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 2018. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; Amec Foster Wheeler, 2016). 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

In order to meet anticipated changes to the guidelines for ozone zero/span/precision (zsp) QC checks by EPA's Office of Air Quality Planning and Standards (EPA, 2018), Amec Foster Wheeler began developing criteria for acceptable target concentrations for data validation purposes. This will identify zsp QC checks that pass accuracy criteria but require investigation to ensure the system is operating as intended.

The Amec Foster Wheeler laboratory continued evaluating nylon filter replacements for the Nylasorb filters. Pre-washed nylon filters (lot 709) received from MTL Corp during January 2018 did not pass acceptance testing. However, once the MTL nylon filters were washed by Amec Foster Wheeler, they passed CASTNET acceptance tests.

Performance data were reviewed from testing MTL nylon filters from lot 701 (unwashed) at the co-located sites in Kentucky and Colorado, and MTL nylon filters were found to be comparable with the co-located Nylasorb filters. Review of performance data for filters from lot 709 that were washed in-house by Amec Foster Wheeler found the filters to be satisfactory. Once Amec Foster Wheeler's supply of MTL lot 701 has been depleted, filters from lot 709 that have been washed in-house will be used.

Review of the 2017 annual summary of filter pack receipt statistics indicated increasing numbers of filter packs were not being received within 14 days after removal from the tower. During first quarter 2018, review of filter pack receipt statistics continued. Investigation into possible causes of the increase in late filter packs found that the capacity of the local mail service to process and deliver network filter packs has diminished. The project manager is working with the local post office to ensure timely delivery. In addition, the site operators have been informed of the need to promptly return filter packs after exposure and to take proper steps to package the filter packs securely prior to shipping. For first quarter 2018, filter pack return statistics remained within the 95 percent criterion.

Documentation needed for the annual review by the American Association for Laboratory Accreditation (A2LA) in order to maintain International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2005 accreditation for Amec Foster Wheeler's laboratory and field operations was prepared. Required documentation was due to A2LA on or before April 2, 2018.

Planning began for preparation of the annual management review report in support of ISO/IEC 17025:2005 accreditation. The meeting to discuss the report will be held during second quarter.

Amec Foster Wheeler's QA lead for the eastern region of the United States performed an internal project audit of Task Order 1003, CASTNET Base Program, during mid-March. The audit verified that project activities, record keeping, and documentation protocols are followed. There was one finding. An annual project review is required for projects with a gross budget greater than $3,000,000. The CASTNET V Base Program (Task Order 1003) meets this criterion. The project review is scheduled for early April 2018.

Table 1 lists the quarters of data that were validated to Level 3 during first quarter 2018 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 2018.

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 first quarter 2018.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for first quarter 2018. All results were within the criteria listed in Table 3.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during first quarter 2018. 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 2018. 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. During first quarter, no values exceeded documented criteria or were otherwise notable.

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 2018. All recovery values were between 92 percent and 114 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for first quarter 2018. All first quarter results were within criteria (2 times the reporting limit) listed in Table 3 with the exception of 1 Teflon FB calcium result at 3.5 times the reporting limit, 1Teflon FB sodium result at 3.7 times the reporting limit, and 16 Teflon potassium FB results ranging from just above twice the reporting limit to 17.4 times the reporting limit. The LB results along with all other QC during the period were within criteria. Investigation of the elevated FB results is ongoing.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during first quarter 2018 are listed in Table 11. This table also includes associated site identification and a brief description of the reason the sample was flagged. During first quarter, eight 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 first quarter 2018. 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

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler). 2016. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan* (QAPP) Revision 9.0. 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.

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). 2015. 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."

U.S. Environmental Protection Agency (EPA). 2018. Technical Memorandum "Steps to Qualify or Validate Data after an Exceedance of Critical Criteria Checks." Office of Air Quality Planning and Standards, Research Triangle Park, NC. Critical_criteria_qualifier_memo_v1_0.pdf (January 30, 2018). https://www.epa.gov/amtic/policy-memoranda-and-technical-guidance (accessed 04-27-18)

Table 1 Data Validated to Level 3 during First Quarter 2018

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	May 2016 – October 2016	6	Quarter 3 2016	1
SE-4/MW-6‡	July 2016 – December 2016	6	Quarter 3 2016 – Quarter 4 2016	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 2018

Calibration Group	Months Calibrated	Sites Calibrated			
Eastern Sites (24 Total)					
E-1 (8 Sites)	February/August	BEL116, MD BWR139, MD	WSP144, NJ CTH110, NY	ARE 128, PA PSU106, PA	PED108, VA VPI120, VA
E-2 (11 Sites)	April/October	ABT147, CT ASH135, ME HOW191, ME	WST109, NH CAT175, NY HWF187, NY[2]	NIC001, NY WFM007, NY WFM105, NY	EGB181, ON UND002, VT
E-3 (5 Sites)	May/November	KEF112, PA MKG113, PA	LRL117, PA PAR107, WV	CDR119, WV	
Southeastern Sites (11 Total)					
SE-4 (6 Sites)	January/July	SND152, AL GAS153, GA	BFT142, NC CND125, NC	COW137, NC SPD111, TN	
SE-5 (5 Sites)	February/August	CAD150, AR IRL141, FL	SUM156, FL CVL151, MS	DUK008, NC[1]	
Midwestern Sites (19 Total)					
MW-6 (6 Sites)	January/July	CDZ171, KY CKT136, KY	MCK131, KY MCK231, KY	PNF126, NC[2] ESP127, TN	
MW-7 (9 Sites)	March/September	ALH157, IL BVL130, IL[3] STK138, IL	VIN140, IN RED004, MN DCP114, OH	OXF122, OH QAK172, OH PRK134, WI	
MW-8 (4 Sites)	April/October	SAL133, IN HOX148, MI	ANA115, MI UVL124, MI		
Western Sites (11 Total)					
W-9 (5 Sites)	March/September	KNZ184, KS KIC003, KS	CHE185, OK SAN189, NE	ALC188, TX	
W-10 (6 Sites)	May/November	GTH161, CO ROM206, CO[1]	NPT006, ID CNT169, WY	PND165, WY[1] PAL190, TX	

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

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.
[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, (Amec Foster Wheeler, 2016).

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, 2015). 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, 2015). 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 2018

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-}	54	208	87	18	24	93
	NO_3^-	54	208	87	18	24	93
	NH_4^+	36	184	86	18	24	93
	Cl^-	54	208	87	18	24	93
	Ca^{2+}	37	190	86	18	24	93
	Mg^{2+}	37	190	86	18	24	93
	Na^+	37	190	86	18	24	93
	K^+	37	190	86	18	24	93
Nylon	SO_4^{2-}	52	221	85	17	26	120
	NO_3^-	52	221	85	17	26	120
Cellulose	SO_4^{2-}	54	194	87	18	26	93

Table 7 Filter Pack Receipt Summary for First Quarter 2018

Count of samples received more than 14 days after removal from tower:	38
Count of all samples received:	796
Fraction of samples received within 14 days:	0.952
Average interval in days:	6.7
First receipt date:	1/2/18
Last receipt date:	3/28/18

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 2018 (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	0.45	100.00	0.48	100.00	0.32
ALC188, TX	100.00	1.44	100.00	1.30	100.00	0.29
ALH157, IL	100.00	0.93	100.00	1.04	100.00	0.22
ANA115, MI	98.95	3.09	100.00	2.97	100.00	0.12
ARE128, PA	95.65	5.18	95.65	5.22	100.00	0.29
ASH135, ME	100.00	1.78	100.00	2.01	100.00	0.28
BEL116, MD	98.78	2.88	100.00	1.67	100.00	0.26
BFT142, NC	100.00	0.33	100.00	0.43	100.00	0.16
BVL130, IL	100.00	1.78	100.00	1.57	100.00	0.14
BWR139, MD	100.00	3.07	100.00	2.47	100.00	0.42
CAD150, AR	100.00	1.11	100.00	1.14	100.00	0.30
CDR119, WV	100.00	1.45	100.00	1.67	100.00	0.31
CDZ171, KY	100.00	1.31	100.00	1.55	100.00	0.20
CKT136, KY	100.00	0.62	100.00	0.61	100.00	0.19
CND125, NC	100.00	0.96	100.00	1.06	100.00	0.26
CNT169, WY	100.00	0.55	100.00	0.66	100.00	0.20
COW137, NC	100.00	0.91	100.00	1.03	98.77	0.25
CTH110, NY	100.00	1.41	100.00	1.08	100.00	0.49
CVL151, MS	100.00	2.49	100.00	1.82	100.00	0.18
DCP114, OH	100.00	1.55	100.00	2.23	100.00	0.26
ESP127, TN	100.00	1.12	100.00	1.20	100.00	0.19
GAS153, GA	100.00	1.04	100.00	1.62	100.00	1.12
GTH161, CO	83.17	10.36	87.13	9.24	91.09	1.11

Table 8 Ozone QC Summary for First Quarter 2018 (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	2.65	100.00	1.94	100.00	0.47
HWF187, NY	100.00	1.25	100.00	1.35	100.00	0.12
IRL141, FL	98.99	1.35	100.00	1.14	100.00	1.04
KEF112, PA	100.00	1.34	100.00	1.90	100.00	0.65
LRL117, PA	100.00	0.63	100.00	1.11	100.00	0.19
MCK131, KY	100.00	1.83	100.00	1.97	97.78	0.49
MCK231, KY	97.70	1.81	100.00	0.74	100.00	0.32
MKG113, PA	100.00	1.99	100.00	2.15	100.00	0.28
NPT006, ID	100.00	0.78	100.00	1.13	100.00	0.21
OXF122, OH	97.83	3.03	97.83	2.67	100.00	0.34
PAL190, TX	100.00	1.82	100.00	2.47	100.00	0.69
PAR107, WV	100.00	0.61	100.00	0.80	100.00	0.19
PED108, VA	100.00	0.65	100.00	0.75	100.00	0.14
PND165, WY	100.00	0.37	100.00	0.89	100.00	0.63
PNF126, NC	100.00	1.09	100.00	1.43	100.00	0.32
PRK134, WI	100.00	1.75	100.00	2.18	100.00	0.50
PSU106, PA	100.00	0.86	100.00	0.92	100.00	0.31
QAK172, OH	100.00	3.71	100.00	2.61	100.00	1.03
ROM206, CO	100.00	2.46	100.00	2.03	100.00	0.15
SAL133, IN	100.00	2.75	100.00	2.33	100.00	0.21
SAN189, NE	100.00	1.84	100.00	1.95	100.00	0.67
SND152, AL	100.00	0.96	100.00	2.11	100.00	1.30
SPD111, TN	100.00	0.80	100.00	0.63	100.00	0.43
STK138, IL	88.64	57.59	88.64	58.27	90.91	1.14
SUM156, FL	100.00	2.04	100.00	1.73	100.00	0.52
UVL124, MI	100.00	0.80	100.00	0.85	100.00	0.18
VIN140, IN	100.00	1.20	100.00	1.11	100.00	0.29
VPI120, VA	100.00	1.10	100.00	1.06	100.00	0.39
WSP144, NJ	98.91	3.00	98.91	2.27	100.00	0.66
WST109, NH	100.00	0.31	100.00	0.36	100.00	0.11

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.

%D = percent difference

ppb = parts per billion

Table 9 Ozone QC Observations for First Quarter 2018

Site ID	QC Criterion	Comments
GTH161, CO	% Span Pass Span |%D| % Single Point QC Pass Single Point QC |%D|	The sample pump malfunctioned on 01/03/2018 and was replaced 01/12/2018.
STK138, IL	% Span Pass Span |%D| % Single Point QC Pass Single Point QC |%D|	The site analyzer malfunctioned on 03/13/2018 and was replaced 03/17/2018.

Note: %D = percent difference

Table 10 Trace-level Gas QC Summary for First Quarter 2018

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	1.18	100.00	0.17
NO_y	100.00	1.81	100.00	2.45	92.50	0.74
CO	100.00	1.52	100.00	4.26	100.00	13.64
DUK008, NC						
NO_y	96.55	5.57	96.55	6.54	100.00	0.60
HWF187, NY						
NO_y	100.00	1.64	100.00	1.97	100.00	0.16
PND165, WY						
NO_y	100.00	2.77	100.00	5.39	100.00	0.12
PNF126, NC						
NO_y	100.00	1.12	100.00	3.95	100.00	0.32
ROM206, CO						
NO_y	100.00	0.38	100.00	1.94	100.00	0.20

Notes: [1] Percentage of comparisons that pass the criteria listed in Table 5 . No values were below 90 percent.
[2] Absolute value of the average percent differences between the supplied and observed concentrations. .

%D = percent difference
ppb = parts per billion

Table 11 Filter Packs Flagged as Suspect or Invalid during First Quarter 2018

Site ID	Sample No.	Reason
JOT403, CA	1805003-12	Insufficient flow data
NIC001, NY	1801001-35 1802001-35 1803001-35 1804001-35	There was an undetected leak in the flow system. The site operator was retrained in leak check procedures.
NPT006, ID	1803004-04	Power failure
PNF126, NC	1802001-41 1803001-41	The data logger malfunctioned and was replaced.

Table 12 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	424
60	20
90	2
Unresolved by End of Quarter	16

Figure 1 Reference Standard Results for First Quarter 2018 (percent recovery)

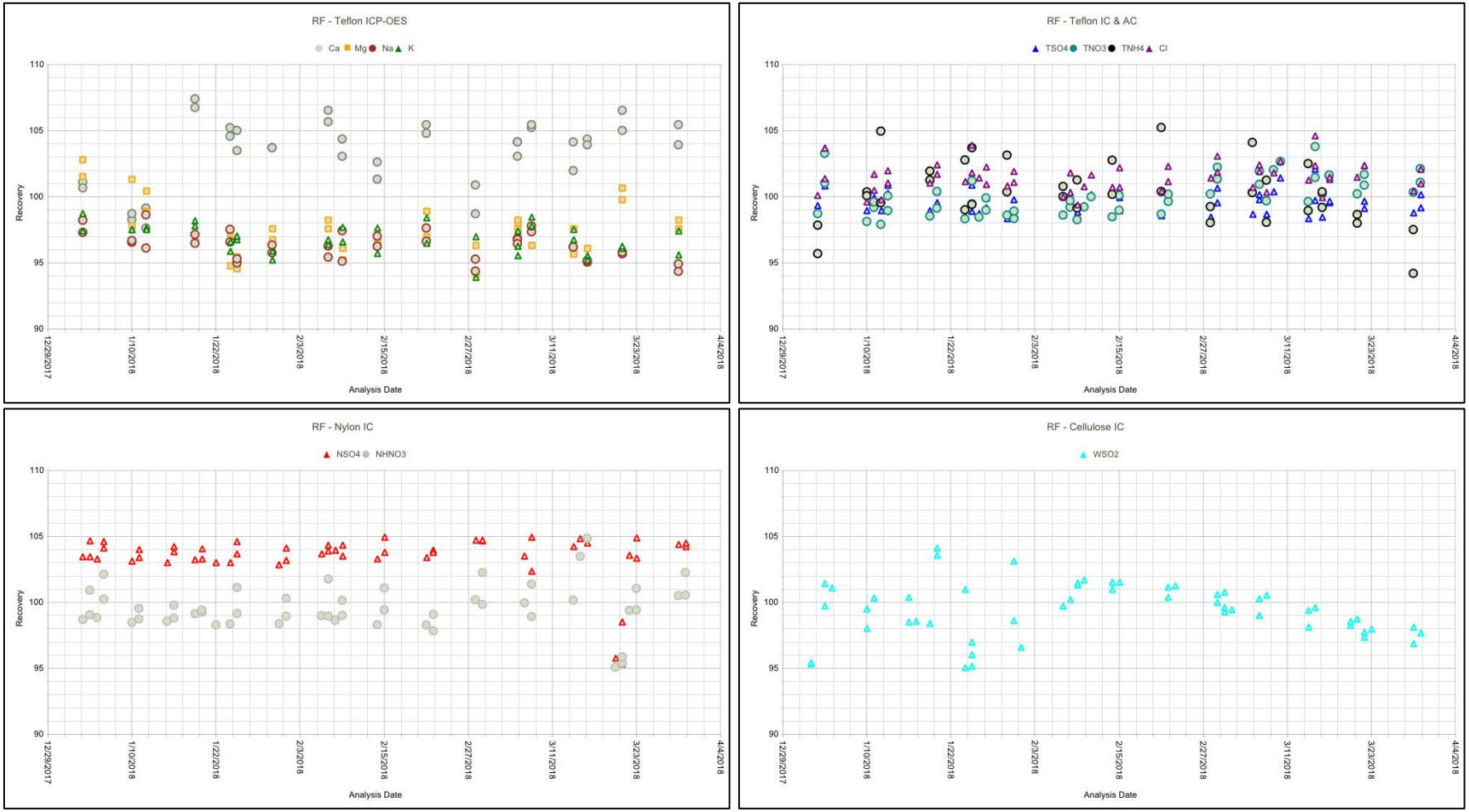

Figure 2 Continuing Calibration Spike Results for First Quarter 2018 (percent recovery)

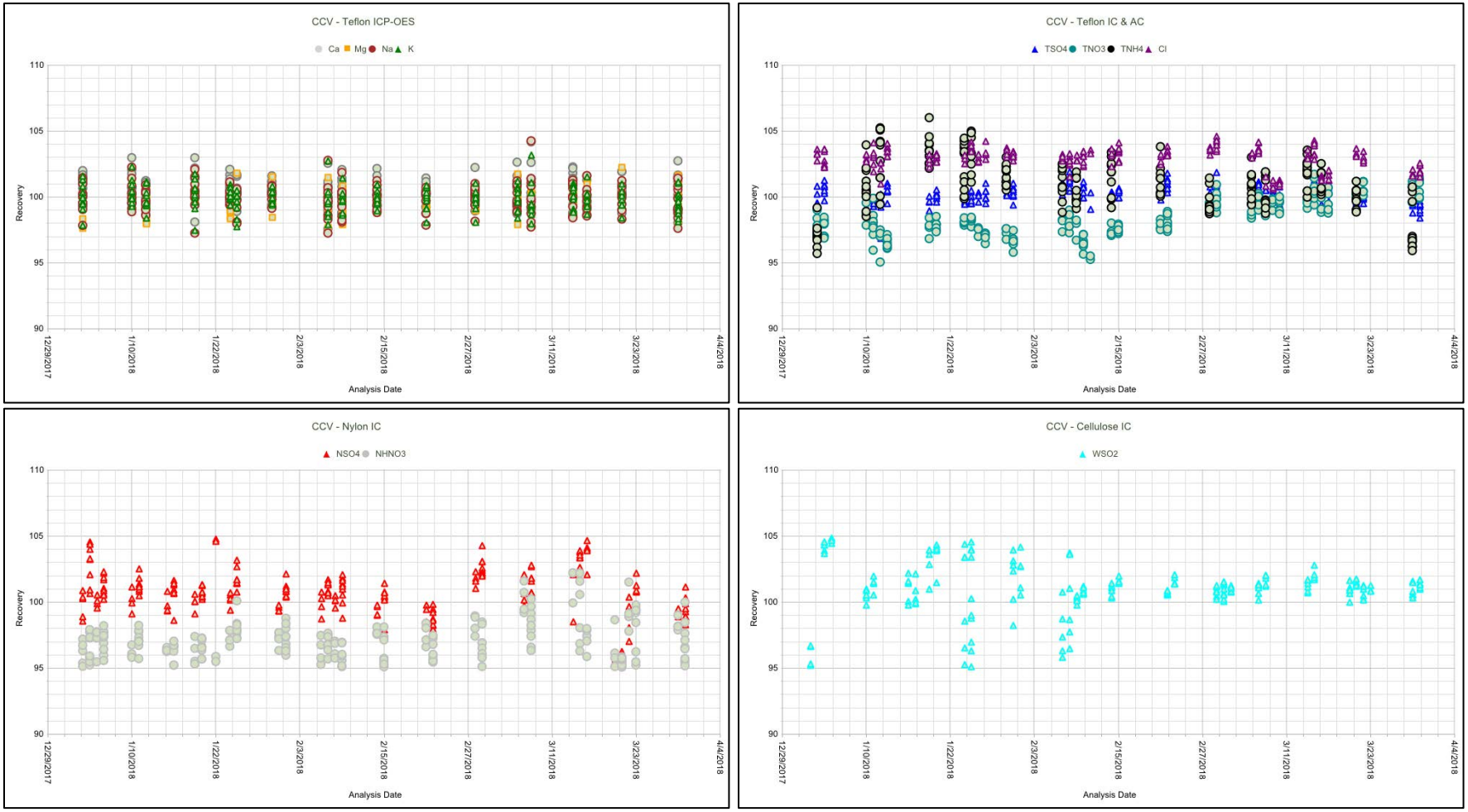

Figure 3 Replicate Sample Analysis Results for First Quarter 2018 (percent difference)

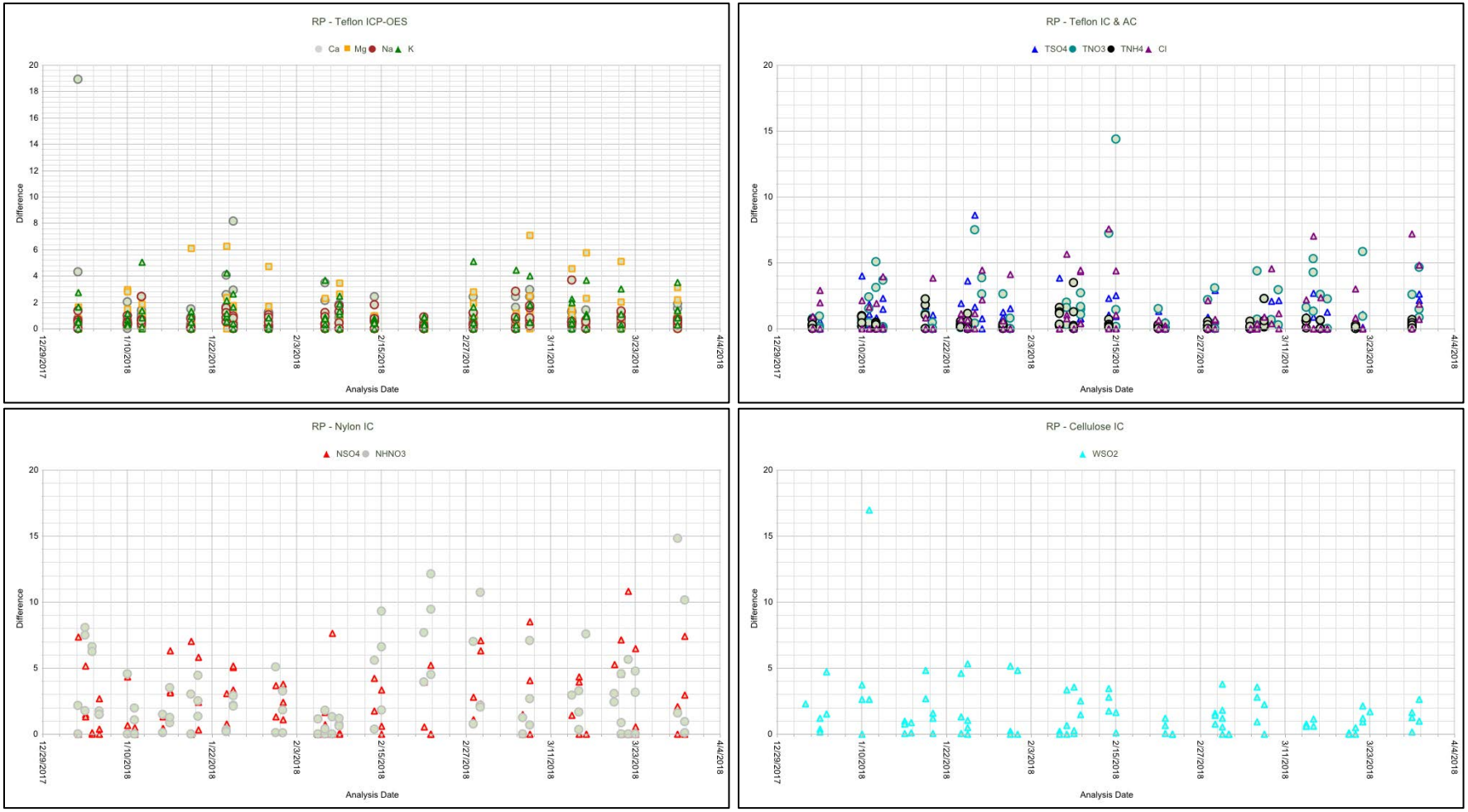

Figure 4 Laboratory Control Sample Results for First Quarter 2018 (percent recovery)

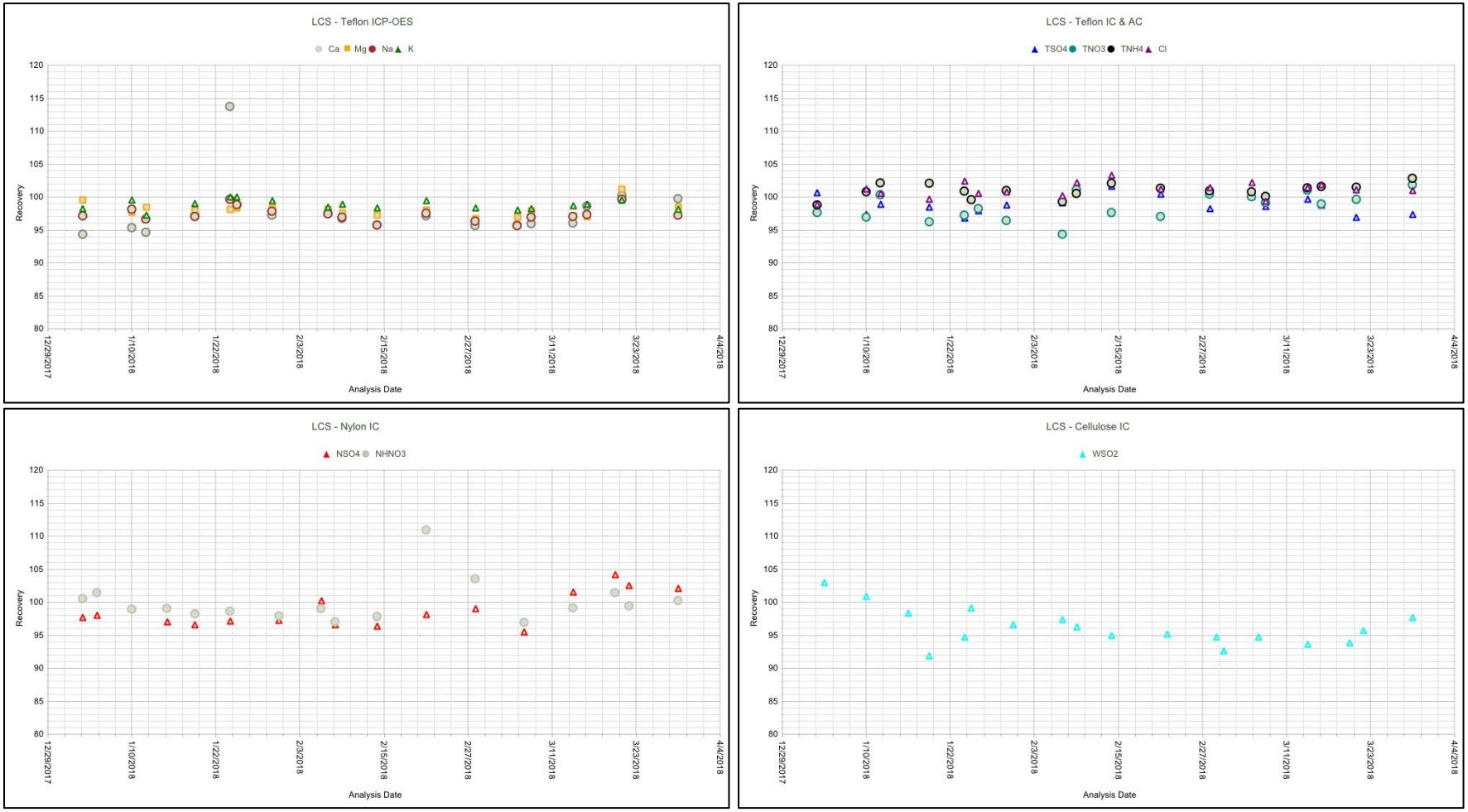

Figure 5 Method Blank Analysis Results for First Quarter 2018 (total micrograms)

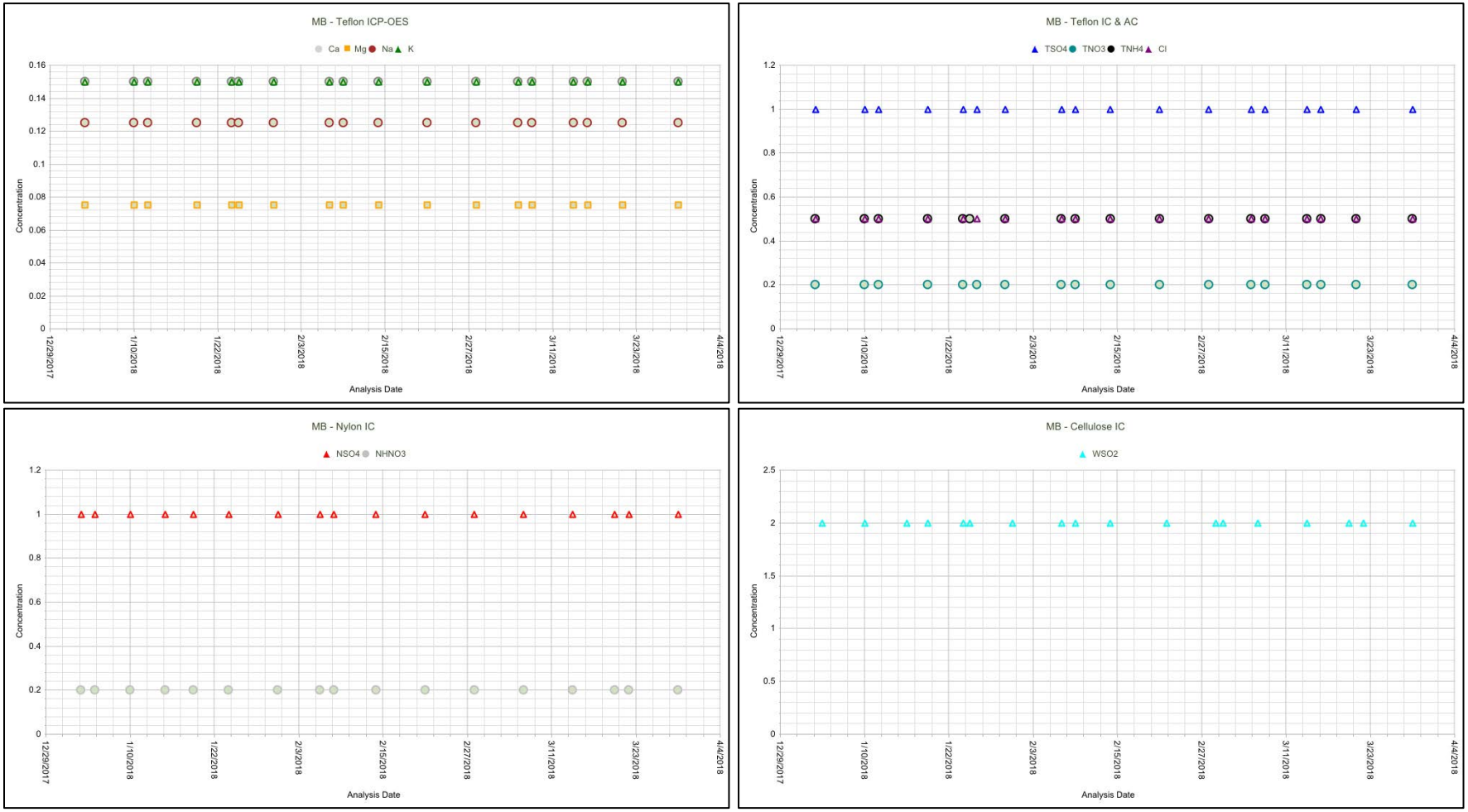

Figure 6 Laboratory Blank Analysis Results for First Quarter 2018 (total micrograms)

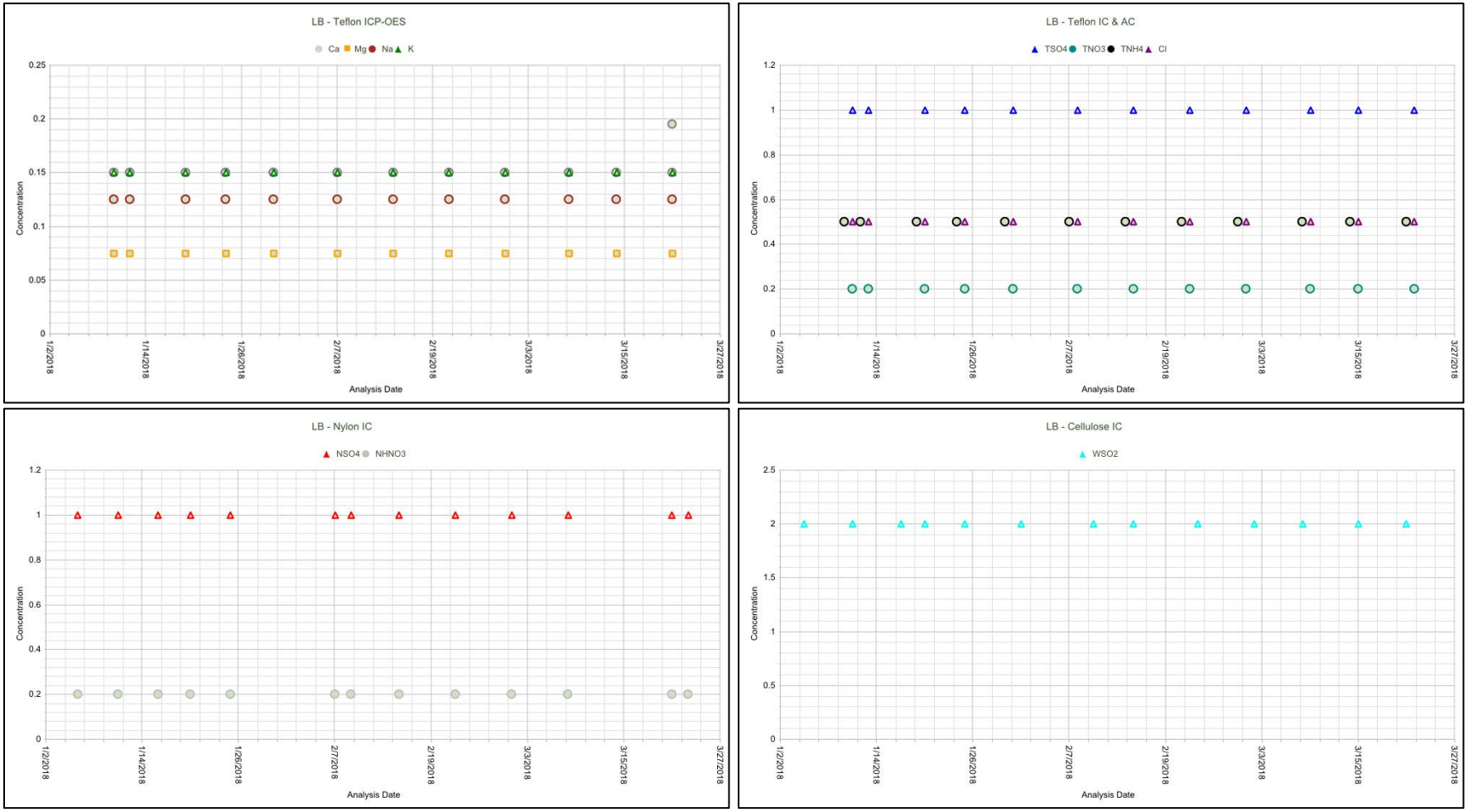

Figure 7 Field Blank Analysis Results for First Quarter 2018 (total micrograms)