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

This report documents SWIFT Water Quality results for recharge operations from October 1 - December 31, 2019. 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 the following tables (Tables 1-4), extracted from Attachment B of the UIC-IIP. Figures 1 and 2 and Table 6 provide a summary of the data from the referenced quarter of operations relative to these 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 full suite of 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 0.10 NTU to initiate backwash or place a filter in standby
Total Organic Carbon (TOC)[1]	4 mg/L Monthly Average 6 mg/L Maximum	Critical Operating Point (COP) Action Limit to Initiate GAC Regeneration
Total Coliform	<2 CFU/100 mL 95% of time; Not to exceed geometric mean of 3 CFU/100 mL, based on a running calculation of 20 days of daily samples for total coliforms	N/A
E.coli	Non-detect	N/A
TDS[2]	N/A	Monitor PAS Compatibility

Table 1: SWIFTRC Regulatory and Monitoring Limits for SWIFT Water

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

[2] No limit for TDS proposed as the primary driver is aquifer compatibility. The concentration of SWIFT Water at the SWIFTRC generally ranges from 500-850 mg/L.

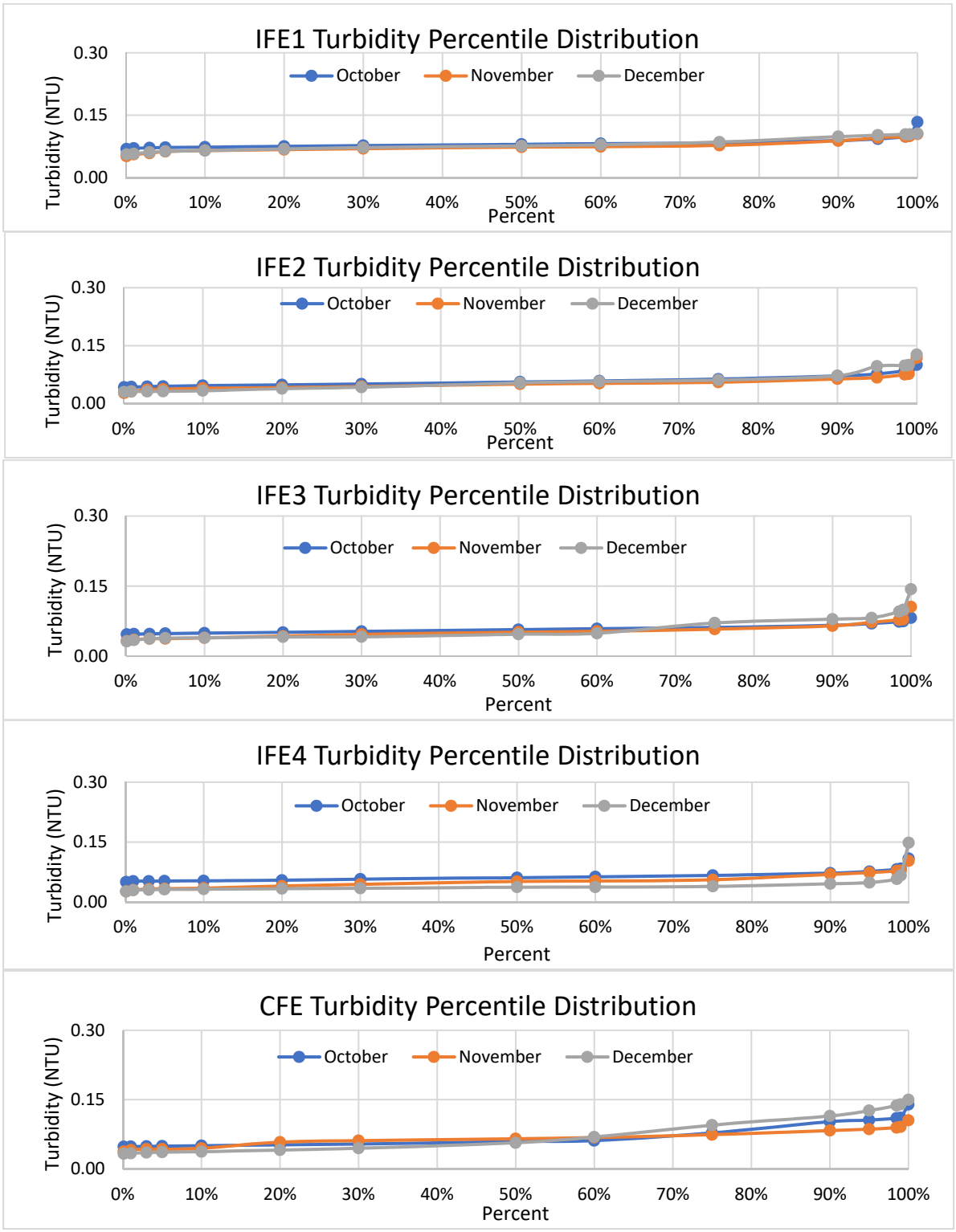

Figure 1: Percentile distribution of 15-minute average Individual Filter Effluent (IFE) Turbidities for Biofilters 1-4 (IFE1-4) and Combined Filter Effluent (CFE). There were no 15-minute periods in this quarter with biofilter effluent turbidity values greater than 0.3 NTU. The 95% measured value for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

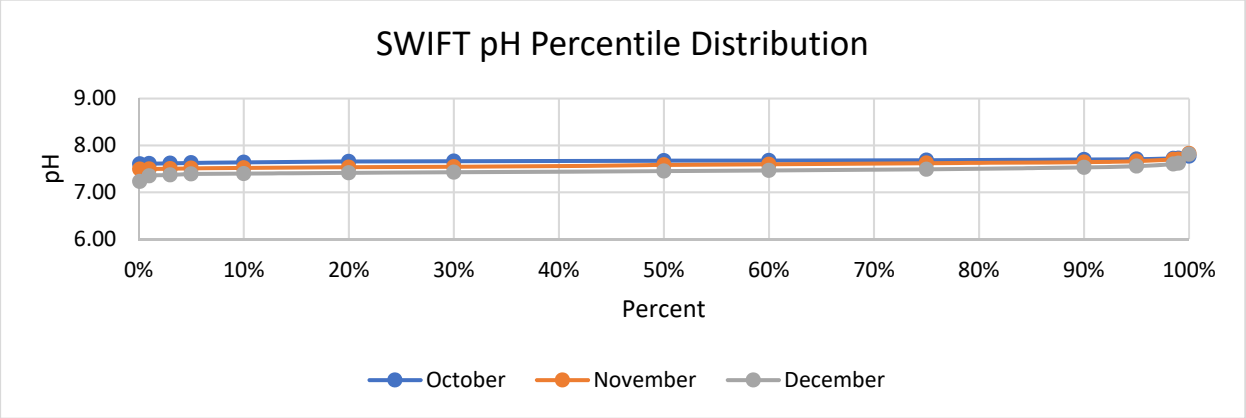

Figure 2: Distribution of Monthly SWIFT Water pH values.

Monitoring at the SWIFTRC also includes monitoring for performance indicators as documented in Table 2, extracted from Attachment B of the UIC-IIP.

Constituent	Category	Trigger Value	Unit	Notes
1,4-Dioxane	Public Health	1	µg/L	CCL4; CA Notification Limit
17-β-Estradiol	Public Health	TBD	ng/L range	CCL4
DEET	Public Health	200	µg/L	MN Health Guidance Value
Ethinyl Estradiol	Public Health	TBD	ng/L range	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

TBD = to be determined

Table 2: SWIFTRC Non-Regulatory Performance Indicators

Pathogen Log Removal Value (LRV) is not strictly regulated but the SWIFTRC 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: SWIFTRC 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 SWIFTRC 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 SWIFTRC 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 SWIFTRC 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 SWIFTRC. Modifications have been made to the CCPs since startup as compared to the original design documents in order to optimize their performance. Each of the modifications from previous quarters was discussed in each of the previous reports. Additional modifications made during this period of operation are noted in the table in redline and discussed below.

- Decreased the Influent Pump Station Conductivity CCP alert value from 1,500 µS/cm to 1,400 and alarm value from 1,800 µS/cm to 1,600. Conductivity is used as a surrogate for bromide, however this correlation is affected by high tides. Data collected during high conductivity events due to high tides at Nansemond Plant indicated that 1,600 µS/cm is the appropriate alarm value.

Parameter	Alert Value	Alarm Value	Unit	Action
Critical Control Points (CCPs)				
Influent Pump Station Conductivity	~~1,500~~1,400	~~1,800~~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
Free Chlorine CT ***(This CCP is not being used since free chlorination of the SWIFT Water is not currently being practiced)***	<120% of CT Target	<105% of CT Target	%	Divert SWIFT Water

Parameter	Alert Value	Alarm Value	Unit	Action
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 SWIFTRC

					October			November			December		
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**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**
Regulatory Parameters													
Total Nitrogen (TN)	mg/L	NA	0.50	Daily[3]	**3.33**	**3.78**	**25**	**3.29**	**3.86**	**23**	**3.53**	**4.20**	**23**
NO_3	mg/L	10	0.01	Daily[3]	**2.58**	**3.12**	**25**	**2.59**	**3.16**	**23**	**2.72**	**3.41**	**23**
NO_2	mg/L	1	0.01	Daily[3]	**0.03**	**0.11**	**25**	**0.02**	**0.12**	**23**	**0.01**	**0.06**	**23**
Turbidity	NTU	NA	0.01	Continuous	**Figure 1**								
Total Organic Carbon (TOC)	mg/L	NA	1.00	3x/Wk[3]	**2.82**	**3.12**	**11**	**3.02**	**3.20**	**9**	**3.61**	**3.86**	**9**
pH		NA	NA	Continuous	**Figure 2**								
TDS[4]	mg/L	Potomac Aquifer System Range: 694-8,720	2.5	Monthly		**840**	**1**		**780**	**1**		**705**	**1**
Microorganisms													
Total Coliform[5]	MPN/100 mL	MCLG = 0	1	Daily[3]	**<1**	**<1**	**25**	**<1**	**<1**	**23**	**1**	**2**	**23**
E. coli	MPN/100 mL	NA	1	Weekly	**<1**	**<1**	**25**	**<1**	**<1**	**23**	**<1**	**<1**	**23**
Disinfection Byproducts													
Bromate	µg/L	10	0.15	Monthly		**4.01**	**1**		**4.19**	**1**		**3.76**	**1**
HAAs													
Dichloroacetic acid	µg/L		0.60	Monthly		**1.27**	**1**		**1.70**	**1**		**1.75**	**1**
Trichloroacetic acid	µg/L		0.20	Monthly		**0.42**	**1**		**<0.2**	**1**		**0.61**	**1**
Monochloroacetic acid	µg/L		0.60	Monthly		**<0.6**	**1**		**<0.6**	**1**		**<0.6**	**1**
Bromoacetic acid	µg/L		0.40	Monthly		**<0.4**	**1**		**<0.4**	**1**		**<0.4**	**1**
Dibromoacetic acid	µg/L		0.20	Monthly		**1.67**	**1**		**0.34**	**1**		**0.29**	**1**
Total Haloacetic Acids	µg/L	60											
Disinfectants													
Monochloramine (as Cl2) [6]	mg/L	4		Continuous	**0.59**	**1.33**		**0.41**	**1.07**		**0.30**	**0.55**	
Chlorine (as Cl2) [6]	mg/L	4		Continuous	**0.60**	**1.19**		**0.40**	**0.56**		**0.30**	**0.53**	
Inorganic Chemical													
Antimony	µg/L	6	0.5	Monthly		**<0.5**	**1**		**<0.5**	**1**		**0.6**	**1**
Barium	mg/L	2	0.005	Monthly		**0.013**	**1**		**0.008**	**1**		**0.007**	**1**
Cyanide (total)	µg/L	200	10	Monthly		**<10**	**1**		**<10**	**1**		**23**	**1**
Fluoride	mg/L	4.0	0.05	Monthly	**1.05**	**1.94**	**25**	**0.95**	**1.04**	**22**	**0.88**	**0.94**	**24**
Organic Chemicals													
Radionuclides													
Beta particles and photon emitters	pCi/L	4 mrem/yr[7]	3	Monthly		**18**	**1**		**18**	**1**		**18**	**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	October			November			December		
					Average[2]	Maximum	Numer of Samples	Average[2]	Maximum	Numer of Samples	Average[2]	Maximum	Numer of Samples
Non-regulatory Performance Indicators													
Public Health Indicators		**Trigger Limits**											
1,4-dioxane	µg/L	1	0.06	Quarterly	**0.55**	**0.58**	**2**	**0.52**	**0.56**	**4**	**0.54**	**0.62**	**4**
Perchlorate	µg/L	6	0.50	Quarterly		**0.70**	**1**						
Treatment Efficacy Indicators		**Trigger Limits**											
Sucralose	ng/L	150,000,000	100	Quarterly		**780**	**1**						
Additional Monitoring (Ozone & UV LRV)													
Ozone Virus LRV				Continuous	**4.50**	**3.36**		**4.57**	**3.61**		**4.51**	**3.94**	
Ozone Giardia LRV				Continuous	**2.13**	**1.57**		**2.31**	**1.83**		**2.27**	**1.98**	
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 there is no or limited recharge. TOC sample collection occurs routinely on Monday, Wednesday and 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. Recharge occurred on 26 days in October, 25 days in November, and 29 days in December. Recharge was limited for an additional 1 day in October, 2 days in November and 6 days in December.

[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] A positive Total coliform result was documented on December 5 with a result of 1 CFU/100 mL and again on December 31 with a result of 2 CFU/100 mL. In both samples E. coli were absent.

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

[7] 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.

Recharge Statistics

The total volume recharged during this operational period was 50.5 million gallons. 4.8 million gallons was backflushed for a net recharge of 45.7 million gallons (Figure 3). Brief backflushing periods occur as part of routine well maintenance on an approximate daily basis.

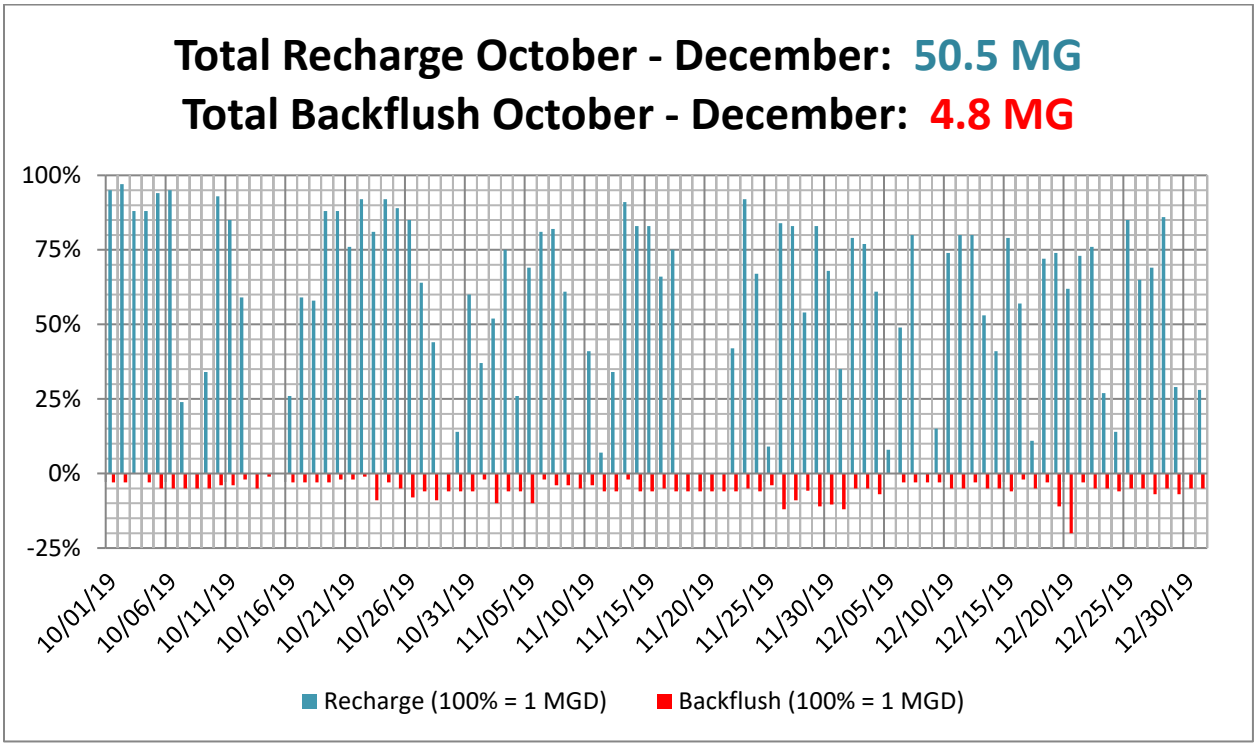

Figure 3: Recharge and Backflush Volumes, October 1 – December 31, 2019.

Conventional Monitoring Wells

The conventional monitoring well for the upper zone of the Potomac Aquifer (MW-UPA), located approximately 400 ft from the recharge well, has been monitored daily for fluoride to evaluate the migration of recharge water. Fluoride concentration in SWIFT Water averaged 0.96 mg/L in the May – December 2019 operational period. Monthly average fluoride concentration in MW-UPA averaged 4.44 mg/L during this same operational period. Despite the lack of fluoride response in MW-UPA, a review of total organic carbon (TOC) concentration in MW-UPA indicated the potential arrival of the recharge front (Figure 4) with TOC concentrations appearing to begin to stabilize in October. Similar increases in TOC have not been observed in the monitoring wells located in the middle and lower zones of the Potomac Aquifer (MW-MPA, MW-LPA). Based on the observed increase in TOC in MW-UPA, samples for all PMCLs and the indicator compounds were collected in November. All parameters were less than the PMCL and all regulated organics were non-detect. Nitrite and arsenic observations are described in further detail in the sections below.

Monitoring identified quantifiable concentrations of the indicator compounds, 1,4 dioxane, NDMA, and sucralose (Table 7). All reported values were less than the action thresholds ("trigger values") identified in Table 2 of this report.

NDMA is most commonly < 2.00 ng/L in SWIFT Water. With reported MW-UPA sample concentrations of NDMA as high as 4.45 ng/L, HRSD is working to better understand NDMA formation potential within the aquifer. Studies are on-going and will be reported upon in an upcoming quarterly report.

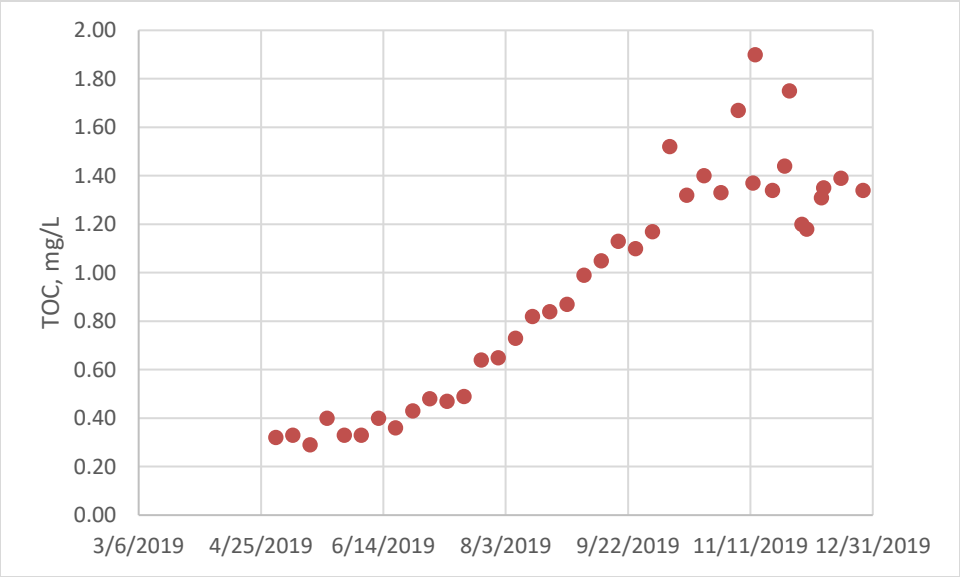

Figure 4: TOC concentration in the Upper Potomac conventional monitoring well, MW-UPA. TOC concentration in the October – December monitoring period in MW-UPA averaged 1.4 mg/L. The monthly average of SWIFT Water TOC since the start of operations is 2.1 mg/L. The monthly average for the 2018 and 2019 operational periods was 1.5 and 2.6 mg/L, respectively.

Table 7: Indicator compounds quantified in MW-UPA. Average values are not calculated when the maximum value reported represents a single sample.

Indicator	Indicator Trigger Limit	MW-UPA				SWIFT Water	
		November		December		2018-2019 Operations	
		Max	Avg	Max	Avg	Max	Monthly Avg
1,4 Dioxane, µg/L	1	0.38	-	0.39	0.38	0.61	0.40
NDMA, ng/L	10	4.45	-	4.15	2.80	5.43	1.15
Sucralose, ng/L	150,000,000	340	-	300	-	780	175

As additional data are generated, we will be able to evaluate the capacity for additional soil aquifer treatment over multiple months of travel time. Annual monitoring for PMCLs

and indicator compounds is also occurring in wells located in the upper and middle Potomac at USGS's Nansemond Research Station, located approximately 1,000 ft from the recharge well. This is expected to provide further insights into travel time and the changing characteristics of the recharge front as it moves through the aquifer.

Due to the shut-down of the SWIFT Research Center for warranty repairs, it is difficult to quantify a travel time associated with this movement of recharge water to MW-UPA. At the beginning of October when TOC concentration appears to begin to stabilize, the net volume of recharge water was approximately 148 million gallons. A bromide tracer study designed to resolve some of the existing uncertainty associated with travel time estimations will begin at the end of March.

Nitrite in MW-SAT Update

HRSD continues to monitor nitrite levels within the monitoring well located 50 ft from the recharge well, MW-SAT, and the conventional wells to better understand the occurrence of in situ partial denitrification and the potential for nitrite migration with the recharge front. Nitrite has consistently remained less than ½ the MCL in MW-SAT with a maximum nitrite concentration of 0.44 mg/L quantified in screen interval 9 in November. As described above, recharge water is being detected in the upper zone of the Potomac in the conventional monitoring well, MW-UPA. Nitrite concentrations in MW-UPA during this monitoring period remain <0.01 mg/L.

Arsenic in MW-SAT Update

As described in a brief report issued on May 16, 2019, the concentration of arsenic in MW-SAT screen interval 9 increased above the MCL of 10 µg/L in a sample collected on May 6, eight days after resuming recharge. Since that time, groundwater monitoring and soil column studies have been on-going to better understand the potential for arsenic mobilization within the aquifer. The concentration of arsenic in MW-SAT has remained < 3 µg/L since November and all monthly averages for the three-month monitoring period were < 2 µg/L (Table 8).

In October, the concentration of a single sample in interval 10 was 6.38 µg/L. Analytical results for the remaining three samples collected from interval 10 that same month were < 1.00, <1.00 and 1.01 µg/L, yielding a monthly average of 1.85 µg/L.

As described above, recharge water is being detected in the upper zone of the Potomac in the conventional monitoring well, MW-UPA. The concentration of arsenic in MW-UPA during this monitoring period remained <1.00 µg/L.

Table 8: Total arsenic concentration in selected screen intervals of MW-SAT. Total arsenic concentration in the remaining screen intervals was < 1.50 µg/L in each month of the monitoring period. Total arsenic concentration in the conventional monitoring wells, MW-UPA, MW-MPA and MW-LPA as well as SWIFT Water remained <1.00 µg/L during the monitoring period.

MW-Sat Screen	Total Arsenic, µg/L					
	October		November		December	
	Max	Avg	Max	Avg	Max	Avg
2	3.72	1.76	2.02	1.64	2.24	1.23
3	1.59	1.37	1.74	1.51	1.56	1.39
5	1.87	1.81	2.14	1.79	1.75	1.62
6	1.80	1.06	1.16	1.14	1.21	1.10
9	1.43	0.91	1.97	1.60	2.60	1.99
10	6.38	1.85	1.59	0.97	1.10	0.42

Appendix
Monitoring Data for SWIFT Water Quality Regulatory Targets

					October			November			December		
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**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**
Regulatory Parameters													
Total Nitrogen (TN)	mg/L	NA	0.50	Daily[3]	**3.33**	**3.78**	**25**	**3.29**	**3.86**	**23**	**3.53**	**4.20**	**23**
NO_3	mg/L	10	0.01	Daily[3]	**2.58**	**3.12**	**25**	**2.59**	**3.16**	**23**	**2.72**	**3.41**	**23**
NO_2	mg/L	1	0.01	Daily[3]	**0.03**	**0.11**	**25**	**0.02**	**0.12**	**23**	**0.01**	**0.06**	**23**
Turbidity	NTU	NA	0.01	Continuous	**Figure 1**								
Total Organic Carbon (TOC)	mg/L	NA	1.00	3x/Wk[3]	**2.82**	**3.12**	**11**	**3.02**	**3.20**	**9**	**3.61**	**3.86**	**9**
pH		NA	NA	Continuous	**Figure 2**								
TDS[4]	mg/L	Potomac Aquifer System Range: 694-8,720	2.5	Monthly		**840**	**1**		**780**	**1**		**705**	**1**
Microorganisms													
Total Coliform[5]	MPN/100 mL	MCLG = 0	1	Daily[3]	**<1**	**<1**	**25**	**<1**	**<1**	**23**	**1**	**2**	**23**
E. coli	MPN/100 mL	NA	1	Weekly	**<1**	**<1**	**25**	**<1**	**<1**	**23**	**<1**	**<1**	**23**
Cryptosporidium	oocysts/L	Treatment Technique, MCLG = 0	0.089	Quarterly		**<0.089**	**1**						
Giardia lamblia	oocysts/L	Treatment Technique, MCLG = 0	0.089	Quarterly		**<0.089**	**1**						
Legionella	MPN/100 mL	Treatment Technique, MCLG = 0	10	Quarterly		**<10**	**1**						
Disinfection Byproducts													
Bromate	µg/L	10	0.15	Monthly		**4.01**	**1**		**4.19**	**1**		**3.76**	**1**
Chlorite	mg/L	1.0	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Trihalomethanes													
Bromodichloromethane	µg/L		1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Bromoform	µg/L		1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Chloroform	µg/L		1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Dibromochloromethane	µg/L		1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Total Trihalomethanes	µg/L	80											
HAAs													
Dichloroacetic acid	µg/L		0.60	Monthly		**1.27**	**1**		**1.70**	**1**		**1.75**	**1**
Trichloroacetic acid	µg/L		0.20	Monthly		**0.42**	**1**		**<0.2**	**1**		**0.61**	**1**
Monochloroacetic acid	µg/L		0.60	Monthly		**<0.6**	**1**		**<0.6**	**1**		**<0.6**	**1**
Bromoacetic acid	µg/L		0.40	Monthly		**<0.4**	**1**		**<0.4**	**1**		**<0.4**	**1**
Dibromoacetic acid	µg/L		0.20	Monthly		**1.67**	**1**		**0.34**	**1**		**0.29**	**1**
Total Haloacetic Acids	µg/L	60											

					October			November			December		
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**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**
Disinfectants													
Monochloramine (as Cl2) [6]	mg/L	4		Continuous	**0.59**	**1.33**		**0.41**	**1.07**		**0.30**	**0.55**	
Chlorine (as Cl2) [6]	mg/L	4		Continuous	**0.60**	**1.19**		**0.40**	**0.56**		**0.30**	**0.53**	
Inorganic Chemical													
Antimony	µg/L	6	0.5	Monthly		**<0.5**	**1**		**<0.5**	**1**		**0.6**	**1**
Arsenic	µg/L	10	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Asbestos	MFL	7	0.18	Monthly		**<0.18**	**1**		**<0.18**	**1**		**<0.18**	**1**
Barium	mg/L	2	0.005	Monthly		**0.013**	**1**		**0.008**	**1**		**0.007**	**1**
Beryllium	µg/L	4	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Cadmium	µg/L	5	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Chromium (total)	µg/L	100	5	Monthly		**<5**	**1**		**<5**	**1**		**<5**	**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	10	Monthly		**<10**	**1**		**<10**	**1**		**23**	**1**
Fluoride	mg/L	4.0	0.05	Monthly	**1.05**	**1.94**	**25**	**0.95**	**1.04**	**22**	**0.88**	**0.94**	**24**
Lead	µg/L	15 (action level)	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Mercury	µg/L	2	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Selenium	µg/L	50	5	Monthly		**<5**	**1**		**<5**	**1**		**<5**	**1**
Thallium	µg/L	2	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Organic Chemicals													
Acrylamide	µg/L	Treatment Technique, MCLG = 0	0.1	Monthly		**<0.10**	**1**		**<0.10**	**1**		**<0.10**	**1**
Alachlor	µg/L	2	0.05	Monthly		**<0.05**	**1**		**<0.05**	**1**		**<0.05**	**1**
Atrazine	µg/L	3	0.05	Monthly		**<0.05**	**1**		**<0.05**	**1**		**<0.05**	**1**
Benzo(a)pyrene (PAHs)	µg/L	0.2	0.02	Monthly		**<0.02**	**1**		**<0.02**	**1**		**<0.02**	**1**
Di(2-ethylhexyl) adipate	µg/L	400	0.6	Monthly		**<0.6**	**1**		**<0.6**	**1**		**<0.6**	**1**
Di(2-ethylhexyl) phthalate	µg/L	6	0.6	Monthly		**<0.6**	**1**		**<0.6**	**1**		**<0.6**	**1**
Hexachlorocyclopentadiene	µg/L	50	0.05	Monthly		**<0.05**	**1**		**<0.05**	**1**		**<0.05**	**1**
Hexachlorobenzene	µg/L	1	0.05	Monthly		**<0.05**	**1**		**<0.05**	**1**		**<0.05**	**1**
Simazine	µg/L	4	0.05	Monthly		**<0.05**	**1**		**<0.05**	**1**		**<0.05**	**1**
Carbofuran	µg/L	40	0.5	Monthly		**<0.5**	**1**		**<0.5**	**1**		**<0.5**	**1**
Oxamyl (Vydate)	µg/L	200	0.5	Monthly		**<0.5**	**1**		**<0.5**	**1**		**<0.5**	**1**
Chlordane	µg/L	2	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Endrin	µg/L	2	0.01	Monthly		**<0.01**	**1**		**<0.01**	**1**		**<0.01**	**1**
Heptachlor	µg/L	0.4	0.01	Monthly		**<0.01**	**1**		**<0.01**	**1**		**<0.01**	**1**
Heptachlor Epoxide	µg/L	0.2	0.01	Monthly		**<0.01**	**1**		**<0.01**	**1**		**<0.01**	**1**
Lindane	µg/L	0.2	0.01	Monthly		**<0.01**	**1**		**<0.01**	**1**		**<0.01**	**1**
Methoxychlor	µg/L	40	0.05	Monthly		**<0.05**	**1**		**<0.05**	**1**		**<0.05**	**1**
Toxaphene	µg/L	3	0.5	Monthly		**<0.5**	**1**		**<0.5**	**1**		**<0.5**	**1**

					October			November			December		
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**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**
PCB Arochlor1016	µg/L		0.08	Monthly		**<0.08**	**1**		**<0.08**	**1**		**<0.08**	**1**
PCB Arochlor1221	µg/L		0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1232	µg/L		0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1242	µg/L		0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1248	µg/L		0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1254	µg/L		0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1260	µg/L		0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Total Polychlorinated Biphenyls (PCBs)	µg/L	0.5											
2,4-D	µg/L	70	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Dalapon	µg/L	200	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Picloram	µg/L	500	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
2,4,5-TP (Silvex)	µg/L	50	0.2	Monthly		**<0.2**	**1**		**<0.2**	**1**		**<0.2**	**1**
Dinoseb	µg/L	7	0.2	Monthly		**<0.2**	**1**		**<0.2**	**1**		**<0.2**	**1**
Pentachlorophenol	µg/L	1	0.04	Monthly		**<0.04**	**1**		**<0.04**	**1**		**<0.04**	**1**
Dioxin (2,3,7,8-TCDD)	pg/L	30	5	Monthly		**<5**	**1**		**<5**	**1**		**<5**	**1**
Diquat	µg/L	20	0.4	Monthly		**<0.4**	**1**		**<0.4**	**1**		**<0.4**	**1**
Endothall	µg/L	100	5	Monthly		**<5**	**1**		**<5**	**1**		**<5**	**1**
Epichlorohydrin	µg/L	Treatment Technique, MCLG = 0	0.4	Monthly		**<0.4**	**1**		**<0.4**	**1**		**<0.4**	**1**
Glycophosphate	µg/L	700	6	Monthly		**<6**	**1**		**<6**	**1**		**<6**	**1**
Benzene	µg/L	5	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Carbon Tetrachloride	µg/L	5	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Chlorobenzene	µg/L	100	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**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	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
p-Dichlorobenzene	µg/L	75	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
1,2-Dichloroethane	µg/L	5	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
1,1-Dichlororethylene	µg/L	7	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
cis-1,2-Dichloroehtylene	µg/L	70	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
trans-1,2-Dichloroethylene	µg/L	100	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Dichloromethane	µg/L	5	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
1,2-Dichloropropane	µg/L	5	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Ethylbenzene	µg/L	700	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Ethylene Dibromide (EDB)	µg/L	0.05	0.02	Monthly		**<0.02**	**1**		**<0.02**	**1**		**<0.02**	**1**

					October			November			December		
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**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**
Styrene	µg/L	100	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Tetrachloroethylene	µg/L	5	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Toluene	µg/L	1,000	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
1,2,4-Trichlorobenzene	µg/L	70	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
1,1,1-Trichloroethane	µg/L	200	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
1,1,2-Trichloroethane	µg/L	5	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Trichloroethylene	µg/L	5	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Vinyl Chloride	µg/L	2	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Total Xylene	µg/L	10,000	3	Monthly		**<3**	**1**		**<3**	**1**		**<3**	**1**
Radionuclides													
Alpha particles	pCi/L	15	3	Monthly		**<3**	**1**		**<3**	**1**		**<3**	**1**
Beta particles and photon emitters	pCi/L	4 mrem/yr[7]	3	Monthly		**18**	**1**		**18**	**1**		**18**	**1**
Radium 226	pCi/L	5 (226+228)	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Radium 228	pCi/L	5 (226+228)	1	Monthly		**<1**	**1**		**<1**	**1**		**<1**	**1**
Uranium	µg/L	30	0.1	Monthly		**<0.1**	**1**		**<0.1**	**1**		**<0.1**	**1**
Strontium-90	pCi/L	NA	0.676*	Monthly		**<0.676**	**1**		**<0.676**	**1**		**<0.676**	**1**
Tritium	pCi/L	NA	390*	Monthly		**<390**	**1**		**<390**	**1**		**<390**	**1**
Non-regulatory Performance Indicators **Public Health Indicators**		**Trigger Limits**											
1,4-dioxane	µg/L	1	0.06	Quarterly	**0.55**	**0.58**	**2**	**0.52**	**0.56**	**4**	**0.54**	**0.62**	**4**
17-β-estradiol	ng/L	TBD	0.0044	Quarterly		**<0.0044, D1**	**1**						
DEET	ng/L	200,000	10	Quarterly		**<10**	**1**						
Ethinyl estradiol	ng/L	TBD	10	Quarterly		**<10**	**1**						
Tris(2-carboxyethyl)phosphine (TCEP)	ng/L	5,000	10	Quarterly		**<10**	**1**						
NDMA	ng/L	10	2	Quarterly	**<2**	**<2**	**2**	**<2**	**<2**	**4**	**<2**	**<2**	**4**
Perchlorate	µg/L	6	0.50	Quarterly		**0.70**	**1**						
Perfluorooctanoic Acid (PFOA)	µg/L	0.070 (PFOA+PFOS)	0.002	Quarterly		**<0.002**	**1**						
Perfluorooctanesulfonic Acid (PFOS)	µg/L	0.070 (PFOA+PFOS)	0.002	Quarterly		**<0.002**	**1**						
Treatment Efficacy Indicators		**Trigger Limits**											
Cotinine	ng/L	1,000	10	Quarterly		**<10, M1**	**1**						
Primidone	ng/L	10,000	5	Quarterly		**<5**	**1**						
Phenytoin (Dilantin)	ng/L	2,000	20	Quarterly		**<20**	**1**						
Meprobamate	ng/L	200,000	5	Quarterly		**<5, M1**	**1**						
Atenolol	ng/L	4,000	5	Quarterly		**<5**	**1**						
Carbemazepine	ng/L	10,000	5	Quarterly		**<5**	**1**						
Estrone	ng/L	320	10	Quarterly		**<10**	**1**						

					October			November			December		
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**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**	**Average[2]**	**Maximum**	**Numer of Samples**
Sucralose	ng/L	150,000,000	100	Quarterly		**780**	**1**						
Triclosan	ng/L	210,000	20	Quarterly		**<20**	**1**						
Additional Monitoring (Ozone & UV LRV)													
Ozone Virus LRV				Continuous	**4.50**	**3.36**		**4.57**	**3.61**		**4.51**	**3.94**	
Ozone Giardia LRV				Continuous	**2.13**	**1.57**		**2.31**	**1.83**		**2.27**	**1.98**	
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 there is no or limited recharge. TOC sample collection occurs routinely on Monday, Wednesday and 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. Recharge occurred on 26 days in October, 25 days in November, and 29 days in December. Recharge was limited for an additional 1 day in October, 2 days in November and 6 days in December.

[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] A positive Total coliform result was documented on December 5 with a result of 1 CFU/100 mL and again on December 31 with a result of 2 CFU/100 mL. In both samples E. coli were absent.

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

[7] 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.

Contract Laboratory Flags

(D1) - Sample required dilution due to matrix.

(M1) - Matrix spike recovery was high; the associated blank spike recovery was acceptable.