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SUBJECT: Toxicological Assessment of ISS Air and Water Quality: June 24, 2019 – October 3, 2019 (Increment 60) Including SpaceX-18 and HTV-8 Ingress

SUMMARY: Based on these data, air quality was acceptable on ISS for this period and potable water remains acceptable for crew consumption.

AIR QUALITY

Six archive air samples were collected in mini grab sample containers (mGSCs) on ISS during Increment 60; two each on July 17 and August 28, 2019, as well as ingress samples for SpaceX-18 (July 28, 2019) and HTV-8 (September 28, 2019). Samples from July 2019 were returned on SpX-18 while the samples from August and September 2019 were returned on SpX-19. Two sets of formaldehyde badges were deployed in the US Lab and Russian Service Module (SM) in August 2019. The formaldehyde badges were returned on 58S.

Table 1. Analytical summary of ISS air analyses (Increment 60)

Return Flight	Sample Location	Sample Date	Freon 218 (mg/m^3)	Alcohols[a] (mg/m^3)	T-Value[b] (units)	Formaldehyde ($\mu g/m^3$)
SpaceX-18	US Lab	7/17/2019	25	4.4	0.3	---
SpaceX-18	Columbus	7/17/2019	28	4.7	0.3	---
SpaceX-18	SpaceX-18 Ingress	7/28/2019	6.4	2.3	0.3 (0.1)	---
SpaceX-19	US Lab	8/28/2019	26	7.2	0.2	29
SpaceX-19	Russian SM	8/28/2019	21	4.7	0.1	20
SpaceX-19	HTV-8 Ingress	9/28/2019	11	5.1	2.4 (1.5)	---
Guideline			---	*<5*	*<1*[c]	*<120*

[a] Includes acetone
[b] Sum of the ratios of the measured concentrations and the corresponding 180-day SMAC for each compound; parenthesis indicate value based on 7-day SMACs and applicable to first ingress
[c] T-value <1 used to evaluate routine monthly sampling; <3 used to evaluate first ingress

Data tables containing measured concentrations and corresponding T-values based on appropriate Spacecraft Maximum Allowable Concentrations (SMACs) for compounds present at levels above the laboratory reporting limit are attached to this report. Complete data tables, which include compounds assessed but not detected, are available upon request. Pressure readings for the mGSCs indicate that all samples in Increment 60 were considered acceptable. The initial pressure reading was low (2-3 psia) for the sample collected in the Russian SM on August 28, 2019. As a result, the reporting limits for this sample

are higher. The mean relative recoveries of the three surrogate standards from the mGSC samples returned on SpX-18 and -19 were all within acceptable limits.

On-orbit, the Air Quality Monitors (AQMs) automatically collect and analyze samples every 73 hours, which results in 2-3 sampling sessions per unit per week. Monthly average concentrations as well as the Increment average concentrations for compounds measured on the AQMs are presented in Table 2. AQM2 failed in June 2019 and was returned to the ground for diagnosis and troubleshooting. As a result, data are lacking for several of the compounds measured on AQM2. Data from AQM1 were used to estimate concentrations of acetaldehyde and ethanol during this period. A replacement for AQM2 was delivered on NG-12 in November 2019.

Table 2. Average monthly concentrations (mg/m^3) of AQM target compounds

Compound	June Average	July Average	August Average	September Average	October Average	Increment Average
2-Propanol	MI	MI	MI	MI	MI	--
Acetone	0.32	0.21	0.26	0.25	0.26	0.26
Acrolein	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND
Decamethylcyclopentasiloxane#	TRACE	ND	ND	ND	ND	ND
Hexanal	ND	ND	ND	ND	ND	ND
Hexane	ND	ND	ND	ND	ND	ND
m,p-Xylenes#	ND	ND	ND	ND	ND	ND
Methanol	0.23	0.23	0.22	0.22	0.22	0.22
o-Xylene#	ND	ND	ND	ND	ND	ND
Octamethylcylcotetrasiloxane#	ND	ND	ND	ND	ND	ND
Toluene#	ND	ND	ND	ND	ND	ND
2-Butanone	ND	--	--	--	--	--
Acetaldehyde	0.21	TRACE	0.21	0.23	0.17	0.21
Dichloromethane	ND	--	--	--	--	--
Ethanol	2.5	4.8	6.1	6.1	5.9	5.1
Ethyl Acetate	ND	--	--	--	--	--
Hexamethycyclotrisiloxane#	TRACE	ND	ND	ND	ND	ND
n-Butanol	ND	--	--	--	--	--
Trimethylsilanol	ND	--	--	--	--	--

ND: Not detected; <MDL (Minimum Detection Limit)
TRACE: >MDL, <MQL (Minimum Quantification Limit)
MI: matrix interference
--: Data are not available due to failure of AQM2.

Toxicological Evaluation of ISS Air Quality

Routine air quality monitoring is performed in-flight using the AQMs. Archive air samples (mGSCs and formaldehyde badges) are collected during each Increment and returned for analysis in the Toxicology and Environmental Chemistry (TEC) Air Quality Laboratory. Data from the ground analyses complement the in-flight data and provide a more complete understanding of air quality on the ISS. The routine mGSC samples for this Increment that returned on SpX-18 and SpX-19 confirmed air quality was acceptable. **All measured values for routine samples (mGSC and AQM) met 180-d T-value guideline criteria (T < 1), indicating no concern for crew health.** The average, rounded T-value calculated from the nominal Increment 60 mGSC samples was 0.2 (Figure 1). The T-value decreased as acrylonitrile fell below the level of quantitation in August. As mentioned previously, the pressure in sample AQ200082, taken in the SM on

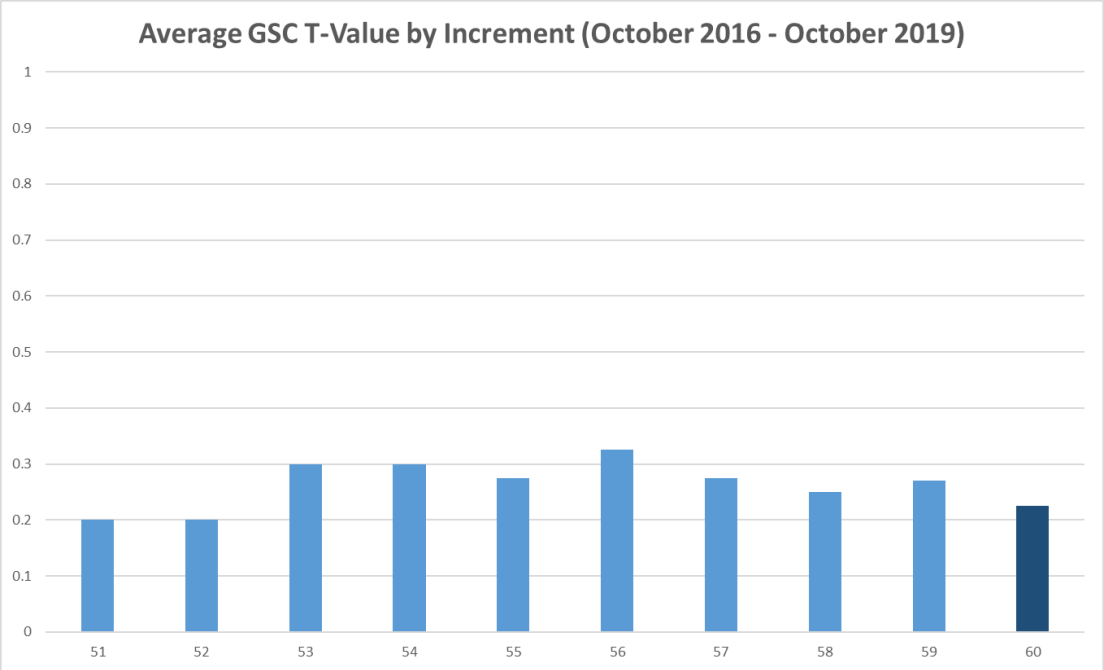

Figure 1. GSC-Derived T-values for Increments 51- 60

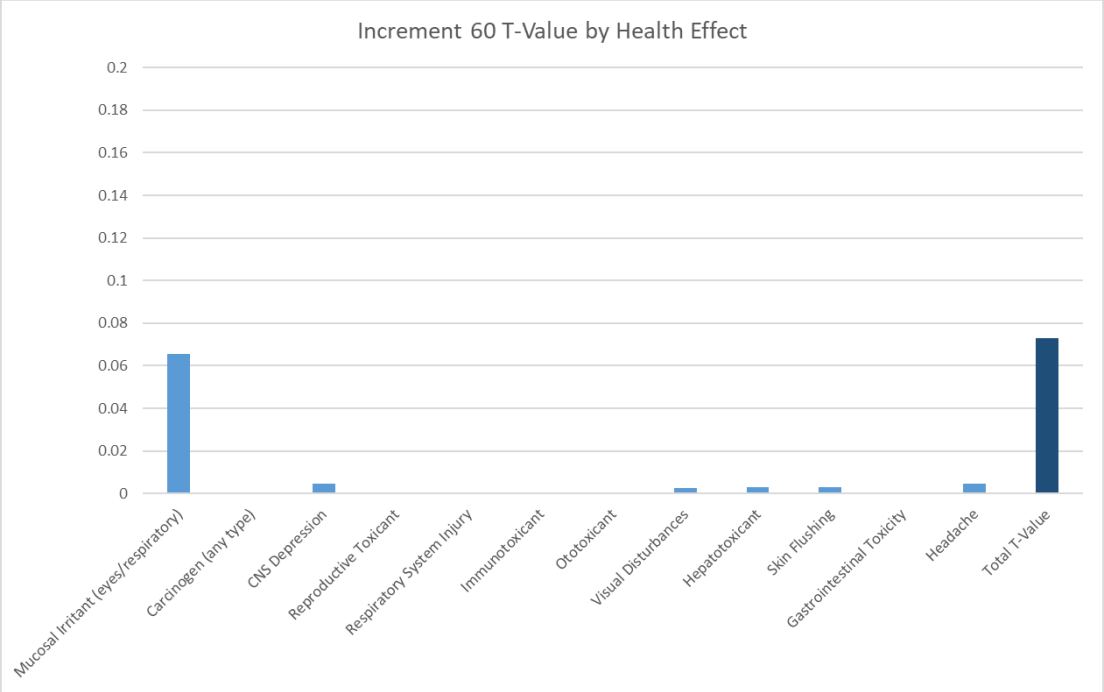

Figure 2. AQM-Derived T-Values by Health Effect for Increment 60

August 28, 2019, was low (2-3 psia), which resulted in higher than usual reporting limits. This may have contributed to the low T-value for this sample (0.08). T-values calculated from GSC results (Figure 1; 0.23) and AQM (Figure 2; 0.07) diverged during this Increment. This is a primarily the result of the loss of data

for analytes measured on AQM2 and the continuing difficulties in quantitating 2-propanol (isopropanol) due to matrix interference.

The four mGSC samples from July and August 2019 contained a CO_2 concentration below the limit documented in Flight Note F091532D, which requests that the 24-hour average concentration not exceed 3.1 mmHg (7300 mg/m^3) on the US segment. While mGSC CO_2 sampling provides a snap-shot of the CO_2 concentration, the major constituent analyzer (MCA) routinely monitors CO_2 levels in the US segment (Figure 3). For this reason, data from the MCA are better suited for evaluation of short and long-term trends in CO_2. Concentrations measured by the MCA fluctuate as a result of multiple factors including the number of crew on ISS, current scrubbing capability, and processes and activities that generate CO_2.

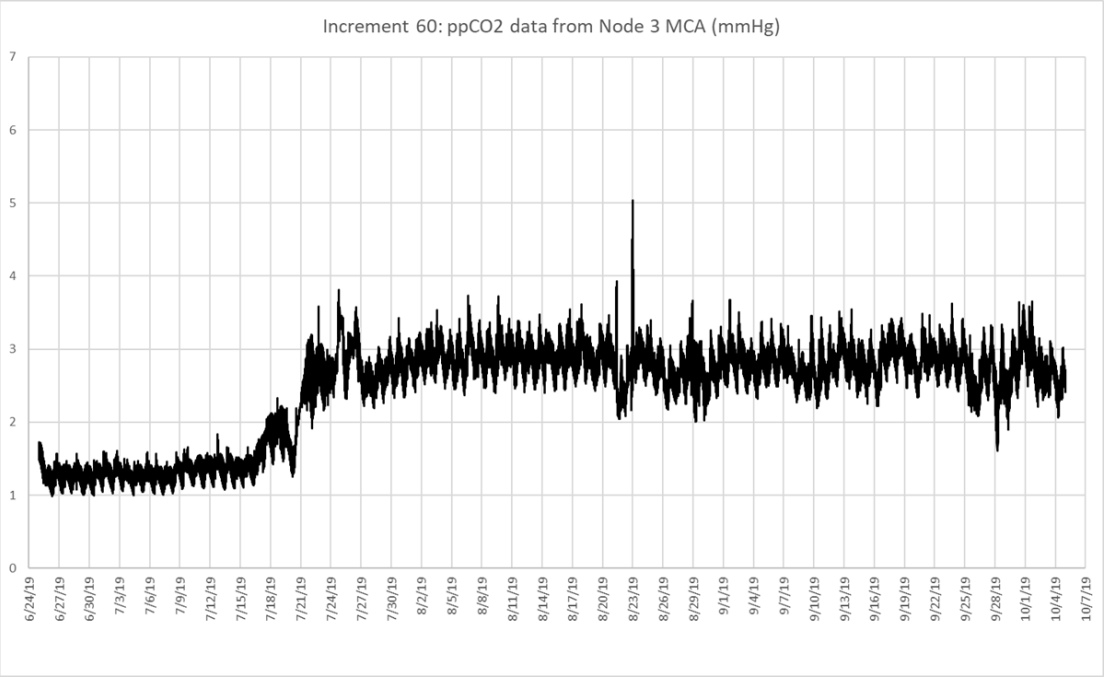

Figure 3. Environmental CO_2 Concentrations on ISS Increment 60 in mmHg

CO_2 data during Increment 60 were obtained from the MCA in Node 3. Overall, CO_2 concentrations were well-controlled throughout the Increment (Figure 3). CO_2 control on the US segment was provided by the Thermal Amine Scrubber (TAS) until the blower failed on August 16, 2019. At that time, one of the Carbon Dioxide Removal Assemblies (CDRAs) was reactivated. CO_2 levels have historically been maintained between 1.5 and 2 mmHg with 3-person crew and closer to 3 mmHg with 6 crew. The ISS crew was comprised of 3 crew from the beginning of the Increment until additional personnel arrived on July 20, 2019. Three additional crew arrived on September 25, 2019, bringing the total crew to 9. CO_2 levels were well controlled during 9-crew operations and the concentration was maintained below the 3.1 mmHg limit despite the additional load. To prepare for 9-crew ops, additional CO_2 scrubbing capacity was engaged, including the ESA Life Support Rack (LSR), the Lab CDRA, and Vozdukh. A rise to near 4 mmHg on August 21 was associated with the EVA (rapid sampling in the airlock) on that date. Subsequent metox regeneration resulted in a short excursion to 5 mmHg on August 23. Node 3 CDRA was activated to provide additional removal capacity during the regeneration.

Alcohol values in the mGSC samples taken in the US Lab in August 2019 returned on SpaceX-19 exceeded the guideline of <5 mg/m^3, which is intended to protect the water recovery system from risk of overloading. Total alcohol levels in this sample were primarily attributable to ethanol and 2-propanol in

the ISS atmosphere (5.3 mg/m^3 and 1.2 mg/m^3, respectively). Total alcohol levels in excess of 5 mg/m^3 were also observed in the ingress sample for HTV-8. These levels were mostly attributable to ethanol and 2-propanol. Levels of total alcohols have been fluctuating over the last two Increments (58-59). The concentration of 2-propanol on ISS increased notably following NG-11 berthing in April 2019. The most likely source of the increase appears to be the charcoal/HEPA filters that were delivered on NG-11 and installed throughout the USOS. Measured levels do not present a risk to crew health but could adversely impact the lifetime of consumables in the water recovery system. This trend will continue to be monitored.

Two sets of passive formaldehyde badges were deployed on ISS during Increment 60 (on August 28 and October 8, 2019). Analytical results from these badges indicated that formaldehyde remains in the historical range observed on ISS, and concentrations are well below the long term SMAC of 120 µg/m^3 (Figure 4). The concentrations in the SM ranged from 17-23 µg/m^3, and in the US Lab the concentration was 29 µg/m^3, similar to levels observed in March and May 2019.

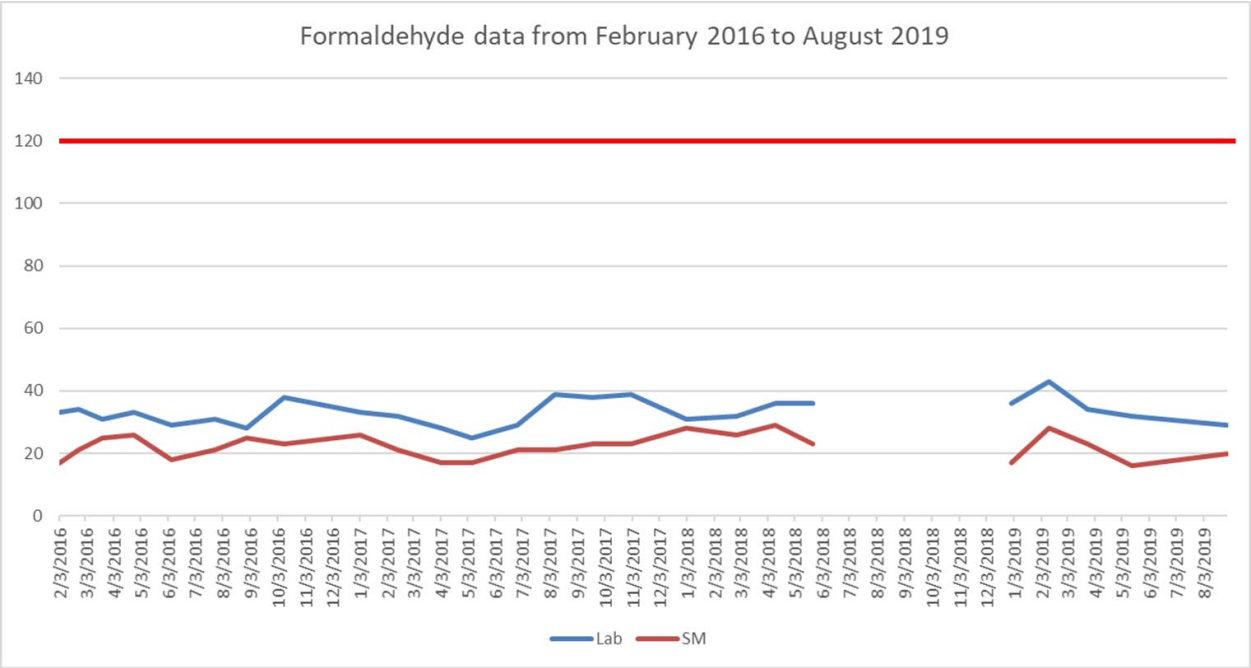

Figure 4: Formaldehyde Concentrations in ISS Air, February 2016 through August 2019

WATER QUALITY

Two water samples were collected from the US Potable Water Dispenser (PWD) during Increment 60: hot water on August 27, and ambient water on September 16, 2019. Samples of US wastewater, stagnant water from the Universal Waste Management System (UWMS), product water from the WPA auxiliary port, and US condensate were also collected during the Increment. Complete data tables with results for all measured parameters are available upon request. A summary of select analytical results from the Increment 60 samples is provided in Table 3. Expanded summary tables containing organic carbon recoveries and results for all analytes present at concentrations above reporting limits are included as attachments to this report.

Table 3. Analytical Summary of ISS Water Analyses (Increment 60)

Return Mission	Sample Location	Sample Date	TOC (mg/L)	DMSD (mg/L)	Methyl Sulfone (mg/L)	Conductivity (µS/cm)	Total Iodine (mg/L)
SpaceX-18	US Condensate	7/17/2019	24.3	3.7	< 0.02	172	NA
SpaceX-18	WPA Wastewater	8/6/2019	12.2	2.1	0.1	30	NA
SpaceX-18	WHC Wastewater	8/7/2019	4.7	15	NA	4	NA
SpaceX-18	WPA Product Water	8/14/2019	0.47	< 1	0.1	2	2.24
Soyuz-58	PWD Hot	8/27/2019	0.40	< 1	0.1	1	< 0.05
Soyuz-58	PWD Ambient	9/16/2019	0.15	< 1	0.1	< 1	< 0.05

NA: not analyzed

Toxicological Evaluation of ISS Water Quality

Routine water quality monitoring is performed in-flight using the total organic carbon analyzer (TOCA). Results from these analyses provide a general indication of overall water quality. Typically, archive water samples are also collected during each Increment and returned for comprehensive analysis in ground laboratories. Data from the ground analyses complement the in-flight data and provide a more complete understanding of water quality on the ISS.

Potable Water

Concentrations of all chemicals detected in the potable water samples met the requirements listed in SSP 41000, *System Specification for the International Space Station* and JSC 63414, *Spacecraft Water Exposure Guidelines (SWEGs)*. Total organic carbon (TOC) concentrations from in-flight (PWD TOC and WPA TOC) and ground analyses (Archive TOC) performed between October 2016 and October 2019 are shown in Figure 5. The TOC concentration in the two potable samples were lower than those measured in Increment 59, and even further below both the specification for the US segment (<3 mg/L) and the 100-day SWEG (5 mg/L). The WPA was reconfigured in July 2019 to operate with a single multifiltration (MF) bed. A new catalytic reactor was also installed during the reconfiguration. This resulted in a notable drop in TOC and DMSD concentrations in samples collected in August and September compared to samples collected in May and June. **Based on results from analyses run on TOCA and from ground-based analysis, the water produced by the Water Processor Assembly (WPA) met the US potability requirement for TOC.**

Iodine is a biocide used on the US Segment. It is added to the water produced by the WPA but removed prior to crew consumption to avoid potential thyroid dysfunction. The total iodine level in the potable samples collected from the PWD was below the reporting limit (0.05 mg/L), indicating effective removal of iodine in water intended for consumption. For additional information regarding microbial analyses, see the Increment 60 post-flight report generated by the JSC Environmental Microbiology Laboratory.

US Condensate

A sample of condensate from the US segment was collected on July 17, 2019. The TOC concentration in the sample was 24.3 mg/L, and accountability for TOC was >100%. Organic compounds detected at or above 1 mg/L include ethanol (16.0 mg/L), acetate (11.1 mg/L), 2-propanol (8.1 mg/L), acetone (7.3 mg/L), methanol (5.0 mg/L), DMSD (3.7 mg/L), propylene glycol (3.5 mg/L), and ethylene glycol (2.8 mg/L). Silicon was present at a concentration of 1.7 mg/L, which is accounted for by DMSD. Of the metals analyzed, only zinc was detected at levels above 0.1 mg/L (1.4 mg/L). Trace amounts of aluminum, boron, copper, nickel, and silver were also present.

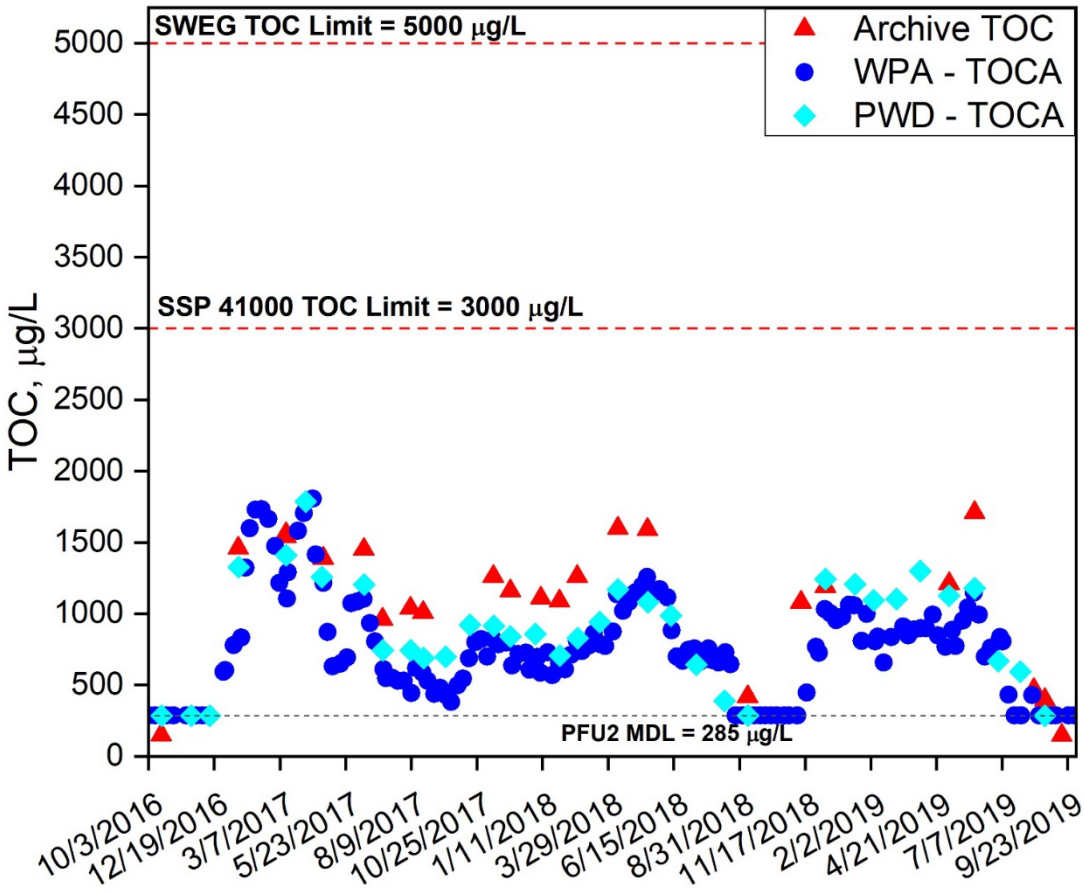

Figure 5. Total Organic Carbon (TOC) trending in US Potable Water

WPA Wastewater

A sample was collected from the WPA Wastewater ORU on August 6, 2019. The TOC concentration was 12.2 mg/L, which is much lower than the historical average of 44.0 mg/L. Organic compounds detected at or above 1 mg/L include acetone (9.7 mg/L), methanol (5.4. mg/L), and DMSD (2.1 mg/L). The organic carbon recovery was 76.3%. The silicon concentration was 0.7 mg/L, which can be accounted for by the presence of DMSD. Zinc (0.5 mg/L) was the only metal present at or above 1.0 mg/L. Ammonium was present at a concentration of 3.4 mg/L, which is the lowest concentration ever measured in WPA wastewater. The low TOC and ammonia concentrations in this sample suggest that the wastewater may have been diluted with water from the Water Supply System resupply tanks.

Stagnant Water in UWMS

A sample of stagnant water from an unused leg of the flush water line connected to the UWMS was collected on August 7, 2019. The sample was collected to ensure that no corrosion products or other unusual chemical species were present in the line prior to activation of the UWMS. The TOC concentration in the sample was 4.7 mg/L. DMSD was present in this sample at a concentration of 15.0 mg/L. Silicon was detected at 5.0 mg/L, of which 91% can be accounted for by DMSD. Trace metals in the sample included copper (0.9 mg/L), manganese (0.04 mg/L), nickel (0.03 mg/L), and barium (0.01 mg/L).

WPA Auxiliary Port Product Water

A sample of iodinated product water was collected from the WPA auxiliary port on August 14, 2019. The TOC concentration in the sample was 0.47 mg/L. The only organic compound detected above reporting limits was methyl sulfone (45 µg/L). Trace amounts of nickel, aluminum, copper, and zinc were detected, along with small amounts of potassium and sodium. The total iodine concentration was 2.24 mg/L and the biocidal iodine concentration was 1.93 mg/L.

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Enclosures

Table 1A: Analytical concentrations of compounds quantified in the mGSC returned on SpaceX-18

Table 1B: Analytical concentrations of compounds quantified in the mGSC returned on SpaceX-19

Table 2A: T-values corresponding to concentrations for routine mGSC samples returned on SpaceX-18, based on 180-day SMACs

Table 2B: T-values corresponding to concentrations for SpaceX-18 ingress air sample, based on 7-day and 180-day SMACs

Table 2C: T-values corresponding to concentrations for routine mGSC samples returned on SpaceX-19, based on 180-day SMACs

Table 2D: T-values corresponding to concentrations for HTV-8 ingress air sample returned on SpaceX-19, based on 7-day and 180-day SMACs

Table 3A: Analytical concentrations of compounds quantified in potable ambient and hot water samples returned on Soyuz 58

Table 3B: Analytical concentrations of compounds quantified in WPA product water, US condensate, WPA wastewater, and UWMS stagnant water returned on SpaceX-18

TABLE 1A
ANALYTICAL RESULTS FOR SPACEX-18 RETURN AIR SAMPLES (CONDENSED TABLE)

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M3)		
	AQ190525 S/N 2034 Lab 7/17/2019 @ 9:51	**AQ190526 S/N 2035 COL 7/17/2019 @ 9:52**	**AQ190527 S/N 2031 SpaceX-18 Ingress 7/28/2019 @ 8:02**
TARGET COMPOUNDS (TO-15) *			
1,1,1,2-Tetrafluoroethane (Norflurane)	0.10	0.10	0.61
Propene	0.20	0.21	TRACE
Chloromethane	TRACE	TRACE	<0.025
Isobutane	TRACE	TRACE	<0.025
Methanol	0.36	0.37	0.38
Acetaldehyde	0.10	0.10	0.054
2-Methyl-1-propene	TRACE	TRACE	<0.025
Ethanol	2.3	2.4	0.81
Acetone	0.24	0.24	0.16
2-Propanol (Isopropanol)	1.5	1.5	0.88
Acrylonitrile	TRACE	TRACE	<0.025
Methylene chloride (Dichloromethane)	<0.025	<0.025	0.052
Carbon disulfide	TRACE	TRACE	<0.025
1-Propanol	0.031	0.054	<0.025
Trimethylsilanol	0.047	0.054	0.040
1-Butanol	<0.025	<0.025	0.029
Octafluoropropane (Perfluoropropane)	25	28	6.4
SPECIAL INTEREST COMPOUND			
Special Interest Compound was below its reporting limit			
NON-TARGET COMPOUNDS **			
Non-Target Compound was below its reporting limit			
TOTAL ALCOHOLS PLUS ACETONE	4.4	4.7	2.3
TARGET COMPOUNDS (GC) *			
Methane	18	19	4.3
Carbon dioxide	4500	4800	1700
Hydrogen	2.8	2.9	1.1
Carbon monoxide	0.73	0.71	4.2

* Quantified using a multi-point calibration

** Quantified using "B" response factor except where noted; concentrations are estimates only.

< : Value is less than the laboratory reporting limit.

TRACE: Amount detected is sufficient for compound identification only.

TABLE 1B
ANALYTICAL RESULTS FOR SPACEX-19 RETURN SAMPLES (CONDENSED TABLE)

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M^3)		
	AQ200081 S/N 2024 LAB 8/28/19 @ 13:30	**AQ200082 S/N 2025 SERVICE MODULE 8/28/19 @ 13:35**	**AQ200083 S/N 2036 HTV-8 INGRESS 9/28/19 @ 19:25**
TARGET COMPOUNDS (TO-15) *			
1,1,1,2-Tetrafluoroethane (Norflurane)	0.17	<0.25	<0.050
Carbonyl sulfide (Carbon oxide sulfide)	<0.025	<0.10	0.057
Isobutane	<0.025	<0.10	0.092
Methanol	0.33	0.31	0.26
Acetaldehyde	0.14	0.15	0.12
2-Methyl-1-propene	<0.025	<0.10	0.080
Ethanol	5.3	3.4	2.3
Acetone	0.33	0.50	0.26
Propanal (Propionaldehyde)	<0.025	<0.10	TRACE
2-Propanol (Isopropanol)	1.2	0.54	2.3
Methylene chloride (Dichloromethane)	<0.025	<0.12	0.34
Carbon disulfide	<0.025	<0.12	0.073
1-Propanol	<0.025	<0.10	0.030
Trimethylsilanol	<0.025	<0.15	4.1
2-Butanone (Methyl ethyl ketone)	<0.025	<0.10	0.053
Ethyl acetate	<0.025	<0.12	0.13
1-Butanol	<0.025	<0.12	0.041
Toluene	<0.025	<0.15	0.27
Octafluoropropane (Perfluoropropane)	26	21	11
SPECIAL INTEREST COMPOUNDS #			
Hexamethylcyclotrisiloxane (HMCTS)	0.21	<1.1	0.56
NON-TARGET COMPOUNDS **			
Fluorotrimethylsilane	<0.050	<0.28	0.16
TOTAL ALCOHOLS PLUS ACETONE	**7.2**	**4.7**	**5.1**
TARGET COMPOUNDS (GC) *			
Methane	31	23	19
Carbon dioxide	6300	5600	4500
Hydrogen	4.8	3.6	2.4
Carbon monoxide	0.76	<1.9	18

* Quantified using a multi-point calibration

** Quantified using "B" response factor except where noted; concentrations are estimates only.

Response factor generated from an internal study; concentrations are estimates only.

< : Value is less than the laboratory reporting limit.

TRACE: Amount detected is sufficient for compound identification only.

TABLE 2A
T-VALUES FOR SPACEX-18 RETURN AIR SAMPLES (CONDENSED TABLE)

CHEMICAL CONTAMINANT	AQ190525 S/N 2034 Lab 7/17/2019 @ 9:51	AQ190526 S/N 2035 COL 7/17/2019 @ 9:52
TARGET COMPOUNDS (TO-15)		
1,1,1,2-Tetrafluoroethane (Norflurane)	0.000	0.000
Propene	0.001	0.001
Chloromethane	0.007	0.007
Isobutane	0.000	0.000
Methanol	0.014	0.014
Acetaldehyde	0.026	0.026
2-Methyl-1-propene	0.001	0.001
Ethanol	0.001	0.001
Acetone	0.005	0.005
2-Propanol (Isopropanol)	0.010	0.010
Acrylonitrile	0.179	0.179
Carbon disulfide	0.011	0.011
1-Propanol	0.000	0.001
Trimethylsilanol	0.012	0.013
Octafluoropropane (Perfluoropropane)	0.000	0.000
SPECIAL INTEREST COMPOUND		
Special Interest Compound was below its reporting limit		
NON-TARGET COMPOUND		
Non-Target Compound was below its reporting limit		
TARGET COMPOUNDS (GC)		
Methane	0.004	0.005
Hydrogen	0.006	0.009
Carbon monoxide	0.017	0.036
TOTAL T-VALUE	**0.29**	**0.32**

ND : Value is less than the laboratory reporting limit.
Note: Number of decimal places in T-Values do not represent significant figures of measurements.

TABLE 2B
T-VALUES FOR SPACEX-18 INGRESS SAMPLE (CONDENSED TABLE)

CHEMICAL CONTAMINANT	T-VALUE (7- & 180-d)	
	7-d SMAC AQ190527 S/N 2031 SpaceX-18 Ingress 7/28/2019 @ 8:02	180-d SMAC AQ190527 S/N 2031 SpaceX-18 Ingress 7/28/2019 @ 8:02
TARGET COMPOUNDS (TO-15)		
1,1,1,2-Tetrafluoroethane (Norflurane)	0.000	0.000
Propene	0.000	0.000
Methanol	0.015	0.015
Acetaldehyde	0.014	0.014
Ethanol	0.000	0.000
Acetone	0.003	0.003
2-Propanol (Isopropanol)	0.006	0.006
Methylene chloride (Dichloromethane)	0.001	0.005
Trimethylsilanol	0.010	0.010
1-Butanol	0.000	0.001
Octafluoropropane (Perfluoropropane)	0.000	0.000
SPECIAL INTEREST COMPOUNDS		
Compound was below its laboratory reporting limit		
NON-TARGET COMPOUNDS		
All Non-target compounds were below their laboratory reporting limit		
TARGET COMPOUNDS (GC)		
Methane	0.005	0.001
Hydrogen	0.009	0.003
Carbon monoxide	0.010	0.244
TOTAL T-VALUE	**0.073**	**0.30**

ND : Value is less than the laboratory reporting limit.
Note: Number of decimal places in T-Values do not represent significant figures of measurements.

TABLE 2C
T-VALUES FOR SPACEX-19 RETURN SAMPLES (CONDENSED TABLE)

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)	
	AQ200081 S/N 2024 LAB 8/28/19 @ 13:30	AQ200082 S/N 2025 SERVICE MODULE 8/28/19 @ 13:35
TARGET COMPOUNDS (TO-15)		
1,1,1,2-Tetrafluoroethane (Norflurane)	0.000	ND
Methanol	0.013	0.012
Acetaldehyde	0.035	0.037
Ethanol	0.003	0.002
Acetone	0.006	0.010
2-Propanol (Isopropanol)	0.008	0.004
Octafluoropropane (Perfluoropropane)	0.000	0.000
SPECIAL INTEREST COMPOUNDS		
Hexamethylcyclotrisiloxane (HMCTS)	0.024	ND
NON-TARGET COMPOUNDS		
All Non-Target Compounds were below their reporting limit		
TARGET COMPOUNDS (GC)		
Methane	0.009	0.007
Hydrogen	0.014	0.011
Carbon monoxide	0.044	ND
TOTAL T-VALUE	**0.157**	**0.081**

ND : Value is less than the laboratory reporting limit.
Note: Number of decimal places in T-Values do not represent significant figures of measurements.

TABLE 2D
T-VALUES FOR SPACEX-19 RETURN INGRESS SAMPLE (CONDENSED TABLE)

CHEMICAL CONTAMINANT	T-VALUE (7-d & 180-d SMAC)	
	7-d SMAC	180-d SMAC
	AQ200083 S/N 2036 HTV-8 INGRESS 9/28/19 @ 19:25	AQ200083 S/N 2036 HTV-8 INGRESS 9/28/19 @ 19:25
TARGET COMPOUNDS (TO-15)		
Carbonyl sulfide (Carbon oxide sulfide)	0.001	0.003
Isobutane	0.000	0.000
Methanol	0.010	0.010
Acetaldehyde	0.030	0.030
2-Methyl-1-propene	0.001	0.003
Ethanol	0.001	0.001
Acetone	0.005	0.005
Propanal (Propionaldehyde)	0.001	0.001
2-Propanol (Isopropanol)	0.015	0.015
Methylene chloride (Dichloromethane)	0.007	0.034
Carbon disulfide	0.067	0.067
1-Propanol	0.000	0.000
Trimethylsilanol	1.03	1.03
2-Butanone (Methyl ethyl ketone)	0.002	0.002
Ethyl acetate	0.001	0.001
1-Butanol	0.001	0.001
Toluene	0.018	0.018
Octafluoropropane (Perfluoropropane)	0.000	0.000
SPECIAL INTEREST COMPOUNDS		
Hexamethylcyclotrisiloxane (HMCTS)	0.006	0.062
NON-TARGET COMPOUNDS		
Fluorotrimethylsilane	0.042	0.070
TARGET COMPOUNDS (GC)		
Methane	0.006	0.006
Hydrogen	0.007	0.007
Carbon monoxide	0.283	1.05
TOTAL T-VALUE	**1.54**	**2.42**

ND : Value is less than the laboratory reporting limit.
Note: Number of decimal places in T-Values do not represent significant figures of measurements.

Table 3A: Analytical concentrations of compounds quantified in potable ambient and hot water samples returned on Soyuz 58

Increment					60	
Mission					Soyuz 58	
Sample Location			Potable Water		WPA PWD Hot	WPA PWD Ambient
Sample Description		Test	Maximum Contaminant	Maximum Contaminant	Potable water	Potable water
Sample Date		Conducted	Level	Level	8/27/2019	9/16/2019
Analysis/Sample ID	Units	by	(MCL)	Source	WQ190456	WQ190457
Physical Characteristics						
Conductivity	µS/cm	U.S.			1	< 1
pH	pH units	U.S.	4.5-8.5	41000	5.69	5.59
Minerals ICPMS						
Calcium	mg/L	U.S.	30	41000	0.02	< 0.01
Trace Metals ICPMS						
Aluminum	µg/L	U.S.			2	1
Copper	µg/L	U.S.	1,000	41000	1	< 1
Nickel	µg/L	U.S.	300	SWEG&41000	3	3
Silicon ICPMS						
Silicon	µg/L	U.S.			224	54
Total Organic Carbon-Sievers						
Total Inorganic Carbon (TIC)	mg/L	U.S.			0.96	0.97
Total Organic Carbon (TOC)	mg/L	U.S.		SWEG / 41000	0.40	0.15
Semi-volatile Organics-Targets						
Methyl sulfone	µg/L	U.S.	1,500,000	interim SWEG (06-2017)	72	71
Base and Neutral Extractables-EPA 625 List GCMS						
Diethylphthalate	µg/L	U.S.			32	32
Organic Carbon Recovery	percent	U.S.			9.80	26.53
Unaccounted Organic Carbon	mg/L	U.S.			0.36	0.11

Comments: None.

Data Qualifiers: WQ190456 & -457 Methyl sulfone - Possible high bias

Table 3B: Analytical concentrations of compounds quantified in WPA product water, US condensate, WPA wastewater, and UWMS stagnant water returned on SpaceX-18

Increment					60			
Mission					SpaceX-18			
Sample Location			Potable Water		WPA PWD Aux Port	WPA Condensate Sample Port	WPA Wastewater ORU	Waste Hygiene Compartment (WHC)
Sample Description					WPA Product Water	US Condensate	WPA Wastewater	Stagnant Water to Universal Waste Management System (UWMS)
Sample Date		Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	8/14/2019	7/17/2019	8/6/2019	8/7/2019
Analysis/Sample ID	Units				WQ190424	WQ190425	WQ190426	WQ190427
Physical Characteristics								
Conductivity	µS/cm	U.S.			2	172	30	4
pH	pH units	U.S.	4.5-8.5	41000	5.46	7.73	7.06	6.50
Iodine LCV								
Iodide	mg/L	U.S.			0.31	NA	NA	NA
Iodine	mg/L	U.S.			1.93	NA	NA	NA
Total I	mg/L	U.S.	6/0.2	41000 (tl I max/tl I at pt of consumption)	2.24	NA	NA	NA
Anions IC								
Fluoride	mg/L	U.S.			< 0.1	< 0.1	0.3	NA
Phosphate (as P)	mg/L	U.S.			< 0.1	< 0.1	0.5	NA
Cations IC								
Ammonium (as N)	mg/L	U.S.	1	SWEG&41000	< 0.25	23.8	3.4	NA
Minerals ICPMS								
Calcium	mg/L	U.S.	30	41000	< 0.01	0.02	0.04	0.75
Magnesium	mg/L	U.S.	50	41000	< 0.01	< 0.01	0.01	0.51
Potassium	mg/L	U.S.	340	41000	0.02	< 0.01	0.29	< 0.10
Sodium	mg/L	U.S.			0.07	< 0.01	0.26	0.64
Trace Metals ICPMS								
Aluminum	µg/L	U.S.			20	7	6	< 10
Barium	µg/L	U.S.	10,000	SWEG&41000	< 1	< 1	< 1	10
Boron	µg/L	U.S.			< 1	34	6	< 10
Chromium	µg/L	U.S.	230	41000	< 1	< 1	85	< 10
Copper	µg/L	U.S.	1,000	41000	12	1	< 1	872
Manganese	µg/L	U.S.	300	SWEG&41000	< 1	< 1	< 1	41
Nickel	µg/L	U.S.	300	SWEG&41000	42	35	62	32
Zinc	µg/L	U.S.	2,000	SWEG&41000	4	1,440	520	< 10
Silicon ICPMS								
Silicon	µg/L	U.S.			388	1,650	671	5,040
Total Organic Carbon-Sievers & Total Organic Carbon-OI								
Total Inorganic Carbon (TIC)	mg/L	U.S.			0.61	17.6	3.73	< 3.00
Total Organic Carbon (TOC)	mg/L	U.S.		SWEG / 41000	0.47	24.3	12.2	4.72
Volatile Organics-Targets								
Acetone	µg/L	U.S.	15,000	SWEG	< 50	See Alcohols	See Alcohols	NA
Semi-volatile Organics-Targets								
Benzothiazole	µg/L	U.S.			< 20	< 20	24	NA
Methyl sulfone	µg/L	U.S.	1,500,000	**interim SWEG (06-2017)**	45	< 20	86	NA
N-n-Butylbenzenesulfonamide	µg/L	U.S.			< 20	< 20	29	NA
Acid Extractables-EPA 625 List GCMS								
Benzoic acid	µg/L	U.S.			< 100	177	< 100	NA
Base and Neutral Extractables-EPA 625 List GCMS								
Benzyl alcohol	µg/L	U.S.			< 20	259	< 20	NA
Diethylphthalate	µg/L	U.S.			< 20	69	23	NA
Di-n-butylphthalate	µg/L	U.S.	40,000	SWEG	< 20	45	< 20	NA
Semi-volatile Organics-Special Interest Compounds (Semi-quantitative)								
2-Butoxyethanol	µg/L	U.S.			not found	55	not found	NA
2-Phenoxyethanol	µg/L	U.S.			not found	80	not found	NA
Ibuprofen	µg/L	U.S.			not found	not found	560	NA
Monomethyl phthalate	µg/L	U.S.			not found	29	< 10	NA
Neomenthol	µg/L	U.S.			not found	not found	81	NA
Alcohols & Acetone GCMS								
2-Propanol (Isopropanol)	µg/L	U.S.			< 400	8,120	< 400	NA
Acetone	µg/L	U.S.	15000	SWEG	See Volatiles	7,310	9,960	NA
Ethanol	µg/L	U.S.			< 400	16,000	< 400	NA
Methanol	µg/L	U.S.	40,000	SWEG	< 400	4,970	5,420	NA
Glycols GCMS								
1,2-Ethanediol (Ethylene glycol)	µg/L	U.S.	4000	SWEG	< 1000	2,780	< 1000	NA

Table 3B: Analytical concentrations of compounds quantified in WPA product water, US condensate, WPA wastewater, and UWMS stagnant water returned on SpaceX-18

Increment					60			
Mission					SpaceX-18			
Sample Location			Potable Water		WPA PWD Aux Port	WPA Condensate Sample Port	WPA Wastewater ORU	Waste Hygiene Compartment (WHC)
Sample Description					WPA Product Water	US Condensate	WPA Wastewater	Stagnant Water to Universal Waste Management System (UWMS)
Sample Date		Test	Maximum Contaminant	Maximum Contaminant	8/14/2019	7/17/2019	8/6/2019	8/7/2019
Analysis/Sample ID	Units	Conducted by	Level (MCL)	Level Source	WQ190424	WQ190425	WQ190426	WQ190427
1,2-Propanediol (Propylene glycol)	µg/L	U.S.	1,700,000	SWEG	< 1000	3,490	< 1000	NA
Silanols LCRI (Semi-Quantitative-NIST traceable standard not available)								
Dimethylsilanediol (DMSD)	µg/L	U.S.	35,000	SWEG	< 1000	3,700	2,100	15,000
Carboxylates IC								
Acetate	µg/L	U.S.			< 500	11,100	< 500	NA
Organic Carbon Recovery	percent	U.S.			2.36	116.55	76.33	N/A
Unaccounted Organic Carbon	mg/L	U.S.			0.46	0.00	2.89	N/A

Comments: NA=Not analyzed
N/A=Not applicable

Data Qualifiers: WQ190424: Dimethylsilanediol (DMSD) - Result close to RL (~ 998 µg/L)
WQ190427: Monomethylsilanetriol (MMST) - Result < but close to RL (~ 910 µg/L)