



Clean Air Status and Trends Network

Second Quarter 2024 Quality Assurance Report

Summary of Quarterly Operations (April through June)

EPA Contract No. 68HERH21D0006

Introduction

This quarterly report summarizes results from the Clean Air Status and Trends Network (CASTNET) quality assurance/quality control (QA/QC) program for data collected during second quarter 2024. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan [QAPP; WSP USA Environment & Infrastructure Inc. (WSP), 2022]. 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 needed.

Quarterly Summary

The CASTNET QA Manager finished incorporating the annual changes to the CASTNET QAPP Revision 10.1 and submitted it to EPA on April 5, 2024. It was decided to update Revision 10.1 with changes in transfer standard protocols as set forth in publication EPA-454/B-22-003, *Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone*, a technical assistance document (TAD) revised by EPA's Office of Air Quality Planning and Standards in January 2023 and posted in November 2023 (EPA, 2023). This TAD identifies updated procedures for what is necessary to establish and maintain the traceability of ozone measurements within a monitoring network. Air agencies are required to implement these verification protocols by 2025. However, some air agencies are already using these protocols, so they were incorporated in this revision of the CASTNET QAPP. WSP submitted the updated QAPP Revision 10.1 to EPA on June 27, 2024.

During second quarter 2024, the CASTNET QA Manager completed work on the annual managerial review in support of International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2017 accreditation by the American Association for Laboratory Accreditation (A2LA).

The QA Manager performed the supplier evaluation for 2023. As per A2LA requirements, suppliers are audited for both the quality of the products provided and their adherence to scheduling requirements. All suppliers met performance requirements. In 2023, Measurement Technology Laboratories (MTL) accepted the return of the boxes of contaminated nylon filters WSP was holding and replaced them with uncontaminated filters.

On June 4, 2024, WSP received samples for proficiency test (PT) 124 for Rain and Soft Waters from the Water Science and Technology Directorate (WS&TD), a branch of Environmental Science and Technology Laboratories with Environment and Climate Change Canada. Results for PT 124 are due to WS&TD on or before July 29, 2024.

During second quarter 2024, National Performance Audit Program audits were performed at PAR107, WV and CTH110, NY. The ozone systems at both sites passed audit criteria.

Table 1 lists the quarters of data that were validated to Level 3 during second quarter 2024 by site calibration group. Table 2 lists the sites in each calibration group along with the calibration schedule.

Table 3 presents the measurement criteria for laboratory filter pack measurements. These criteria apply to the QC samples listed in the following section of this report. Table 4 presents the critical criteria for ozone monitoring. Table 5 presents the critical criteria for trace-level gas monitoring.

Quality Control Analysis Count

The QC sample statistics presented in this report are for reference standards (RF) and continuing calibration verification spikes (CCV) used to assess accuracy and for replicate sample analyses (RP) used to assess “in-run” precision. In addition, laboratory method blanks (MB) containing reagents without a filter; laboratory blanks (LB) containing reagents and a new, unexposed filter; and field blanks (FB) containing reagents and an unexposed filter that was loaded into a filter pack assembly and shipped to and from the monitoring site while remaining in sealed packaging are also included. Table 6 presents the number of analyses in each category that were performed during second quarter 2024.

Sample Receipt Statistics

Ninety-five percent of field samples from EPA-sponsored sites must be received by the CASTNET laboratory in Gainesville, FL no later than 14 days after removal from the sampling tower. Table 7 presents the relevant sample receipt statistics for second quarter 2024.

Data Quality indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for second quarter 2024. All results were within the criteria listed in Table 3.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during second quarter 2024. The statistics presented contain data validated at Level 2 and Level 3. Data collection ceased at SAN189, NE on May 1, 2024 in preparation to relocate the site. The relocated site is now designated as SAN192, NE and began collected data on June 6, 2024. Both sites are listed in Table 8. All data associated with QC checks that fail to meet the criteria listed in Table 4 were or will be invalidated unless the cause of failure has no effect on ambient data collection and passing results still meet frequency criteria. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 9 presents observations associated with the shaded cell results in Table 8.

Table 10 presents summary statistics of critical criteria measurements at trace-level gas monitoring sites collected during second quarter 2024. Trace-level gas monitoring began at SAN192 and STK138, IL in June 2024. These sites have been added to Table 10. The statistics presented contain data validated at Level 2 and Level 3. All data associated with QC checks that fail to meet the criteria listed in Table 5 were or will be invalidated unless the cause of failure has no effect on ambient data collection, and passing results still meet frequency criteria. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 11 presents observations associated with the shaded cell results in Table 10.

Laboratory Control Sample Analysis

The laboratory control sample (LCS) is a reagent blank spiked with the target analytes from the established analytical methods and carried through the same extraction process that field samples

must undergo. LCS analyses are performed by the laboratory to monitor for potential sample handling artifacts and provide a means to identify possible analyte loss from extraction to extraction. Figure 4 presents LCS analysis results for second quarter 2024. All recovery values were between 93 percent and 109 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for second quarter 2024. All second quarter results were within criteria (two times the reporting limit) listed in Table 3 except for one cellulose filter SO₂ FB result at 2.2 times the reporting limit.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during second quarter 2024 are listed in Table 12. This table also includes associated site identification and a brief description of the reason the sample was flagged. During second quarter, eight filter pack samples were invalidated.

Field Problem Count

Table 13 presents counts of field problems affecting continuous data collection for more than one day for second quarter 2024. The problem counts are sorted by a 30-, 60-, or 90-day time period to resolution. A category for unresolved problems is also included.

References

- American Society for Testing and Materials (ASTM). 2022. ASTM E29-22, “Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications.” ASTM International, West Conshohocken, PA, DOI:10.1520/E0029-22. www.astm.org.
- International Organization for Standardization (ISO). 2015. Statistical Methods for the Use in Proficiency Testing by Interlaboratory Comparisons, Annex C, Robust Analysis, Section C.1: Algorithm A. Standard 13528. ISO 13528:2015(E).
- U.S. Environmental Protection Agency (EPA). 2023. *Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone – Technical Assistance Document*. EPA-454/B-22-003. https://www.epa.gov/system/files/documents/2023-11/o3_tad_508_20230906_final.pdf
- U.S. Environmental Protection Agency (EPA). 2023. *Title 40 Code of Federal Regulations Part 58, “Appendix A to Part 58 – Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards.”*
- WSP USA Environment & Infrastructure Inc. (WSP) formerly known as Wood Environment & Infrastructure Solutions, Inc. 2022. Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 9.5. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC. Contract No. 68HERH21D0006. Gainesville, FL. <https://java.epa.gov/castnet/documents.do>.

Table 1 Data Validated to Level 3 through Second Quarter 2024

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-1/SE-5	August 2023– January 2024	6	Quarter 4 2023	1
MW-7/W-9	September 2023– February 2024	6	Quarter 4 2023	1
E-2/MW-8	October 2023– March 2024	6	Quarter 4 2023– Quarter 1 2024	2

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

Table 2 Field Calibration Schedule for 2024

Calibration Group	Months Calibrated	Sites Calibrated			
Eastern Sites (22 Total)					
E-1 (8 Sites)	February/August	ARE128, PA PED108, VA	BEL116, MD PSU106, PA	BWR139, MD VPI120, VA	CTH110, NY WSP144, NJ
E-2 (9 Sites)	April/October	ABT147, CT HWF187, NY ¹ WST109, NH	ASH135, ME NIC001, NY	CAT175, NY UND002, VT	EGB181, ON WFM105, NY
E-3 (5 Sites)	May/November	CDR119, WV PAR107, WV	KEF112, PA	LRL117, PA	MKG113, PA
Southeastern Sites (11 Total)					
SE-4 (7 Sites)	January/July	BFT142, NC GAS153, GA	CND125, NC SND152, AL	COW137, NC SPD111, TN	DUK008, NC ¹
SE-5 (4 Sites)	February/August	CAD150, AR	CVL151, MS	IRL141, FL	SUM156, FL
Midwestern Sites (18 Total)					
MW-6 (5 Sites)	January/July	CKT136, KY PNF126, NC ¹	ESP127, TN	MCK131, KY	MCK231, KY
MW-7 (8 Sites)	March/September	BVL130, IL ² QAK172, OH	DCP114, OH RED004, MN	OXF122, OH STK138, IL ²	PRK134, WI VIN140, IN
MW-8 (4 Sites)	April/October	ANA115, MI	HOX148, MI	SAL133, IN	UVL124, MI
Western Sites (13 Total)					
W-9 (4 Sites)	March/September	ALC188, TX	CHE185, OK	KNZ184, KS	SAN192, NE ²
W-10 (8 Sites)	May/November	CNT169, WY PAL190, TX	GTH161, CO PND165, WY ³	LPO010, CA ROM206, CO ³	NPT006, ID UMA009, WA

Notes: CDZ171, KY and KIC003, KS have been decommissioned and therefore removed from this table.

¹ Trace-level gas calibrations are performed quarterly in January, April, July, and October.

² Trace-level gas calibrations are performed quarterly in March, June, September, and December.

³ Trace-level gas calibrations are performed quarterly in February, May, August, and November.

Table 3 Data Quality Indicators for CASTNET Laboratory Measurements

Analyte	Method	Precision ¹ (MARPD)	Accuracy ² (%)	Nominal Reporting Limits ³	
				mg/L	µg/Filter
Ammonium (NH ₄ ⁺)	AC	20	90-110	0.020*	0.5
Sodium (Na ⁺)	ICP-OES	20	95-105	0.005	0.125
Potassium (K ⁺)	ICP-OES	20	95-105	0.006	0.15
Magnesium (Mg ²⁺)	ICP-OES	20	95-105	0.003	0.075
Calcium (Ca ²⁺)	ICP-OES	20	95-105	0.006	0.15
Chloride (Cl ⁻)	IC	20	95-105	0.020	0.5
Nitrate (NO ₃ ⁻)	IC	20	95-105	0.008*	0.2
Sulfate (SO ₄ ²⁻)	IC	20	95-105	0.040	1.0

Notes: ¹ This column lists precision goals for both network precision calculated from co-located filter samples and laboratory precision based on replicate samples for samples > five times the reporting limit. The criterion is ± the reporting limit if the sample is ≤ five times the reporting limit.

² This column lists laboratory accuracy goals based on reference standards and continuing calibration verification spikes. The criterion is 90–110 percent for ICP-OES reference standards.

³ The reporting limit for sulfate on cellulose filters is 0.080 mg/L (2.0 µg/filter).

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, (WSP, 2022).

Table 4 Ozone Critical Criteria*

Type Check	Analyzer Response
Zero	Less than ± 3.1 parts per billion (ppb)
Span	Less than ± 7.1 percent between supplied and observed concentrations
Single Point QC	Less than ± 7.1 percent between supplied and observed concentrations

Notes: * Applies to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the Code of Federal Regulations (EPA, 2023). The minimum frequency for these checks is once every two weeks.

Values are rounded according to ASTM E29-22, “Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications” (ASTM, 2022).

Table 5 Trace-level Gas Monitoring Critical Criteria*

Parameter	Analyzer Response	
	Zero Check	Span Check / Single Point QC Check
SO ₂	Less than ± 1.51 ppb	Less than ± 10.1 percent between supplied and observed concentrations
NO _y	Less than ± 1.51 ppb	
CO	Less than ± 50 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, 2023). The minimum frequency for these checks is once every two weeks.

Values are rounded according to ASTM E29-22, "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications" (ASTM, 2022).

SO₂ = sulfur dioxide
 NO_y = total reactive oxides of nitrogen
 CO = carbon monoxide
 ppb = parts per billion

Table 6 QC Analysis Count for Second Quarter 2024

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⁻	51	149	63	13	22	43
	NO ₃ ⁻	51	149	63	13	22	43
	NH ₄ ⁺	26	134	63	13	22	43
	Cl ⁻	51	149	63	13	22	43
	Ca ²⁺	26	134	63	13	22	43
	Mg ²⁺	26	134	63	13	22	43
	Na ⁺	26	134	63	13	22	43
	K ⁺	26	134	63	13	22	43
Nylon	SO ₄ ²⁻	36	149	65	12	24	45
	NO ₃ ⁻	36	149	65	12	24	45
Cellulose	SO ₄ ²⁻	45	125	52	13	24	33

Table 7 Filter Pack Receipt Summary for Second Quarter 2024

Count of samples received more than 14 days after removal from tower:	15
Count of all samples received	641
Fraction of samples received within 14 days:	0.977
Average interval in days:	5.058
First receipt date:	4/1/2024
Last receipt date:	6/26/2024

Note: Sample shipments for the Egbert, Ontario site (EGB181) are in groups of four. Samples associated with EGB181 are excluded from this statistic.

Table 8 Ozone QC Summary for Second Quarter 2024 (1 of 2)

Site ID	% Span Pass ¹	Span [%D] ²	% Single Point QC Pass ¹	Single Point QC [%D] ²	% Zero Pass ¹	Zero Average (ppb) ²
ABT147, CT	100.00	1.04	98.94	1.51	100.00	0.15
ALC188, TX	100.00	2.08	100.00	2.12	100.00	0.34
ALH157, IL	N/A	N/A	N/A	N/A	N/A	N/A
ANA115, MI	100.00	1.30	100.00	1.17	100.00	0.14
ARE128, PA	100.00	0.68	100.00	0.84	100.00	0.56
ASH135, ME	N/A	N/A	N/A	N/A	N/A	N/A
BEL116, MD	100.00	1.30	100.00	0.71	100.00	0.38
BFT142, NC	100.00	1.98	97.89	1.75	100.00	0.27
BVL130, IL	100.00	1.29	100.00	1.11	100.00	0.22
BWR139, MD	100.00	1.21	100.00	1.02	100.00	0.37
CAD150, AR	100.00	0.75	100.00	1.13	100.00	0.31
CDR119, WV	N/A	N/A	N/A	N/A	N/A	N/A
CDZ171, KY	N/A	N/A	N/A	N/A	N/A	N/A
CKT136, KY	98.90	1.13	100.00	1.22	100.00	0.16
CND125, NC	100.00	1.12	100.00	1.44	100.00	0.33
CNT169, WY	100.00	1.11	100.00	1.14	100.00	0.38
COW137, NC	100.00	1.01	100.00	1.56	100.00	0.77
CTH110, NY	100.00	0.77	100.00	0.95	100.00	0.22
CVL151, MS	100.00	1.52	100.00	1.53	100.00	0.24
DCP114, OH	N/A	N/A	N/A	N/A	N/A	N/A
DUK008, NC	100.00	3.91	96.84	4.45	100.00	0.54
ESP127, TN	100.00	1.34	100.00	1.13	100.00	0.78
GAS153, GA	100.00	0.63	100.00	1.11	100.00	0.54
GTH161, CO	100.00	1.92	100.00	2.14	100.00	0.58
HOX148, MI	100.00	0.62	100.00	0.78	100.00	0.16
HWF187, NY	N/A	N/A	N/A	N/A	N/A	N/A
IRL141, FL	95.88	2.00	98.97	1.65	100.00	0.38
KEF112, PA	98.96	3.97	98.96	2.03	100.00	0.63
LPO010, CA	99.02	1.50	100.00	0.78	100.00	0.25
LRL117, PA	100.00	1.67	100.00	1.44	100.00	0.26
MCK131, KY	100.00	2.27	100.00	2.40	100.00	0.30
MCK231, KY	100.00	1.07	100.00	1.06	100.00	0.19
MKG113, PA	100.00	1.84	97.89	2.21	100.00	0.46
NPT006, ID	97.85	3.29	97.85	3.46	100.00	0.16
OXF122, OH	100.00	2.05	100.00	3.12	100.00	0.22
PAL190, TX	100.00	0.76	100.00	0.64	100.00	0.17
PAR107, WV	100.00	1.07	100.00	0.91	100.00	0.21
PED108, VA	100.00	1.06	100.00	0.76	100.00	0.18
PND165, WY	100.00	1.27	100.00	1.01	100.00	0.30
PNF126, NC	N/A	N/A	N/A	N/A	N/A	N/A
PRK134, WI	98.92	2.60	98.92	1.72	98.92	0.23
PSU106, PA	100.00	2.47	100.00	3.25	100.00	0.49
QAK172, OH	100.00	0.80	100.00	1.05	100.00	0.32
ROM206, CO	90.00	11.83	89.00	11.28	100.00	0.32

Table 8 Ozone QC Summary for Second Quarter 2024 (2 of 2)

Site ID	% Span Pass ¹	Span [%D] ²	% Single Point QC Pass ¹	Single Point QC [%D] ²	% Zero Pass ¹	Zero Average (ppb) ²
SAL133, IN	100.00	0.95	100.00	0.71	100.00	0.23
SAN189, NE	100.00	1.71	100.00	1.92	100.00	0.54
SAN192, NE	100.00	1.36	100.00	1.69	100.00	0.35
SND152, AL	100.00	0.72	100.00	1.29	100.00	1.01
SPD111, TN	100.00	4.23	100.00	3.02	97.62	0.80
STK138, IL	100.00	2.34	100.00	1.39	100.00	0.37
SUM156, FL	95.12	3.45	98.75	1.41	100.00	0.24
UMA009, WA	100.00	0.76	100.00	0.73	100.00	0.35
UVL124, MI	100.00	2.12	100.00	1.53	98.91	0.37
VIN140, IN	100.00	0.77	100.00	1.03	100.00	0.20
VPI120, VA	96.81	2.78	100.00	2.12	100.00	0.26
WSP144, NJ	98.78	1.87	98.78	1.94	100.00	0.30
WST109, NH	100.00	1.69	100.00	1.74	100.00	0.49

Notes: ¹ Percentage of comparisons that pass the criteria listed in Table 4. 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 4 are addressed in Table 9.

%D = percent difference

ppb = parts per billion

Table 9 Ozone QC Observations for Second Quarter 2024

Site ID	QC Criterion	Comments
ROM206, CO	Span [%D] % Single Point QC Pass Single Point QC [%D]	Analyzer sample pump failed.

Note: %D = percent difference

Table 10 Trace-level Gas QC Summary for Second Quarter 2024

Parameter	% Span Pass ¹	Span [%D] ²	% Single Point QC Pass ¹	Single Point QC [%D] ²	% Zero Pass ¹	Zero Average (ppb) ²
BVL130, IL						
SO ₂	88.68	10.08	88.68	16.88	100.00	0.76
NO _y	100.00	2.43	100.00	2.20	100.00	0.60
CO	97.92	4.03	95.83	4.83	97.92	18.95
DUK008, NC						
NO _y	100.00	2.20	100.00	2.22	100.00	0.96
PND126, NC						
NO _y	100.00	0.70	100.00	1.85	90.91	1.01
ROM206, CO						
NO _y	100.00	0.93	100.00	1.41	100.00	0.39
SAN192, NE						
NO _y	83.33	5.49	44.44	10.48	100.00	0.41
STK138, IL						
NO _y	50.00	21.45	50.00	22.56	100.00	0.63

Notes: ¹ Percentage of comparisons that pass the criteria listed in Table 5. Values falling below 90 percent are addressed in Table 11.
² Absolute value of the average percent differences between the supplied and observed concentrations. Values exceeding the criteria listed in Table 5 are addressed in Table 11.

%D = percent difference
 ppb = parts per billion

Table 11 Trace-level Gas QC Observations for Second Quarter 2024

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	SO ₂	% Span Pass Span [%D] % Single Point QC Pass Single Point QC [%D]	Low data recovery was due to sample pump failures.
SAN192, NE	NO _y	% Span Pass % Single Point QC Pass Single Point QC [%D]	Trace monitoring installation was performed in early June but calibration was not completed until late June. Failures occurred prior to completion of calibration.
STK138, IL	NO _y	% Span Pass Span [%D] % Single Point QC Pass Single Point QC [%D]	Trace monitoring installation was performed in early June but calibration was not completed until late June. Failures occurred prior to completion of calibration.

Note: %D = percent difference

Table 12 Filter Packs Flagged as Suspect or Invalid During Second Quarter 2024

Site ID	Sample No.	Reason
ALB801, AB	2418007-01	Flow data acquisition issue. Data may be recovered by level 3 review.
BUF603, WY	2418005-02	Flow data acquisition issue. Data may be recovered by level 3 review.
FOR605, WY	2418005-03	Flow data acquisition issue. Data may be recovered by level 3 review.
GTH161, CO	2419001-24	The mass flow controller lost communication with the data logger after power failure.
NEC602, WY	2418005-04	Flow data acquisition issue. Data may be recovered by level 3 review.
ROM206, CO	2421001-44	Mass flow controller malfunctioned.
SHN418, VA	2421003-19	Affected by power failure.
VPI120, VA	2421001-53	Affected by power failure.

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	226
60	6
90	1
Unresolved by end of quarter	5

Figure 1 Reference Standard Results for Second Quarter 2024 (percent recovery)

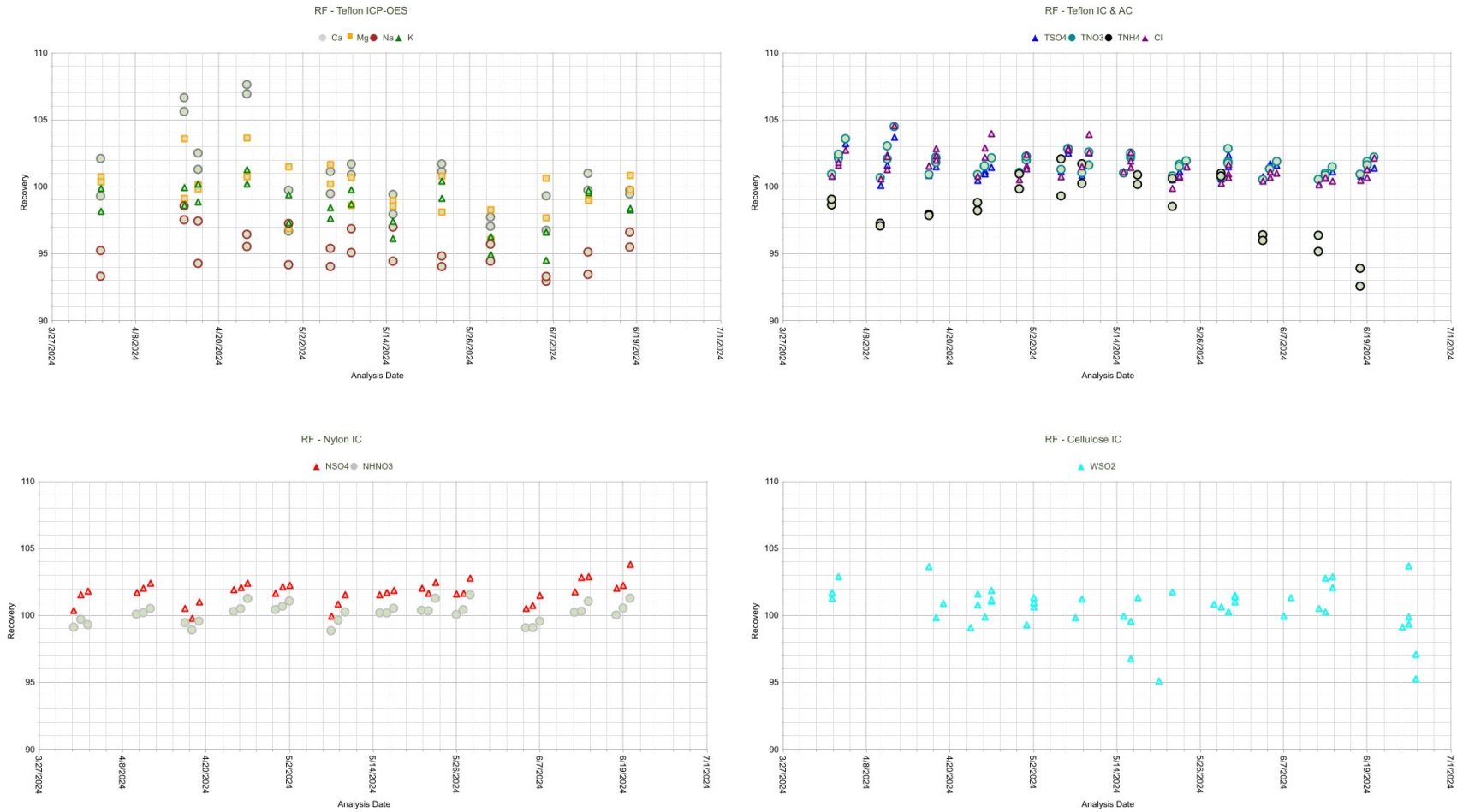


Figure 2 Continuing Calibration Spike Results for Second Quarter 2024 (percent recovery)

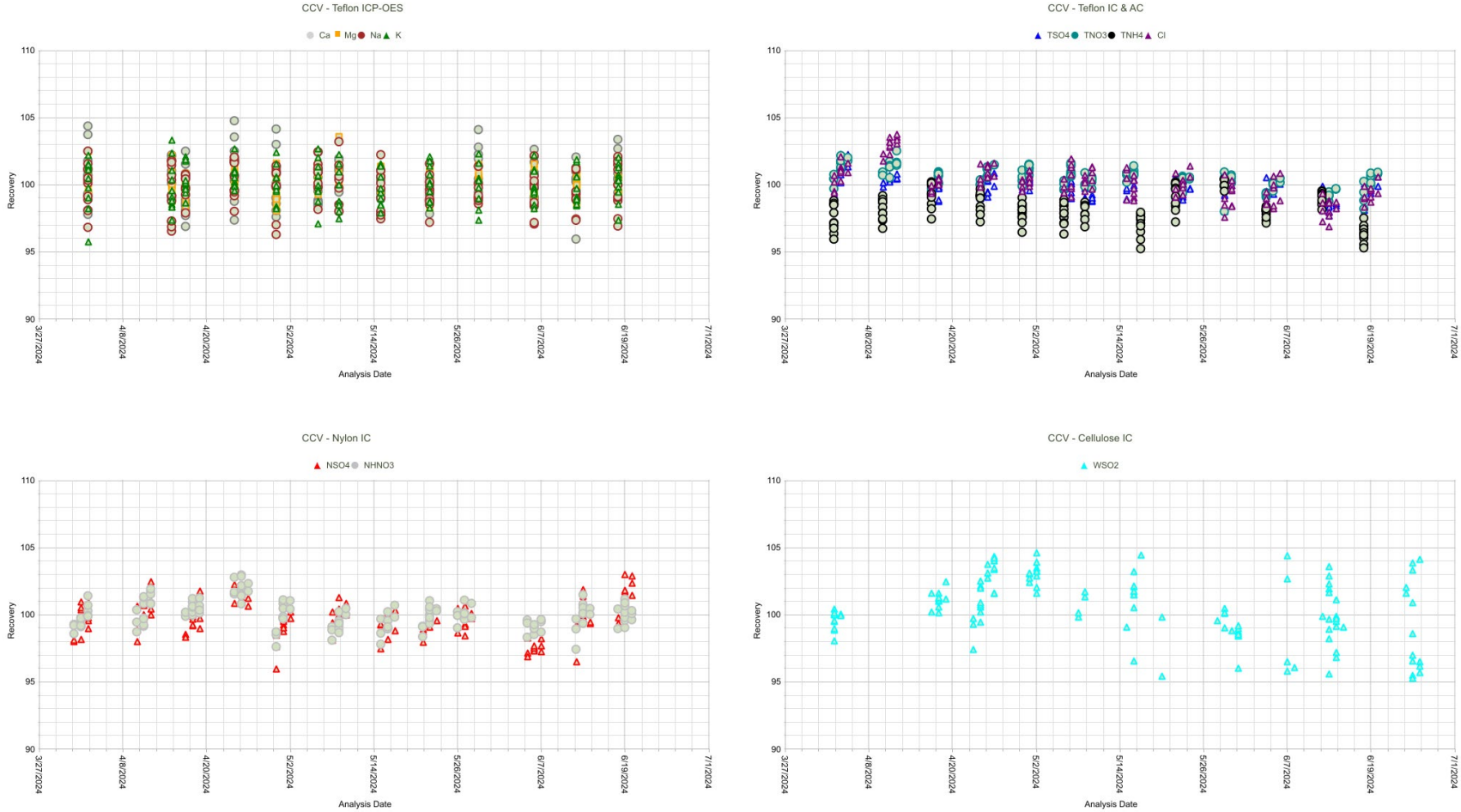


Figure 3 Replicate Sample Analysis Results for Second Quarter 2024 (percent difference)

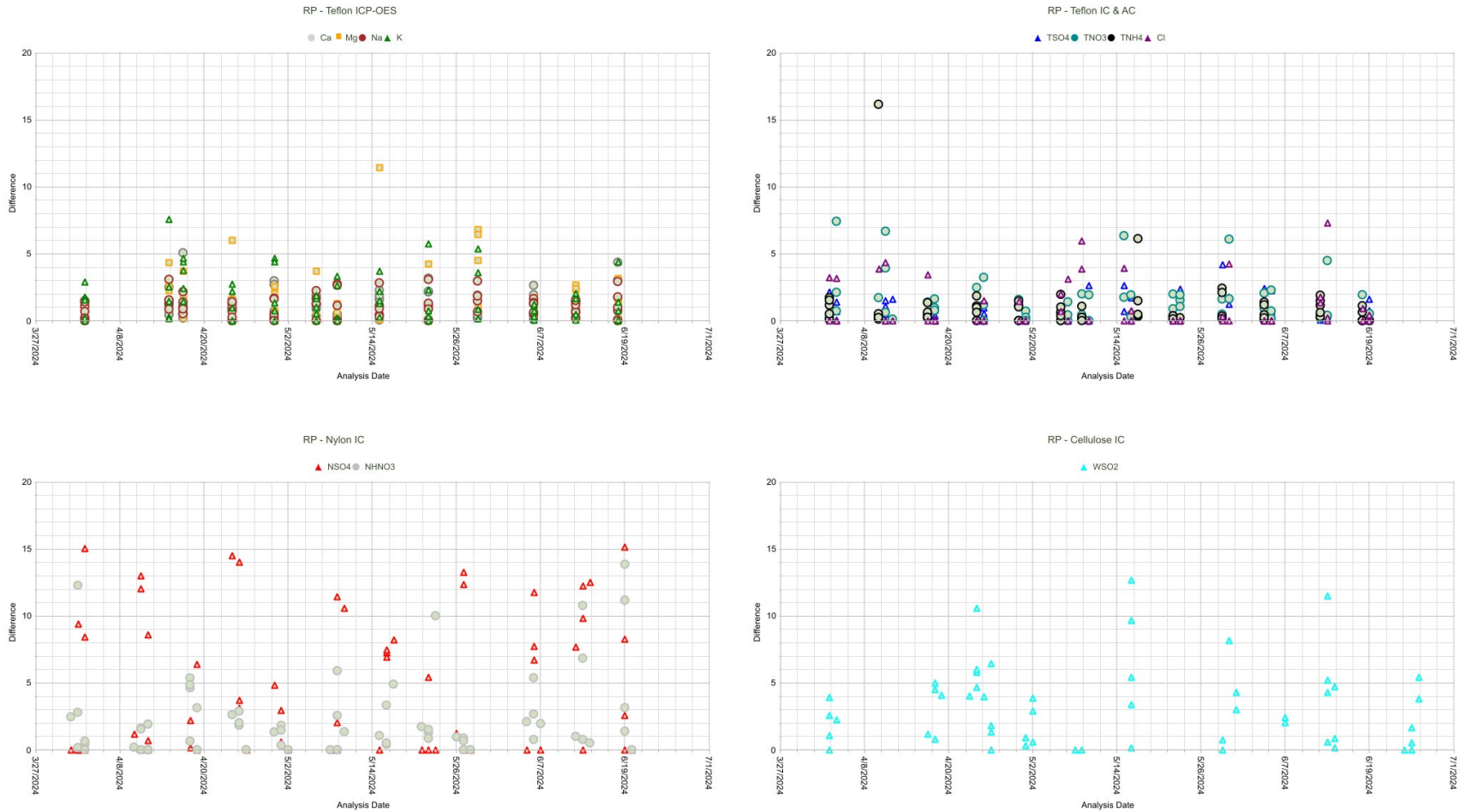


Figure 4 Laboratory Control Sample Results for Second Quarter 2024 (percent recovery)

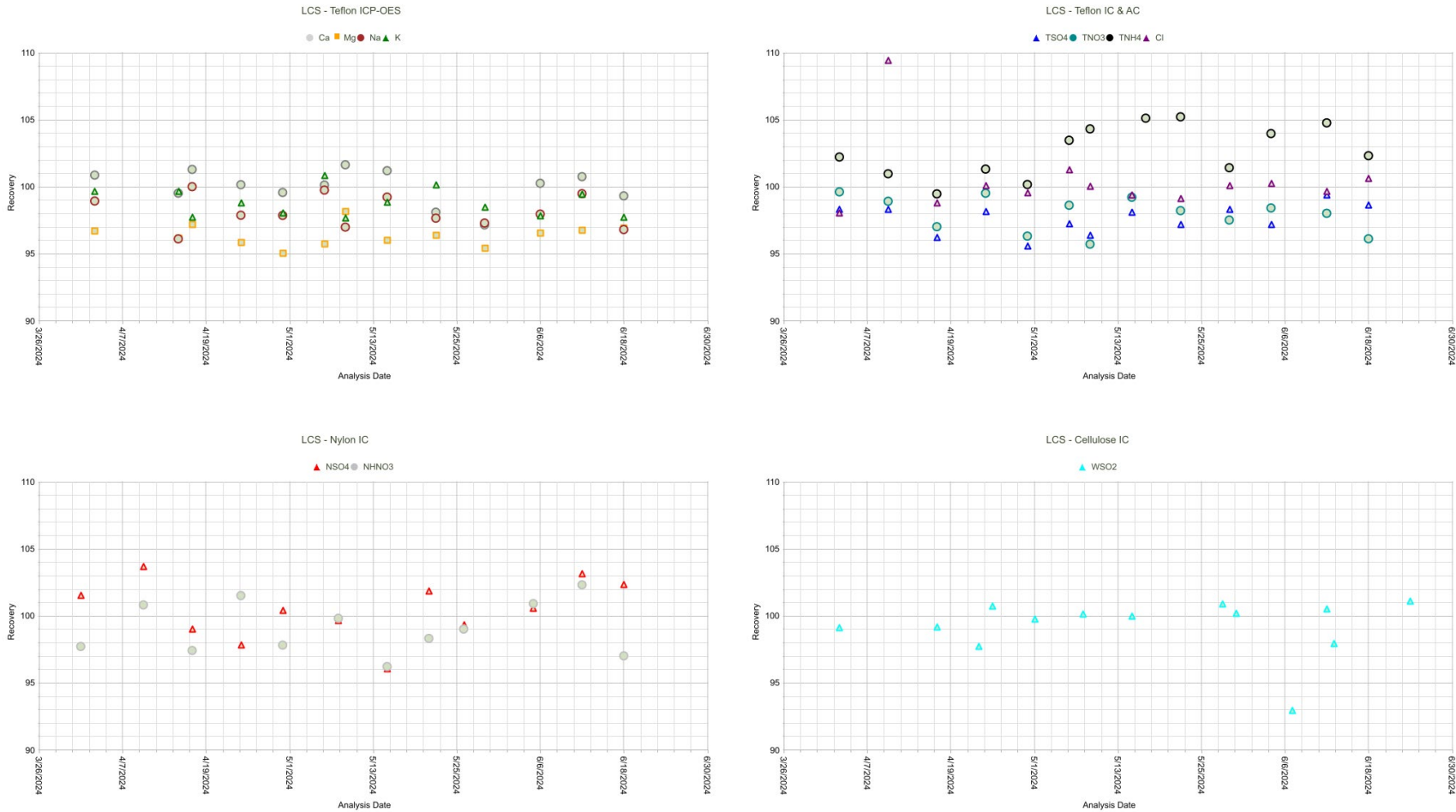


Figure 5 Method Blank Analysis Results for Second Quarter 2024 (total micrograms)

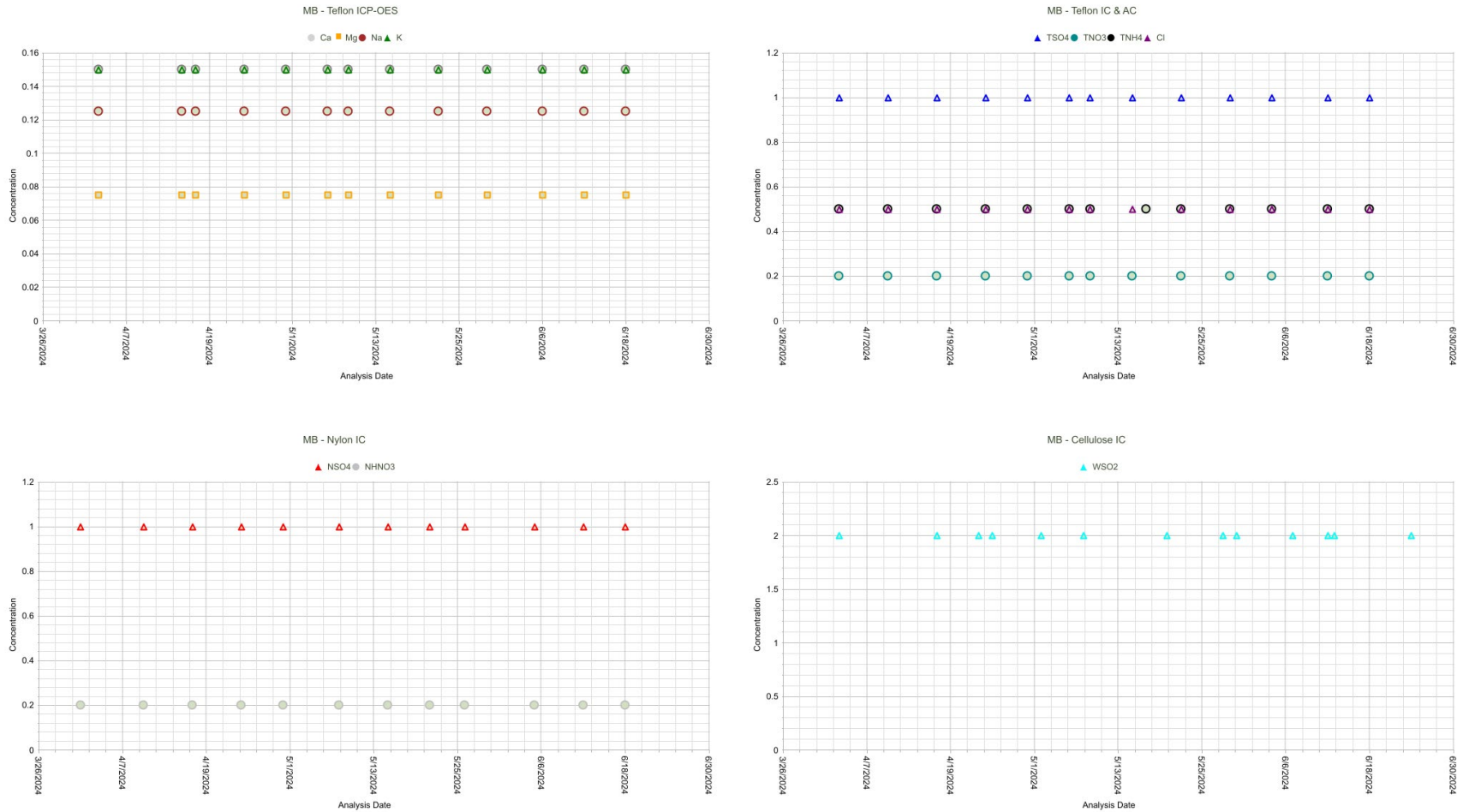


Figure 6 Laboratory Blank Analysis Results for Second Quarter 2024 (total micrograms)

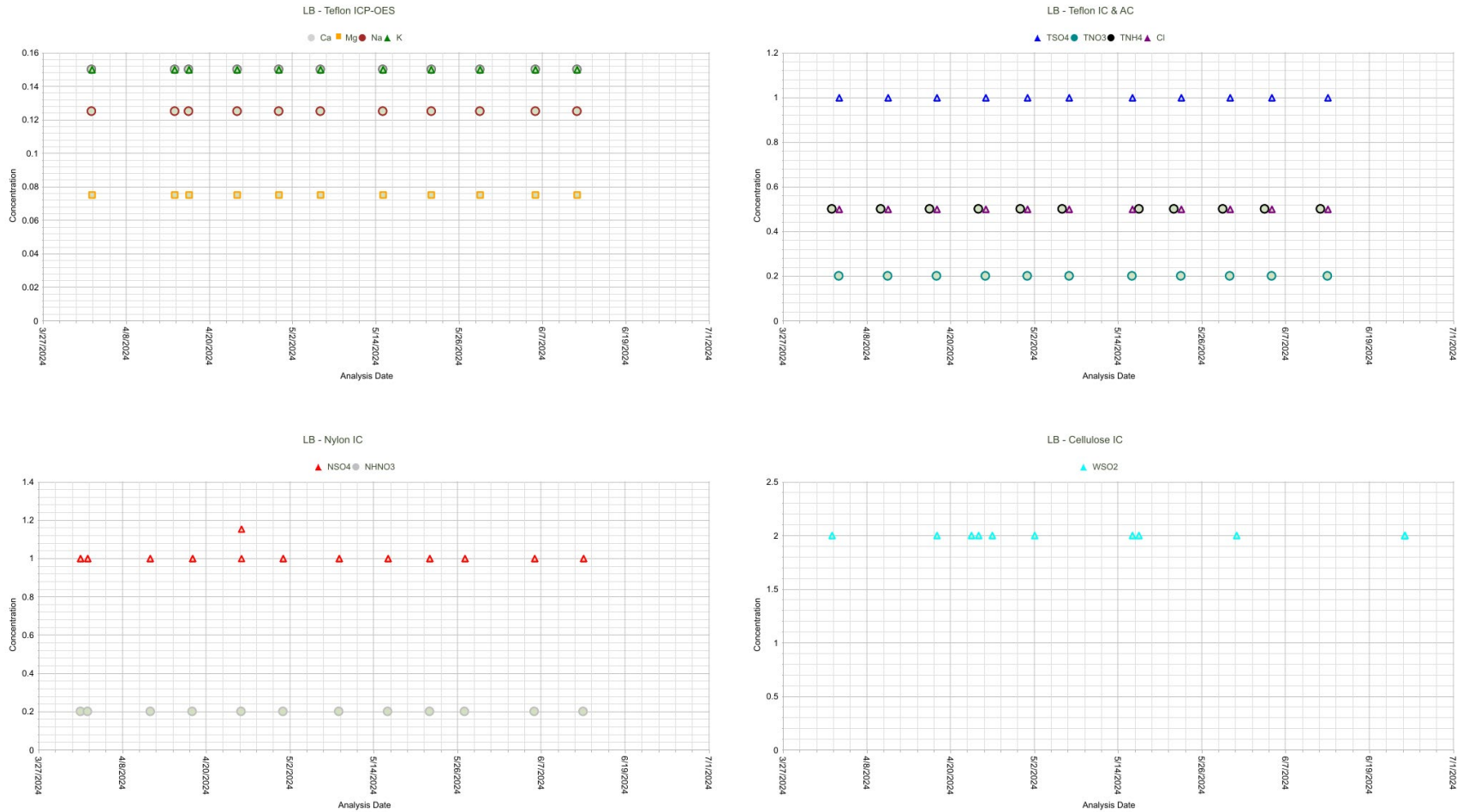


Figure 7 Field Blank Analysis Results for Second Quarter 2024 (total micrograms)

