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DATE: October 21, 2025

SUBJECT: Toxicological Assessment of ISS Air and Water Quality: March 26, 2024 to September 23, 2024 (Increment 71) Including NG-21 Ingress and Boeing-CFT Ascent

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

AIR QUALITY

Nine archive air samples were collected in mini grab sample containers (mGSCs) on ISS during Increment 71: 8 routine and 1 ingress sample. A sample was also collected in Boeing's Starliner vehicle during its ascent to ISS in June 2024. A summary of the key air quality indicators from the Increment 71 mGSC samples is provided in Table 1. As during the previous Increment, technical issues with formaldehyde badges caused concern about the validity of data from those samples; no results are reported from the badges deployed during the Increment.

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 collected during Increment 71 were within acceptable limits. The mean relative recoveries of the three surrogate standards were all within acceptable limits for the reported samples.

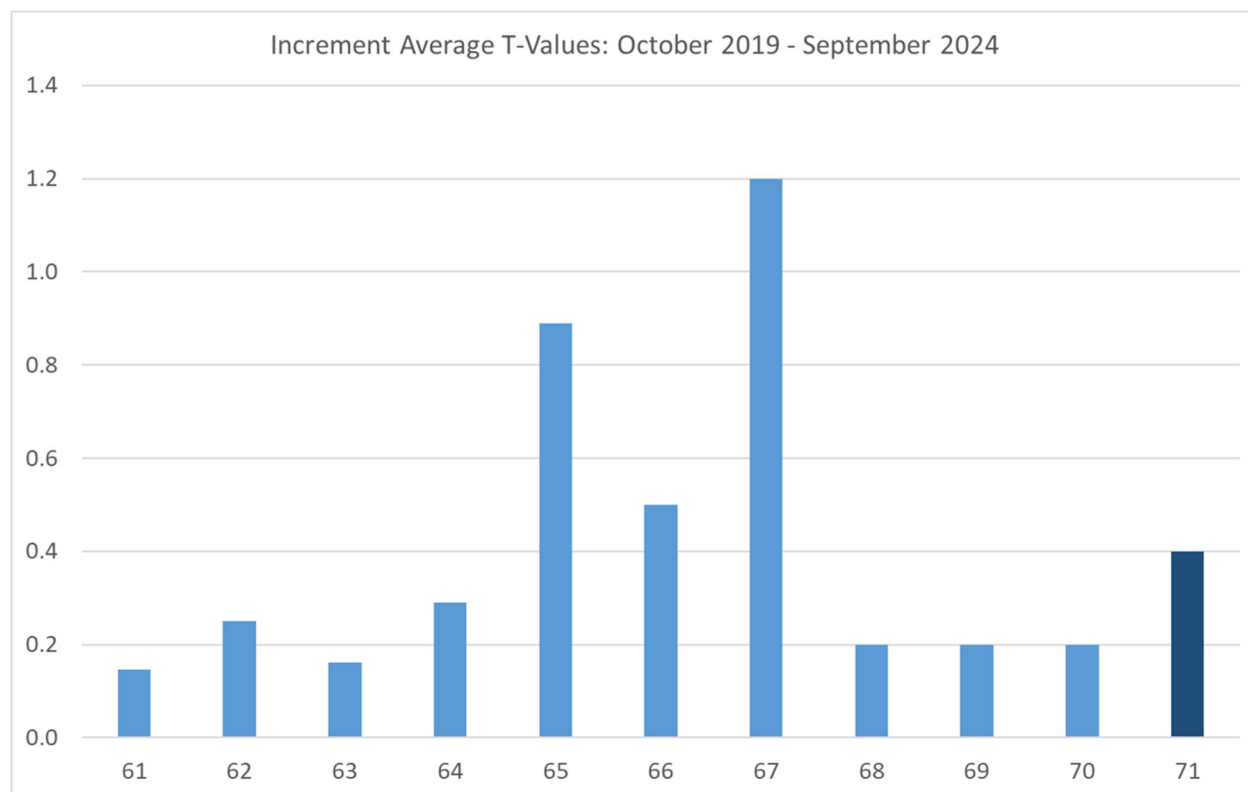
Toxicological Evaluation of ISS Air Quality

Archive air samples (mGSCs and formaldehyde badges) are collected during each Increment and returned for analysis in the Environmental Chemistry Laboratory. Data from the ground analyses complement the in-flight data and provide a more complete understanding of air quality on the ISS. Analytical results from the routine mGSC samples that returned on Crew-8 confirmed that air quality was acceptable during this Increment. **T-values calculated using data from all routine archive samples met the 180-d T-value guideline ($T < 1$), indicating no concern for crew health.**

The average, rounded T-value calculated from the nominal Increment 71 mGSC samples was 0.4 (Figure 1). This value is a slight increase from the 0.2 T-value averages observed in Increment 68-70. The increase is attributable to acrylonitrile in samples collected from June through September. Acrylonitrile was previously seen on ISS during Increment 65-67 (T-values 0.5 - 1.2). The temporary source of acrylonitrile in earlier Increments was not determined despite evaluation of several potential sources; acrylonitrile was detected in the JPM in March 2024 (0.016 mg/m³), and the T-value of that sample was 0.4.

Table 1. Analytical summary of ISS air analyses from mGSCs during Increment 71

Return Flight	Sample Location	Sample Date	Alcohols ^a (mg/m ³)	T-Value ^b (units)
Crew-8	US Lab	5/8/2024	5.6	0.2
Crew-8	Columbus	5/8/2024	5.5	0.2
Boeing-CFT	Ascent	6/6/2024	0.3	0.2
Crew-8	SM	6/17/2024	4.6	0.2
Crew-8	US Lab	6/17/2024	5.4	0.4
Crew-8	US Lab	7/22/2024	4.0	0.7
Crew-8	JPM	7/22/2024	4.0	0.7
Crew-8	NG-21 ingress	8/6/2024	1.5	0.8 (0.5)
Crew-8	US Lab	9/11/2024	2.8	0.4
Crew-8	Columbus	9/11/2024	2.8	0.5
<i>Guideline</i>			<5	<1 ^c

^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.**Figure 1. mGSC-Derived T-values for Increments 61-71
(does not include CO₂, first ingress, or contingency samples)**

Alcohol values for three of the eight routine mGSC samples returned on Crew-8 exceeded the ECLS guideline of $<5 \text{ mg/m}^3$. The levels are mostly attributable to ethanol. Measured levels do not present a risk to crew health but are a potential concern for the water recovery system. Data from ANITA-2 indicates that ethanol levels averaged above 3.5 mg/m^3 from March through June but dropped markedly through the rest of the Increment.

Seven of the eight routine mGSC samples collected and analyzed during Increment 71 contained a CO_2 concentration below the limit documented in Flight Note F091532D, which requests that the 24-hour average concentration not exceed 3.0 mmHg (7100 mg/m^3 , 4000 ppm) on the US segment. The sample collected in the SM on June 17, 2024, slightly exceeded that guideline value (7500 mg/m^3). While mGSC CO_2 sampling provides a snapshot of the CO_2 concentration, real-time CO_2 data are available from the Commercial Major Atmospheric Constituents Sensors (CMACS), from ANITA-2 (Analyzing Interferometer for Ambient Air, a Fourier-transform infrared spectrometer built by Sintef and flown to ISS by the European Space Agency) in Columbus, and intermittently from the Major Constituent Analyzers (MCAs) in Node 3 and the US Lab (daily average CO_2 concentrations are represented in Figure 2). To preserve the longevity of the instrumentation, MCAs are only activated during EVA activities, crew metabolic characterization, tech demo analysis, anomaly resolution, and when requested by crew surgeons.

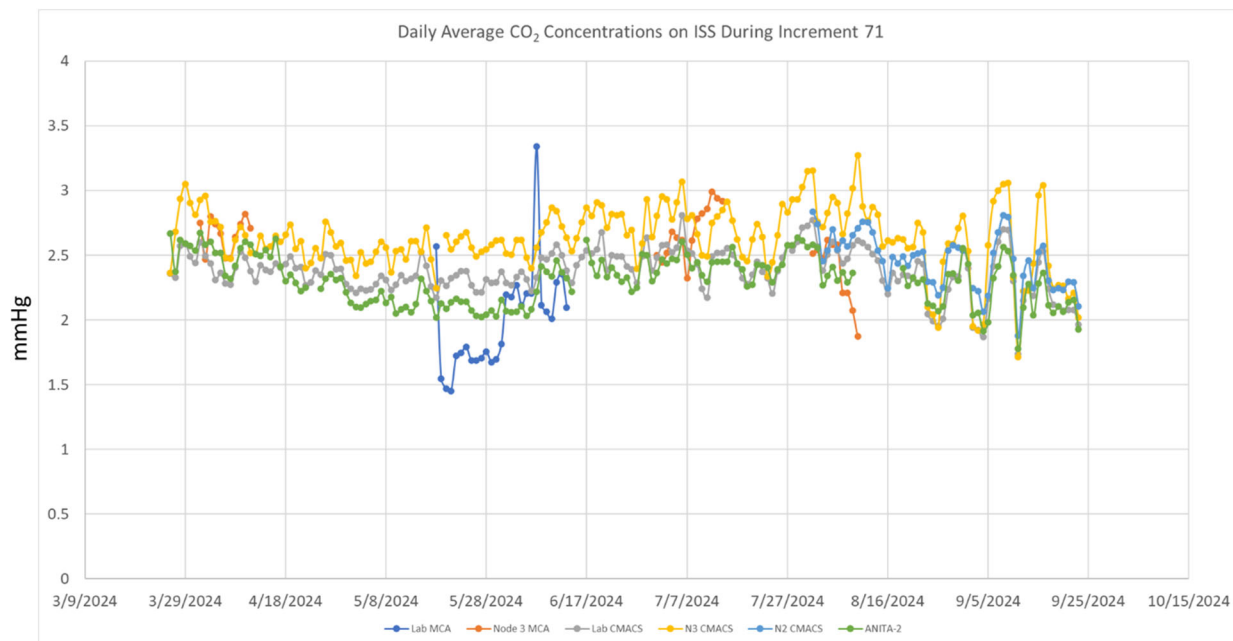


Figure 2. Environmental ppCO_2 Concentrations on ISS During Increment 71 (mmHg)

Since 2013, ISS air quality monitoring is performed in-flight using the Air Quality Monitors (AQMs). During this Increment, NASA received additional information on trace contaminant levels in ISS from ANITA-2. ANITA-2 began operations on ISS as a technological demonstration unit in March 2022 and provides data on up to 48 analytes every 6-10 minutes. Initially, ANITA-2 was installed in the US Lab but has since been relocated to the Columbus module. Recently (early 2025), NASA has selected ANITA-2 as its primary trace contaminants monitor for ISS after a review of its performance against archive samples and AQM readings. Monthly average readings for several of ANITA-2's target compounds are presented in Table 2. Detailed information about the ANITA-2 hardware is available upon request.

On-orbit, the Air Quality Monitors (AQMs) nominally collect and analyze samples every 73 hours, which results in 2-3 sampling sessions per unit per week. However, both AQMs failed during Increment 69 and were replaced during Increment 70. Review of data from the AQMs suggests that AQM1 was overly sensitive to several analytes during this period; ground personnel developed an ad hoc adjustment to the process for developing concentrations from the instruments. This adjustment relied on data from ANITA-2, and as such there is little value in reporting data from AQM during Increment 71 or beyond. AQMs were decommissioned in April 2025 and returned on SpaceX-32 (May 2025).

Levels of octafluoropropane (Freon 218) continue to be very low in ISS air compared with historical measurements due to continued operation of a CO₂ removal technology demonstration unit that very efficiently scrubs octafluoropropane from the ISS atmosphere. ANITA-2 observed very low average octafluoropropane concentrations through June, but a release of octafluoropropane took place in July (Table S-1).

Four sets of passive formaldehyde badges were deployed on ISS during Increment 71. Unfortunately, the analytical results from these samples cannot be reported due to quality concerns. Four of the badges were not properly sealed for return, and anomalous results from controls and blanks indicate that these sets of badges are unlikely to provide accurate results. ANITA-2 has the capability to measure formaldehyde at levels on the order of 80 µg/m³, but this instrument did not report any detections of formaldehyde during Increment 71.

Table 2: Monthly average concentrations (mg/m³) of ANITA-2 target compounds (Increment 71)

Compound	March 2024	April 2024	May 2024	June 2024	July 2024	August 2024	September 2024	Increment Average
Methanol	0.42	0.42	0.39	0.35	0.31	0.31	0.31	0.36
Ethanol	3.5	4.1	4.1	3.5	2.7	2.4	2.1	3.2
2-Propanol	0.44	0.41	0.44	0.42	0.53	0.97	1.31	0.64
PFP	0.14	0.30	0.42	0.82	74	33	12	17.3
R134a	0.11		0.14	0.12		0.10		
DMCPS	1.02				1.03	1.02		
TMS						0.33		
HMCTS						0.11		
OCTMS						0.05		
SF6	0.04	0.02	0.02	0.04	0.07	0.05	0.08	0.05
Ammonia		0.03					0.03	
CO	1.72	2.10	2.10	2.11	2.32	1.52	1.75	1.9
Methane	61	64	50	49	67	88	98	68
CO2	2.3	2.4	2.1	2.3	2.5	2.3	2.2	2.3
Isobutane	0.43					0.56		
N2O	0.18	0.09	0.15			0.06	0.40	0.18
CF4	0.13	0.12	0.12	0.11	0.12	0.15	0.17	0.13

Note: Blank cells indicate that the compound was not detected during that month.

NG-21 Ingress

An mGSC sample was collected upon ingress on NG-21 on August 6, 2024. The hatch was opened at 14:17, and the sample was taken at 14:26. Analytical results from the sample indicate a lower level of methane (13 mg/m³) than found on ISS (~70-95 mg/m³), which indicates low levels of mixing between the visiting vehicle and the full ISS volume. Levels of ethanol were also markedly lower (0.9 mg/m³ vs. ~2 mg/m³). The vehicle also had levels of isobutane (1.5 mg/m³) higher than expected on ISS (<0.05 mg/m³). **The T-value for this sample was 0.5, well below levels of concern for crew health.** Trimethylsilanol and fluorotrimethylsilane were leading contributors to T-value in the ingress sample.

WATER QUALITY

In total, six water samples were collected from the US Segment during Increment 71 and returned on SpX-30, -31, and Crew-8. Two of these were hot potable water samples collected from the US Potable Water Dispenser (PWD) and the Exploration Potable Water Dispenser (xPWD) and one ambient water sample from xPWD, which fall under the ISS Crew Health Care System (CHeCS). The remaining three samples were non-potable water, including one wastewater and two condensate samples (ECLS). Summaries of select analytical results from the Increment 71 samples are provided in Tables 3A and 3B.

Table 3A. Analytical Summary of ISS Water Analyses for CHeCS Samples (Increment 71)

Return Mission	Sample Location	Sample Date	TOC (mg/L)	DMSD (mg/L)	Methyl Sulfone (mg/L)	Conductivity (μS/cm)	Total Iodine (mg/L)
SpX-30	xPWD Ambient	4/2/2024	0.7	<1	0.1	<1	0.05
SpX-30	PWD Hot	4/24/2024	1.1	<1	0.2	1	<0.05
Crew-8	xPWD Hot	9/10/2024	0.5	<1	0.2	1	<0.05

Table 3B. Analytical Summary of ISS Water Analyses for ECLS Samples (Increment 71)

Return Mission	Sample Location	Sample Date	TOC (mg/L)	DMSD (mg/L)	Methyl Sulfone (mg/L)	Conductivity (μS/cm)	Total Iodine (mg/L)
SpX-30	Condensate	4/18/2024	54.2	5.2	0.37	220	0.25
Crew-8	Wastewater	7/2/2024	4.14	1.3	0.15	86	0.34
SpX-31	Condensate	7/2/2024	30	6.8	0.14	145	0.12

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 (Table 3A, 3B). 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 February 2021 and September 2024 are shown in Figure 3. The TOC concentrations in the five potable samples continued to be low and were well below both the specification for the US segment (<3 mg/L) and the 100-day SWEG (5 mg/L). Methyl sulfone was detected in all potable water samples at levels well below the SWEG of 1,500 mg/L. Silicon was also detected in both potable samples (0.1 – 1.6 mg/L).

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 two potable samples collected from the PWD were below the reporting limit and the other was right at the reporting limit of 0.05 mg/L, indicating effective removal of iodine in water intended for consumption. For additional information regarding microbial analyses, see the Increment 71 post-flight report generated by the JSC Environmental Microbiology Laboratory.

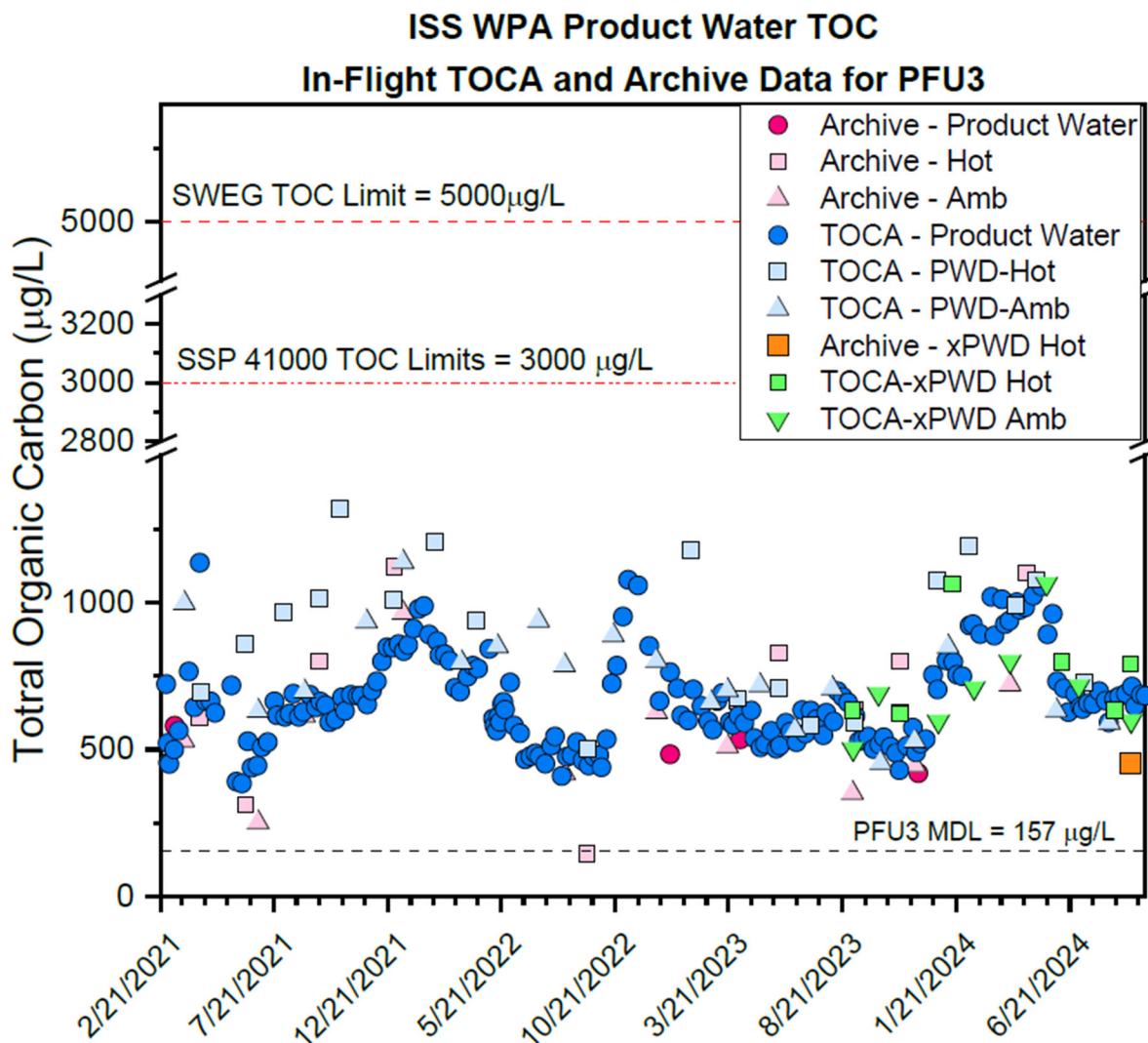


Figure 3. Total Organic Carbon (TOC) trending in US Potable Water from Archive Water Samples and On-Orbit TOCA (PFU3) for February 2021 to September 2024

Condensate (April 18, 2024)

The condensate sample collected on April 18, 2024, contained TOC levels of 54.2 mg/L, well below the historical average of 147 mg/L. Organic compounds detected at or above 1 mg/L are listed in Table 4. Zinc (7.3), manganese (0.15), and nickel (0.27) were detected above 0.1 mg/L. The concentration of ammonium was 24.3 mg/L.

Condensate (July 2, 2024)

The condensate sample collected on July 2, 2024, contained TOC levels of 30 mg/L, well below the historical average of 147 mg/L. Organic compounds detected at or above 1 mg/L are listed in Table 4. Zinc (8.7) and nickel (0.13) were detected above 0.1 mg/L. The concentration of ammonium was 16.4 mg/L.

Table 4: Organic Compounds Detected >1 mg/L in US Condensate Sampled During Increment 71

Compound	Condensate (mg/L)		Historical average (mg/L)
	April 18, 2024	July 2, 2024	
Ethanol	40	7.7	49
Acetate	17.6	<1	39.0
Methanol	6.2	3.6	4.9
1,2-propanediol	5.7	1.71	26.4
Dimethylsilanediol	5.2	6.8	33.6
Acetone	5.0	2.7	2.0
1,2-ethanediol	2.6	<1	5.4
Glycolate	1.2	3.8	<RL
2-propanol	1.0	1.8	1.4

Wastewater (July 2, 2024)

The wastewater sample collected on July 2, 2024, contained TOC levels of 4.2 mg/L, below the historical average of 40 mg/L. The only organic compound detected above 1 mg/L was DMSD (1.3 mg/L). Nickel was present at 0.13 mg/L, and zinc was detected at 4.4 mg/L. No other metals were detected at levels above 0.1 mg/L. Ammonium was present at a concentration of 9.4 mg/L.

Given the results from wastewater and condensate, the cleanliness of potable water dispensed from the PWD and xPWD provide strong evidence that the Water Recovery System is performing well on ISS. 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.

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Enclosures

- Table S-1: Analytical concentrations of compounds quantified in mGSCs collected during Increment 71 and returned on Boeing-CFT and Crew-8
- Table S-2A: T-values corresponding to concentrations for routine mGSC samples returned on Boeing-CFT and Crew-8
- Table S-2B: T-values corresponding to concentrations for NG-21 ingress air samples, based on 7-day and 180-day SMACs
- Table S-3A: Analytical concentrations of compounds quantified in hot and ambient water samples returned on SpaceX-30 and Crew-8
- Table S-3B: Analytical concentrations of compounds quantified in US condensate and wastewater returned on SpaceX-30, -31, and Crew-8

TABLE S-1: ANALYTICAL CONCENTRATIONS OF COMPOUNDS QUANTIFIED IN mGSCs COLLECTED DURING INCREMENT 71 AND RETURNED ON BOEING-CFT AND CREW-8

Increment Mission Sample Location Sample Description Sample Date Sample Time Analysis/Sample ID	71									
	BOE-CFT Return	Crew-8								Crew-8
	Cabin	Lab	Columbus	SM	Lab	Lab	JPM	Lab	Columbus	Cygnus
	Nominal Air Sample, Ascent S/N 2102	Nominal air sample, S/N 2013	Nominal air sample, S/N 2012	Nominal air sample, S/N 2019	Nominal air sample, S/N 2035	Nominal air sample, S/N 2043	Nominal air sample, S/N 2046	Nominal air sample, S/N 2017	Nominal air sample, S/N 2085	NG-21 Ingress, S/N 2071
	6/6/2024 11:28 AQ240841	5/8/2024 14:11 AQ250061	5/8/2024 14:12 AQ250062	6/17/2024 14:20 AQ250063	6/17/2024 14:21 AQ250064	7/22/2024 19:00 AQ250065	7/22/2024 19:00 AQ250066	9/11/2024 17:00 AQ250068	9/11/2024 17:00 AQ250069	8/6/2024 15:25 AQ250067
Volatiles Targets GCMS (TO-15 mod)										
1,1,1,2-Tetrafluoroethane	<0.044	0.12	0.086	0.065	0.078	0.057	0.059	0.083	0.058	<0.044
1-Butanol	<0.019	<0.019	<0.019	0.029	<0.019	<0.018	0.021	0.020	0.026	0.055
1-Propanol	<0.016	0.023	0.034	0.023	0.030	0.033	0.041	0.071	0.042	<0.016
2,3-Dimethylpentane	<0.025	<0.025	<0.025	<0.025	<0.025	<0.024	<0.025	<0.025	<0.025	0.069
2-Butanone (Methyl ethyl ketone)	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	0.057
2-Methyl-1-propene	<0.014	0.017	<0.014	<0.014	0.015	<0.014	<0.014	0.017	<0.014	0.10
2-Methyl-2-propanol	<0.019	<0.019	<0.019	<0.019	<0.019	<0.018	<0.019	<0.019	<0.019	0.023
2-Propanol (Isopropanol)	0.077	0.43	0.57	0.35	0.47	0.50	0.56	See GC-FID	See GC-FID	See GC-FID
3-Methylhexane	<0.025	<0.025	<0.025	<0.025	<0.025	<0.024	<0.025	<0.025	<0.025	0.061
Acetaldehyde	0.026	0.12	0.12	0.14	0.15	0.096	0.11	0.11	0.11	0.27
Acetone	0.17	0.27	0.30	0.33	0.37	0.41	0.47	0.38	0.40	0.33
Acetonitrile	<0.011	<0.011	<0.011	<0.011	0.012	<0.010	<0.011	<0.011	<0.011	<0.011
Acrylonitrile	<0.014	<0.014	<0.014	<0.014	0.016	0.036	0.035	0.019	0.019	<0.014
Carbon disulfide	<0.020	<0.020	<0.020	<0.020	<0.020	<0.019	<0.020	<0.020	<0.020	0.022
Carbonyl sulfide (Carbon oxide sulfide)	<0.016	<0.016	<0.016	<0.016	<0.016	<0.015	<0.016	<0.016	<0.016	0.058
Chloromethane	0.024	<0.013	<0.013	<0.013	<0.013	<0.012	<0.013	<0.013	<0.013	<0.013
Ethanol	0.052	See GC-FID	See GC-FID	See GC-FID	See GC-FID	See GC-FID	See GC-FID	See GC-FID	See GC-FID	See GC-FID
Ethyl acetate	<0.023	<0.023	<0.023	<0.023	<0.023	<0.022	<0.023	0.025	0.023	0.095
Hexamethylcyclotrisiloxane (HMCTS)	<0.19	<0.19	<0.19	<0.19	<0.19	<0.18	<0.19	<0.19	<0.19	0.70
Hexane	0.41	<0.023	<0.023	<0.023	<0.023	<0.022	<0.023	<0.023	<0.023	<0.023
Isobutane	<0.015	0.026	0.026	<0.015	<0.015	0.024	0.030	<0.015	<0.015	1.5
Isoprene (2-Methyl-1,3-butadiene)	0.044	0.024	<0.018	0.027	0.026	0.032	0.036	0.051	0.039	<0.018
Methanol	0.046	See GC-FID	See GC-FID	See GC-FID	See GC-FID	0.34	0.36	0.35	0.37	0.20
Methylene chloride (Dichloromethane)	<0.021	<0.021	<0.021	<0.021	<0.021	<0.020	<0.021	<0.021	<0.021	0.11
Pentane	<0.019	0.080	0.10	0.068	0.087	0.090	0.10	0.17	0.18	0.41
Propanal (Propionaldehyde)	0.046	<0.015	<0.015	<0.015	<0.015	<0.014	<0.015	<0.015	<0.015	0.019
Trimethylsilanol	0.49	0.026	0.044	0.028	0.060	0.038	0.076	0.044	0.065	0.75
Volatiles Non-Targets GCMS (estimated conc.)										
2-Methylpentane	0.070	not found	not found	not found	not found	not found	not found	not found	not found	not found
3,3-Dimethylpentane	0.099	not found	not found	not found	not found	not found	not found	not found	not found	0.061
C11-Alkanes	not found	not found	not found	not found	not found	not found	not found	not found	not found	1.2
C12-Alkanes	not found	not found	not found	not found	not found	not found	not found	not found	not found	0.64
C13-Alkanes	not found	not found	not found	not found	not found	not found	not found	not found	not found	1.1
Fluorotrimethylsilane	not found	not found	not found	not found	not found	not found	not found	not found	not found	0.15
Volatiles Targets GCFID										
2-Propanol (Isopropanol)	NR	NR	NR	NR	NR	NR	NR	0.79	0.84	1.9
Ethanol	NR	4.6	4.3	3.6	4.2	2.7	2.6	2.0	2.0	0.91
Methanol	NR	0.31	0.30	0.28	0.31	NR	NR	NR	NR	NR
Octafluoropropane (Perfluoropropane)	<0.77	<1.6	<1.6	<1.6	<1.6	110	120	8.0	7.8	2.1
Volatiles Targets TGA										
Carbon dioxide	4,300	<760	4,900	7,500	6,000	6,300	6,000	3,800	4,100	2,600
Carbon monoxide	<0.48	1.7	1.8	1.8	1.8	2.1	2.2	1.3	1.4	1.5
Hydrogen	2.9	8.2	8.2	8.8	8.9	8.9	9.5	9.2	9.3	1.8
Methane	29	53	54	48	48	69	72	95	94	13
	GMT 158	GMT 129	GMT 129	GMT 169	GMT 169	GMT 204	GMT 204	GMT 255	GMT 255	GMT 219

Comments: NR= Not Reported

Not Found =No unknown peaks above the threshold limit

Project Specific SMACs: C11-Alkanes: 7d-(383mg/m³) and 180d-(19mg/m³)C12-Alkanes: 7d-(418mg/m³) and 180d-(21mg/m³)C13-Alkanes: 7d-(442mg/m³) and 180d-(22mg/m³)

TABLE S-2A: T-VALUES CORRESPONDING TO CONCENTRATIONS FOR ROUTINE mGSC SAMPLES RETURNED ON BOEING-CFT AND CREW-8

Increment Mission	71											
	Crew-8								BOE-CFT Return		Crew-8	
	T-Value (180-day)								T-Value (7-day)	T-Value (180-day)	T-Value (7-day)	T-Value (180-day)
	Lab	Columbus	SM	Lab	Lab	JPM	Lab	Columbus	Cabin	Cabin	Cygnus	Cygnus
	Nominal air sample, S/N 2013	Nominal air sample, S/N 2012	Nominal air sample, S/N 2019	Nominal air sample, S/N 2035	Nominal air sample, S/N 2043	Nominal air sample, S/N 2046	Nominal air sample, S/N 2017	Nominal air sample, S/N 2085	Nominal Air Sample, Ascent S/N 2102	Nominal Air Sample, Ascent S/N 2102	NG-21 Ingress, S/N 2071	NG-21 Ingress, S/N 2071
Sample Location												
Sample Description												
Sample Date	5/8/2024	5/8/2024	6/17/2024	6/17/2024	7/22/2024	7/22/2024	9/11/2024	9/11/2024	6/6/2024	6/6/2024	8/6/2024	8/6/2024
Sample Time	14:11	14:12	14:20	14:21	19:00	19:00	17:00	17:00	11:28	11:28	15:25	15:25
Analysis/Sample ID	AQ250061	AQ250062	AQ250063	AQ250064	AQ250065	AQ250066	AQ250068	AQ250069	AQ240841	AQ240841	AQ250067	AQ250067
Volatiles Targets GCMS (TO-15 mod)												
1,1,1,2-Tetrafluoroethane	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	ND	ND	ND	ND
1-Butanol	ND	ND	0.001	ND	ND	0.001	0.001	0.001	ND	ND	0.001	0.001
1-Propanol	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	ND	ND	ND	ND
2,3-Dimethylpentane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.000	0.006
2-Butanone (Methyl ethyl ketone)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.002
2-Methyl-1-propene	0.000	ND	ND	0.000	ND	ND	0.000	ND	ND	ND	0.000	0.000
2-Methyl-2-propanol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.000	0.000
2-Propanol (Isopropanol)	0.003	0.004	0.002	0.003	0.003	0.004	See GC-FID	See GC-FID	0.001	0.001	See GC-FID	See GC-FID
3-Methylhexane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.000	0.005
Acetaldehyde	0.030	0.030	0.035	0.038	0.024	0.028	0.027	0.026	0.006	0.006	0.068	0.068
Acetone	0.01	0.006	0.006	0.007	0.008	0.009	0.007	0.008	0.003	0.003	0.006	0.006
Acetonitrile	ND	ND	ND	0.000	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	0.231	0.508	0.493	0.268	0.268	ND	ND	ND	ND
Carbon disulfide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.020	0.020
Carbonyl sulfide (Carbon oxide sulfide)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.001	0.003
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	0.001	0.013	ND	ND
Ethanol	See GC-FID	See GC-FID	See GC-FID	See GC-FID	See GC-FID	See GC-FID	See GC-FID	See GC-FID	0.000	0.000	See GC-FID	See GC-FID
Ethyl acetate	ND	ND	ND	ND	ND	ND	0.000	0.000	ND	ND	0.000	0.000
Hexamethylcyclotrisiloxane (HMCTS)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.008	0.078
Hexane	ND	ND	ND	ND	ND	ND	ND	ND	0.048	0.048	ND	ND
Isobutane	0.000	0.000	ND	ND	0.000	0.000	ND	ND	ND	ND	0.008	0.008
Isoprene (2-Methyl-1,3-butadiene)	0.008	ND	0.009	0.009	0.011	0.012	0.017	0.013	0.007	0.015	ND	ND
Methanol	See GC-FID	See GC-FID	See GC-FID	See GC-FID	0.013	0.014	0.014	0.014	0.002	0.002	0.008	0.008
Methylene chloride (Dichloromethane)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.011
Pentane	0.009	0.012	0.008	0.010	0.010	0.011	0.019	0.020	ND	ND	0.002	0.045
Propanal (Propionaldehyde)	ND	ND	ND	ND	ND	ND	ND	ND	0.004	0.004	0.002	0.002
Trimethylsilanol	0.007	0.011	0.007	0.015	0.009	0.019	0.011	0.016	0.123	0.123	0.187	0.187
Volatiles Non-Targets GCMS (estimated conc.)												
2-Methylpentane	ND	ND	ND	ND	ND	ND	ND	ND	0.008	0.008	ND	ND
3,3-Dimethylpentane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.000	0.005
3-Methylpentane	ND	ND	ND	ND	ND	ND	ND	ND	0.012	0.012	ND	ND
C11-Alkanes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.003	0.061
C12-Alkanes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.031
C13-Alkanes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.049
Fluorotrimethylsilane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.134	0.134
Volatiles Targets GCFID												
2-Propanol (Isopropanol)	NR	NR	NR	NR	NR	NR	0.005	0.006	NR	NR	0.012	0.012
Ethanol	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	NR	NR	0.000	0.000
Methanol	0.012	0.011	0.011	0.012	NR	NR	NR	NR	NR	NR	NR	NR
Octafluoropropane (Perfluoropropane)	ND	ND	ND	ND	0.001	0.001	0.000	0.000	ND	ND	0.000	0.000
Volatiles Targets TGA												
Carbon monoxide	0.101	0.104	0.105	0.107	0.121	0.127	0.079	0.080	ND	ND	0.024	0.088
Total T-Value	0.2	0.2	0.2	0.4	0.7	0.7	0.4	0.5	0.2	0.2	0.5	0.8

Comments: ND= Value is less than the laboratory reporting limit.

NR= Not Reported

Project Specific SMACS: C11-Alkanes: 7d-(383mg/m³) and 180d-(19mg/m³)C12-Alkanes: 7d-(418mg/m³) and 180d-(21mg/m³)C13-Alkanes: 7d-(442mg/m³) and 180d-(22mg/m³)

**TABLE S-2B: T-VALUES CORRESPONDING TO CONCENTRATIONS
FOR NG-21 INGRESS AIR SAMPLE, BASED ON 7-DAY AND 180-DAY
SMACs**

	Increment Mission	71	
		Crew-8	
		T-Value (7-Day)	T-Value (180 day)
Sample Location		Cygnus NG-21	Cygnus NG-21
Sample Description		Ingress, S/N 2071	Ingress, S/N 2071
Sample Date		8/6/2024	8/6/2024
Sample Time		15:25	15:25
Analysis/Sample ID		AQ250067	AQ250067
Volatiles Targets GCMS (TO-15 mod)			
1-Butanol		0.001	0.001
2,3-Dimethylpentane		0.000	0.006
2-Butanone (Methyl ethyl ketone)		0.002	0.002
2-Methyl-1-propene		0.000	0.000
2-Methyl-2-propanol		0.000	0.000
2-Propanol (Isopropanol)		See GC-FID	See GC-FID
3-Methylhexane		0.000	0.005
Acetaldehyde		0.068	0.068
Acetone		0.006	0.006
Carbon disulfide		0.020	0.020
Carbonyl sulfide (Carbon oxide sulfide)		0.001	0.003
Chloromethane		ND	ND
Ethanol		See GC-FID	See GC-FID
Ethyl acetate		0.000	0.000
Hexamethylcyclotrisiloxane (HMCTS)		0.008	0.078
Hexane		ND	ND
Isobutane		0.008	0.008
Isoprene (2-Methyl-1,3-butadiene)		ND	ND
Methanol		0.008	0.008
Methylene chloride (Dichloromethane)		0.002	0.011
Pentane		0.002	0.045
Propanal (Propionaldehyde)		0.002	0.002
Trimethylsilanol		0.187	0.187
Volatiles Non-Targets GCMS (estimated conc.)			
2-Methylpentane		ND	ND
3,3-Dimethylpentane		0.000	0.005
3-Methylpentane		ND	ND
C11-Alkanes		0.003	0.061
C12-Alkanes		0.002	0.031
C13-Alkanes		0.002	0.049
Fluorotrimethylsilane		0.134	0.134
Volatiles Targets GCFID			
2-Propanol (Isopropanol)		0.012	0.012
Ethanol		0.000	0.000
Octafluoropropane (Perfluoropropane)		0.000	0.000
Volatiles Targets TGA			
Carbon monoxide		0.024	0.088
Total T-Value		0.5	0.8

Comments: ND= Value is less than the laboratory reporting limit.

NR= Not Reported

Project Specific SMACs: C11-Alkanes:

C12-Alkanes: 7d-(418mg/m3) and 180d-(21mg/m3)

C13-Alkanes: 7d-(442mg/m3) and 180d-(22mg/m3)

**TABLE S-3A: ANALYTICAL CONCENTRATIONS OF COMPOUNDS QUANTIFIED IN HOT AND AMBIENT POTABLE WATER
SAMPLES RETURNED ON SPACEX-30 AND CREW-8**

Increment Mission	Sample Location	Sample Description	Sample Date Analysis/Sample ID	Units	Test Conducted by	Potable Water Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	71		
								SpX-30		Crew-8
								WPA xPWD Ambient	WPA PWD Hot	WPA xPWD Hot
								Potable Water 4/2/2024 WQ240196	Potable Water 4/24/2024 WQ240197	Potable Water 9/10/2024 WQ240449
Physical Characteristics										
Conductivity				µS/cm	U.S.			<1	1	1
pH				pH units	U.S.	4.5-8.5	41000	5.83	5.76	5.66
Iodine LCV										
Total I				mg/L	U.S.	6/0.2	41000 (tl I max in product water/tl I at pt of consumption)	0.05	<0.05	<0.05
Minerals ICPMS										
Calcium				mg/L	U.S.	30	41000	0.02	0.02	< 0.01
Trace Metals ICPMS										
Aluminum				µg/L	U.S.			<1	< 1	1
Barium				µg/L	U.S.	10,000	SWEG&41000	<1	2	< 1
Boron				µg/L	U.S.			10	<1	<1
Nickel				µg/L	U.S.	300	SWEG&41000	7	1	4
Silicon ICPMS										
Silicon				µg/L	U.S.			1,050	1,580	82
Total Organic Carbon-Sievers										
Total Inorganic Carbon (TIC)				mg/L	U.S.			0.835	0.901	0.855
Total Organic Carbon (TOC)				mg/L	U.S.	5 / 3	SWEG / 41000	0.721	1.10	0.454
Volatile Organics-Targets										
Acetone				µg/L	U.S.	15,000	SWEG	<5	< 5	7
Semi-volatile Organics-Targets										
Methyl sulfone				µg/L	U.S.	1,500,000	interim SWEG (06-2017)	149	172	241
Base and Neutral Extractables-EPA 625 List GCMS										
Diethylphthalate				µg/L	U.S.			<20	< 20	23
Alcohols & Acetone GCMS										
Acetone				µg/L	U.S.	15,000	SWEG	See Volatiles	See Volatiles	See Volatiles
Silanols LCRI (Semi-Quantitative-NIST traceable standard not available)										
Monomethylsilanetriol (MMST)				µg/L	U.S.	110,000	SWEG	3,300	4,800	< 1000
Organic Carbon Recovery										
Unaccounted Organic Carbon				percent	U.S.			63.66	59.9	17.8
				mg/L	U.S.			0.26	0.440	0.370

Comments: NR= Not Reported
NA=Not Analyzed

TABLE S-3B: ANALYTICAL CONCENTRATIONS OF COMPOUNDS QUANTIFIED IN US CONDENSATE AND WASTEWATER RETURNED ON SPACEX-30, -31, AND CREW-8

Increment Mission	Sample Location	Sample Description	Sample Date Analysis/Sample ID	Units	Test Conducted by	Potable Water Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	71		
								SpX-30	Crew-8	SpX-31
								WPA Condensate Sample Port	WPA Wastewater ORU	WPA Condensate Sample Port
								US Condensate 4/18/2024 WQ240198	WPA Wastewater 7/2/2024 WQ240450	US Condensate 7/2/2024 WQ240506
Physical Characteristics										
Conductivity				µS/cm	U.S.			220	86	145
pH				pH units	U.S.	4.5-8.5	41000	7.63	7.23	7.44
Iodine ICPMS										
Total I				mg/L	U.S.			0.261	0.341	0.116
Anions IC										
Fluoride				mg/L	U.S.			< 0.1	0.1	0.1
Cations IC										
Ammonium (as N)				mg/L	U.S.	1	SWEG&41000	24.3	9.4	16.4
Minerals ICPMS										
Calcium				mg/L	U.S.	30	41000	0.06	0.02	0.04
Phosphate (as P)				mg/L	U.S.			0.02	0.11	0.01
Potassium				mg/L	U.S.	340	41000	0.02	0.07	0.02
Trace Metals ICPMS										
Aluminum				µg/L	U.S.			2	2	5
Barium				µg/L	U.S.	10,000	SWEG&41000	2	< 1	< 1
Boron				µg/L	U.S.			26	5	15
Chromium				µg/L	U.S.	230	41000	2	12	4
Copper				µg/L	U.S.	1,000	41000	1	1	5
Manganese				µg/L	U.S.	300	SWEG&41000	148	1	3
Molybdenum				µg/L	U.S.			2	< 1	< 1
Nickel				µg/L	U.S.	300	SWEG&41000	273	126	127
Silver				µg/L	U.S.	400	SWEG&41000	5	21	50
Strontium				µg/L	U.S.			5	2	2
Zinc				µg/L	U.S.	2,000	SWEG&41000	7,300	4,430	8,660
Silicon ICPMS										
Silicon				µg/L	U.S.			3,020	695	2,880
Total Organic Carbon-Sievers										
Total Inorganic Carbon (TIC)				mg/L	U.S.			19.6	10.1	16.5
Total Organic Carbon (TOC)				mg/L	U.S.	5 / 3	SWEG / 41000	54.2	4.14	30.0
Volatile Organics-Targets										
Acetone				µg/L	U.S.	15,000	SWEG	See Alcohols	< 25	See Alcohols
Volatile Organics-Special Interest Compounds (Semi-quantitative)										
Acetaldehyde				µg/L	U.S.			55	not found	260
Trimethylsilano				µg/L	U.S.			35	34	130
Semi-volatile Organics-Targets										
Methyl sulfone				µg/L	U.S.	1,500,000	interim SWEG (06-2017)	371	148	143
N-n-Butylbenzenesulfonamide				µg/L	U.S.			53	< 20	< 20
Acid Extractables-EPA 625 List GCMS										
Benzoic acid				µg/L	U.S.			264	< 100	< 100
Base and Neutral Extractables-EPA 625 List GCMS										
Diethylphthalate				µg/L	U.S.			< 40	36	60
Semi-volatile Organics-Special Interest Compounds (Semi-quantitative)										
1-Methyl-2-pyrrolidinone				µg/L	U.S.			not found	not found	< 80
2-Ethoxyethanol				µg/L	U.S.			280	not found	< 40
2-Phenoxyethanol				µg/L	U.S.			< 40	not found	not found
Ibuprofen				µg/L	U.S.			not found	210	not found
Monomethyl phthalate				µg/L	U.S.			< 20	not found	not found
N,N-Diethylformamide				µg/L	U.S.			not found	< 20	27
N,N-Dimethyl acetamide				µg/L	U.S.			not found	< 40	130
N,N-Dimethylformamide				µg/L	U.S.			410	< 80	130
Neomenthol				µg/L	U.S.			not found	21	not found
Thymol				µg/L	U.S.			< 100	not found	not found
Alcohols & Acetone GCMS										
2-Propanol (Isopropanol)				µg/L	U.S.			1,040	< 400	1,670
Acetone				µg/L	U.S.	15,000	SWEG	4,990	See Volatiles	2,700
Ethanol				µg/L	U.S.			40,400	< 400	7,680
Methanol				µg/L	U.S.	40,000	SWEG	6,210	< 400	3,620
Glycols GCMS										
1,2-Ethanediol (Ethylene glycol)				µg/L	U.S.	4000	SWEG	2,560	< 1000	< 1000
1,2-Propanediol (Propylene glycol)				µg/L	U.S.	1,700,000	SWEG	5,680	< 1000	1,710
Silanols LCRI (Semi-Quantitative-NIST traceable standard not available)										
Dimethylsilanediol (DMSD)				µg/L	U.S.	35,000	SWEG	5,200	1,300	6,800
Carboxylates IC										
Acetate				µg/L	U.S.			17,600	< 500	< 500
Glycolate				µg/L	U.S.			1,170	< 1000	3,790
Glyoxylate				µg/L	U.S.			521	< 500	< 500
Aldehydes GCMS										
Formaldehyde (Methanal)				µg/L	U.S.	12,000	SWEG	55	< 10	22
Organic Carbon Recovery				percent	U.S.			74.8	14.2	40.8
Unaccounted Organic Carbon				mg/L	U.S.			13.7	3.55	17.8

Comments: NR= Not Reported NA=Not Analyzed

WQ240198: Amines were not analyzed due to the low volume of the sample.

Data Qualifiers: WQ240506: Valerate-Data Qualifier: Possible low bias (MS 74.9%)

1,2-Ethanediol (Ethylene Glycol)-Data Qualifier: Possible low bias (MS Rec.

Freon 12: Data Qualifier-Possible low bias (MS Rec. 58.1%)

Hexachlorobutadiene: Data Qualifier-Possible low bias (MS Rec. 63.9%)