Clean Air Status and Trends Network
Third Quarter 2017 Quality Assurance Report

Summary of Quarterly Operations (July through September)

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 third quarter 2017. 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

All ozone 1-point QC checks that did not meet the criterion for a passing check promulgated in the January 2017 revision of the EPA Quality Assurance Handbook for Air Pollution Measurement Systems were deleted from EPA's Air Quality System (AQS). This resulted in deletion of 768 records. Two checks for KNZ184, KS from 2011 were not deleted because the status of the site in AQS indicates that it has been closed since 2013. Ozone 1-point QC checks for January through April 2017 were submitted to AQS using the updated criterion.

Amec Foster Wheeler began developing a standard protocol to ensure that newly installed inlet filters at CASTNET ozone sites are properly conditioned.

On July 27, 2017, Amec Foster Wheeler submitted sample analyses for proficiency test (PT) study 110 for Rain and Soft Waters to the National Laboratory of Environmental Testing (NLET), a branch of the National Water Research Institute (NWRI) with Environment Canada that provides QA services. Results for PT study 110 were received on September 5, 2017. Analyses of all parameters passed. There was a slight low bias (-2.6 percent) for calcium; however, no corrective action is required The laboratory's proficiency testing plan requires action for individual test results that are greater than three standard deviations from the assigned value, bias 5 percent or higher for a single parameter, three or more biased results of any magnitude in a single study, or a consecutive study result indicating bias of any magnitude for a given parameter. The overall rating was "Very Good," the highest rating available.

Table 1 lists the quarters of data that were validated to Level 3 during third quarter 2017 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 third quarter 2017.

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 third quarter 2017.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for third quarter 2017. All results were within the criteria listed in Table 3. The RF recovery values for calcium from 8/24/2017 through 9/19/2017 ranged from 106 to 110 percent, returning to between 100 and 107 percent from 9/22/2017 through 10/25/2017, the most recent data available.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during third quarter 2017. 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 third quarter 2017. 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 third quarter 2017. All recovery values were between 93 percent and 108 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for third quarter 2017. All third 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 third quarter 2017 are listed in Table 12. This table also includes associated site identification and a brief description of the reason the sample was flagged. During third quarter, eight 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 third quarter 2017. 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*.

Table 1 Data Validated to Level 3 during Third Quarter 2017

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	November 2016 – April 2017	6	Quarter 1 2017	1
SE-4/MW-6‡	January 2017 – June 2017	6	Quarter 1 2017 – Quarter 2 2017	2

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

Table 2 Field Calibration Schedule for 2017

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 collocated 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 Third Quarter 2017

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-}	52	205	87	18	24	91
	NO_3^-	52	205	87	18	24	91
	NH_4^+	34	182	85	17	24	91
	Cl^-	52	205	87	18	24	91
	Ca^{2+}	34	183	85	17	24	91
	Mg^{2+}	34	183	85	17	24	91
	Na^+	34	183	85	17	24	91
	K^+	34	183	85	17	24	91
Nylon	SO_4^{2-}	48	208	80	16	24	89
	NO_3^-	48	208	80	16	24	89
Cellulose	SO_4^{2-}	48	176	80	16	24	89

Table 7 Filter Pack Receipt Summary for Third Quarter 2017

Count of samples received more than 14 days after removal from tower:	18
Count of all samples received:	815
Fraction of samples received within 14 days:	0.978
Average interval in days:	5.171
First receipt date:	07/03/2017
Last receipt date:	09/29/2017

Table 8 Ozone QC Summary for Third Quarter 2017 (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	1.42	96.63	1.60	100.00	0.42
ALC188, TX	95.79	1.74	100.00	1.45	100.00	0.29
ALH157, IL	100.00	1.04	97.89	1.48	100.00	0.31
ANA115, MI	100.00	1.13	92.86	1.95	92.86	1.26
ARE128, PA	100.00	1.17	100.00	1.32	100.00	0.33
ASH135, ME	100.00	1.22	100.00	1.35	98.92	0.37
BEL116, MD	93.88	2.08	97.96	1.68	97.96	0.66
BFT142, NC	98.96	1.20	97.92	1.55	98.96	0.40
BVL130, IL	98.89	0.98	96.67	1.04	100.00	0.40
BWR139, MD	98.94	2.50	100.00	2.30	100.00	0.32
CAD150, AR	100.00	1.21	100.00	0.98	100.00	0.42
CDR119, WV	100.00	2.26	98.95	1.84	100.00	0.42
CDZ171, KY	96.88	1.25	100.00	1.23	100.00	0.17
CKT136, KY	100.00	0.66	100.00	0.67	100.00	0.15
CND125, NC	97.44	2.21	98.72	1.51	100.00	0.25
CNT169, WY	100.00	0.75	100.00	0.57	100.00	0.20
COW137, NC	100.00	0.75	100.00	0.87	98.89	0.27
CTH110, NY	100.00	0.81	100.00	1.48	98.95	0.54
CVL151, MS	100.00	1.66	100.00	1.83	100.00	0.35
DCP114, OH	98.98	2.01	96.94	2.04	100.00	0.22
ESP127, TN	100.00	1.30	100.00	1.01	100.00	0.20
GAS153, GA	100.00	1.09	100.00	2.09	100.00	0.56
GTH161, CO	100.00	0.96	100.00	1.06	100.00	0.18
HOX148, MI	100.00	1.70	86.24	3.15	95.41	0.70
HWF187, NY	100.00	0.69	100.00	0.76	100.00	0.20
IRL141, FL	92.52	3.69	67.29	5.46	98.13	0.67
KEF112, PA	98.95	0.67	97.89	1.20	100.00	0.37

Table 8 Ozone QC Summary for Third Quarter 2017 (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]
LRL117, PA	100.00	0.46	100.00	0.59	100.00	0.15
MCK131, KY	97.98	1.34	96.97	1.22	100.00	0.45
MCK231, KY	97.73	1.72	100.00	1.32	100.00	0.33
MKG113, PA	100.00	0.93	95.92	1.30	90.82	0.74
NPT006, ID	100.00	0.75	98.86	0.77	100.00	0.18
OXF122, OH	96.30	2.66	89.81	4.56	92.59	1.47
PAL190, TX	100.00	1.23	100.00	1.41	100.00	0.34
PAR107, WV	99.00	2.25	95.00	2.48	98.00	0.37
PED108, VA	98.95	1.04	100.00	1.07	100.00	0.22
PND165, WY	100.00	0.76	100.00	1.75	100.00	0.55
PNF126, NC	93.55	2.18	94.62	2.77	91.40	1.01
PRK134, WI	94.68	3.00	97.87	2.93	100.00	0.37
PSU106, PA	100.00	0.81	98.94	0.72	100.00	0.43
QAK172, OH	98.95	3.41	100.00	3.26	100.00	0.34
ROM206, CO	100.00	1.88	100.00	1.99	100.00	0.18
SAL133, IN	93.40	2.41	91.51	2.66	96.23	0.64
SAN189, NE	97.92	1.81	97.92	2.21	100.00	0.74
SND152, AL	100.00	1.69	100.00	2.65	97.85	1.57
SPD111, TN	100.00	0.91	95.70	1.58	96.77	0.78
STK138, IL	100.00	1.09	95.92	1.39	97.96	1.23
SUM156, FL	100.00	2.27	100.00	2.46	100.00	0.25
UVL124, MI	100.00	1.57	95.83	1.46	98.96	0.47
VIN140, IN	96.00	2.65	99.00	2.58	100.00	0.44
VPI120, VA	97.92	2.63	95.83	2.24	97.92	0.83
WSP144, NJ	100.00	1.54	95.92	1.85	96.94	0.82
WST109, NH	100.00	1.30	97.92	1.12	100.00	0.25

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 Third Quarter 2017

Site ID	QC Criterion	Comments
HOX148, MI	% Single Point QC Pass	There were intermittent system moisture issues throughout third quarter. Associated data will be invalidated.
IRL141, FL	% Single Point QC Pass	There were intermittent system moisture issues throughout third quarter. Associated data will be invalidated.

Table 10 Trace-level Gas QC Summary for Third Quarter 2017

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	97.56	1.38	100.00	2.91	100.00	0.40
NO_y	100.00	0.77	100.00	2.64	100.00	0.95
CO	100.00	1.37	100.00	3.09	100.00	6.38
DUK008, NC						
NO_y	86.36	7.85	86.36	7.26	90.91	0.96
HWF187, NY						
NO_y	100.00	1.12	100.00	1.00	100.00	0.43
PND165, WY						
NO_y	100.00	3.03	95.65	5.28	97.83	0.40
PNF126, NC						
NO_y	100.00	1.86	100.00	2.90	100.00	0.92
ROM206, CO						
NO_y	100.00	1.85	100.00	3.67	100.00	0.88

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.

%D = percent difference
ppb = parts per billion

Table 11 Trace-level Gas QC Observations for Third Quarter 2017

Site ID	Parameter	QC Criterion	Comments
DUK008, NC	NO_y	% Span Pass % Single Point QC Pass	There was a leak in NO_y channel during August. The associated data were invalidated.

Table 12 Filter Packs Flagged as Suspect or Invalid during Third Quarter 2017

Site ID	Sample No.	Reason
BUF603, WY	1727005-02	Power failure
NEC602, WY	1729005-04 1731005-04	There are missing or invalid data. Polling errors – data may be recoverable.
UND002, VT	1727001-51 1728001-51 1730001-51	Intermittent power failures
VOY413, MN	1731003-22	Insufficient flow volume
WFM007, NY	1729013-01	The filter pack ran during a cloud event.

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	729
60	11
90	4
Unresolved by End of Quarter	26

Figure 1 Reference Standard Results for Third Quarter 2017 (percent recovery)

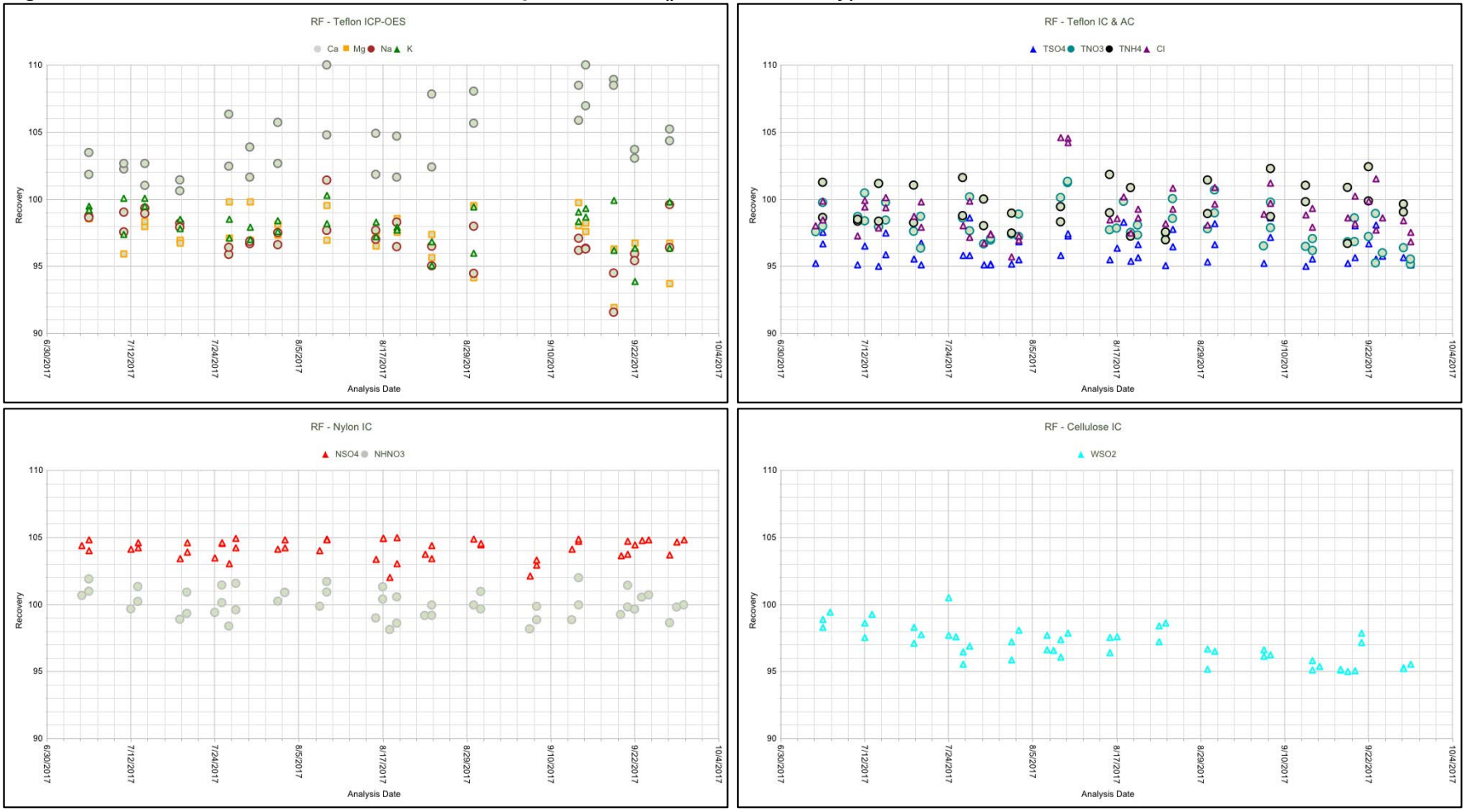

Figure 2 Continuing Calibration Spike Results for Third Quarter 2017 (percent recovery)

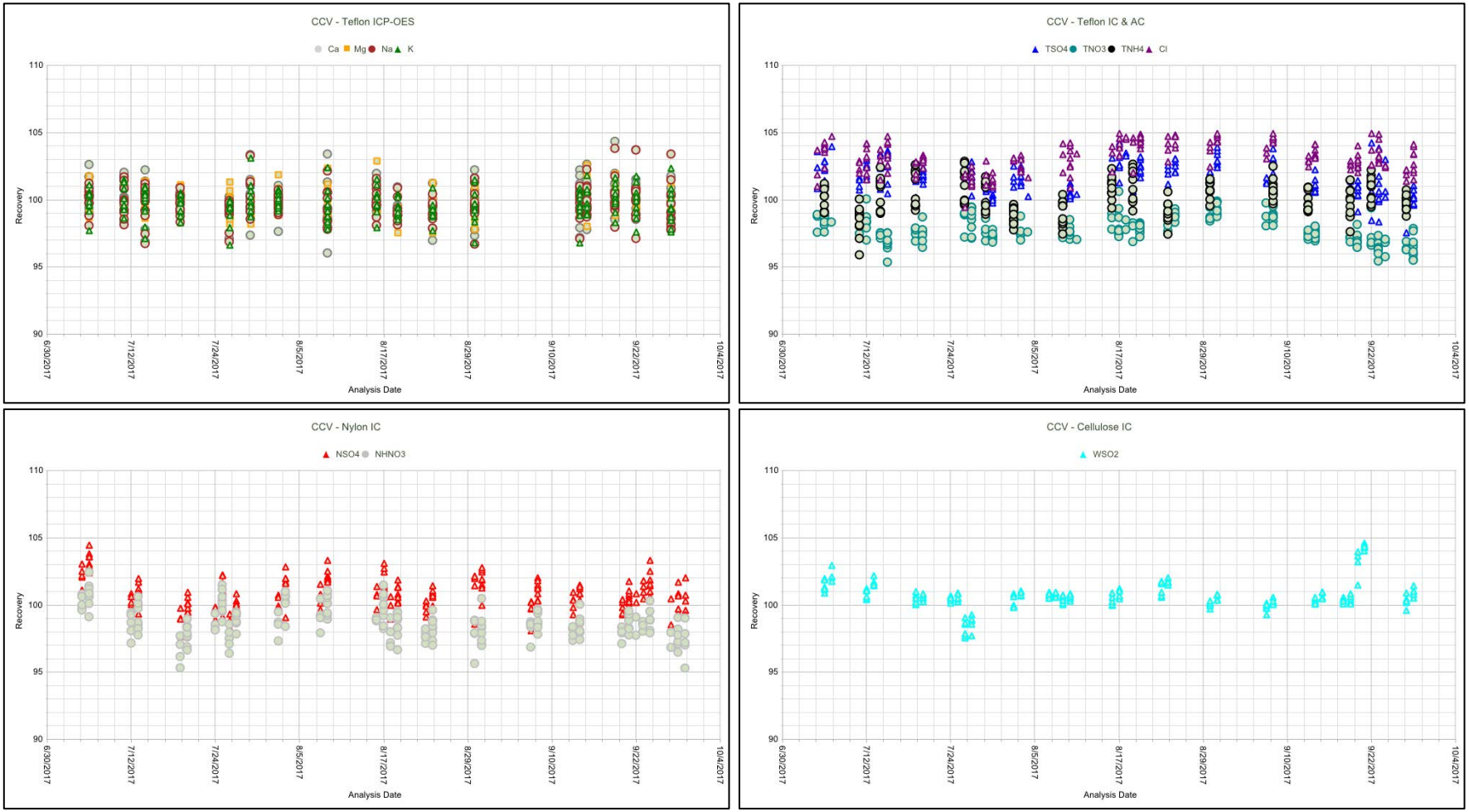

Figure 3 Replicate Sample Analysis Results for Third Quarter 2017 (percent difference)

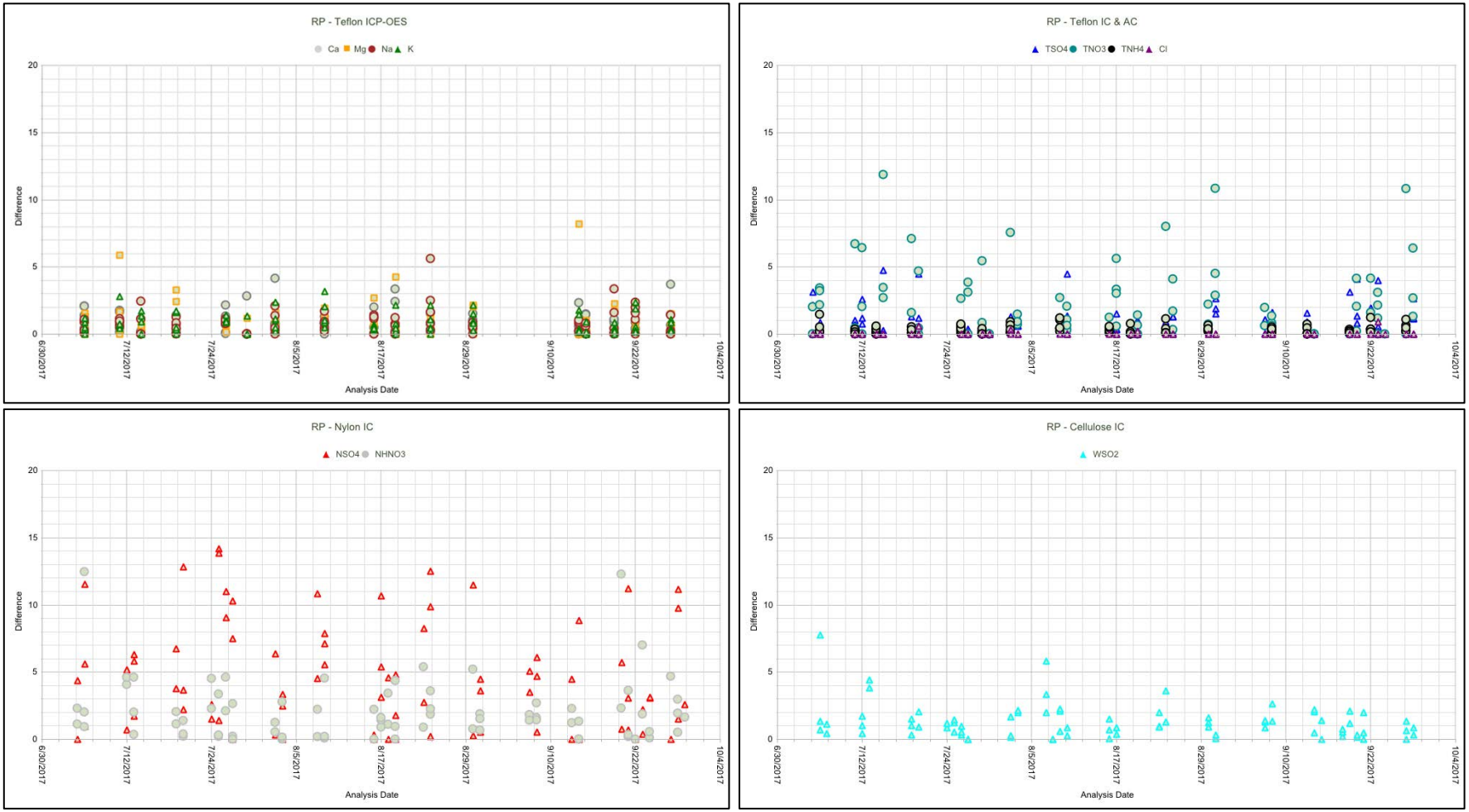

Figure 4 Laboratory Control Sample Results for Third Quarter 2017 (percent recovery)

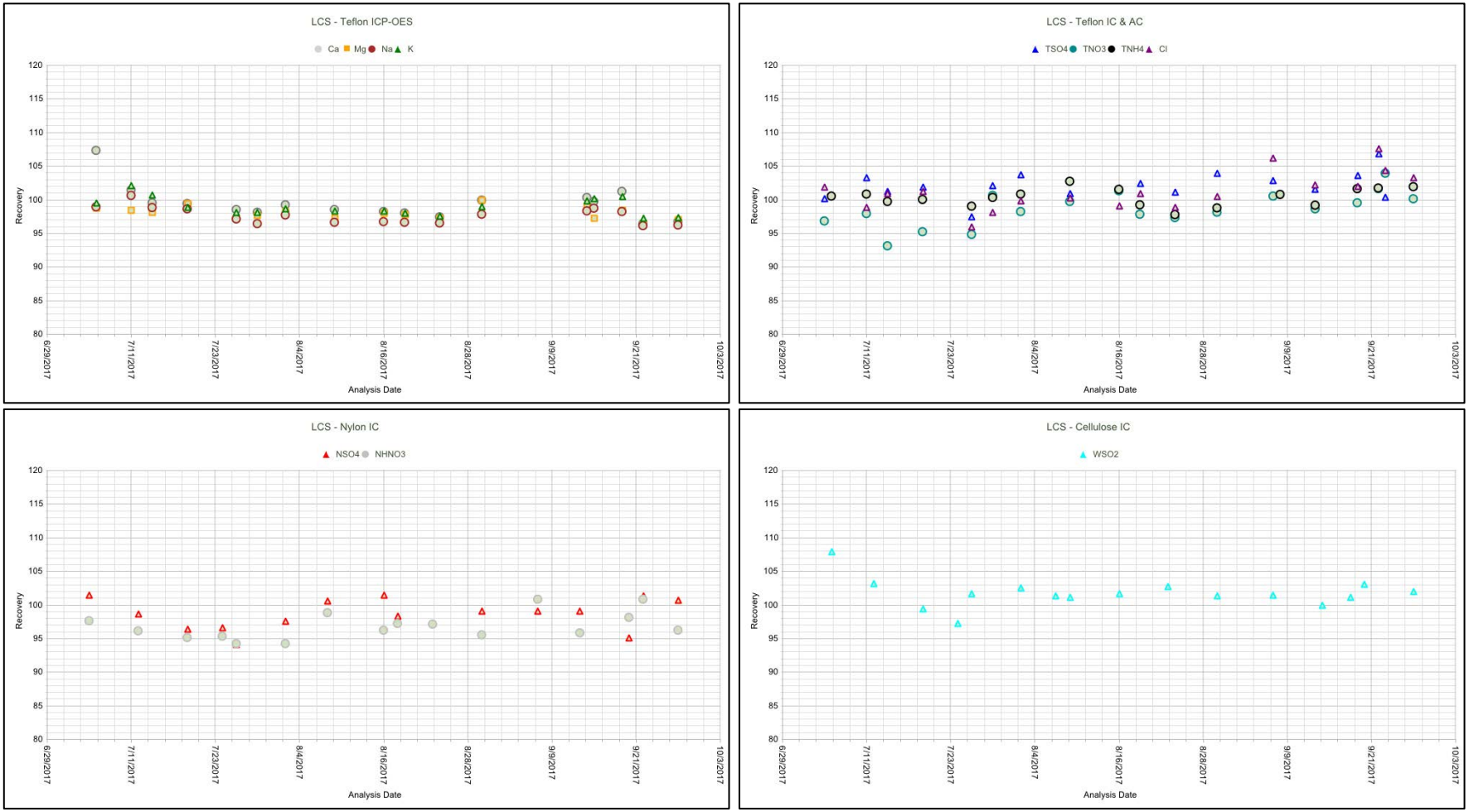

Figure 5 Method Blank Analysis Results for Third Quarter 2017 (total micrograms)

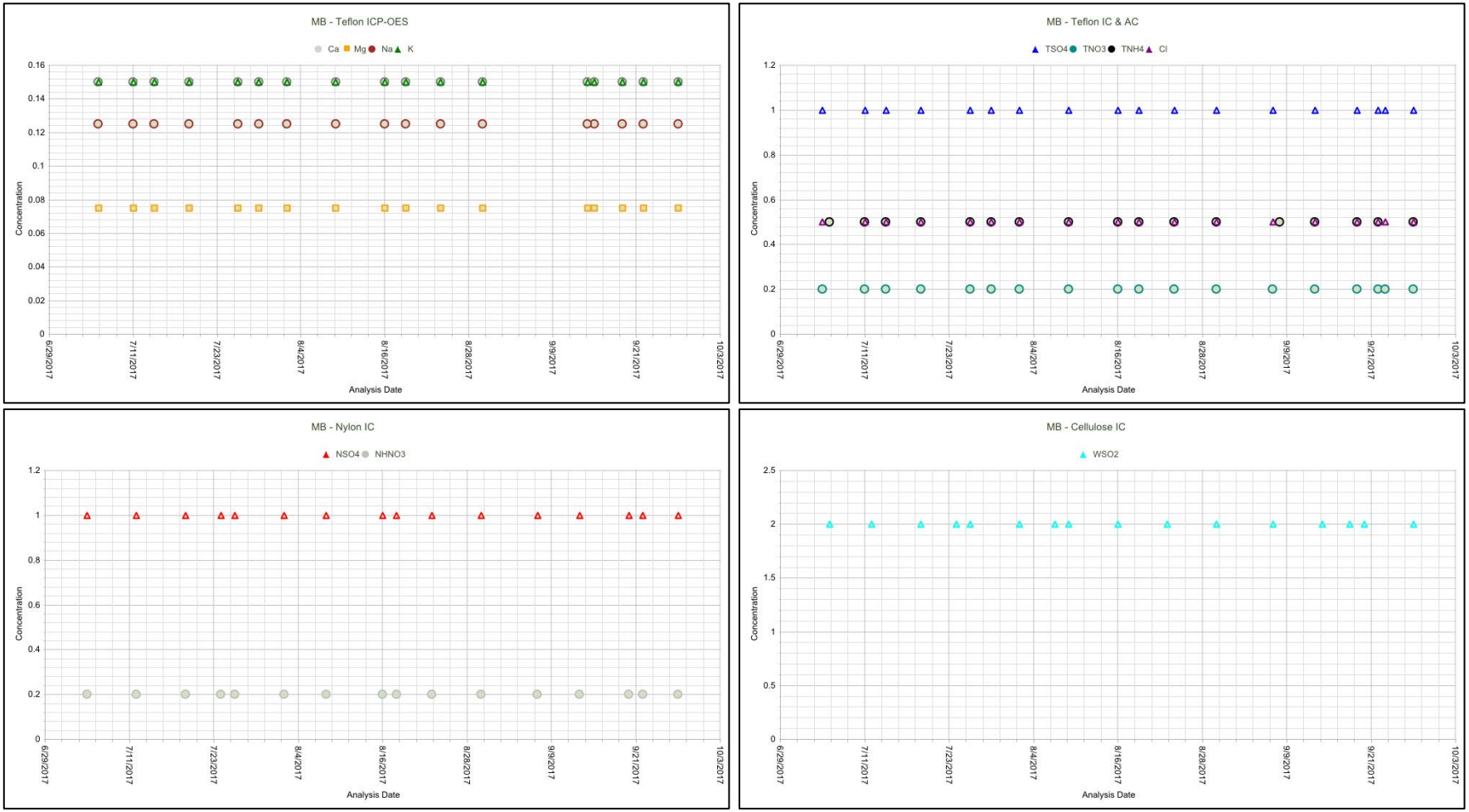

Figure 6 Laboratory Blank Analysis Results for Third Quarter 2017 (total micrograms)

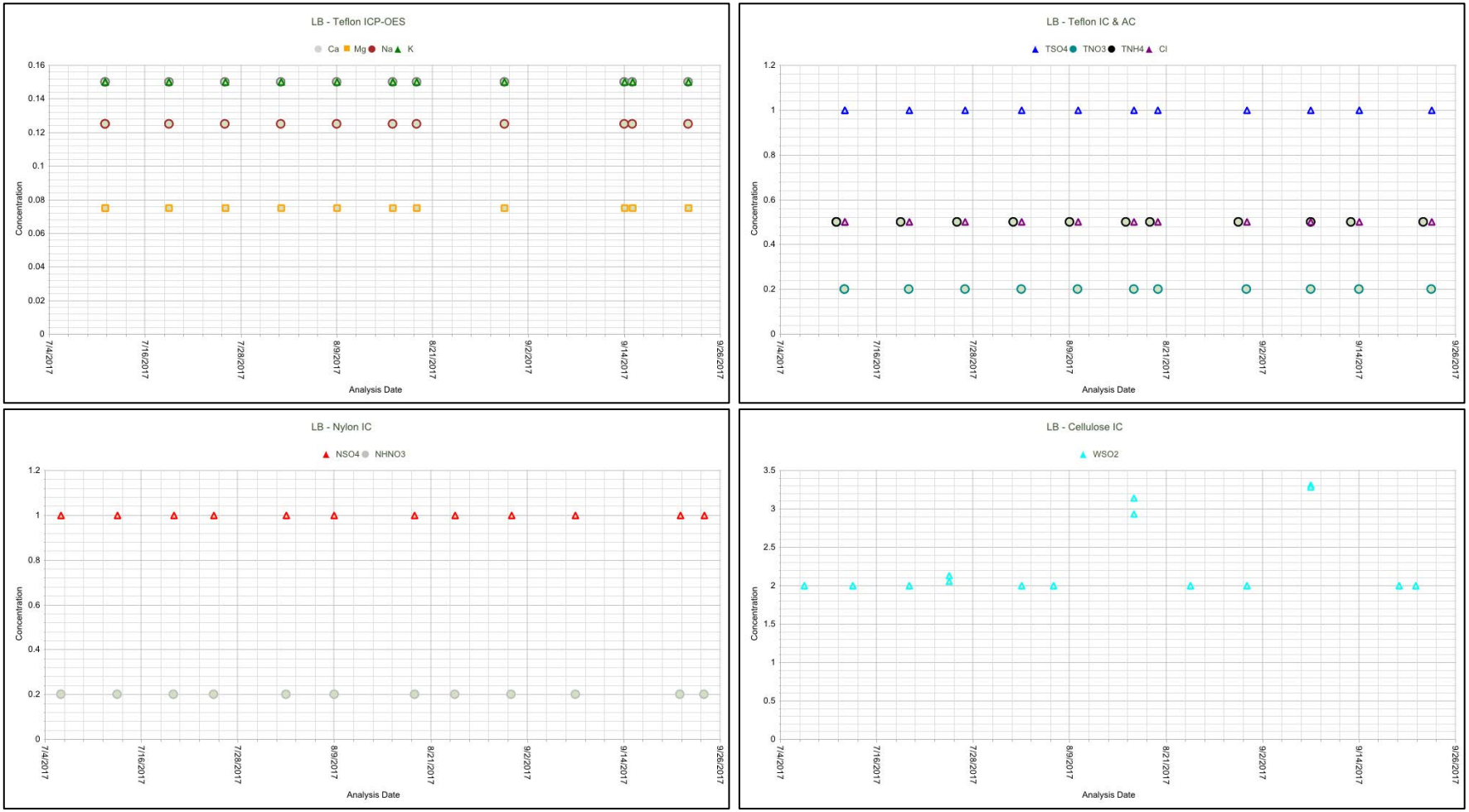

Figure 7 Field Blank Analysis Results for Third Quarter 2017 (total micrograms)