Summary of Quarterly Operations (July through September)

EPA Contract No. EP-W-09-028

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 2014. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; AMEC, 2013). 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 QA Manager completed an audit of the data management and data documentation systems during July 2014. There were recommendations to add details to system description documentation and establish formal training documentation.

During September 2014, AMEC received sample analyses results for proficiency test (PT) study 104 for Rain and Soft Waters from the National Laboratory of Environmental Testing (NLET), a branch of the National Water Research Institute (NWRI) with Environment Canada that provides QA services. The eight parameters measured for CASTNET were free of systemic bias.

Table 1 lists the quarters of data that were validated to Level 3 during third quarter 2014 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 continuous field measurements. These criteria apply to the instrument challenges performed during site calibrations. Table 4 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 5 presents the critical criteria for ozone monitoring at sites that are configured to meet EPA's AQS criteria for QA/QC procedures and are operated in accordance with Part 58 of Title 40 of the

Code of Federal Regulations (CFR; EPA, 2012). Table 6 presents the critical criteria for AQS-protocol 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 7 presents the number of analyses in each category that were performed during third quarter 2014.

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 8 presents the relevant sample receipt statistics for third quarter 2014.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for third quarter 2014. All results were within the criteria listed in Table 4.

Table 9 presents summary statistics of critical criteria measurements at AQS-protocol ozone sites collected during third quarter 2014. 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 affect on ambient data collection, and passing results still meet frequency criteria. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 10 presents observations associated with the shaded cell results in Table 9.

Table 11 presents summary statistics of critical criteria measurements at AQS-protocol trace-level gas monitoring sites collected during third quarter 2014. 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 6 were or will be invalidated unless the cause of failure has no affect on ambient data collection, and passing results still meet frequency criteria. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 12 presents observations associated with the shaded cell results in Table 11.

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. The current action limits for LCS recovery are 80 percent and 120 percent. Figure 4 presents LCS analysis results for third quarter 2014. 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 third quarter 2014. All third quarter results were within criteria (two times the reporting limit) listed in Table 4.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during third quarter 2014 are listed in Table 13. 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 14 presents counts of field problems affecting continuous data collection for more than one day for third quarter 2014. 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 Environment & Infrastructure, Inc. (AMEC). 2013. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 8.1*. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC. Contract No. EP-W-09-028. Gainesville, FL. http://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). 2012. Appendix A to Part 58 – Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS), Special Purpose Monitors (SPMs), and Prevention of Significant Deterioration (PSD) Air Monitoring. 40 *CFR* Part 58.

Table 1 Data Validated to Level 3 during Third Quarter 2014

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	November 2013 – April 2014	6	Quarter 1 2014	1
SE-4/MW-6‡	January 2014 – June 2014	6	Quarter 1 2014 – Quarter 2 2014	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 2014

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	WFM105, NY NIC001, NY EGB181, ON	UND002, VT
E-3 (5 Sites)	May/November	KEF112, PA MKG113, PA	LRL117, PA PAR107, WV	CDR119, WV	
Southeastern Sites (10 Total)					
SE-4 (6 Sites)	January/July	SND152, AL GAS153, GA	BFT142, NC CND125, NC	COW137, NC SPD111, TN	
SE-5 (4 Sites)	February/August	CAD150, AR CVL151, MS	IRL141, FL SUM156, FL		
Midwestern Sites (19 Total)					
MW-6 (6 Sites)	January/July	CDZ171, KY CKT136, KY	MCK131, KY MCK231, KY	PNF126, NC ESP127, TN	
MW-7 (9 Sites)	March/September	ALH157, IL BVL130, IL 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 (10 Total)					
W-9 (5 Sites)	March/September	KNZ184, KS KIC003, KS	CHE185, OK SAN189, NE	ALC188, TX	
W-10 (5 Sites)	May/November	GTH161, CO ROM206, CO	CNT169, WY PND165, WY	PAL190, TX	

Table 3 Data Quality Indicators for CASTNET Continuous Measurements

Measurement		Criteria[1]	
Parameter[2]	Method	Precision	Accuracy
Filter pack flow	Mass flow controller	± 10%	± 5%
Ozone[3]	UV absorbance	All points within ± 2% of full scale of best fit straight line Linearity error < 5%	
Wind speed	Anemometer	± 0.5 m/s	The greater of ± 0.5 m/s for winds < 5 m/s or ± 5% for winds ≥ 5 m/s
Wind direction	Wind vane	± 5°	± 5°
Sigma theta	Wind vane	Undefined	Undefined
Ambient temperature	Platinum RTD	± 1.0°C	± 0.5°C
Delta temperature	Platinum RTD	± 0.5°C	± 0.5°C
Relative humidity	Thin film capacitor	± 10% (of full scale)	± 10%
Precipitation	Tipping bucket rain gauge	± 10% (of reading)	± 0.05 inch[4]
Solar radiation	Pyranometer	± 10% (of reading taken at local noon)	± 10%
Surface wetness	Conductivity bridge	Undefined	Undefined

Notes: °C = degrees Celsius
m/s = meters per second
RTD = resistance-temperature device
UV = ultraviolet

[1] Precision criteria apply to collocated instruments, and accuracy criteria apply to calibration of instruments. Collocated precision criteria do not apply to AQS-protocol ozone measurements.

[2] Meteorological parameters are only measured at four of the EPA-sponsored CASTNET sites: BVL130, IL; BEL116, MD; CHE185, OK; and PAL190, TX.

[3] Ozone is not measured at eight EPA-sponsored CASTNET sites: KIC004, KS; KNZ184, KS; RED004, MN; EGB181, ON; CAT175, NY; NIC001, NY; WFM105, NY; and UND002, VT.

[4] For target value of 0.50 inch

Table 4 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, 2013).

Table 5 AQS-Protocol Ozone Critical Criteria*

Type of Check	Analyzer Response
Zero	Less than ± 5 parts per billion (ppb)
Span	Less than or equal to ± 7 percent between supplied and observed concentrations
Single Point QC	Less than or equal to ± 7 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, 2012). 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 6 AQS-Protocol Trace-level Gas Monitoring Critical Criteria*

Parameter	Analyzer Response	
	Zero Check	Span Check / Single Point QC Check
SO_2	Less than ± 3 ppb	Less than or equal to ± 10 percent between supplied and observed concentrations
NO_y	Less than ± 3 ppb	
CO	Less than ± 40 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, 2012). 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 E29 (ASTM, 2008).

SO_2 = sulfur dioxide
NO_y = total reactive oxides of nitrogen
CO = carbon monoxide
ppb = parts per billion

Table 7 QC Analysis Count for Third Quarter 2014

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-}	48	184	75	16	26	48
	NO_3^-	48	184	75	16	26	48
	NH_4^+	32	166	86	16	26	48
	Cl^-	48	184	75	16	26	48
	Ca^{2+}	33	171	84	16	26	48
	Mg^{2+}	33	171	84	16	26	48
	Na^+	33	171	84	16	26	48
	K^+	33	171	84	16	26	48
Nylon	SO_4^{2-}	34	166	76	17	26	48
	NO_3^-	34	166	76	17	26	48
Cellulose	SO_4^{2-}	34	166	75	17	26	48

Table 8 Filter Pack Receipt Summary for Third Quarter 2014

Count of samples received more than 14 days after removal from tower:	14
Count of all samples received:	861
Fraction of samples received within 14 days:	0.984
Average interval in days:	4.15
First receipt date:	7/3/2014
Last receipt date:	9/30/2014

Table 9 AQS-Protocol Ozone QC Summary for Third Quarter 2014 (1 of 2)

Site ID	% Span Pass[1]	Span |%D |[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	Single Point QC CL[3]	% Zero Pass[1]	Zero Average (ppb)[2]
ABT147, CT	100.0	2.1	98.9	2.1	0.2	100.0	0.2
ALC188, TX	100.0	1.7	100.0	1.4	0.1	100.0	0.4
ALH157, IL	100.0	2.3	97.9	1.7	0.4	97.9	0.6
ANA115, MI	84.2	3.2	84.2	2.7	0.8	100.0	0.3
ARE128, PA	100.0	1.1	100.0	1.0	0.2	100.0	0.4
ASH135, ME	100.0	0.7	98.9	1.0	0.2	100.0	0.4
BEL116, MD	96.0	2.9	72.7	5.7	0.5	99.0	2.3
BFT142, NC	98.9	1.6	93.4	2.2	1.2	98.9	0.5
BVL130, IL	93.4	5.4	91.2	7.2	2.2	100.0	1.6
BWR139, MD	99.0	1.4	91.7	2.8	1.3	99.0	0.9
CAD150, AR	100.0	1.7	100.0	2.2	0.3	100.0	0.7
CDR119, WV	100.0	1.7	100.0	1.6	0.1	100.0	0.4
CDZ171, KY	88.7	5.2	80.4	15.2	8.6	89.7	7.4
CKT136, KY	100.0	2.8	98.9	4.4	0.2	100.0	0.1
CND125, NC	98.9	1.8	100.0	2.0	0.1	100.0	0.3
CNT169, WY	100.0	1.1	100.0	1.0	0.2	100.0	0.6
COW137, NC	100.0	0.9	100.0	1.4	0.1	100.0	0.3
CTH110, NY	100.0	1.8	100.0	1.4	0.2	100.0	0.7
CVL151, MS	95.1	3.7	91.1	5.0	3.6	97.0	1.2
DCP114, OH	100.0	2.1	96.8	2.8	0.3	99.0	1.1
ESP127, TN	100.0	1.4	98.9	1.5	0.2	100.0	0.1
GAS153, GA	100.0	0.8	100.0	0.8	0.1	100.0	0.5
GTH161, CO	100.0	1.3	100.0	1.4	0.2	100.0	0.3

Table 9 AQS-Protocol Ozone QC Summary for Third Quarter 2014 (2 of 2)

Site ID	% Span Pass[1]	Span |%D |[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	Single Point QC CL[3]	% Zero Pass[1]	Zero Average (ppb)[2]
HOX148, MI	100.0	0.6	100.0	0.9	0.1	100.0	0.5
HWF187, NY	100.0	3.1	97.7	4.8	0.2	100.0	1.8
IRL141, FL	100.0	0.5	100.0	0.8	0.1	100.0	0.3
KEF112, PA	100.0	0.6	100.0	1.5	0.3	98.9	1.0
LRL117, PA	100.0	1.8	100.0	0.8	0.1	100.0	0.2
MCK131, KY	100.0	1.2	98.9	1.0	0.2	100.0	0.6
MCK231, KY	100.0	0.5	100.0	1.6	0.2	100.0	0.5
MKG113, PA	100.0	1.3	100.0	1.3	0.2	100.0	0.5
OXF122, OH	100.0	1.3	100.0	1.5	0.2	100.0	0.8
PAL190, TX	100.0	1.9	100.0	2.8	0.2	100.0	0.5
PAR107, WV	98.9	1.0	100.0	2.8	0.2	100.0	0.8
PED108, VA	98.0	2.5	91.9	3.6	1.5	99.0	0.8
PND165, WY	100.0	2.0	100.0	3.0	0.2	100.0	1.2
PNF126, NC	98.7	2.5	100.0	2.7	0.2	100.0	0.5
PRK134, WI	100.0	2.1	100.0	2.3	0.2	100.0	0.4
PSU106, PA	100.0	1.9	98.9	3.3	0.2	100.0	0.7
QAK172, OH	96.8	4.1	97.9	3.6	1.7	97.9	0.8
ROM206, CO	100.0	1.0	100.0	0.9	0.1	100.0	2.3
SAL133, IN	100.0	0.8	98.7	1.0	0.2	100.0	0.4
SAN189, NE	100.0	1.3	100.0	1.4	0.1	100.0	0.1
SND152, AL	100.0	1.9	100.0	2.0	0.1	100.0	0.4
SPD111, TN	100.0	1.7	100.0	1.7	0.2	100.0	0.6
STK138, IL	100.0	1.0	100.0	0.5	0.1	100.0	0.5
SUM156, FL	95.7	3.8	96.8	6.8	8.3	97.9	1.2
UVL124, MI	100.0	1.7	100.0	1.5	0.1	100.0	0.2
VIN140, IN	100.0	1.8	100.0	1.3	0.1	100.0	0.3
VPI120, VA	100.0	2.0	100.0	1.3	0.2	100.0	0.6
WSP144, NJ	100.0	1.9	100.0	1.4	0.2	100.0	0.5
WST109, NH	100.0	2.3	97.8	2.0	0.3	100.0	0.2

Notes: [1] Percentage of comparisons that pass the criteria listed in Table 5. Values falling below 90 percent are addressed in Table 10.

[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 5 are addressed in Table 10.

[3] 90 percent confidence limit of the coefficient of variation. This should be less than or equal to the 7 percent single point QC check critical criterion. Values exceeding this criterion are addressed in Table 10.

%D = percent difference
CL = confidence limit
ppb = parts per billion

Table 10 AQS-Protocol Ozone QC Observations for Third Quarter 2014

Site ID	QC Criterion	Comments
ANA115, MI	% Span Pass % Single Point QC Pass	The site analyzer malfunctioned* between 8/19/14 and 8/26/14. Data collected during this period were invalidated.
BEL116, MD	% Single Point QC Pass	The site analyzer malfunctioned* between 8/22/14 and 8/31/14. Data collected during this period were invalidated.
CDZ171, KY	% Span Pass % Single Point QC Pass Single Point QC |%D| Single Point QC CL Zero Average	Associated data were invalidated*.
SUM156, FL	Single Point QC CL	This was skewed by results from the 7/15/14 QC checks. Associated data were invalidated 7/14/14 through 7/16/14.

Notes: %D = percent difference
CL = confidence limit
* = suspected moisture intrusion

Table 11 AQS-Protocol Trace-level Gas QC Summary for Third Quarter 2014

Parameter	% Span Pass[1]	Span |%D |[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	Single Point QC CL[3]	% Zero Pass[1]	Zero Average (ppb)[2]
BEL116, MD							
SO_2	100.0	3.2	95.3	4.5	1.2	100.0	0.2
NO_y	100.0	3.3	100.0	3.6	0.6	98.0	0.9
BVL130, IL							
SO_2	94.2	2.2	100.0	1.3	0.2	100.0	0.6
NO_y	100.0	3.2	82.9	5.4	1.4	73.2	3.2
CO	100.0	1.7	74.1	10.0	2.3	92.6	23.6
HWF187, NY							
NO_y	100.0	4.7	100.0	3.2	0.5	95.6	1.3
PND165, WY							
NO_y	100.0	3.8	100.0	3.5	0.5	100.0	1.0
PNF126, NC							
NO_y	100.0	2.4	95.1	3.0	0.8	100.0	0.5
ROM206, CO							
NO_y	95.7	6.6	100.0	5.2	0.5	100.0	0.3

Notes: [1] Percentage of comparisons that pass the criteria listed in Table 6. Values falling below 90 percent are addressed in Table 12.

[2] Absolute value of the average percent differences between the supplied and observed concentrations. Values exceeding the criteria listed in Table 6 are addressed in Table 12.

[3] 90 percent confidence limit of the coefficient of variation. This should be less than or equal to the 10 percent single point QC check critical criterion. Values exceeding this criterion are addressed in Table 12.

%D = percent difference
CL = confidence limit
ppb = parts per billion

Table 12 AQS-Protocol Trace-level Gas QC Observations for Third Quarter 2014

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	NO_y	% Single Point QC Pass % Zero Pass	The analyzer's adaptive filter, which switches to "fast" integration mode during QC checks, switched to "slow" (ambient measurements) mode prematurely on several occasions. Ambient data were not affected.
BVL130, IL	CO	% Single Point QC Pass	Elevated baseline due to automated zero reference errors in August. Associated data will be invalidated.

Table 13 Filter Packs Flagged as Suspect or Invalid during Third Quarter 2014

Site ID	Sample No.	Reason
EGB181, ON	1435001-29	Insufficient flow volume
EVE419, FL	1431001-31	Insufficient flow volume
FOR605, WY	1431003-02	Insufficient flow volume
GLR468, MT	1431001-33	Insufficient flow volume
JOT403, CA	1431001-42	Insufficient flow volume
PNF126, NC	1436001-63 1437001-63	Site power failure and subsequent loss of data logger settings
UND002, VT	1430001-79	Extended site power failure

Table 14 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	225
60	9
90	1
Unresolved by End of Quarter	3

Figure 1 Reference Standard Results for Third Quarter 2014 (percent recovery)

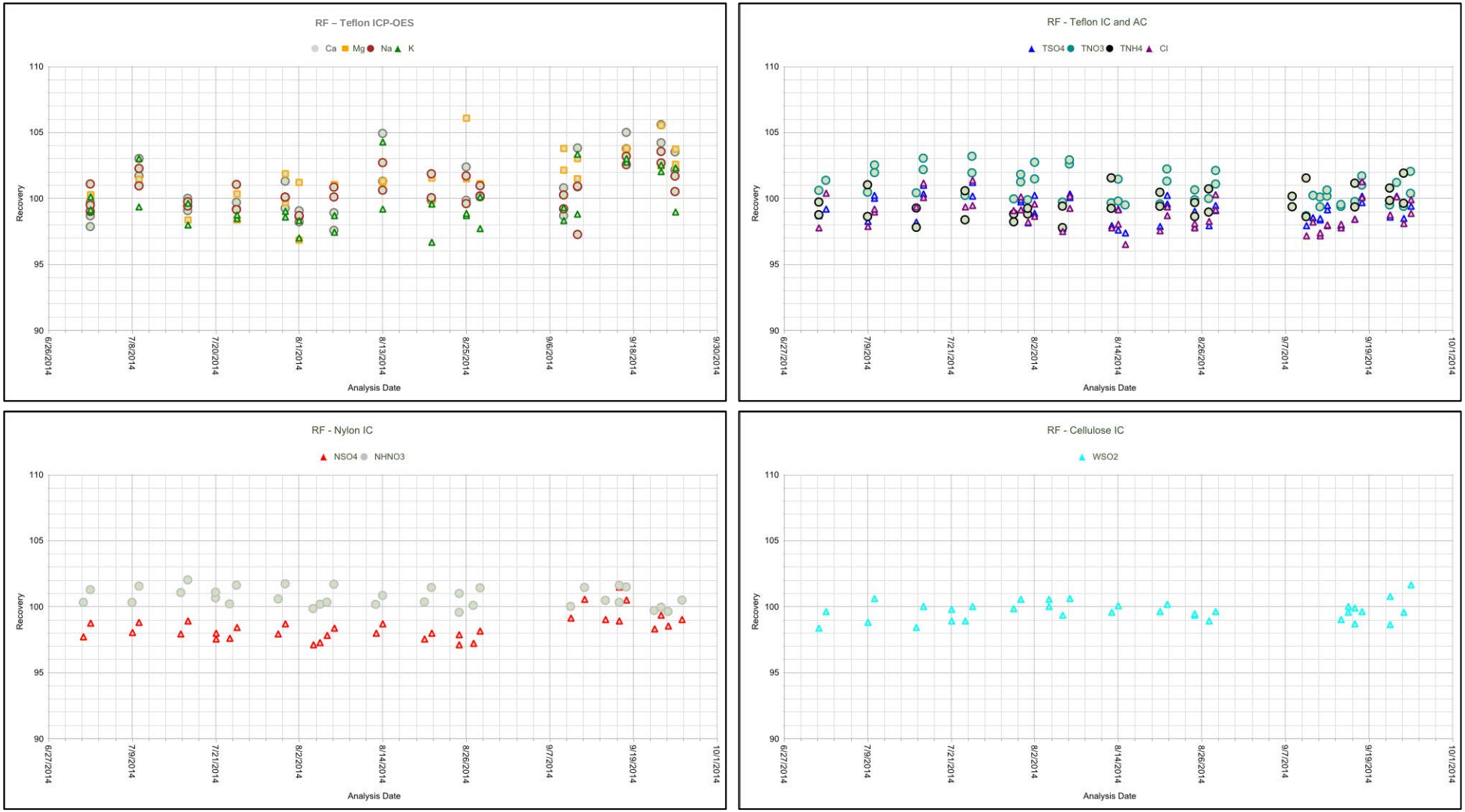

Figure 2 Continuing Calibration Spike Results for Third Quarter 2014 (percent recovery)

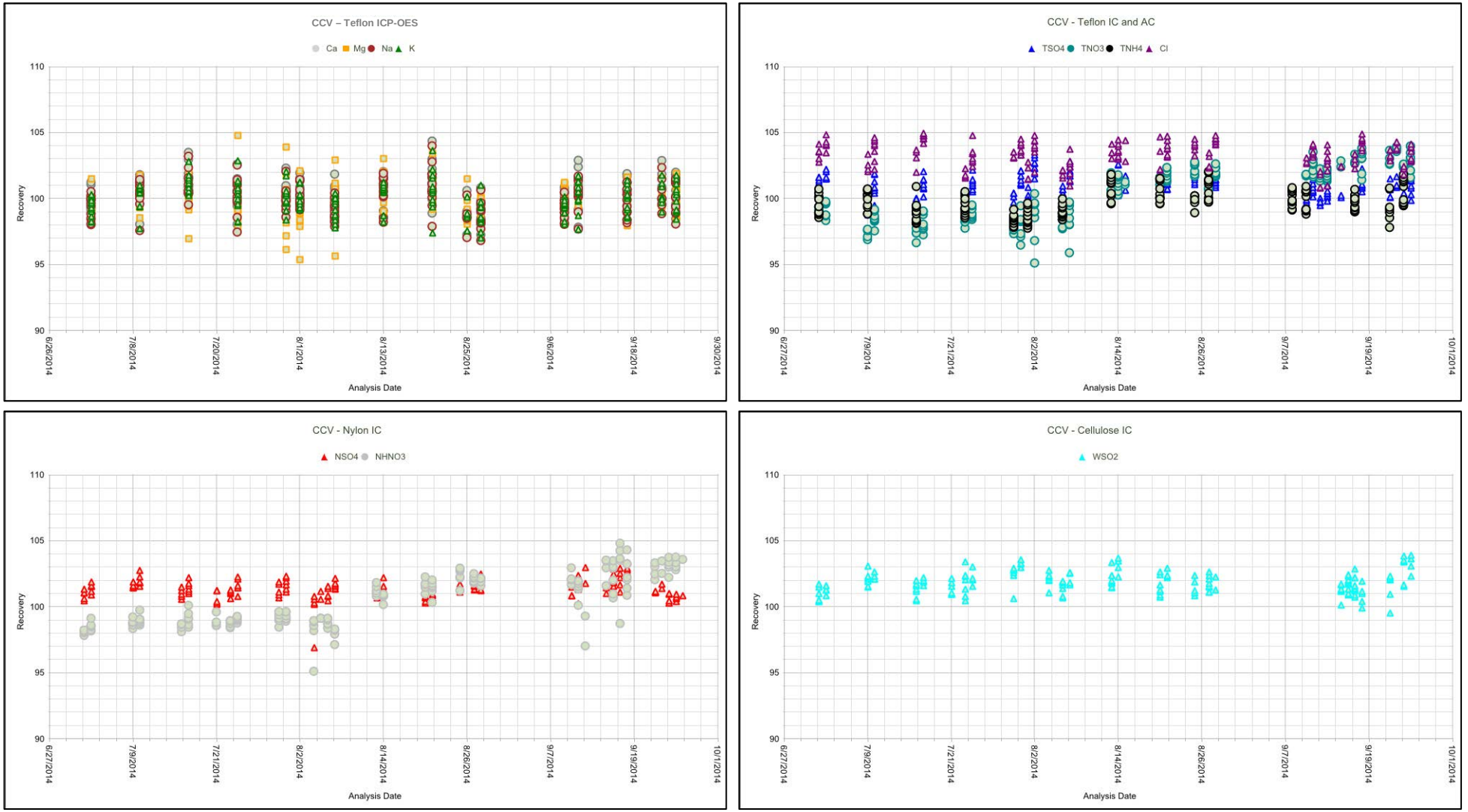

Figure 3 Replicate Sample Analysis Results for Third Quarter 2014 (percent difference)

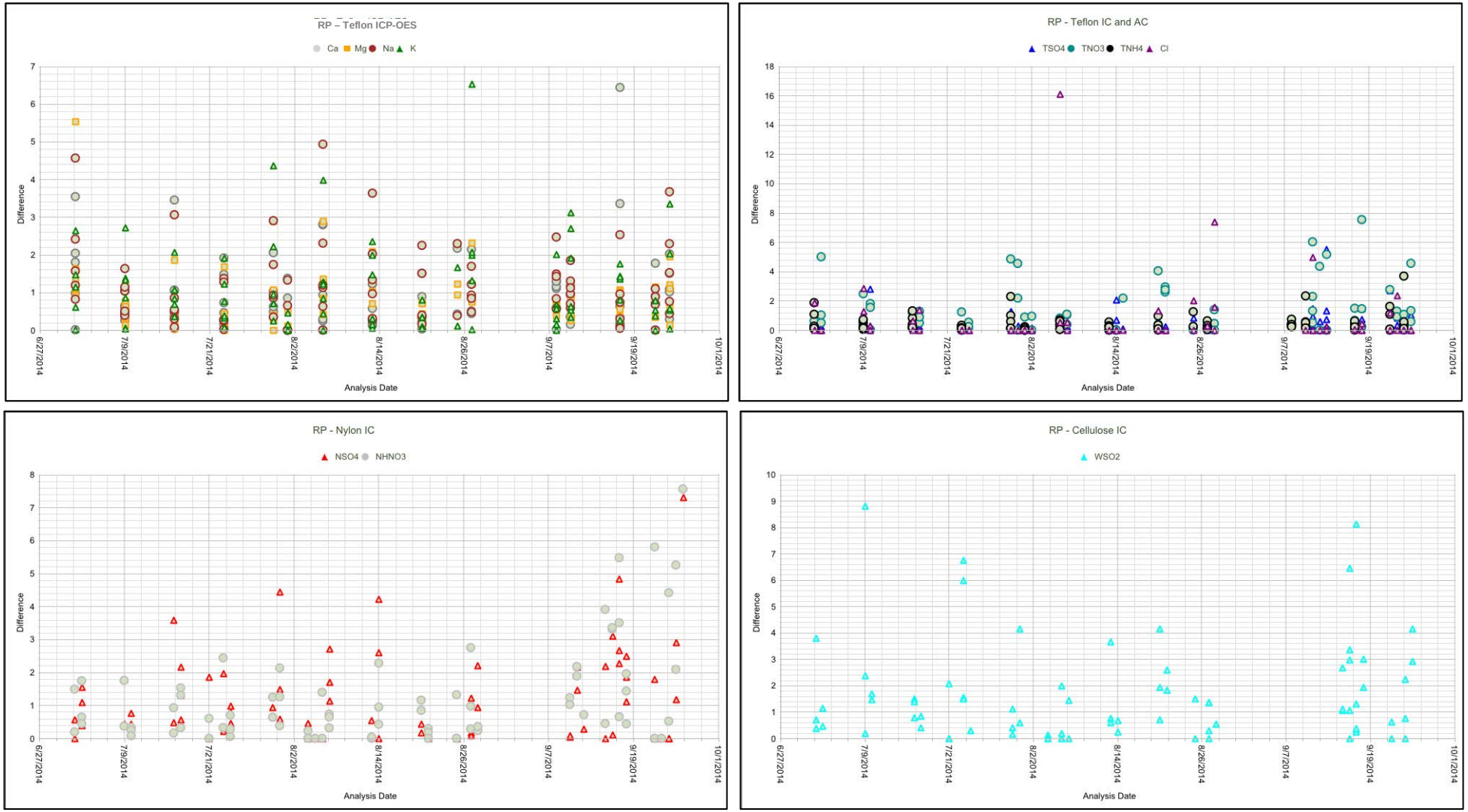

Figure 4 Laboratory Control Sample Results for Third Quarter 2014 (percent recovery)

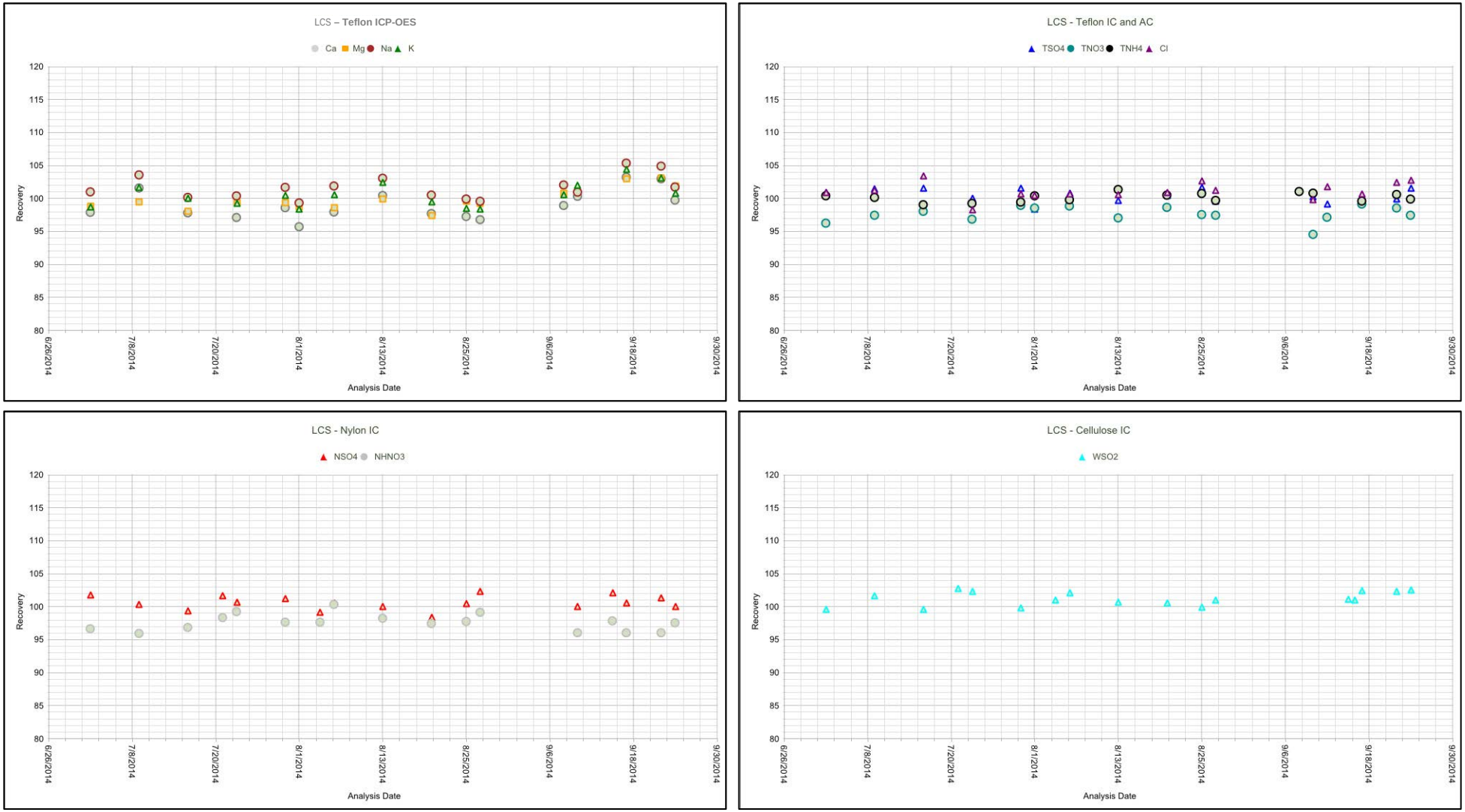

Figure 5 Method Blank Analysis Results for Third Quarter 2014 (total micrograms)

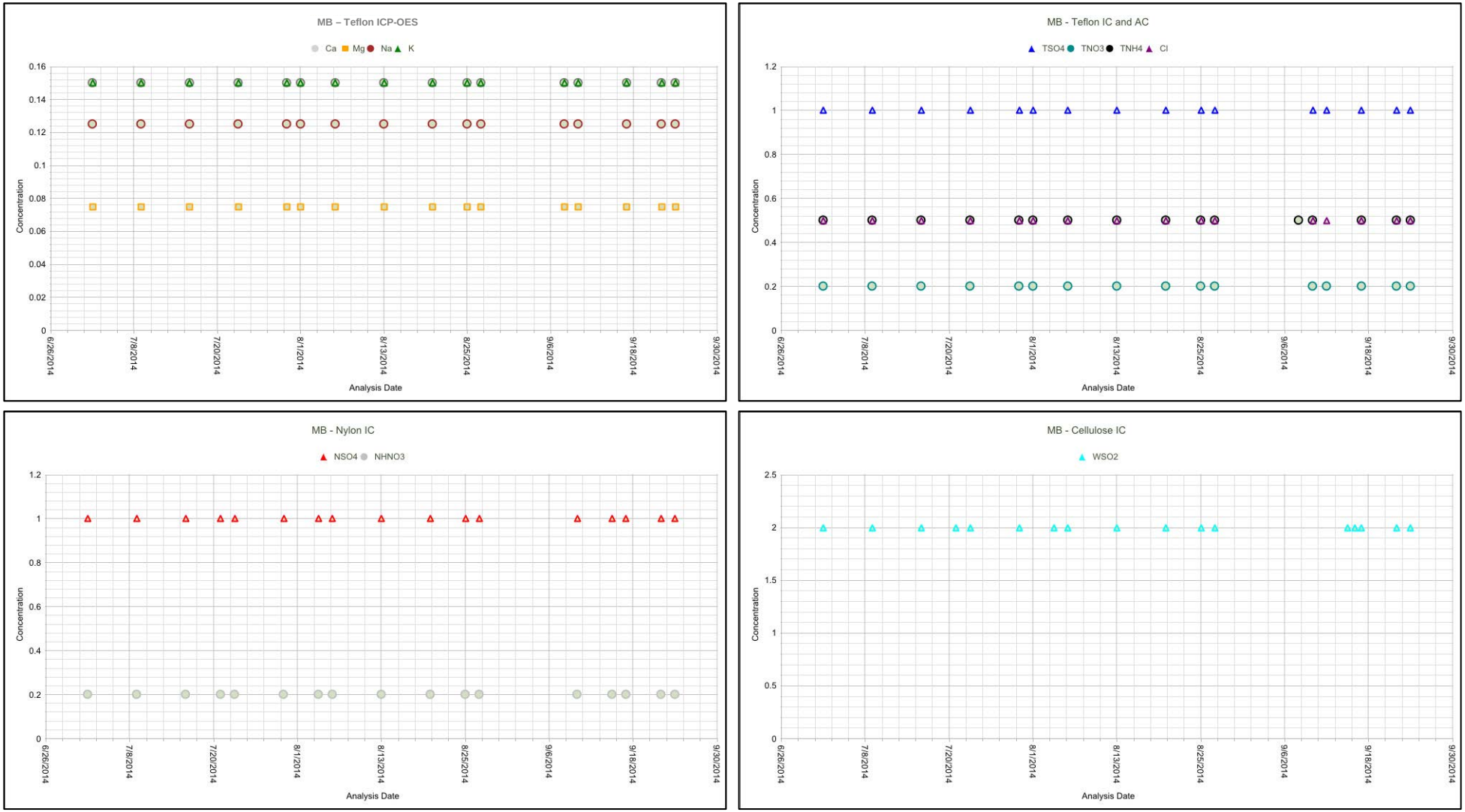

Figure 6 Laboratory Blank Analysis Results for Third Quarter 2014 (total micrograms)

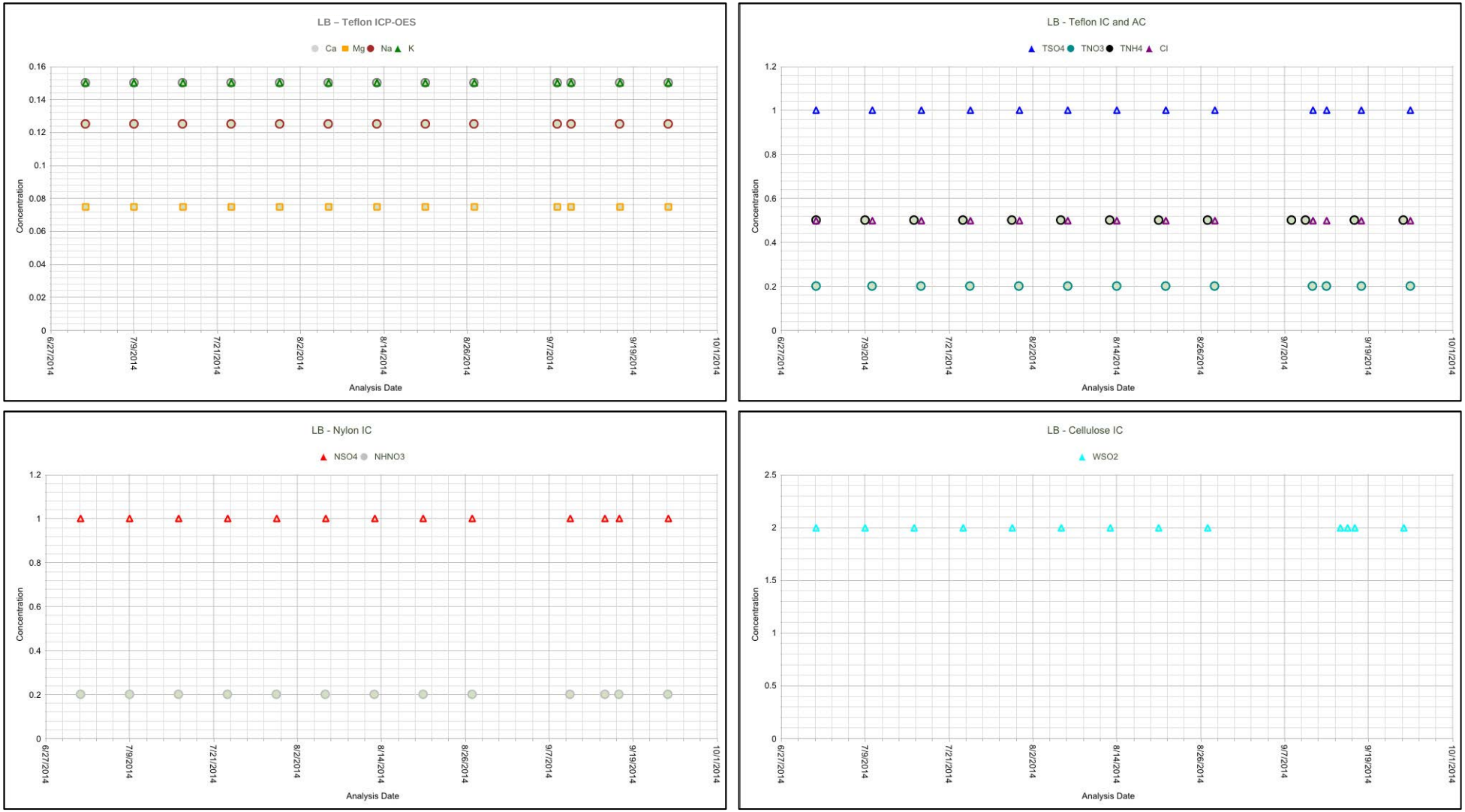

Figure 7 Field Blank Analysis Results for Third Quarter 2014 (total micrograms)