Summary of Quarterly Operations (April through June)

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 second quarter 2019. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; Wood, 2019). 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 CASTNET QAPP Revision 9.2 was approved and signed by CASTNET stakeholders during April 2019.

The annual management meeting to discuss the review results in support of International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2005 accreditation was held April 11, 2019. The Wood management group remains supportive of ISO/IEC 17025 accreditation activities.

Preparations for the ISO/IEC 17025:2017 accreditation assessment by the American Association for Laboratory Accreditation (A2LA) were completed. The assessment took place during the week of April 29, 2019. The assessment went well. There were two related findings regarding the reporting of field measurements performance testing to A2LA. Wood implemented the corrective action and submitted the required information to A2LA. The existing ISO/IEC 17025:2005 accreditation had been scheduled to expire at the end of May 2019. Wood submitted a request and received an extension in order to remain accredited until the paperwork related to the recent assessment was processed. Wood's 17025:2017 accreditation was renewed through May 2021. A copy of the certificate was provided to EPA in early June 2019.

During April 2019, Wood received final results of sample analyses for proficiency test study 0113 for Rain and Soft Waters to the National Laboratory of Environmental Testing (NLET), a branch of the National Water Research Institute with Environment Canada that provides QA services. All results passed.

A corrective action was initiated after it was discovered that there was an error in entering the intercept for a traveling ozone transfer. One of the six runs entered in the spreadsheet had a typo. Data entered for site transfers are routinely double-checked, but data for traveling transfers have not been. A procedure to check entries for traveling ozone transfers has been developed and documented.

Wood continued working with MTL Corp on their production of an acceptable pre-washed nylon filter. Wood's laboratory has confirmed that the water used by MTL meets CASTNET acceptance criteria. MTL's filter washing standard operating procedure, including maintenance of the water system, was approved by Wood.

Wood continued to work with the calibrators to fine-tune calibration adjustments for low level ozone and trace gas measurements at the sites. The sites are reviewed monthly and flagged for the calibrator. A calibration factor is determined after review of several weeks of data by Wood's field personnel. The data observed only during the calibration visit are insufficient to properly determine this factor. The calibration factor is then provided to the calibrator. Generally, this procedure will be required only once per ozone instrument, not for each calibration visit. Trace gas instruments may require more frequent fine-tuning.

In order to satisfy the hazard communications rule promulgated by the Occupational Safety and Health Administration (OSHA, 2013), Wood is supplying safety data sheets for the gas cylinders used at the trace-level gas sites. This documentation will be provided as hard copies in folders for the calibrators to leave at the sites that use gas cylinders.

Table 1 lists the quarters of data that were validated to Level 3 during second quarter 2019 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 2019.

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 2019.

Data Quality Indicator (DQI) Results
Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for second quarter 2019. 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 2019. 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 2019. 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 second 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 second quarter 2019. All recovery values were between 95 percent and 110 percent.

Blank Results
Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for second quarter 2019. All second quarter results were within criteria (two times the reporting limit) listed in Table 3 with the exception of one Teflon calcium FB result at 3.75 times the reporting limit. Related analytical batch QC were within criteria and the associated sample value was normal.

Suspect/Invalid Filter Pack Samples
Filter pack samples that were flagged as suspect or invalid during second quarter 2019 are listed in Table 10. 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 11 presents counts of field problems affecting continuous data collection for more than one day for second quarter 2019. 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.

Occupational Safety and Health Administration (OSHA). 2013. Title 29 *Code of Federal Regulations* Part 1910, Subpart Z, Section 1910.1200, "Hazard Communication." https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10099&p_table=STANDARDS. Accessed July 2019.

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) 2019. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan* (QAPP) Revision 9.2. 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.

Youden, W.J. (Ku, H.H., ed). 1969. *Precision Measurement and Calibration*. NBS Special Publication 300-Volume 1. U.S. Government Printing Office, Washington, DC.

Table 1 Data Validated to Level 3 during Second Quarter 2019

Calibration Group[*]	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-1/SE-5	August 2018 – January 2019	6	Quarter 4 2018	1
MW-7/W-9	September 2018 – February 2019	6	Quarter 4 2018	1
E-2/MW-8	October 2018 – March 2019	6	Quarter 4 2018 – Quarter 1 2019	2

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

Table 2 Field Calibration Schedule for 2019

Calibration Group	Months Calibrated	Sites Calibrated				
Eastern Sites (23 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 (10 Sites)	April/October	ABT147, CT ASH135, ME	HOW191, ME WST109, NH	CAT175, NY HWF187, NY[2]	NIC001, 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, (Wood, 2019).

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 $\pm$ 1.51 ppb	Less than $\pm$ 10.1 percent between supplied and observed concentrations
NO_y	Less than $\pm$ 1.51 ppb	
CO	Less than $\pm$ 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 Second Quarter 2019

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-}	68	202	85	18	26	93
	NO_3^-	68	202	85	18	26	93
	NH_4^+	36	183	85	18	26	93
	Cl^-	68	202	85	18	26	93
	Ca^{2+}	36	183	85	18	26	93
	Mg^{2+}	36	183	85	18	26	93
	Na^+	36	183	85	18	26	93
	K^+	36	183	85	18	26	93
Nylon	SO_4^{2-}	57	223	88	19	26	93
	NO_3^-	57	223	88	19	26	93
Cellulose	SO_4^{2-}	50	188	84	19	26	93

Table 7 Filter Pack Receipt Summary for Second Quarter 2019

Count of samples received more than 14 days after removal from tower:	14
Count of all samples received:	783
Fraction of samples received within 14 days:	0.982
Average interval in days:	5.487
First receipt date:	04/01/2019
Last receipt date:	06/28/2019

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 2019 (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	1.08	100.00	1.10	100.00	0.14
ALC188, TX	100.00	1.53	100.00	1.97	100.00	0.52
ALH157, IL	100.00	0.90	100.00	1.35	100.00	0.29
ANA115, MI	100.00	1.12	100.00	0.74	100.00	0.11
ARE128, PA	100.00	1.45	100.00	1.38	100.00	0.15
ASH135, ME	100.00	1.28	100.00	1.28	100.00	0.27
BEL116, MD	100.00	0.56	100.00	0.78	100.00	0.49
BFT142, NC	100.00	2.84	100.00	2.50	100.00	0.52
BVL130, IL	98.84	2.47	100.00	2.20	100.00	0.17
BWR139, MD	100.00	0.60	100.00	0.82	100.00	0.36
CAD150, AR	100.00	1.40	98.81	1.59	100.00	0.61
CDR119, WV	94.74	1.82	98.95	1.60	100.00	0.29
CDZ171, KY	100.00	0.64	100.00	1.34	100.00	0.42
CKT136, KY	100.00	0.54	100.00	0.64	100.00	0.17
CND125, NC	100.00	1.11	100.00	1.25	100.00	0.34
CNT169, WY	100.00	0.39	100.00	0.78	100.00	0.19
COW137, NC	97.92	1.84	97.92	1.62	97.92	0.65
CTH110, NY	100.00	0.75	100.00	0.98	100.00	0.12
CVL151, MS	100.00	0.36	100.00	0.79	100.00	0.20
DCP114, OH	100.00	1.92	100.00	1.52	100.00	0.31
DUK008, NC	100.00	2.08	100.00	1.95	100.00	0.20
ESP127, TN	98.85	2.19	100.00	1.99	100.00	0.31
GAS153, GA	100.00	1.40	97.78	3.46	98.89	1.72

Table 8 Ozone QC Summary for Second Quarter 2019 (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	1.32	100.00	1.85	100.00	0.14
HOX148, MI	100.00	1.78	100.00	1.65	100.00	0.49
HWF187, NY	98.88	1.55	100.00	0.58	100.00	0.16
IRL141, FL	100.00	0.59	98.90	1.22	98.90	0.80
KEF112, PA	100.00	1.31	100.00	1.78	100.00	0.48
LRL117, PA	98.88	1.79	98.88	0.99	100.00	0.18
MCK131, KY	98.88	1.27	98.88	1.30	98.88	0.41
MCK231, KY	100.00	0.87	100.00	0.95	100.00	0.12
MKG113, PA	96.81	3.89	96.81	3.11	96.81	1.05
NPT006, ID	97.26	5.54	100.00	0.79	100.00	0.36
OXF122, OH	97.89	3.23	96.84	3.85	97.89	0.65
PAL190, TX	97.78	1.87	100.00	1.16	100.00	0.60
PAR107, WV	100.00	0.59	100.00	0.65	98.88	0.22
PED108, VA	100.00	0.50	100.00	0.53	100.00	0.23
PND165, WY	100.00	0.63	100.00	1.48	100.00	0.66
PNF126, NC	98.85	1.45	100.00	0.81	100.00	0.35
PRK134, WI	100.00	0.96	98.86	0.81	100.00	0.16
PSU106, PA	100.00	1.30	100.00	1.04	100.00	0.22
QAK172, OH	100.00	2.09	100.00	2.44	100.00	0.63
ROM206, CO	97.73	3.02	96.59	1.92	97.73	1.21
SAL133, IN	100.00	1.97	100.00	2.01	100.00	0.16
SAN189, NE	95.65	2.94	95.60	3.52	95.60	1.77
SND152, AL	100.00	1.42	100.00	2.01	100.00	0.65
SPD111, TN	100.00	0.78	96.70	1.02	98.90	0.48
STK138, IL	100.00	0.83	100.00	0.55	100.00	0.23
SUM156, FL	98.72	1.18	98.72	0.93	100.00	0.95
UVL124, MI	93.48	4.58	93.48	4.06	93.48	2.01
VIN140, IN	100.00	1.01	100.00	1.67	100.00	0.68
VPI120, VA	100.00	1.05	97.30	1.95	100.00	0.48
WSP144, NJ	100.00	2.44	98.90	2.89	98.90	0.46
WST109, NH	100.00	1.10	100.00	1.07	100.00	0.12

Notes: [1]Percentage of comparisons that pass the criteria listed in Table 4. No values were below 90 percent.

[2]Absolute value of the average percent differences between the on-site transfer standard and the site monitor. No values exceeded the criteria listed in Table 4.

%D = percent difference

ppb = parts per billion

Table 9 Trace-level Gas QC Summary for Second Quarter 2019

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	0.56	100.00	1.84	100.00	0.36
NO_y	100.00	0.81	100.00	1.66	95.45	0.70
CO	NA	NA	NA	NA	NA	NA
DUK008, NC						
NO_y	100.00	2.96	100.00	4.23	97.73	0.94
HWF187, NY						
NO_y	100.00	0.50	100.00	0.84	100.00	0.47
PND165, WY						
NO_y	100.00	1.86	100.00	2.72	100.00	0.20
PNF126, NC						
NO_y	100.00	4.01	100.00	3.50	100.00	0.67
ROM206, CO						
NO_y	100.00	1.66	100.00	1.42	100.00	0.16

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. No values exceeded the criteria listed in Table 5.

%D = percent difference
ppb = parts per billion
NA =   no available data

Table 10 Filter Packs Flagged as Suspect or Invalid during Second Quarter 2019

Site ID	Sample No.	Reason
BFT142, NC	1916001-07	The data logger malfunctioned.
FOR605, WY	1918005-03	The mass flow controller malfunctioned.
JOT403, CA	1918003-12	There was a problem with polling. Data may be recovered.
MEV405, CO	1914003-15	The flow pump failed.
NPT006, ID	1918004-04 1922004-04	The data logger malfunctioned.
PET427, AZ	1914003-16	Sampling tower was left down.
SND152, AL	1914001-48	The flow system leaked.
UND002, VT	1917001-52 1922001-52	Power failures interfered with data collection.

Table 11 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	307
60	5
90	0
Unresolved by End of Quarter	35

Figure 1 Reference Standard Results for Second Quarter 2019 (percent recovery)
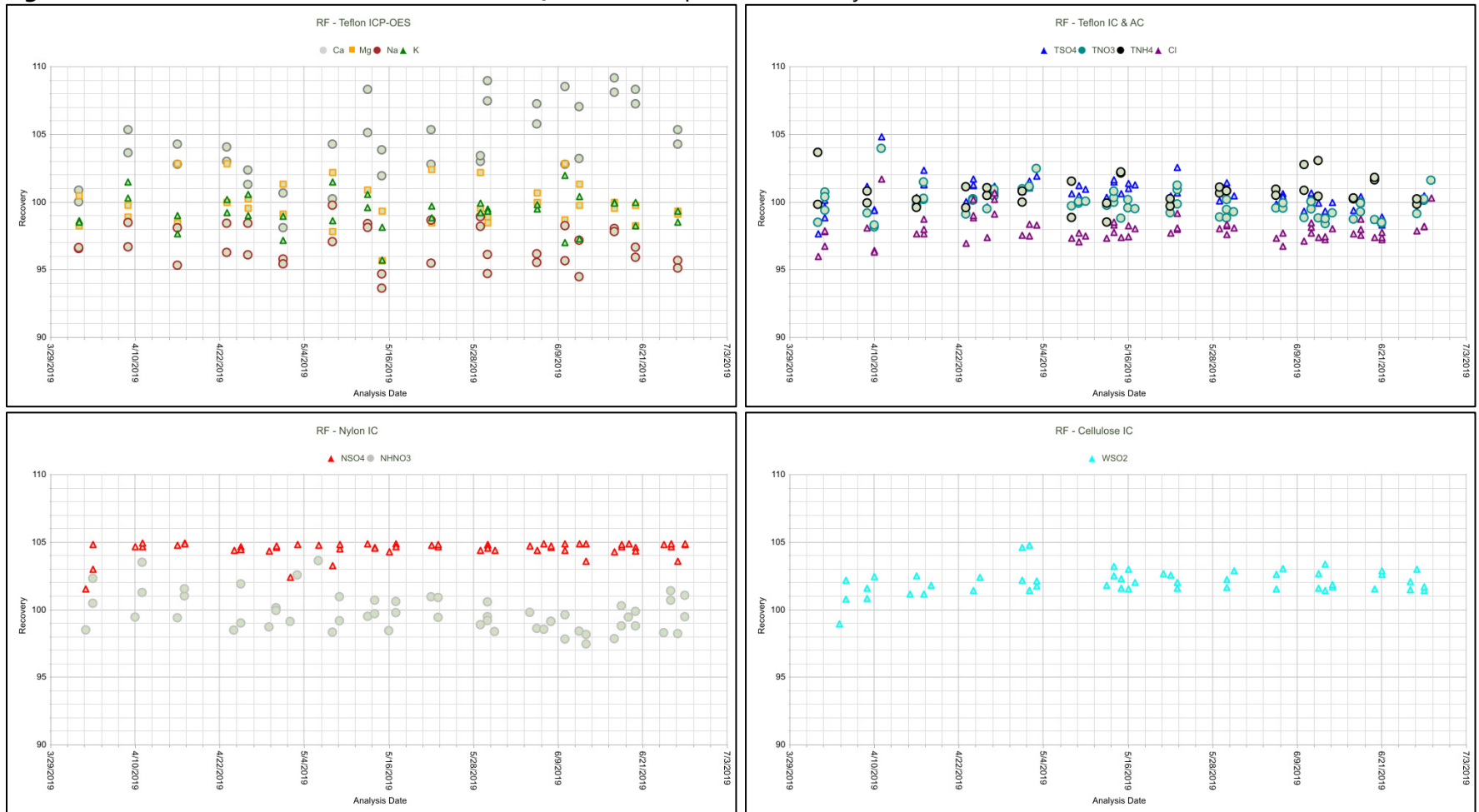
Figure 2 Continuing Calibration Spike Results for Second Quarter 2019 (percent recovery)
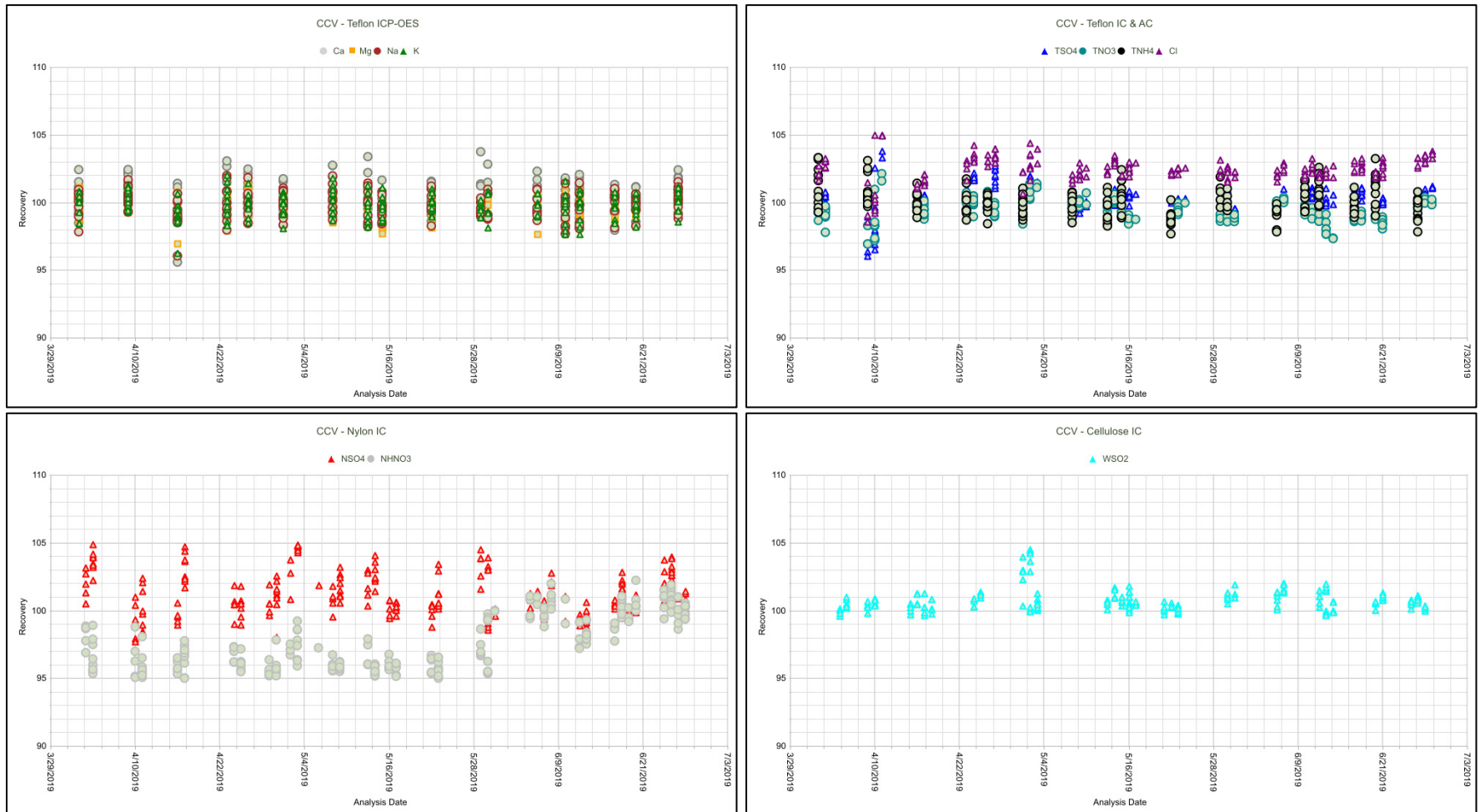
Figure 3 Replicate Sample Analysis Results for Second Quarter 2019 (percent difference)
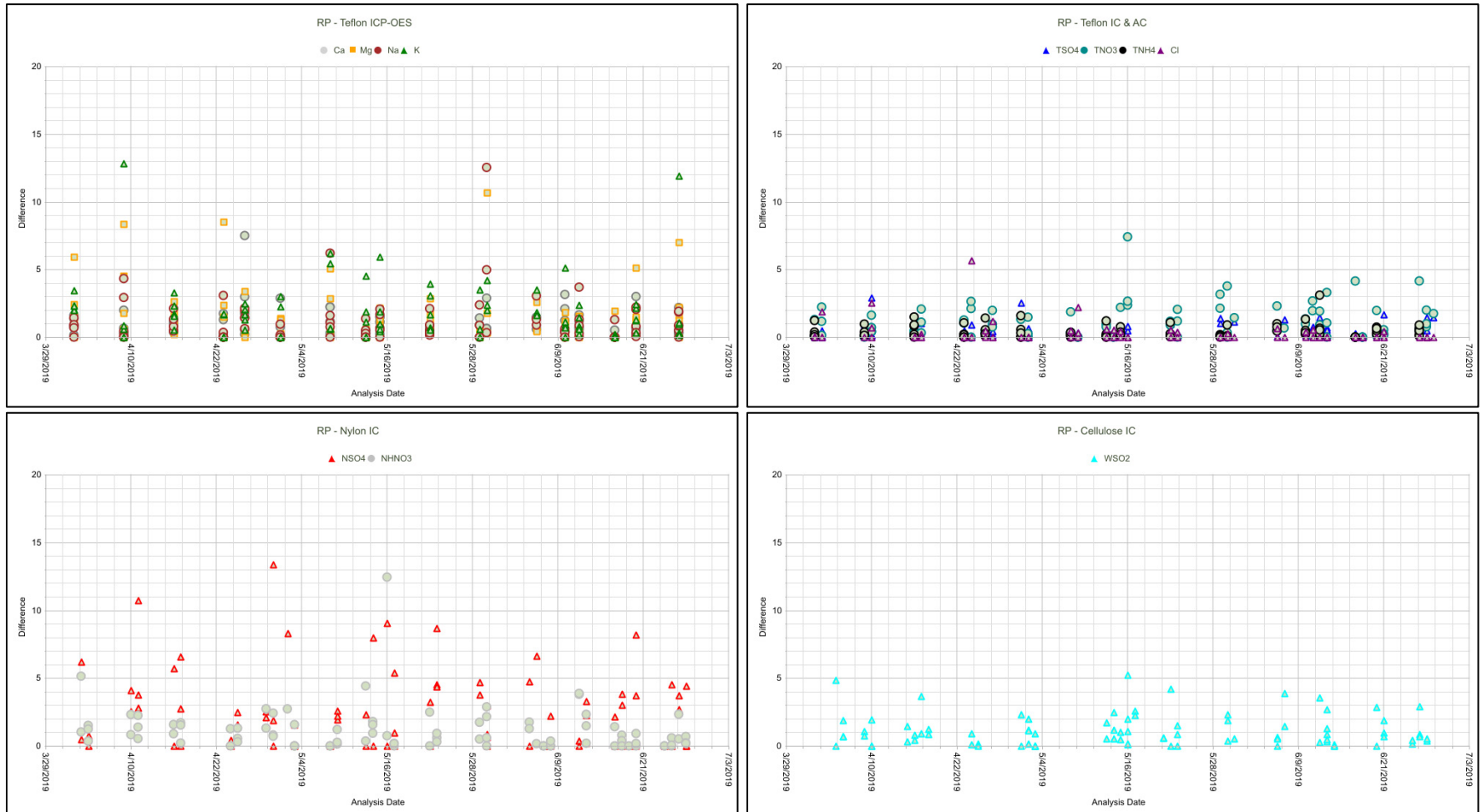
Figure 4 Laboratory Control Sample Results for Second Quarter 2019 (percent recovery)
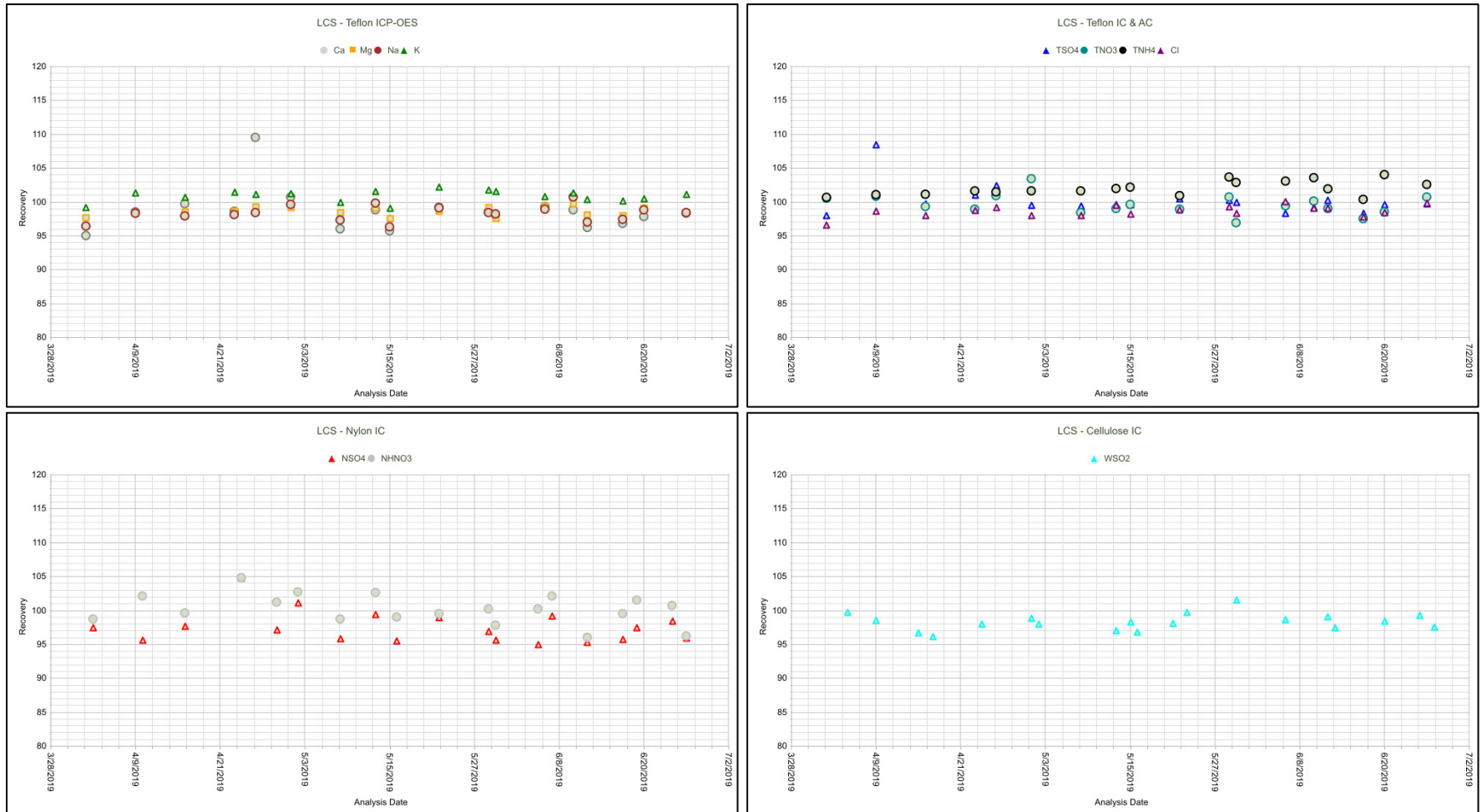
Figure 5 Method Blank Analysis Results for Second Quarter 2019 (total micrograms)
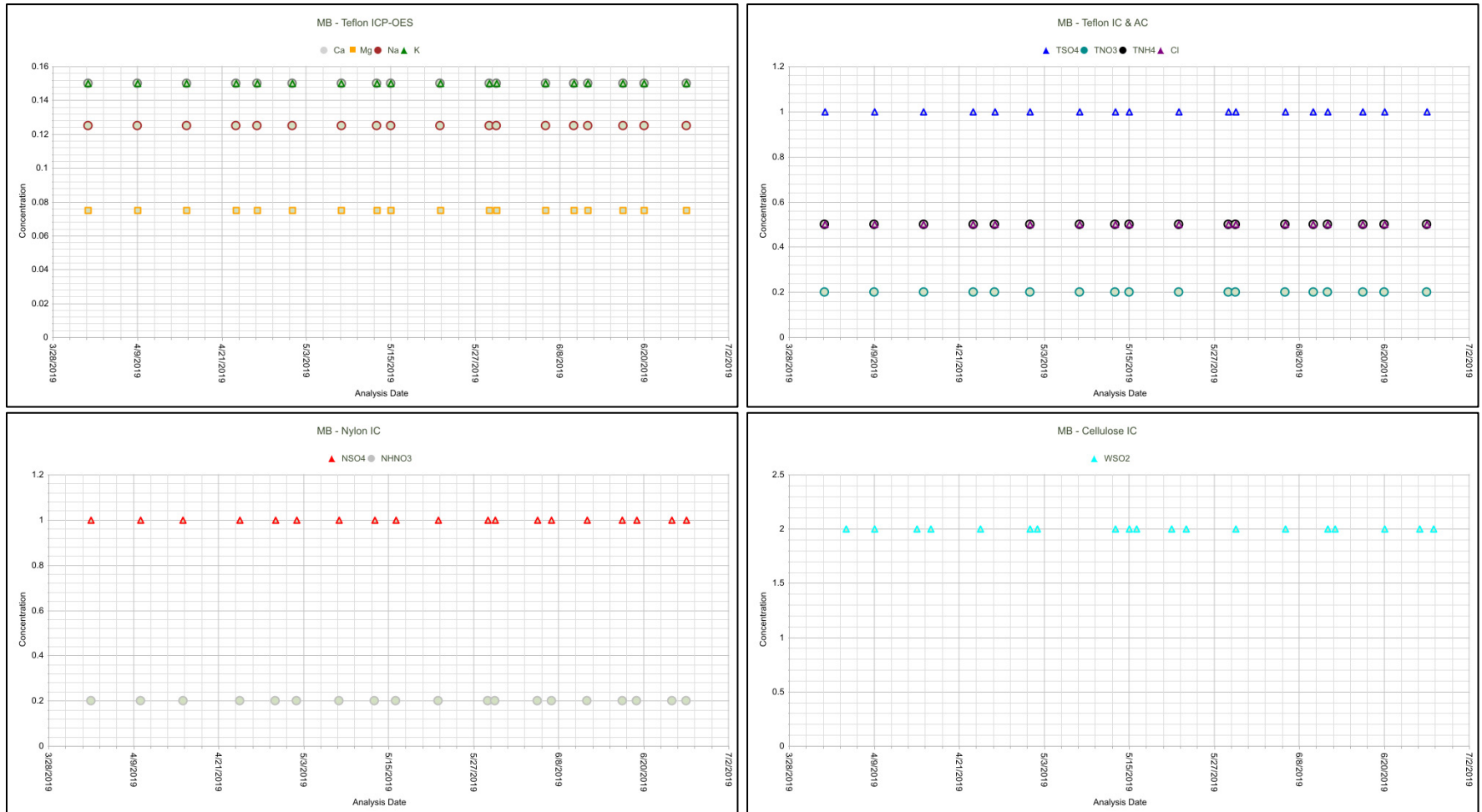
Figure 6 Laboratory Blank Analysis Results for Second Quarter 2019 (total micrograms)
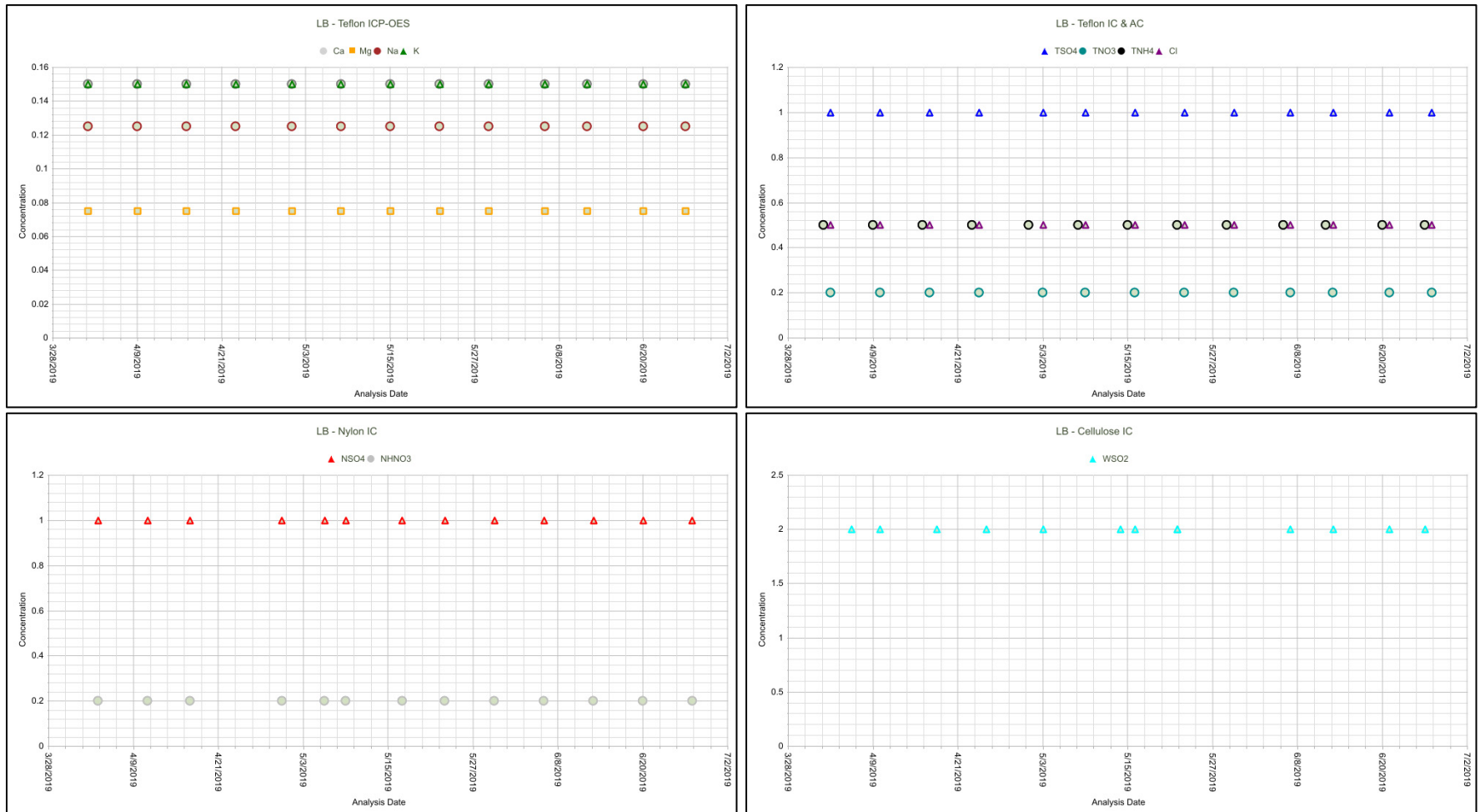
Figure 7 Field Blank Analysis Results for Second Quarter 2019 (total micrograms)