Clean Air Status and Trends Network
Quality Assurance Report

EPA Contract No.:	**68-D-03-052 (Base Program)**
MACTEC Project No.:	**6064068000**
Reporting Period:	**Third Quarter 2006 (July – September)**

Summary of Quarterly Operations

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 2006. 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 necessary.

During third quarter 2006, statistical analyses to support acceptance testing for the nylon filters was completed. To achieve a 95 percent confidence that an entire box of filters is acceptable, at least four filters per box must be satisfactorily tested. This applies to boxes of both Teflon® and nylon filters.

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 current CASTNET project, which began on July 30, 2003, the Environmental Protection Agency (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 2006.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for third quarter 2006. All results were within the criteria listed in Table 4 with the exception of several individual RP results. However, these are considered reasonable in most cases since higher relative percent differences (RPD) generally correlate with lower sample concentrations. Five cellulose filter replicate values were outside of the established criterion with RPD values ranging from 5.6 percent to 16.2 percent. In each case, the analyst noted an interfering peak on the chromatogram. The interference was confirmed via reanalysis. This interference has been noted in previous reports and its cause to date remains undetermined. 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.

During third quarter 2006, the CASTNET analytical laboratory began processing a laboratory control sample (LCS) to monitor the effects of sample handling. The LCS is a reagent blank spiked with a known concentration of a target analyte and extracted along with a group of field samples. The LCS results for this quarter were within the nominal 80 - 120 percent limit set for spike recovery with one exception wherein an LCS for chloride showed a 156 percent spiked sample recovery. All other QC samples associated with the batch were within criteria. The LCS recovery was investigated and determined to be likely due to isolated sample contamination. The analyst was reminded of the proper techniques to prevent such contamination.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for third quarter 2006. All results were within criteria (two times the detection limit) listed in Table 4.

Suspect/Invalid Filter Pack Samples

Five filter pack samples were invalidated due to incomplete flow. Of those, one has been validated to Level 3. Data for the remaining four 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. 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 22 sites during third quarter 2006. All sites and parameters were within the criteria listed in Table 3 with the exception of those listed in Table 9.

Tables and Figures

Table 1. Data Validated to Level 3 during Third Quarter 2006

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
5†	November 2005 – April 2006	6	Quarter 1 2006	1
1	January 2006 – June 2006	6	Quarter 1 2006 – Quarter 2 2006	2

Note: * The sites contained in each calibration group are listed in Table 2.
† Contains ROM206 of the ROM406/206 collocated pair

Table 2. Field Calibration Schedule

Calibration Group Number	Months Calibrated	Sites Calibrated			
1	January/July	SND152, AL	BFT142, NC	PNF126, NC	PED108, VA
		GAS153, GA	CND125, NC	ESP127, TN	VPI120, VA
		CDZ171, KY	COW137, NC	SPD111, TN	
2	February/August	CAD150, AR	BEL116, MD	WSP144, NJ	ARE128, PA
		IRL141, FL	BWR139, MD	CTH110, NY	PSU106, PA
		SUM156, FL	CVL151, MS	CHE185, OK	ALC188, TX
3	March/September	ALH157, IL	VIN140, IN	MCK131, KY	DCP114, OH
		BVL130, IL	KNZ184, KS	MCK231, KY	OXF122, OH
		STK138, IL	CKT136, KY	SAN189, NE	PRK134, WI
4	April/October	ABT147, CT	ANA115, MI	CAT175, NY	EGB181, ON
		SAL133, IN	HOX148, MI	HWF187, NY	LYE145, VT
		ASH135, ME	UVL124, MI	LYK123, OH	
		HOW132,ME	WST109, NH		
5	May/November	CON186, CA	QAK172, OH	MKG113, PA	CNT169, WY
		ROM206, CO	KEF112, PA	CDR119, WV	PND165, WY
		GTH161, CO	LRL117, PA	PAR107, WV	

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)	± 5%, rel. hum. > 85% ± 20%, rel. hum. ≤ 85%
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
O_3	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
rel. hum. = relative humidity
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	0.005	0.125
Magnesium (Mg^{2+})	F	ICP-AES	5	95 - 105	0.003	0.075
Calcium (Ca^{2+})	F	ICP-AES	5	95 - 105	0.003	0.075
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 new 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 new 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 3.0 (MACTEC, 2005).

Table 5. QC Analysis Count for Third Quarter 2006

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-}	41	198	77	19	28	42
	NO_3^-	41	198	77	19	28	42
	NH_4^+	36	185	67	17	28	42
	Cl^-	41	198	76	19	28	42
	Ca^{2+}	54	207	77	18	28	42
	Mg^{2+}	54	207	77	18	28	42
	Na^+	54	207	77	18	28	42
	K^+	54	207	77	18	28	42
Nylon	SO_4^{2-}	39	180	71	19	26	41
	NO_3^-	39	180	71	19	26	41
Cellulose	SO_4^{2-}	48	177	61	24	24	55

Table 6. Filter Pack Receipt Summary

Count of samples received more than 14 days after removal from tower:	6
Count of all samples received:	747
Fraction of samples received within 14 days:	0.992
Average interval in days:	5.07
First receipt date:	07/01/06
Last receipt date:	9/29/2006

Table 7. Filter Packs Flagged as Suspect or Invalid

Site ID	Sample ID
BEL116, MD	0627001-09
CKT136, KY	0633001-20
ESP127, TN	0629001-33
OXF122, OH	0630001-59
STK138, IL	0630001-76

Table 8. Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	18
60	0
90	0
Unresolved by date of publication	53

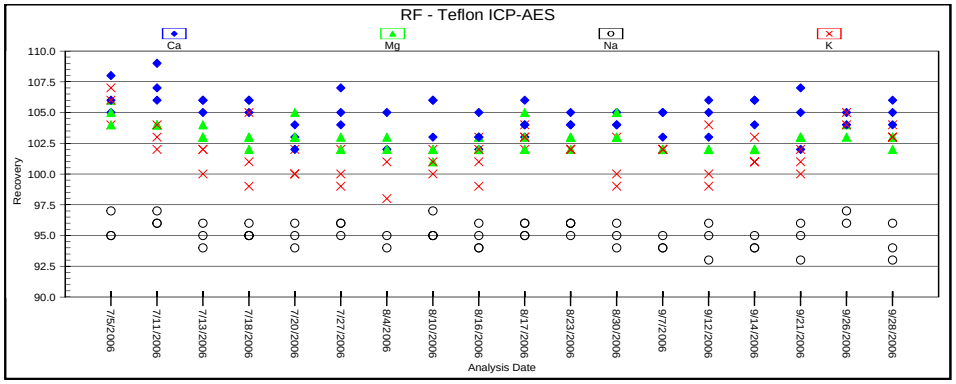
Note: Counts were extracted using the new problem tracking system (PTS) feature of the CDMSA. Problems requiring corrective action are flagged by field personnel with a ticket number.

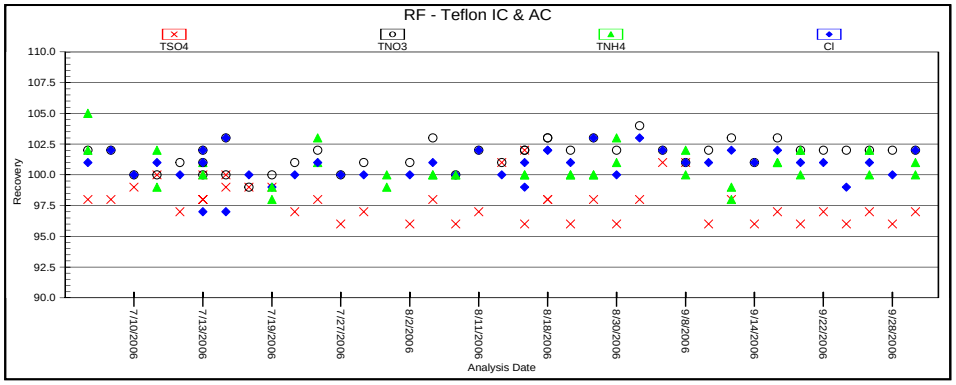
Table 9. Field Calibration Failures by Parameter

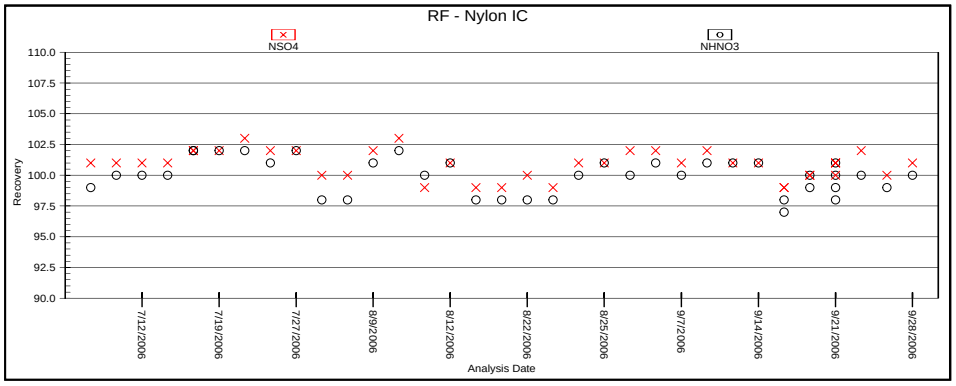
Site ID	Parameter(s)
ALC188, TX	Relative Humidity
BWR139, MD	Relative Humidity
CTH110, NY	Wind Direction
ESP127, TN	Wind Direction
IRL141, FL	Wind Direction
PNF126, NC	Relative Humidity Temperature
PSU106, PA	Solar Radiation
SND152, AL	Relative Humidity
SPD111, TN	Solar Radiation Flow Rate
STK138, IL	Wind Speed
VPI120, VA	Temperature

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 3.0 (MACTEC, 2005).

Figure 1. Reference Standard Results for Third Quarter 2006 (percent recovery)







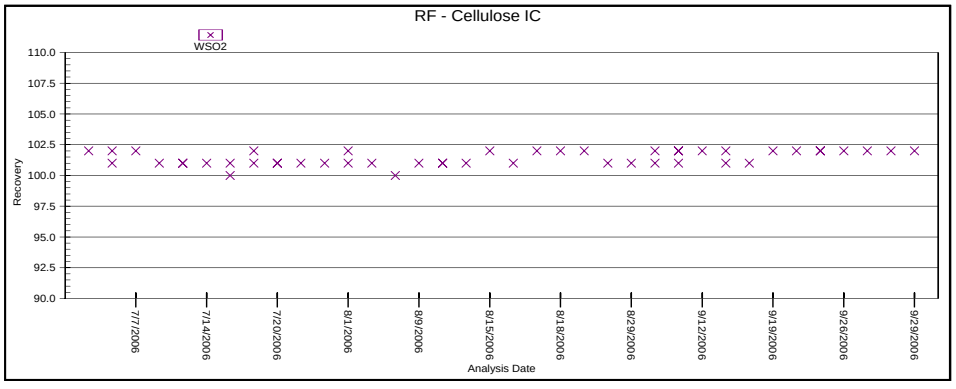
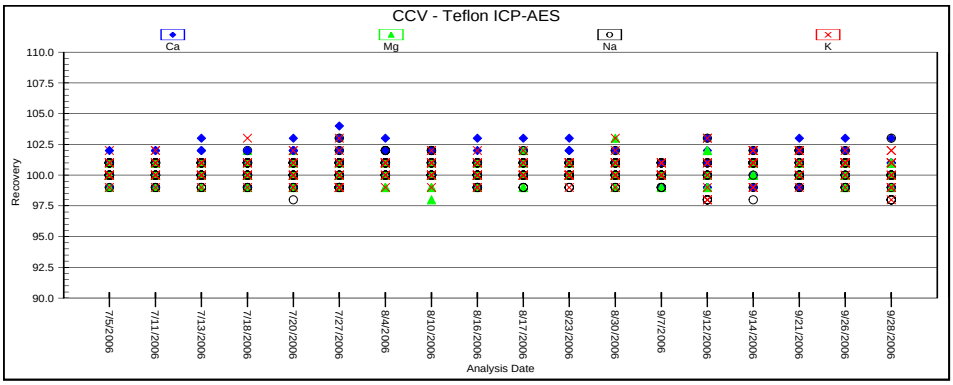
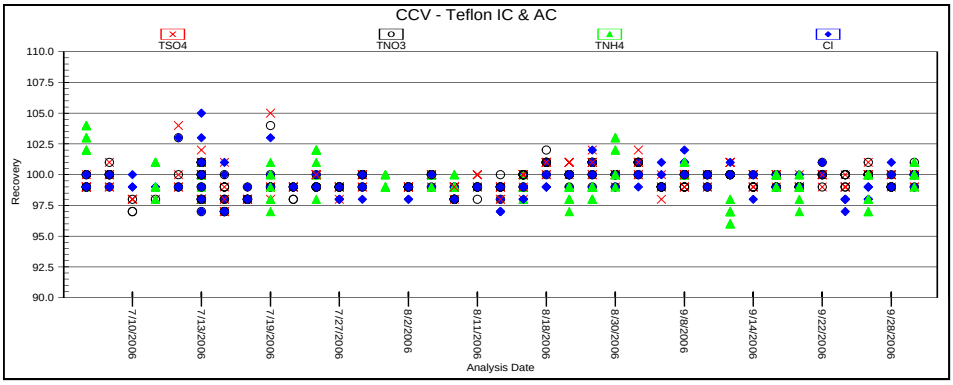
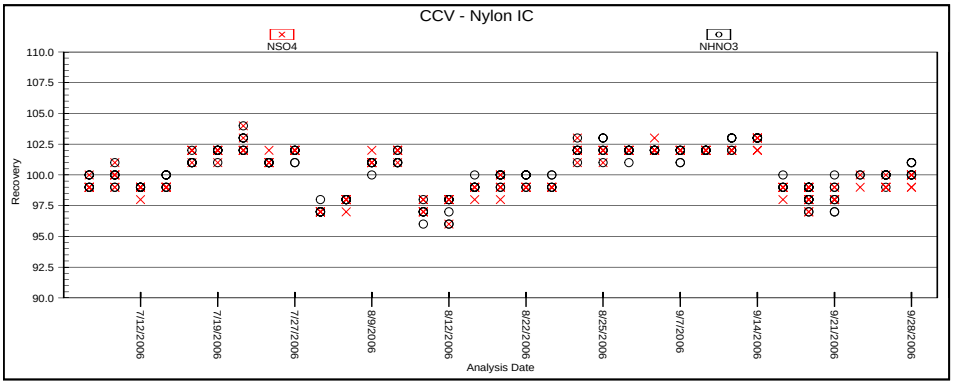


Figure 2. Continuing Calibration Verification Spike Results for Third Quarter 2006 (percent recovery)







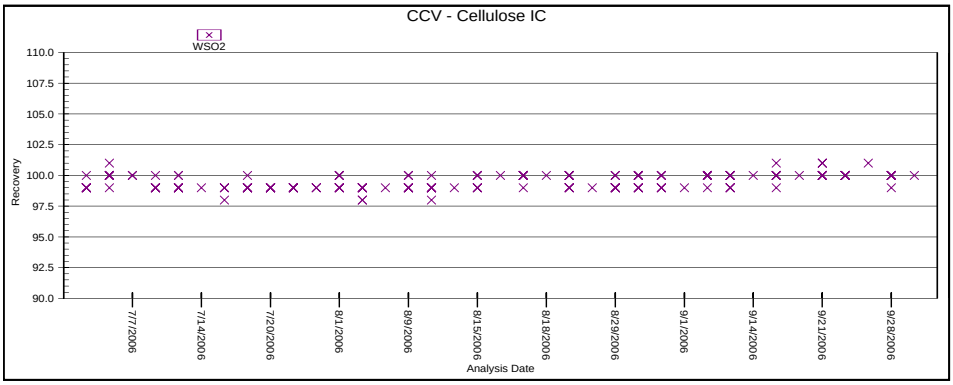


Figure 3. Replicate Sample Analysis Results for Third Quarter 2006 (total micrograms)

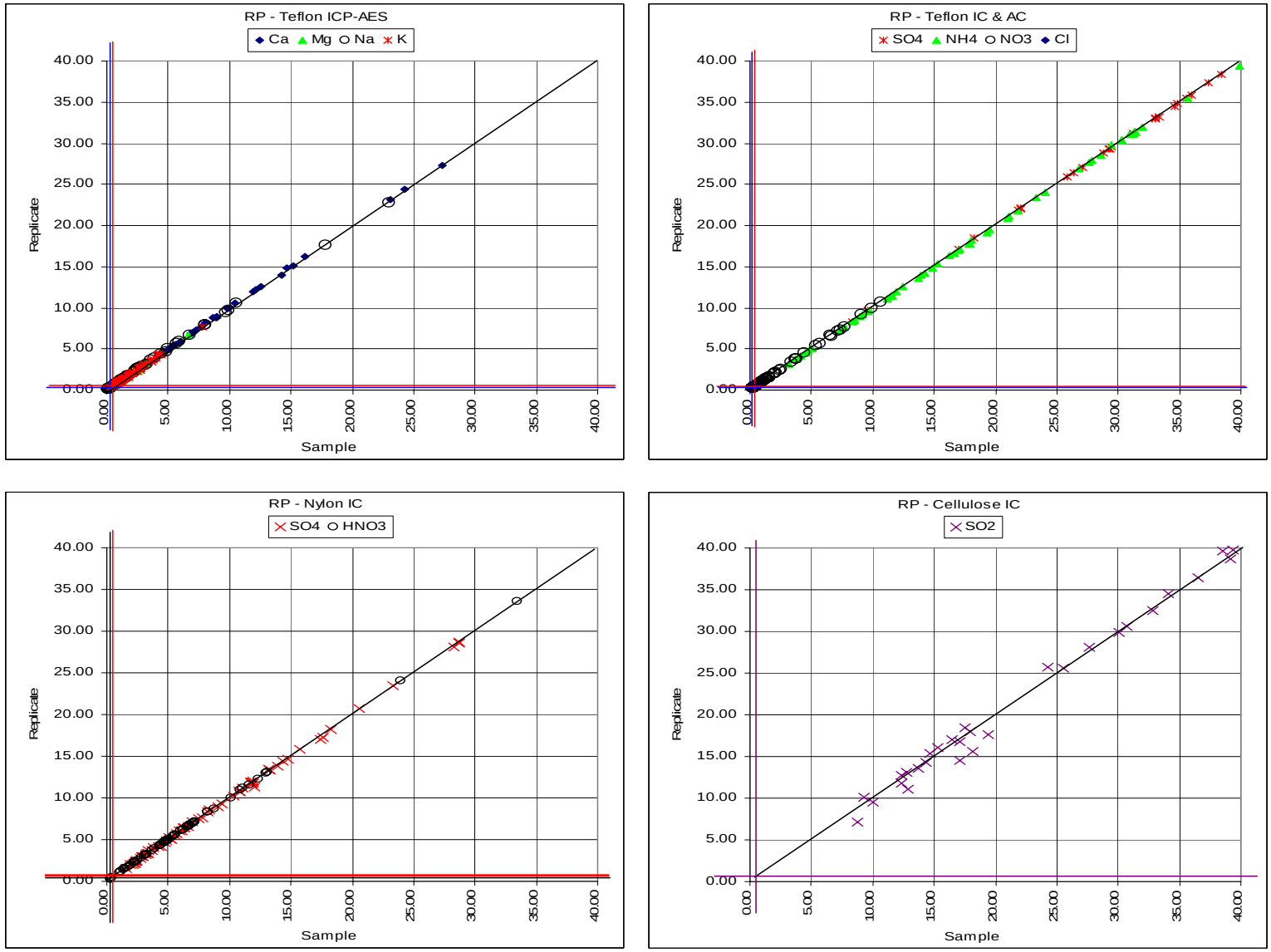
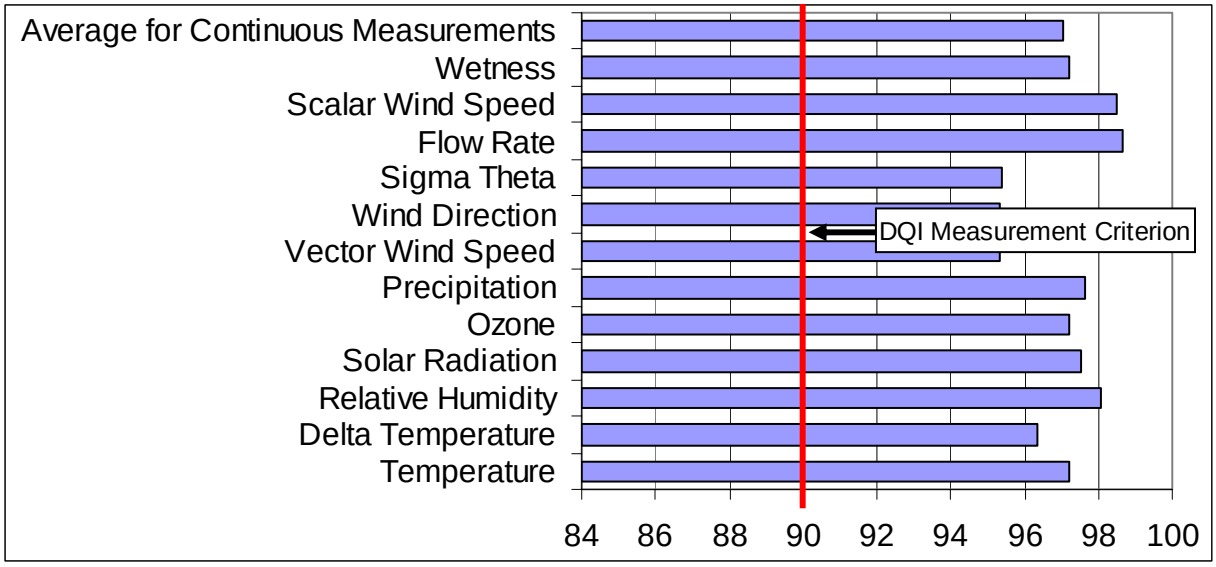
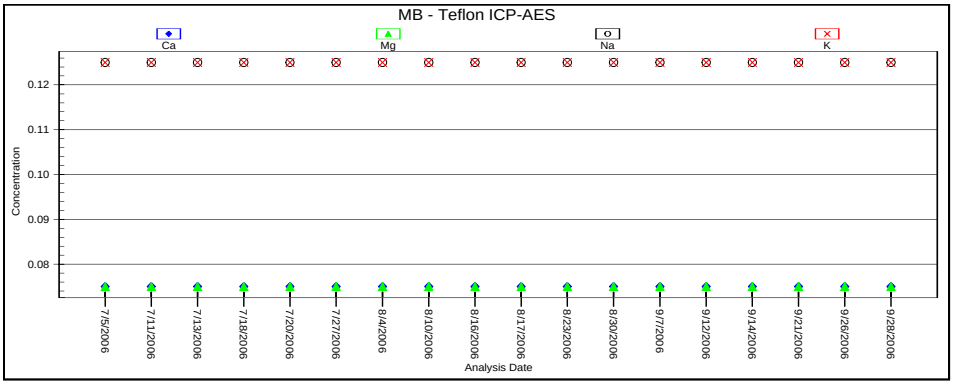


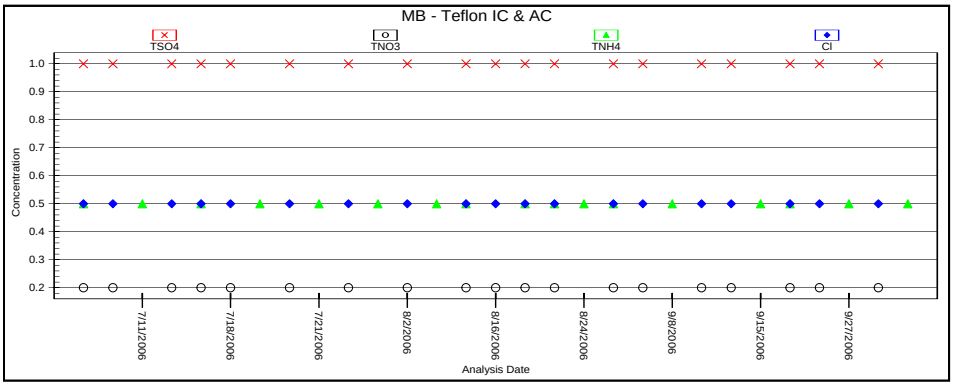
Figure 4. Percent Completeness of Measurements for Fourth Quarter 2005 through Third Quarter 2006*

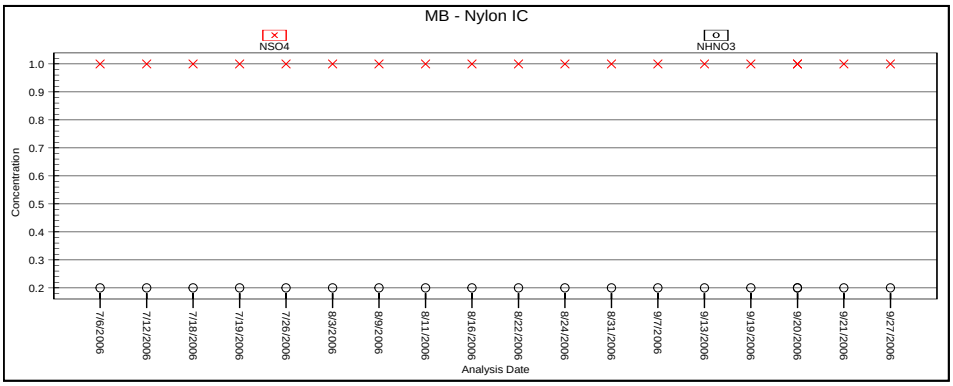


Note: *Presents Level 3 data available during the third calendar quarter of 2006.

Figure 5. Method Blank Analysis Results for Third Quarter 2006 (total micrograms)







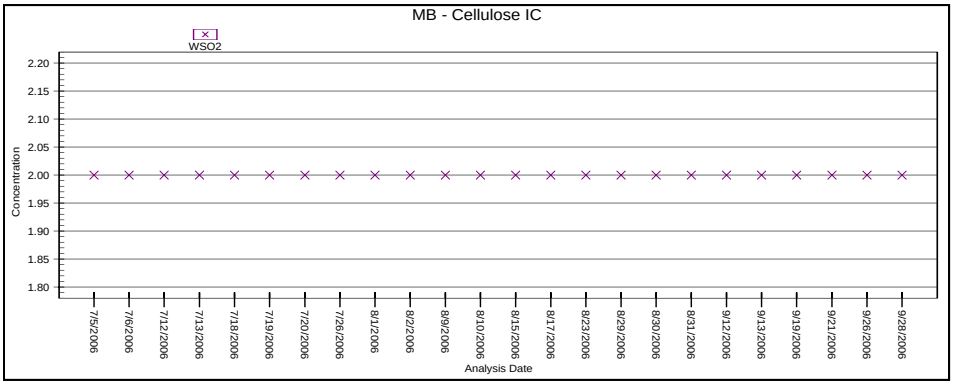
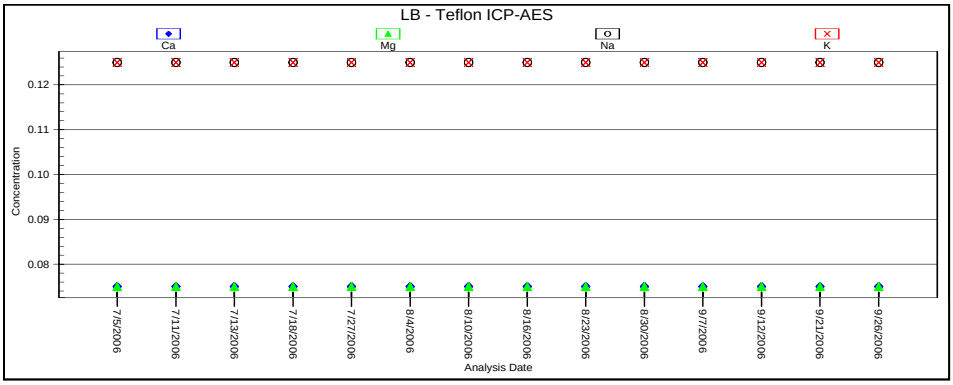
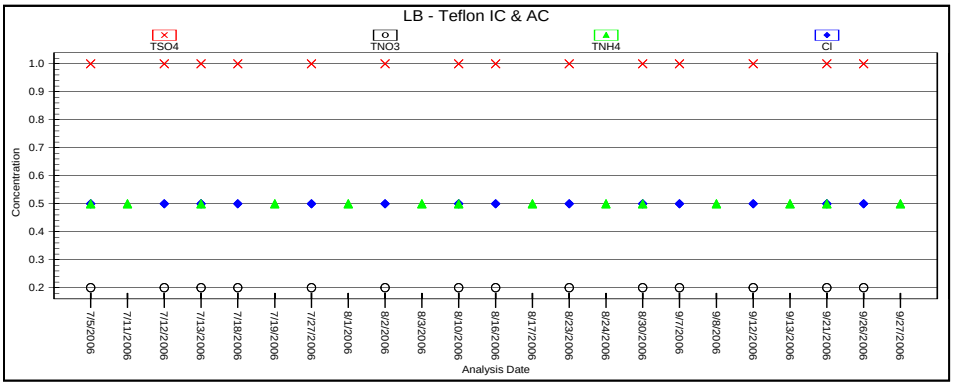
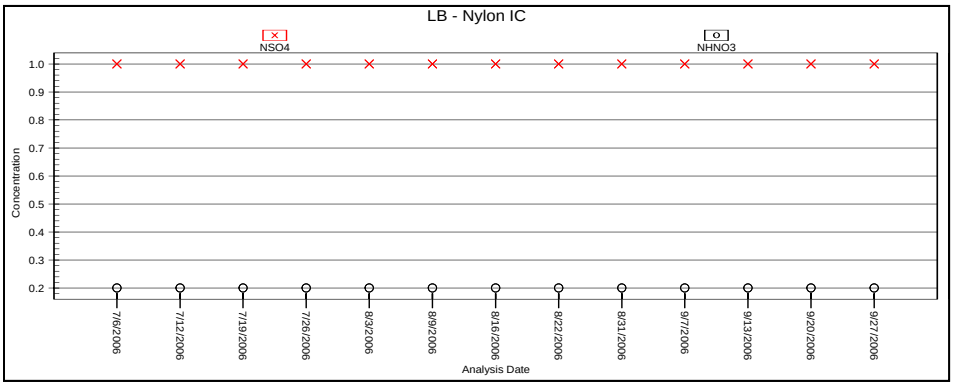


Figure 6. Laboratory Blank Analysis Results for Third Quarter 2006 (total micrograms)







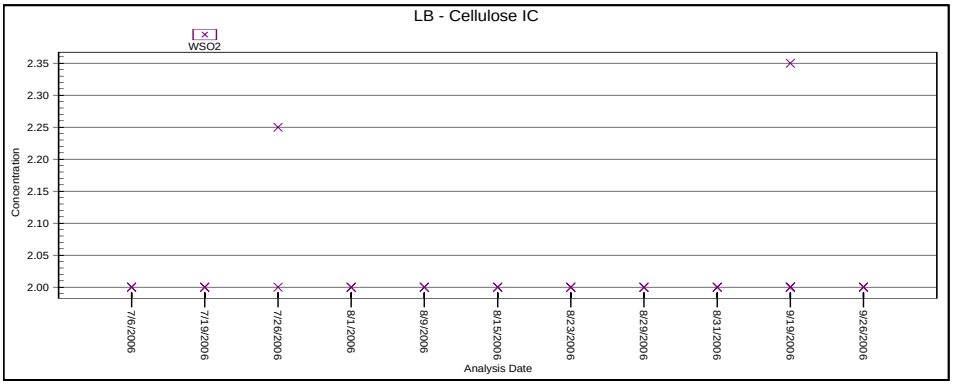


Figure 7. Field Blank Analysis Results for Third Quarter 2006 (total micrograms)