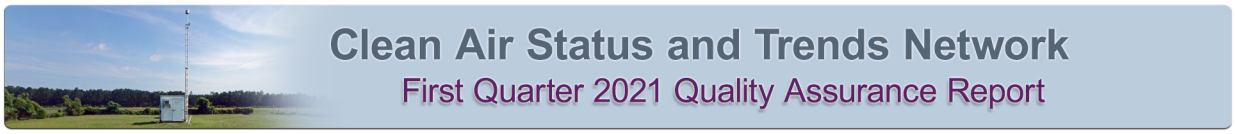

Summary of Quarterly Operations (January through March)

EPA Contract No. EP-W-16-015

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 first quarter 2021. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; Wood, 2020). 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

The assessment required to continue International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2017 accreditation by the American Association for Laboratory Accreditation (A2LA) is scheduled for April 12–14, 2021, as a virtual assessment. During first quarter, documentation continued to be reviewed and updated as needed. The assessor requested advance, electronic copies of general documentation along with many laboratory and field-related records. Wood supplied the requested documentation and answered questions from the assessor to help make the audit go smoothly. Additionally, Wood worked with assessor so he could securely access the Wood network for the remote audit.

The QA Manager completed review of the metrics for the annual site operator performance assessment. These metrics are evaluated annually to determine where additional training is needed.

NADP hosted a Data Quality Objective (DQO) Summit during January 2021. Marcus Stewart, Wood's CASTNET QA Manager, served as a moderator. Previously, Mr. Stewart worked closely with EPA during the development of CASTNET DQO and data quality indicators.

Results for samples received 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 were submitted to ECCC on February 19, 2021.

During first quarter, approximately 35 sites received a weekly shipment of filter packs with the incorrect quick connect. Most sites were able to use the next week's filter pack instead. About six sites did not have an extra filter pack and ran two-week samples. Replacement filter packs were shipped to the sites that needed them. Laboratory identification numbers were adjusted as filter packs were received to indicate the actual sampling period. Corrective Action No. 0104 was initiated. Actions included retraining personnel, further separation of storage for differing filter pack configurations, and posting a visual reference guide.

The NO/NO_y analyzer at the PNF126, NC site failed an audit by EEMS in November 2020. A few days prior to the audit, Wood calibrated the analyzer and verified that it was operating within criteria. Wood has not been able to replicate or determine the source of the problem encountered by EEMS. A Wood field calibrator subcontractor visited the site in January 2021 for additional, in depth troubleshooting. Both the gas calibrator and the analyzer were found to be within criteria and were not recalibrated during the January site visit.

The CASTNET QA Manager documented the results of co-located testing that compared MTL nylon filters from lots 709 and 710. The filters compared well. Wood began using nylon filters from lot 710 in CASTNET filter packs during first quarter beginning sampling week 7.

Table 1 lists the quarters of data that were validated to Level 3 during first 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 first quarter.

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 or action must be taken to address the issue. Table 7 presents the relevant sample receipt statistics for first quarter 2021. Wood continued to experience delayed receipt of filter packs from the local post office. The CASTNET Project Manager discussed the importance of receiving the filter packs in a timely manner with the local postmaster. Additionally, alternate return delivery options are being evaluated for sites that are regularly late.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for first quarter 2021. All results were within the criteria listed in Table 3. The Teflon RP result for measured calcium was less than five times the reporting limit and was within the plus or minus reporting limit criterion.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during first 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. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 9 presents observations associated with the shaded cell results in Table 8.

Table 10 presents summary statistics of critical criteria measurements at trace-level gas monitoring sites collected during first 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 11 presents observations associated with the shaded cell results in Table 10.

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 first quarter 2021. All recovery values were between 93 percent and 109 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for first quarter 2021. All first quarter results were within criteria (two times the reporting limit) listed in Table 3.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during first quarter 2021 are listed in Table 12. This table also includes associated site identification and a brief description of the reason the sample was flagged. During first quarter, six filter pack samples were invalidated.

Field Problem Count

Table 13 presents counts of field problems affecting continuous data collection for more than one day for first 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). 2017. 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) 2020. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan* (QAPP) Revision 9.3. 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 First Quarter 2021

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	May 2020 – October 2020	6	Quarter 3 2020	1
SE-4/MW-6‡	July 2020 – December 2020	6	Quarter 3 2020 – Quarter 4 2020	2

Notes: * The sites contained in each calibration group are listed in Table 2.
† Contains ROM206 of the ROM406/ROM206 co-located pair
‡ Contains MCK131/231 co-located pair

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.

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, 2020).

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, 2017). 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, 2017). 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 First 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	87	19	26	97
	NO_3^-	75	211	87	19	26	97
	NH_4^+	38	179	88	19	26	101
	Cl^-	75	211	87	19	26	97
	Ca^{2+}	38	194	88	19	26	101
	Mg^{2+}	38	194	88	19	26	101
	Na^+	38	194	88	19	26	101
	K^+	38	194	88	19	26	101
Nylon	SO_4^{2-}	58	203	82	18	26	100
	NO_3^-	58	203	82	18	26	100
Cellulose	SO_4^{2-}	51	184	84	19	26	100

Table 7 Filter Pack Receipt Summary for First Quarter 2021

Count of samples received more than 14 days after removal from tower:	231
Count of all samples received:	611
Fraction of samples received within 14 days:	0.622
Average interval in days:	14.309
First receipt date:	01/07/2021
Last receipt date:	03/18/2021

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 First 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	0.65	100.00	0.58	100.00	0.13
ALC188, TX	100.00	3.97	100.00	2.86	100.00	0.33
ALH157, IL	100.00	0.66	100.00	0.76	100.00	0.13
ANA115, MI	100.00	1.07	100.00	1.12	100.00	0.13
ARE128, PA	100.00	0.97	100.00	0.95	100.00	0.12
ASH135, ME	100.00	0.60	100.00	0.61	100.00	0.18
BEL116, MD	100.00	0.82	100.00	0.71	100.00	0.33
BFT142, NC	89.41	4.27	89.29	3.14	93.98	1.13
BVL130, IL	100.00	1.02	100.00	1.27	100.00	0.14
BWR139, MD	100.00	2.68	100.00	1.54	100.00	1.28
CAD150, AR	100.00	1.55	100.00	2.15	100.00	0.40
CDR119, WV	100.00	1.73	100.00	1.46	100.00	0.19
CDZ171, KY	100.00	1.41	100.00	1.24	100.00	0.33
CKT136, KY	100.00	0.58	100.00	0.67	100.00	0.17
CND125, NC	100.00	2.06	100.00	1.41	100.00	0.46
CNT169, WY	100.00	0.52	100.00	0.57	100.00	0.27
COW137, NC	100.00	0.78	100.00	1.19	100.00	0.51
CTH110, NY	100.00	3.71	100.00	3.81	100.00	0.18
CVL151, MS	100.00	0.58	100.00	0.53	100.00	0.46
DCP114, OH	100.00	1.25	100.00	1.30	100.00	0.25
DUK008, NC[3]	NA	NA	NA	NA	NA	NA
ESP127, TN	100.00	0.76	100.00	0.96	100.00	0.28
GAS153, GA	100.00	1.92	100.00	2.34	100.00	0.55

Table 8 Ozone QC Summary for First 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]
GTH161, CO	100.00	1.17	100.00	1.53	100.00	0.20
HOX148, MI	100.00	0.74	100.00	0.60	100.00	0.22
HWF187, NY	100.00	2.46	100.00	2.74	100.00	0.29
IRL141, FL	100.00	0.46	100.00	0.94	100.00	0.43
KEF112, PA	100.00	0.61	100.00	0.61	100.00	0.12
LRL117, PA	100.00	0.33	100.00	0.49	100.00	0.23
MCK131, KY	100.00	1.04	100.00	0.79	100.00	0.17
MCK231, KY	100.00	0.43	100.00	0.50	100.00	0.21
MKG113, PA	100.00	3.02	100.00	2.37	100.00	0.20
NPT006, ID	100.00	0.99	100.00	1.75	100.00	0.16
OXF122, OH	100.00	1.64	100.00	1.90	100.00	0.26
PAL190, TX	100.00	0.56	100.00	0.69	100.00	0.36
PAR107, WV	100.00	0.41	100.00	0.51	100.00	0.27
PED108, VA	100.00	1.45	100.00	1.39	100.00	0.22
PND165, WY	100.00	0.82	100.00	0.98	100.00	0.20
PNF126, NC	100.00	0.40	100.00	0.82	100.00	0.29
PRK134, WI	100.00	0.81	100.00	0.71	100.00	0.13
PSU106, PA	100.00	2.11	100.00	2.40	100.00	0.32
QAK172, OH	100.00	0.90	100.00	1.79	100.00	0.68
ROM206, CO	100.00	3.47	100.00	3.93	100.00	0.23
SAL133, IN	100.00	0.55	100.00	0.67	100.00	0.15
SAN189, NE	100.00	1.16	100.00	1.62	100.00	0.80
SND152, AL	100.00	0.65	100.00	1.02	100.00	0.42
SPD111, TN	100.00	0.76	100.00	0.95	100.00	0.22
STK138, IL	100.00	0.51	100.00	0.54	100.00	0.18
SUM156, FL	100.00	3.35	100.00	2.80	100.00	0.14
UVL124, MI	100.00	0.85	100.00	1.27	100.00	0.15
VIN140, IN	100.00	1.11	100.00	1.18	100.00	0.18
VPI120, VA	100.00	1.66	100.00	1.52	100.00	0.13
WSP144, NJ	100.00	1.45	100.00	1.17	100.00	0.20
WST109, NH	100.00	0.44	100.00	0.61	100.00	0.21

Notes: [1]Percentage of comparisons that pass the criteria listed in Table 4. Values falling below 90 percent are addressed in Table 9.

[2]Absolute value of the average percent differences between the on-site transfer standard and the site monitor. Values exceeding the criteria listed in Table 4 are addressed in Table 9.

[3]A tree fell on the sampling tower at DUK008, NC and damaged it. No sampling activities took place during first quarter 2021.

%D = percent difference
ppb = parts per billion
NA = not assessed

Table 9 Ozone QC Observations for First Quarter 2021

Site ID	QC Criterion	Comments
BFT142, NC	% Span Pass % Single Point QC Pass	The ozone drier failed.

Table 10 Trace-level Gas QC Summary for First 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	97.87	2.81	97.87	4.60	100.00	0.46
NO_y	100.00	1.22	100.00	1.44	100.00	0.42
CO	100.00	1.40	73.81	9.97	71.43	22.67
DUK008, NC[3]						
NO_y	NA	NA	NA	NA	NA	NA
HWF187, NY						
NO_y	100.00	1.48	100.00	1.41	100.00	0.20
PND165, WY						
NO_y	95.65	5.48	100.00	2.17	97.83	0.28
PNF126, NC						
NO_y	93.62	1.80	93.62	4.96	100.00	0.27
ROM206, CO						
NO_y	100.00	3.01	100.00	5.39	97.83	0.26

Notes: [1]Percentage of comparisons that pass the criteria listed in Table 5. Values falling below 90 percent are addressed in Table 11.

[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 11.

[3]A tree fell on the sampling tower at DUK008, NC and damaged it. No sampling activities took place during first quarter 2021.

%D = percent difference
ppb = parts per billion
NA = not assessed

Table 11 Trace-level Gas QC Observations for First Quarter 2021

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	CO	% Single Point QC Pass % Zero Pass	The analyzer required recalibration in February. It malfunctioned in March and was replaced.

Table 12 Filter Packs Flagged as Suspect or Invalid during First Quarter 2021

Site ID	Sample No.	Reason
CAT175, NY	2107001-11	Power failures
MEV405, CO	2107003-15	Power failure
NPT006, ID	2106004-04	Power failure
PED108, VA	2107001-39	Power failure
SHE604, WY	2107005-05	Power failure
SUM156, FL	2106001-50	Suspected contamination during sampling

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	218
60	5
90	2
Unresolved by End of Quarter	3

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

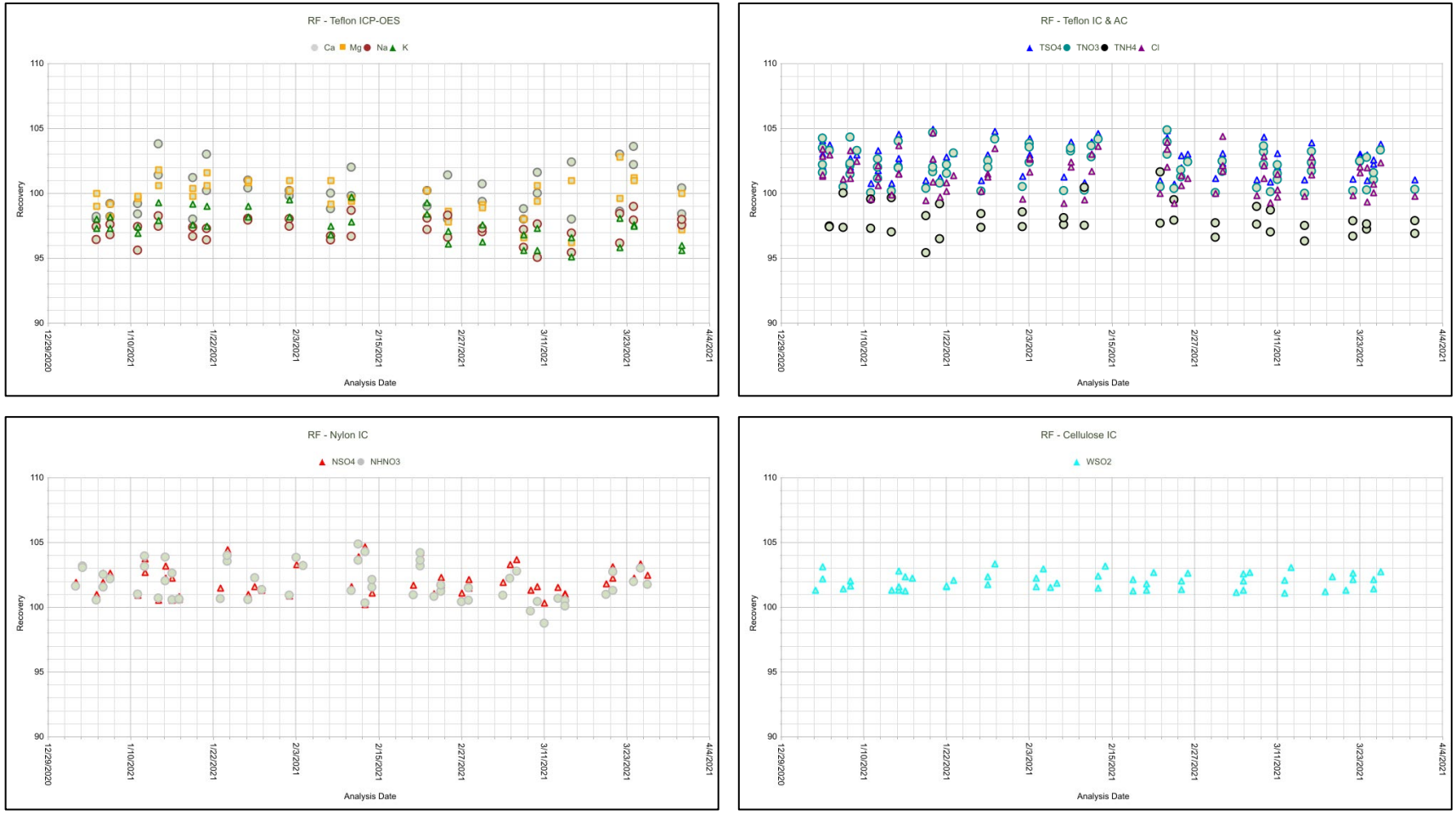

Figure 2 Continuing Calibration Spike Results for First Quarter 2021 (percent recovery)

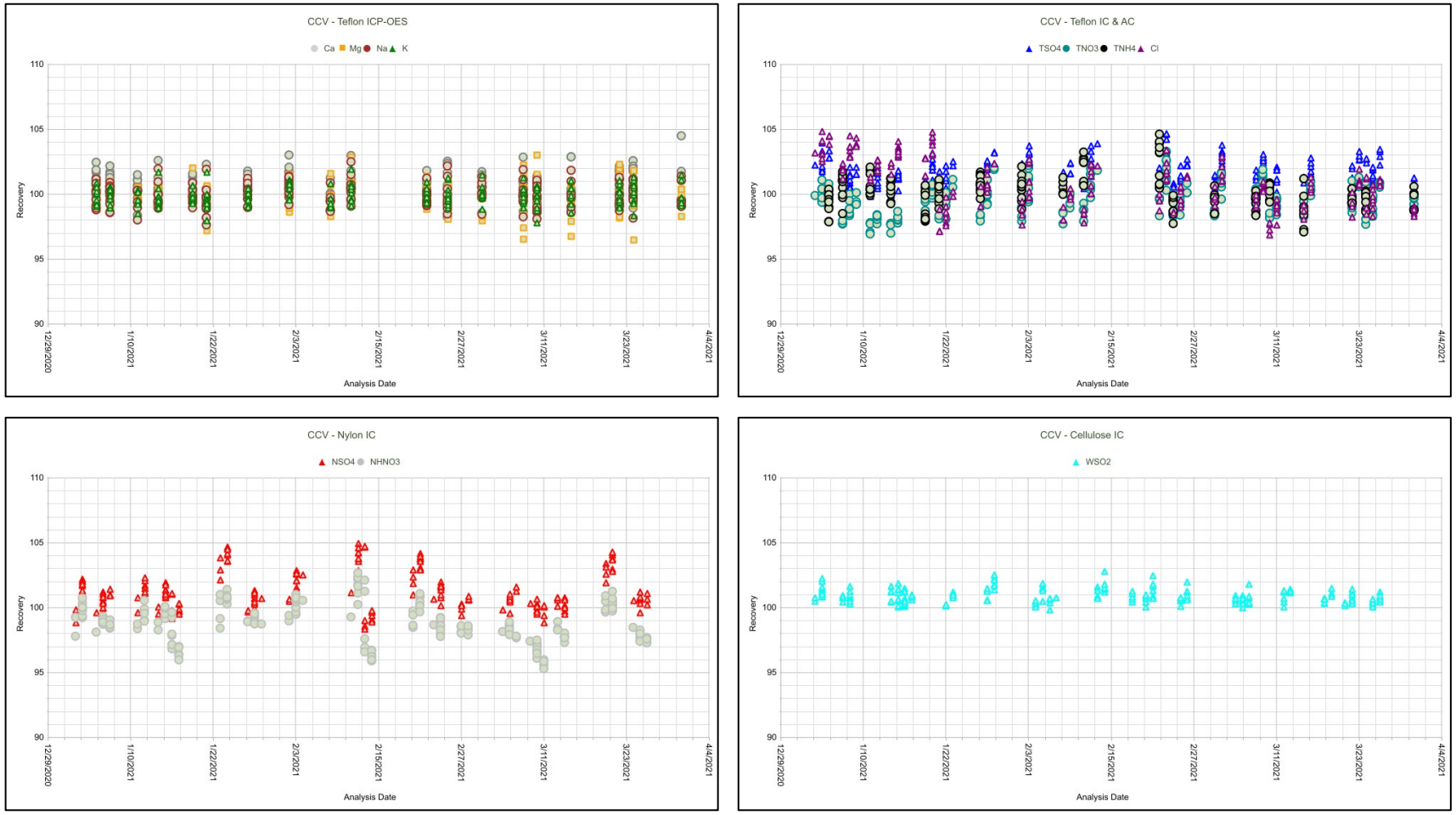

Figure 3 Replicate Sample Analysis Results for First Quarter 2021 (percent difference)

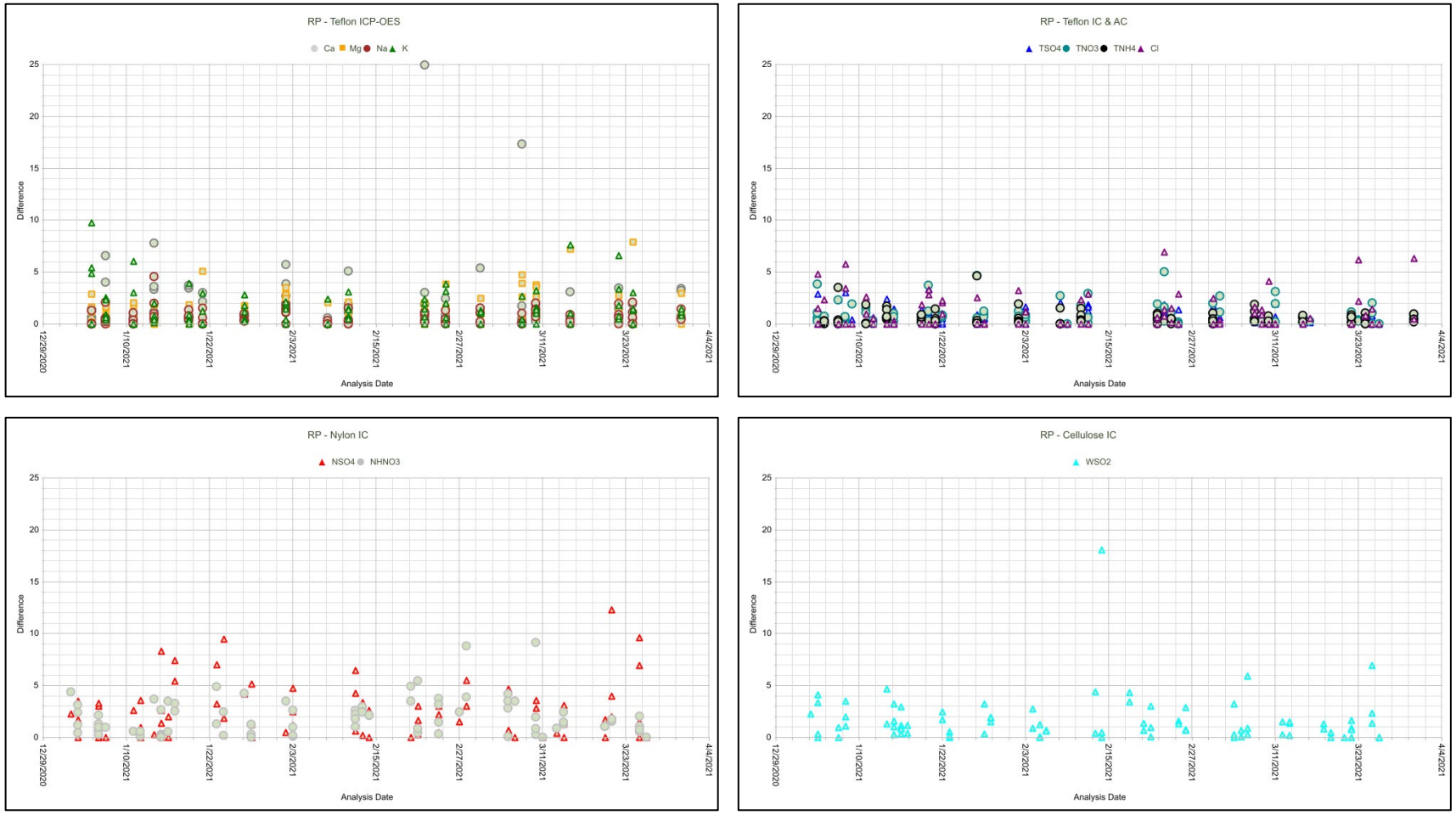

Figure 4 Laboratory Control Sample Results for First Quarter 2021 (percent recovery)

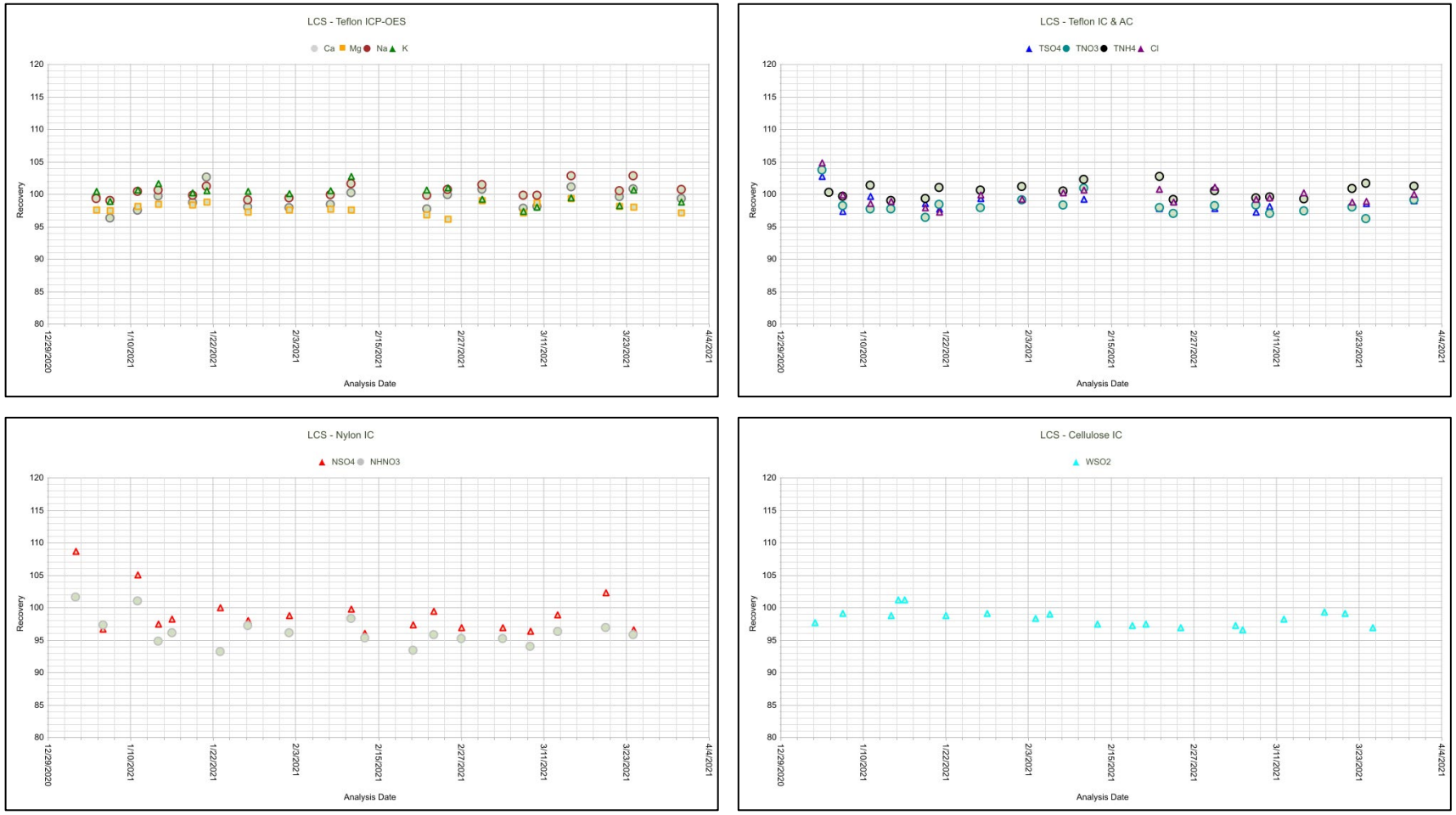

Figure 5 Method Blank Analysis Results for First Quarter 2021 (total micrograms)

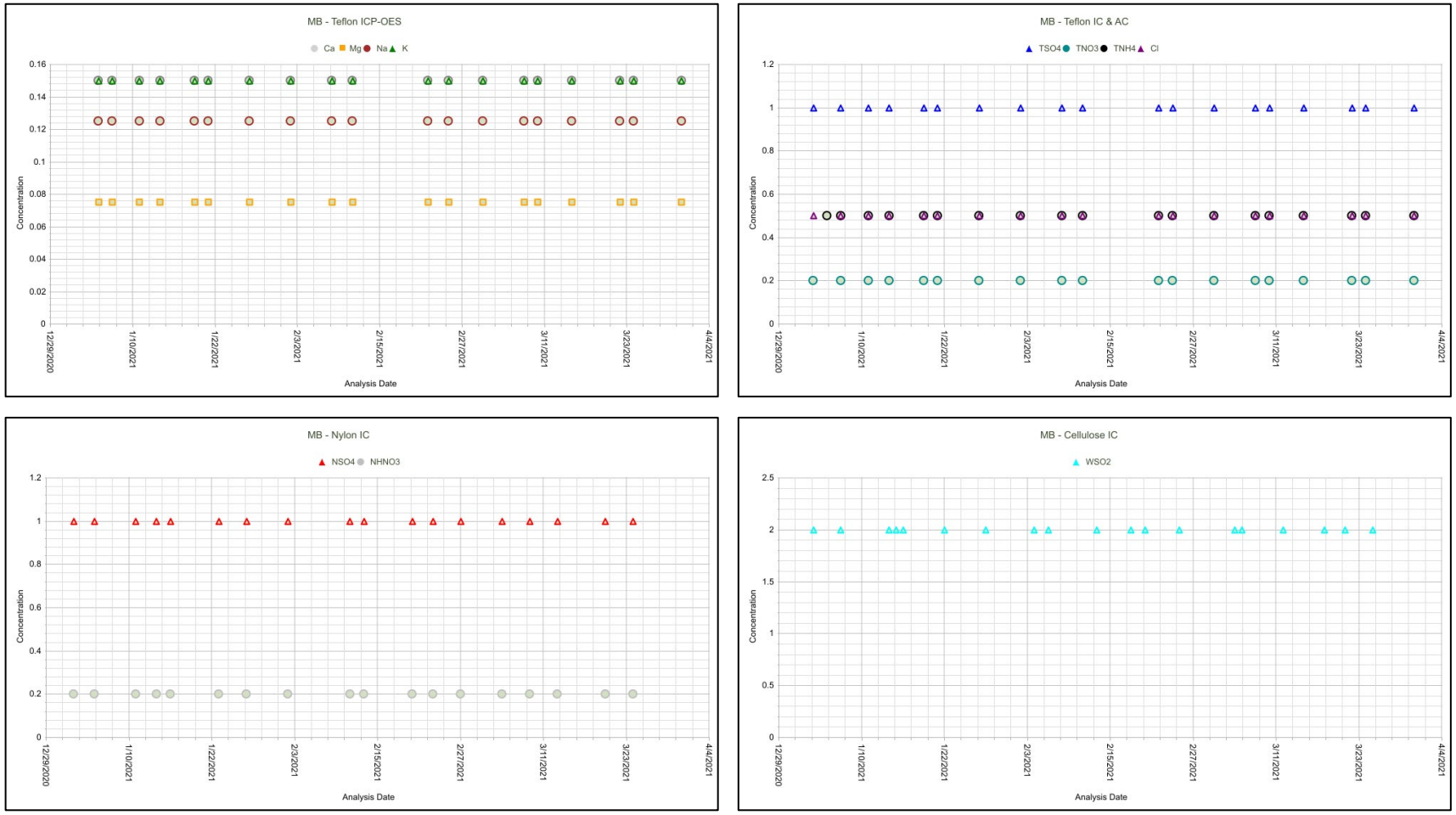

Figure 6 Laboratory Blank Analysis Results for First Quarter 2021 (total micrograms)

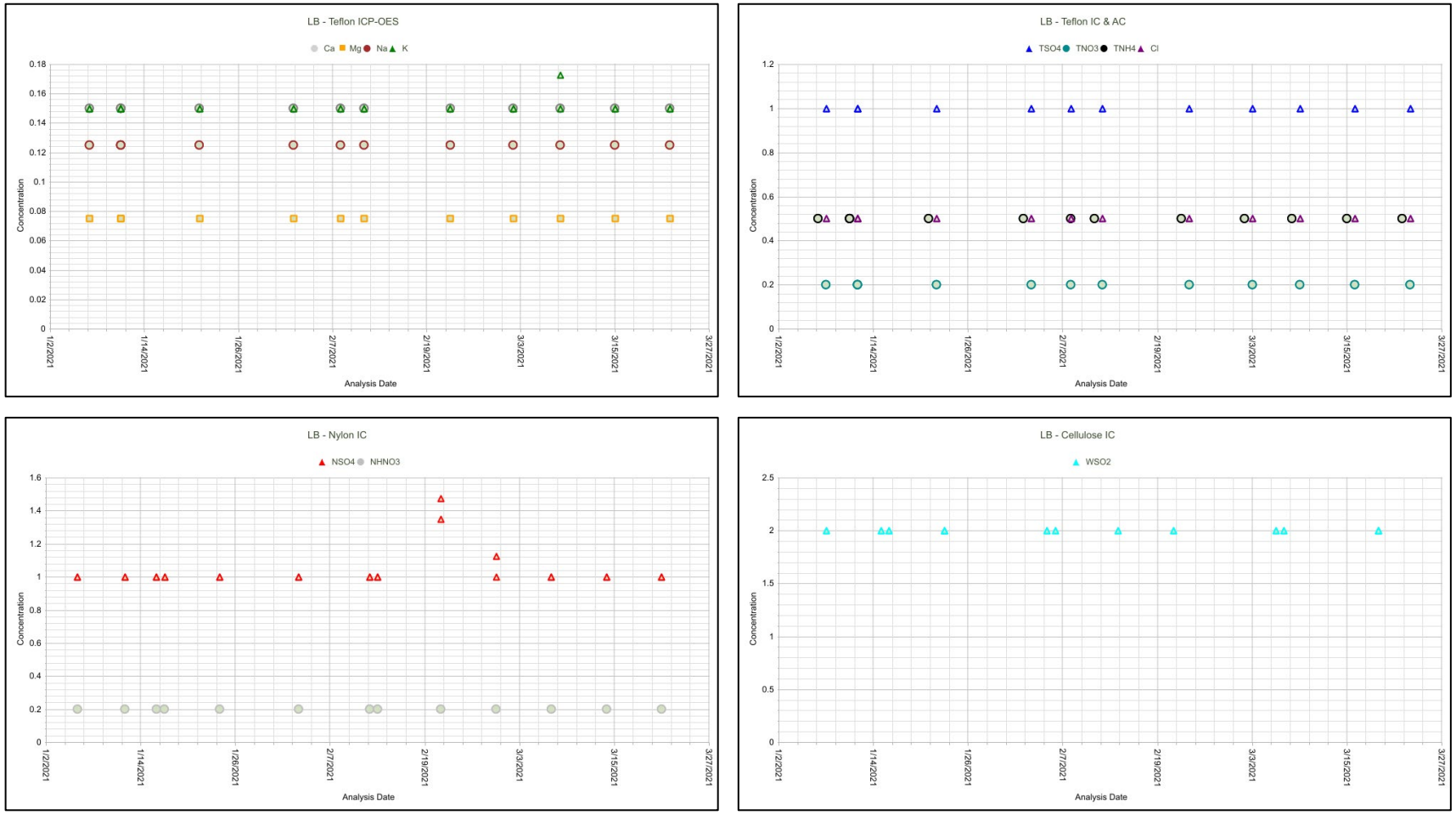

Figure 7 Field Blank Analysis Results for First Quarter 2021 (total micrograms)