Necessary to evaluate quarterly reports
    - Names each documentation package
      - SWIFT Facility Details
      - SWIFT Monitoring and Operations
  - Note Appendix
    - Some Monitoring and Operations documents call for PAROC review
    - Appendix describes the review process
- Specification of Document Packages
  - SWIFT Facility Details
    - List specific docs
  - SWIFT Monitoring and Operations
    - List specific docs

Resolution Specifies Contents of Each Package

SWIFT Facility Details

- Existing wells in project area
- Geologic description of project area
- Native groundwater data
- Well construction
- Facility construction
- Process descriptions
- Design parameters
- Process flow diagram
- Final UIC permit (Draft – update as issued)
- Mechanism/responsibility for updating as documents are updated (by outside parties, ex. Record drawings, change orders, etc)

SWIFT Monitoring and Operations

- SWIFT Treatment
  - CEC and performance indicator monitoring plan
  - Critical control points
  - Chemical addition schedule
  - Pathogen LRV credit
- Groundwater monitoring plan

Appendix Outline

- Introduction
  - PAROC has responsibility and authority to oversee SWIFT
  - HRSD submits documentation to PAROC, some documents call for PAROC review
  - PAROC has authority to create an advisory council, called the PAROC Review Committee (PRC)
- PAROC Review Committee
  - Authorized by 62.1-273.D
  - Members selected from stakeholder orgs
  - Members confirmed annually
- Committee Review Levels
  - Assigned at time of document creation
  - Pre-Approved
  - Level 1
  - Level 2

PAROC Review Committee - 3 Levels of Review

Review Level	Summary	Example
Pre-Approved	HRSD submits several operating scenarios and is free to switch between them	Chemical addition
Level 1	HRSD notifies PRC ahead of making a change, PRC members have X time to object	Phased reduction of NDMA precursor testing
Level 2	PRC must meet to discuss and approve. Approvals reviewed by PAROC board at next meeting.	Claim disinfection credit for ozone PRC member objects to Level 1 review item

Questions?

VDH Contact -
Ryder Bunce
Ryder.bunce@vdh.Virginia.gov
804-864-7469

Potomac Aquifer Recharge Monitoring Laboratory Update

Mark Widdowson and Gary Schafran
PARML Co-Directors

June 30, 2021

Role of PARML – Non-Regulatory Oversight (*DRAFT*)

Consistent with the PAROC/PARML duties and responsibilities, the PARML Co-Directors have identified (3) key areas of engagement:

- SWIFT Treatment Performance
- Groundwater Impact Assessment
- Communication, Reporting and Coordination

Role of PARML – Non-Regulatory Oversight (*DRAFT*)

- SWIFT Treatment Performance
    - Verification of SWIFT Water Quality
        - CEC and performance indicators
        - Disinfection
        - Critical Control Points – Review of effectiveness
    - Monitoring of SWIFT facility operations
- Groundwater Impact Assessment
    - Verification monitoring of groundwater constituents
    - Local-scale hydrogeological data analysis
    - Modeling of chemical and pathogen fate and transport in the subsurface
- Communication, Reporting and Coordination
    - Reporting results to PAROC (including proposed Review Committee) and the public
    - Maintaining regular communications with HRSD and SWIFT contractors

PARML Groundwater Advisory Workgroup

- First Meeting – May 21
  - Full participation: DEQ, VDH, HRPDC, USGS, HRSD and PARML Co-Directors
  - Quarterly meeting schedule

- Scope: SWIFT Project impacts on the Potomac Aquifer System
  - Identifying critical groundwater data gaps
  - Coordination of local and regional monitoring strategies
  - Approaches to groundwater modeling and data analysis

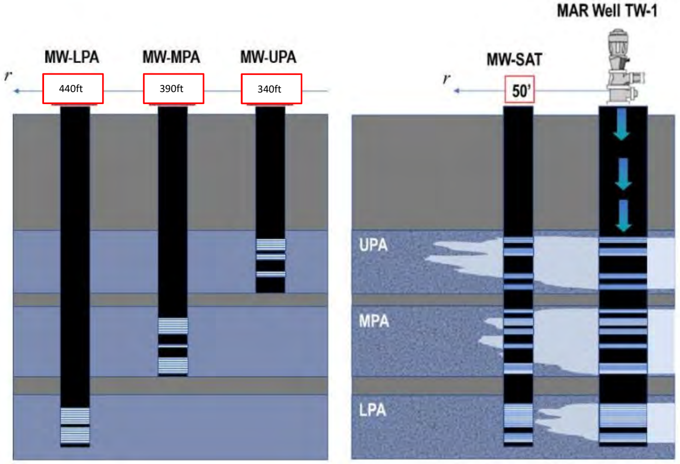
Groundwater Impacts – Lessons Learned

Chemical transport is influenced by recharge well dynamics at SWIFTRC

- Travel distance and Travel time
- Concentrations

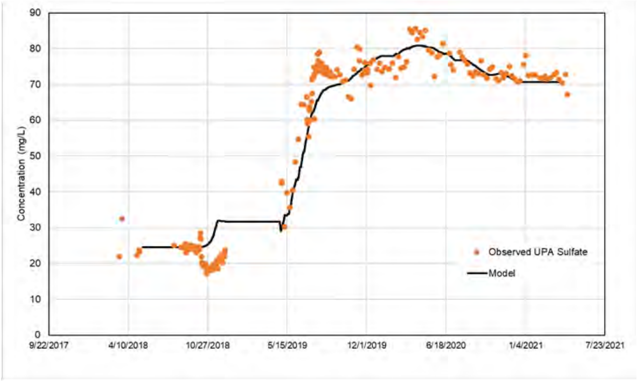
Recharge well dynamics – Influencing factors:

- Hydrogeology and Biogeochemistry (PAS)
- SWIFT treatment operations



Meredith Martinez (VT)

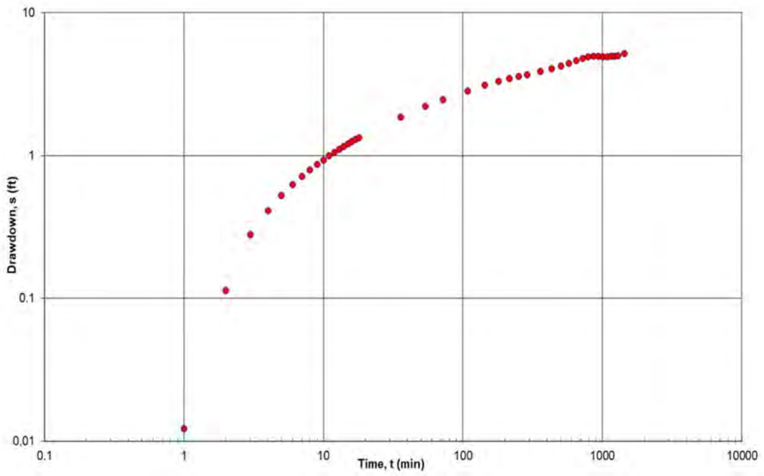
Lines of Evidence: Groundwater Impacts



Breakthrough concentration data at monitoring wells

- Travel time and chemical attenuation
- Multi-constituent analysis

Flow distribution at recharge well

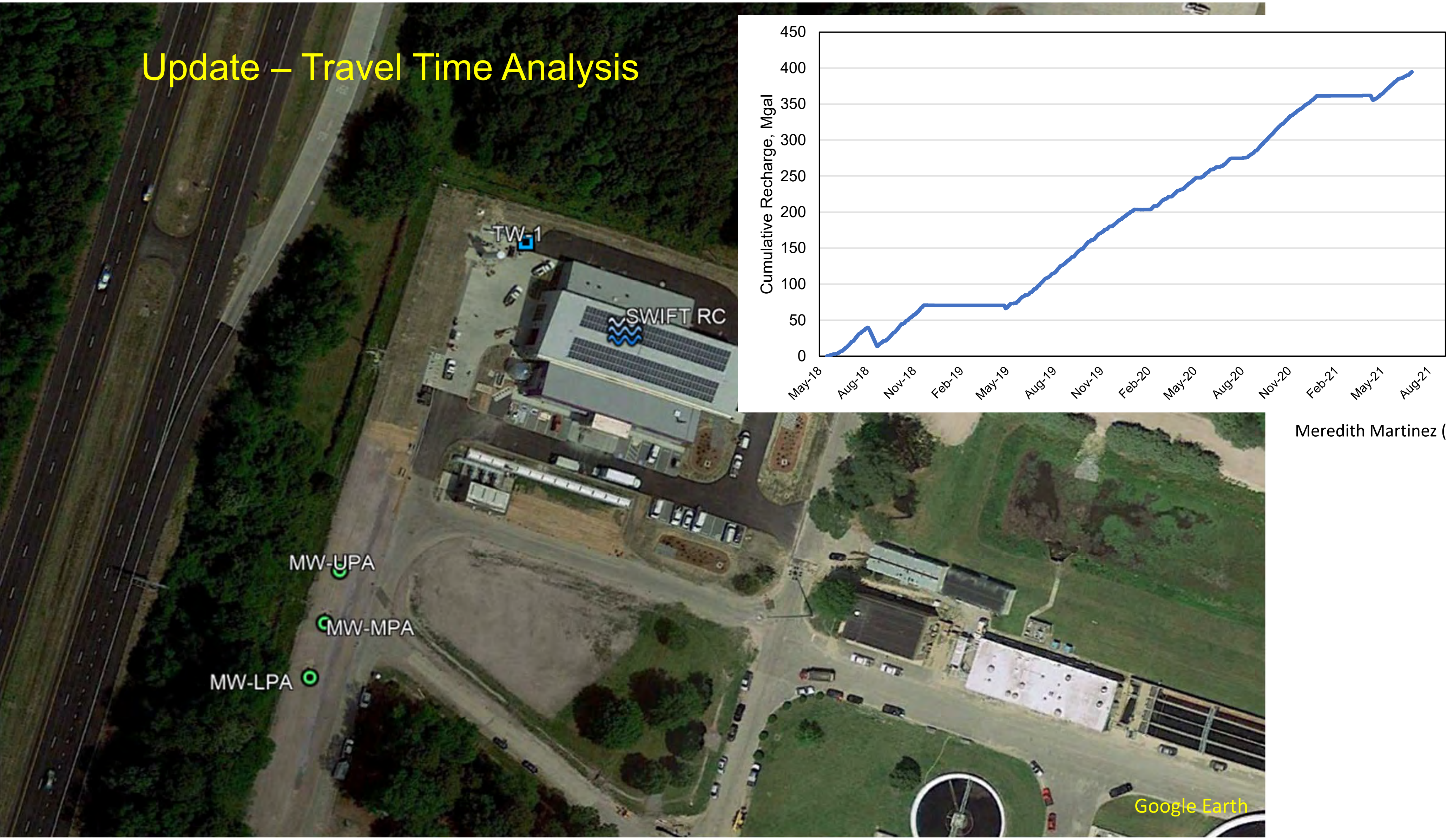


- In-well flow meter
- Water levels – Transient behavior

PAS subsurface characteristics

- Geochemical parameters
- Microbial activity
- Aquifer hydraulics/storage parameters (site-specific)

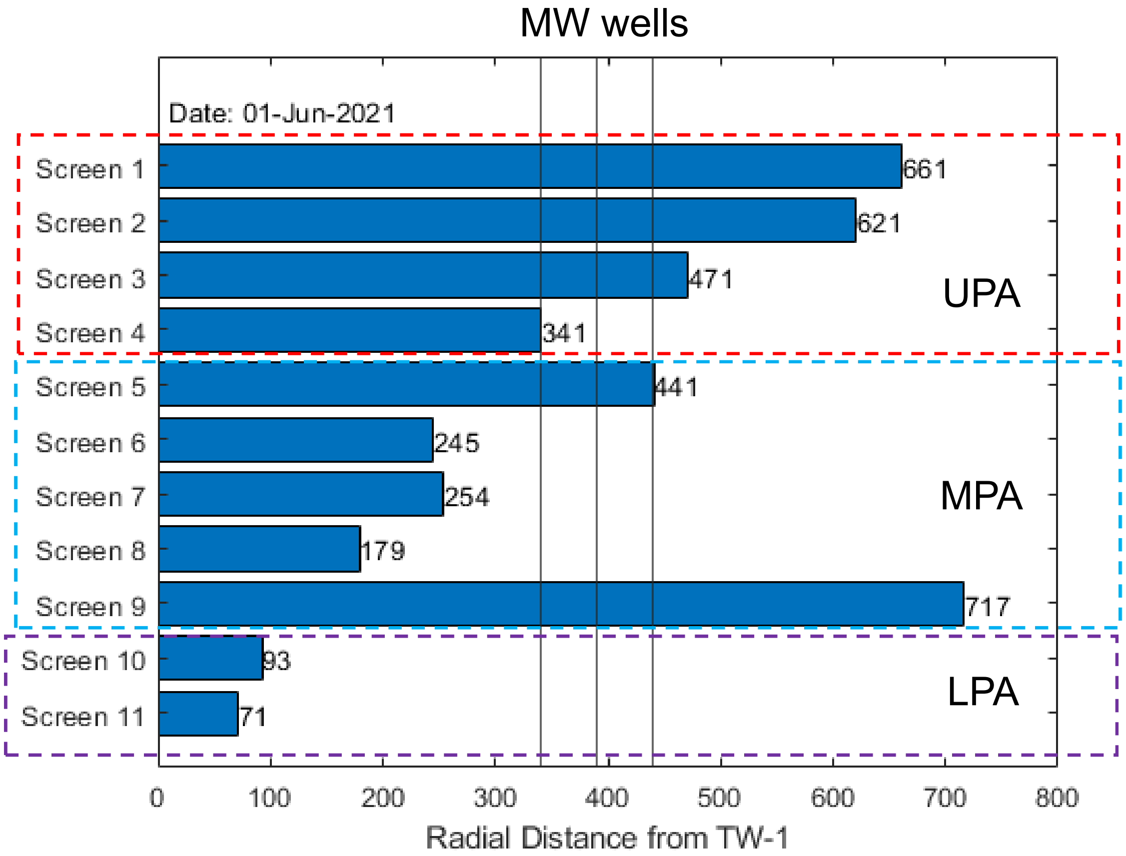
Update – Travel Time Analysis



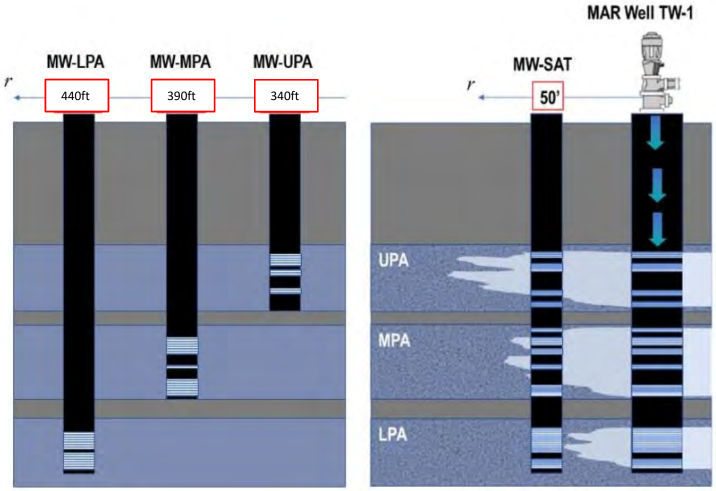
Google Earth

Meredith Martinez (VT)

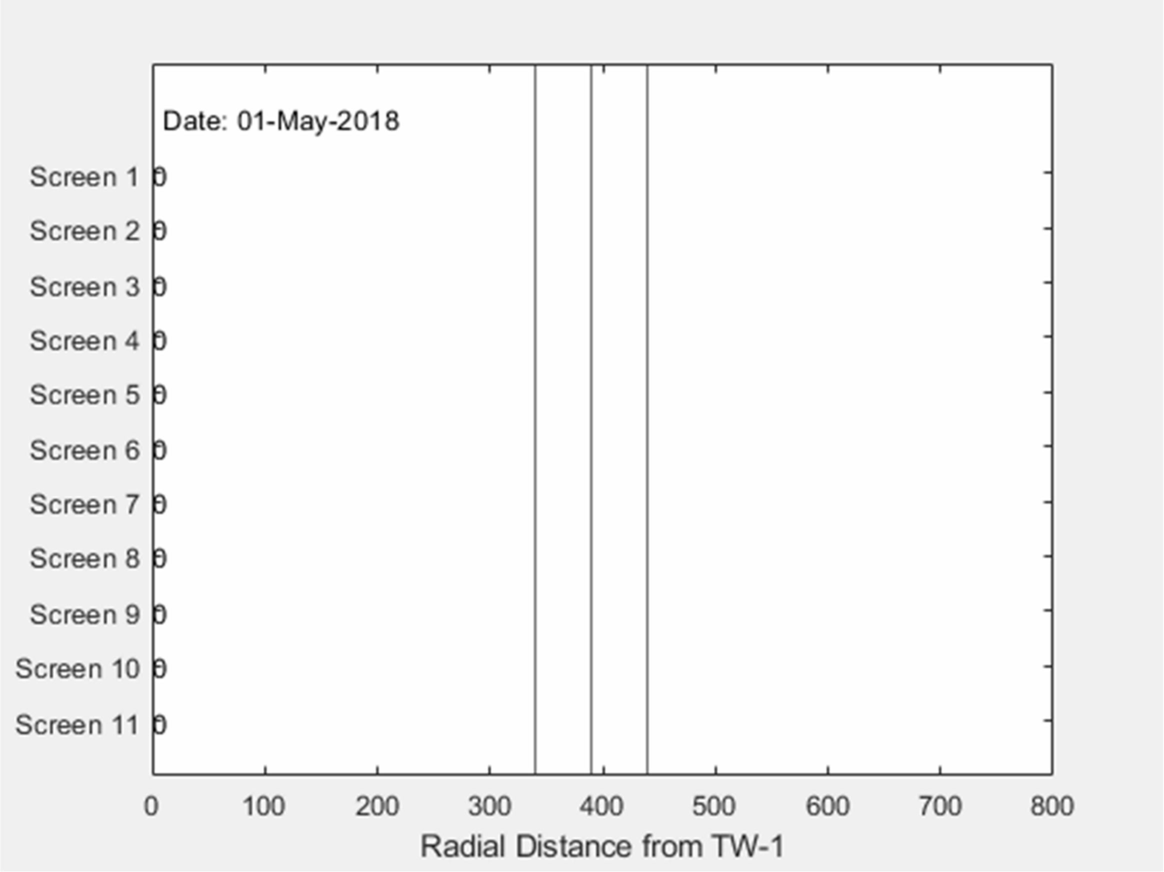
Advective Transport – Depth-Dependent/Transient Flow



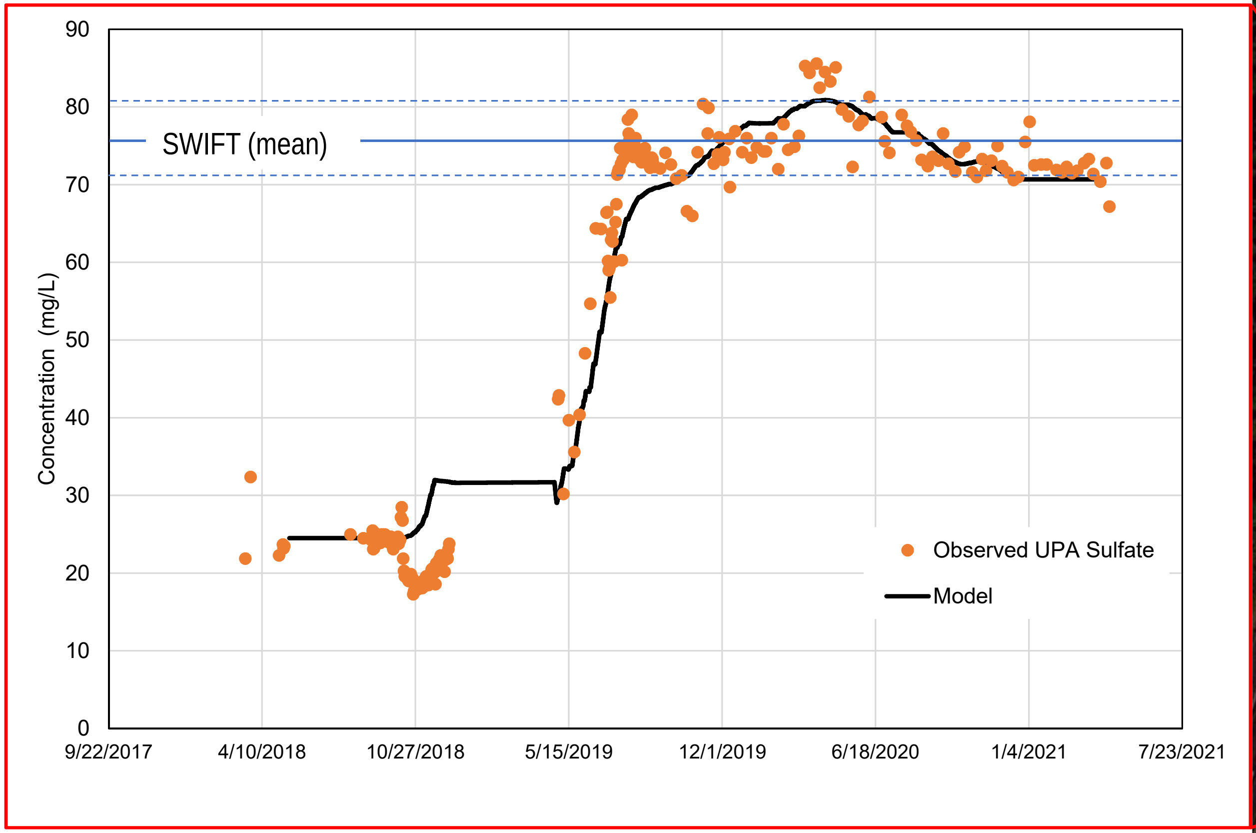
Meredith Martinez (VT)



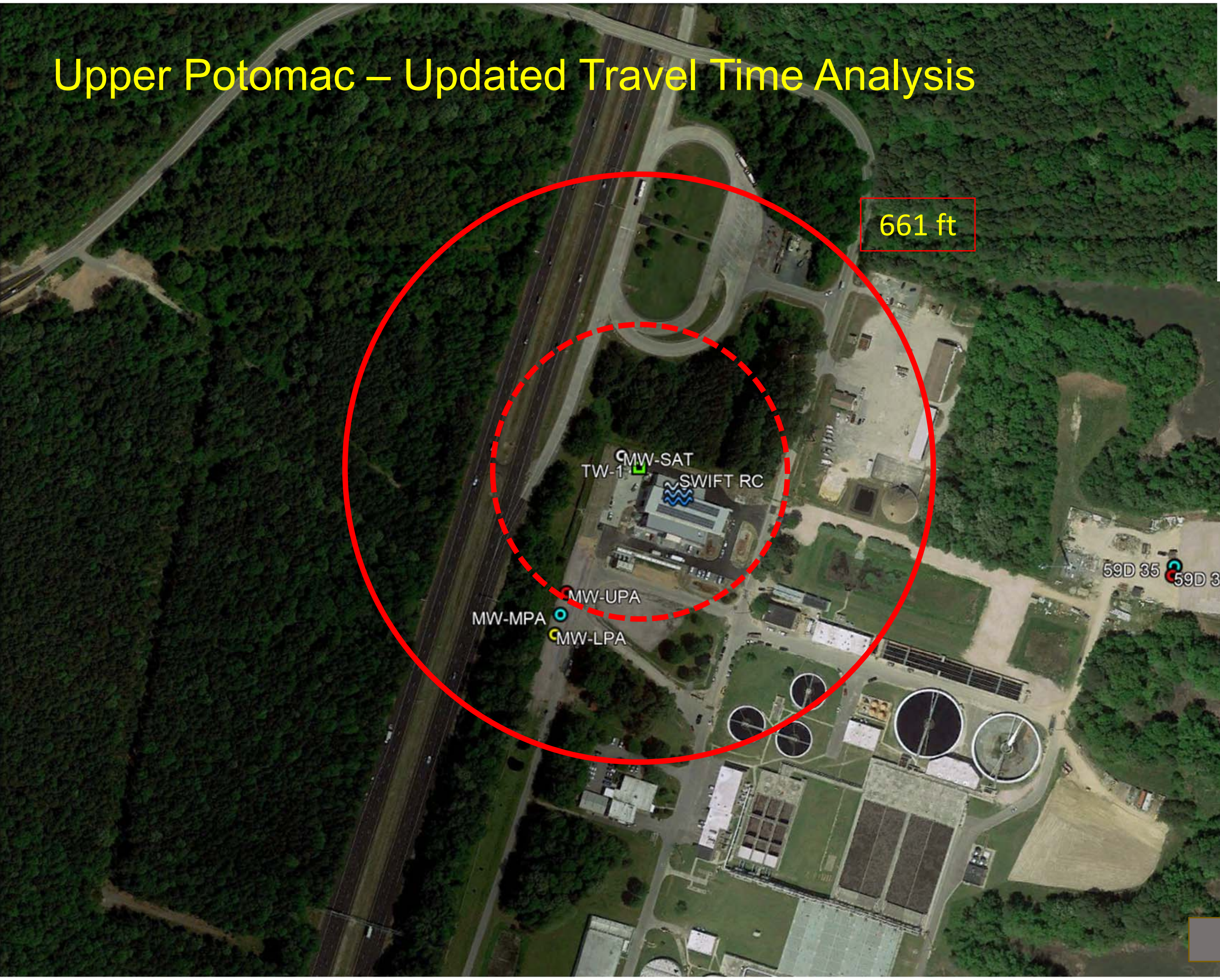
Advective Transport – Depth-Dependent/Transient Flow

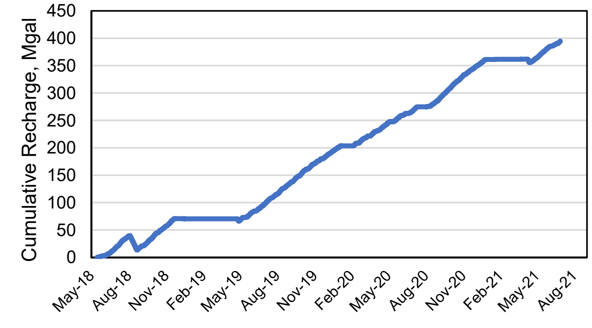


Sulfate Breakthrough – UPA

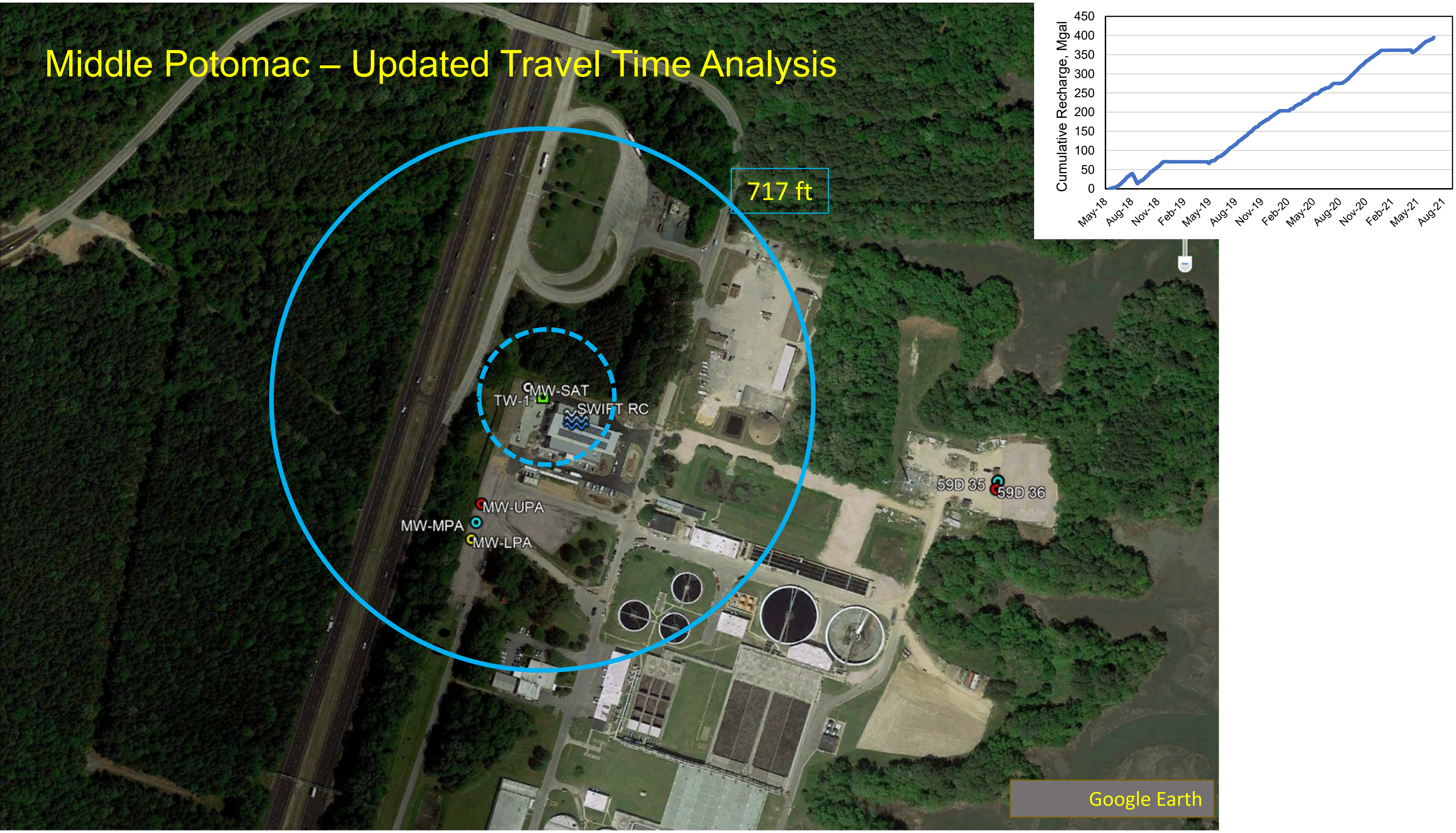


Upper Potomac – Updated Travel Time Analysis

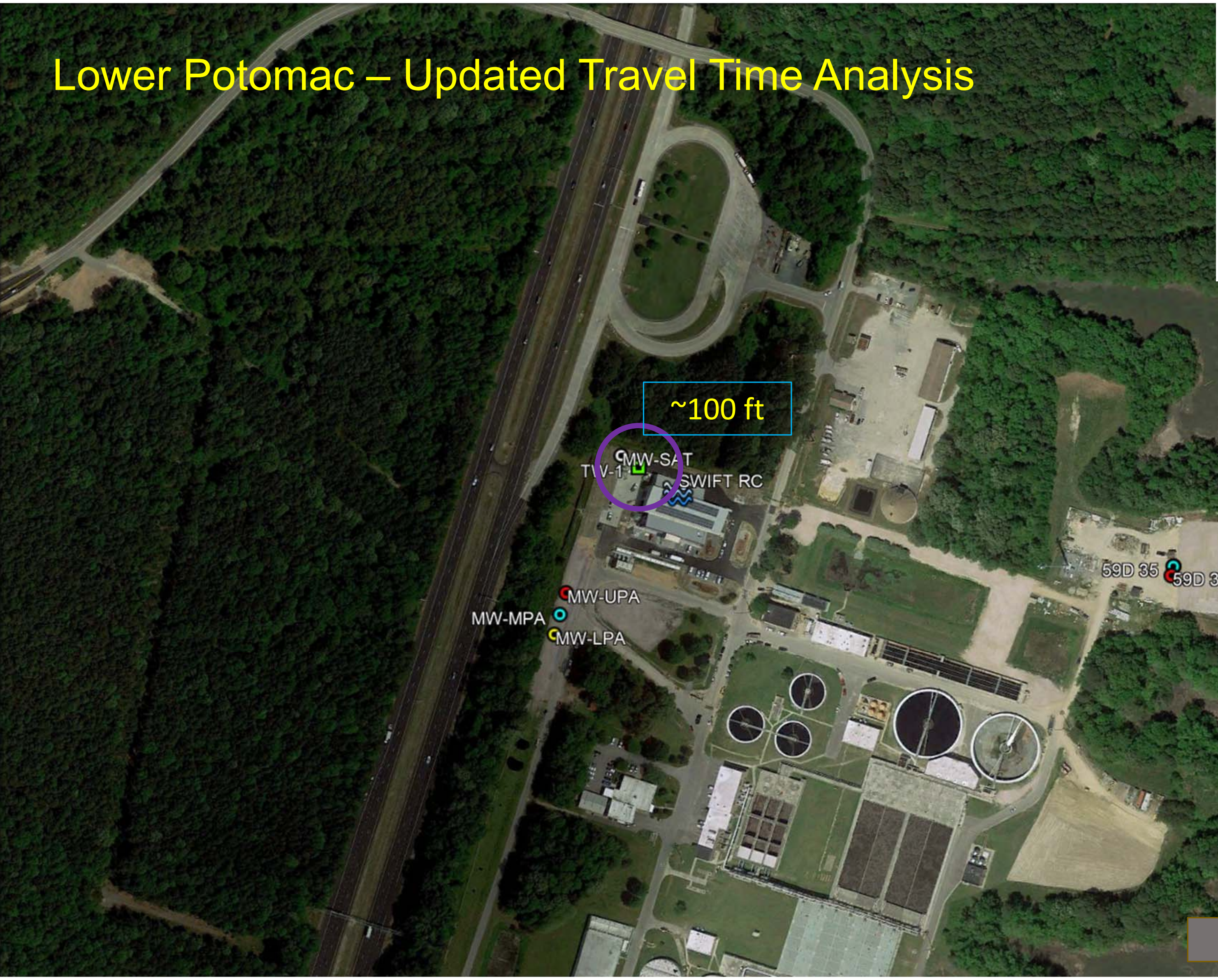




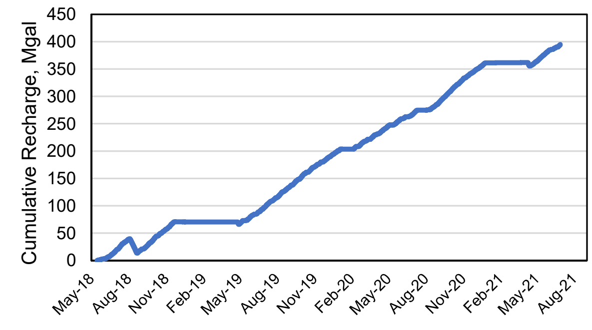
Middle Potomac – Updated Travel Time Analysis



Lower Potomac – Updated Travel Time Analysis



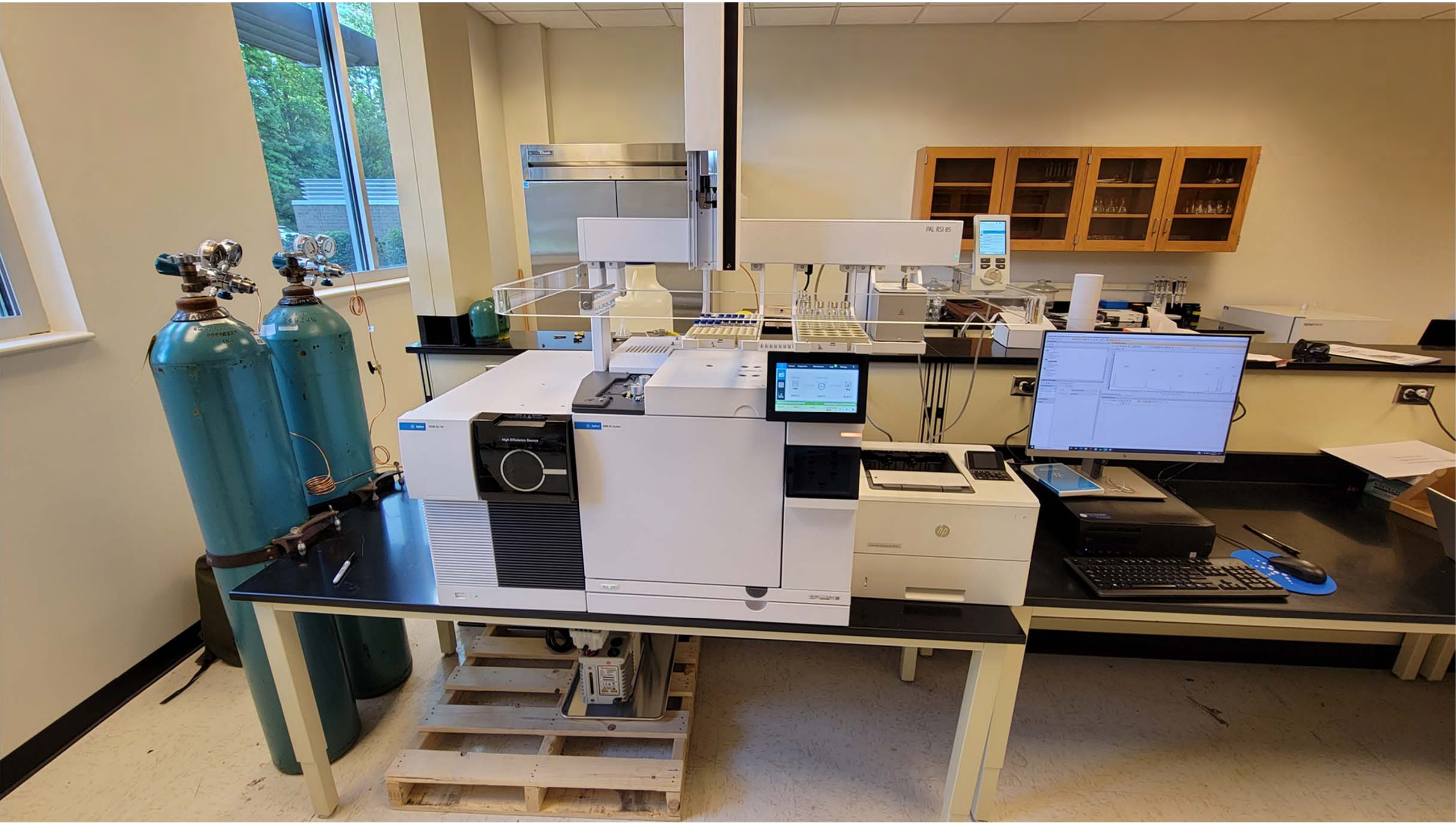
Google Earth



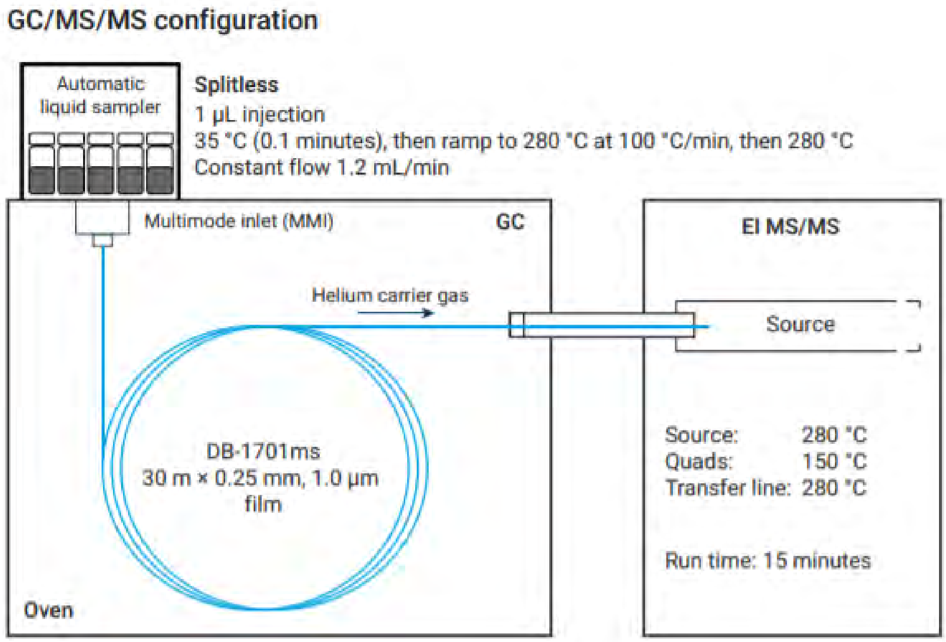
Outline:

- Continuing Development of Laboratory Analytical Capabilities
- Some Recent SWIFT Monitoring Efforts
- Recent and Next Acquisitions

Triple-Quadrupole GC/MS waiting to be installed two months ago


PAL RSI 85
High Efficiency Source

Nitrosamines Analysis



Splitless
1 µL injection
35 °C (0.1 minutes), then ramp to 280 °C at 100 °C/min, then 280 °C
Constant flow 1.2 mL/min

Source: 280 °C
Quads: 150 °C
Transfer line: 280 °C

Run time: 15 minutes

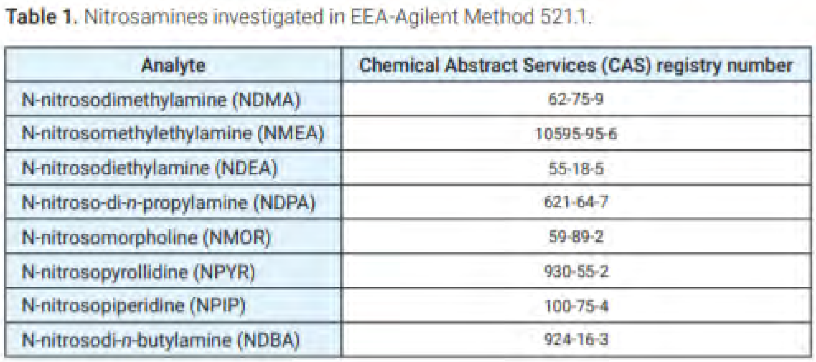
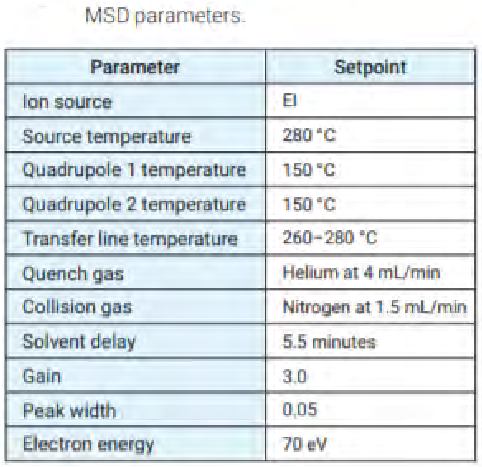


Table 1. Nitrosamines investigated in EEA-Agilent Method 521.1.

Analyte	Chemical Abstract Services (CAS) registry number
N-nitrosodimethylamine (NDMA)	62-75-9
N-nitrosomethylethylamine (NMEA)	10595-95-6
N-nitrosodiethylamine (NDEA)	55-18-5
N-nitroso-di-*n*-propylamine (NDPA)	621-64-7
N-nitrosomorpholine (NMOR)	59-89-2
N-nitrosopyrollidine (NPYR)	930-55-2
N-nitrosopiperidine (NPIP)	100-75-4
N-nitrosodi-*n*-butylamine (NDBA)	924-16-3



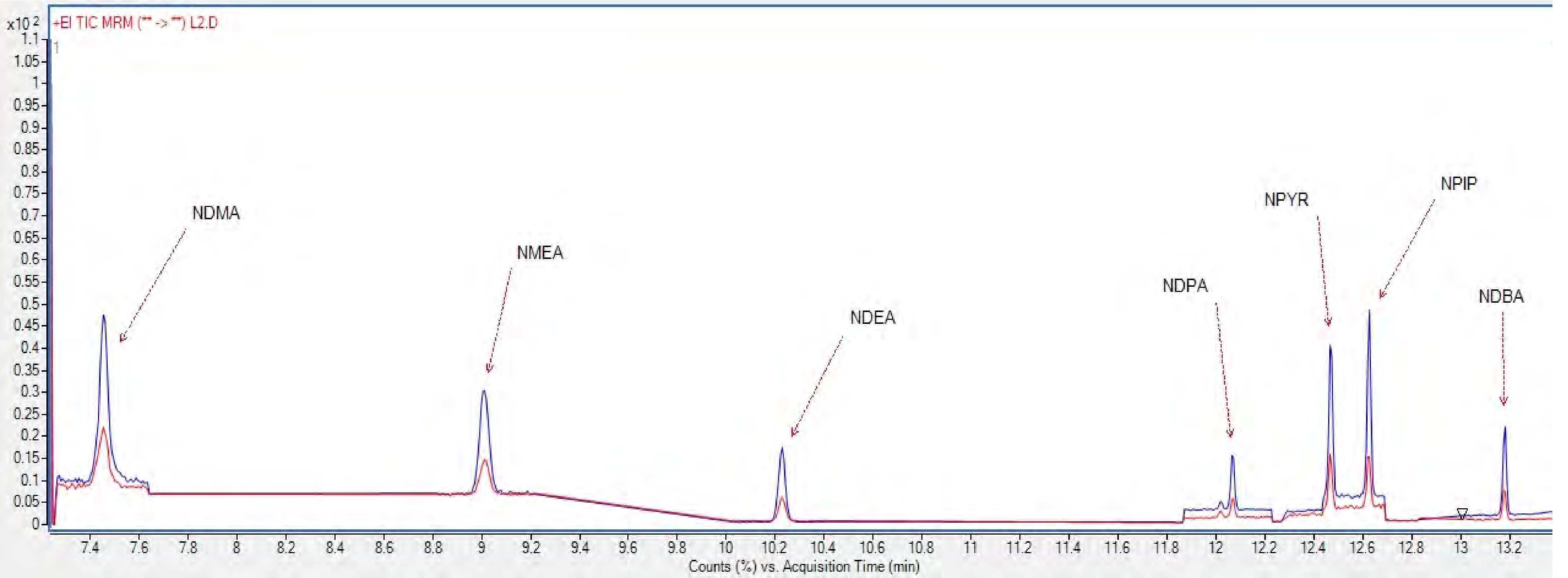
MSD parameters.

Parameter	Setpoint
Ion source	EI
Source temperature	280 °C
Quadrupole 1 temperature	150 °C
Quadrupole 2 temperature	150 °C
Transfer line temperature	260–280 °C
Quench gas	Helium at 4 mL/min
Collision gas	Nitrogen at 1.5 mL/min
Solvent delay	5.5 minutes
Gain	3.0
Peak width	0.05
Electron energy	70 eV

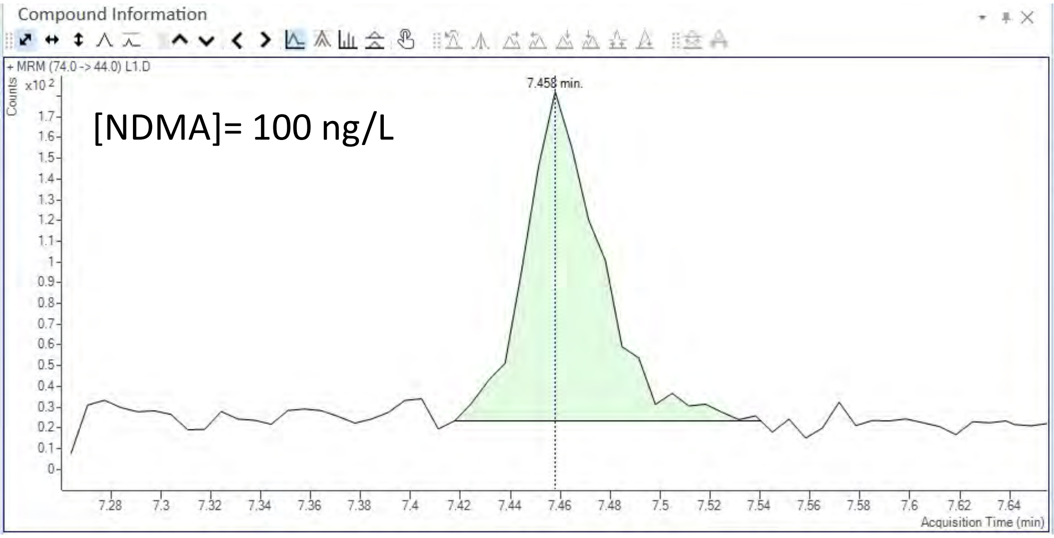
Nitrosamines Analysis in Drinking Water Using GC/MS/MS—Meeting Equivalence to EPA Method 521 (Application Note)

Andy Eaton, Charles Grady, and Konjit Tadigo Eurofins Eaton Analytical, Monrovia, CA, USA Yongtao Li and William Davis Eurofins Eaton Analytical, South Bend, IN, USA Ralph Hindle Vogon Laboratories, Cochrane, AB, Canada Diana Wong, Ron Honnold, and Craig Marvin Agilent Technologies, Inc

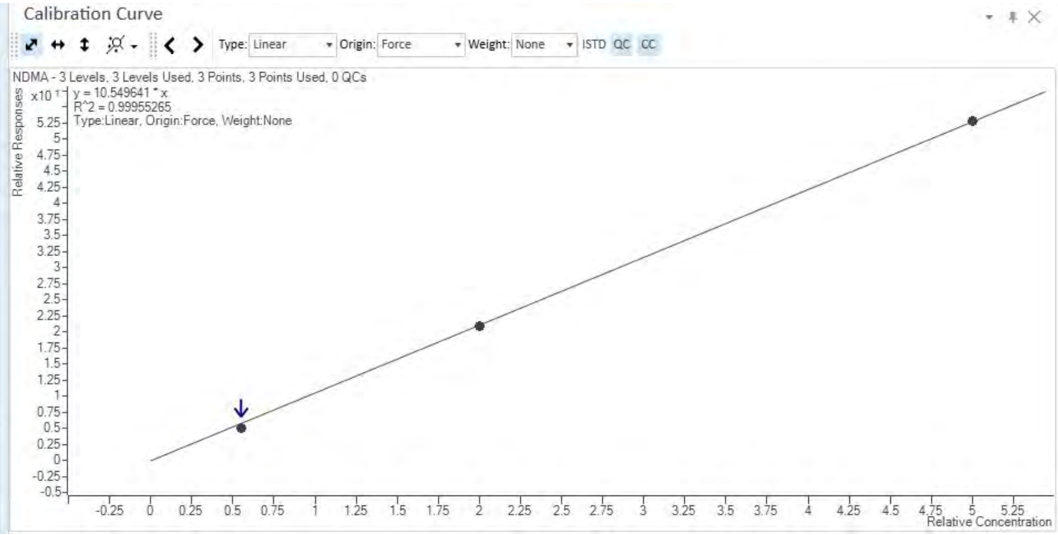
GC/MS/MS: Separation of Nitrosamines (100 and 400 ng/L)



Calibration Curve (100, 400, 1000 ng/L)



[NDMA]= 100 ng/L



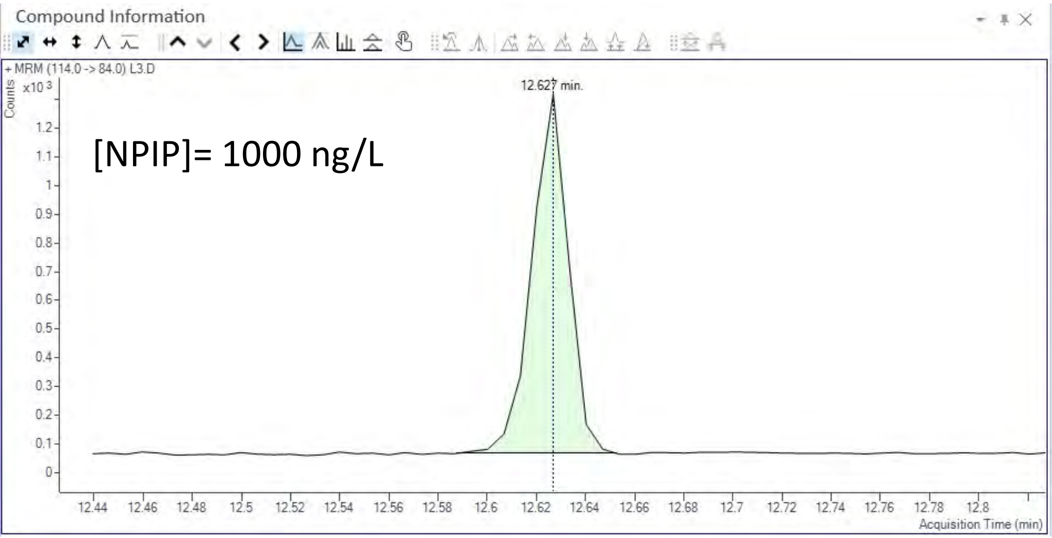
Type: Linear Origin: Force Weight: None

NDMA - 3 Levels, 3 Levels Used, 3 Points, 3 Points Used, 0 QCs

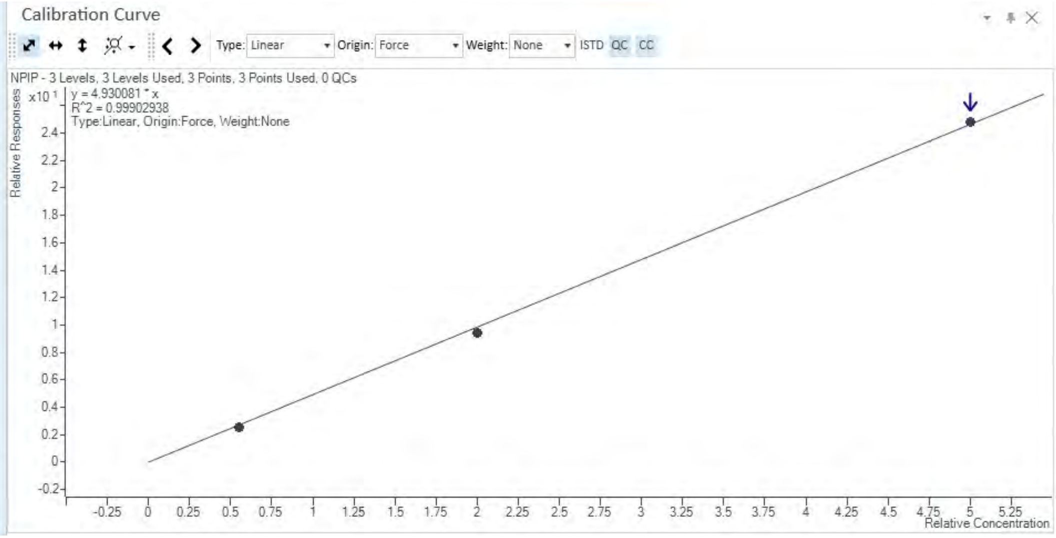
y = 10.549641 * x

R^2 = 0.99955265

Type:Linear, Origin:Force, Weight:None



[NPIP]= 1000 ng/L



Type: Linear Origin: Force Weight: None

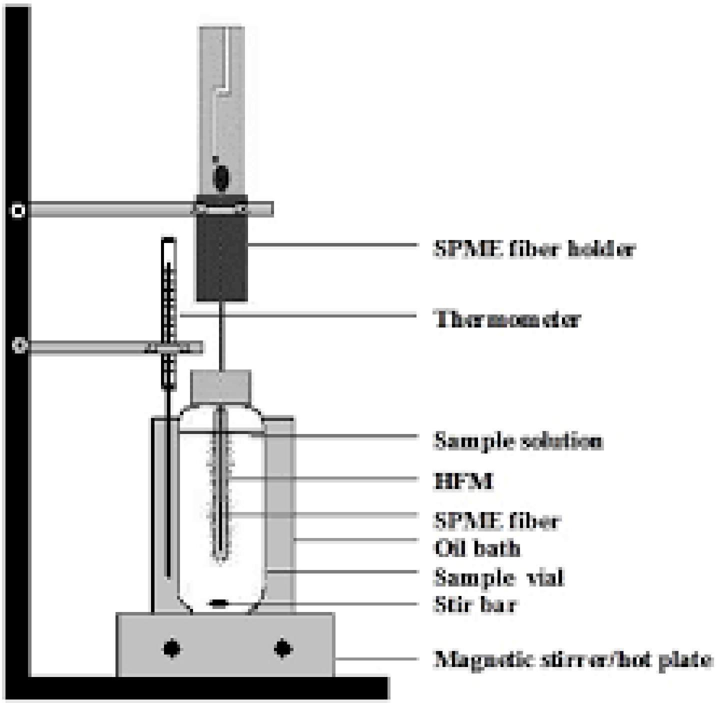
NPIP - 3 Levels, 3 Levels Used, 3 Points, 3 Points Used, 0 QCs

y = 4.930081 * x

R^2 = 0.99902938

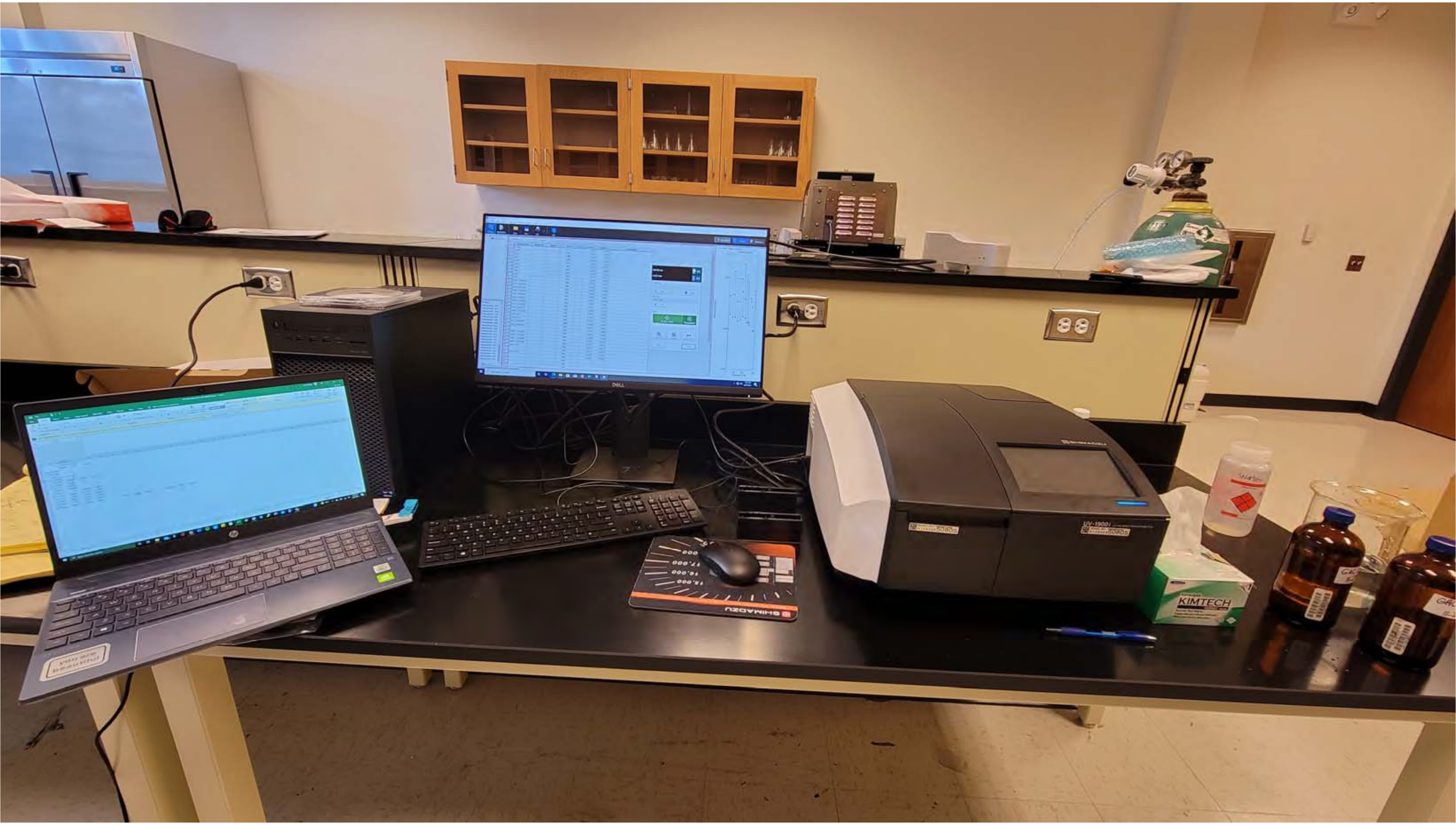
Type:Linear, Origin:Force, Weight:None

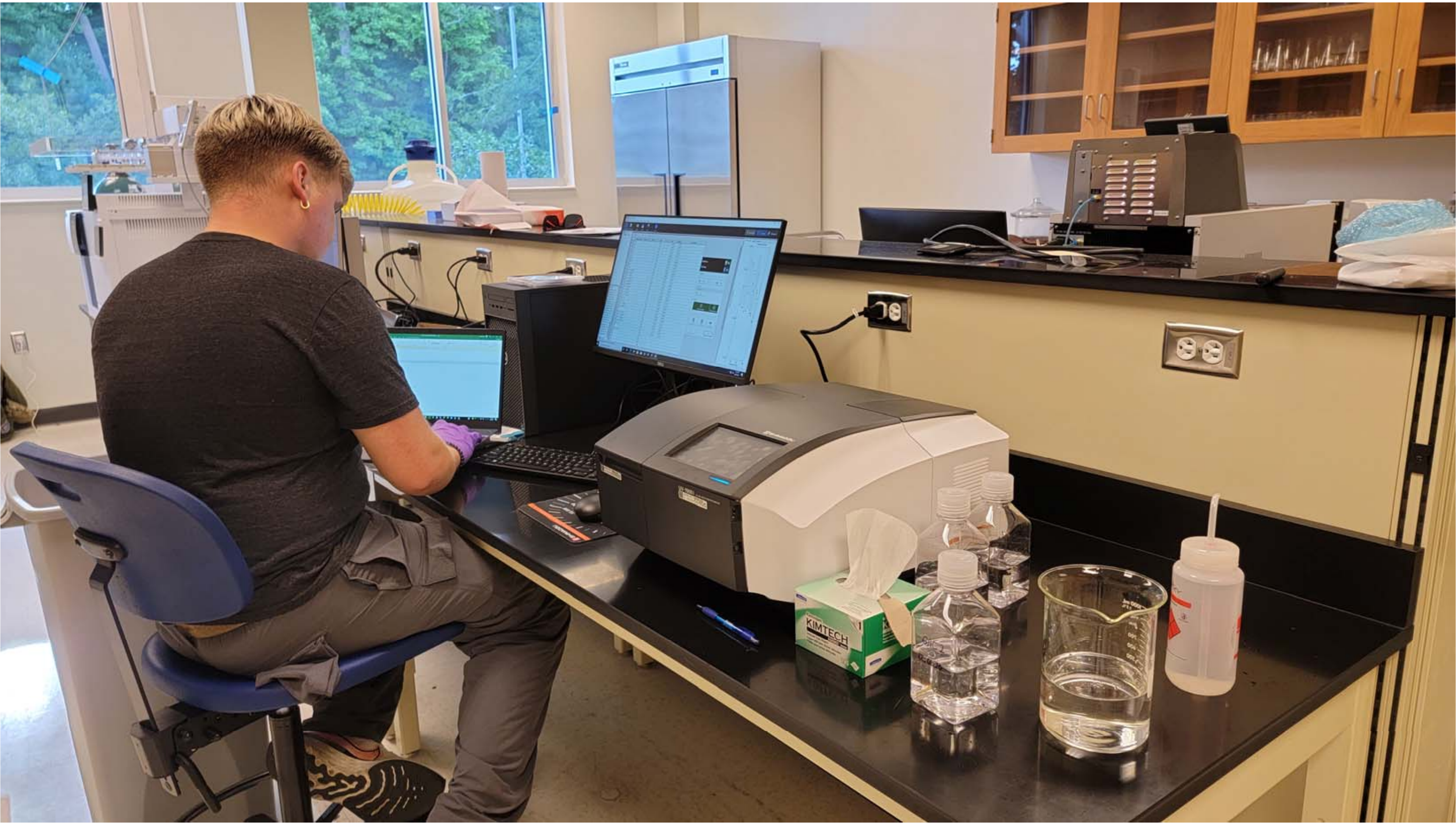
Next Acquisition: Solid-phase Microextraction Instrument



Double-beam, Scanning UV-VIS Spectrophotometer

Used for organic matter characterization and spectrophotometric analytical methods


UV-1900i
SHIMADZU
KIMTECH
DELL



Specific Ultraviolet Violet Absorbance (SUVA)

$$SUVA_{254} = \frac{UV_{254}\ \text{Absorbance (abs cm}^{-1}\text{)}}{\text{DOC (mg C/L)}}$$

Higher SUVA values correlate to greater oxidant demand per mg organic carbon and greater halogenated organic DBP formation per mg organic carbon.

$$\log(DBP) = \text{intercept} + k_{turb}\log(turb) + k_{br}\log(br) + k_{temp}temp + k_{alk}alk + k_{toc}\log(toc) + k_{uv}\log(uv) + k_{cl2}\log(cl2) + k_{t}\log(t) + k_{ph}pH + k_{res}\log(res) + k_{precl2}precl2$$

Obolensky, A. and Singer, P., 2008. Development and Interpretation of Disinfection Byproduct Formation Models Using the Information Collection Rule Database.

DBP Models

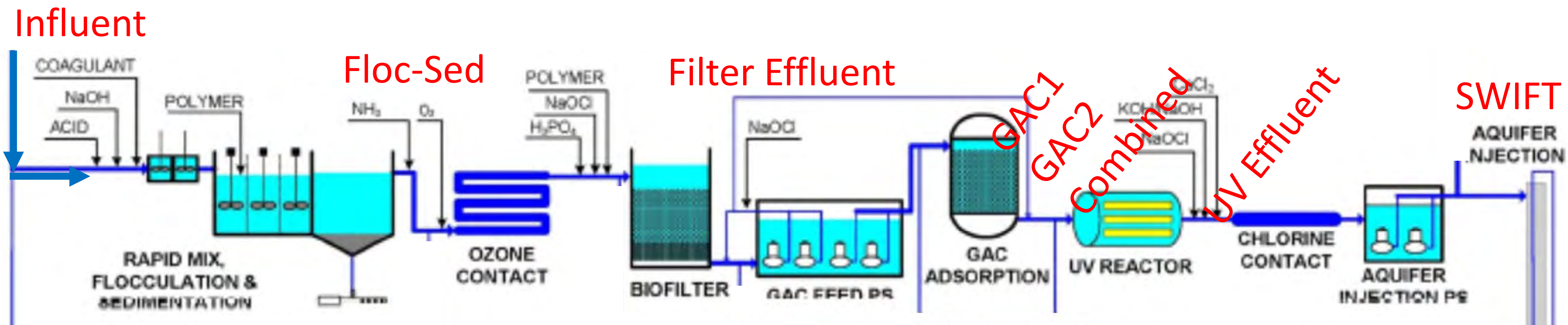
Harrington, G., Z. K. Chowdhury, D. M. Owen, 1992. Developing a Computer Model to Simulate DBP Formation During Water Treatment. *JAWWA* 84(11):78-87.

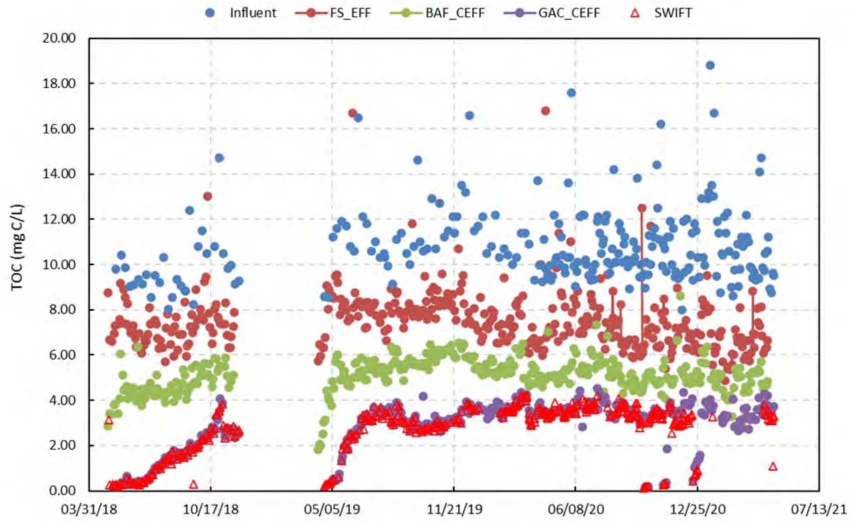
$$TTHM = 0.00309[(DOC)\boxed{(UV_{254})}]^{0.440}\ (CL_2)^{0.409}\ t^{0.265}\ T^{1.06}\ (pH - 2.6)^{0.715}\ (Br + 1)^{0.036}$$

Obolensky, A. and Singer, P., 2008. Development and Interpretation of Disinfection Byproduct Formation Models Using the Information Collection Rule Database.

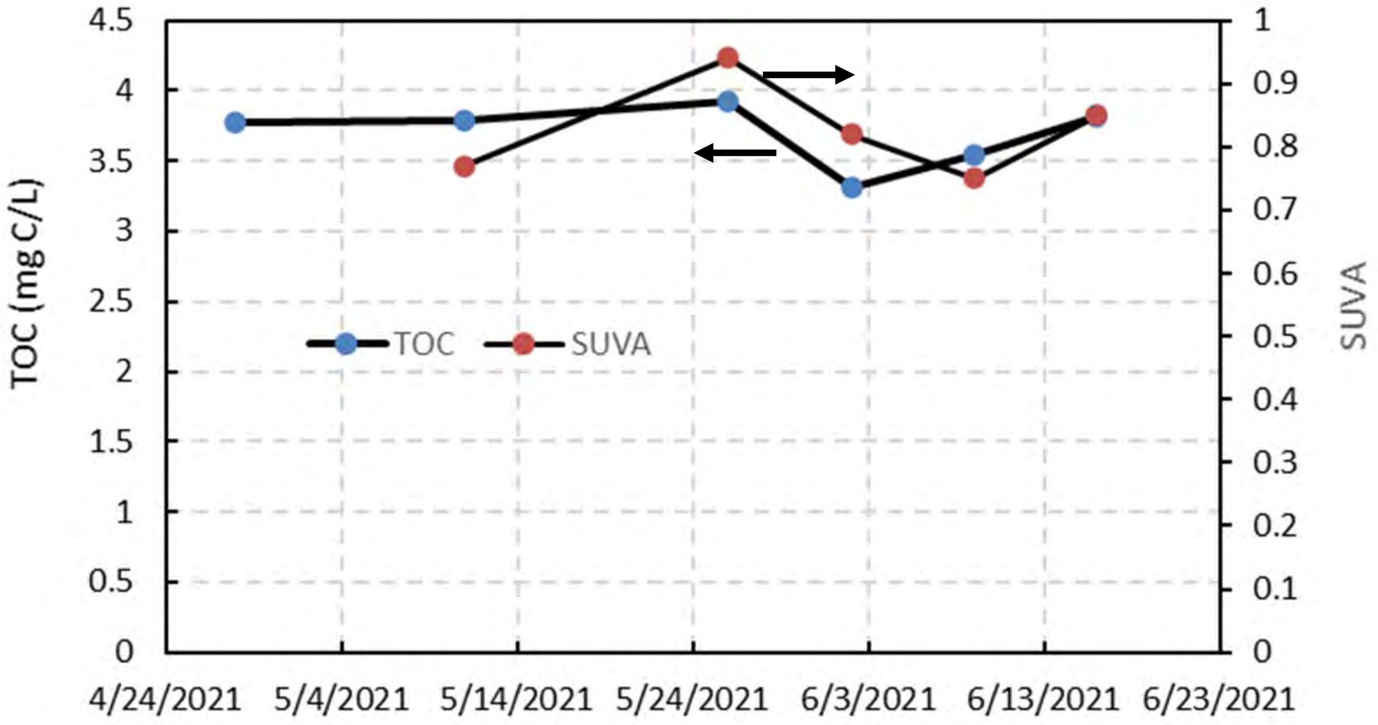
$$\log(\mathrm{DBP}) = \mathrm{intercept} + k_{turb}\log(\mathrm{turb}) + k_{br}\log(\mathrm{br}) + k_{temp}\mathrm{temp} + k_{alk}\mathrm{alk} + k_{toc}\log(\mathrm{toc}) + k_{uv}\log(\mathrm{uv}) + k_{cl2}\log(\mathrm{cl2}) + k_{t}\log(\mathrm{t}) + k_{ph}\mathrm{pH} + k_{res}\log(\mathrm{res}) + k_{precl2}\mathrm{precl2}$$

SWIFT Process Train

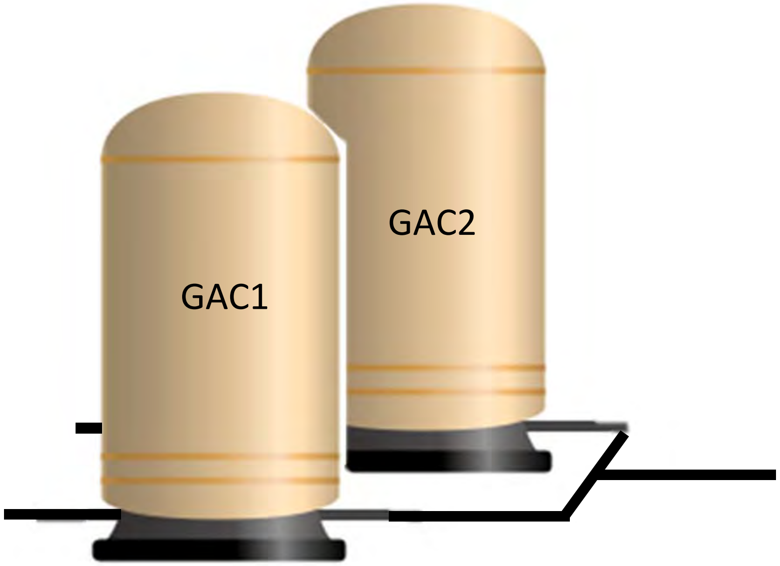




SWIFT Water TOC and SUVA Values at SWIFT Research Center

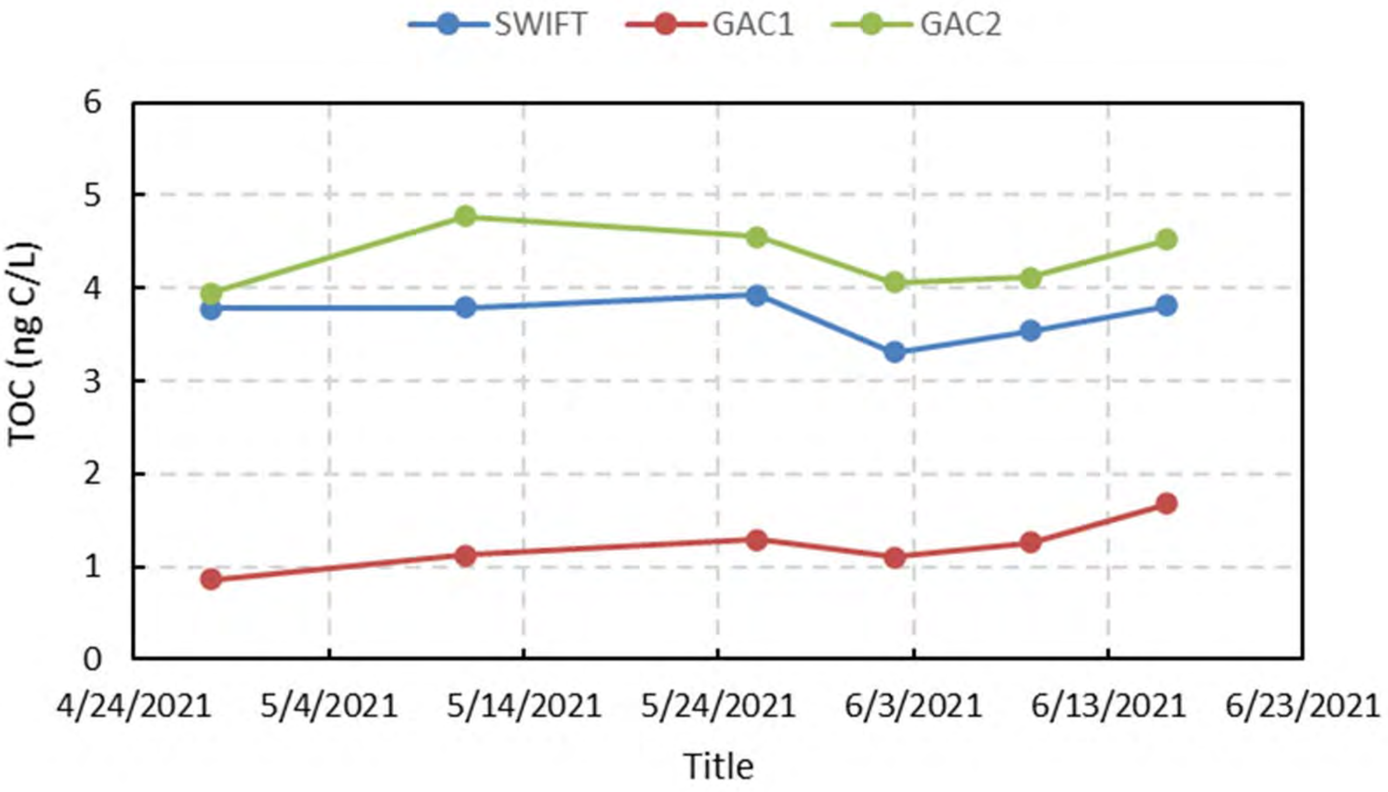


GAC Columns Running in Parallel at Different Flow Rates and Different Aged GAC

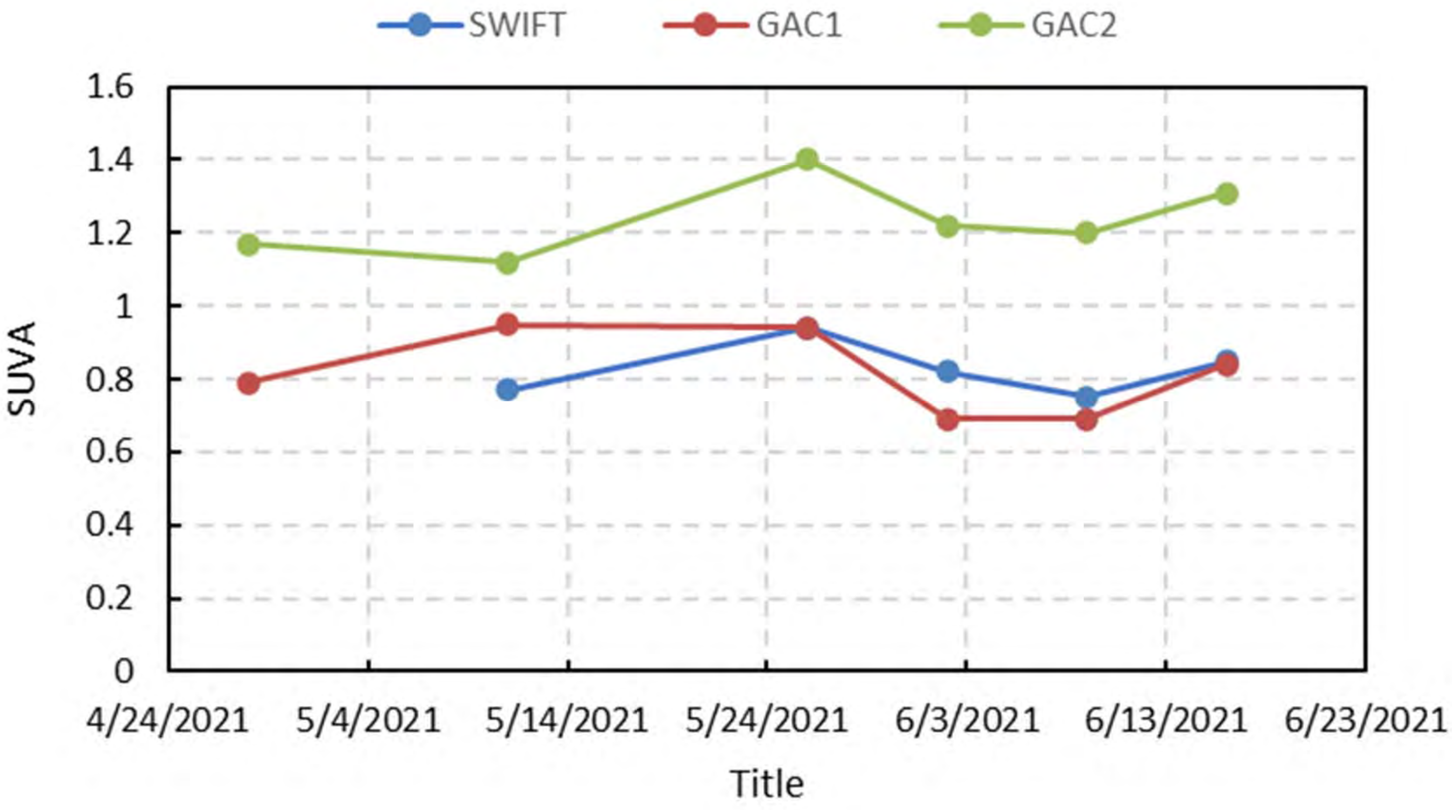


UV Treatment → SWIFT

Variation in TOC in GAC1, GAC2, and SWIFT

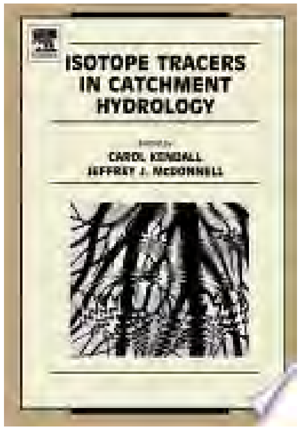


Variation in SUVA in GAC1, GAC2, and SWIFT



Examination of Isotopic Ratios of Oxygen ($^{18}O/^{16}O$) and Hydrogen ($^{2}H/^{1}H$) in Water Molecules to Potentially Serve as a Groundwater Tracer

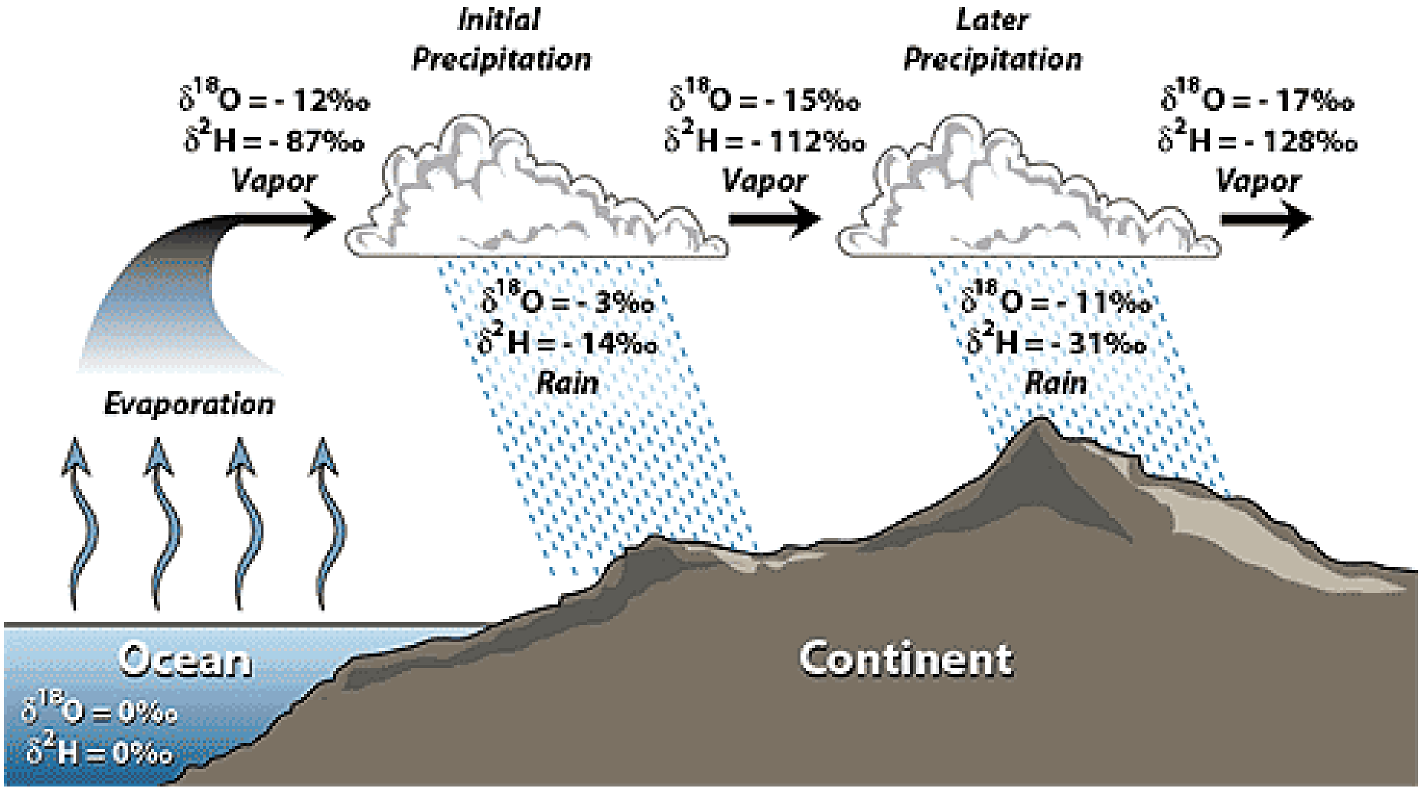
- A practice used in water resources engineering and hydrology to identify the origin (different flow paths) of water flowing through a watershed
- Isotope ratios of $^{18}O/^{16}O$ and $^{2}H/^{1}H$ in water can be measured.
- Can be used as a natural tracer where waters of different isotopic signature are mixed
- Essentially unaffected by geochemical reactions on short time scales



ISOTOPE TRACERS
IN CATCHMENT
HYDROLOGY

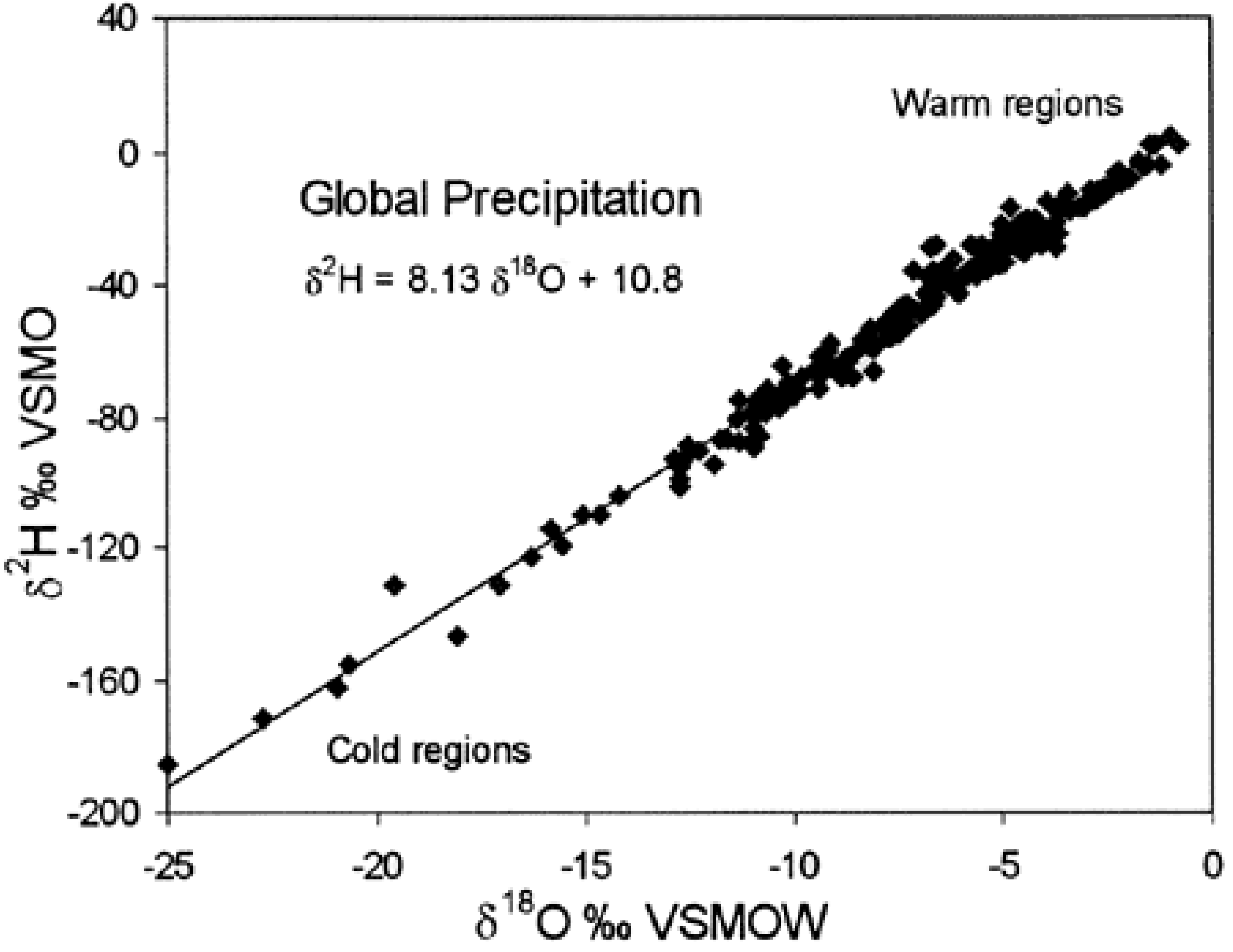
CAROL KENDALL
JEFFREY J. McDONNELL

Isotopic Fractionation in the Water Cycle



http://web.sahra.arizona.edu/programs/isotopes/oxygen.html

Global Precipitation Isotopic Relationship of H and O in Water



Calculation of Isotope Ratio (for O)

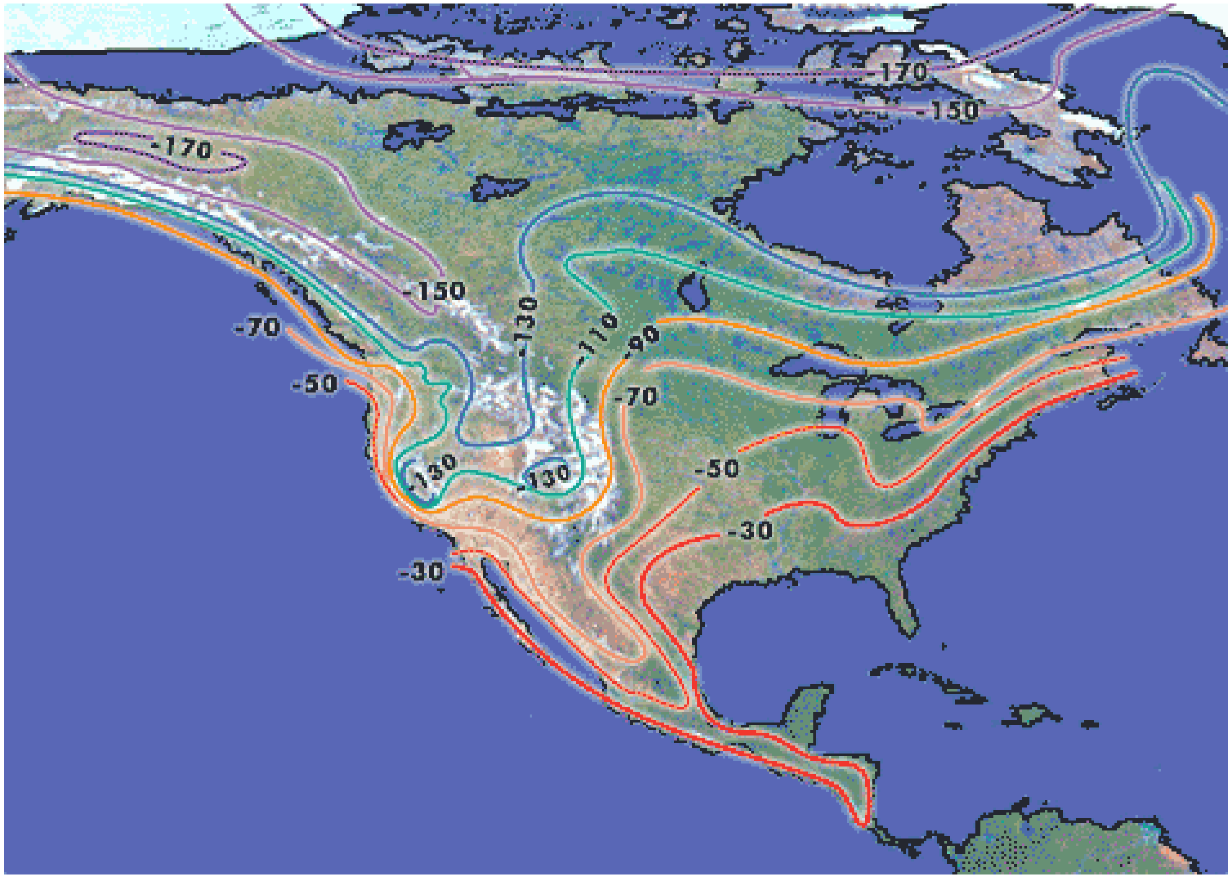
$$\delta^{18}\mathrm{O}\ \text{(in o/oo)} = \left[\frac{(^{18}\mathrm{O}/^{16}\mathrm{O})_{\mathrm{Sample}}}{(^{18}\mathrm{O}/^{16}\mathrm{O})_{\mathrm{Standard}}} - 1\right]1000.$$

Determination of SWIFT Water in the Potomac Aquifer

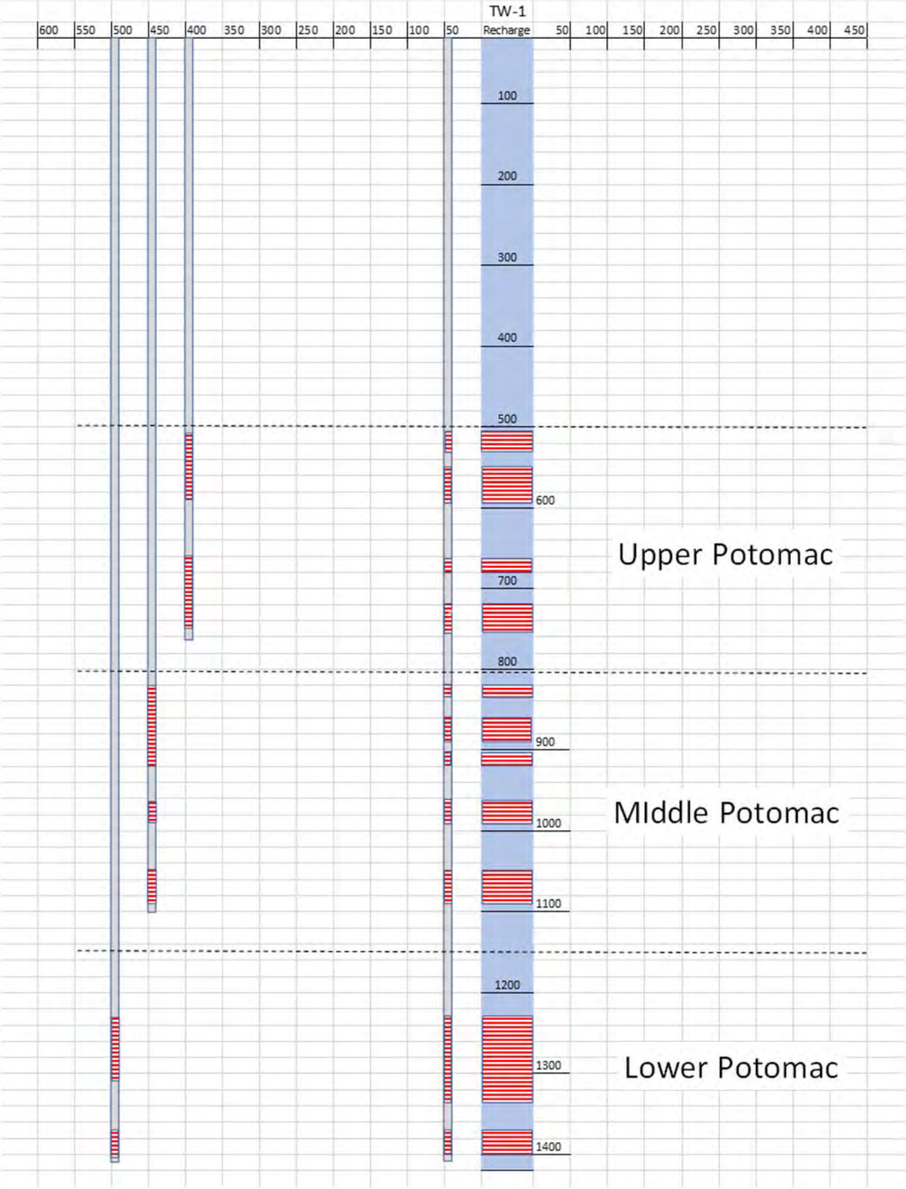
$$\text{Percentage of SWIFT water In the aquifer} = \left[\frac{\delta^{18}O_{\text{Native aquifer}} - \delta^{18}O_{\text{Sample}}}{\delta^{18}O_{\text{Native aquifer}} - \delta^{18}O_{\text{SWIFT}}}\right]100$$

δ^{1}

Average δ ^{2}H of Precipitation in North America.

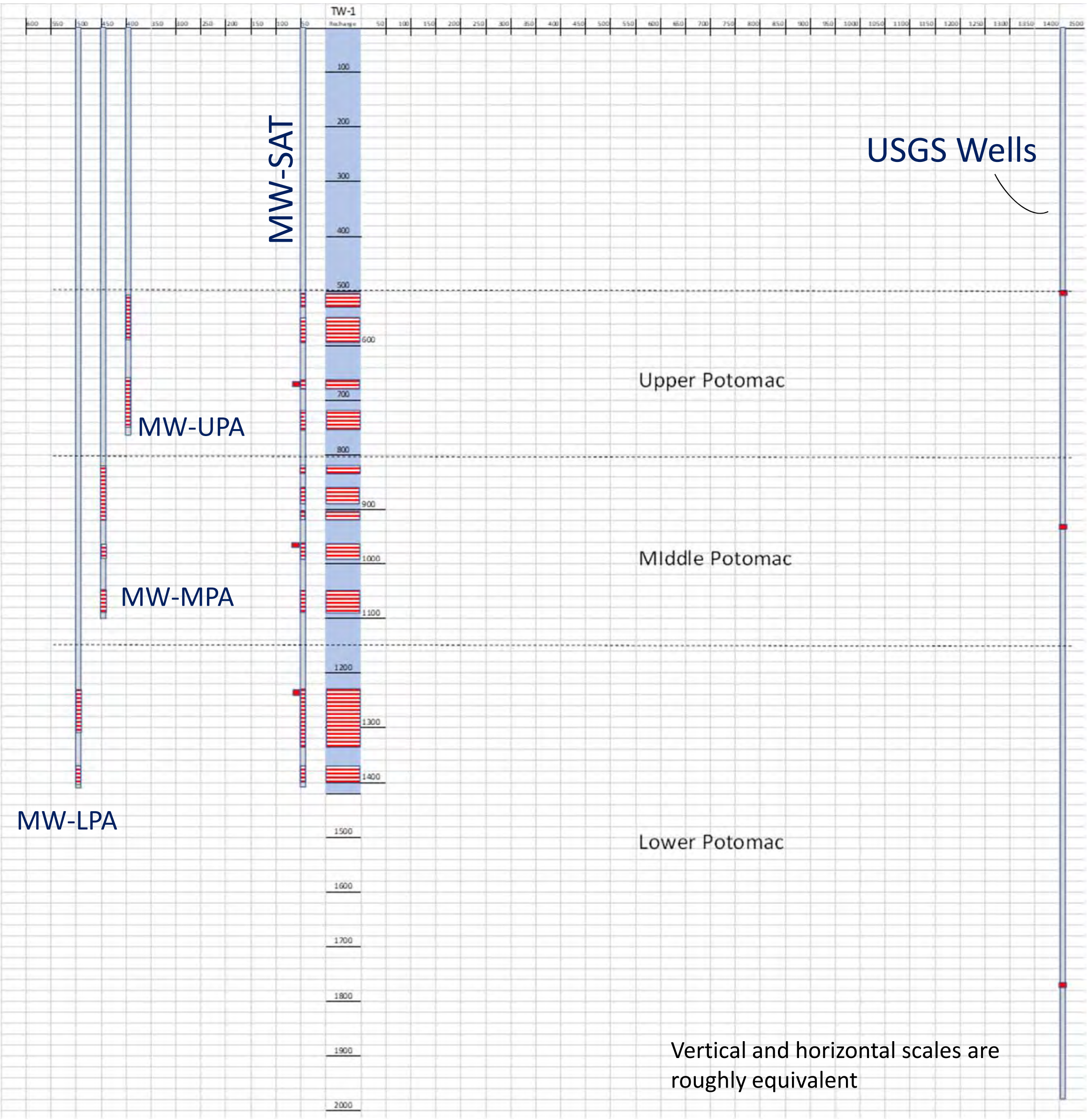


http://web.sahra.arizona.edu/programs/isotopes/oxygen.html



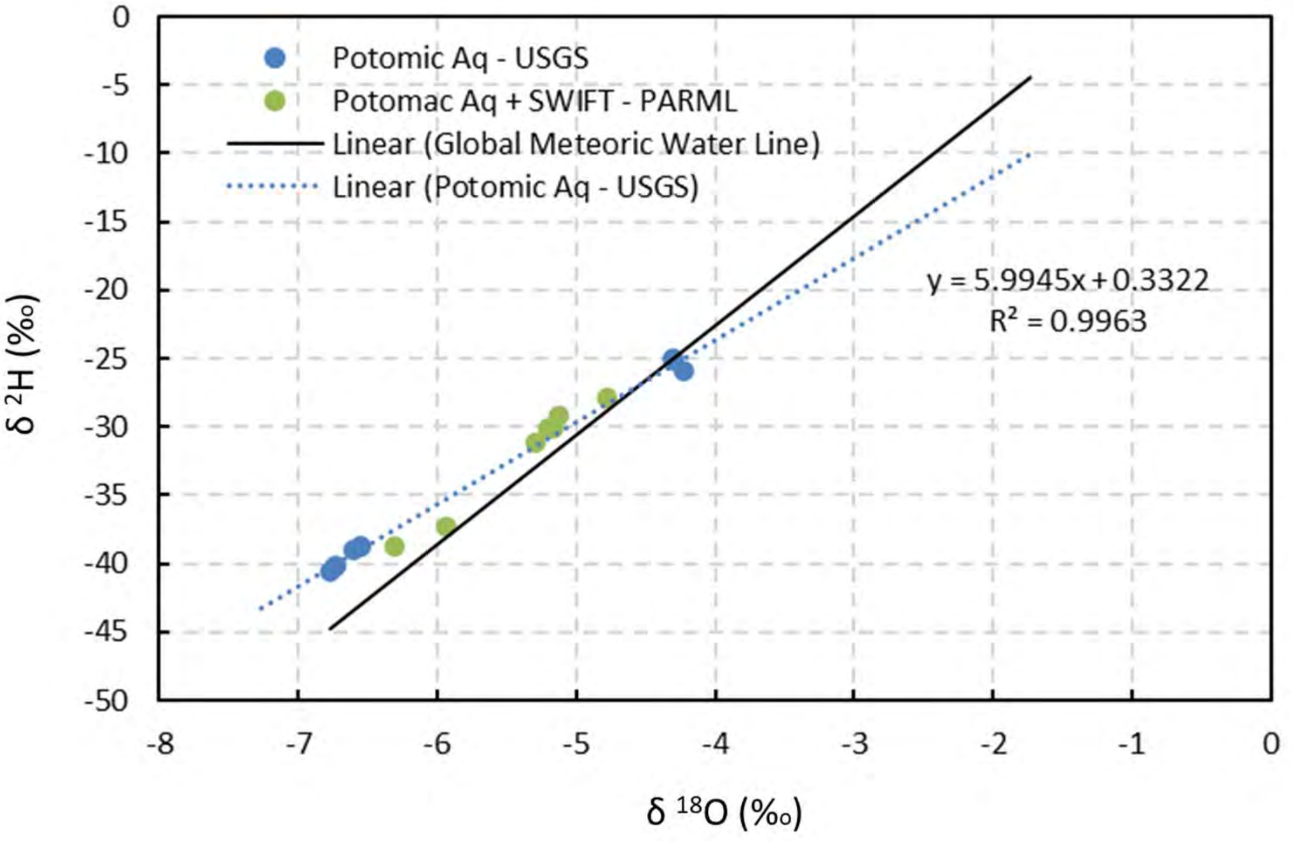
SWIFT Research Center Recharge and Monitoring Wells

Recharge and Monitoring Wells at the SWIFT Research Center and USGS Wells

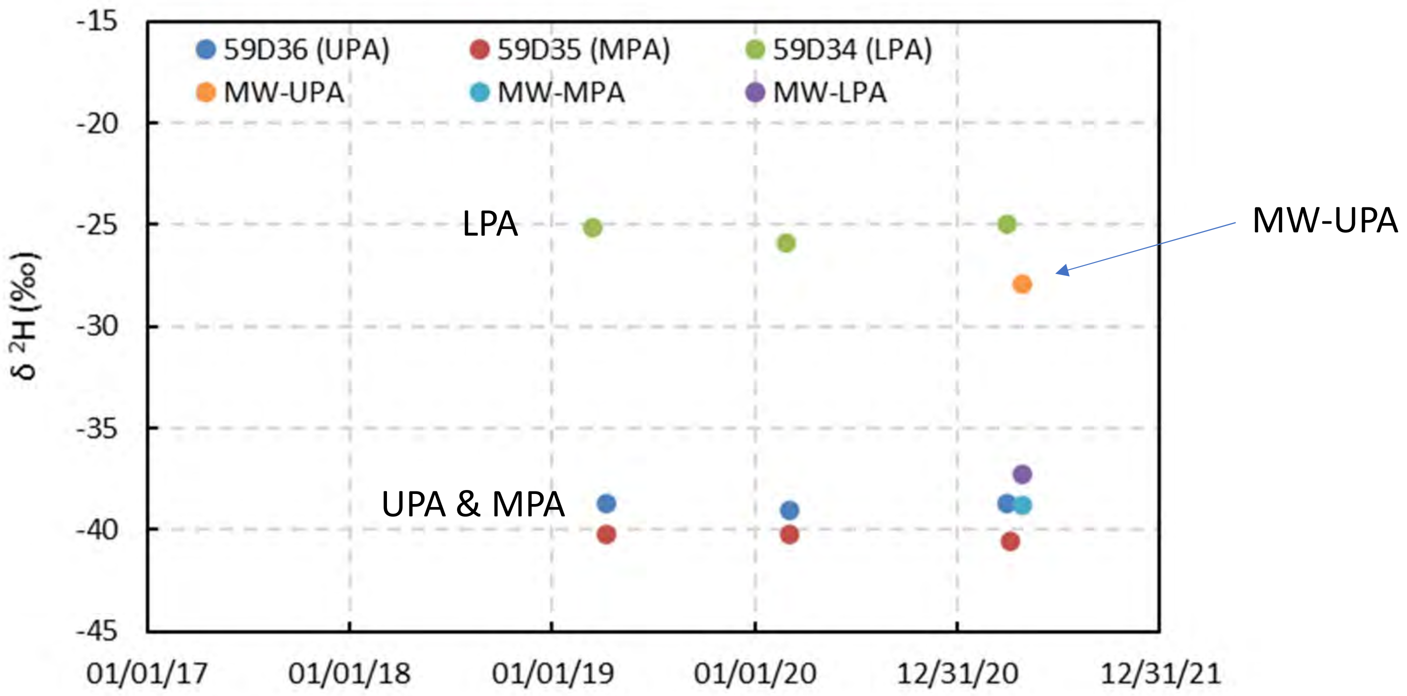


Vertical and horizontal scales are roughly equivalent

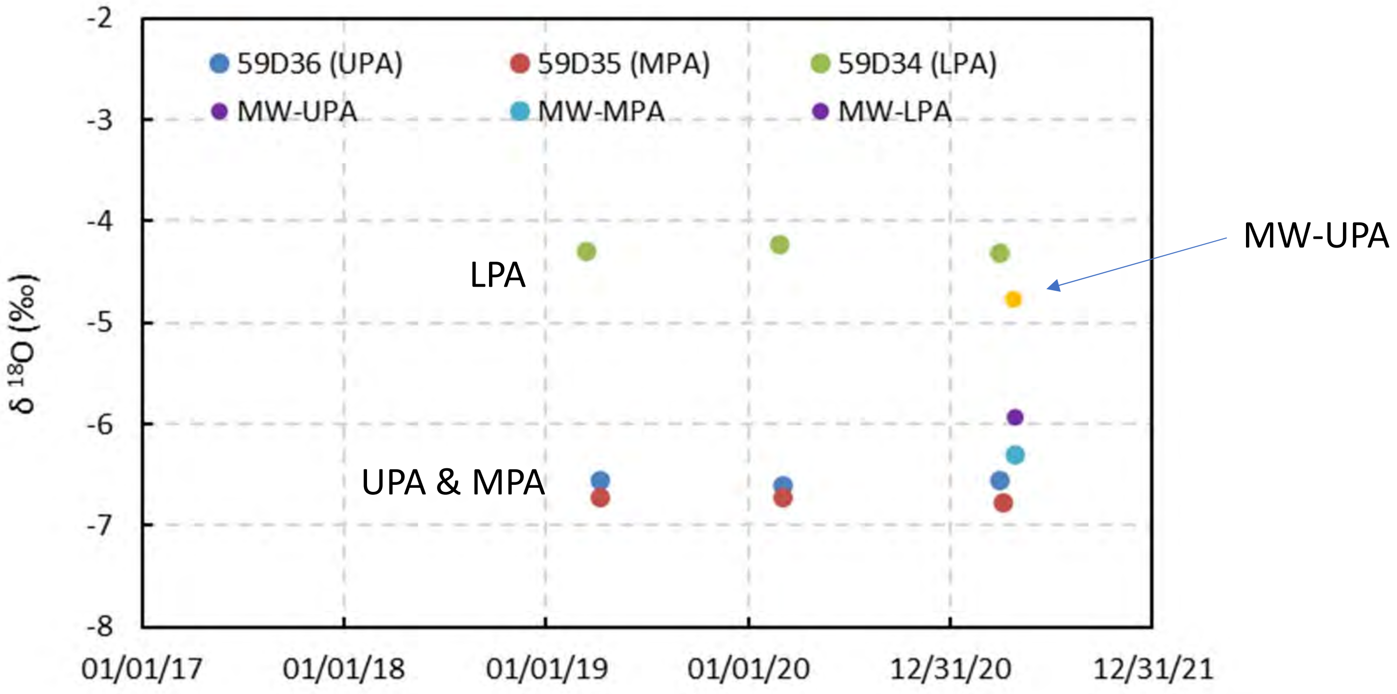
Measured Isotopic Ratios of Water in the Potomac Aquifer

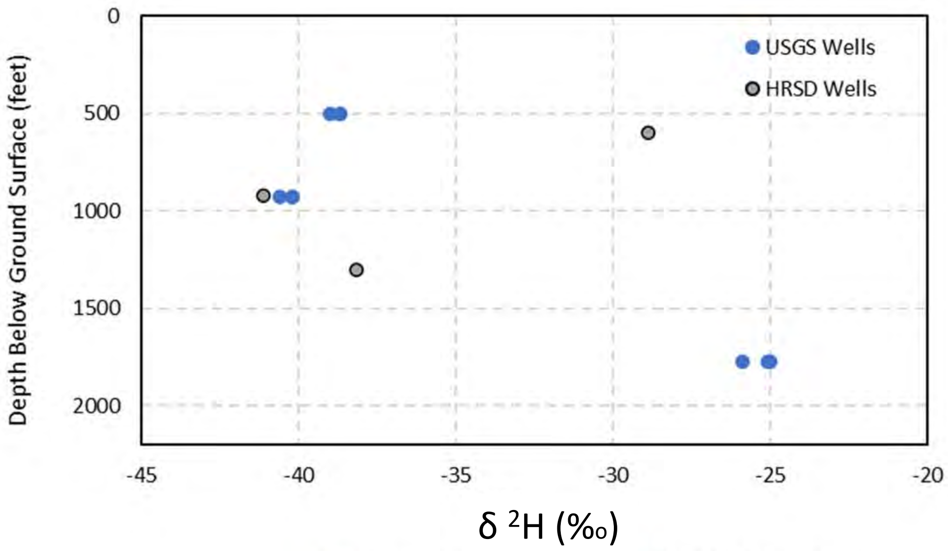


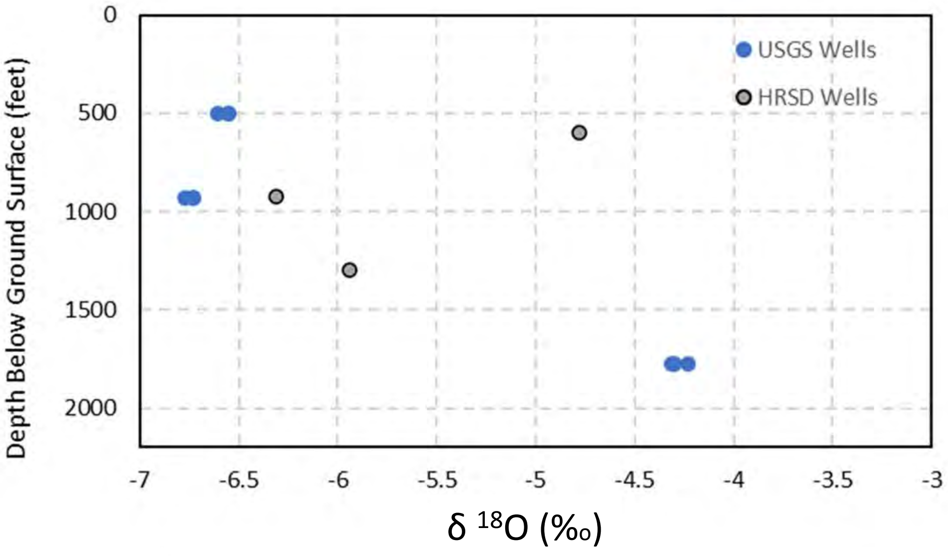
δ ^{2}H Measurements in Potomac Aquifer > 350 feet from Recharge Well

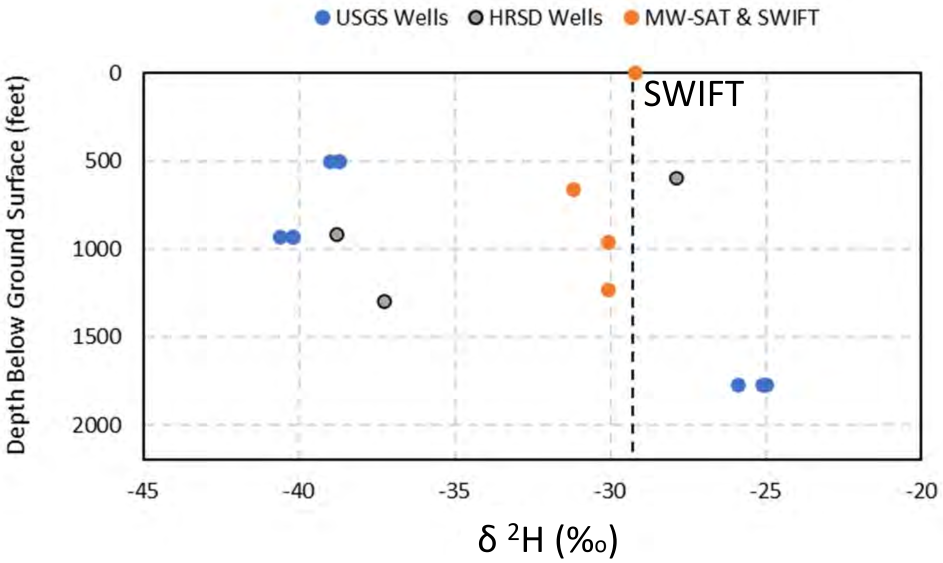


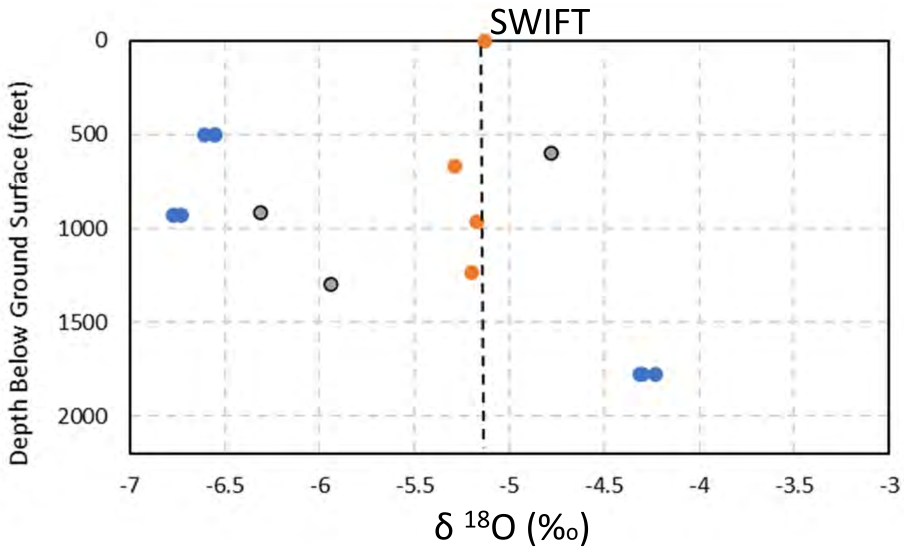
δ ^{18}O Measurements in Potomac Aquifer > 350 Feet from Recharge Well




USGS Wells
HRSD Wells
Depth Below Ground Surface (feet)
0
500
1000
1500
2000
-45
-40
-35
-30
-25
-20
δ ²H (‰)


USGS Wells
HRSD Wells
Depth Below Ground Surface (feet)
0
500
1000
1500
2000
-7
-6.5
-6
-5.5
-5
-4.5
-4
-3.5
-3
δ ¹⁸O (‰)


USGS Wells
HRSD Wells
MW-SAT & SWIFT
SWIFT
Depth Below Ground Surface (feet)
0
500
1000
1500
2000
-45
-40
-35
-30
-25
-20
δ ²H (‰)


SWIFT
Depth Below Ground Surface (feet)
0
500
1000
1500
2000
-7
-6.5
-6
-5.5
-5
-4.5
-4
-3.5
-3
δ ¹⁸O (‰)

Isotopic Ratio Analysis Summary

- Effort/evaluation is continuing
- Appears to be a potential tool to assess the movement and mixing of SWIFT water with aquifer water

PFAS Research Briefing

swift
Sustainable
Water Initiative
for Tomorrow

Potomac Aquifer Recharge Oversight Committee

Presented by Dana Gonzalez, PhD| HRSD

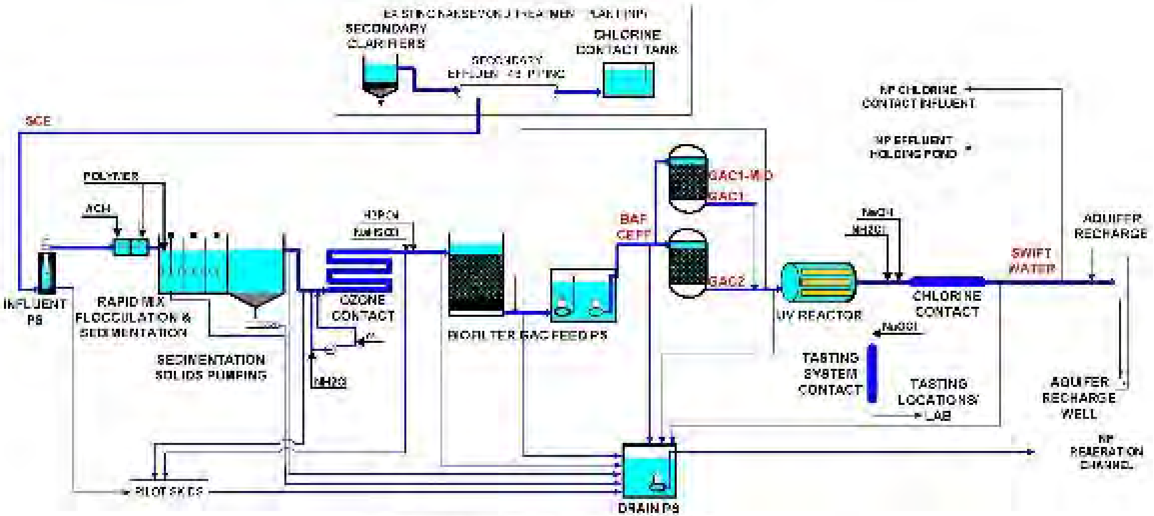
June 30, 2021

PFAS Dynamics at SWIFT

- Collaboration with SNWA as part of WRF Grant 4913 (Investigation of Treatment Alternatives for Short-Chain Poly and Perfluoroalkyl Substances)
- Main goals:
  - Assess removal of PFAS across GAC contactors over the course of the study
  - Compare PFAS removal to performance-based metrics like TOC, iohexol, and sucralose

Sample Points

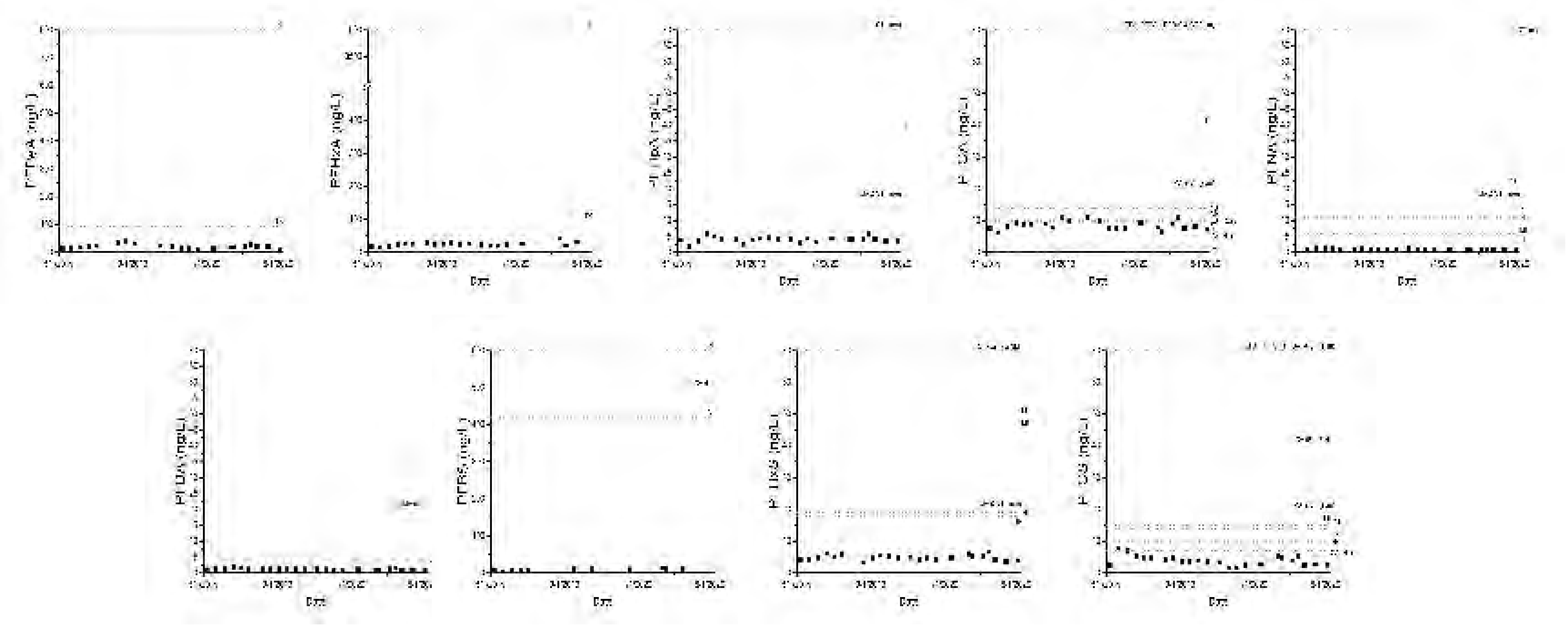
- Fresh GAC installed in spring 2019
  - May to Aug 2019: duty stand-by
  - Aug 2019 to May 2020: parallel with flow split to target 4 mg/L TOC in effluent
- Sampled 2X per month for 12 months
- 27 PFAS compounds analyzed by SNWA, only 11 seen regularly



SWIFT RESEARCH CENTER PROCESS FLOW DIAGRAM

PFBA	**PFBS**	**PFDA**	4:2 FTSA	5:3 FTCA	N-EtFOSAA	ADONA
PFPeA	**6:2 FTSA**	**PFHxS**	8:2 FTSA	6:2 FTAB	N-MeFOSAA	Gen X
PFHxA	**PFOA**	**PFOS**	6:2 FTUCA	FBSA	PFO2HxA	F-53B
PFHpA	**PFNA**	FOSA	8:2 FTUCA	FHxSA	PFO3OA	

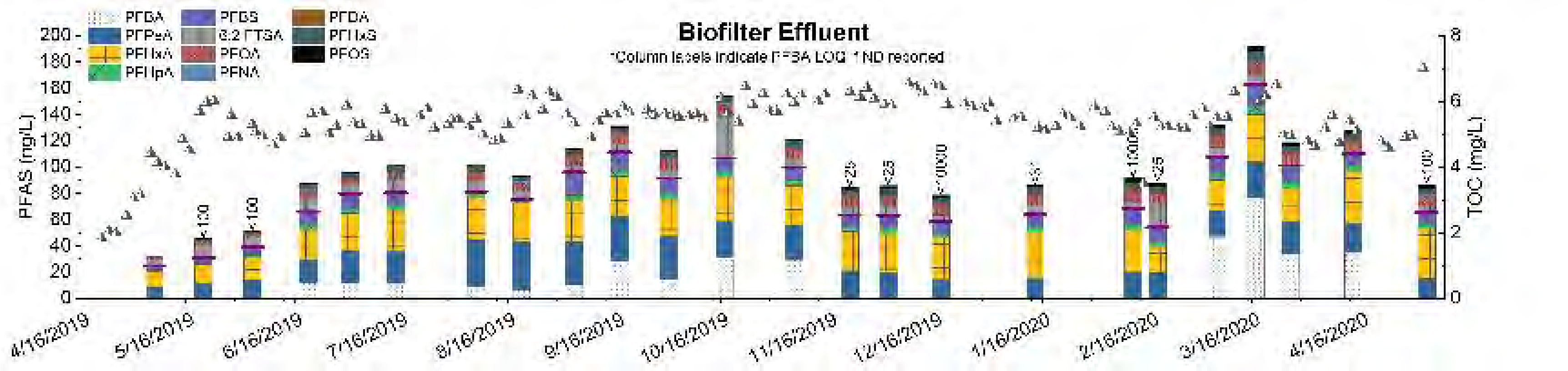
SCE going into SWIFT meets many of the most stringent US drinking water limits prior to advanced treatment



Source Control and SCE Quality

- Few industrial PFAS sources in NP service area
- Long chain PFAA relatively constant and low over time – 15-20 ppt
- 6:2 FTSA: ND – 40 ppt
- Short chain typically less than 50-60 ppt

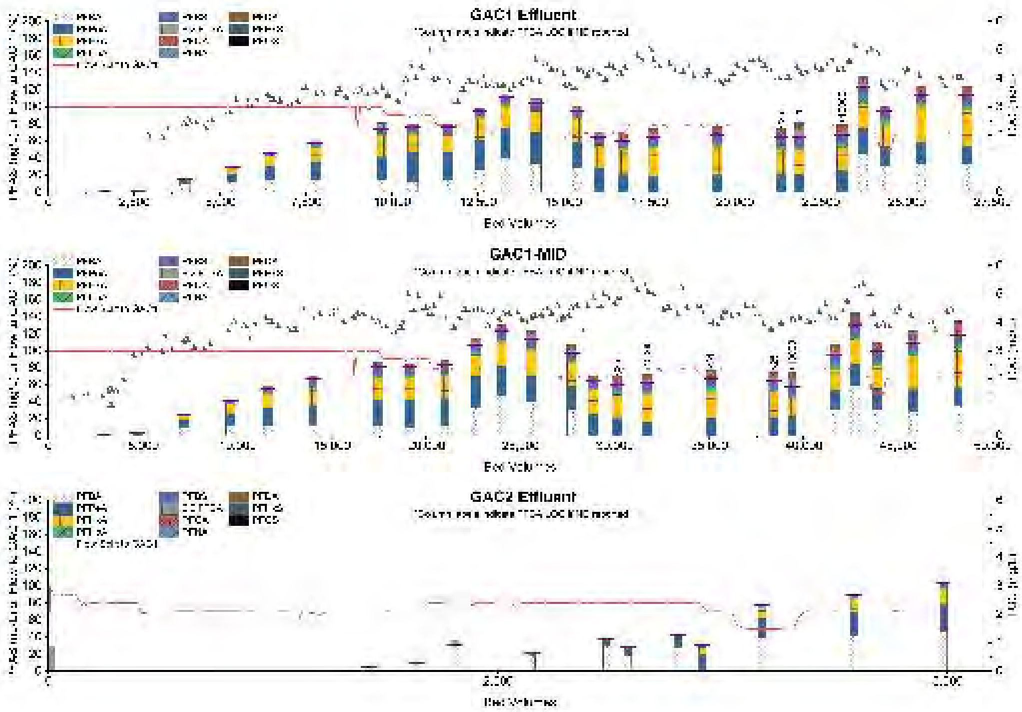
PFAS in Biofilter Effluent



- Initial decrease in PFAS until June—virgin carbon in BAF
- Some increases in BAF effluent when compared to SCE
  - Precursor breakdown
  - Short-chain competitive desorption

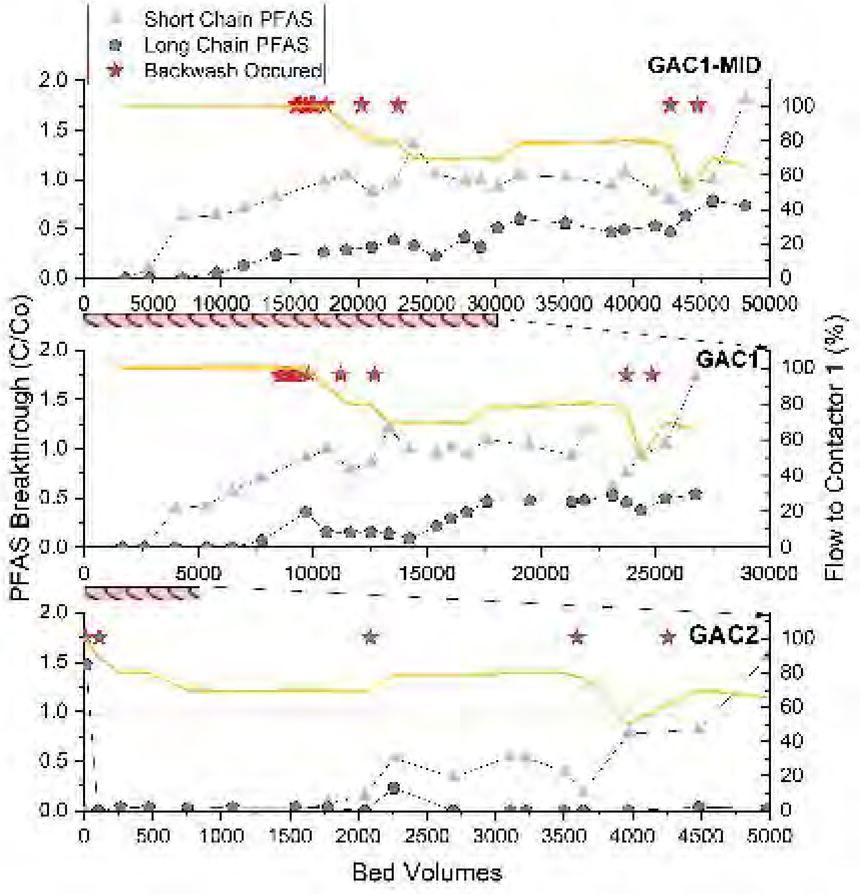
PFAS, TOC, and Flow Splits for GAC1, GAC1-MID, GAC2

- Complete removal of PFAS initially
- Short-chains only from ~4000 BVs until ~8000-9000 BVs in GAC1 & GAC1-MID
- Short chains only seen in GAC2 until end of study ~5000 BVs



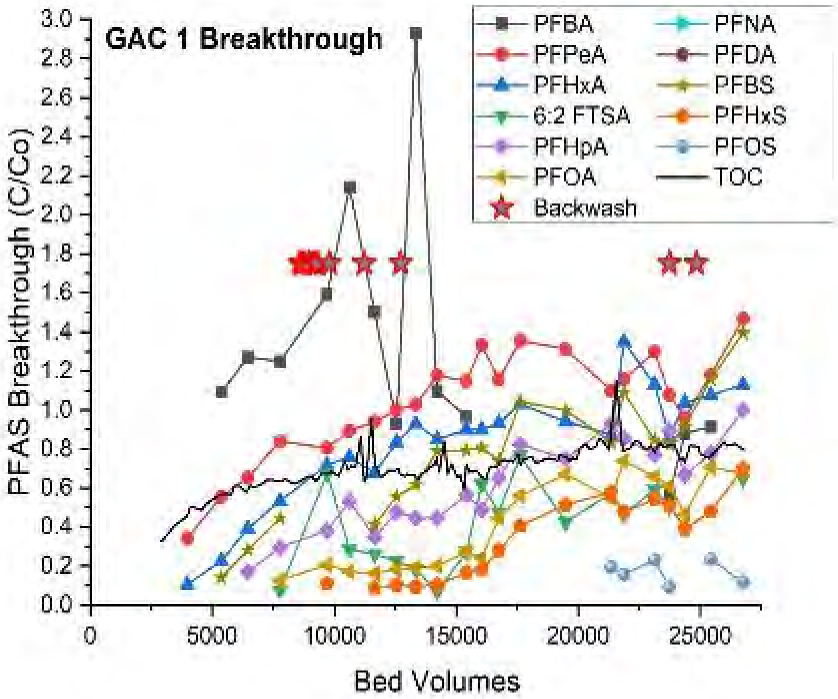
PFAS Breakthrough at three GAC Sample Points

- Even after over 45,000 BVs at GAC1-MID, there was still removal of long chain PFAS
- Variable breakthrough of short chain PFAS in contactor 1 & 2
  - Different influent PFAS concentrations over time (BAF initially removed PFAS when GAC1 first online)
  - Flow splitting used to target 4 mg/L TOC in effluent
  - Longitudinal mixing from backwashing

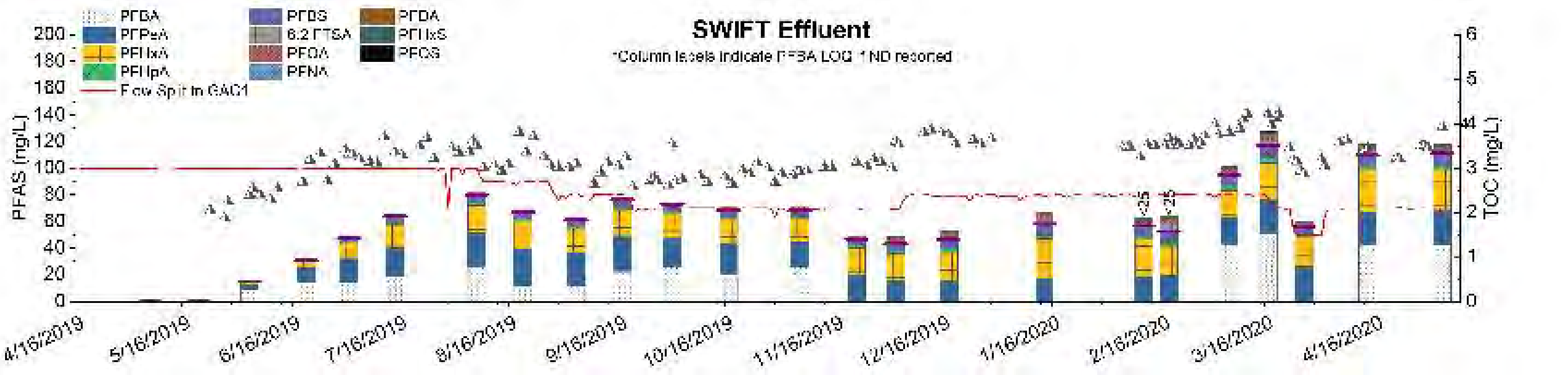


Breakthrough of PFAS in GAC1 Effluent

- Breakthrough in-line with other published studies (especially when TOC considered)
- Complete breakthrough of long-chain PFAS not seen
  - PFOA C/Co = 0.74 (Avg In: 7.29 ± 2.20 ng/L)
  - PFHxS C/Co = 0.58 (Avg In: 3.36 ± 1.18 ng/L)
- Short-chain breakthrough
  - PFBA: 5,000 BVs
  - PFPeA: 12,000 BVs
  - PFHxA & PFBS: 17,000 BVs
  - PFHpA: 26,000 BVs



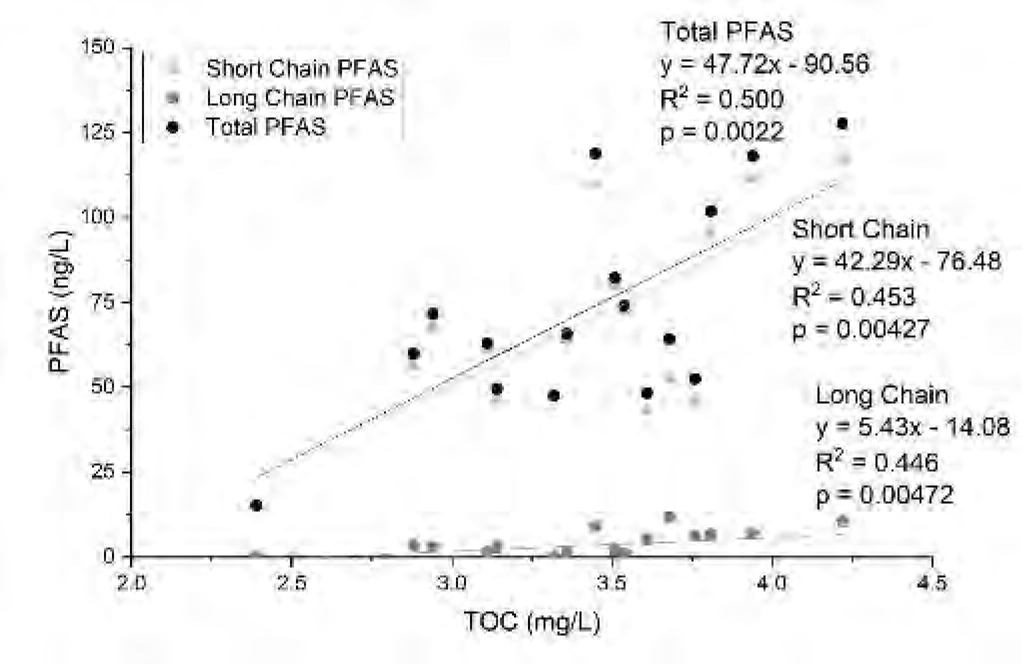
SWIFT Water PFAS and TOC



- $\sum_{\text{Long chain PFAA}} < 8$ ppt
- $\sum_{\text{Short chain}}$ max in mid March of 120 ppt, otherwise $\sum_{\text{Short chain}}$ <100 ppt prior to leachate increase
- Proper response after leachate increase mid-March
- How effective is TOC at predicting PFAS?

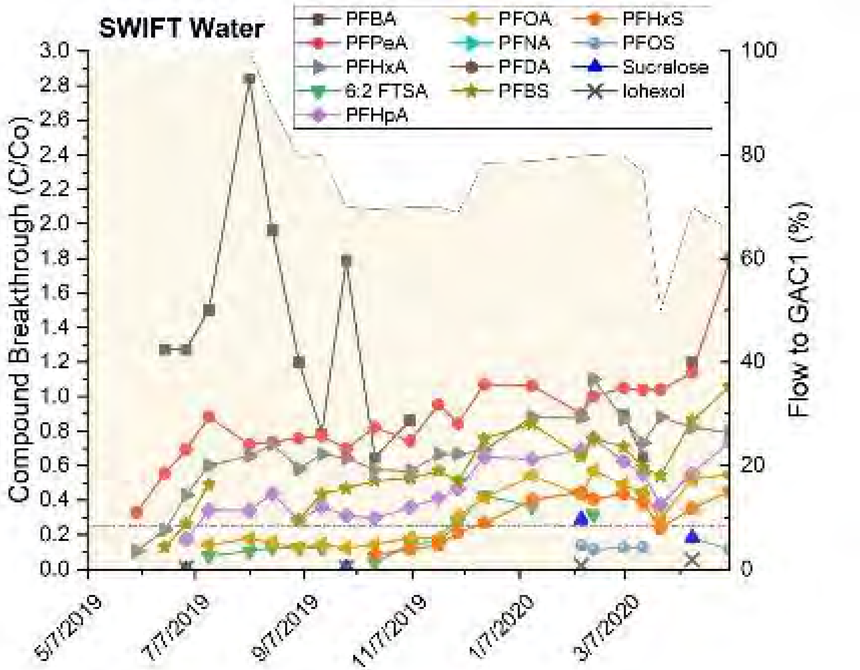
TOC is a good indicator of PFAS

- Fairly good correlation between TOC in SWIFT effluent and all PFAS (total, short, long)
- Online critical control points at SWIFT
- Monthly average/ max any sample based on laboratory TOC data



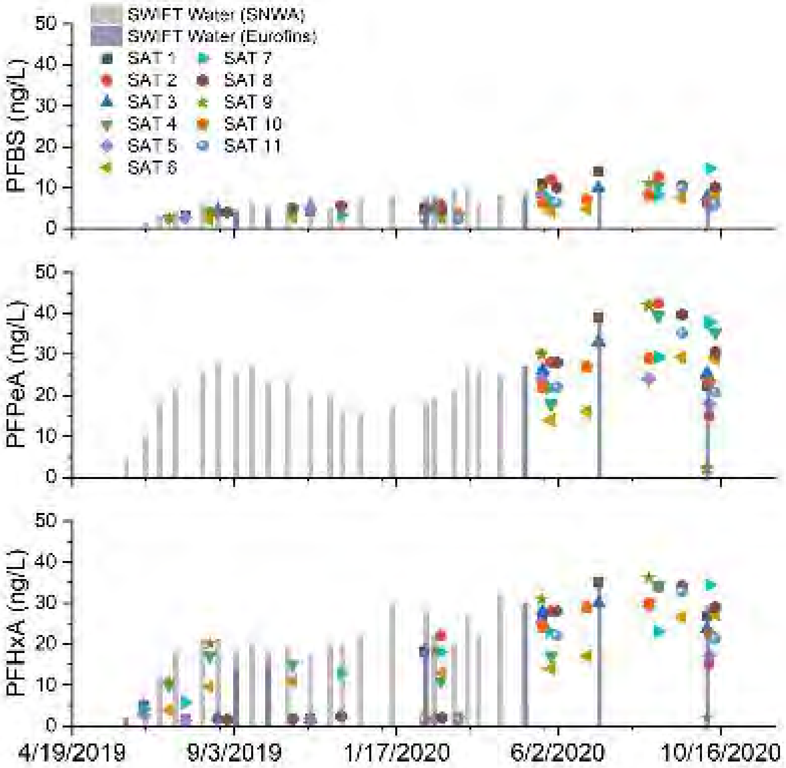
SWIFT Water PFAS Content and Indicator Compounds

- Always met all state guidelines for PFOS
- PFOA met all except most stringent Illinois HAL of 2 ppt (first exceeded on 12/3/2019 and ranged between 2.6 and 4.9 ppt afterwards)
- Recommended that carbon be replaced when pass-through of sucralose and iohexol >25%
  - Max sucralose pass-through: 29%
  - Max iohexol pass-through: 5%



Short Chain PFAS

- SAT Well (~2 week travel time)
- Movement of short chain PFAS through Potomac Aquifer is not surprising
  - Low organic carbon content in Potomac Aquifer
  - Short chain PFAS known to move faster than long chains
- Most stringent US limits
  - PFBS: 420 (MI DW)
  - PFPeA: 93 ppt (TX GW)
  - PFHxA: 93 ppt (TX GW), 400,000 ppt (MI DW)



Conclusions

- Treatment technology will continue to develop, but PFAS are difficult
- Control of concentrated sources has been an important part of HRSD's approach to PFAS
- TOC is a promising real-time indicator for PFAS in reuse effluent

swift
Sustainable
Water Initiative
for Tomorrow

TW-1 and NP_MAR_01 Update
Potomac Aquifer Recharge Oversight Committee

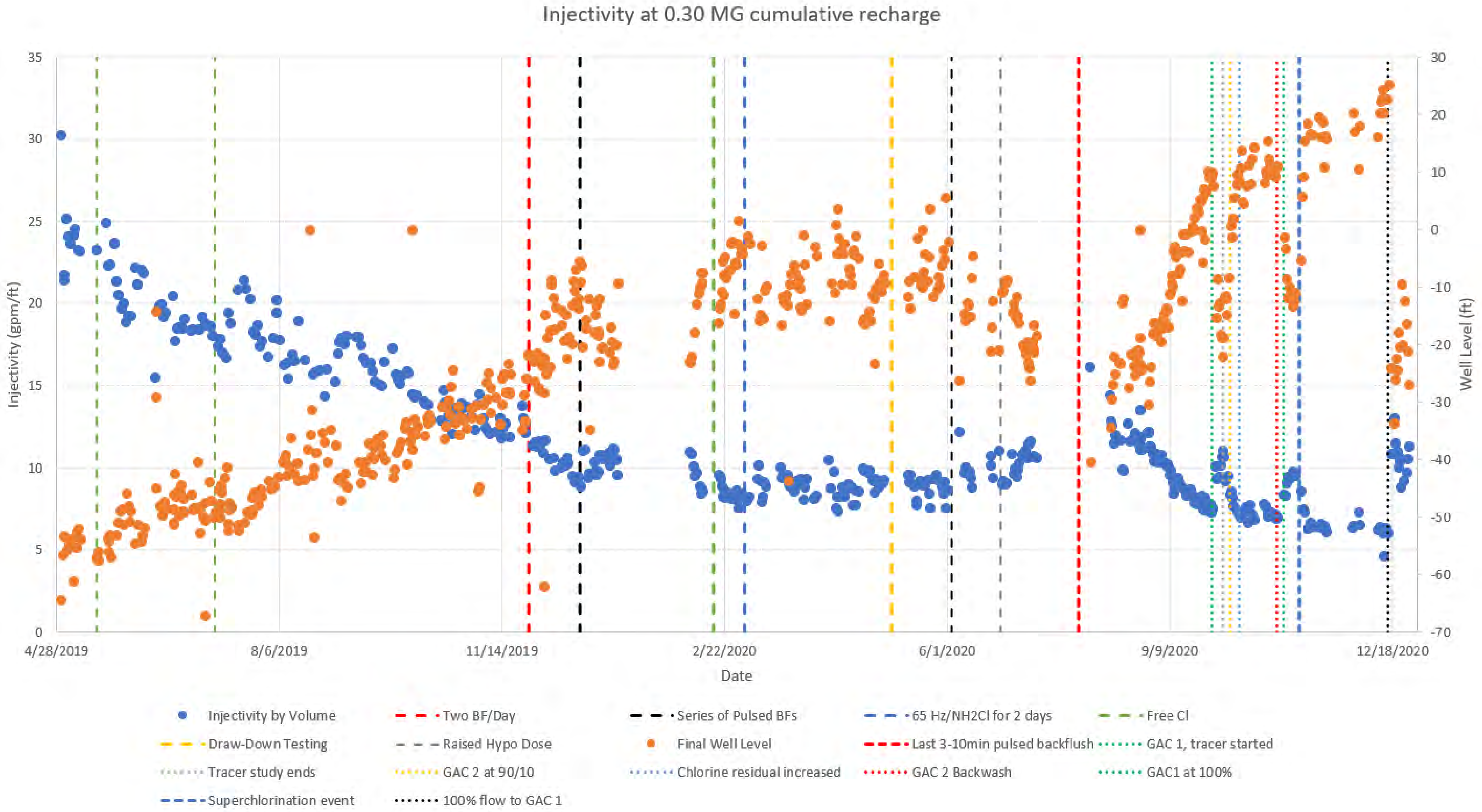
HRSD

June 2021

Agenda

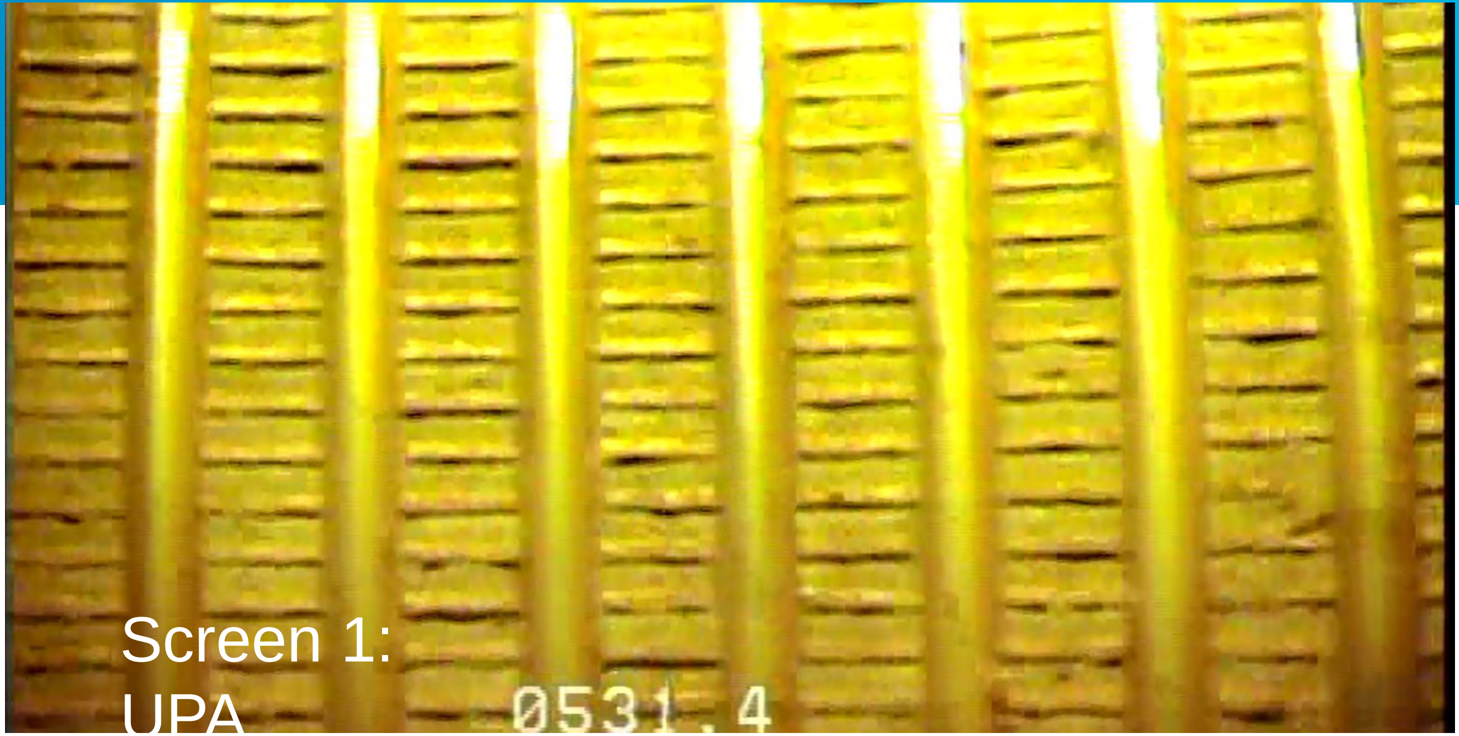
- TW-1 rehabilitation
- Update on NP_MAR_01

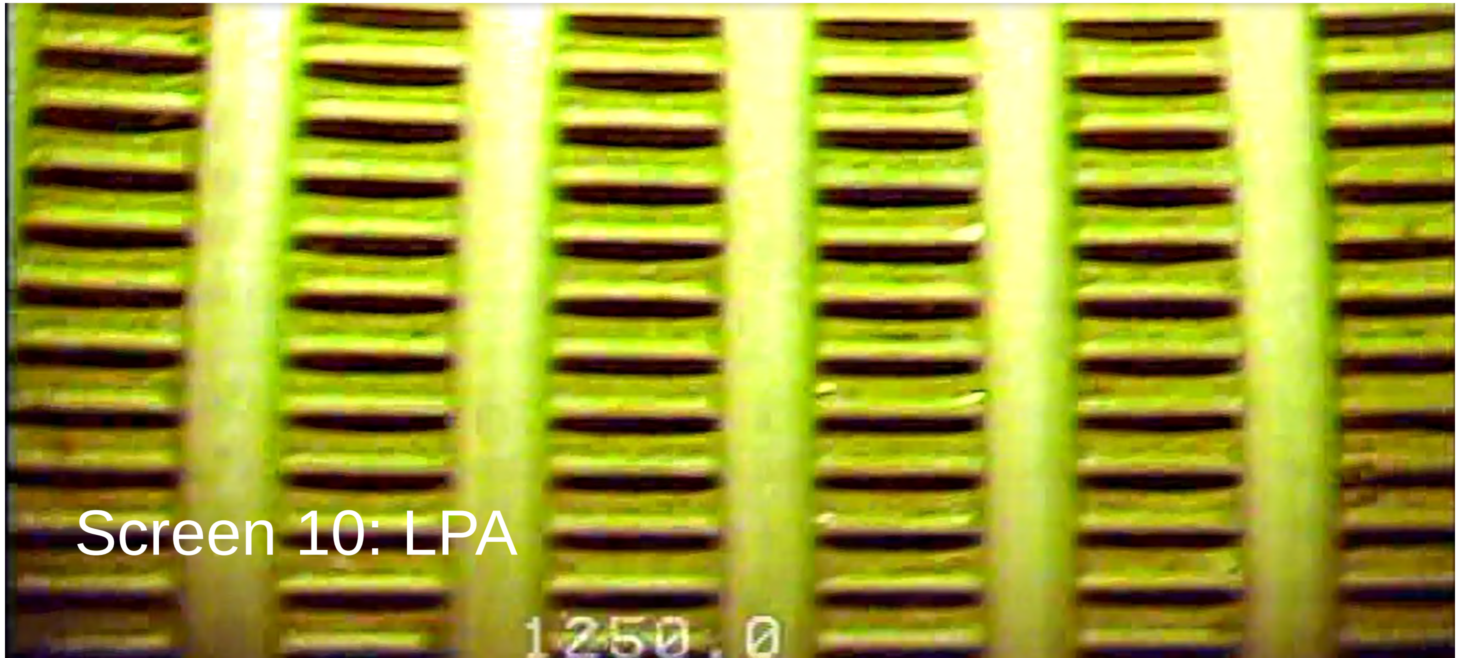
TW-1 Injectivity and Recharge Well Water Level


Injectivity at 0.30 MG cumulative recharge

Pre-Rehab Video Log at TW-1

- Screen(s) exhibit clogging by siltation with fine- grained material filling screen slots.
- No visual evidence of biofilm or mineral incrustation appears on screen faces.
- Shallower screens show greater clogging than deeper screens
- Overall, clogging not as severe as observed in video log from December 2018.
- Bottom of TW-1, contained 28 feet of sand accumulation compared to 83 feet in December 2018


Screen 1: UPA


Screen 10: LPA

Biofilm/Incrustation Clogging in Well Screening Potomac Aquifer (middle zone) SE VA

- **NOT TW-1**
- Video run after brushing screens.
- Although not a photogenic as text-book examples, photo shows amorphous mineral growth over fibrous iron oxide slime.
- Slide intends to show biofilm and incrustation morphology in local wells screening Potomac Aquifer

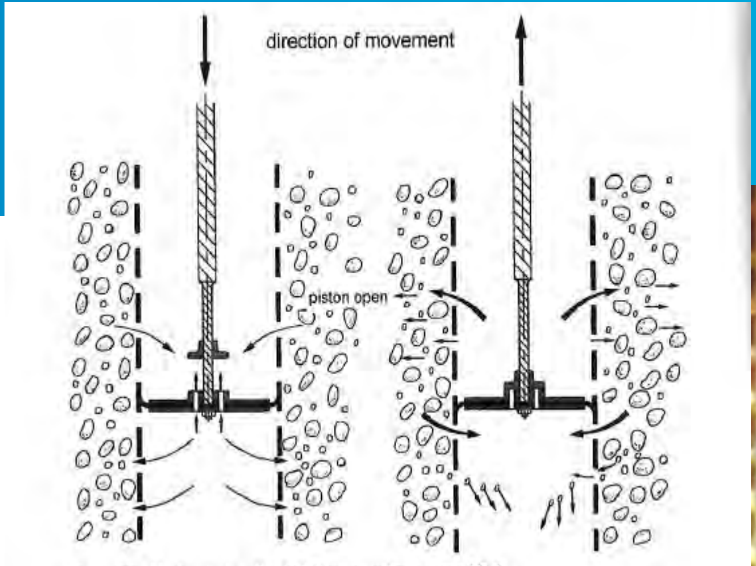
Percent of Screen Slots Clogged Based on Visual Analysis of Video Survey

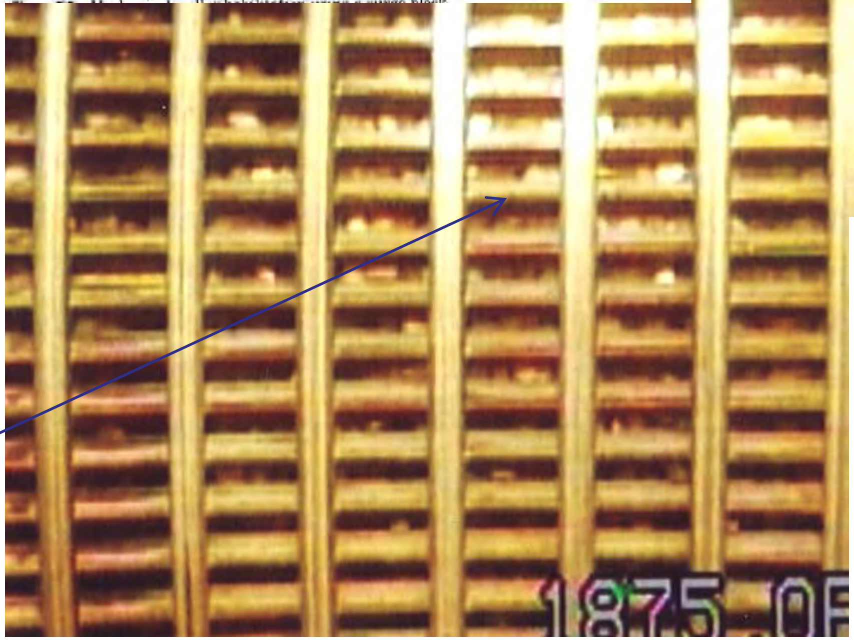
- Screens are between 15 and 83 percent clogged.
- Screens in UPA significantly more clogged than the MPA and LPA.
- Injectivity @ 8 gpm/ft now 1/3 of original value.
- From the perspective of transmissivity, clogging the screens set against the UPA drops the transmissivity by 2/3.

Depth (fbg)	Screen	Aquifer Zone	Visual average clogged for screen (%)
508 to 531	1	UPA	51
555 to 595	2		27
677 to 685	3		83
725 to 756	4		36
822 to 835	5	MPA	17
861 to 885	6		15
906 to 920	7		18
965 to 989	8		18
1050 to 1090	9		23
1230 to 1335	10	LPA	23
1375 to 1395	11		31

Rehab at TW-1

- Brush casing and screen
- Swabbing Pass #1
- Swabbing Pass #2 with chemical addition (acid/dispersant)
- Post swabbing video survey
- Over-pumping
- Post-rehab #2: Flowmeter and video surveys
- Re-swab & airlift Screen 4
- Airlift material 1,395 to 1,415 fbg
- Install new pump and shafting
- Backflush to raise pH
- Resume MAR operations
- Post rehab video of well screening Lower Zone of Potomac Aquifer





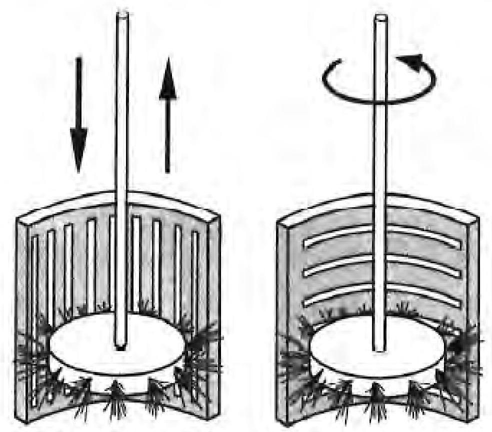


Figure 7.2 Brushing of wells with different screen slot arrangements. *Drawing: Schröder.*

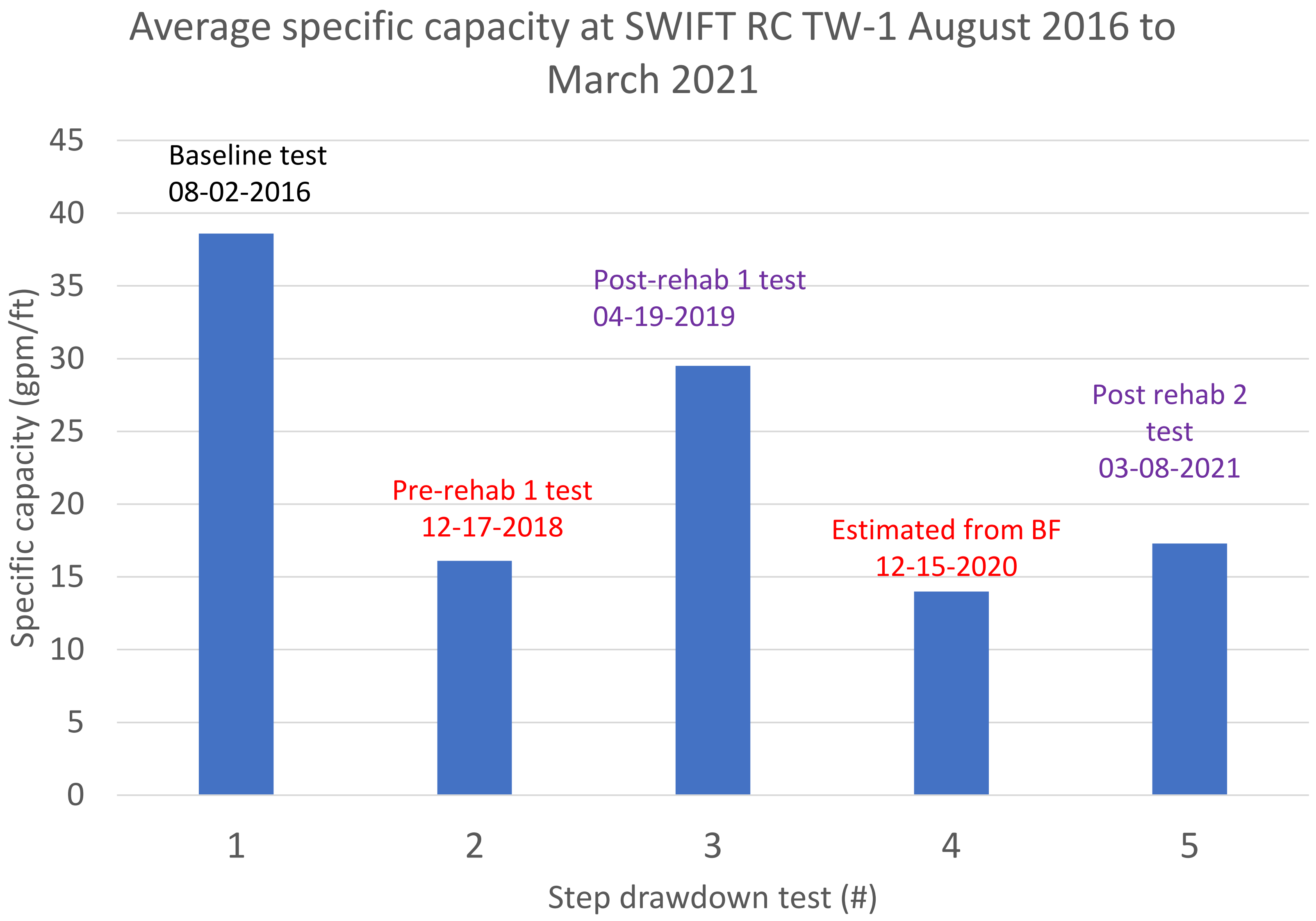
Post-Rehab video log at TW-1 - effectiveness

- With one exception, screen(s) cleaned up sufficiently to view filter pack behind slots.
- Screen 4 displayed significant zones of clogging that laterally spanned rods and vertically through slots
  - gray to red brown silt still clogs screen slots in Screen 4.
  - swabbing and airlift pumping Screen 4 again from 720 to 755 fbg.


Screen 9


Screen 4

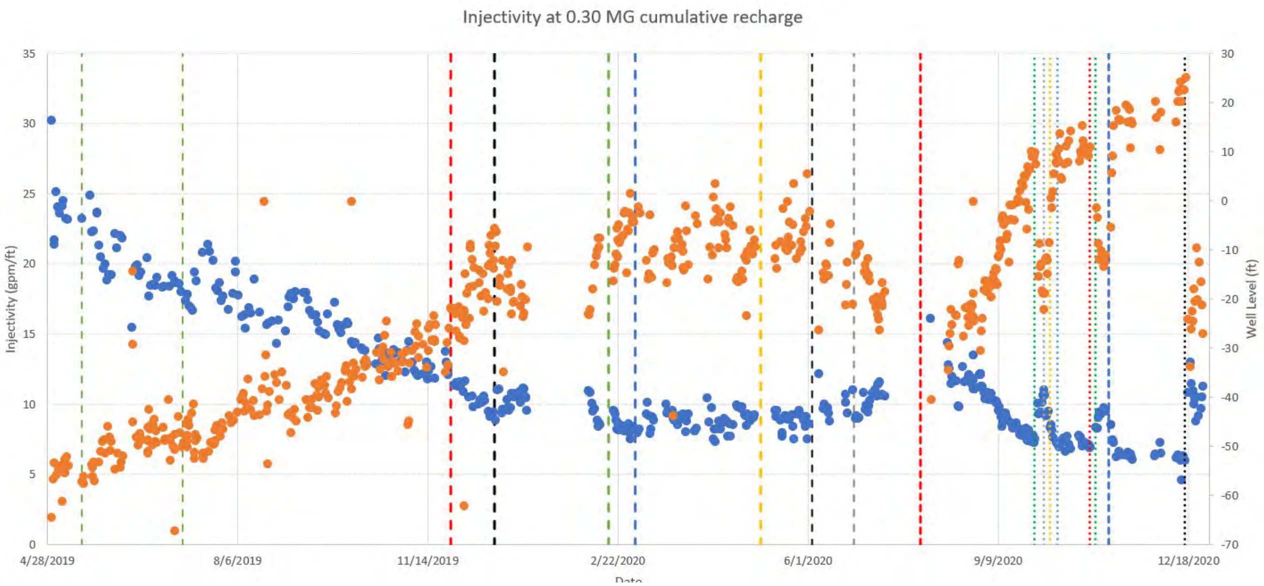
Comparing Average SC's from step tests at TW-1

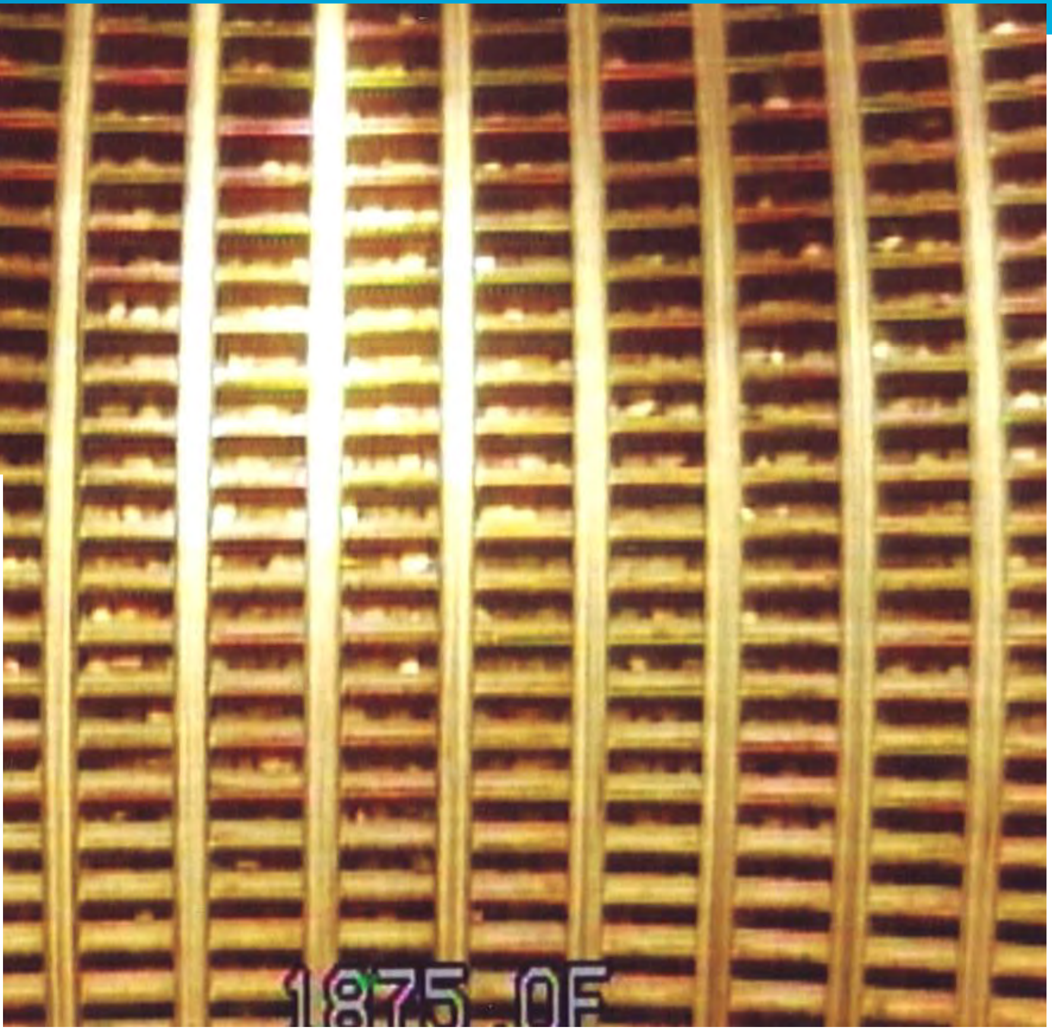


Sustainable
Water Initiative
for Tomorrow

TW-1 operations

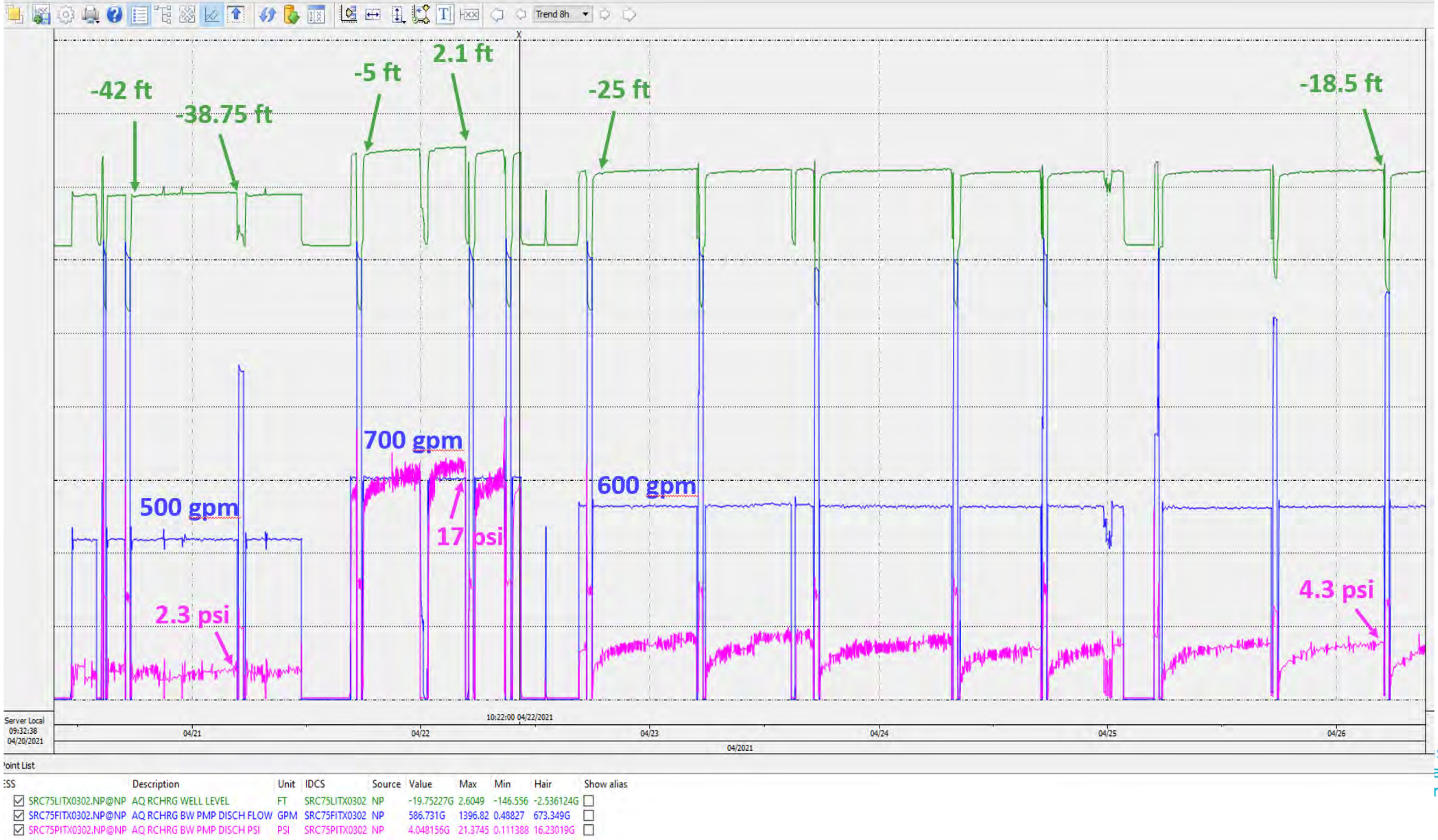
- Goal is to preserve capacity, NP_MAR_01 online end of 2021
- Operate at lower recharge rate @ TW-1~ 500 - 600 gpm.
- Backflush twice/day


Injectivity at 0.30 MG cumulative recharge



swift Sustainable Water Initiative for Tomorrow

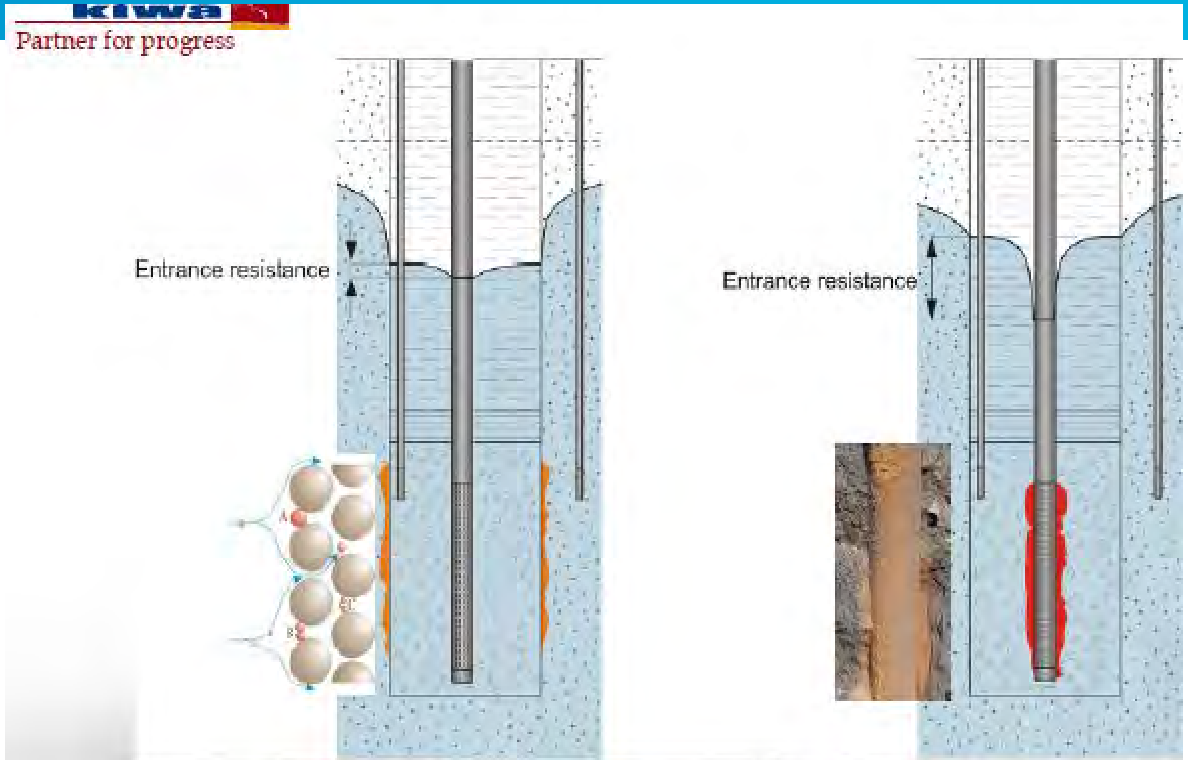
Post Rehabilitation Operations at TW-1

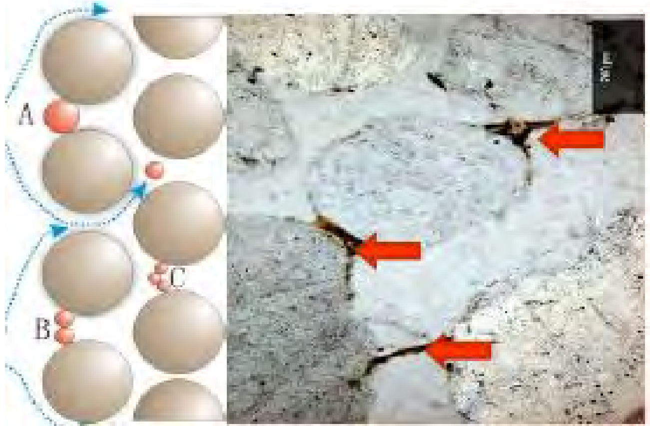


ESS	Description	Unit	IDCS	Source	Value	Max	Min	Hair	Show alias
☑ SRC75LITX0302.NP@NP	AQ RCHRG WELL LEVEL	FT	SRC75LITX0302	NP	-19.75227G	2.6049	-146.556	-2.536124G	☐
☑ SRC75FITX0302.NP@NP	AQ RCHRG BW PMP DISCH FLOW	GPM	SRC75FITX0302	NP	586.731G	1396.82	0.48827	673.349G	☐
☑ SRC75PITX0302.NP@NP	AQ RCHRG BW PMP DISCH PSI	PSI	SRC75PITX0302	NP	4.048156G	21.3745	0.111388	16.23019G	☐

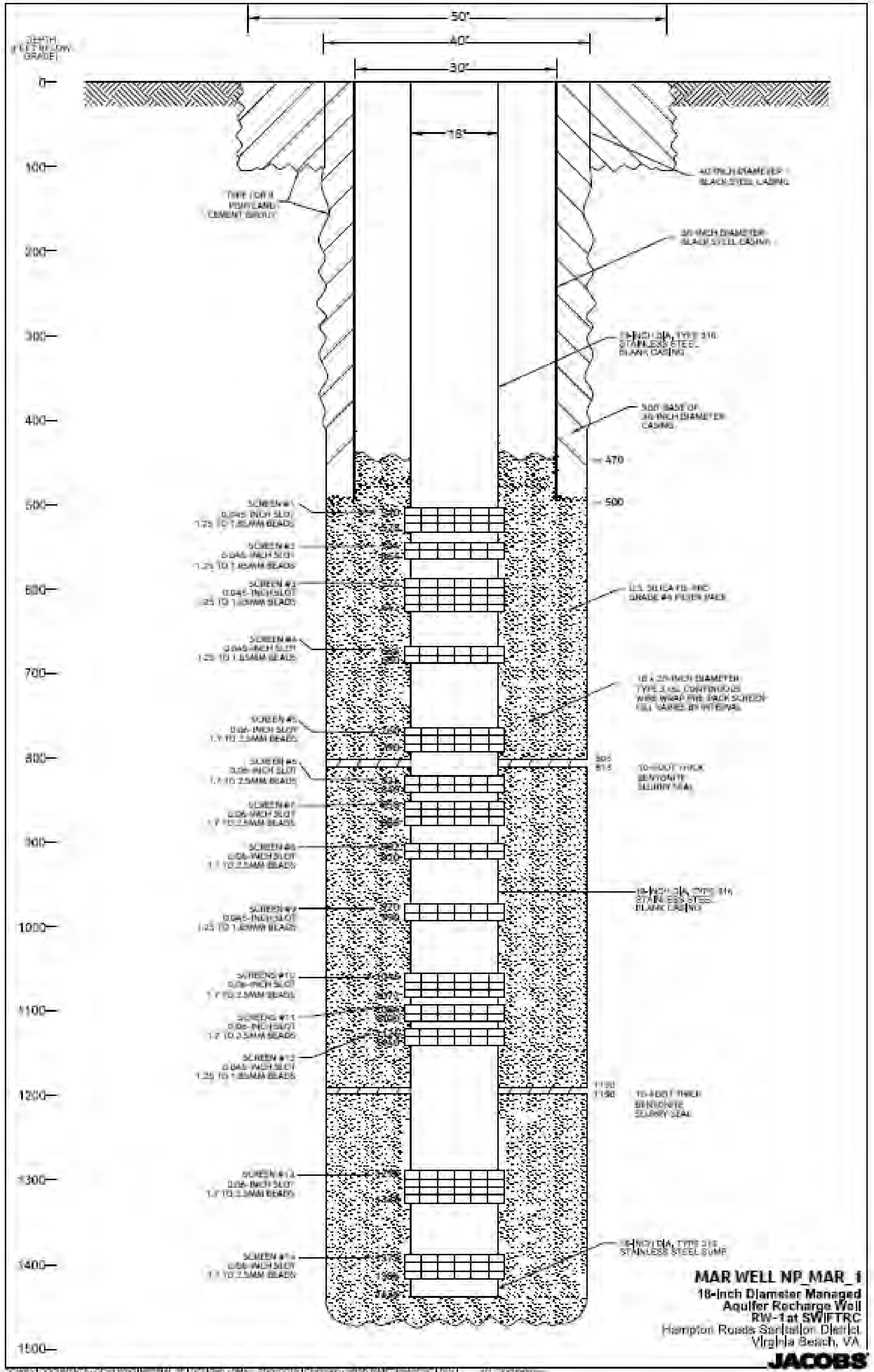
Injectivity Diagnostic Testing

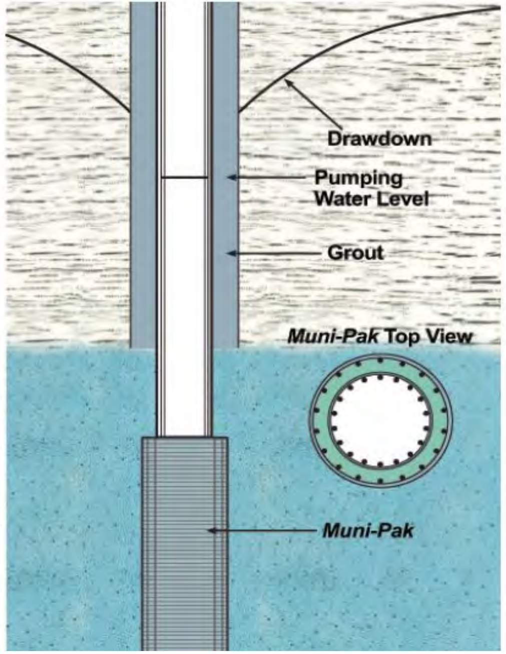
1. Perform MFI test plan on GAC1 and GAC2 with different filter mesh sizes
2. Perform BFI test plan on GAC1 and GAC2 with different filter sizes and running tests to completion
3. Install particle counter where old TOC analyzer was and test on GAC1, GAC2, and SWIFT Water
4. Consider installing online SDI analyzer
   - Contains 4 filter cartridges and automatically switches between them
   - Requires changing cartridges after 4 tests





NP_MAR_01 full scale recharge well: Update





Packing process allows for a thinner filter pack

- 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
- **Stainless steel** casing
- **Muni-Pak type screen i**nstead of conventional screen and filter pack
- Drill out Potomac Formation using **reverse circulation** drilling

swift Sustainable Water Initiative for Tomorrow

NP_MAR_01 full scale recharge well: Update

- 12” pilot hole down to 1470’ bgs - complete
- Geophysical logging complete
  - Logging indicated differences in the lower portion of the borehole
  - Not atypical of Potomac Aquifer
  - Could be better resolution of resistivity logs b/c of SWIFT water
- Well design finalized,materials ordered
- Reamed out top ~70’ and installed 42” surface casing
- Ream down to 500’ bgs and set 30” casing
- Next steps:
  - Ream out Potomac Formation – reverse circulation
  - Build the well
  - Treat the clays with ACH
  - Perform testing and surveys
  - Well ready in August