Summary of Quarterly Operations (October – December) with 2011 Annual Summary

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 fourth quarter 2011. It also provides an annual summary that includes data from the three previous quarters. The results presented for filter pack data collection and field calibrations are generated from data extracted from the CASTNET Data Management Center database using the CASTNET Data Management System Application and Microsoft Access. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP). 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.

Significant Events for 2011

EPA issued Contract Modification 0028 to the CASTNET IV contract (EP-W-09-028) on October 7, 2011 to accept MACTEC Engineering and Consulting, Inc.'s name change to AMEC E&I, Inc. (AMEC). For consistency within this report, AMEC is used to refer to both MACTEC and AMEC activities.

During 2011, AMEC continued investigating the cause of occasional low-level potassium contamination on the Teflon filters. As a result, new procedures were implemented for coding wet filters returning from the field. Now, exposed filters are coded as being wet if even slightly wet since potassium from impregnated cellulose filters can migrate when the filters are wet. Additionally, it was noted that the contamination correlates with high temperatures in the filter pack shipping tube and primarily occurs during the warmest months and in warmer regions. Moisture may also be a factor.

Twice during 2011, AMEC tied for first place in proficiency test (PT) studies 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. During March 2011, AMEC received final results and rankings for PT study 0097. AMEC tied for first place out of the 33 participating laboratories. Additionally, in September 2011, AMEC tied for first place out of the 31 participating laboratories for PT study 0098. In both studies, AMEC showed no flags and no indication of bias. All parameters tested were appraised as "ideal." AMEC's laboratory was rated, "Very Good," the highest rating available. AMEC's 5-year historical average for Environment Canada PT studies is rated "Very Good," which shows AMEC's consistent performance for laboratory analyses.

One of the more stable parameters measured at CASTNET sites is filter pack flow. During 2011, AMEC noted an unusual series of flow calibration audit challenge results outside the ±2 percent window used to determine whether instrument adjustment is required. A few were outside the ±5 percent window used for data validation. The majority of the failures were biased the same direction (low) and were eventually found to correlate with two flow transfer standards being used for field calibrations. Subsequent AMEC testing indicated that these standards were suspect. They have been returned to the manufacturer for further evaluation and servicing. A memorandum containing best practice operating guidelines was developed for use by field personnel to minimize errors. The new procedures were implemented during fourth quarter 2011 calibrations. Corrective action was also determined for sites showing audit results beyond the 5 percent window. Flow data for these sites will be rescaled to the correct values, and, if necessary, resubmitted to the EPA database.

The CASTNET QAPP Revision 7.0 was approved by EPA during February 2011.

RTI International (RTI) audited AMEC's analytical laboratory in April 2011. The audit was very thorough and covered all laboratory activities described in the CASTNET QAPP and standard operating procedures. Findings indicated that the AMEC laboratory personnel are qualified, properly trained, and adhere to documented project procedures. There were no major findings. Minor findings included the need to reconcile nomenclature between project documents.

Final results were received in April 2011 for AMEC's analytical laboratory's 2010 analyses of U.S. Geological Survey (USGS) interlaboratory comparison test samples. Results indicated good performance. AMEC submitted analyses of interlaboratory comparison test samples to USGS each quarter of 2010. Currently, AMEC is waiting for results from the 2011 USGS interlaboratory comparison analyses and is participating in the 2012 interlaboratory program.

During May 2011, calibration data for the trace-level gas analyzers at the BEL116, MD site were evaluated, and reporting limits were developed. The proposed reporting limits were sent to EPA and were approved.

In early June 2011, AMEC traveled to the ROM406/206, CO site to work with the National Park Service (NPS) contractor, Air Resource Specialists, Inc. (ARS), to identify any differences that may be the potential cause(s) of observed ozone measurement bias. Transfer standard readings were compared. Calibration procedures and associated equipment configuration were also compared. While differences in instruments and procedures were noted, no one procedure stood out as the cause of the bias nor was the cumulative error observed sufficient to account for it. Data from the comparisons, as well as from configuration and procedural differences, were further evaluated to try to isolate the cause(s) of the continued bias. The results were inconclusive.

During June 2011, AMEC's CASTNET QA Manager verified that corrective action either had been taken or was in process with regard to the findings from the November 2010 annual internal technical systems audits of the CASTNET analytical laboratory and the CASTNET field instrumentation laboratory. These audits are designed to verify conformance of laboratory activities with those established by the CASTNET QAPP and associated standard operating procedures. The follow-up of the audit indicated general compliance by AMEC personnel.

Thermo Scientific (Thermo) is replacing 100 of the ozone analyzer pressure transducers and providing rubber feet for the internal pump to minimize vibration. AMEC worked with EPA to establish a protocol for component replacement at affected sites. At sites where the transducer must be replaced in a site transfer standard, the serviced transfer standard will be subject to a 6-day verification procedure. The protocol, therefore, entails maintaining a small inventory of verified transfer standards to enable rapid replacement of site standards while serviced units undergo verification at AMEC's Gainesville, FL facility.

During September 2011, AMEC began officially submitting ozone data from EPA-sponsored sites to the EPA Air Quality System (AQS). As of fourth quarter, AMEC began submitting data to AQS on a monthly basis for all EPA-sponsored sites that measure ozone.

During an investigation of suspect wind speed data at BVL130, IL, it was found that the data logger had an incorrect setting. This setting identifies a site as a Climatronics or RM Young site. Further review of all data for all sites and discussion of the findings determined that the data loggers occasionally lose their correction factors and the Climatronics or RM Young site setting, which affect the wind parameters. Historical data were reviewed and data affected were corrected where possible and otherwise invalidated. All data affected will be resubmitted when this process is completed beginning with updates submitted on November 1, 2011. To prevent

the loss of settings in data loggers in the future, a phased rollout of an updated program to stabilize the settings and correction factors in the site data loggers began during fourth quarter 2011 and was completed in early 2012. Prior to completion of the program update, AMEC monitored each data logger and restored settings when they were lost.

Quarterly/Annual Summary

Collocated filter pack precision data and completeness data for the continuous measurements are presented for data validated to Level 3 during the quarter/year. Table 1 lists the quarters of data that were validated to Level 3 during 2011 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.

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. Tables 6 through 9 present the number of analyses in each category that were performed during each quarter of 2011.

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 10 presents the relevant sample receipt statistics for each of the four quarters of 2011 together with an annual summary for each category.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for fourth quarter 2011. All results were within the criteria listed in Table 4 . Table 11 presents the percent recoveries and standard deviations for RF, CCV, and RP QC sample analyses for 2011. Quarterly averages are all within criteria.

Table 12 presents quarterly collocated filter pack precision results for data validated to Level 3 during the year. Results for MCK131/231, KY were within criteria for 10 of the 11 parameters reported. Results for ROM406/206, CO were within criteria for all of the 11 parameters. All but one of site-parameters were within the current 20 percent criterion.

Figure 4 presents completeness statistics for continuous measurements validated to Level 3 during the year. All parameters met the 90 percent criterion with the exception of wind data. These data were affected by invalidation of data from BVL130, IL during implementation of corrective action for the loss of data logger settings previously discussed.

Table 13 presents summary statistics of critical criteria measurements at AQS-protocol ozone sites collected during fourth quarter 2011. All data associated with QC checks that fail to meet the criteria listed in Table 5 will be invalidated. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 14 presents observations associated with the shaded cell results in Table 13.

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 5 presents LCS analysis results for fourth quarter 2011.

Blank Results

Figures 6 through 8 present the results of MB, LB, and FB QC sample analyses for fourth quarter 2011. All results were within criteria (two times the reporting limit) listed in Table 4 with the exception of one potassium FB result that fell between two and three times the reporting limit. Table 15 summarizes the record of filter blanks for 2011.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during each of the four quarters of 2011 are listed in Table 16. This table also includes associated site identification and a brief description of the reason the sample was flagged. During fourth quarter, eight filter pack samples were invalidated.

Field Problem Count

Table 17 presents counts of field problems affecting continuous data collection for more than one day for each quarter during quarter 2011. 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.

Field Calibration Results

A summary of field calibration failures by parameter for each quarter of 2011 is listed in Table 18. Calibrations were performed at 21 sites during fourth quarter 2011. For fourth quarter, all sites and parameters were within the criteria listed in Table 3 with the exception of the parameters at the four sites that are listed in Table 18. The table includes several entries that were not listed in the reports published during 2011. This was due to calibration results entered in the database after publication of the reports.

Table 19 presents field accuracy results for 2011 based on instrument challenges performed using independent reference standards during site calibration visits. Each parameter was within its criterion with at least 90 percent frequency except wind direction and solar radiation, which were each within criterion with 87.5 percent frequency.

Table 1 Data Validated to Level 3 through Fourth Quarter 2011

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
SE-4 MW-6†	July 2010 – June 2011	12	Quarter 3 2010 – Quarter 2 2011	4
E-1 SE-5	August 2010 – July 2011	12	Quarter 4 2010 – Quarter 2 2011	3
MW-7 W-9	September 2010 – August 2011	12	Quarter 4 2010 – Quarter 2 2011	3
E-2 MW-8	October 2010 – September 2011	12	Quarter 4 2010 – Quarter 3 2011	4
E-3 W-10‡	May 2010 – April 2011	12	Quarter 3 2010 – Quarter 1 2011	3

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

Table 2 Field Calibration Schedule

Calibration Group	Months Calibrated	Sites Calibrated			
Eastern Sites (20 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 (7 Sites)	April/October	ABT147, CT WST109, NH	HOW132, ME ASH135, ME	CAT175, NY HWF187, NY	EGB181 ON
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 PNF126, NC	
SE-5 (4 Sites)	February/August	CAD150, AR CVL151, MS	IRL141, FL SUM156, FL		
Midwestern Sites (18 Total)					
MW-6 (6 Sites)	January/July	CDZ171, KY CKT136, KY	MCK131, KY MCK231, KY	ESP127, TN SPD111, TN	
MW-7 (8 Sites)	March/September	ALH157, IL BVL130, IL	STK138, IL VIN140, IN	DCP114, OH OXF122, OH	QAK172, OH PRK134, WI
MW-8 (4 Sites)	April/October	SAL133, IN HOX148, MI	ANA115, MI UVL124, MI		
Western Sites (9 Total)					
W-9 (4 Sites)	March/September	KNZ184, 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 third
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] As of January 2011, meteorological parameters were only measured at four EPA-sponsored CASTNET sites: PAL190, TX; CHE185, OK; BVL130, IL; and BEL116, MD.

[3] Ozone is not measured at two EPA-sponsored CASTNET sites: EGB181, ON and CAT175, NY.

[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	Nominal Reporting Limits µg/Filter
Ammonium (NH_4^+)	AC	20	90 - 110	0.020*	0.5
Sodium (Na^+)	ICP-AES	20	95 - 105	0.005	0.125
Potassium (K^+)	ICP-AES	20	95 - 105	0.006	0.15
Magnesium (Mg^{2+})	ICP-AES	20	95 - 105	0.003	0.075
Calcium (Ca^{2+})	ICP-AES	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-AES reference standards.

AC = automated colorimetry
IC = ion chromatography
ICP-AES = inductively coupled plasma-atomic emission spectrometry
MARPD = mean absolute relative percent difference
* = as nitrogen

Values are rounded according to American Society for Testing and Materials (ASTM) (Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications E 29).

For more information on analytical methods and associated precision and accuracy criteria, see the CASTNET QAPP, Revision 7.0 (MACTEC Engineering and Consulting, Inc., now known as AMEC, 2011)

Table 5 AQS-Protocol Ozone Critical Criteria*

Type of Check	Analyzer Response
Zero	Less than ± 10 parts per billion (ppb)
Span	Less than or equal to ± 7 percent between supplied and observed concentrations
One Point QC	Less than or equal to ± 7 percent between supplied and observed concentrations

Note: * Applies to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the Code of Federal Regulations

Table 6 QC Analysis Count for First Quarter 2011

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-}	32	169	80	16	28	83
	NO_3^-	32	169	80	16	30	83
	NH_4^+	34	181	86	17	30	120
	Cl^-	32	169	78	16	28	83
	Ca^{2+}	34	180	83	17	30	120
	Mg^{2+}	34	180	83	17	30	120
	Na^+	34	180	83	17	30	120
	K^+	34	180	83	17	30	120
Nylon	SO_4^{2-}	32	165	81	16	26	81
	NO_3^-	32	165	81	16	26	81
Cellulose	SO_4^{2-}	44	176	88	22	28	95

Table 7 QC Analysis Count for Second Quarter 2011

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-}	32	167	82	16	26	80
	NO_3^-	32	167	82	16	26	80
	NH_4^+	32	168	81	16	26	80
	Cl^-	32	167	75	16	26	80
	Ca^{2+}	32	172	75	16	26	80
	Mg^{2+}	32	172	75	16	26	80
	Na^+	32	172	75	16	26	80
	K^+	32	172	75	16	26	80
Nylon	SO_4^{2-}	34	162	77	15	26	80
	NO_3^-	34	162	77	15	26	80
Cellulose	SO_4^{2-}	37	152	78	19	26	80

Table 8 QC Analysis Count for Third Quarter 2011

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-}	34	165	73	17	26	81
	NO_3^-	34	165	82	17	26	81
	NH_4^+	34	168	89	17	26	81
	Cl^-	34	165	70	17	26	81
	Ca^{2+}	35	165	78	17	26	81
	Mg^{2+}	35	165	78	17	26	81
	Na^+	35	165	78	17	26	81
	K^+	35	165	78	17	26	81
Nylon	SO_4^{2-}	33	165	70	16	26	81
	NO_3^-	33	165	78	16	26	81
Cellulose	SO_4^{2-}	49	183	90	23	26	81

Table 9 QC Analysis Count for Fourth Quarter 2011

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-}	32	160	75	16	22	47
	NO_3^-	32	160	82	16	22	47
	NH_4^+	32	160	91	16	22	47
	Cl^-	32	160	73	16	22	46
	Ca^{2+}	32	161	76	16	22	46
	Mg^{2+}	32	161	76	16	22	46
	Na^+	32	161	76	16	22	46
	K^+	32	161	76	16	22	46
Nylon	SO_4^{2-}	30	159	70	15	22	47
	NO_3^-	30	159	76	15	22	47
Cellulose	SO_4^{2-}	40	160	81	20	22	46

Table 10 Filter Pack Receipt Summary for 2011

Description	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Summary
Count of samples received more than 14 days after removal from tower:	3	6	7	4	20
Count of all samples received:	597	727	692	742	2758
Fraction of samples received within 14 days:	0.995	0.992	0.990	0.995	0.993
Average interval in days:	4.54	4.27	4.029	4.563	4.351*
First receipt date:	01/03/2011	04/01/2011	07/01/2011	10/3/2011	1/3/2011
Last receipt date:	03/28/2011	06/30/2011	09/28/2011	12/30/2011	12/30/2011

Note: *annual average

Table 11 Filter Pack QC Summary for 2011

Filter Type	Parameter	Reference Sample[1] Recovery (%R)			Continuing Calibration Verification Samples (%R)			In-Run Replicate[2] (RPD)		
		Mean	Std. Dev.	Count[3]	Mean	Std. Dev.	Count[3]	Mean	Std. Dev.	Count[3]
Teflon	SO_4^{2-}	98.97	1.49	130	99.72	1.41	661	0.37	0.56	310
	NO_3^-	100.85	0.91	130	100.51	1.12	661	0.99	1.18	326
	NH_4^+	102.96	2.34	132	101.32	2.18	677	0.78	0.91	347
	Ca^{2+}	99.18	2.34	133	100.45	0.94	678	0.80	0.81	312
	Mg^{2+}	103.41	1.29	133	100.03	0.88	678	1.39	1.61	312
	Na^+	99.96	1.66	133	100.01	0.96	678	1.11	1.48	312
	K^+	100.80	2.23	133	100.03	0.78	678	1.79	2.21	312
	Cl^-	103.48	0.83	130	100.83	1.59	661	1.61	1.78	296
Nylon	SO_4^{2-}	98.83	1.27	129	99.97	1.59	651	1.55	2.20	298
	NO_3^-	100.54	1.16	129	100.72	1.17	651	1.07	1.19	312
Cellulose	SO_4^{2-}	98.28	1.49	170	99.42	1.58	671	1.54	2.19	337

Notes: % R = percent recovery
RPD = relative percent difference

[1] Results of reference sample analyses provide accuracy estimates
[2] Results of replicate analyses provide precision estimates
[3] Number of QC Samples

Table 12 Precision Results for Third Quarter 2010 through Second Quarter 2011

Site Pairs	SO_4^{2-}	NO_3^-	NH_4^+	Ca^{2+}	Mg^{2+}	Na^+	K^+	Cl^-	HNO_3	SO_2	Total NO_3^-
MCK131/231, KY											
2010 Q3	8.81	7.86	8.19	12.50	12.06	11.76	27.08	0.00	13.43	11.06	11.36
2010 Q4	3.49	7.21	3.31	10.01	8.87	6.98	8.77	4.81	5.12	2.74	5.16
2011 Q1	2.21	4.46	2.15	7.76	6.69	5.02	13.23	8.46	5.63	2.47	3.98
2011 Q2	6.02	10.67	6.28	9.03	7.32	7.17	6.77	6.08	4.76	4.76	6.78
Average	5.13	7.55	4.98	9.83	8.74	7.73	13.96	4.84	7.24	5.26	6.82
ROM406/206, CO											
2010 Q3	4.80	9.06	3.83	5.47	7.76	6.72	19.33	3.18	14.25	7.72	11.33
2010 Q4	4.31	16.22	7.03	9.26	7.44	9.76	19.90	2.93	11.35	6.47	11.74
2011 Q1	4.86	11.80	5.09	11.31	9.76	11.00	19.28	2.48	7.77	5.68	6.49
2011 Q2	4.11	12.40	3.66	8.46	8.79	4.95	13.88	7.58	9.27	7.81	7.30
Average	4.52	12.37	4.90	8.63	8.44	8.11	18.10	4.04	10.66	6.92	9.22

Note: 1 of 88 site-quarter-parameters were outside criterion

Table 13 AQS-Protocol Ozone QC Summary for Fourth Quarter 2011 (1 of 2)

Site ID	% Span Pass[1]	Span |%D |[2]	% One Point QC Pass	One Point QC |%D|	One Point QC CL[3]	% Zero Pass	Zero Average (ppb)
ABT147, CT	100.00	0.99	100.00	1.03	0.07	100.00	0.14
ALC188, TX	97.87	1.46	91.49	2.70	0.56	89.36	2.68
ALH157, IL	100.00	0.88	100.00	0.72	0.06	98.94	0.42
ANA115, MI	100.00	0.80	100.00	0.45	0.05	100.00	0.19
ARE128, PA	79.07	10.36	79.07	9.65	3.42	98.84	7.74
ASH135, ME	100.00	3.75	100.00	3.73	0.23	100.00	0.25
BEL116, MD	98.72	1.85	98.72	2.02	1.53	97.47	0.79
BFT142, NC	100.00	2.06	98.96	1.76	0.19	98.96	1.34
BVL130, IL	100.00	3.18	100.00	3.55	0.10	100.00	1.28
BWR139, MD	94.74	31.96	95.79	29.00	22.43	100.00	0.35
CAD150, AR	98.91	2.49	100.00	1.54	0.15	100.00	0.36
CDR119, WV	97.92	2.64	97.89	2.63	2.38	100.00	0.81
CDZ171, KY	100.00	1.30	97.87	1.25	0.26	100.00	1.64
CKT136, KY	100.00	1.35	98.97	1.29	0.15	99.74	0.46
CND125, NC	93.81	17.06	93.81	17.14	14.08	100.00	0.47
CNT169, WY	76.67	19.07	75.56	11.24	3.18	78.89	9.96
COW137, NC	100.00	1.23	100.00	1.14	0.10	68.09	5.22
CTH110, NY	100.00	1.78	100.00	1.27	0.04	100.00	0.53
CVL151, MS	100.00	1.08	100.00	1.92	0.10	100.00	0.91
DCP114, OH	94.79	33.71	94.79	30.21	21.40	100.00	0.47
ESP127, TN	100.00	0.35	100.00	0.33	0.05	100.00	0.59
GAS153, GA	92.77	10.51	92.77	8.17	4.84	100.00	3.57
GTH161, CO	93.94	6.28	93.94	4.50	2.23	93.94	2.61
HOW132, ME	100.00	1.17	100.00	1.10	0.07	100.00	1.40
HOX148, MI	100.00	1.47	100.00	1.32	0.13	98.78	0.60
HWF187, NY	91.00	10.29	97.30	3.80	2.40	92.31	2.34
IRL141, FL	98.94	1.21	98.94	0.76	0.80	97.87	2.34
KEF112, PA	100.00	0.41	100.00	0.60	0.09	100.00	0.56
KNZ184, KS	98.42	2.84	98.45	4.42	3.71	99.04	0.82
LRL117, PA	100.00	2.04	98.70	1.76	0.20	100.00	0.84
MCK131, KY	100.00	3.73	100.00	3.98	0.15	100.00	0.65
MCK231, KY	100.00	4.16	100.00	4.12	0.09	100.00	1.56

Table 13 AQS-Protocol Ozone QC Summary for Fourth Quarter 2011 (2 of 2)

Site ID	% Span Pass[1]	Span |%D |[2]	% One Point QC Pass[1]	One Point QC |%D|[2]	One Point QC CL[3]	% Zero Pass[1]	Zero Average (ppb)[2]
MKG113, PA	100.00	1.92	100.00	1.55	0.13	100.00	0.41
OXF122, OH	100.00	3.61	100.00	4.10	0.11	98.92	0.66
PAL190, TX	93.81	18.30	96.91	17.62	15.30	100.00	0.42
PAR107, WV	90.00	78.88	89.90	15.47	12.94	95.00	2.05
PED108, VA	100.00	1.09	100.00	0.95	0.11	100.00	0.73
PND165, WY	100.00	1.10	98.95	1.30	0.21	100.00	0.46
PNF126, NC	100.00	1.53	100.00	1.57	0.15	100.00	0.30
PRK134, WI	100.00	1.61	100.00	1.65	0.07	100.00	0.87
PSU106, PA	100.00	1.55	100.00	1.30	0.06	100.00	0.25
QAK172, OH	60.00	127.05	77.42	15.60	13.88	98.94	0.90
ROM206, CO	90.82	9.80	90.82	6.58	2.22	89.11	5.30
SAL133, IN	100.00	0.74	100.00	0.98	0.07	100.00	1.14
SAN189, NE	100.00	0.99	100.00	0.51	0.04	100.00	0.21
SND152, AL	84.69	17.81	84.69	16.41	5.16	92.86	1.83
SPD111, TN	98.88	1.63	100.00	0.73	0.08	98.88	0.84
STK138, IL	93.65	8.96	93.65	7.87	3.53	94.62	1.72
SUM156, FL	100.00	1.56	100.00	1.54	0.14	100.00	0.24
UVL124, MI	96.84	2.07	97.89	2.11	0.44	100.00	0.39
VIN140, IN	100.00	4.63	100.00	4.37	0.10	98.94	0.67
VPI120, VA	100.00	0.91	100.00	0.84	0.11	100.00	0.82
WSP144, NJ	100.00	0.30	100.00	0.71	0.05	100.00	0.48
WST109, NH	100.00	4.90	100.00	5.21	0.11	98.94	0.70

Notes: [1] Percentage of comparisons that pass the criteria listed in Table 5. 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 5 are addressed in Table 9.

[3] 90% confidence limit of the coefficient of variation. This should be less than or equal to the 7% one point QC check critical criterion. Values exceeding this criterion are addressed in Table 9.

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

Table 14 AQS-Protocol Ozone QC Observations for Fourth Quarter 2011

Site ID	QC Criterion	Comments
ALC188, TX	% Zero Pass	There was a flow leak in one of the zero air canisters that lasted for approximately one week. Ambient data were not affected.
ARE128, PA	%Span, Span |%D |, % Single Point QC Pass, Single Point QC |%D|	The analyzer's sample pump failed affecting reported values for three weeks until the analyzer was replaced.
BWR139, MD	Span |%D |, Single Point QC |%D|, Single Point QC CL	The pressure transducer failed in the site analyzer.
CND125, NC	Span |%D |, Single Point QC |%D|, Single Point QC CL	The pressure transducer failed in the site analyzer.
CNT169, WY	%Span, Span |%D |, % Single Point QC Pass, Single Point QC |%D|, % Zero Pass	Ice formed in the sample and calibration gas lines.
COW137, NC	% Zero Pass	The zero air canisters were installed in incorrect order during October. Ambient data were not affected.
DCP114, OH	Span |%D |, Single Point QC |%D|, Single Point QC CL	The pressure transducer in the site analyzer was malfunctioning.
GAS153, GA	Span |%D |, Single Point QC |%D|	The analyzer's sample pump failed affecting reported values for three weeks until the analyzer was replaced.
HWF187, NY	Span |%D |	The zero air compressor was off for two weeks. Ambient data were not affected.
PAL190, TX	Span |%D |, Single Point QC |%D|, Single Point QC CL	The pressure transducer in the site analyzer was malfunctioning.
PAR107,WV	Span |%D |, Single Point QC |%D|, Single Point QC CL	The zero air canisters were disconnected for approximately one week. Ambient data were not affected.
QAK172, OH	%Span, Span |%D |, % Single Point QC Pass, Single Point QC |%D|, Single Point QC CL	The pressure transducer failed in the site analyzer.
ROM206, CO	Span |%D |, % Zero Pass	There was ice in the calibration gas line on several occasions. Ambient data were not affected.
SND152, AL	%Span, Span |%D |, % Single Point QC Pass, Single Point QC |%D|	The analyzer's sample pump failed affecting reported values for one week until it was replaced in mid-November. Then the zero air canisters were disconnected for approximately one week in late November.
STK138, IL	Span |%D |, Single Point QC |%D|	There was a flow leak in one of the zero air canisters that lasted for approximately one week. Ambient data were not affected.

Notes: %D = percent difference
CL = confidence limit

Table 15 Summary of Filter Blanks for 2011 (page 1 of 2)

Parameter Name	Detection Limit Total µg	Total Number	Number > Detection Limit	Average Total µg	Average Absolute Deviation	Maximum Total µg
FIELD BLANKS						
Teflon-NH_4^+-N	0.50	333	1	0.500	0.001	0.623
Teflon- NO_3^--N	0.20	296	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.00	296	0	1.000	0.000	1.000
Cl^-	0.50	290	0	0.500	0.000	0.500
Ca^{2+}	0.150	327	4	0.151	0.002	0.292
Mg^{2+}	0.075	327	0	0.075	0.000	0.075
Na^+	0.125	327	0	0.125	0.000	0.125
K^+	0.150	327	7	0.154	0.008	0.786
Nylon- NO_3^--N	0.20	294	0	0.200	0.000	0.200
Nylon - SO_4^{2-}	1.00	294	2	1.001	0.002	1.280
Cellulose - SO_4^{2-}	2.00	302	0	2.000	0.000	2.000
LABORATORY BLANKS						
Teflon-NH_4^+-N	0.50	104	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.20	102	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.00	102	0	1.000	0.000	1.000
Cl^-	0.50	102	0	0.500	0.000	0.500
Ca^{2+}	0.150	104	1	0.152	0.004	0.383
Mg^{2+}	0.075	104	0	0.075	0.000	0.075
Na^+	0.125	104	1	0.125	0.000	0.140
K^+	0.150	104	0	0.150	0.000	0.150
Nylon- NO_3^--N	0.20	100	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.00	100	0	1.000	0.000	1.000
Cellulose -SO_4^{2-}	2.00	102	0	2.000	0.000	2.000
METHOD BLANKS						
Teflon-NH_4^+-N	0.50	66	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.20	65	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.00	65	0	1.000	0.000	1.000
Cl^-	0.50	65	0	0.500	0.000	0.500
Ca^{2+}	0.150	66	0	0.150	0.000	0.150
Mg^{2+}	0.075	66	0	0.075	0.000	0.075
Na^+	0.125	66	0	0.125	0.000	0.125
K^+	0.150	66	0	0.150	0.000	0.150
Nylon- NO_3^--N	0.20	62	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.00	62	0	1.000	0.000	1.000
Cellulose -SO_4^{2-}	2.00	84	0	2.000	0.000	2.000

Table 15 Summary of Filter Blanks for 2011 (page 2 of 2)

Parameter Name	Detection Limit Total µg	Total Number	Number > Detection Limit	Average Total µg	Average Absolute Deviation	Maximum Total µg
ACCEPTANCE TEST VALUES						
Teflon-NH_4^+-N	0.50	216	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.20	216	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.00	216	0	1.000	0.000	1.000
Cl^-	0.50	216	0	0.500	0.000	0.500
Ca^{2+}	0.150	216	0	0.150	0.000	0.150
Mg^{2+}	0.075	216	0	0.075	0.000	0.075
Na^+	0.125	216	0	0.125	0.000	0.125
K^+	0.150	216	0	0.150	0.000	0.150
Nylon- NO_3^--N	0.20	220	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.00	220	0	1.000	0.000	1.000
Cellulose -SO_4^{2-}	2.00	288	0	2.000	0.000	2.000

Note: Cellulose filters are not analyzed for ambient NO_3^-. The blank results are used only for QC.

Table 16 Filter Packs Flagged as Suspect or Invalid

Site ID	Sample	Reason
First Quarter 2011		
ALC188, TX	1106001-03	Polling problems
ARE128, PA	1104001-06	Polling problems
	1105001-06	Polling problems
BEL116, MD	1104001-09	Power outage
	1108001-09	Polling problems
CAD150, AR	1107001-13	Polling problems
CNT169, WY	1106001-22	Polling problems
CVL151, MS	1107001-25	Polling problems
EGB181, ON	1109001-28	Polling problems
ESP127, TN	1104001-29	Polling problems
GLR468, MT	1106001-32	Insufficient flow
JOT403, CA	1108001-41	Insufficient flow
OXF122, OH	1105001-52	Polling problems
	1106001-52	Polling problems
QAK172, OH	1105001-62	Polling problems
SHN418, VA	1104001-68	Insufficient flow
STK138, IL	1105001-71	Data logger power problems
VPI120, VA	1109001-77	Polling problems
WNC429, SD	1105001-78	Insufficient flow
	1108001-78	Insufficient flow
	1110001-78	Insufficient flow
Second Quarter 2011		
ABT147, CT	1114001-01	Polling problems
ALC188, TX	1115001-03	Insufficient flow
BBE401, TX	1115001-08	Suspect potassium value
BEL116, MD	1116001-09	Polling problems
	1119001-09	Polling problems
	1121001-09	Polling problems
	1123001-09	Polling problems
BFT142, NC	1118001-10	Insufficient flow
CNT169, WY	1119001-22	Polling problems
GRC474, AZ	1123001-34	Insufficient flow
GRS420, TN	1117001-35	Insufficient flow
HOW132, ME	1122001-37	Insufficient flow

Site ID	Sample	Reason
Second Quarter 2011 (continued)		
HWF187, NY	1120001-39	Insufficient flow
JOT403, CA	1116001-41	Insufficient flow
	1117001-41	Insufficient flow
	1119001-41	Insufficient flow
LRL117, PA	1114001-45	Insufficient flow
OXF122, OH	1119001-52	Insufficient flow
PND165, WY	1117001-58	Polling problems
SHN418, VA	1120001-68	Insufficient flow
SND152, AL	1117001-69	Polling problems
YEL408, WY	1121001-81	Insufficient flow
Third Quarter 2011		
ABT147, CT	1130001-01	Polling problem
BEL116, MD	1130001-09	Insufficient flow*
CHA467, NM	1127001-18	Power failure
CKT136, KY	1128001-20	Flow channel down
	1129001-20	Flow channel down
CNT169, WY	1128001-22	Flow channel down
EVE419, FL	1129001-30	Missing flow data
	1130001-30	Missing flow data
	1131001-30	Missing flow data
GLR468, MT	1127001-32	Missing flow data
GRB411, NV	1129001-33	Suspect data
MCK131, KY	1130001-47	Insufficient flow
MCK231, KY	1130001-48	Insufficient flow
	1131001-48	Insufficient flow
OXF122, OH	1128001-52	Insufficient flow
Fourth Quarter 2011		
CKT136, KY	1140001-20	Polling problems
	1143001-20	Flow channel down
	1145001-20	Flow channel down
CNT169, WY	1143001-22	Power outage
	1145001-22	Power outage
GRB411, NV	1142001-33	Insufficient flow
SAL133, IN	1148001-65	Power outage
WSP144, NJ	1143001-79	Power outage

Table 17 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
First Quarter 2011	
30	97
60	7
90	0
Unresolved by End of Quarter	10
Second Quarter 2011	
30	161
60	3
90	0
Unresolved by End of Quarter	33
Third Quarter 2011	
30	160
60	14
90	0
Unresolved by End of Quarter	23
Fourth Quarter 2011	
30	154
60	4
90	1
Unresolved by Date of Publication	16

Table 18 Field Calibration Failures by Parameter for 2011

Site ID	Parameter(s)
First Quarter 2011	
ALH157, IL	Flow Rate
BEL116, MD	Wind Direction
BVL130, IL	Solar Radiation
COW137, NC	Temperature
OXF122, OH	Temperature
Second Quarter 2011	
BVL130, IL	Ozone
CNT169, WY	Flow Rate
GTH161, CO	Flow Rate
MKG113, PA	Flow Rate
PAR107, WV	Flow Rate
PND165, WY	Flow Rate
Third Quarter 2011	
SUM156, FL	Temperature
PRK134, WI	Flow Rate
Fourth Quarter 2011	
CNT169, WY	Flow Rate
GTH161, CO	Flow Rate
PAL190, TX	Wind Direction
SUM156, FL	Temperature

Note: Per CASTNET project protocols, data for all parameters except flow are flagged as "suspect" (S) but still considered valid if the calibration criterion is not exceeded by more that its magnitude (i.e., if within 2x the criterion). If flow calibrations fall within 2x the criteria, these data are adjusted per approved protocol described in the CASTNET QAPP, Revision 7.0 (MACTEC Engineering and Consulting, Inc., now known as AMEC, 2011). Please refer to Table 13 for documentation of the QC failures affecting the validity of AQS-protocol ozone data. .

Table 19 Accuracy Results for 2011 Field Measurements

Parameter	Percent Within Criterion
Flow Rate	90.9
Ozone Slope	97.0
Ozone Intercept	100.0
Wind Speed < 5 m/s	100.0
Wind Speed ≥ 5 m/s	100.0
Wind Direction North	87.5*
Wind Direction South	100.0
Temperature (0°C)	100.0
Temperature (ambient)	97.1
Delta Temperature (0°C)	100.0
Delta Temperature (ambient)	100.0
Relative Humidity	100.0
Precipitation	100.0
Solar Radiation	87.5*
Wetness (w/in 0.5 volts)	100.0

Notes: °C = degrees Celsius.
m/s = meters per second.
* = Per CASTNET project protocols, data are flagged as "suspect" (S) but still considered valid if the calibration criterion is not exceeded by more than its magnitude (i.e., if within 2x the criterion). All calibration failures reported in 2011 for the indicated parameters were within 2x the criterion.

Figure 1 Reference Standard Results for Fourth Quarter 2011 (percent recovery)

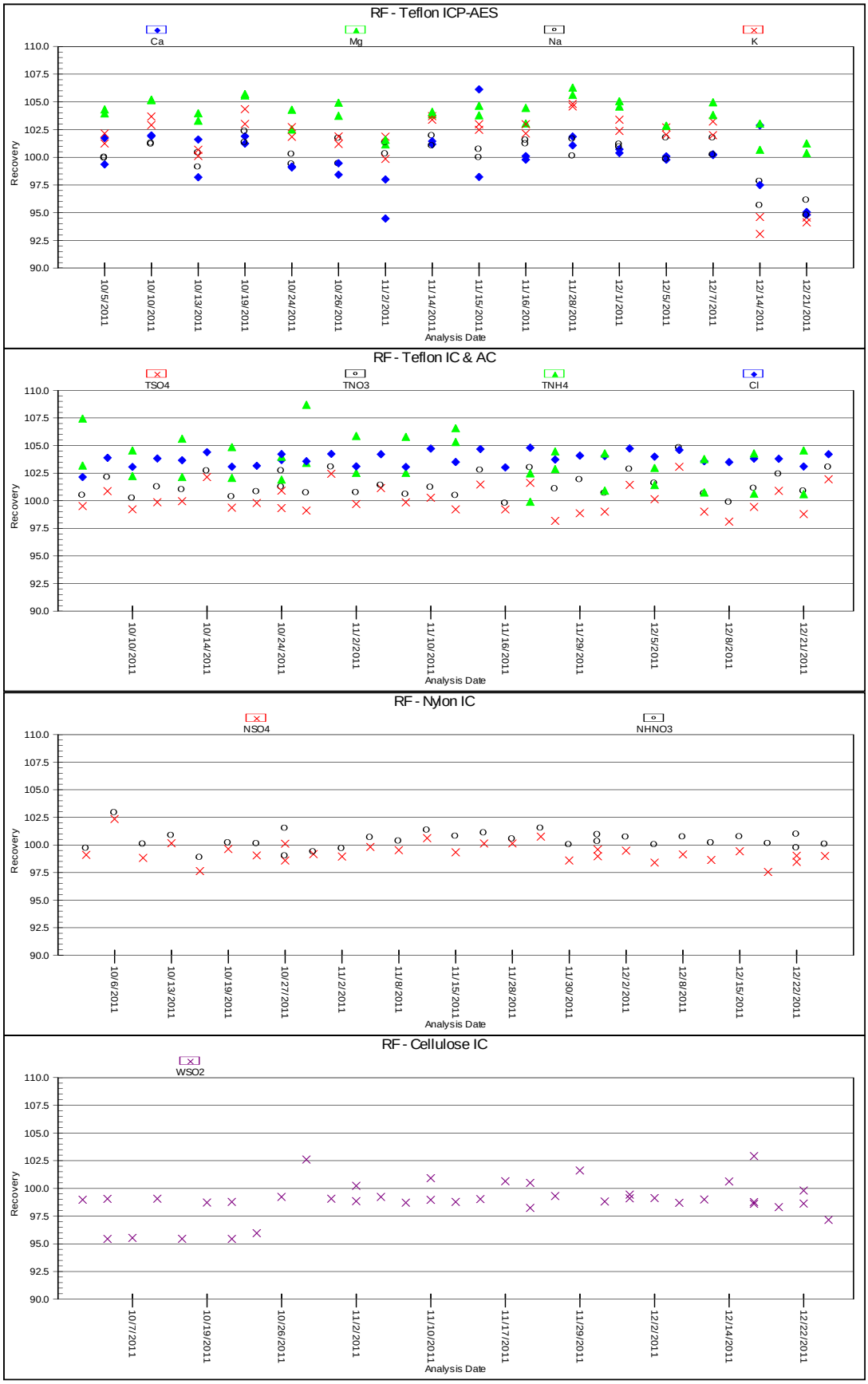


Figure 2 Continuing Calibration Spike Results for Fourth Quarter 2011 (percent recovery)

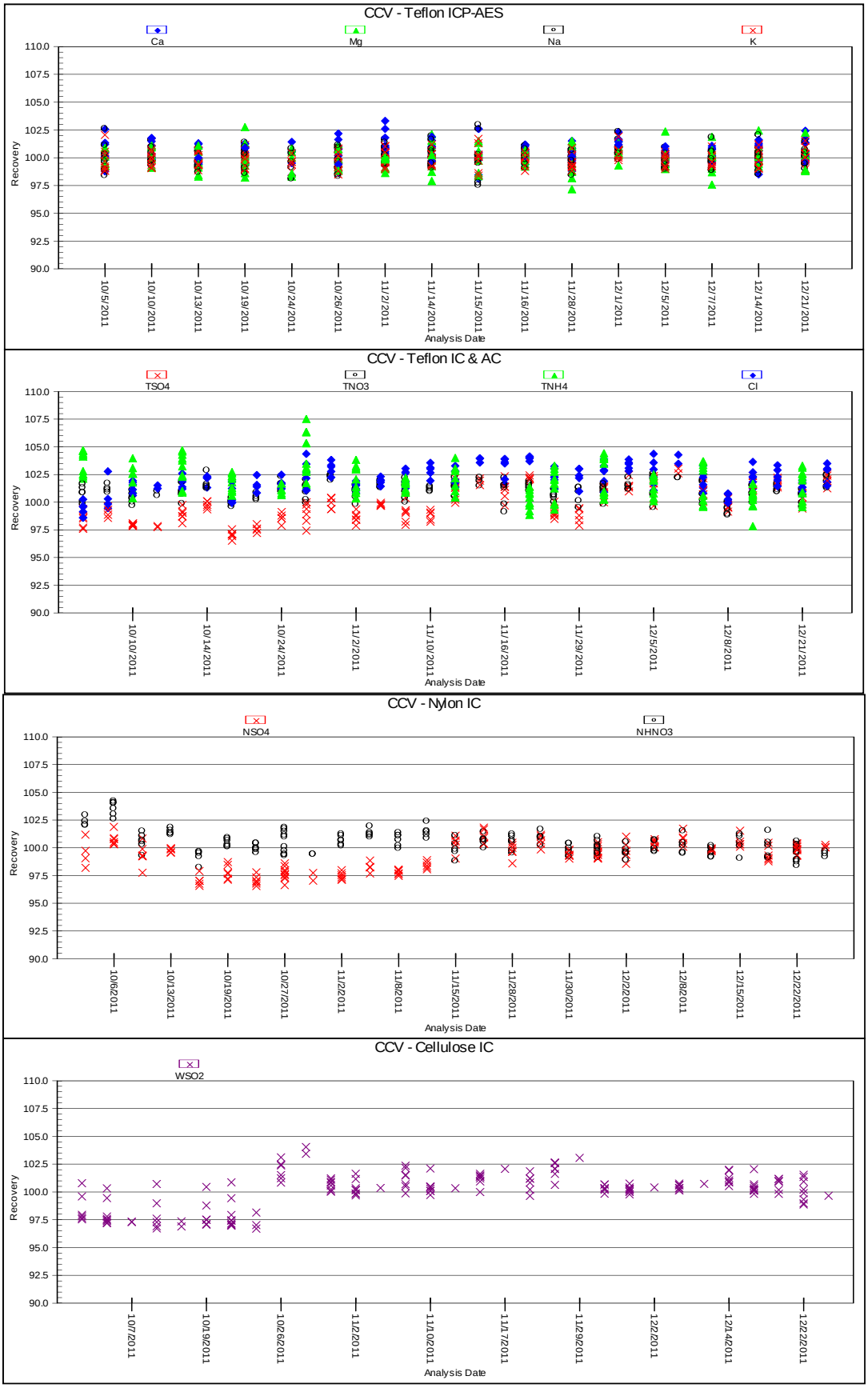


Figure 3 Replicate Sample Analysis Results for Fourth Quarter 2011 (percent difference)

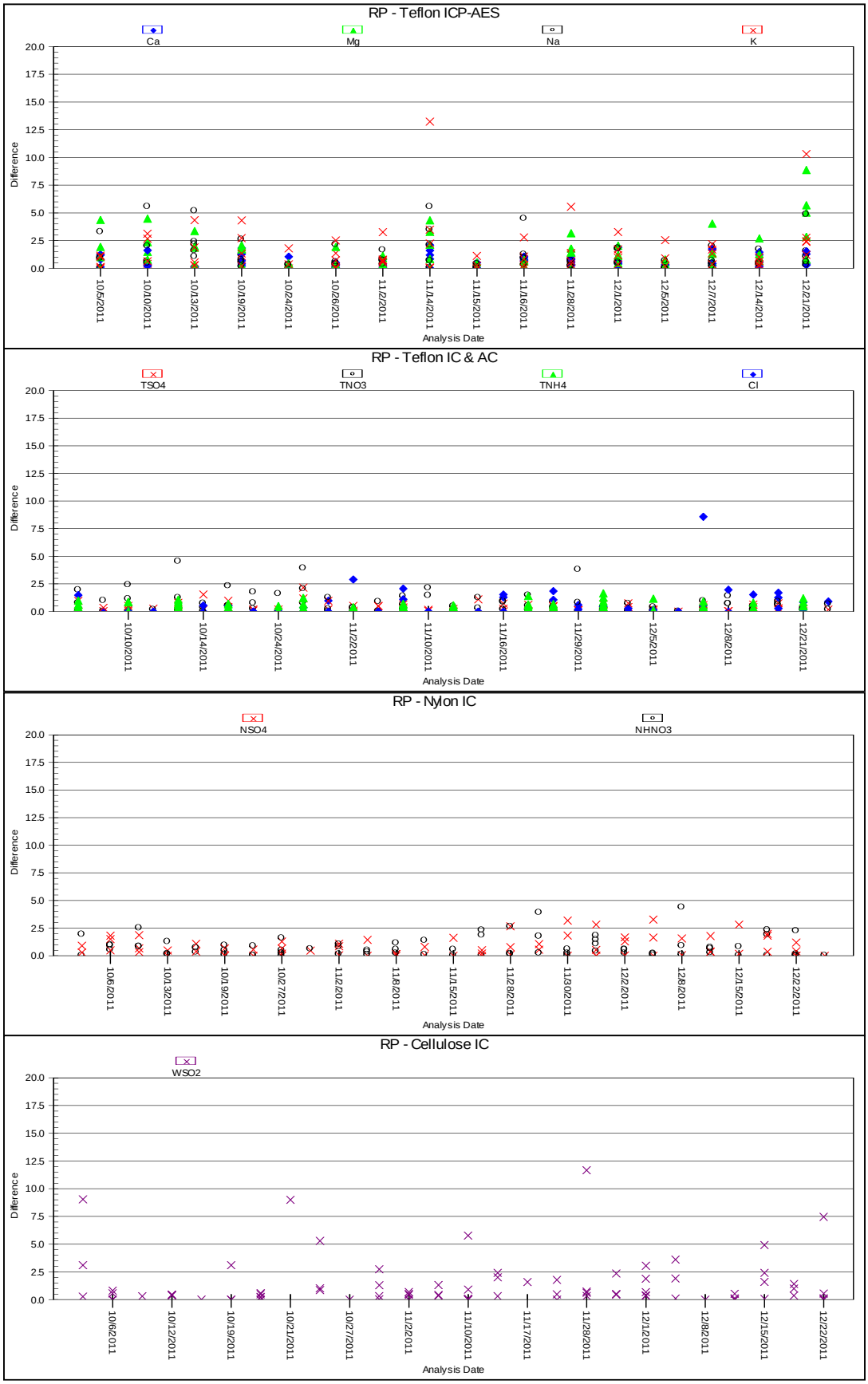
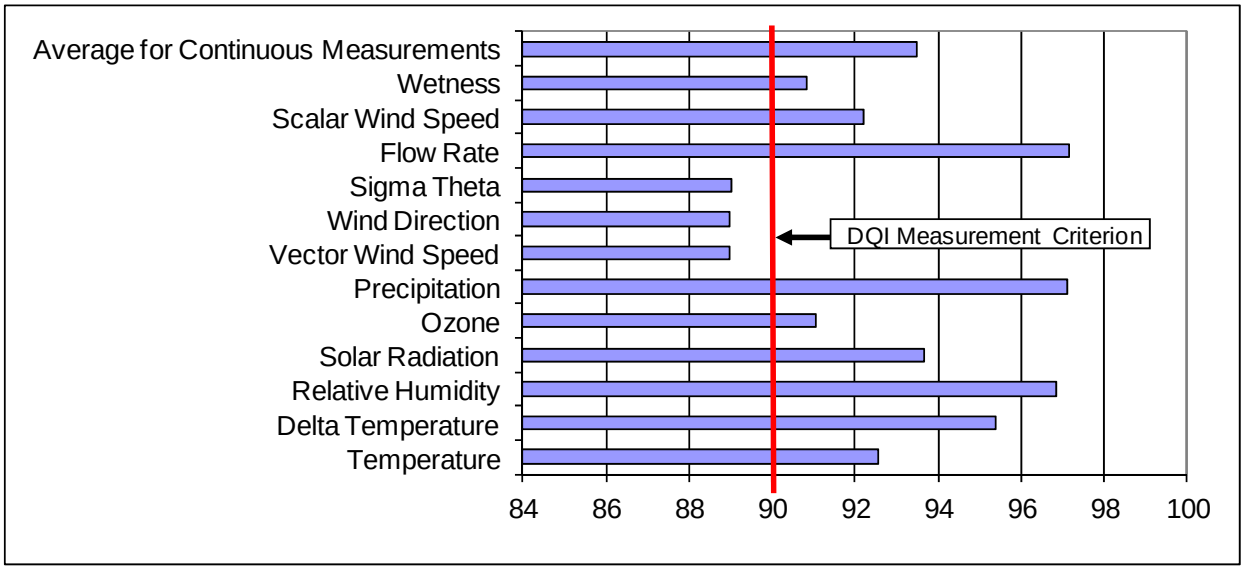
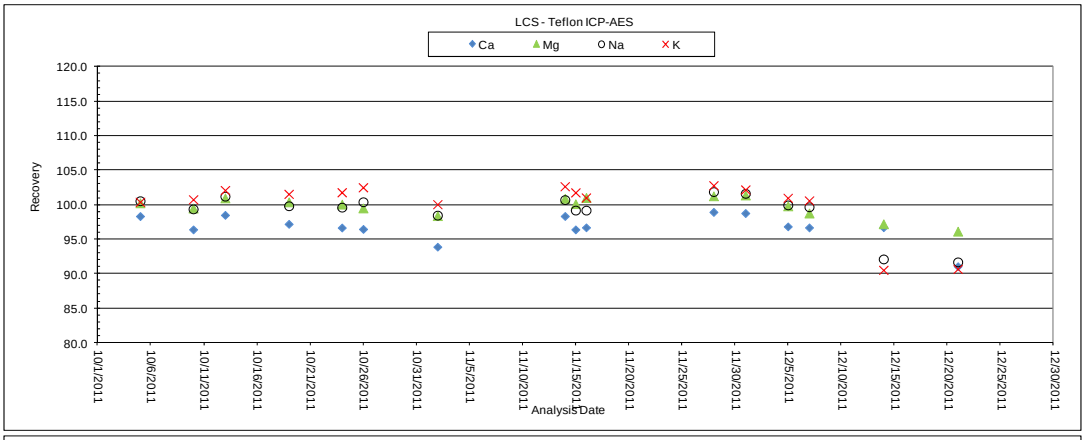


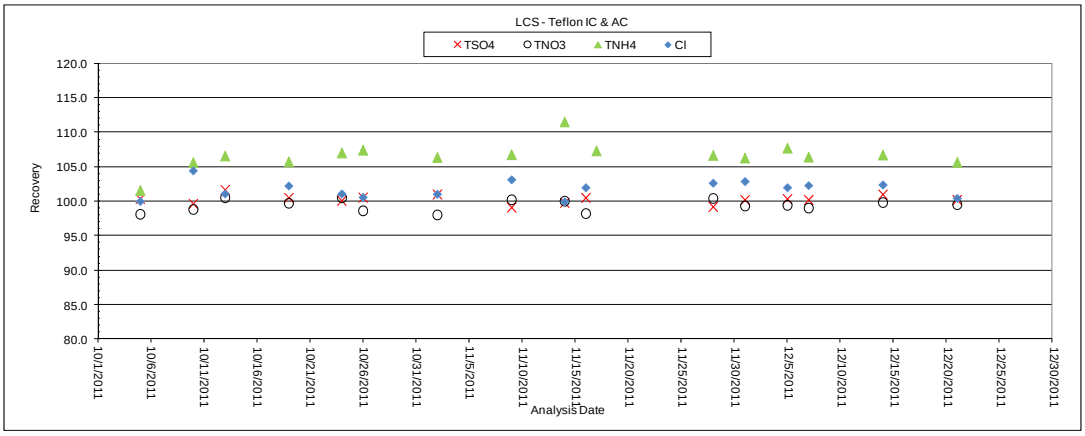
Figure 4 Percent Completeness of Measurements for Fourth Quarter 2010 through Fourth Quarter 2011*

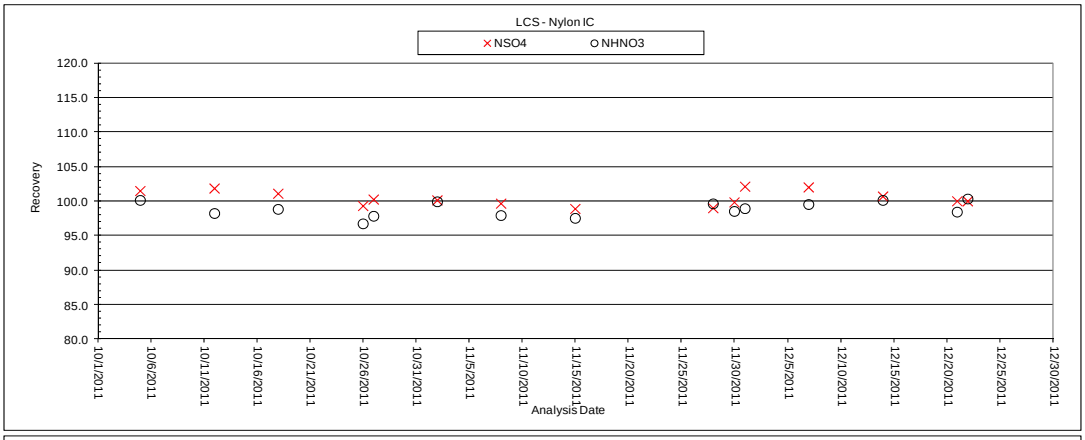


Note: *Presents Level 3 data available during the fourth quarter of 2011.

Figure 5 Laboratory Control Sample Results for Fourth Quarter 2011 (percent recovery)







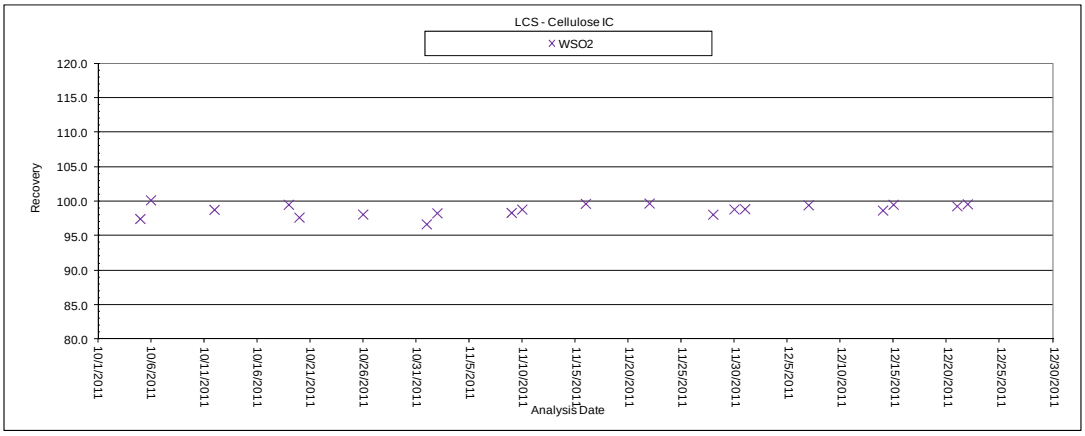


Figure 6 Method Blank Analysis Results for Fourth Quarter 2011 (total micrograms)

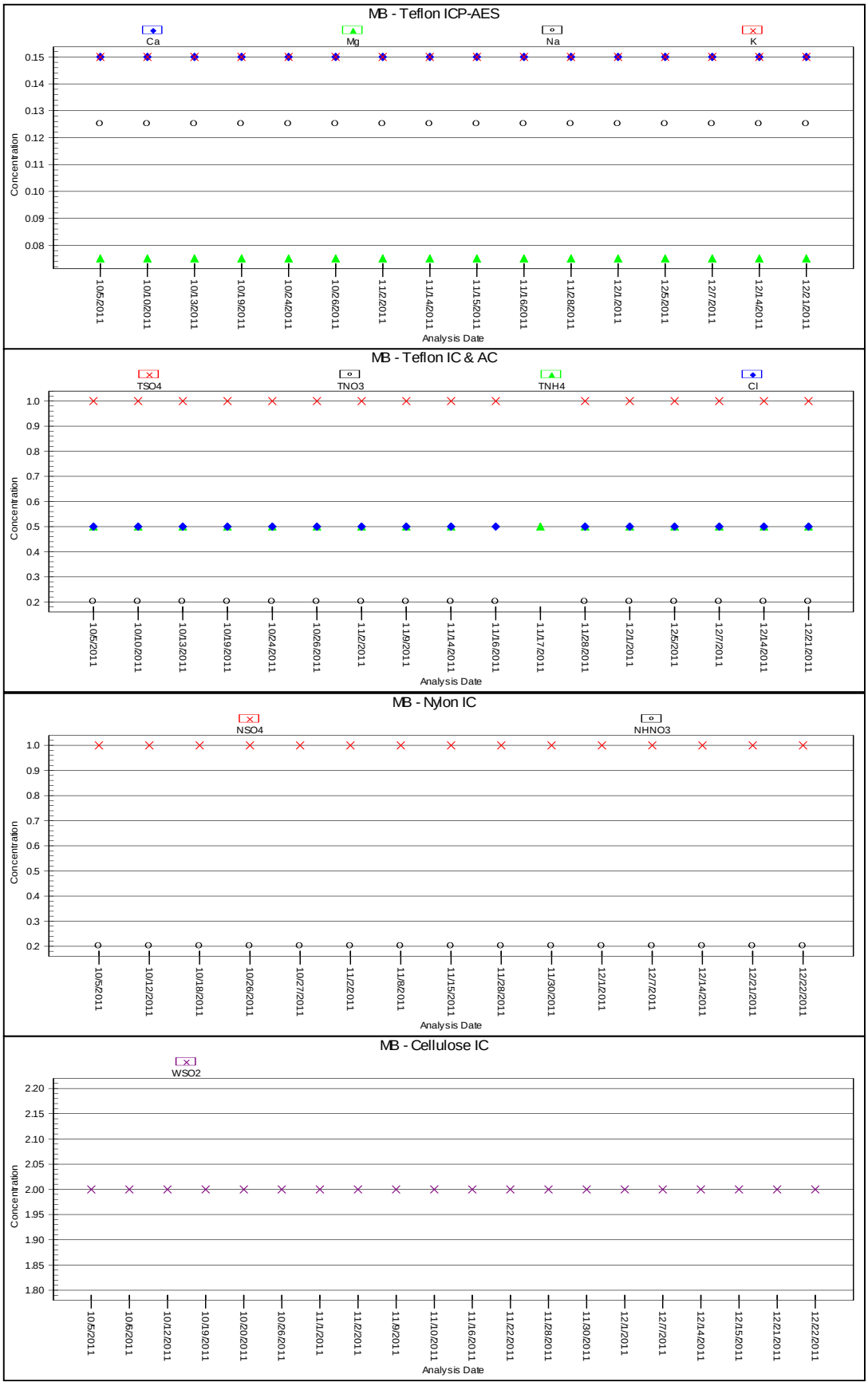


Figure 7 Laboratory Blank Analysis Results for Fourth Quarter 2011 (total micrograms)

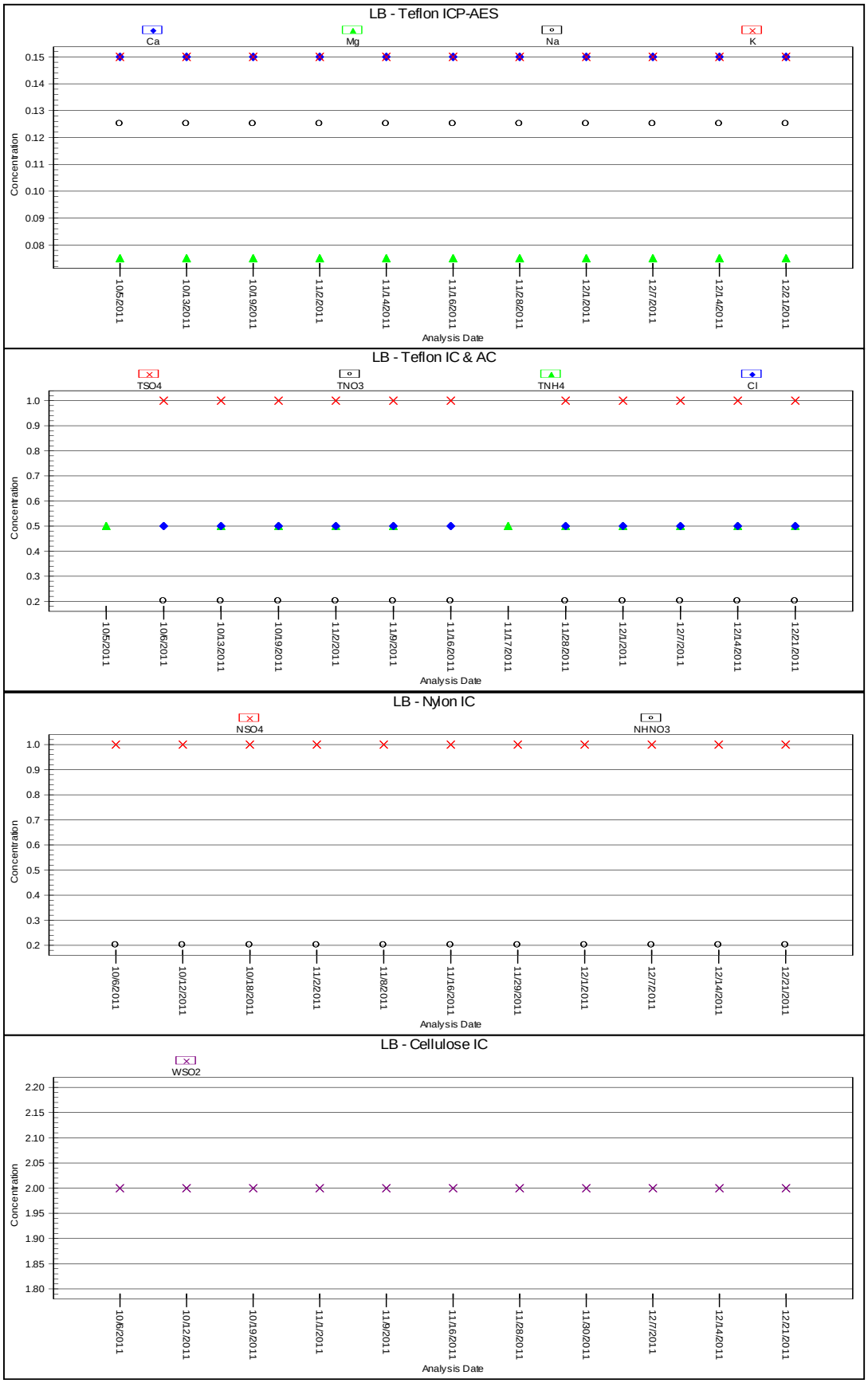


Figure 8 Field Blank Analysis Results for Fourth Quarter 2011 (total micrograms)