Summary of Quarterly Operations
July – September 2009

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 2009. The results presented for filter pack data collection and field calibrations are generated from data extracted from the CASTNET Data Management Center (DMC) database using the CASTNET Data Management System Application (CDMSA). 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.

During July 2009, an internal change order system that stipulates planning and notification requirements and utilization of a master list of resources was implemented in response to an ad hoc data logger programming change that had not been reviewed and approved by management. The internal change order system provides a framework for management and non-management staff to utilize when determining what steps to take, what questions to ask, and the effects that may occur with the introduction of a new component or system.

An audit of CASTNET site calibration and repair procedures at MACTEC's office in Gainesville, FL took place during July 2009. The audit verified that preparations prior to a technician's departure to the site are performed according to standard operating procedures (SOPs). The documentation needed was checked and verified, as were the calibration kit parts and equipment, parts and equipment inventory list, procedure list, and notification of special tasks required at the site, including the necessary parts needed for the special tasks. Additional preparatory tasks such as the sending of notification letters to the site operators and shipment of parts needed to the site were also verified.

After analysis and final data reporting are completed, current procedures for post-analysis storage of filter concentrations are to refrigerate the samples for one year and then move the samples to ambient temperature storage. During third quarter 2009, the cooler failed in the auxiliary cold room where samples are stored after analysis and final data reporting approximately six months after receipt. The samples reached ambient temperature. The exact date of failure is unknown because the auxiliary cold room had not been included in the routine temperature verification schedule. After proper cold room function had been restored and samples were again at 2 - 6 degrees Celsius, three of the oldest samples from the Beltsville, MD (BEL116) site were reanalyzed. The reanalysis indicated that the samples had not changed and were stable. A corrective action was initiated to ensure adequate monitoring of this cold room in the future.

Safety-related findings were noted during an external audit at the Bondville, IL (BVL130) site. A bolt that secures the meteorological tower was missing. Additionally, two receptacle covers were missing from outlets inside the shelter. MACTEC shipped the missing parts immediately after notification by the auditor. The site operator installed the parts during the next site visit.

A general safety audit was conducted at the Sumatra, FL (SUM156) site by MACTEC's Gainesville, FL Health and Safety Officer. The site passed the audit. No unsafe working conditions were noted.

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

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 5 presents the number of analyses in each category that were performed during this quarter.

Sample Receipt Statistics

For the CASTNET III project, which began on July 30, 2003, EPA requires that 95 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 6 presents the relevant sample receipt statistics for third quarter 2009.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for third quarter 2009. All results were within the criteria listed in Table 4 with the exception of several individual RP results. However, these are considered reasonable since higher relative percent differences generally correlate with lower sample concentrations. Quarterly averages are all within criteria.

Figure 4 presents completeness statistics for continuous measurements validated to Level 3 during the quarter. All parameters met the 90 percent criterion.

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. These limits may change as data are collected and analyzed. Figure 5 presents LCS analysis results for third quarter 2009.

Blank Results

Figures 6 through 8 present the results of MB, LB, and FB QC sample analyses for third quarter 2009. All results were within criteria (two times the reporting limit) listed in Table 4 with the exception of one Teflon filter FB result. All values were less than four times the reporting limit. No systemic problems were indicated upon review.

Suspect/Invalid Filter Pack Samples

Five filter pack samples were invalidated. Three were invalidated due to insufficient flow volume, one due to polling problems, and another due to site damage caused by a lightning strike. Data for nearly all samples may be recovered during Level 3 validation. The samples and associated site identification are presented in Table 7.

Field Problem Count

Table 8 presents counts of field problems affecting continuous data collection during third quarter 2009. 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. The time period does not correlate with the quantity of data affected. For example, if a 5-hour block of missing data takes 60 days to replace, it will show up in the 60-day category. By the same token, a site missing 200 hours of data due to the damage caused by a lightning strike will show up in the 30-day category if the site is repaired within 30 days, even though the data cannot be replaced.

Field Calibration Results

Calibrations were performed at 29 sites during third quarter 2009. All sites and parameters were within the criteria listed in Table 3 with the exception of the parameters at the 12 sites that are listed in Table 9.

Tables and Figures

Table 1. Data Validated to Level 3 during Third Quarter 2009

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	November 2008 – April 2009	6	Quarter 1 2009	1
SE-4/MW-6‡	January 2009 – June 2009	6	Quarter 1 2009 – Quarter 2 2009	2

Note: * 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

Calibration Group Number	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 (19 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 (5 Sites)	April/October	SAL133, IN HOX148, MI	ANA115, MI UVL124, MI	LYK123, OH	
Western Sites (10 Total)					
W-9 (4 Sites)	March/September	KNZ184, KS CHE185, OK	SAN189, NE ALC188, TX		
W-10 (6 Sites)	May/November	CON186, CA PAL190, TX	GTH161, CO ROM206, CO	CNT169, WY PND165, WY	

Table 3. Data Quality Indicators for CASTNET Continuous Measurements

Measurement		Criteria*	
Parameter	**Method**	**Precision**	**Accuracy**
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
Relative humidity	Thin film capacitor	± 10% (of full scale)	± 10%
Solar radiation	Pyranometer	± 10% (of reading taken at local noon)	± 10%
Precipitation	Tipping bucket rain gauge	± 10% (of reading)	± 0.05 inch†
Ambient temperature	Platinum RTD	± 1.0°C	± 0.5°C
Delta temperature	Platinum RTD	± 0.5°C	± 0.5°C
Ozone	UV absorbance	± 10% (of reading)	± 10%
Filter pack flow	Mass flow controller	± 10%	± 5%
Surface wetness	Conductivity bridge	Undefined	Undefined

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

* Precision criteria apply to collocated instruments, and accuracy criteria apply to calibration of instruments
† For target value of 0.50 inch

Table 4. Data Quality Indicators for CASTNET Laboratory Measurements

Analyte	Medium	Method	Precision[1] (MARPD)	Accuracy[2] (%)	Nominal Reporting Limits	
					mg/L	µg/Filter
Ammonium (NH_4^+)	F	AC	10	90 - 110	0.020 *	0.5
Sodium (Na^+)	F	ICP-AES	5	95 - 105	0.005	0.125
Potassium (K^+)	F	ICP-AES	5	95 - 105	0.006	0.15
Magnesium (Mg^{2+})	F	ICP-AES	5	95 - 105	0.003	0.075
Calcium (Ca^{2+})	F	ICP-AES	5	95 - 105	0.006	0.15
Chloride (Cl^-)	F	IC	5	95 - 105	0.020	0.5
Nitrate (NO_3^-)	F	IC	5	95 - 105	0.008 *	0.2
Sulfate (SO_4^{2-})	F	IC	5	95 - 105	0.040	1.0

Note: [1] This column lists precision goals for both network precision calculated from collocated filter samples and laboratory precision based on replicate samples. The goal for the ICP-AES precision RPD criterion changed from 10 percent to 5 percent at the onset of the CASTNET III contract beginning on July 30, 2003. The precision criterion is applied as described below:

QC conditions: (v1 = initial response; v2 = replicate response; RL = nominal reporting limit)

Condition 1: if (v1 or v2 < RL and the absolute value of (v1 – v2) < RL) = OK

Condition 2: if (v1-v2) < RL and v1 < 5 x RL) = OK

Condition 3: if (v1 > 5*RL and RPD < 5%) = OK

Status: one of the conditions is OK = Precision QC Passes

[2] This column lists laboratory accuracy goals based on reference standards and continuing calibration verification spikes. The goal for the ICP-AES accuracy criterion changed from 90-110 percent to 95-105 percent for continuing calibration verification spikes at the onset of the CASTNET III contract beginning on July 30, 2003. The criterion remains 90-110 percent for ICP-AES reference standards.

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

For more information on analytical methods and associated precision and accuracy criteria, see the CASTNET QAPP, Revision 4.1 (MACTEC, 2008).

Table 5. QC Analysis Count for Third Quarter 2009

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-}	39	184	81	17	26	95
	NO_3^-	39	184	81	17	26	95
	NH_4^+	37	189	88	18	26	85
	Cl^-	39	184	81	17	26	95
	Ca^{2+}	34	172	78	16	26	83
	Mg^{2+}	34	172	78	16	26	83
	Na^+	34	172	78	16	26	83
	K^+	34	172	78	16	26	83
Nylon	SO_4^{2-}	32	168	77	16	26	119
	NO_3^-	32	168	77	16	26	119
Cellulose	SO_4^{2-}	46	182	87	23	26	86

Table 6. Filter Pack Receipt Summary

Count of samples received more than 14 days after removal from tower:	7
Count of all samples received:	758
Fraction of samples received within 14 days:	0.991
Average interval in days:	4.055
First receipt date:	07/01/2009
Last receipt date:	09/28/2009

Table 7. Filter Packs Flagged as Suspect or Invalid

Site ID	Sample ID	Reason
ABT147, CT	0928001-01	Flow volume
ARE128, PA	0930001-06	Lightning strike
CHE185, OK	0928001-19	Polling problems
CON186, CA	0928001-23	Flow volume
EVE419, FL	0928001-31	Flow volume

Table 8. Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	99
60	6
90	0
Unresolved by date of publication	2

Note: Counts were extracted using the problem tracking system (PTS) feature of the CDMSA. Problems requiring corrective action are flagged by field personnel with a ticket number.

Table 9. Field Calibration Failures by Parameter

Site ID	Parameter(s)
ARE128, PA	Wind Direction
BEL116, MD	Wind Speed
BWR139, MD	Wind Direction
CHE185, OK	Wind Direction
CKT136, KY	Relative Humidity Flow Rate
CND125, NC	Temperature Delta Temperature Solar Radiation Ozone
KNZ184, KS	Wind Direction
PED108, VA	Solar Radiation
PRK134, WI	Solar Radiation
QAK172, OH	Wind Direction
SAN189, NE	Precipitation
SPD111, TN	Relative Humidity

Note: Per CASTNET project protocols, data 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 ozone or flow calibrations fall within 2x the criteria, these data are adjusted per approved protocol described in the CASTNET QAPP, Revision 4.1 (MACTEC, 2008).

Figure 1. Reference Standard Results for Third Quarter 2009 (percent recovery)

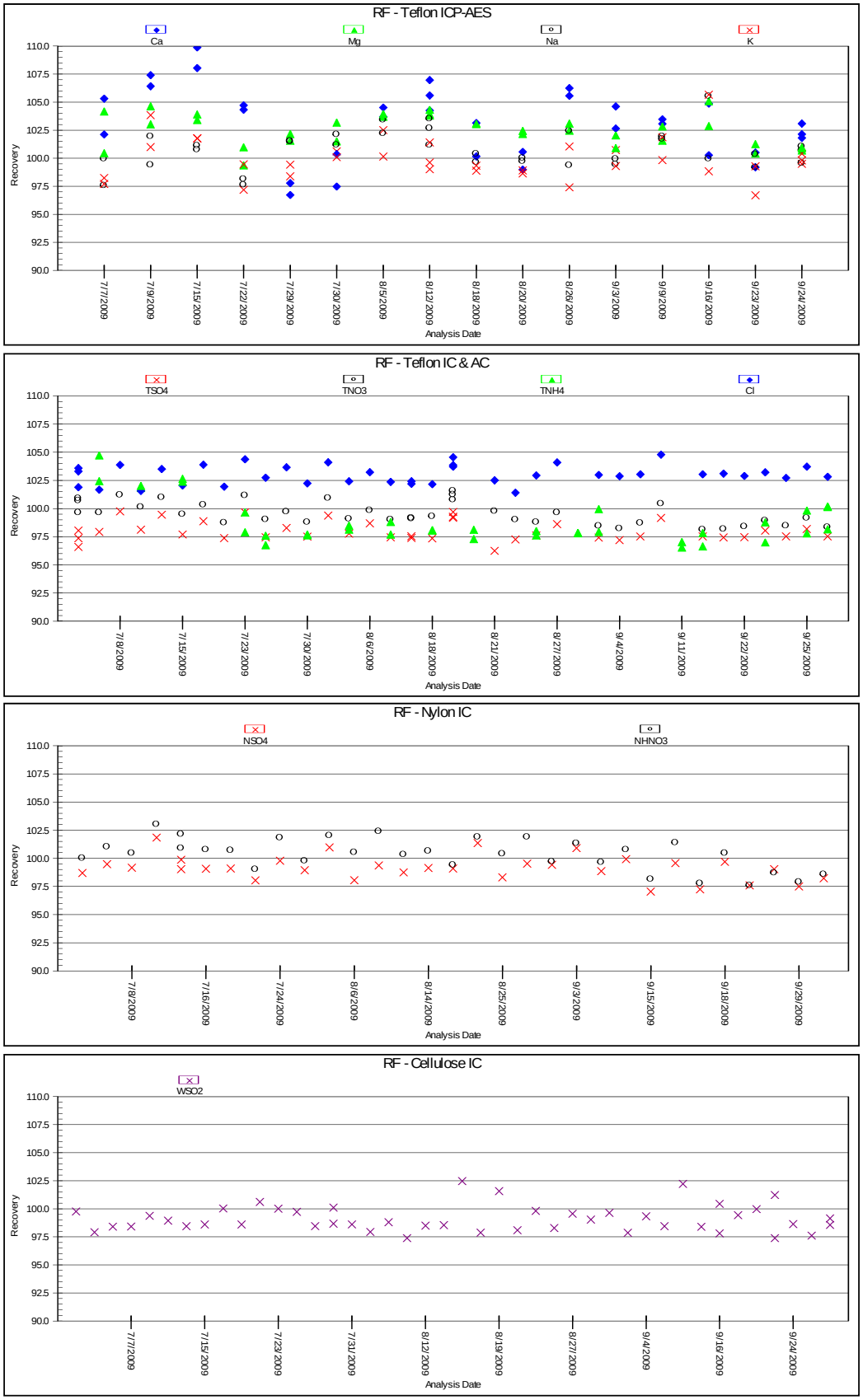


Figure 2. Continuing Calibration Spike Results for Third Quarter 2009 (percent recovery)

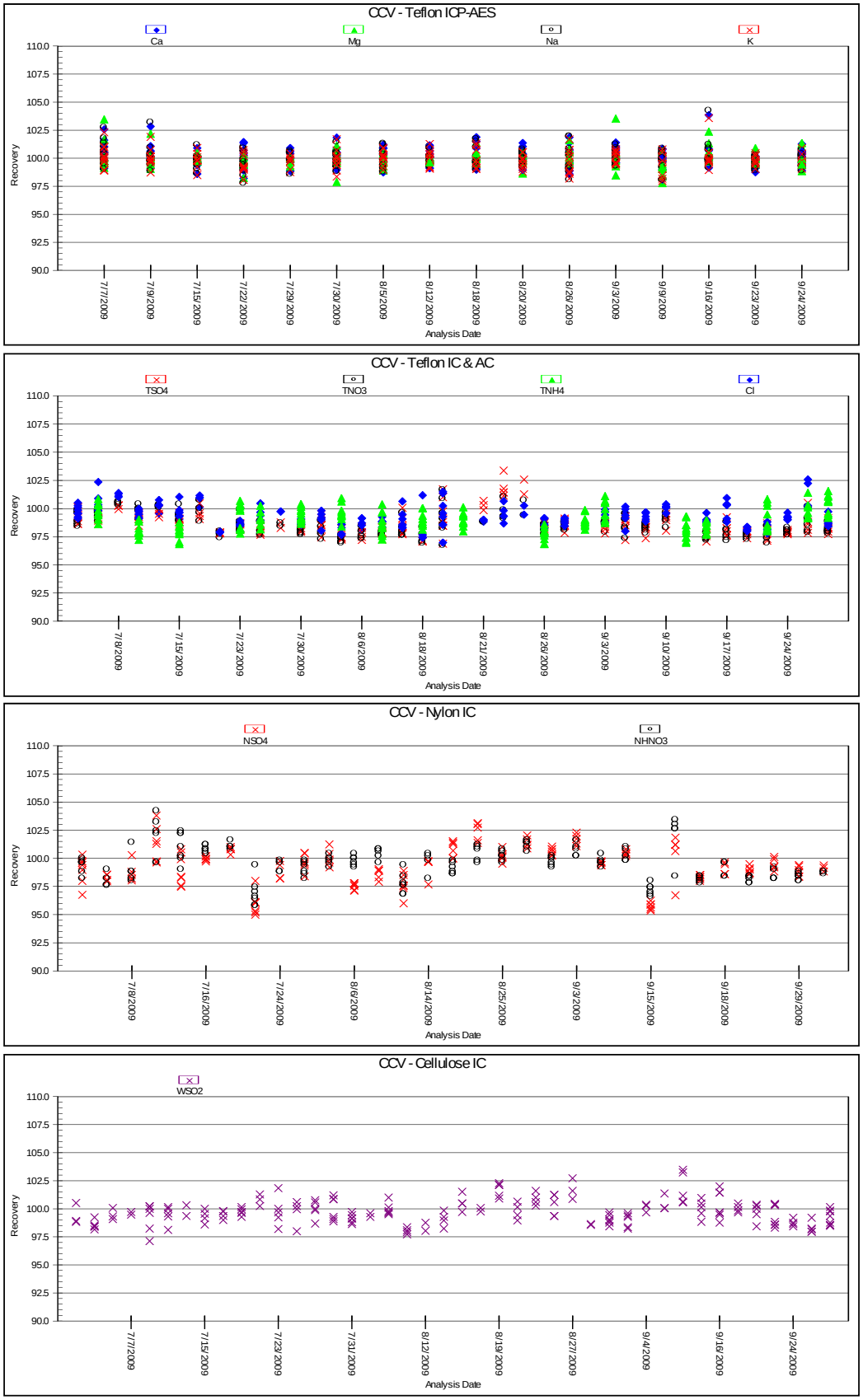


Figure 3. Replicate Sample Analysis Results for Third Quarter 2009 (total micrograms)

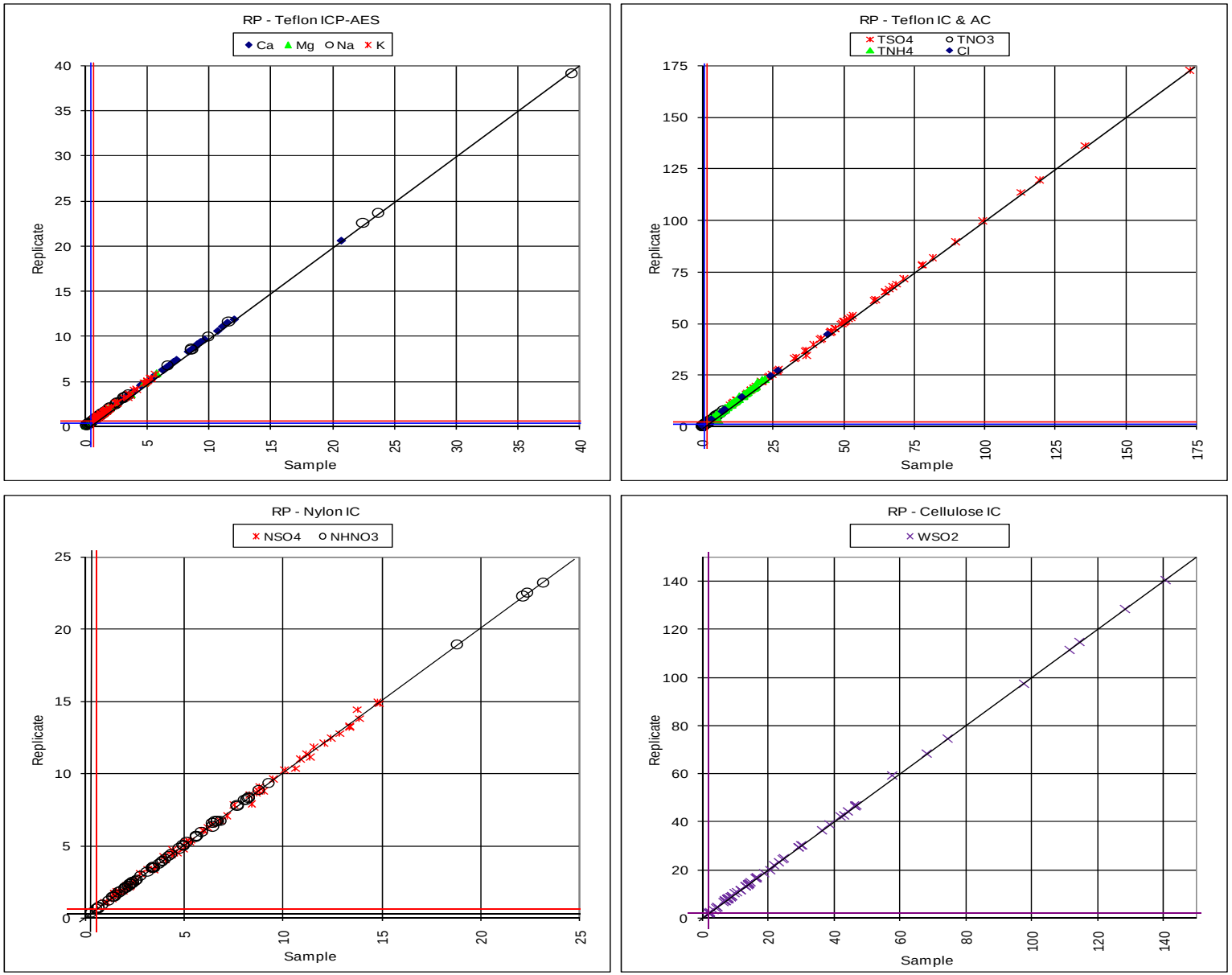
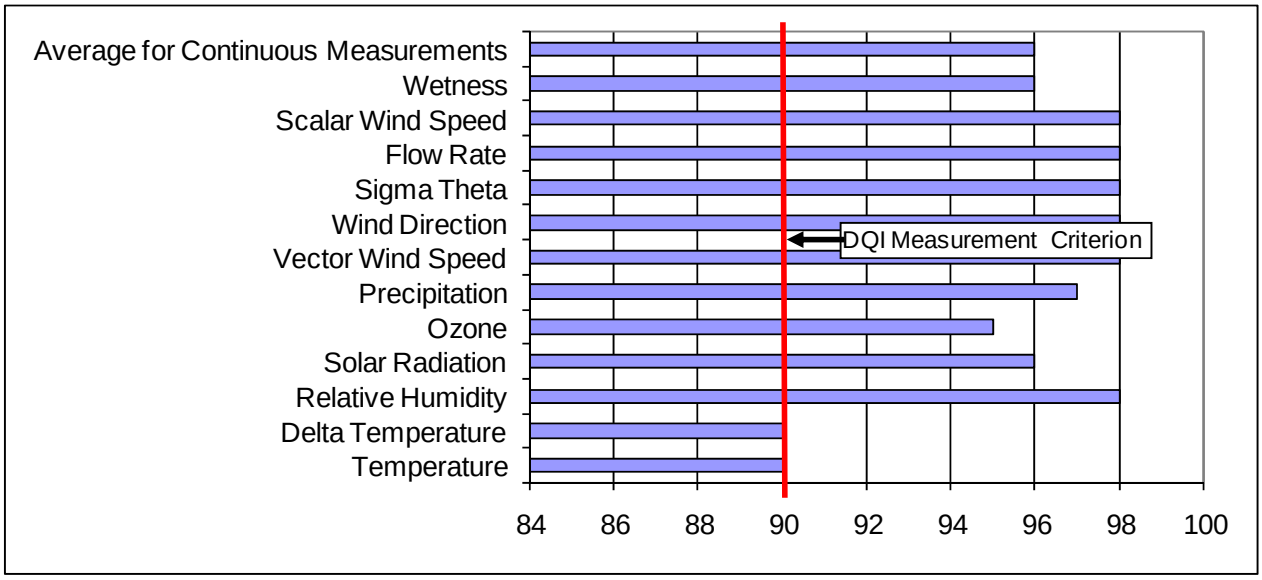


Figure 4. Percent Completeness of Measurements for Fourth Quarter 2008 through Third Quarter 2009*



Note: *Presents Level 3 data available during the third quarter of 2009.

Figure 5. Laboratory Control Sample Results for Third Quarter 2009 (percent recovery)

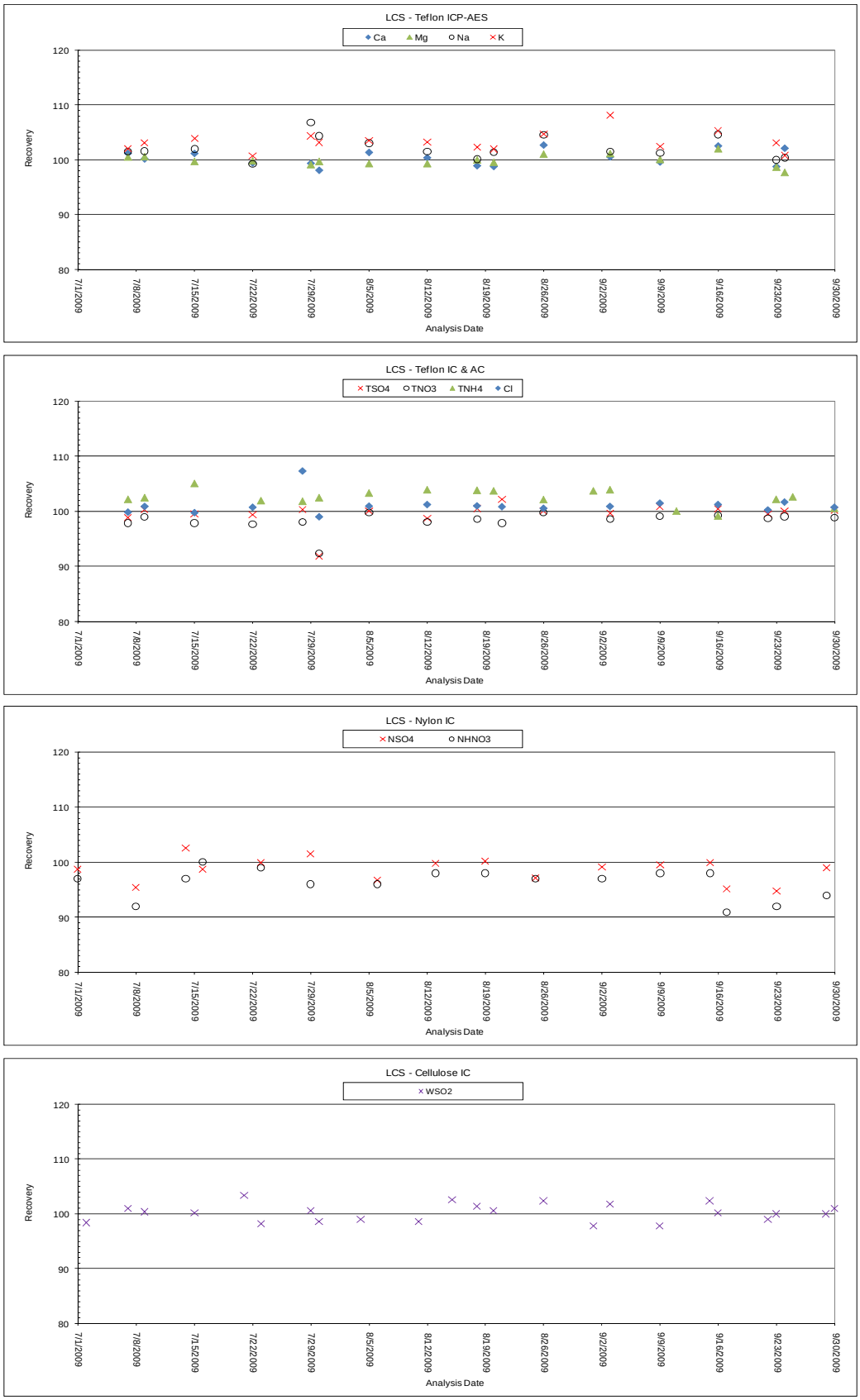


Figure 6. Method Blank Analysis Results for Third Quarter 2009 (total micrograms)

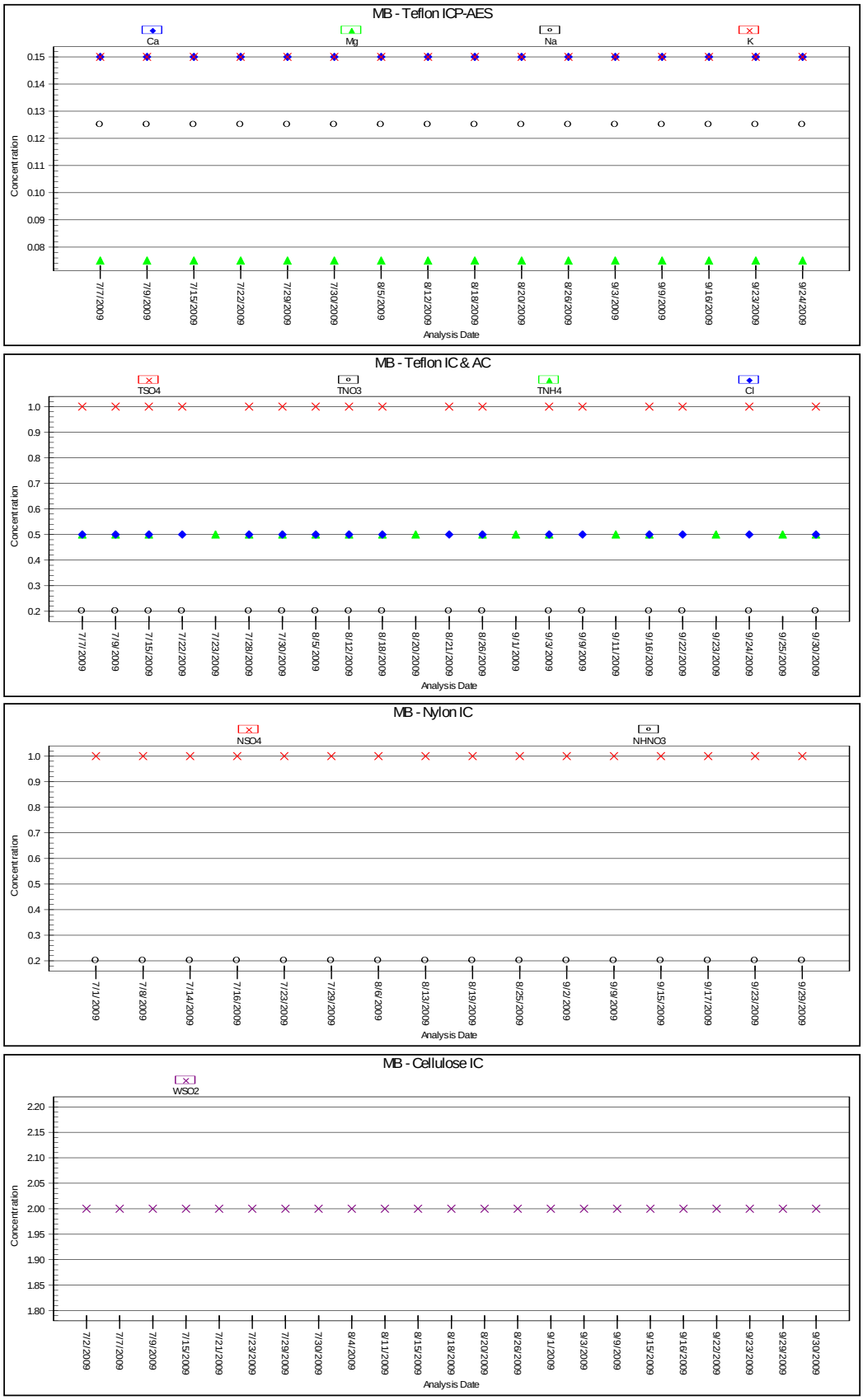


Figure 7. Laboratory Blank Analysis Results for Third Quarter 2009 (total micrograms)

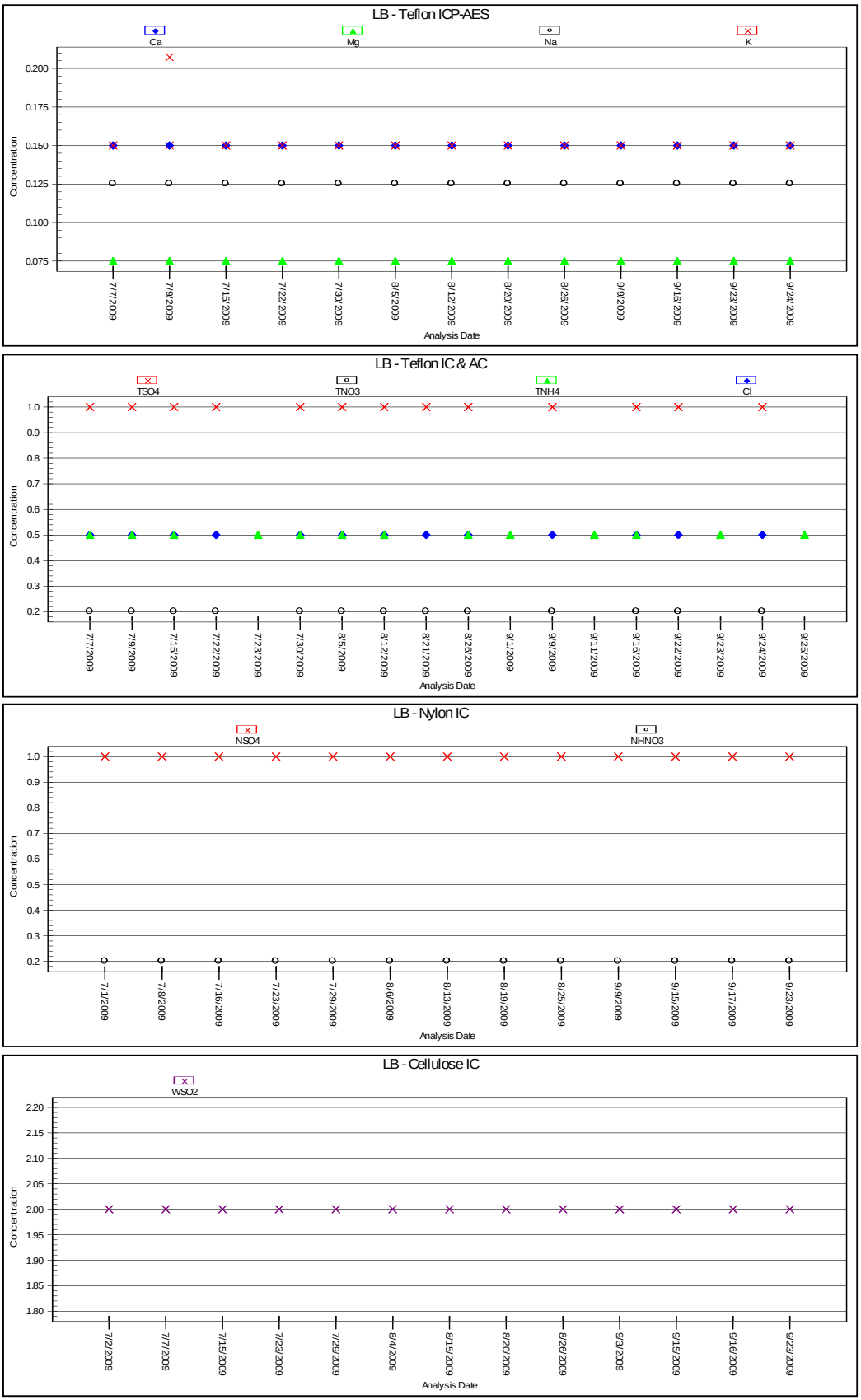


Figure 8. Field Blank Analysis Results for Third Quarter 2009 (total micrograms)