Summary of Quarterly Operations (April through June)

EPA Contract No. 68HERH21D0006

Introduction

This quarterly report summarizes results from the Clean Air Status and Trends Network (CASTNET) quality assurance/quality control (QA/QC) program for data collected during second quarter 2021. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; Wood, 2021). The QAPP is comprehensive and includes standards and policies for all components of project operation from site selection through final data reporting. It is reviewed annually and updated as warranted.

Quarterly Summary

Wood continued working with the American Association for Laboratory Accreditation (A2LA) assessor in preparation for the biannual review required to maintain International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2017 accreditation, which took place April 12–14, 2021. The assessment was virtual. The assessment went smoothly as the assessor had requested advance, electronic copies of general documentation along with many laboratory and field-related records. There were four findings that required corrective action. Wood addressed the corrective actions. Certified, adjustable pipettes with appropriate certification documentation were ordered. Documentation and other issues were addressed, and the appropriate updates/additions were prepared and provided to A2LA. Wood's ISO/IEC 17025:2017 re-accreditation was approved by A2LA will continue through May 2023.

Wood's field and QA personnel began preparing training materials and checklists for calibrators to help them recognize when local conditions (e.g., size and proximity of vegetation) have potential to violate established siting criteria during site visits.

Wood incorporated comments received from reviewers of the Draft Final CASTNET Quality Assurance Project Plan (QAPP) Revision 9.4. Additionally, Wood received approval from EPA to modify statements on double entry to indicate that only items that directly affect atmospheric concentration data (e.g., dates) from the Site Status Report Forms (SSRF) require double entry. With this change, only two fields on the SSRF will require double entry. Wood's QA Manager then worked with the EPA Project Officer and EPA QA Officer on additional details, and the final version of the QAPP was approved by EPA in June 2021.

Wood received the final results for proficiency test study 0117 for Rain and Soft Waters from the National Laboratory of Environmental Testing, a branch of the National Water Research Institute with ECCC that provides quality assurance services. Sodium was flagged high but within limits. No corrective actions were required.

The CASTNET QA Manager prepared the annual management review summary presentation as required to maintain ISO/IEC 17025:2017 accreditation by the A2LA. During third quarter, the presentation will be distributed to the CASTNET management team, and the annual management review meeting will be held to discuss the presentation.

The potassium carbonate used to impregnate the cellulose filters is currently backordered by J.T. Baker, Wood's usual supplier, until January 2022. Wood has a supply sufficient only through August 2021. Wood began acceptance testing potassium carbonate from four other suppliers. Potassium carbonate that passed acceptance testing was then scheduled for field testing at the Gainesville test site. Wood will select a new potassium carbonate supplier based on a product that passes acceptance testing and field testing with performance that most closely compares with J.T. Baker's potassium carbonate. Additionally, Wood will verify that the supplier has a sufficient quantity to ensure availability.

Table 1 lists the quarters of data that were validated to Level 3 during second quarter 2021 by site calibration group. Table 2 lists the sites in each calibration group along with the calibration schedule. Table 3 presents the measurement criteria for laboratory filter pack measurements. These criteria apply to the QC samples listed in the following section of this report. Table 4 presents the critical criteria for ozone monitoring. Table 5 presents the critical criteria for trace-level gas monitoring.

Quality Control Analysis Count

The QC sample statistics presented in this report are for reference standards (RF) and continuing calibration verification spikes (CCV) used to assess accuracy and for replicate sample analyses (RP) used to assess "in-run" precision. In addition, laboratory method blanks (MB) containing reagents without a filter; laboratory blanks (LB) containing reagents and a new, unexposed filter; and field blanks (FB) containing reagents and an unexposed filter that was loaded into a filter pack assembly and shipped to and from the monitoring site while remaining in sealed packaging are also included. Table 6 presents the number of analyses in each category that were performed during second quarter 2021.

Sample Receipt Statistics

Ninety-five percent of field samples from EPA-sponsored sites must be received by the CASTNET laboratory in Gainesville, FL no later than 14 days after removal from the sampling tower. Table 7 presents the relevant sample receipt statistics for second quarter 2021. Beginning in early 2020, deliveries of filter packs to the analytical laboratory have been frequently delayed in transit. For example, in second quarter 2019, the average interval in days to delivery was 5.487 days. In second quarter 2020, the average interval in days was 7.285 days. In second quarter 2021, the average interval was 8.382 days. During review of first quarter 2021 filter pack concentrations (see the CASTNET Quarterly Data Summary for First Quarter 2021; Wood, 2021), it was noted that one of the Mackville, KY co-located filter packs for the week of 2/9/21 was not delivered to the analytical laboratory on time. The MCK131 filter pack was delayed in the postal system for three weeks. Comparison of MCK131 concentrations with concentrations from the co-located MCK231 site showed that the delay allowed particulate NO_3^- to volatize resulting in higher HNO_3 concentrations.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for second quarter 2021. All results were within the criteria listed in Table 3.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during second quarter 2021. The statistics presented contain data validated at Level 2 and Level 3. All data associated with QC checks that fail to meet the criteria listed in Table 4 were or will be invalidated unless the cause of failure has no effect on ambient data collection, and passing results still meet frequency criteria. During second quarter, no values exceeded documented criteria or were otherwise notable.

Table 9 presents summary statistics of critical criteria measurements at trace-level gas monitoring sites collected during second quarter 2021. The statistics presented contain data validated at Level 2 and Level 3. All data associated with QC checks that fail to meet the criteria listed in Table 5 were or will be invalidated unless the cause of failure has no effect on ambient data collection, and passing results still meet frequency criteria. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 10 presents observations associated with the shaded cell results in Table 9.

Laboratory Control Sample Analysis

The laboratory control sample (LCS) is a reagent blank spiked with the target analytes from the established analytical methods and carried through the same extraction process that field samples must undergo. The LCS is not required by the CASTNET QA/QC program. LCS analyses are performed by the laboratory to monitor for potential sample handling artifacts and provide a means to identify possible analyte loss from extraction to extraction. Figure 4 presents LCS analysis results for second quarter 2021. All recovery values were between 85 percent and 102 percent with the exception of one recovery at 36 percent. All other QC in the batch with the low LCS were within criteria, and the sample data are reasonable compared with other sampling weeks. An error in spiking the sample is suspected. Corrective action has been initiated to prevent recurrence.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for second quarter 2021. All second quarter results were within criteria (two times the reporting limit) listed in Table 3. Several FB showed higher than usual results in late June. The LB and MB associated with these FB were below the reporting limit. The higher FB results correlate with a freshly made eluent solution. The laboratory is investigating to ensure there is no quality issue.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during second quarter 2021 are listed in Table 11. This table also includes associated site identification and a brief description of the reason the sample was flagged. During second quarter, 10 filter pack samples were invalidated.

Field Problem Count

Table 12 presents counts of field problems affecting continuous data collection for more than one day for second quarter 2021. The problem counts are sorted by a 30-, 60-, or 90-day time period to

resolution. A category for unresolved problems is also included. Time to resolution indicates the period taken to implement corrective action.

References

American Society for Testing and Materials (ASTM). 2008. ASTM E29-08, "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications." ASTM International, West Conshohocken, PA, DOI:10.1520/E0029-08. www.astm.org.

U.S. Environmental Protection Agency (EPA). 2020. Title 40 *Code of Federal Regulations* Part 58, "Appendix A to Part 58 – Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards."

Wood Environment & Infrastructure Solutions, Inc. (Wood). 2021. *Clean Air Status and Trends Network (CASTNET) Quarterly Data Summary for First Quarter 2021*. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC. Contract No. EP-W-16-015. Gainesville, FL.

Wood Environment & Infrastructure Solutions, Inc. (Wood). 2021. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan* (QAPP) Revision 9.4. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC. Contract No. EP-W-16-015. Gainesville, FL. https://java.epa.gov/castnet/documents.do.

Table 1 Data Validated to Level 3 during Second Quarter 2021

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-1/SE-5	August 2020 – January 2021	6	Quarter 4 2020	1
MW-7/W-9	September 2020 – February 2021	6	Quarter 4 2020	1
E-2/MW-8	October 2020 – March 2021	6	Quarter 4 2020 – Quarter 1 2021	2

Note: * The sites contained in each calibration group are listed in Table 2.

Table 2 Field Calibration Schedule for 2021

Calibration Group	Months Calibrated	Sites Calibrated				
Eastern Sites (22 Total)						
E-1 (8 Sites)	February/August	BEL116, MD	WSP144, NJ	ARE128, PA	PED108, VA	
		BWR139, MD	CTH110, NY	PSU106, PA	VPI120, VA	
E-2 (9 Sites)	April/October	ABT147, CT	WST109, NH	HWF187, NY[1]	WFM105, NY	UND002, VT
		ASH135, ME	CAT175, NY	NIC001, NY	EGB181, ON	
E-3 (5 Sites)	May/November	KEF112, PA	LRL117, PA	CDR119, WV		
		MKG113, PA	PAR107, WV			
Southeastern Sites (11 Total)						
SE-4 (7 Sites)	January/July	SND152, AL	BFT142, NC	COW137, NC	SPD111, TN	
		GAS153, GA	CND125, NC	DUK008, NC[1]		
SE-5 (4 Sites)	February/August	CAD150, AR	SUM156, FL			
		IRL141, FL	CVL151, MS			
Midwestern Sites (19 Total)						
MW-6 (6 Sites)	January/July	CDZ171, KY	MCK131, KY	PNF126, NC[1]		
		CKT136, KY	MCK231, KY	ESP127, TN		
MW-7 (9 Sites)	March/September	ALH157, IL	STK138, IL	RED004, MN	OXF122, OH	PRK134, WI
		BVL130, IL[2]	VIN140, IN	DCP114, OH	QAK172, OH	
MW-8 (4 Sites)	April/October	SAL133, IN	ANA115, MI			
		HOX148, MI	UVL124, MI			
Western Sites (12 Total)						
W-9 (5 Sites)	March/September	KNZ184, KS	CHE185, OK	ALC188, TX		
		KIC003, KS	SAN189, NE			
W-10 (7 Sites)	May/November	GTH161, CO	NPT006, ID	UMA009, WA	PND165, WY[3]	
		ROM206, CO[3]	PAL190, TX	CNT169, WY		

Notes: [1] Trace-level gas calibrations are performed quarterly in January, April, July, and October.
[2] Trace-level gas calibrations are performed quarterly in March, June, September, and December.
[3] Trace-level gas calibrations are performed quarterly in February, May, August, and November.

Table 3 Data Quality Indicators for CASTNET Laboratory Measurements

Analyte	Method	Precision[1] (MARPD)	Accuracy[2] (%)	Nominal Reporting Limits	
				mg/L	µg/Filter
Ammonium (NH_4^+)	AC	20	90–110	0.020*	0.5
Sodium (Na^+)	ICP-OES	20	95–105	0.005	0.125
Potassium (K^+)	ICP-OES	20	95–105	0.006	0.15
Magnesium (Mg^{2+})	ICP-OES	20	95–105	0.003	0.075
Calcium (Ca^{2+})	ICP-OES	20	95–105	0.006	0.15
Chloride (Cl^-)	IC	20	95–105	0.020	0.5
Nitrate (NO_3^-)	IC	20	95–105	0.008*	0.2
Sulfate (SO_4^{2-})	IC	20	95–105	0.040	1.0

Notes: [1] This column lists precision goals for both network precision calculated from co-located filter samples and laboratory precision based on replicate samples for samples > five times the reporting limit. The criterion is ± the reporting limit if the sample is ≤ five times the reporting limit.

[2] This column lists laboratory accuracy goals based on reference standards and continuing calibration verification spikes. The criterion is 90–110 percent for ICP-OES reference standards.

[3] The reporting limit for sulfate on cellulose filters is 0.080 mg/L (2.0 µg/filter).

AC = automated colorimetry
IC = ion chromatography
ICP-OES = inductively coupled plasma-optical emission spectrometry
MARPD = mean absolute relative percent difference
mg/L = milligrams per liter
µg/Filter = micrograms per filter
* = as nitrogen

Values are rounded according to American Society for Testing and Materials (ASTM) E29-08, "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications" (ASTM, 2008).

For more information on analytical methods and associated precision and accuracy criteria, see the CASTNET QAPP, (Wood, 2021).

Table 4 Ozone Critical Criteria*

Type of Check	Analyzer Response
Zero	Less than ± 3.1 parts per billion (ppb)
Span	Less than ± 7.1 percent between supplied and observed concentrations
Single Point QC	Less than ± 7.1 percent between supplied and observed concentrations

Notes: * Applies to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the *Code of Federal Regulations* (EPA, 2020). The minimum frequency for these checks is once every two weeks.

Values are rounded according to ASTM E29-08, "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications" (ASTM, 2008).

Table 5 Trace-level Gas Monitoring Critical Criteria*

Parameter	Analyzer Response	
	Zero Check	Span Check / Single Point QC Check
SO_2	Less than ± 1.51 ppb	Less than ± 10.1 percent between supplied and observed concentrations
NO_y	Less than ± 1.51 ppb	
CO	Less than ± 30.1 ppb	

Notes: *Applies to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the *Code of Federal Regulations* (EPA, 2020). The minimum frequency for these checks is once every two weeks.

Values are rounded according to ASTM E29-08, "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications" (ASTM, 2008).

SO_2 = sulfur dioxide
NO_y = total reactive oxides of nitrogen
CO = carbon monoxide
ppb = parts per billion

Table 6 QC Analysis Count for Second Quarter 2021

Filter Type	Parameter	RF Sample Count	CCV Sample Count	RP Sample Count	MB Sample Count	LB Sample Count	FB Sample Count
Teflon	SO_4^{2-}	75	211	83	18	24	97
	NO_3^-	75	211	83	18	24	97
	NH_4^+	36	171	82	18	22	93
	Cl^-	75	211	83	18	24	97
	Ca^{2+}	36	188	82	18	22	93
	Mg^{2+}	36	188	82	18	22	93
	Na^+	36	188	82	18	22	93
	K^+	36	188	82	18	22	93
Nylon	SO_4^{2-}	54	203	88	18	24	94
	NO_3^-	54	203	88	18	24	94
Cellulose	SO_4^{2-}	51	192	88	20	24	94

Table 7 Filter Pack Receipt Summary for Second Quarter 2021

Count of samples received more than 14 days after removal from tower:	73
Count of all samples received:	743
Fraction of samples received within 14 days:	0.902
Average interval in days:	8.382
First receipt date:	04/01/2021
Last receipt date:	06/24/2021

Note: Sample shipments for the Egbert, Ontario site (EGB181) are in groups of four. Samples associated with EGB181 are excluded from this statistic.

Table 8 Ozone QC Summary for Second Quarter 2021 (1 of 2)

Site ID	% Span Pass[1]	Span |%D|[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	% Zero Pass[1]	Zero Average (ppb)[2]
ABT147, CT	100.00	0.39	100.00	0.45	100.00	0.22
ALC188, TX	100.00	3.83	100.00	2.68	100.00	0.45
ALH157, IL	100.00	1.01	100.00	1.47	100.00	0.15
ANA115, MI	100.00	1.99	100.00	1.49	100.00	0.14
ARE128, PA	100.00	1.45	100.00	1.56	100.00	0.31
ASH135, ME	100.00	0.87	100.00	0.88	100.00	0.17
BEL116, MD	100.00	1.66	100.00	1.14	100.00	0.48
BFT142, NC	100.00	1.18	100.00	1.02	100.00	0.65
BVL130, IL	100.00	1.51	100.00	1.44	100.00	0.24
BWR139, MD	100.00	1.09	100.00	1.52	100.00	0.45
CAD150, AR	100.00	0.87	100.00	1.39	100.00	0.31
CDR119, WV	100.00	2.25	100.00	1.90	100.00	0.19
CDZ171, KY	100.00	2.65	100.00	1.36	100.00	1.09
CKT136, KY	100.00	0.46	100.00	0.45	100.00	0.12
CND125, NC	100.00	1.38	100.00	1.13	100.00	0.66
CNT169, WY	100.00	0.58	100.00	0.64	100.00	0.31
COW137, NC	100.00	0.69	100.00	1.21	100.00	0.89
CTH110, NY	100.00	3.55	100.00	3.97	100.00	0.12
CVL151, MS	97.83	1.41	100.00	0.78	100.00	0.41
DCP114, OH	98.90	1.35	100.00	1.67	98.89	0.55
DUK008, NC	100.00	1.42	98.04	1.63	100.00	0.55
ESP127, TN	100.00	1.02	100.00	0.59	100.00	0.27
GAS153, GA	100.00	3.07	90.38	5.58	100.00	1.62
GTH161, CO	100.00	1.21	100.00	1.48	100.00	0.17

Table 8 Ozone QC Summary for Second Quarter 2021 (2 of 2)

Site ID	% Span Pass[1]	Span |%D|[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	% Zero Pass[1]	Zero Average (ppb)[2]
HOX148, MI	100.00	1.26	100.00	1.19	100.00	0.18
HWF187, NY	100.00	2.27	100.00	1.76	100.00	0.29
IRL141, FL	100.00	1.83	100.00	2.20	100.00	0.57
KEF112, PA	100.00	0.96	100.00	0.80	100.00	0.16
LRL117, PA	100.00	0.88	100.00	0.78	100.00	0.19
MCK131, KY	98.92	1.70	100.00	1.57	100.00	0.21
MCK231, KY	100.00	0.51	100.00	0.51	100.00	0.15
MKG113, PA	100.00	2.85	100.00	2.41	100.00	0.35
NPT006, ID	98.92	1.49	100.00	1.74	100.00	0.18
OXF122, OH	100.00	2.23	100.00	1.86	100.00	0.24
PAL190, TX	100.00	1.26	100.00	1.53	100.00	0.44
PAR107, WV	100.00	0.99	100.00	1.22	100.00	0.21
PED108, VA	100.00	1.35	100.00	1.87	100.00	0.29
PND165, WY	100.00	0.81	100.00	0.90	100.00	0.20
PNF126, NC	100.00	0.41	100.00	0.86	100.00	0.44
PRK134, WI	100.00	1.06	100.00	1.02	100.00	0.21
PSU106, PA	100.00	3.29	100.00	3.27	100.00	0.18
QAK172, OH	100.00	2.34	98.92	3.99	100.00	1.17
ROM206, CO	100.00	1.52	100.00	1.79	100.00	0.42
SAL133, IN	100.00	0.40	100.00	0.38	100.00	0.25
SAN189, NE	100.00	2.01	100.00	2.07	100.00	0.71
SND152, AL	100.00	0.80	100.00	0.74	100.00	0.36
SPD111, TN	100.00	0.78	100.00	0.95	100.00	0.32
STK138, IL	100.00	1.62	100.00	1.37	100.00	0.39
SUM156, FL	100.00	2.73	100.00	2.05	100.00	0.24
UVL124, MI	100.00	0.73	100.00	0.91	100.00	0.44
VIN140, IN	98.94	4.56	96.81	3.84	100.00	0.62
VPI120, VA	94.06	5.11	98.02	4.07	100.00	0.21
WSP144, NJ	95.88	1.85	96.88	1.84	98.96	0.54
WST109, NH	100.00	0.85	100.00	0.87	100.00	0.18

Notes: [1]Percentage of comparisons that pass the criteria listed in Table 4.

[2]Absolute value of the average percent differences between the on-site transfer standard and the site monitor.

%D = percent difference

ppb = parts per billion

Table 9 Trace-level Gas QC Summary for Second Quarter 2021

Parameter	% Span Pass[1]	Span |%D|[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	% Zero Pass[1]	Zero Average (ppb)[2]
BVL130, IL						
SO_2	100.00	2.25	100.00	6.15	96.55	0.69
NO_y	100.00	1.42	100.00	2.63	100.00	0.79
CO	98.18	2.49	45.45	18.58	51.79	44.58
DUK008, NC						
NO_y	NA	NA	NA	NA	NA	NA
HWF187, NY						
NO_y	100.00	0.71	100.00	1.28	97.83	0.55
PND165, WY						
NO_y	97.73	4.56	77.27	5.52	100.00	0.68
PNF126, NC						
NO_y	98.04	2.93	96.00	5.55	96.08	0.39
ROM206, CO						
NO_y	100.00	0.70	100.00	2.66	100.00	0.26

Notes: [1]Percentage of comparisons that pass the criteria listed in Table 5. Values falling below 90 percent are addressed in Table 10.

[2]Absolute value of the average percent differences between the supplied and observed concentrations. Values exceeding the criteria listed in Table 5 are addressed in Table 10.

%D = percent difference

ppb = parts per billion

Table 10 Trace-level Gas QC Observations for Second Quarter 2021

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	CO	% Single Point QC Pass Single Point QC |%D| % Zero Pass Zero Average	The CO analyzer required calibration in April and May.
PND165, WY	NO_y	% Single Point QC Pass	The analyzer required calibration in May.

Notes: %D = percent difference

Table 11 Filter Packs Flagged as Suspect or Invalid during Second Quarter 2021

Site ID	Sample No.	Reason
ALC188, TX	2121004-01	Power failures affected two weeks of sampling.
BBE401, TX	2118003-02	Insufficient flow volume was caused by a flow system leak.
BUF603, WY	2121005-02	The data logger malfunctioned.
CDR119, WV	2119001-12	A power failure affected one week of sampling.
CHE185, OK	2117004-02	The sample was invalidated for suspect data.
FOR605, WY	2118005-03	A polling issue caused missing data. Data may be recovered during review and validation.
JOT403, CA	2118003-12	A polling issue caused missing data. Data may be recovered during review and validation.
LRL117, PA	2115001-31	The sample was invalidated for suspect data.
PIN414, CA	2118003-17	Insufficient flow volume was caused by a flow system leak.
PND165, WY	2120001-40	The data logger malfunctioned.

Table 12 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	401
60	8
90	2
Unresolved by End of Quarter	39

Figure 1 Reference Standard Results for Second Quarter 2021 (percent recovery)

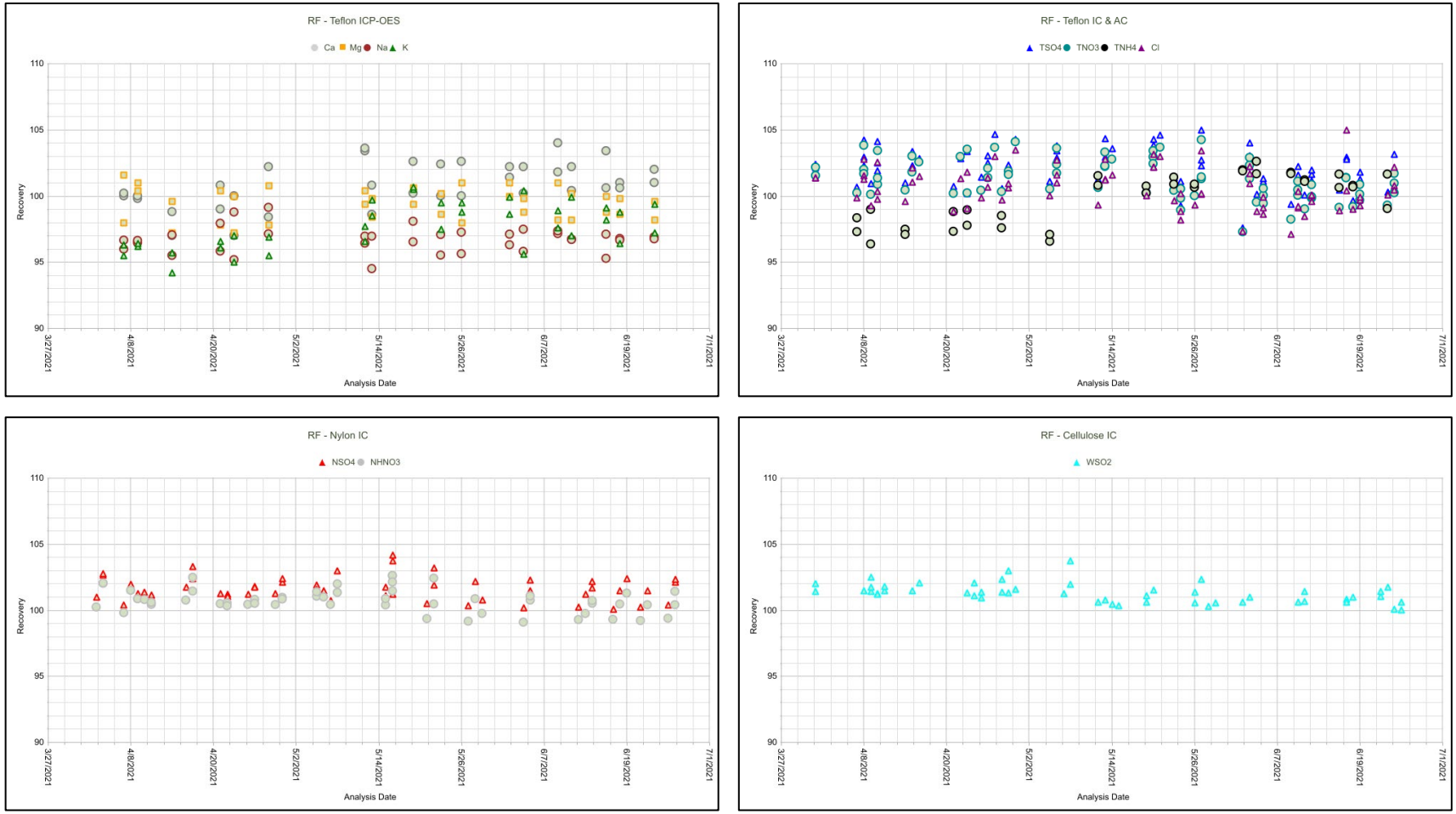

Figure 2 Continuing Calibration Spike Results for Second Quarter 2021 (percent recovery)

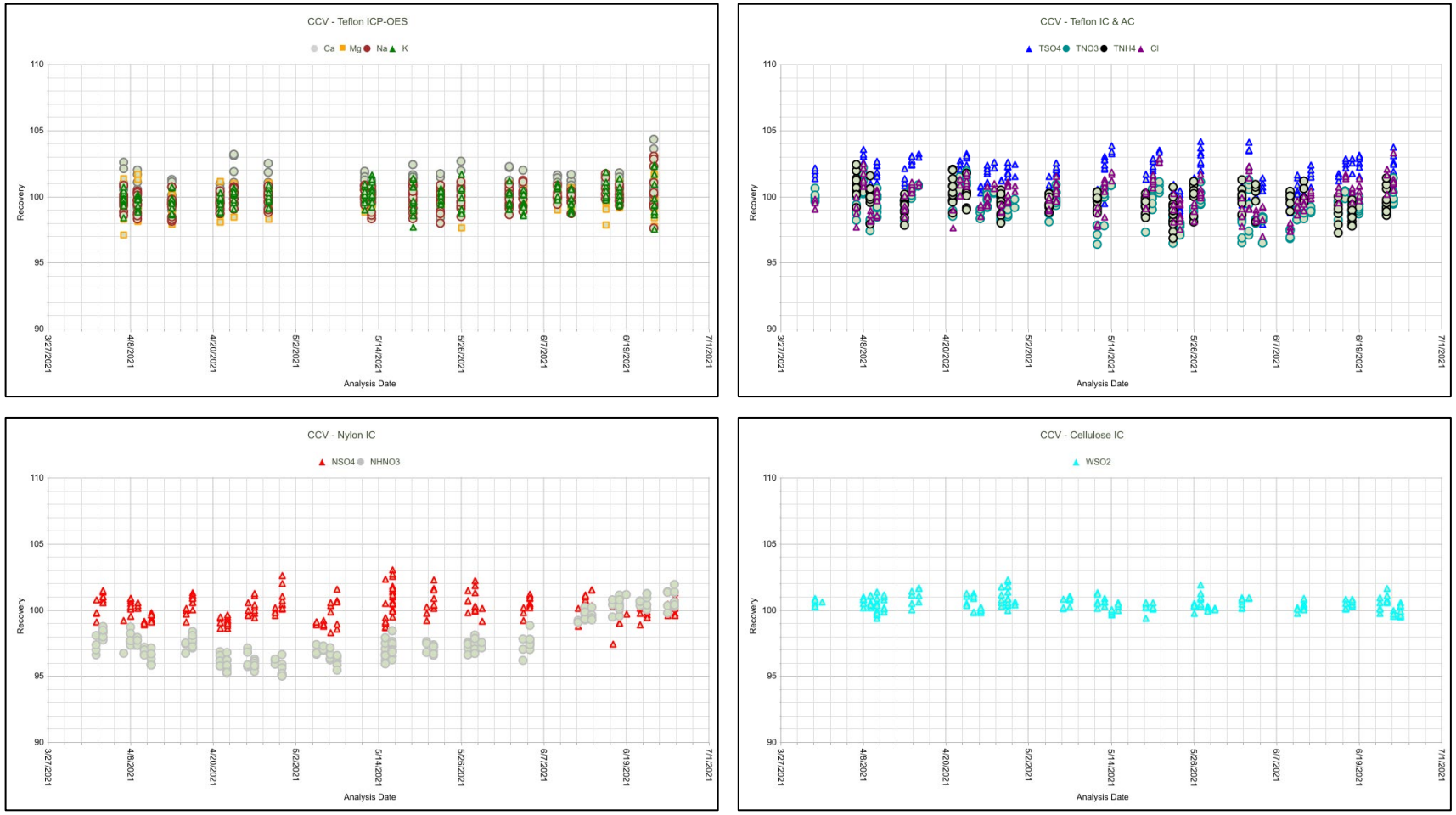

Figure 3 Replicate Sample Analysis Results for Second Quarter 2021 (percent difference)

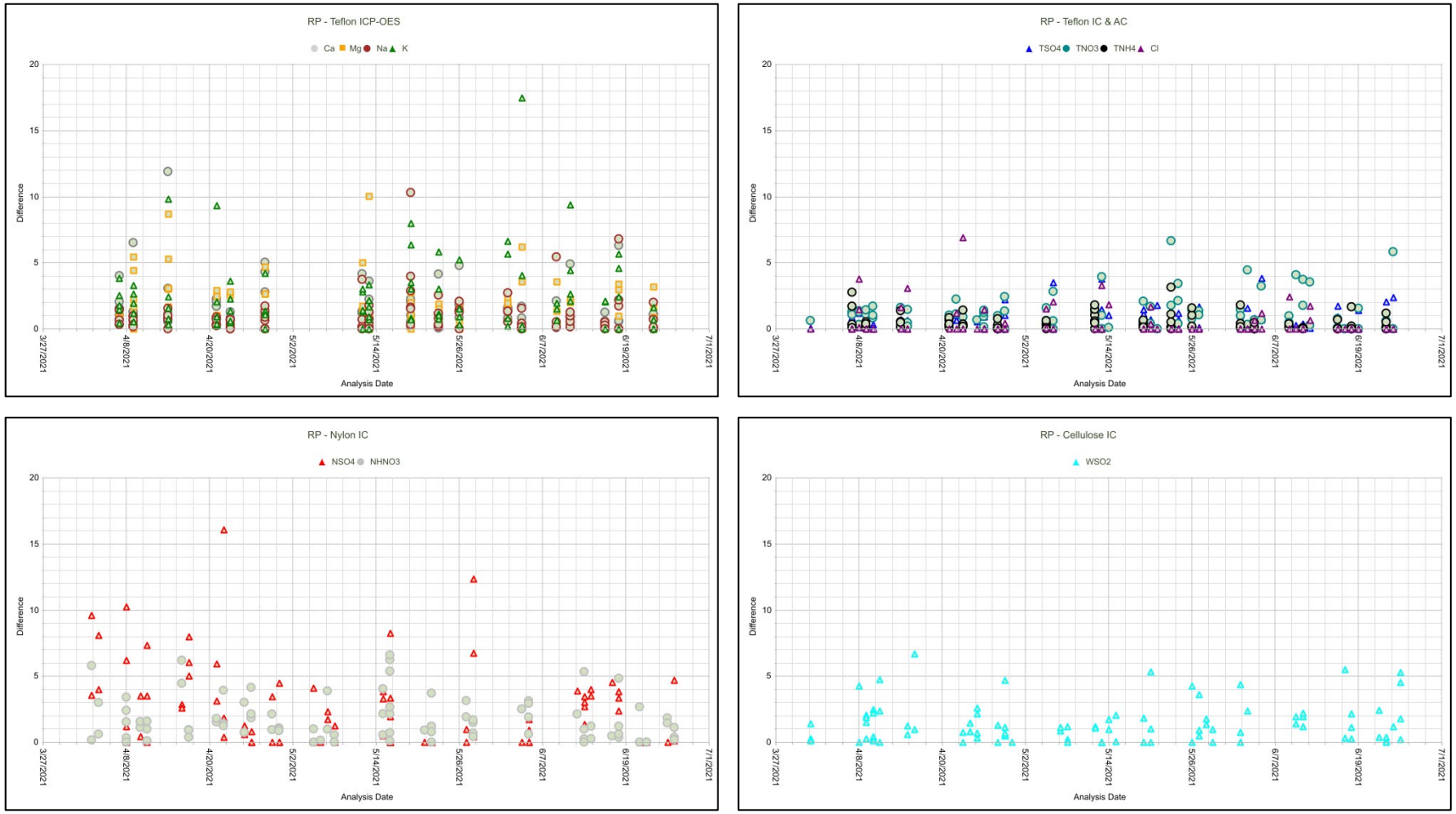

Figure 4 Laboratory Control Sample Results for Second Quarter 2021 (percent recovery)

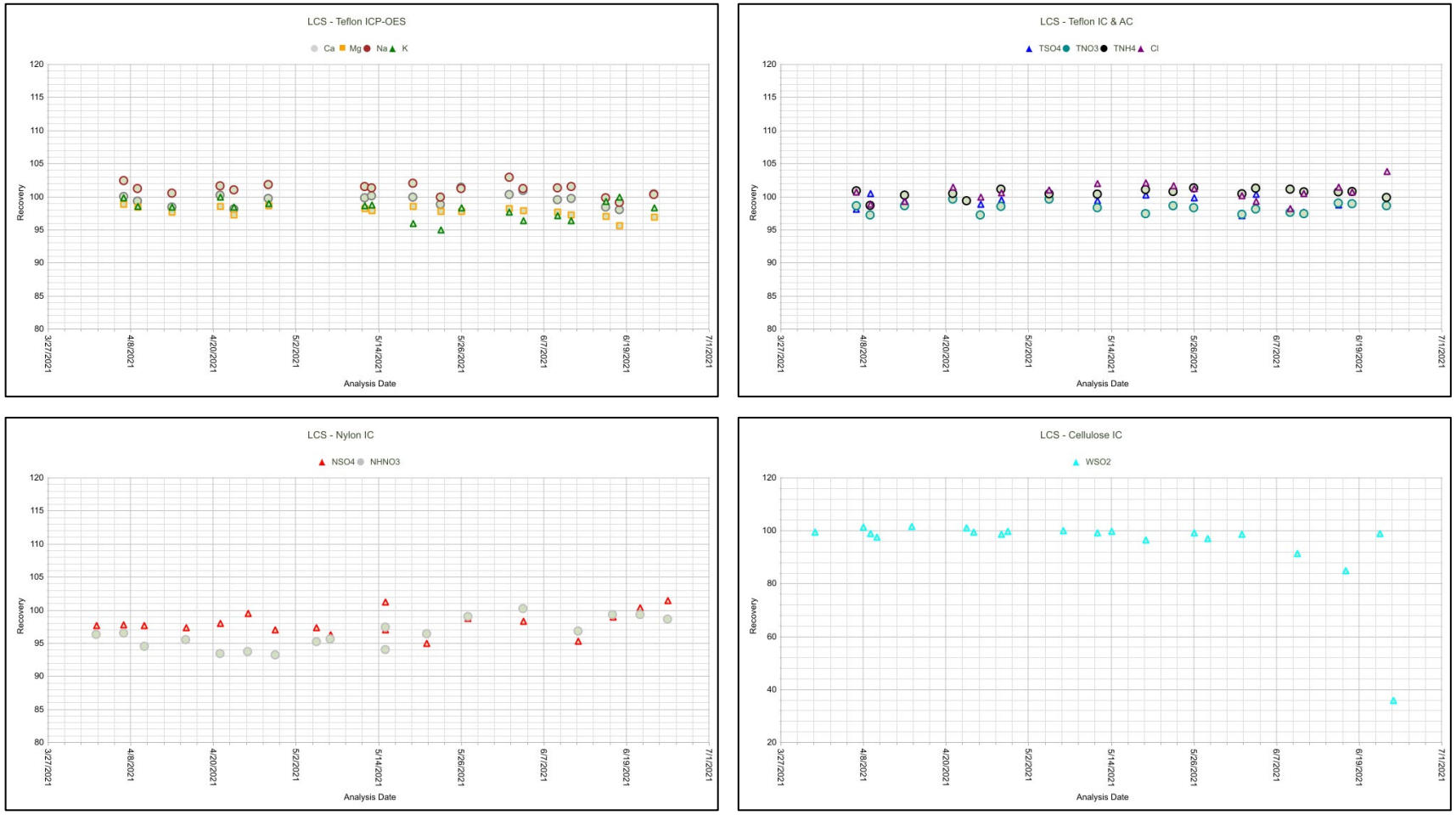

Figure 5 Method Blank Analysis Results for Second Quarter 2021 (total micrograms)

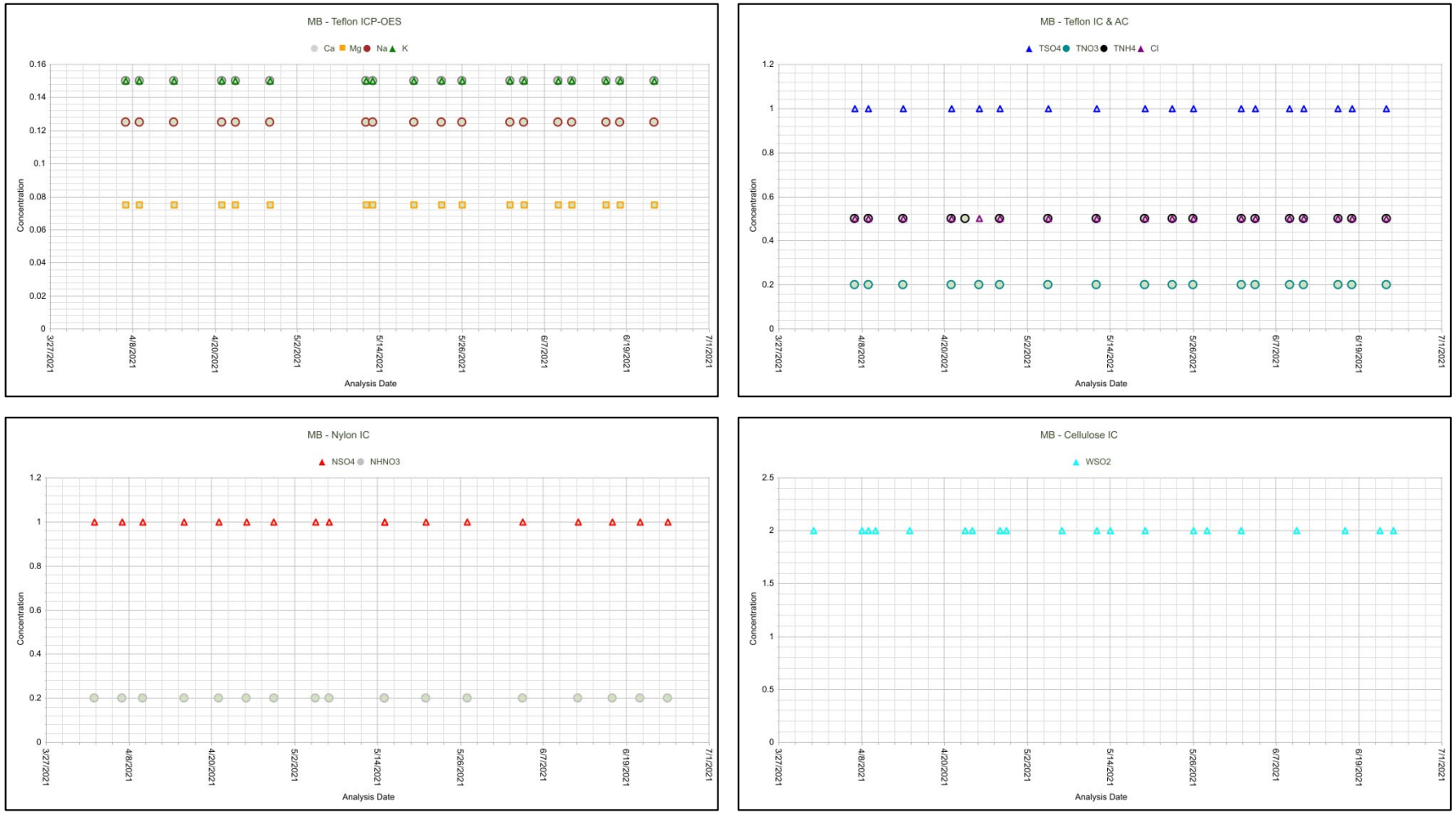

Figure 6 Laboratory Blank Analysis Results for Second Quarter 2021 (total micrograms)

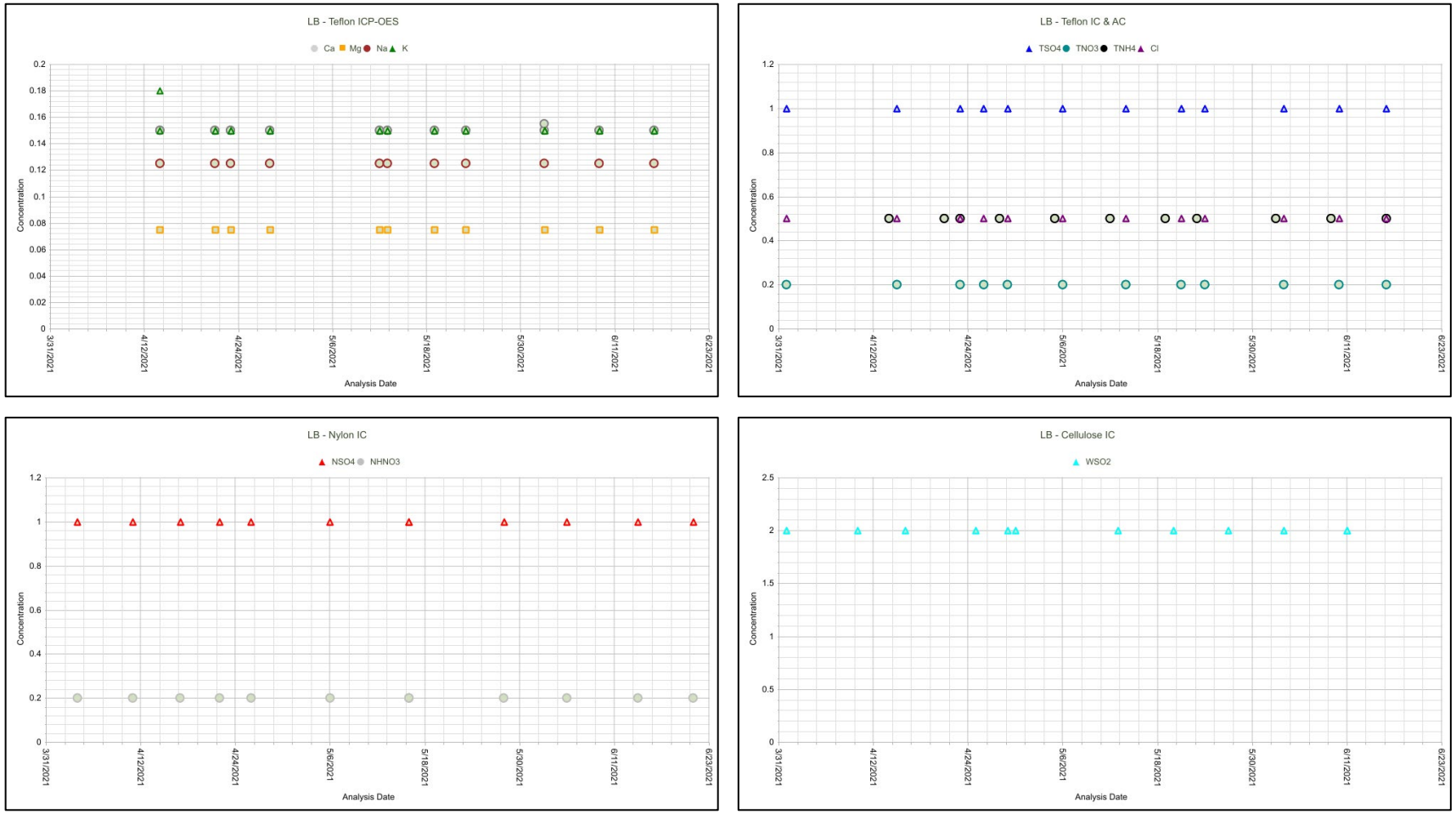

Figure 7 Field Blank Analysis Results for Second Quarter 2021 (total micrograms)