HRSD SWIFT Research Center (SRC) Quarterly Report on SWIFT Water Quality Targets

This report documents SWIFT Water Quality results for recharge operations from January 1 – March 31, 2024. The compliance requirements are documented in HRSD's SWIFT Underground Injection Control Inventory Information Package (UIC-IIP) submitted to EPA Region III in January 2018. These requirements are noted in Tables 1-4 and reflect an update to the monitoring and compliance evaluation for Total coliform.

Figures 1 and 2 and Table 6 provide a summary of the data from the referenced quarter of operations relative to the SWIFT Water Quality Targets. Table 6 represents a summary of all analytes that were present above the laboratory reporting limit. A detailed table identifying the parameters monitored for the purpose of evaluating compliance with the SWIFT Water Quality Targets can be found as an Appendix to this report.

Parameter	Proposed Regulatory Limit	Non-Regulatory Action/Goal
EPA Drinking Water Primary Maximum Contaminant Levels (MCLs)	Meet all primary MCLs	N/A
Total Nitrogen	5 mg/L Monthly Average; 8 mg/L Max Daily	Secondary Effluent Critical Control Point (CCP) Action Limit for Total Inorganic Nitrogen (TIN) = 5 mg/L-N; CCP Action Limit for SWIFT Water Total Nitrogen (TN) = 5 mg/L-N
Turbidity	Individual Filter Effluent (IFE) < 0.15 NTU 95% of time and never >0.3 NTU in two consecutive 15 min measurements	CCP Action Limit IFE of 0.15 NTU to initiate backwash or place a filter in standby
Total Organic Carbon (TOC)[1]	4 mg/L Monthly Average; 6 mg/L Maximum Daily	Critical Operating Point (COP) Action Limit to Initiate Granular Activated Carbon (GAC) Regeneration
Total Coliform (TC)[2]	<2 CFU/100 mL for 95% of calendar month observations, applied as the 95th percentile	N/A
E.coli	Non-detect	N/A
TDS[3]	N/A	Monitor PAS Compatibility

Table 1: SRC Regulatory and Monitoring Limits for SWIFT Water

[1] Regulatory limit applies to the TOC laboratory analysis which is collected at a minimum frequency of 3 times per week.

[2] The TC monitoring and compliance evaluation reflects an update effective in January 2020 following consultation with the Virginia Department of Health and EPA Region III UIC staff.

[3] No limit for Total Dissolved Solids (TDS) proposed as the primary driver is aquifer compatibility. The concentration of TDS in SWIFT Water at the SRC generally ranges from 500-850 mg/L.

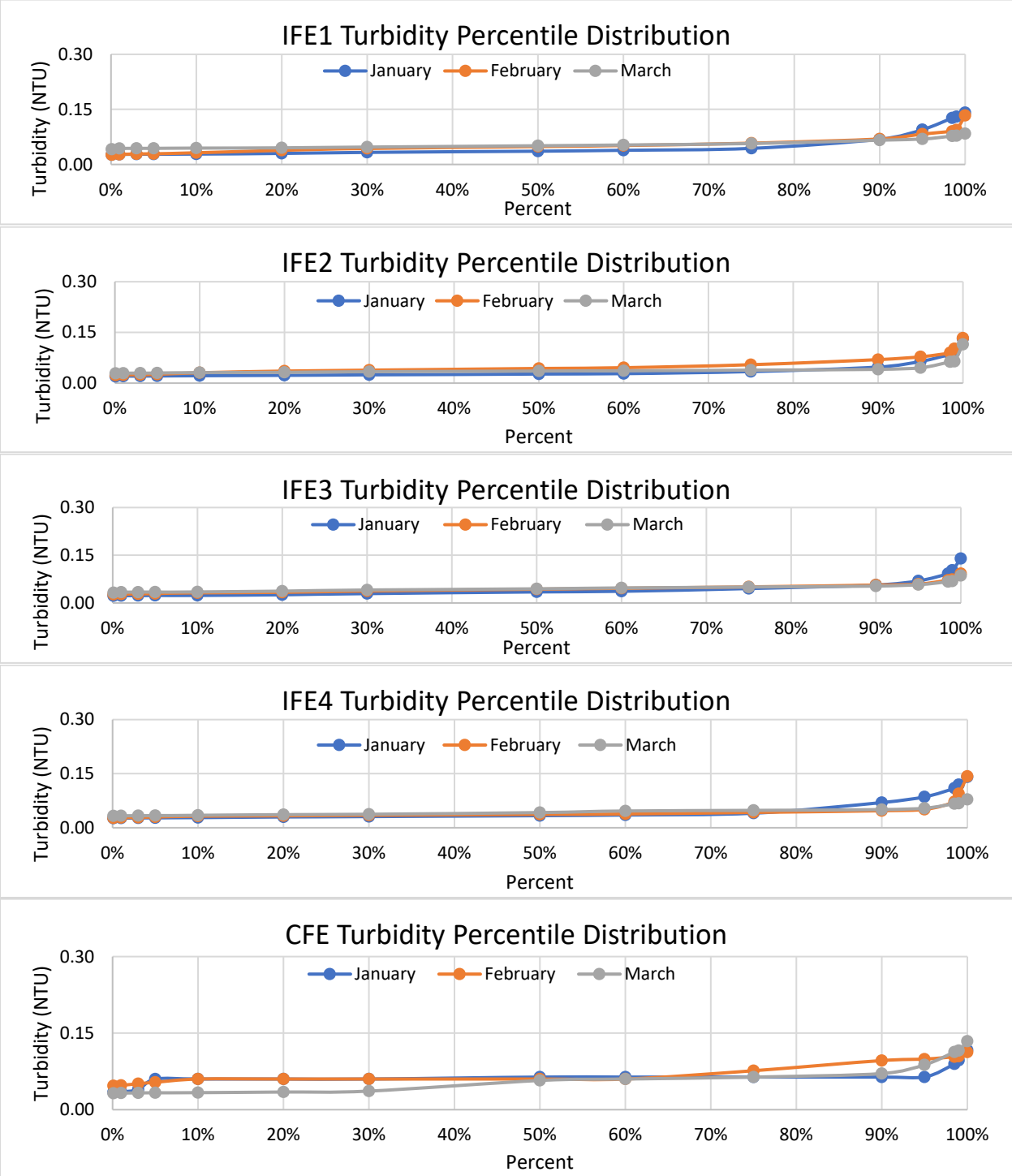

Figure 1: Percentile distribution of 15-minute average Individual Filter Effluent (IFE) Turbidities for Biofilters 1-4 (IFE1-4) and Biofilter Combined Filter Effluent (CFE). There were no 15-minute periods in this quarter with biofilter effluent turbidity values greater than 0.3 NTU. The 95% measured value for each biofilter IFE and the CFE was less than 0.15 NTU for each month in this quarter.

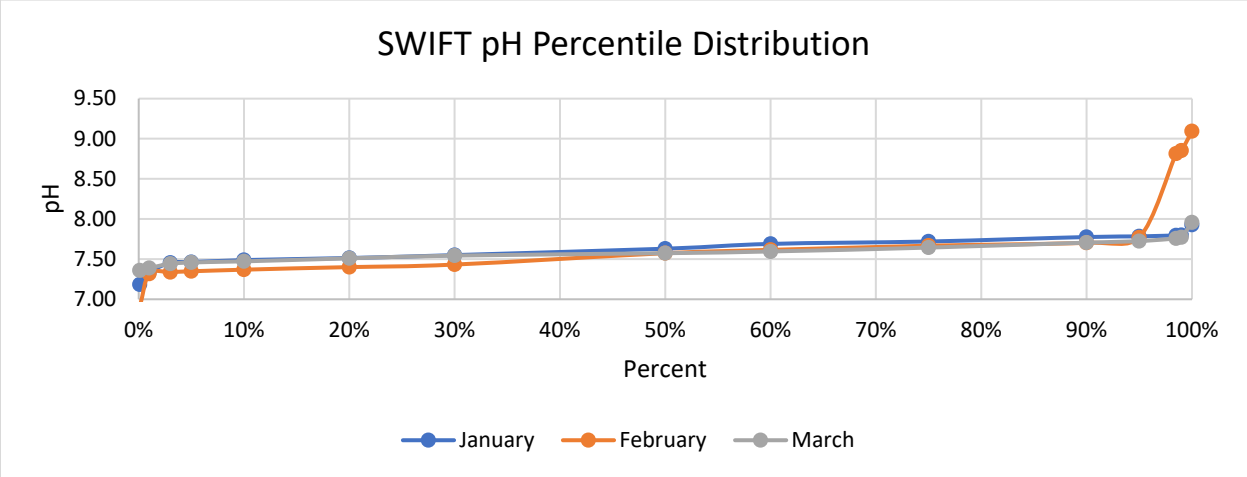

Figure 2: Distribution of Monthly SWIFT Water pH values.

Monitoring at the SRC also includes monitoring for performance indicators as documented in Table 2.

Constituent	Category	Trigger Value	Unit	Notes
1,4-Dioxane	Public Health	1	µg/L	CCL4; CA Notification Limit
17-β-Estradiol	Public Health	0.9[1]	ng/L	CCL4
DEET	Public Health	200	µg/L	MN Health Guidance Value
Ethinyl Estradiol	Public Health	280[1]	ng/L	CCL4
NDMA	Public Health	10	ng/L	CCL4; CA Notification Limit
Perchlorate	Public Health	6	µg/L	CA Notification Limit
PFOA+PFOS	Public Health	70	ng/L	CCL4; EPA Health Advisory
TCEP	Public Health	5	µg/L	MN Health Guidance Value
Cotinine	Treatment Effectiveness	1	µg/L	Surrogate for low molecular weight, partially charged cyclics
Primidone	Treatment Effectiveness	10	µg/L	
Phenytoin	Treatment Effectiveness	2	µg/L	
Meprobamate	Treatment Effectiveness	200	µg/L	High occurrence in wastewater treatment plant effluent
Atenolol	Treatment Effectiveness	4	µg/L	
Carbamazepine	Treatment Effectiveness	10	µg/L	Unique structure
Estrone	Treatment Effectiveness	320	ng/L	Surrogate for steroids
Sucralose	Treatment Effectiveness	150	mg/L	Surrogate for water soluble, uncharged chemicals with moderate molecular weight
Triclosan	Treatment Effectiveness	2,100	µg/L	Chemical of interest

[1] Identified as "To Be Determined" in the UIC-IIP. Since that time, threshold values were identified in *Monitoring Strategies for Constituents of Emerging Concern (CECs) in Recycled Water, Recommendations of a Science Advisory Panel, 2018; SCCWRP Technical Report 1032.*

Table 2: SRC Non-Regulatory Performance Indicators

Pathogen Log Removal Value (LRV) is not strictly regulated but the SRC has been designed and is operated to achieve at least 12 LRV for viruses and 10 LRV for *Cryptosporidium* and *Giardia* through a combination of advanced treatment processes and soil aquifer treatment. Table 3 provides a treatment process pathogen LRV summary for recharge conditions. Table 4 provides additional monitoring that is being completed to document compliance with the LRVs for ozone and UV.

Parameter	Floc/Sed (+BAC)	Ozone	BAC+GAC	UV	Cl2	SAT	Total
Enteric Viruses	2	0-3 (TBD)	0	4	0-4	6	12-19
Cryptosporidium	4	0	0	6	0	6	16
Giardia	2.5	0-1.5 (TBD)	0	6	0	6	14.5-16

Table 3: SRC Pathogen LRV for Potomac Aquifer System (PAS) Recharge.

Ozone LRV
Ozone Influent Temperature
Ozone Influent Flow
Liquid Phase Ozone Concentration[1]
Contact Time
CT
UV LRV
UV Intensity, each reactor
UVT, GAC Combined Effluent
Reactor Flow, each
Calculated Dose, each Lamp
Status, each

[1] The ozone liquid phase probe is verified with lab grab samples performed at least once per week.

Table 4: Additional Monitoring to Support Ozone and UV LRV. All data are collected as continuous measurements. The 15-minute LRV data is submitted in Table 6.

Critical Control Points

The SRC incorporates Critical Control Points (CCP) throughout the treatment process, per Attachment G of UIC-IIP, to verify that treatment goals are being met at each of the individual processes. A violation of any CCP means that the SRC may not be producing water that meets the treatment goals and will trigger a diversion of the SWIFT Water so that it is not directed to the recharge well. In most instances, the SRC will continue to operate through the CCP violation, but the SWIFT Water will be diverted back to the Nansemond Plant chlorine contact tanks (CCT).

CCPs have alert values at which point the operator is expected to take action to correct the performance as well as the alarm values at which point an automated response will trigger action and prevent flow from going to the recharge well. Both the alert and alarm values will be measured consistently for a specified duration before action is taken so that blips in online analyzers do not trigger action. The specific values for the alert and alarm levels will be configured as adjustable set points in the Distributed Control System (DCS) and optimized as needed to meet the water quality requirements.

Table 5 shows the current CCPs in effect at the SRC. Modifications have been made to the CCPs since startup as compared to the original design documents in order to optimize their performance. No modifications to the CCPs were made this quarter. Each of the modifications from previous quarters was discussed in the relevant quarterly report for the period.

Parameter	Alert Value	Alarm Value	Unit	Action
Critical Control Points (CCPs)				
Influent Pump Station Conductivity	1,400	1,600	microSiemens per centimeter	Place Biofilters in Filter To Waste
Influent Pump Station Total Inorganic Nitrogen	4.0	5.0	mg/L-N	Place Biofilters in Filter To Waste
Influent Pump Station Turbidity	3.5	5.0	NTU	Place Biofilters in Filter To Waste
Preformed Chloramine Failure on Injection	N/A	Failure	mg/L	Divert SWIFT Water
Total Chlorine Post Injection upstream of ozone	2.0	1.0	mg/L	Divert SWIFT Water
Chloramine injection upstream of ozone	2.0	1.0	mg/L	Divert SWIFT Water
Ozone Feed	N/A	Failure	N/A	Open Biofilter Backwash Waste Valve
Ozone Contactor Calculated LRV – Virus	<120% LRV Goal	≤110% LRV Goal	%	Open Biofilter Backwash Waste Valve
Biofilter Individual Effluent Turbidity	0.1	0.15	NTU	Place That Biofilter in Filter To Waste
Biofilter Combined Filter Effluent Turbidity	0.1	0.15	NTU	Place Biofilters in Filter To Waste
GAC Combined Effluent TOC, instantaneous online analyzer	4.0	5.0	mg/L	Divert SWIFT Water
UV Reactor Dose	<120% of Dose Setpoint	<105% of Dose Setpoint	%	Divert SWIFT Water
GAC Combined Effluent Nitrite	0.25	0.50	mg/L-N	Divert SWIFT Water
SWIFT Water TN	4.5	5.0	mg/L-N	Divert SWIFT Water
Ozone dose	70	80	lbs/day	Place Biofilters in Filter To Waste
Tasting System Free Chlorine CT	<110% of Required CT	<100% of Required CT	mg-min/L	Shut Down Tasting System
Tasting System Total Ammonia	0.1	0.3	mg/L-N	Shut Down Tasting System

Table 5. Critical Control Points for the SRC

Table 6.
SWIFT Water Quality Monitoring. Results of Detected Analytes.

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	January 2024			February 2024			March 2024		
					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Regulatory Parameters													
Total Nitrogen (TN)	mg/L	NA	0.50	Daily[3]	2.38	3.13	16	3.17	4.29	18	3.87	5.17	22
NO_3	mg/L	10	0.20	Daily[3]	2.33	3.13	13	2.95	4.29	16	3.55	4.67	21
Turbidity	NTU	NA	0.01	Continuous	**Figure 1**								
Total Organic Carbon (TOC)	mg/L	NA	1.00	3x/Wk[3]	2.26	2.77	14	2.91	3.79	16	2.78	3.33	16
pH		NA	NA	Continuous	**Figure 2**								
TDS[4]	mg/L	Potomac Aquifer System Range: 694-8,720	2.5	Monthly		522	1		522	1		420	1
Disinfection Byproducts[5]													
Bromate	µg/L	10	0.250	Monthly		0.825	1		0.678	1		0.653	1
Trihalomethanes													
Bromodichloromethane	µg/L		1.00	Monthly		<1.00	1		<1.00	1		1.05	1
Bromoform	µg/L		1.00	Monthly		1.73	1		2.69	1		2.71	1
Chloroform	µg/L		1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Dibromochloromethane	µg/L		1.00	Monthly		1.41	1		2.29	1		3.26	1
Total Trihalomethanes	µg/L	80				3.14	1		4.98	1		7.02	1
HAAs													
Dichloroacetic acid	µg/L		1.0	Monthly		<1.0	1		0.72	1		1.54	1
Trichloroacetic acid	µg/L		1.0	Monthly		<1.0	1		<0.20	1		0.40	1
Monochloroacetic acid	µg/L		2.0	Monthly		<2.0	1		<0.60	1		<0.60	1
Bromoacetic acid	µg/L		1.0	Monthly		<1.0	1		0.54	1		0.56	1
Dibromoacetic acid	µg/L		1.0	Monthly		3.6	1		4.99	1		3.79	1
Total Haloacetic Acids	µg/L	60				3.6	1		6.25	1		6.29	1
Disinfectants[5]													
Monochloramine (as Cl_2)	mg/L	4		Continuous	0.03	0.07		0.03	0.07		0.04	0.07	
Chlorine (as Cl_2)	mg/L	4		Continuous	2.89	3.22		2.80	3.29		2.53	3.38	
Inorganic Chemical													
Arsenic	µg/L	10	0.20	Monthly		0.50	1		0.41	1		0.48	1
Barium	mg/L	2	0.005	Monthly		0.007	1		0.005	1		0.005	1
Fluoride	mg/L	4.0	0.050	Monthly	0.690	0.771	17	0.763	0.882	19	0.638	0.815	22

Table 6.
SWIFT Water Quality Monitoring. Results of Detected Analytes.

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	January 2024			February 2024			March 2024		
					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Radionuclides													
Beta particles and photon emitters	pCi/L	4 mrem/yr[6]	1.65^	Monthly		10.4	1		12.3	1		7.38	1
Strontium-90	pCi/L	NA	0.368^	Monthly		<0.368 (U)	1		0.766	1		<0.334 (U)	1
Non-regulatory Performance Indicators													
Public Health Indicators		**Trigger Limits**											
1,4-dioxane	µg/L	1	0.03	Quarterly	0.20	0.21	3	0.12	0.14	3	0.08	0.09	4
Perfluorooctanoic Acid (PFOA)	ng/L	70 (PFOA+PFOS)	2.0	Quarterly		<1.8	1		<2.0	1		2.0	1
Treatment Efficacy Indicators		**Trigger Limits**											
Sucralose	ng/L	150,000,000	100	Quarterly		310	1		980	1		4000	1
Additional Monitoring (Ozone & UV LRV)					**Average**	**Minimum**		**Average**	**Minimum**		**Average**	**Minimum**	
Ozone Virus LRV				Continuous	4.63	3.75		4.62	3.41		4.56	3.60	
Ozone Giardia LRV				Continuous	2.26	1.83		2.28	1.67		2.29	2.24	
UV Dose Reactor 1	mJ/cm^2			Continuous	>186	>186		>186	>186		>186	>186	
UV Virus LRV Reactor 1				Continuous	>4	>4		>4	>4		>4	>4	
UV Dose Reactor 2	mJ/cm^2			Continuous	>186	>186		>186	>186		>186	>186	
UV Virus LRV Reactor 2				Continuous	>4	>4		>4	>4		>4	>4	

[1] When minimum reporting limits varied during the quarter, the highest minumum reporting limit used is identified.

[2] Analytical results less than the reporting limit were treated as zero for the purposes of the averaging calculation.

[3] Daily samples are typically not collected on days in which recharge is not occuring or has ceased prior to sample collection. TOC sample collection occurs routinely on Monday through Friday when recharging. Limited or inconsistent recharge impacts the collection of daily samples, particularly for the microbiological samples collected for total coliform and E coli which have limited holding time requirements. In January, limited or no recharge impacted 17 days of sampling. There was also one additional day in which samples were collected and not submitted due to operator error. This has been addressed with the operator. In February, limited or no recharge impacted 13 days of sampling. In March, limited or no recharge impacted 11 days of sampling.

[4] TDS of the Potomac Aquifer System is based on the averages within the upper, middle and lower Potomac Aquifer as determined during baseline montioring.

[5] The maximum residual disinfectant level (or MRDL) MCL for monochloramine and chlorine are based on annual averages.

[6] The measurement unit for beta particles and photon emitters is pCi/L while the MCL is expressed as mrem/yr. Per EPA's Implementation Guidance for Radionuclides (EPA 816-F-00-002, March 2002), the screening threshold for beta particles and photon emitters is 50 pCi/L. If sample concentrations exceed 50 pCi/L, each individual beta particle and photon emitter is converted from pCi/L to mrem using the EPA designated conversion tables, currently available in the referenced document.

^ MDC - Minimum Detectable Concentration (Radiochemistry).

Contract Laboratory Flags:

U : Result is less than the sample detection limit.

Recharge Statistics

The total volume recharged during this operational period was 28.8 million gallons. The backflushed volume was 6.1 million gallons for a net recharge of 22.7 million gallons (Figure 3). Brief backflushing periods occur as part of routine well maintenance on an approximate daily basis. From the start of operation through the end of this reporting period, the SRC has recharged a total volume of 828.1 million gallons.

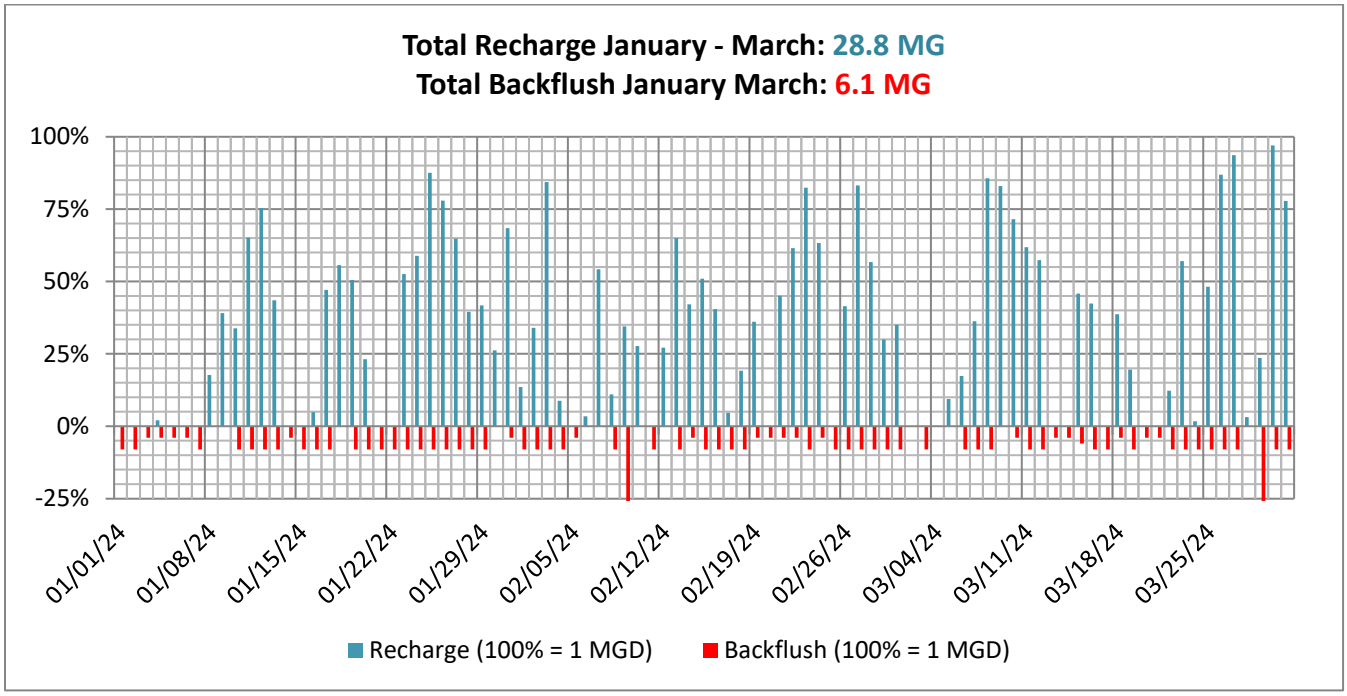

Figure 3: Recharge and Backflush Volumes, January 1 – March 31, 2024

HRSD has developed an internal target to recharge 75% of a SWIFT facility's operational capacity. This is a particularly relevant planning target for full-scale operations and HRSD is striving to meet this target at the SRC. Operational redundancies will exist at full-scale facilities (e.g., multiple recharge wells) which will likely result in a higher rate of recharge at full-scale. Integration of the new well, NP_MAR_01 into the SRC system is complete and the new well has been in operation since November 1, 2022. The recharge rate for NP_MAR_01 is currently 650 gpm (0.94 MGD).

Figure 4 depicts the operational activity for this monitoring period identifying the percentage of operational time spent in recharge as well as the general factors precluding recharge.

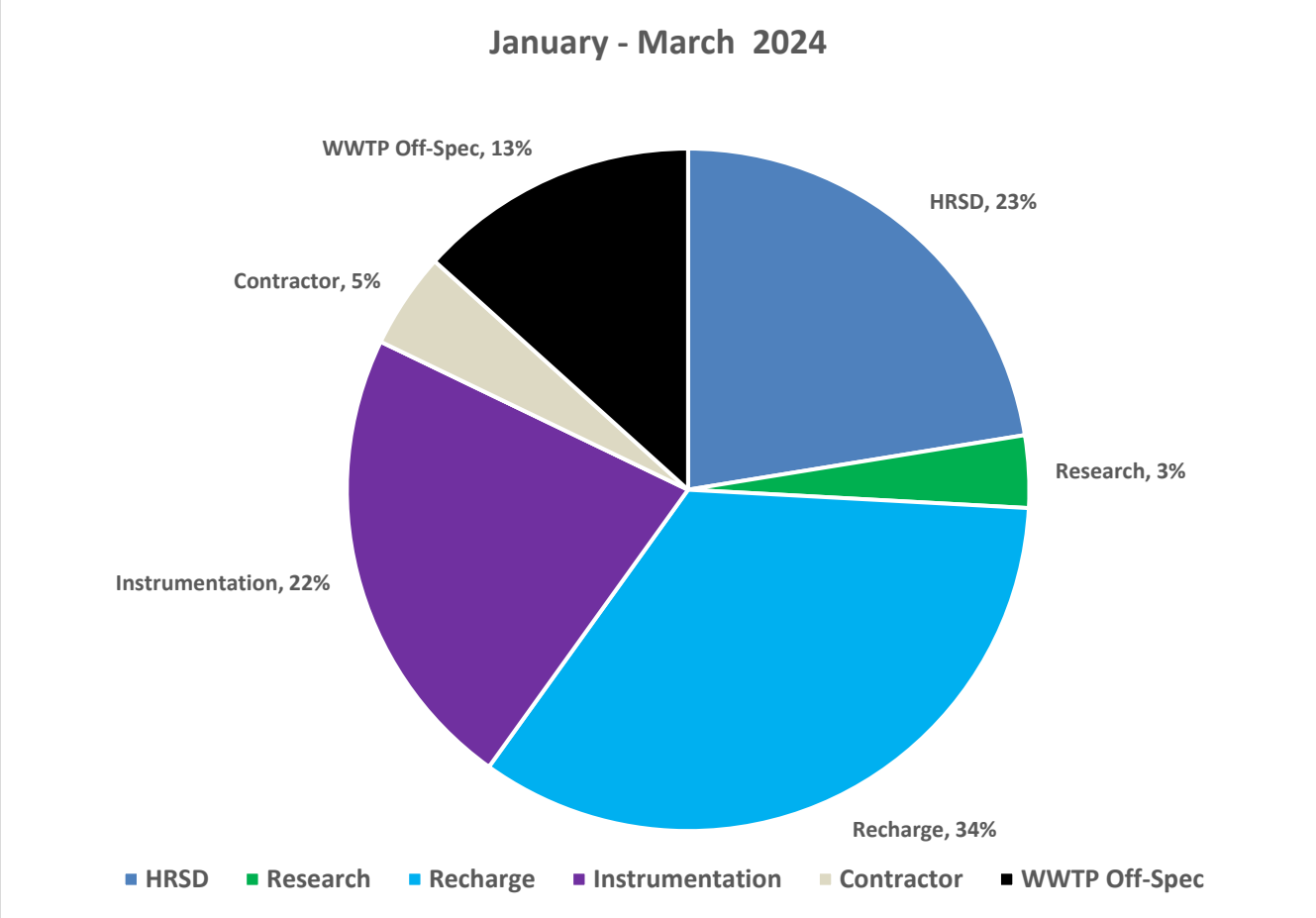

Figure 4: Operational activity for monitoring period. Notes: *HRSD*: Broad category covering activity within SWIFT facility that may lead to shut-down (e.g., maintenance and repairs, operational problems); *Research*: Recharge suspended due to research-driven operational adjustments; *Recharge*: Recharge of SWIFT Water; *Instrumentation*: On-line analyzer and/or instrumentation maintenance and repair; *Contractor:* Recharge suspended to accommodate contractor activity at the AWT and/or recharge well; *WWTP Off-Spec*: Influent to the SWIFT facility (wastewater facility secondary clarifier effluent) does not meet influent quality requirements (e.g., elevated TOC or TN, or WWTP repairs).

Conventional Monitoring Wells

The conventional monitoring wells located in the upper, middle and lower zones of the Potomac Aquifer (MW-UPA, MW-MPA, and MW-LPA, respectively) are located approximately 400 – 500 ft from the recharge well and have been routinely monitored to detect the arrival of the recharge front. Based upon TOC observations, the recharge front reached MW-UPA in late fall 2020 and MW-MPA in mid-late summer 2021 (Figure 5).

Travel time to MW-UPA was confirmed through a bromide tracer study initiated in July of 2020. Bromide from this tracer study was identified in MW-UPA beginning in April 2022. Travel time in days is difficult to estimate due to the frequent recharge stoppages. We can, however, relate travel time to a recharge volume equivalent. From July 2020

until the bromide appeared in MW-UPA in April 2022, approximately 230 million gallons of SWIFT Water was recharged.

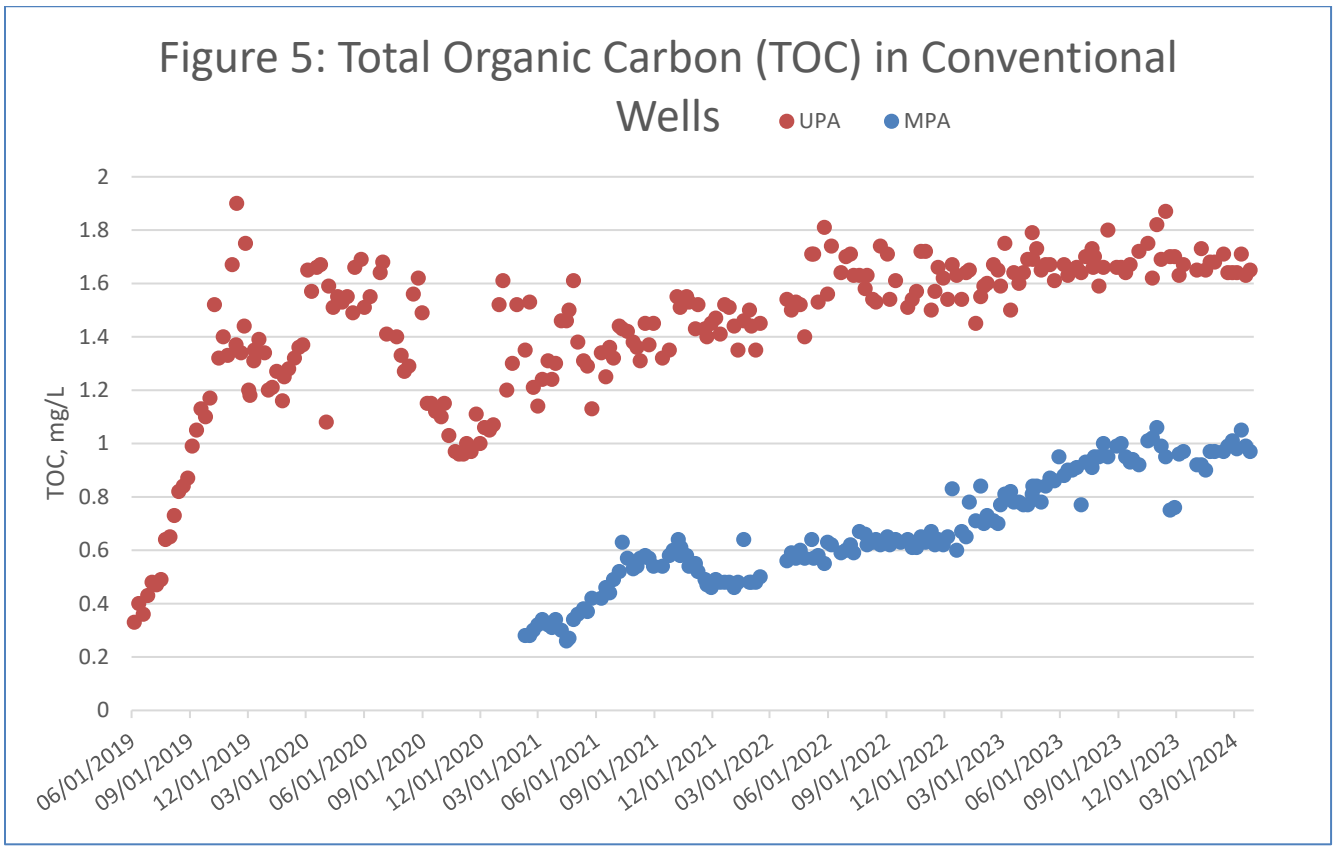

Figure 5: TOC concentration in the Upper and Middle Potomac conventional monitoring wells, MW-UPA and MW-MPA. Based on travel time studies using a conservative tracer, SWIFT Water recharged in the 2nd quarter of 2022 roughly approximates the groundwater represented in this quarter's conventional well monitoring. The SWIFT Water average TOC concentration for April - June 2022 was 3.42 mg/L, with a maximum of 3.74 mg/L (n = 54).

In this monitoring period, three indicator compounds were observed in both conventional monitoring wells, MW-UPA and MW-MPA: 1,4-dioxane, sucralose, and PFOA. 1,4-Dioxane and sucralose have been observed frequently in MW-UPA since November 2019 while PFOA was first observed in MW-UPA in Quarter 2 of 2022. PFOA was observed for the first time in MW-MPA during the 2nd quarter of 2023, with the maximum value reported as 3.3 ng/L. The reported values for 1,4-dioxane and sucralose are less than the action thresholds ("trigger values") identified in Table 2 of this report. Results for all regulatory parameters are less than the Primary Maximum Contaminant Level (PMCL) and all regulated organics are non-detect. Arsenic observations are described in further detail in a subsequent section.

Previous transient detections of 1,4-dioxane in MW-LPA were not repeated this quarter. HRSD will continue to monitor MW-LPA to evaluate the arrival of SWIFT Water.

Using 230 million gallons of recharge volume as a proxy for travel time, we can estimate that the SWIFT Water appearing in MW-UPA was recharged at some point during Quarter 2 of 2022. For 1,4-dioxane, the average concentration observed in SWIFT Water during this time period was 0.31 µg/L. The decreasing trend observed in MW-UPA (Figure 6) is consistent with the reduction seen in SWIFT Water associated with early efforts to optimize 1,4-dioxane removal through the biofilters. Since that time, HRSD has further improved 1,4-dioxane removal in SWIFT Water, with results in this reporting quarter averaging < 0.15 µg/L (Table 6).

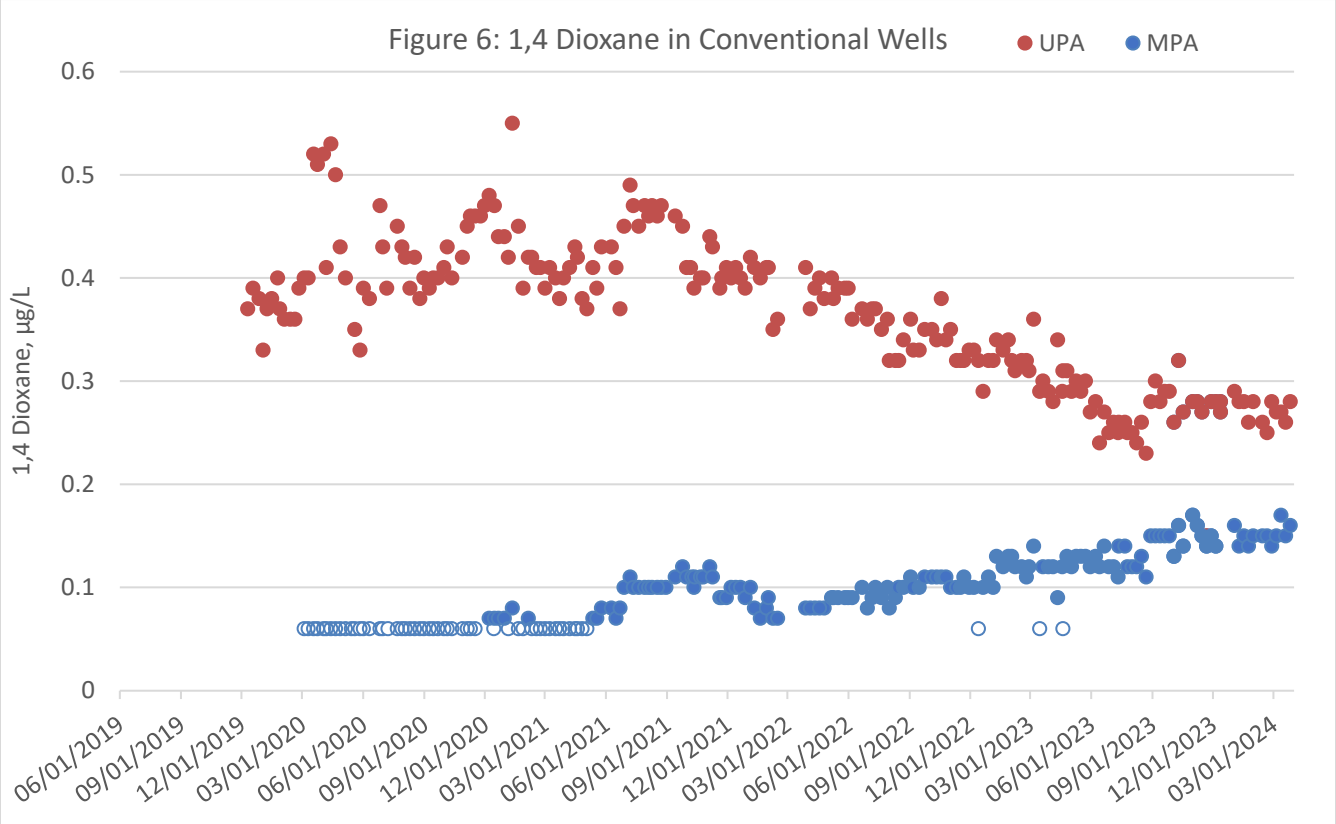

Figure 6: 1,4-Dioxane trending in MW-UPA and MW-MPA. Open circles represent data that is less than the reporting limit. Based on travel time studies using a conservative tracer, SWIFT Water recharged in the 2nd quarter of 2022 roughly approximates the groundwater represented in this quarter's conventional well monitoring. The SWIFT Water average 1,4-dioxane concentration for April - June 2022 was 0.31 µg/L, with a maximum value of 0.39 µg/L (n = 12). More recently, the SWIFT Advanced Water Treatment system has been optimized to enhance the removal of 1,4-dioxane, routinely achieving concentrations of $\leq$ 0.15 µg/L.

In Quarter 2 of 2022, the available data on sucralose and PFOA in SWIFT Water is much more limited, with three data points for sucralose and a single monthly data point for PFOA. The trends for sucralose and PFOA in MW-UPA and MW-MPA is presented in Figures 7 and 8, respectively.

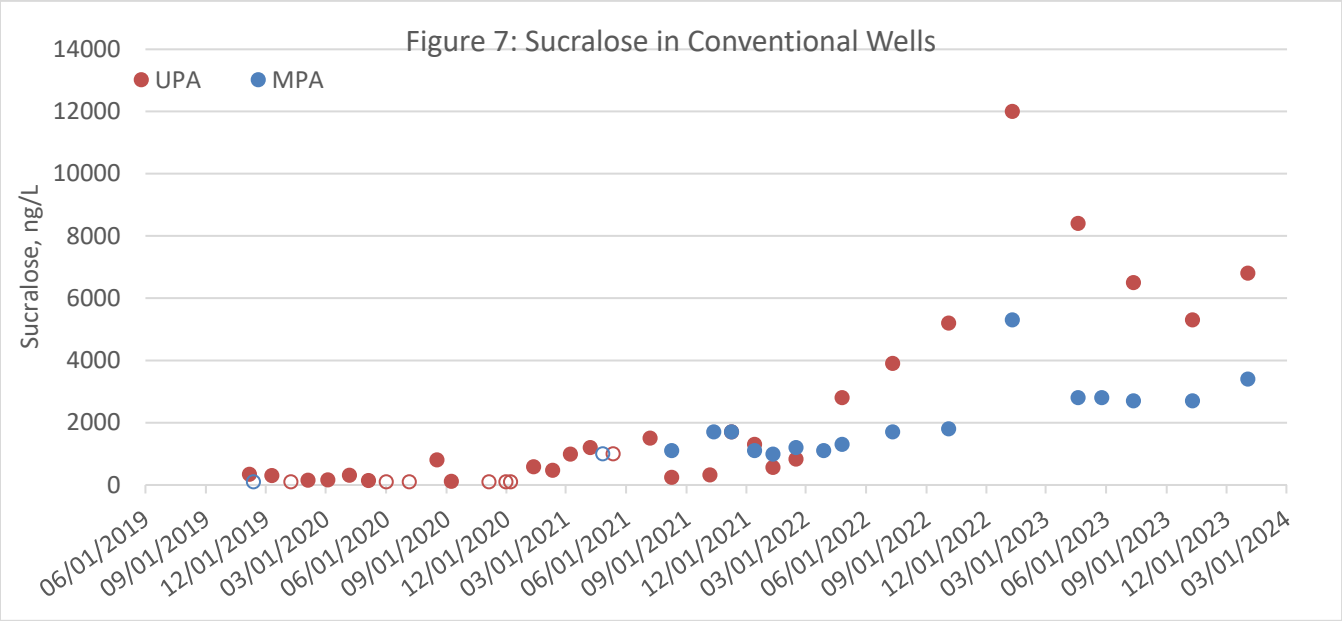

Figure 7: Sucralose trending in MW-UPA and MW-MPA. Open circles represent data that is less than the reporting limit. Based on travel time studies using a conservative tracer, SWIFT Water recharged in the 2nd quarter of 2022 roughly approximates the groundwater represented in this quarter's conventional well monitoring. The SWIFT Water average sucralose concentration for April - June 2022 was 9033 ng/L, with a maximum value of 20,000 ng/L (n = 3).

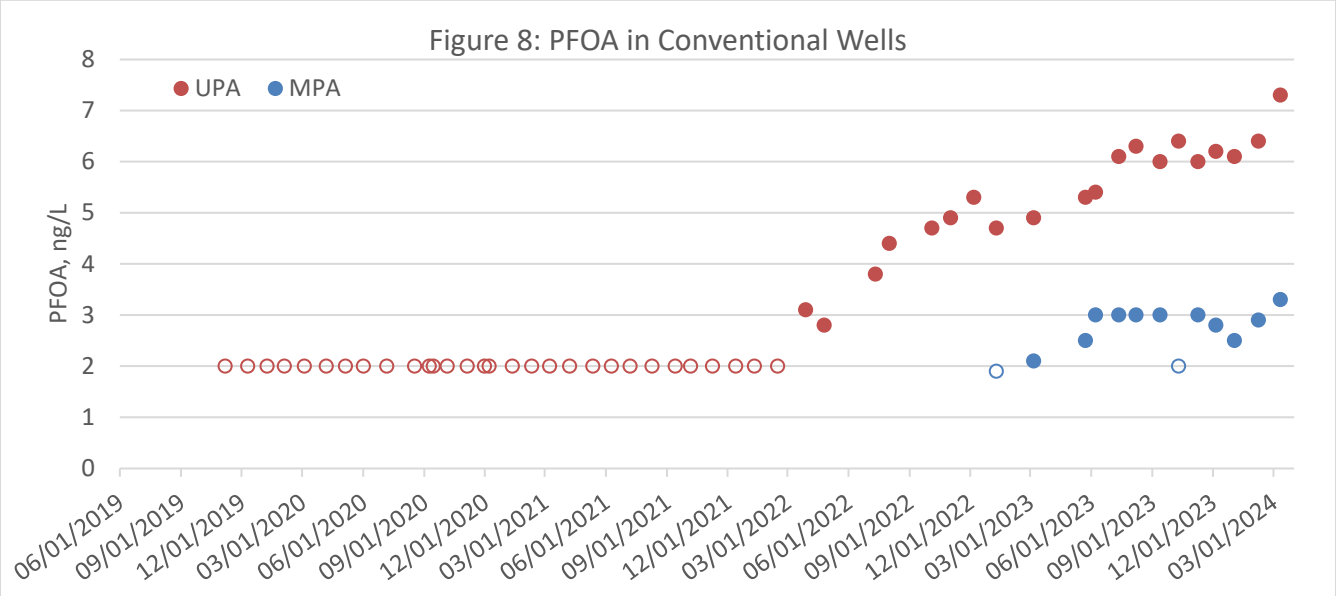

Figure 8: PFOA trending in MW-UPA. Open circles represent data that is less than the reporting limit. Based on travel time studies using a conservative tracer, SWIFT Water recharged in the 2nd quarter of 2022 roughly approximates the groundwater represented in this quarter's conventional well monitoring. The SWIFT Water PFOA concentration for January - March 2022 was 8.4 ng/L (n = 1). It is important to note that until July of 2022 when EPA released interim Health Advisory Limits (HAL) for PFOA and PFOS, HRSD's operational controls for these compounds were based upon the previous HAL of 70 ng/L PFOA+PFOS. Since that time, HRSD has been working to optimize GAC performance to maintain PFOA and PFOS below 4 ng/L.

It is important to note that until July of 2022 when EPA released interim Health Advisory Limits (HAL) for PFOA and PFOS, HRSD's operational controls for these compounds were based upon the previous HAL of 70 ng/L PFOA+PFOS. Since that time, HRSD has been working to optimize GAC performance to maintain PFOA and PFOS below 4 ng/L, each (refer to Potomac Aquifer Recharge Oversight Committee Meeting Summary December 2022 for additional information). On April 10, 2024, the EPA announced final drinking water standards for PFOA, PFOS and four additional PFAS chemicals. While public water systems must comply with these requirements by 2029, HRSD has consistently been able to maintain PFOA and PFOS below the 4 ng/L standard since December 2022. Future SWIFT Quarterly Reports will include results for all six compounds.

Arsenic in MW-SAT Update

MW_SAT is a research well that is located within relatively close proximity to the SRC recharge wells. The monitoring well is constructed to mirror the recharge wells and allows for discrete sampling of each individual screen zone corresponding to the portion of the Potomac aquifer receiving SWIFT Water™. The intent is to provide information related to soil aquifer treatment (SAT) and transient geochemical reactions in discrete lenses of the Potomac aquifer as SWIFT Water™ migrates past the well, provide data related to travel time in different aquifer lenses, and allow observation of potentiometric surface responses to both recharge and withdrawals.

The most recent arsenic (As) data obtained from MW_SAT are within the typical range and below the MCL for all the sampled screen zones. HRSD continues to monitor As concentrations in MW-SAT, focusing on representative screen intervals 1, 2, 4, 9, 10 and 11. Concentrations continue to remain below the Safe Drinking Water Act (SDWA) and PMCL of 10 µg/L on a running annual average (RAA) basis and are consistent with typical concentrations observed in these screen zones.

Screen 9 and 10

Arsenic concentrations in samples collected from screens 9 and 10 have shown brief periods of increasing trends approaching the maximum contaminant limit of 10 µg/L, however, the running annual averages have always been well below the MCL. During these elevated events the running annual average As concentrations in screens has remained well below the SDWA PMCL. Figure 10 below shows As concentrations in samples collected from the second quarter of 2022 through the first quarter of 2024. First quarter 2024 results for these screen zones are as follows:

- Screen 9: the most recent quarterly sample obtained from screen 9 maintained an As concentration of 5.26 µg/L, while higher than the previous quarter this value is in line with historic sample results. The current RAA for screens 9 is 4.7 µg/L.
- Screen 10: the arsenic concentration in the first quarter 2024 sample for screen 10 is observed at 3.23 µg/L. This concentration is lower than the previous quarterly sample but continues to indicate a slight elevation relative to typical historical values. The current RAA for screen 10 is 4.47 µg/L.

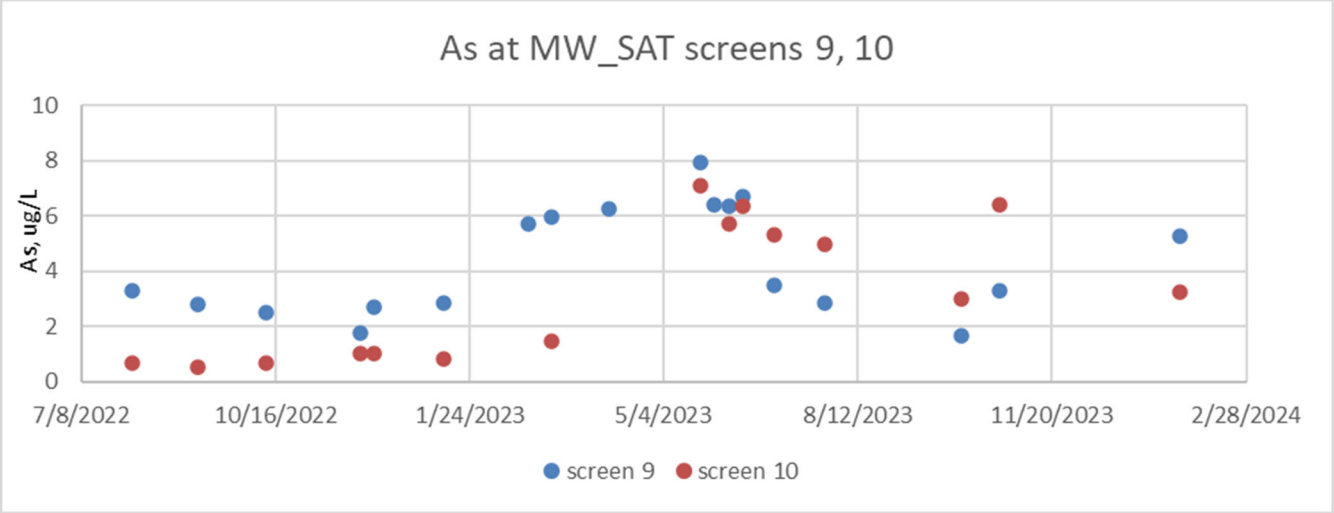

Figure 10, MW_SAT screens 9 and 10 arsenic concentration from the second quarter of 2022 through the first quarter of 2024 sampling. The latest quarterly sample was collected on January 25th.

Discussion

The last elevated trend occurred in early 2023, returning to lower concentrations by the second quarter of the year. These elevated trends are minor and relatively short-lived. They have been coincident with and attributed to one of the following (a more detailed discussion of how these factors can affect As concentrations was included in the 2023 Q3 quarterly report):

- rehabilitation of recharge well TW-1, in which acid is used to dissolve mineralized particles that can plug the well screen and filter pack, the acid reduces the pH below the solubility of iron and removes hydrous ferric oxide (HFO) coatings that passivate the aquifer matrix from further oxidation reactions that might lead to As migration as well as sorbing As ions migrating in the water.
- low dissolved oxygen, occurring in the warm summer months oxygen can be consumed to very low levels by the biological filtration process. This as well causes the deterioration of the HFO coatings and can liberate As. HRSD now uses a Speece Cone to maintain DO at levels that preserve the HFO coating.
- installation of the new recharge well (NP_MAR_01), in which aluminum chlorohydrate was introduced into the well at depressed pHs. Like well rehabilitation, the lower pH can impact the HFO and cause a brief release of As.
- new flow path from NP_MAR_01 to MW_SAT, primary recharge switched from TW-1 to NP_MAR_01 in early 2023. The new flow path resulted in SWIFT Water™ encountering material from a different part of the aquifer (laterally) as it migrates toward the monitoring well, which could contain a slightly higher source of As.

The elevated As concentrations observed in MW_SAT screens 9 and 10 are well below the SDWA PMCL RAA and have not been observed in the corresponding MW_MPA or MW_LPA conventional monitoring wells where As concentrations remain below 1 µg/L. HRSD will continue to monitor and evaluate As in these representative screen intervals of MW-SAT quarterly.

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	January 2024			February 2024			March 2024		
					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Regulatory Parameters													
Total Nitrogen (TN)	mg/L	NA	0.50	Daily[3]	2.38	3.13	16	3.17	4.29	18	3.87	5.17	22
NO_3	mg/L	10	0.20	Daily[3]	2.33	3.13	13	2.95	4.29	16	3.55	4.67	21
NO_2	mg/L	1	0.01	Daily[3]	<0.01	<0.01	14	<0.01	<0.01	17	<0.01	<0.01	21
Turbidity	NTU	NA	0.01	Continuous	**Figure 1**								
Total Organic Carbon (TOC)	mg/L	NA	1.00	3x/Wk[3]	2.26	2.77	14	2.91	3.79	16	2.78	3.33	16
pH		NA	NA	Continuous	**Figure 2**								
TDS[4]	mg/L	Potomac Aquifer System Range: 694-8,720	2.5	Monthly		522	1		522	1		420	1
Microorganisms													
Total Coliform	MPN/100 mL	MCLG = 0	1	Daily[3]	<1	<1	13	<1	<1	16	<1	<1	20
E. coli	MPN/100 mL	NA	1	Weekly	<1	<1	13	<1	<1	16	<1	<1	20
Cryptosporidium	oocysts/L	Treatment Technique, MCLG = 0	0.114	Quarterly		<0.114	1						
Giardia lamblia	oocysts/L	Treatment Technique, MCLG = 0	0.114	Quarterly		<0.114	1						
Legionella	MPN/100 mL	Treatment Technique, MCLG = 0	1.0	Quarterly		<1.0	1						
Disinfection Byproducts[5]													
Bromate	µg/L	10	0.250	Monthly		0.825	1		0.678	1		0.653	1
Chlorite	mg/L	1.0	0.100	Monthly		<0.100	1		<0.100	1		<0.100	1
Trihalomethanes													
Bromodichloromethane	µg/L		1.00	Monthly		<1.00	1		<1.00	1		1.05	1
Bromoform	µg/L		1.00	Monthly		1.73	1		2.69	1		2.71	1
Chloroform	µg/L		1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Dibromochloromethane	µg/L		1.00	Monthly		1.41	1		2.29	1		3.26	1
Total Trihalomethanes	µg/L	80				3.14	1		4.98	1		7.02	1
HAAs													
Dichloroacetic acid	µg/L		1.0	Monthly		<1.0	1		0.72	1		1.54	1
Trichloroacetic acid	µg/L		1.0	Monthly		<1.0	1		<0.20	1		0.40	1
Monochloroacetic acid	µg/L		2.0	Monthly		<2.0	1		<0.60	1		<0.60	1
Bromoacetic acid	µg/L		1.0	Monthly		<1.0	1		0.54	1		0.56	1
Dibromoacetic acid	µg/L		1.0	Monthly		3.6	1		4.99	1		3.79	1
Total Haloacetic Acids	µg/L	60				3.6	1		6.25	1		6.29	1

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	January 2024			February 2024			March 2024		
					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Disinfectants[5]													
Monochloramine (as Cl_2)	mg/L	4		Continuous	0.03	0.07		0.03	0.07		0.04	0.07	
Chlorine (as Cl_2)	mg/L	4		Continuous	2.89	3.22		2.80	3.29		2.53	3.38	
Inorganic Chemical													
Antimony	µg/L	6	0.50	Monthly		<0.50	1		<0.50	1		<0.50	1
Arsenic	µg/L	10	0.20	Monthly		0.50	1		0.41	1		0.48	1
Asbestos	MFL	7	0.18	Monthly		<0.18	1		<0.18	1		<0.18	1
Barium	mg/L	2	0.005	Monthly		0.007	1		0.005	1		0.005	1
Beryllium	µg/L	4	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Cadmium	µg/L	5	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Chromium (total)	µg/L	100	2.50	Monthly		<1.00	1		<0.50	1		<2.50	1
Copper	mg/L	1.3 (action level)	0.005	Monthly		<0.005	1		<0.005	1		<0.005	1
Cyanide (total)	µg/L	200	5	Monthly		<5	1		<5	1		<5	1
Fluoride	mg/L	4.0	0.050	Monthly	0.690	0.771	17	0.763	0.882	19	0.638	0.815	22
Lead	µg/L	15 (action level)	0.20	Monthly		<0.10	1		<0.10	1		<0.20	1
Mercury	µg/L	2	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Selenium	µg/L	50	5.00	Monthly		<5.00	1		<5.00	1		<5.00	1
Thallium	µg/L	2	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Organic Chemicals													
Acrylamide	µg/L	Treatment Technique, MCLG = 0	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Alachlor	µg/L	2	0.049	Monthly		<0.049	1		<0.048	1		<0.049	1
Atrazine	µg/L	3	0.049	Monthly		<0.049	1		<0.048	1		<0.049	1
Benzo(a)pyrene (PAHs)	µg/L	0.2	0.019	Monthly		<0.019	1		<0.019	1		<0.019	1
Di(2-ethylhexyl) adipate	µg/L	400	0.58	Monthly		<0.58	1		<0.58	1		<0.58 (*+)	1
Di(2-ethylhexyl) phthalate	µg/L	6	0.58	Monthly		<0.58	1		<0.58	1		<0.58	1
Hexachlorocyclopentadiene	µg/L	50	0.049	Monthly		<0.049	1		<0.048	1		<0.049	1
Hexachlorobenzene	µg/L	1	0.049	Monthly		<0.049	1		<0.048	1		<0.049	1
Simazine	µg/L	4	0.049	Monthly		<0.049	1		<0.048	1		<0.049	1
Carbofuran	µg/L	40	13	Monthly		<5.0	1		<5.0	1		<13	1
Oxamyl (Vydate)	µg/L	200	13	Monthly		<5.0	1		<5.0	1		<13	1
Chlordane	µg/L	2	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Endrin	µg/L	2	0.010	Monthly		<0.010	1		<0.010	1		<0.010	1
Heptachlor	µg/L	0.4	0.010	Monthly		<0.010	1		<0.010	1		<0.010	1
Heptachlor Epoxide	µg/L	0.2	0.010	Monthly		<0.010	1		<0.010	1		<0.010	1
Lindane	µg/L	0.2	0.010	Monthly		<0.010	1		<0.010	1		<0.010	1
Methoxychlor	µg/L	40	0.051	Monthly		<0.051	1		<0.051	1		<0.050	1
Toxaphene	µg/L	3	0.51	Monthly		<0.51	1		<0.51	1		<0.50	1

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	January 2024			February 2024			March 2024		
					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
PCB Arochlor1016	µg/L		0.071	Monthly		<0.071	1		<0.071	1		<0.070	1
PCB Arochlor1221	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1232	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1242	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1248	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1254	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1260	µg/L		0.071	Monthly		<0.071	1		<0.07	1		<0.070	1
Total Polychlorinated Biphenyls (PCBs)	µg/L	0.5				<0.10	1		<0.10	1		<0.10	1
2,4-D	µg/L	70	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Dalapon	µg/L	200	1.0	Monthly		<1.0	1		<1.0	1		<1.0	1
Picloram	µg/L	500	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
2,4,5-TP (Silvex)	µg/L	50	0.20	Monthly		<0.20	1		<0.20	1		<0.20	1
Dinoseb	µg/L	7	0.20	Monthly		<0.20	1		<0.20	1		<0.20	1
Pentachlorophenol	µg/L	1	0.040	Monthly		<0.040	1		<0.040	1		<0.040	1
Dioxin (2,3,7,8-TCDD)	pg/L	30	4.9	Monthly		<4.9	1		<4.8	1		<4.8	1
Diquat	µg/L	20	0.40	Monthly		<0.40	1		<0.40	1		<0.40	1
Endothall	µg/L	100	5.0	Monthly		<5.0	1		<5.0	1		<5.0	1
Epichlorohydrin	µg/L	Treatment Technique, MCLG = 0	1.0	Monthly		<1.0	1		<0.40	1		<0.40	1
Glycophosphate	µg/L	700	6.0	Monthly		<6.0	1		<6.0	1		<6.0	1
Benzene	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Carbon Tetrachloride	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Chlorobenzene	µg/L	100	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,2-dibromo-3-chloropropane (DBCP)	µg/L	0.2	0.02	Monthly		<0.02	1		<0.02	1		<0.02	1
o-Dichlororbenzene	µg/L	600	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
p-Dichlorobenzene	µg/L	75	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,2-Dichloroethane	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,1-Dichlororethylene	µg/L	7	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
cis-1,2-Dichloroethylene	µg/L	70	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
trans-1,2-Dichloroethylene	µg/L	100	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Dichloromethane	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,2-Dichloropropane	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Ethylbenzene	µg/L	700	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Ethylene Dibromide (EDB)	µg/L	0.05	0.02	Monthly		<0.02	1		<0.02	1		<0.02	1
Styrene	µg/L	100	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Tetrachloroethylene	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Toluene	µg/L	1,000	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,2,4-Trichlorobenzene	µg/L	70	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,1,1-Trichloroethane	µg/L	200	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,1,2-Trichloroethane	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Trichloroethylene	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Vinyl Chloride	µg/L	2	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Total Xylene	µg/L	10,000	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	January 2024			February 2024			March 2024		
					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Radionuclides													
Alpha particles	pCi/L	15	5.30^	Monthly		<5.30 (U G)	1		<3.25 (U G)	1		<3.60 (U G)	1
Beta particles and photon emitters	pCi/L	4 mrem/yr[6]	1.65^	Monthly		10.4	1		12.3	1		7.38	1
Radium 226	pCi/L	5 (226+228)	0.148^	Monthly		<0.148 (U)	1		<0.132 (U)	1		<0.101 (U)	1
Radium 228	pCi/L	5 (226+228)	0.762^	Monthly		0.756	1		<0.617 (U)	1		<0.762 (U)	1
Uranium	µg/L	30	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Strontium-90	pCi/L	NA	0.368^	Monthly		<0.368 (U)	1		0.766	1		<0.334 (U)	1
Tritium	pCi/L	NA	283^	Monthly		<184 (U)	1		<187 (U)	1		<283 (U)	1
Non-regulatory Performance Indicators													
Public Health Indicators		**Trigger Limits**											
1,4-dioxane	µg/L	1	0.03	Quarterly	0.20	0.21	3	0.12	0.14	3	0.08	0.09	4
17-β-estradiol	ng/L	0.9	10	Quarterly		<10	1		<10	1			
DEET	ng/L	200,000	10	Quarterly		<10	1						
Ethinyl estradiol	ng/L	280	10	Quarterly		<10	1		<10	1			
Tris(2-carboxyethyl)phosphine (TCEP)	ng/L	5,000	10	Quarterly		<10	1						
NDMA	ng/L	10	2.00	Quarterly		<2.00	1		<2.00	1	<2.00	<2.00	2
Perchlorate	µg/L	6	0.50	Quarterly		<0.50	1						
Perfluorooctanoic Acid (PFOA)	ng/L	70 (PFOA+PFOS)	2.0	Quarterly		<1.8	1		<2.0	1		2.0	1
Perfluorooctanesulfonic Acid (PFOS)	ng/L	70 (PFOA+PFOS)	2.0	Quarterly		<1.8	1		<2.0	1		<2.0	1
Treatment Efficacy Indicators		**Trigger Limits**											
Cotinine	ng/L	1,000	5.0	Quarterly		<5.0	1						
Primidone	ng/L	10,000	5.0	Quarterly		<5.0	1						
Phenytoin (Dilantin)	ng/L	2,000	10	Quarterly		<10	1		<10	1		<10	1
Meprobamate	ng/L	200,000	5.0	Quarterly		<5.0	1						
Atenolol	ng/L	4,000	5.0	Quarterly		<5.0	1						
Carbamazepine	ng/L	10,000	5.0	Quarterly		<5.0	1						
Estrone	ng/L	320	5.0	Quarterly		<5.0	1		<5.0	1			
Sucralose	ng/L	150,000,000	100	Quarterly		310	1		980	1		4000	1
Triclosan	ng/L	210,000	50	Quarterly		<50	1		<50	1		<50	1

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	January 2024			February 2024			March 2024		
					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Additional Monitoring (Ozone & UV LRV)					**Average**	**Minimum**		**Average**	**Minimum**		**Average**	**Minimum**	
Ozone Virus LRV				Continuous	4.63	3.75		4.62	3.41		4.56	3.60	
Ozone Giardia LRV				Continuous	2.26	1.83		2.28	1.67		2.29	2.24	
UV Dose Reactor 1	mJ/cm^2			Continuous	>186	>186		>186	>186		>186	>186	
UV Virus LRV Reactor 1				Continuous	>4	>4		>4	>4		>4	>4	
UV Dose Reactor 2	mJ/cm^2			Continuous	>186	>186		>186	>186		>186	>186	
UV Virus LRV Reactor 2				Continuous	>4	>4		>4	>4		>4	>4	

[1] When minimum reporting limits varied during the quarter, the highest minumum reporting limit used is identified.

[2] Analytical results less than the reporting limit were treated as zero for the purposes of the averaging calculation.

[3] Daily samples are typically not collected on days in which recharge is not occuring or has ceased prior to sample collection. TOC sample collection occurs routinely on Monday through Friday when recharging. Limited or inconsistent recharge impacts the collection of daily samples, particularly for the microbiological samples collected for total coliform and E coli which have limited holding time requirements. In January, limited or no recharge impacted 17 days of sampling. There was also one additional day in which samples were collected and not submitted due to operator error. This has been addressed with the operator. In February, limited or no recharge impacted 13 days of sampling. In March, limited or no recharge impacted 11 days of sampling.

[4] TDS of the Potomac Aquifer System is based on the averages within the upper, middle and lower Potomac Aquifer as determined during baseline montioring.

[5] The maximum residual disinfectant level (or MRDL) MCL for monochloramine and chlorine are based on annual averages.

[6] The measurement unit for beta particles and photon emitters is pCi/L while the MCL is expressed as mrem/yr. Per EPA's Implementation Guidance for Radionuclides (EPA 816-F-00-002, March 2002), the screening threshold for beta particles and photon emitters is 50 pCi/L. If sample concentrations exceed 50 pCi/L, each individual beta particle and photon emitter is converted from pCi/L to mrem using the EPA designated conversion tables, currently available in the referenced document.

^ MDC - Minimum Detectable Concentration (Radiochemistry).

Contract Laboratory Flags:

*+ : LCS and/or LCSD is outside acceptance limits, high biased.
G : The sample MDC is greater than the requested RL.
U : Result is less than the sample detection limit.