



Clean Air Status and Trends Network

Second Quarter 2020 Quality Assurance Report

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 2020. 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

During second quarter, CASTNET operations adapted to COVID-19 restrictions and stay-at-home orders. Calibration trips for April and May were delayed, and the Wisconsin Department of Natural Resources performance audit adhered to COVID-19 health and safety recommendations including social distancing. Wood prepared COVID-19 safety guidelines for calibration and repair trips to CASTNET sites. The guidelines include personal protective equipment requirements and safety procedures. Calibrations regularly scheduled for May were rescheduled to June. April calibrations have not yet been rescheduled.

The new ozone flagging codes were used beginning with the January 2020 ozone data submitted to AQS. The flags and AQS definitions are as follows:

OZONE_F	AQS FLAG	AQS DEFINITION
B	BA	Maintenance/routine repairs
C	BC	Multi-point calibration
F	AV	Power failure
H	AN	Machine malfunction
I	DA	Aberrant data
J	AS	Poor quality assurance results
M	BG	Missing data
T	AZ	QC audit
Y	AY	QC control points (zero/span)

The annual management review presentation in support of International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2017 accreditation by the American Association for Laboratory Accreditation (A2LA) was completed and distributed to the management team. The meeting on the 2019 management review presentation, as required to maintain Wood's ISO/IEC accreditation by A2LA, was held May 14, 2020. The meeting went well. Wood upper management continues to support CASTNET. In response to the meeting, the CASTNET Laboratory Operations Manager is looking into options for Wood to purchase a new ammonia analyzer.

The EEMS first quarter report indicated a siting criteria violation at the SUM156, FL site. Wood checked the site for trees and other obstacles and took photographs, which were provided to EPA. Wood is taking steps to obtain approval from the appropriate parties to remove trees in or near violation.

Wood implemented programming changes to the iCASTNET data management system. This application is used by field, data, and quality assurance personnel to manage field activities and data collection and validation. During June, ozone and trace gas data review and validation activities were done in duplicate using the normal procedure and iCASTNET to verify the accuracy of iCASTNET. Additionally, electronic data review, validation summary, and data submittal forms were tested for utility and ease of use.

Routine review of records led to identification of a subset of site operators needing official training records. The site operators were contacted, and training materials were provided by Wood. Training materials included both technical and quality management system materials. Site operators also received training questionnaires for discussion with and approval by CASTNET field personnel.

EPA CAMD contacted Wood for information on Wood's experience with Nafion dryers at CASTNET ozone sites. Wood provided EPA with a packet of information on both field and QA aspects of the dryers for EPA's Office of Research and Development. EPA is considering global approval of the use of Nafion dryers.

Results from the 5-week co-located field comparison of the MTL Corp nylon filters from Lot 709 and Lot 710 at the MCK131/231, KY site indicated that nylon sulfate was slightly higher for Lot 710 nylon filters. The precision of nylon sulfate measurements is historically low. Since measured concentrations were very low, Wood decided to extend the co-located comparison study for an additional four months, which began on June 2 and will run through the end of third quarter 2020.

Table 1 lists the quarters of data that were validated to Level 3 during second quarter 2020 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 2020.

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 2020. Package handling changes by shipping carriers and an increased volume of shipping due to the COVID-19 pandemic have led to delays in the receipt of exposed filter packs by the laboratory. The average number of days for filter pack receipt during second quarter 2019 was 5.487 days. During second quarter 2020, it was 7.285 days.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for second quarter 2020. 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 2020. 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 second quarter 2020. 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 second quarter 2020. All recovery values were between 94 percent and 106 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for second quarter 2020. All second quarter results were within criteria (two times the reporting limit) listed in Table 3 with the exception of four potassium FB results between 2.2 and 9.2 times the reporting limit. These results are under investigation. Potassium concentrations for the associated sites were normal, and other QC samples were all within criteria.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during second quarter 2020 are listed in Table 12. This table also includes associated site identification and a brief description of the reason the sample was flagged. During second quarter, five 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 second quarter 2020. 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 Second Quarter 2020

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-1/SE-5	August 2019 – January 2020	6	Quarter 4 2019	1
MW-7/W-9	September 2019 – February 2020	6	Quarter 4 2019	1
E-2/MW-8	October 2019 – March 2020	6	Quarter 4 2019 – Quarter 1 2020	2

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

Table 2 Field Calibration Schedule for 2020

Calibration Group	Months Calibrated	Sites Calibrated			
Eastern Sites (22 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 (9 Sites)	April/October	ABT147, CT ASH135, 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 PRK134, WI QAK172, OH
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 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).

SO₂ = sulfur dioxide

NO_y = total reactive oxides of nitrogen

CO = carbon monoxide

ppb = parts per billion

Table 6 QC Analysis Count for Second Quarter 2020

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⁻	67	192	81	17	26	92
	NO ₃ ⁻	67	192	81	17	26	92
	NH ₄ ⁺	34	176	81	17	26	92
	Cl ⁻	67	192	81	17	26	92
	Ca ²⁺	34	177	81	17	26	92
	Mg ²⁺	34	177	81	17	26	92
	Na ⁺	34	177	81	17	26	92
	K ⁺	34	177	81	17	26	92
Nylon	SO ₄ ²⁻	46	183	78	16	24	92
	NO ₃ ⁻	46	183	78	16	24	92
Cellulose	SO ₄ ²⁻	47	171	78	16	26	92

Table 7 Filter Pack Receipt Summary for Second Quarter 2020

Count of samples received more than 14 days after removal from tower:	33
Count of all samples received:	662
Fraction of samples received within 14 days:	0.950
Average interval in days:	7.285
First receipt date:	04-01-2020
Last receipt date:	06-16-2020

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 2020 (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	1.95	98.95	2.15	98.95	0.34
ALC188, TX	87.13	13.73	88.78	12.06	100.00	0.36
ALH157, IL	97.89	1.53	98.95	1.66	100.00	0.29
ANA115, MI	100.00	1.89	100.00	1.30	100.00	0.35
ARE128, PA	91.01	5.59	91.01	5.84	100.00	0.21
ASH135, ME	100.00	0.67	100.00	0.69	100.00	0.34
BEL116, MD	100.00	0.62	100.00	1.16	98.86	0.41
BFT142, NC	100.00	0.88	100.00	1.14	100.00	0.27
BVL130, IL	96.84	1.99	96.84	1.87	100.00	0.15
BWR139, MD	100.00	0.70	100.00	1.00	100.00	0.31
CAD150, AR	100.00	2.45	100.00	2.09	100.00	0.20
CDR119, WV	100.00	1.24	100.00	1.25	100.00	0.20
CDZ171, KY	100.00	1.23	100.00	0.73	100.00	0.74
CKT136, KY	100.00	0.36	100.00	0.40	98.94	0.18
CND125, NC	100.00	1.06	96.91	1.73	97.92	0.45
CNT169, WY	100.00	0.31	100.00	0.45	100.00	0.22
COW137, NC	100.00	0.86	100.00	2.17	100.00	1.63
CTH110, NY	100.00	1.04	100.00	1.14	100.00	0.23
CVL151, MS	100.00	0.61	100.00	1.01	100.00	0.41
DCP114, OH	96.47	1.87	94.12	2.00	100.00	0.37
DUK008, NC	96.00	2.62	92.00	6.07	93.00	2.74
ESP127, TN	95.33	2.61	85.98	3.25	100.00	0.22
GAS153, GA	100.00	2.52	97.89	4.39	100.00	1.20

Table 8 Ozone QC Summary for Second Quarter 2020 (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	85.15	16.15	86.14	15.99	100.00	0.14
HOX148, MI	100.00	1.02	98.88	2.22	100.00	0.26
HWF187, NY	100.00	0.33	98.94	0.89	98.94	0.31
IRL141, FL	100.00	0.76	100.00	1.80	100.00	0.34
KEF112, PA	100.00	1.10	100.00	1.63	100.00	0.39
LRL117, PA	100.00	0.74	100.00	0.86	100.00	0.16
MCK131, KY	97.59	1.76	97.59	1.69	100.00	0.45
MCK231, KY	100.00	0.40	100.00	0.60	100.00	0.13
MKG113, PA	100.00	0.64	96.91	0.93	98.97	0.31
NPT006, ID	98.95	3.49	98.95	1.79	100.00	0.31
OXF122, OH	100.00	0.85	100.00	0.85	100.00	0.25
PAL190, TX	100.00	0.62	100.00	0.81	100.00	0.34
PAR107, WV	100.00	0.83	98.94	1.00	100.00	0.16
PED108, VA	100.00	0.66	100.00	0.68	100.00	0.29
PND165, WY	100.00	0.80	100.00	0.89	100.00	0.17
PNF126, NC	100.00	0.51	100.00	0.90	100.00	0.34
PRK134, WI	100.00	1.16	100.00	0.95	100.00	0.14
PSU106, PA	100.00	0.33	100.00	0.39	100.00	0.17
QAK172, OH	82.65	861.81	82.65	17.76	97.96	1.18
ROM206, CO	100.00	0.62	100.00	0.62	100.00	0.23
SAL133, IN	100.00	2.03	100.00	1.81	100.00	0.35
SAN189, NE	100.00	1.41	100.00	1.46	100.00	0.42
SND152, AL	100.00	0.62	100.00	0.84	100.00	0.24
SPD111, TN	100.00	0.72	100.00	0.85	97.87	0.33
STK138, IL	100.00	3.20	100.00	1.81	100.00	0.91
SUM156, FL	100.00	2.93	100.00	2.11	100.00	0.25
UVL124, MI	93.33	5.58	94.44	5.73	95.56	1.05
VIN140, IN	90.82	2.20	90.82	2.57	100.00	0.24
VPI120, VA	98.94	1.64	98.94	1.30	100.00	0.20
WSP144, NJ	96.19	2.87	95.24	3.35	92.38	0.95
WST109, NH	100.00	0.60	100.00	0.66	100.00	0.28

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

²Absolute 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 Second Quarter 2020

Site ID	QC Criterion	Comments
ALC188, TX	% Span Pass Span [%D] % Single Point QC Pass Single Point QC [%D]	The analyzer sample pump failed in late May and was replaced.
ESP127, TN	% Single Point QC Pass	The site analyzer malfunctioned in late May and was replaced.
GTH161, CO	% Span Pass Span [%D] % Single Point QC Pass Single Point QC [%D]	The analyzer sample pump failed in early April and was replaced.
QAK172, OH	% Span Pass Span [%D] % Single Point QC Pass Single Point QC [%D]	The analyzer sample pump failed in mid-June and was replaced.

Note: %D = percent difference

Table 10 Trace-level Gas QC Summary for Second Quarter 2020

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	95.45	5.30	90.91	10.69	100.00	0.44
NO _y	100.00	1.03	100.00	1.29	100.00	0.63
CO	97.78	2.08	91.11	7.64	93.33	14.09
DUK008, NC						
NO _y	97.62	3.30	92.86	3.25	100.00	0.71
HWF187, NY						
NO _y	100.00	3.05	100.00	3.15	100.00	0.36
PND165, WY						
NO _y	100.00	1.69	100.00	3.11	100.00	0.33
PNF126, NC						
NO _y	64.71	8.31	56.86	12.08	98.04	0.48
ROM206, CO						
NO _y	95.12	1.92	97.56	3.46	100.00	0.65

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

²Absolute 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 Second Quarter 2020

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	SO ₂	Single Point QC [%D]	The sample pump failed in mid-June and was replaced.
PNF126, NC	NO _y	% Span Pass % Single Point QC Pass Single Point QC [%D]	The site analyzer malfunctioned in mid-June. A repair trip is scheduled for July.

Notes: %D = percent difference

Table 12 Filter Packs Flagged as Suspect or Invalid during Second Quarter 2020

Site ID	Sample No.	Reason
ACA416, ME	2015003-01	The power failed affected one week of sampling.
CVL151, MS	2015001-19 2023001-19	A power failure affected two weeks of sampling. A power failure affected one week of sampling.
FOR605, WY	2018005-03	A polling issue caused missing data. Data may be recovered during review and validation.
JOT403, CA	2018003-12	A polling issue caused missing data. Data may be recovered during review and validation.

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	167
60	0
90	0
Unresolved by End of Quarter	28

Figure 1 Reference Standard Results for Second Quarter 2020 (percent recovery)

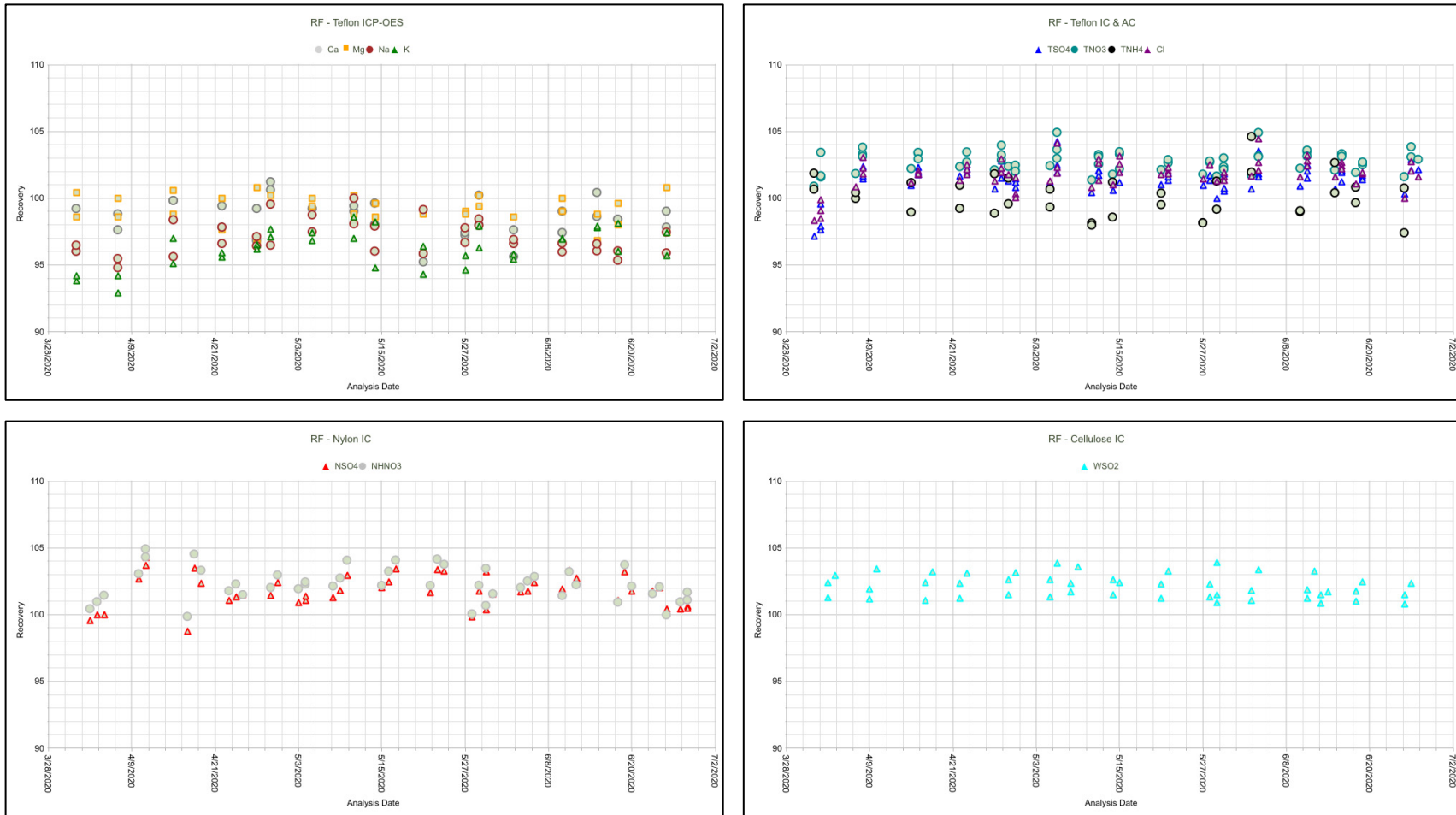


Figure 2 Continuing Calibration Spike Results for Second Quarter 2020 (percent recovery)

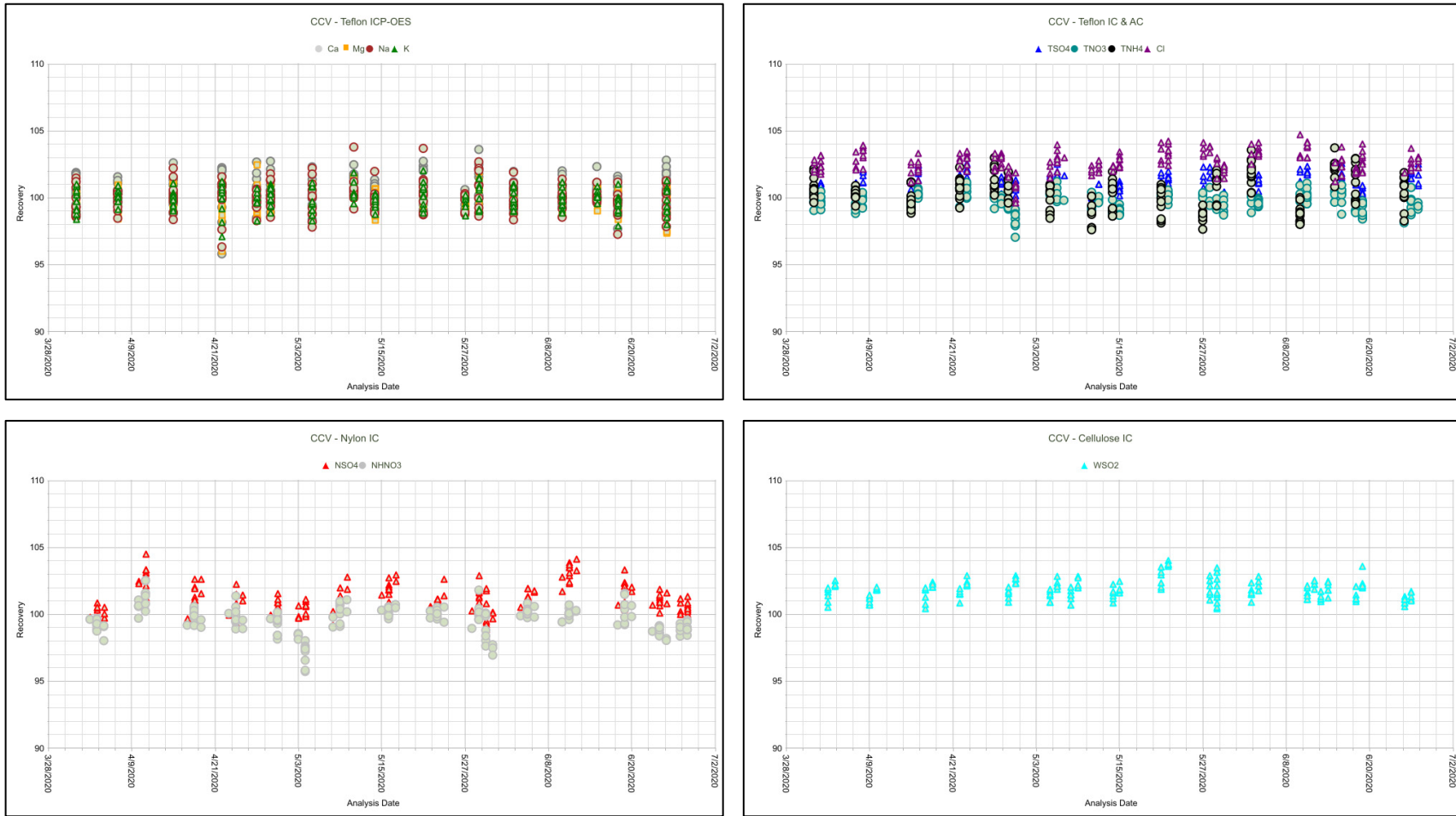


Figure 3 Replicate Sample Analysis Results for Second Quarter 2020 (percent difference)

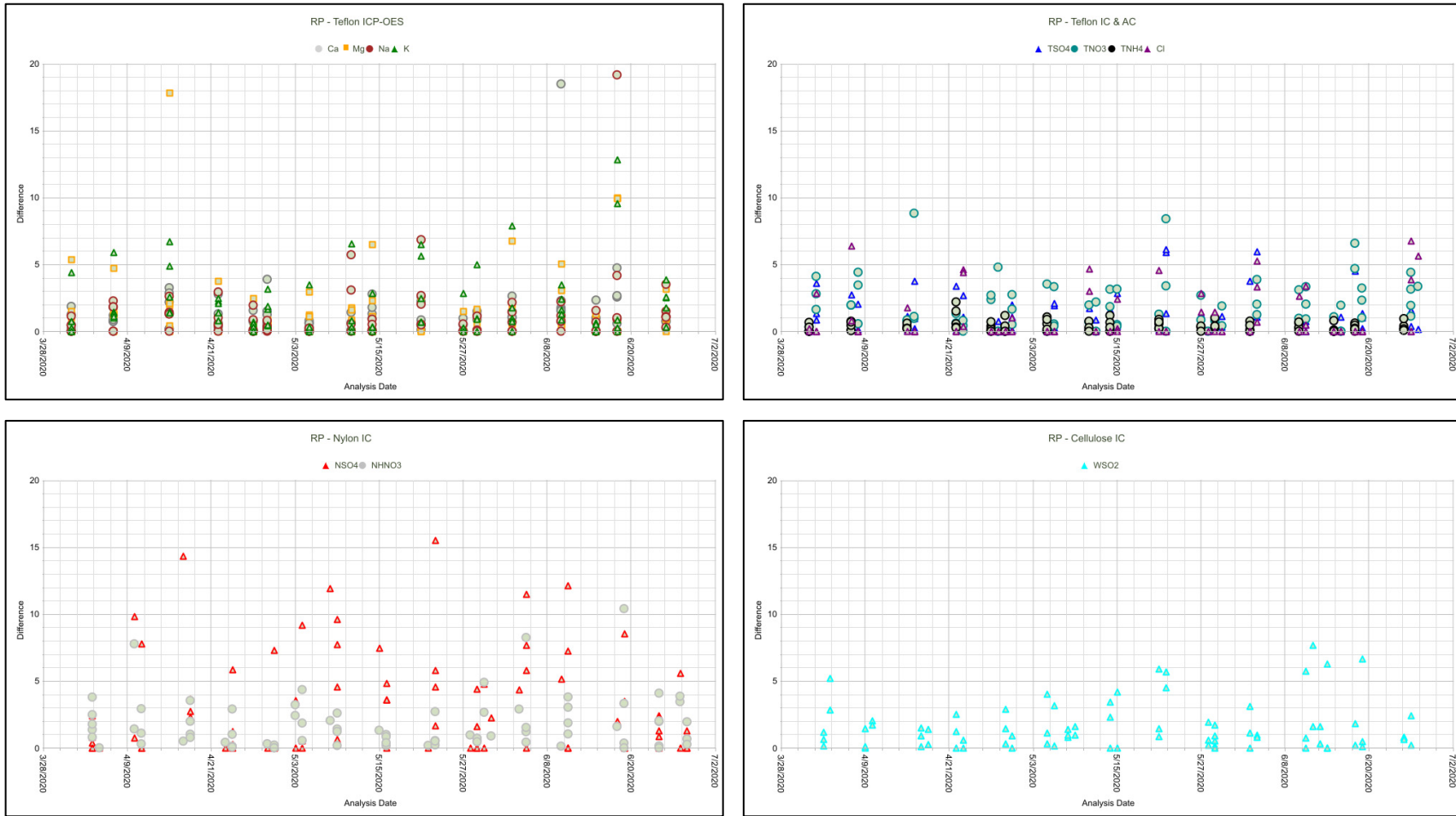


Figure 4 Laboratory Control Sample Results for Second Quarter 2020 (percent recovery)

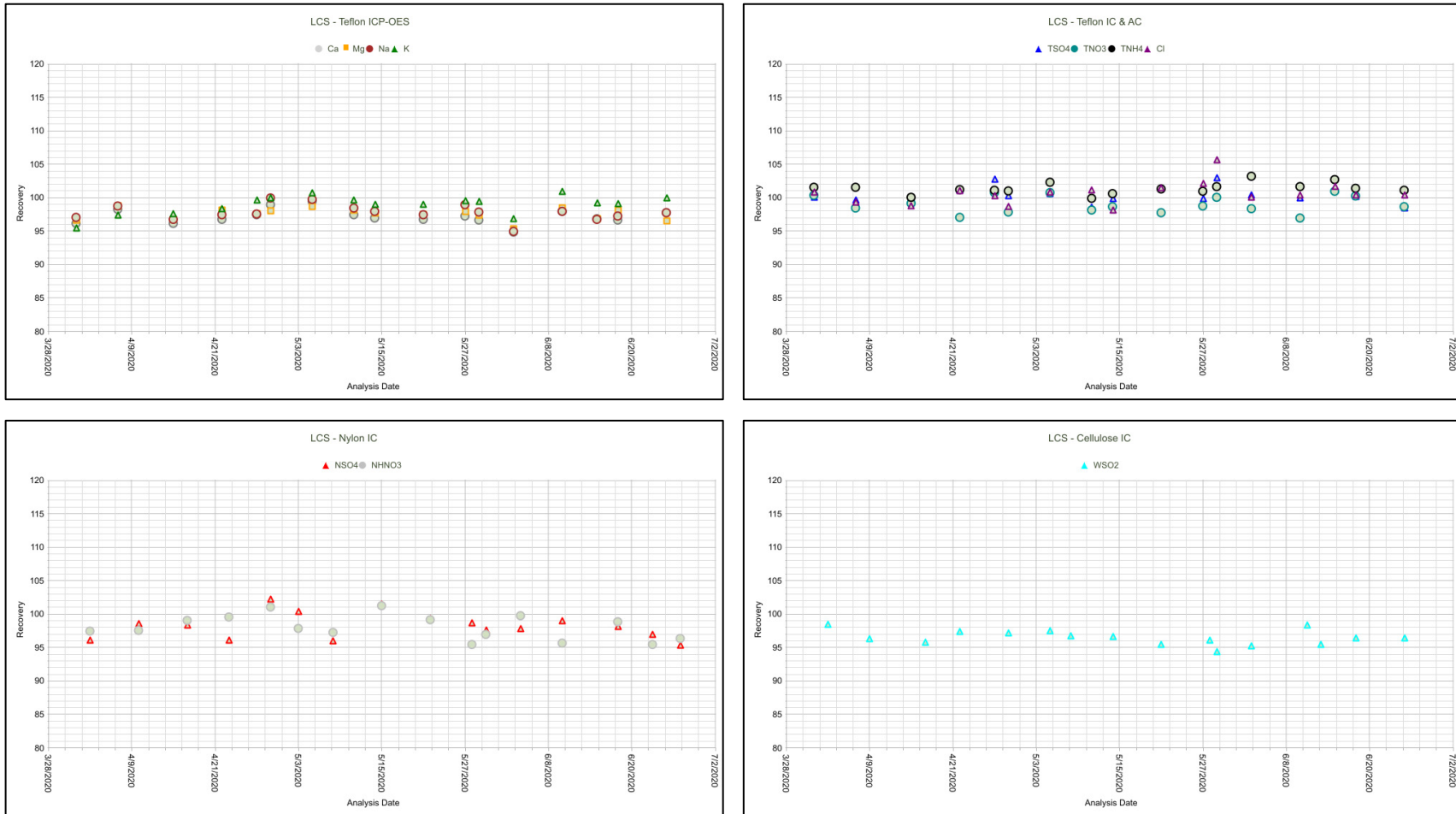


Figure 5 Method Blank Analysis Results for Second Quarter 2020 (total micrograms)

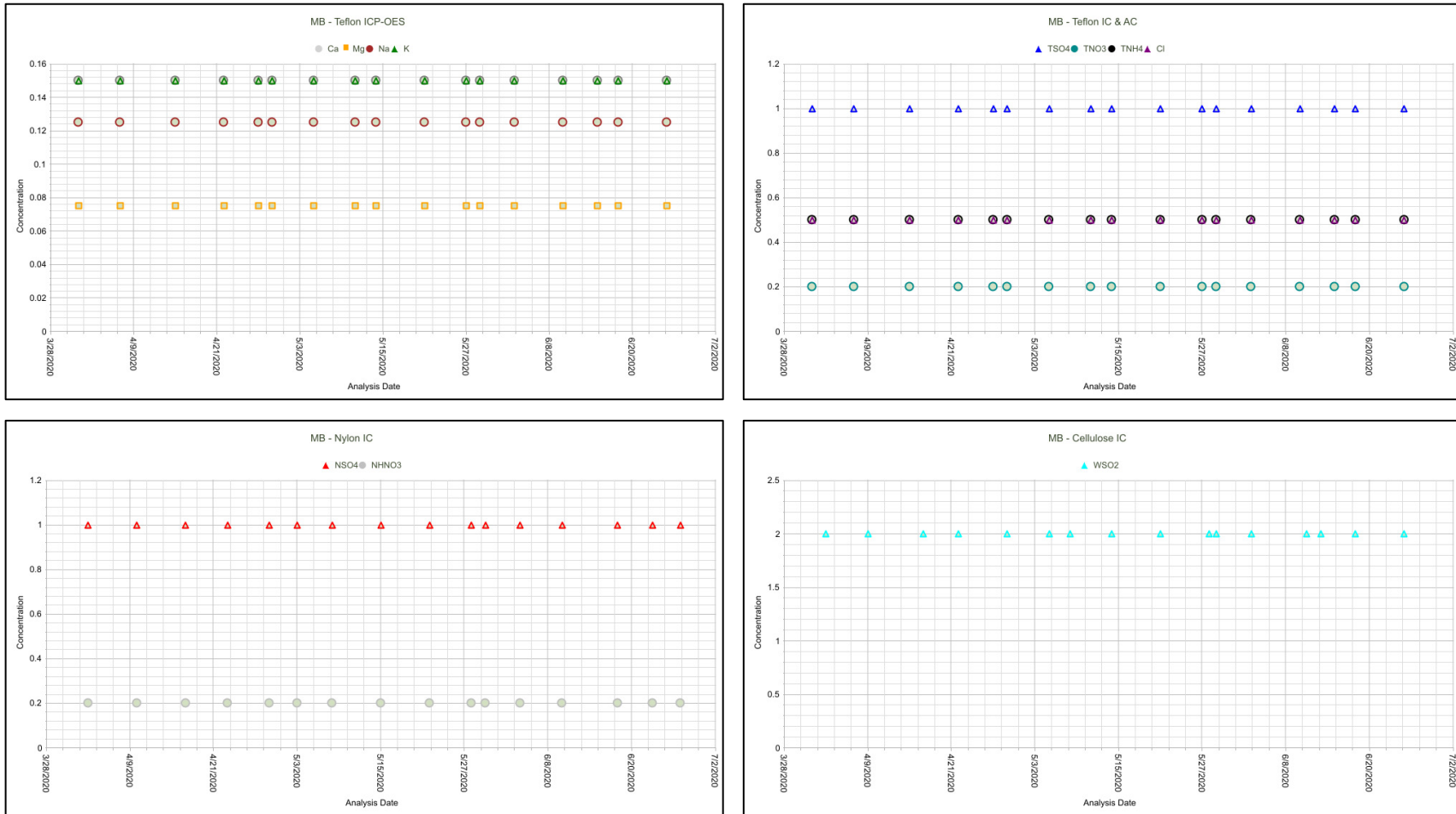


Figure 6 Laboratory Blank Analysis Results for Second Quarter 2020 (total micrograms)

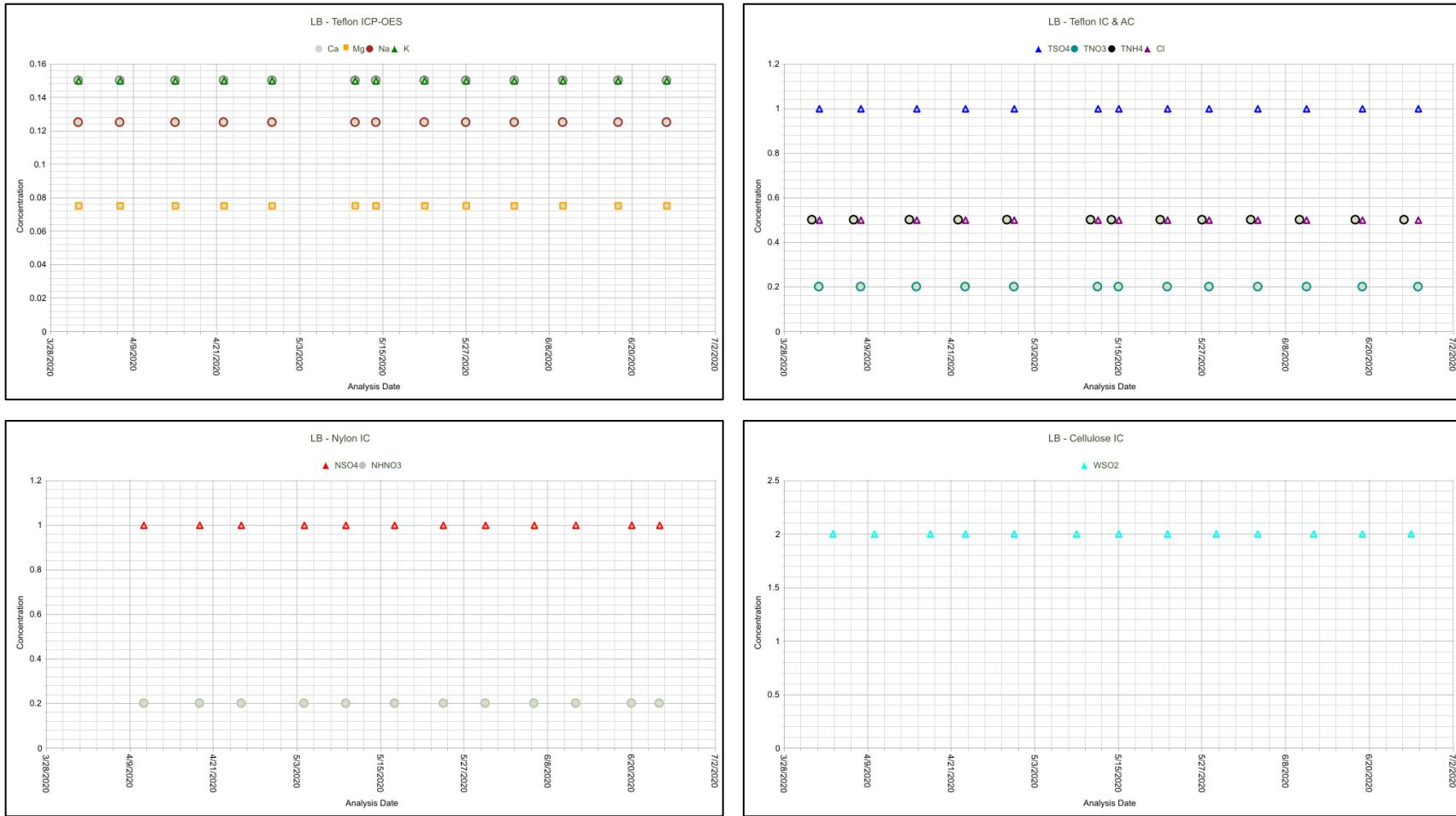


Figure 7 Field Blank Analysis Results for Second Quarter 2020 (total micrograms)

