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WELD COUNTY MONITORING NETWORK

AIR QUALITY AND METEOROLOGICAL MONITORING DATA: 2ND QUARTER 2024 SUMMARY REPORT

RAMBOLL

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ACRONYMS AND ABBREVIATIONS

agl	Above Ground Level
pH	Acidity
NH3	Ammonia
AMoN	Ammonia Monitoring Network
NH4	Ammonium
Br	Bromide
Ca	Calcium
Cl	Chloride
CAAQS	Colorado Ambient Air Quality Standards
GHG	Greenhouse Gas
GPT	Gas Phase Titration
GPTZ	Gas Phase Titration Zero
L	Lab
Mg	Magnesium
m	Meter
µg/m3	Micrograms per meter cubed
µS/cm	Micro-Siemens per centimeter
mg/m3	Milligrams per meter cubed
MDT	Mountain Daylight Time
MSP	Missile Site Park
NAAQS	National Ambient Air Quality Standards
AAQS	National Ambient Air Quality Standards and Colorado Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
NTN	National Trends Network
NO3	Nitrate
NO2	Nitrogen Dioxide
NO	Nitrogen Oxide
NOx	oxides of nitrogen
ppb	parts per billion
ppm	parts per million

PO4	Phosphate
K	Potassium
QAPP	Quality Assurance Project Plan
RH	Relative Humidity
Na	Sodium
SO4	Sulfate
TAPI	Teledyne Advanced Pollution Instrumentation

1. INTRODUCTION AND REPORT SUMMARY

Weld County has commissioned the installation and operation of an air quality and meteorological monitoring network consisting of three monitoring stations located in areas that do not have existing air quality monitoring stations. The purpose of the monitoring network is to collect ambient air quality and meteorological data to inform current and future air quality management actions and policies. Weld County monitoring objectives support a wide variety of air quality management goals that were developed in consideration of current and expected future regulatory drivers related to ozone (O_3), greenhouse gases (GHG), and nitrogen air pollutants. The three stations are named Missile Site Park (MSP), Hereford, and Orchard and their locations are shown in **Figure 1**. MSP was operational and began collecting data on November 16, 2020. Hereford was operational and began collecting data on December 16, 2020. Orchard was operational and began collecting data on December 30, 2020.

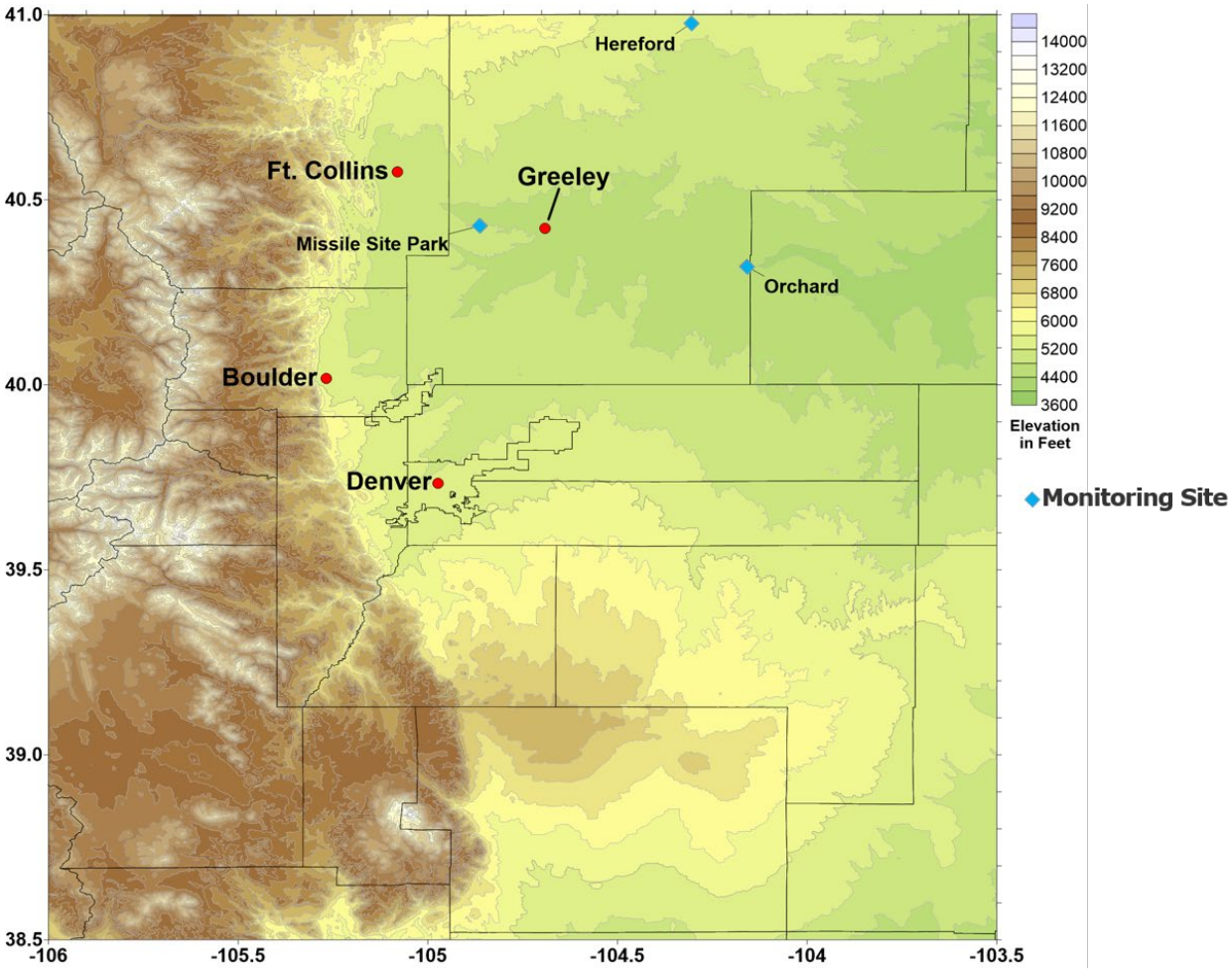


Figure 1. Weld County Monitoring Station Locations

All three monitoring stations measure O_3 concentrations and a full suite of meteorological parameters. A complete list of all collected meteorological measurements is included in **Chapter 2** of this report. In addition, oxides of nitrogen (NO_X) concentrations, measured as NO_X, nitrogen dioxide (NO_2) and

nitrogen oxide (NO) are measured at MSP. Lastly, gaseous ammonia and precipitation chemistry are measured at MSP and Orchard. Based on an air monitoring network assessment conducted for Weld County,[1] it was recommended to monitor these compounds at these locations to best support Weld County's near-term data needs and air quality management goals. The Weld County Air Monitoring Network Assessment[2] considered locations of existing monitors, concentration trends, and spatial distributions of emissions.

Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Quarterly Report for Weld County's air quality and meteorological monitoring program to summarize the final, validated data and provide transparent, publicly-available documentation regarding the quality assurance and quality control procedures. This report for the 2nd quarter of 2024 (Q2 2024) provides a monthly and quarterly summary of all air quality and meteorological data collected at Weld County's monitoring stations during the period from April 1, 2024 through June 30, 2024. Details regarding the monitoring program, the three monitoring station locations, equipment specifications, and quality assurance procedures are included in the following sections. Lastly, a comprehensive summary of Q2 2024 data is presented in comparison to National Ambient Air Quality Standards (NAAQS) and Colorado Ambient Air Quality Standards (CAAQS) to help readers understand how measurements compare to federal and state air quality standards.

NAAQS and CAAQS are collectively referred to as "AAQS". The AAQS for O_3 and NO_2 are listed in **Table 1** below. For O_3 there are two different AAQS: one standard of 0.075 part per million (ppm), which was established in 2008, and a more restrictive O_3 standard of 0.070 ppm, which was established in 2015. Both standards are still in effect; therefore, measured O_3 concentrations are compared to both standards. Similarly, for NO_2 there are two different AAQS: one standard is 100 parts per billion (ppb) for a 1-hr average and another standard is 53 ppb for a yearly average.

Both O_3 and NO_2 AAQS have both a "Primary" standard and a "Secondary" standard. The Primary standard is for protection of public health while the Secondary standard is for protection of public welfare (such as protection against damage to crops, animals, and vegetation). For O_3 and NO_2, the level of the Primary and the Secondary standards are the same.

Meteorology measurements for Q2 2024 were all within normal ranges for the area and season. At all three stations, average temperatures were coldest during April and warmest during June. Average solar radiation gradually increased as the Quarter progressed at all three sites while maximum solar radiation occurred in May at MSP and Orchard and in June at Hereford. Precipitation was highest at both Hereford and Orchard in June and peaked in May at MSP. Continuous gaseous pollutant measurements for Q2 2024 indicate that all three stations generally had good air quality. Concentrations remained below the respective AAQS values for NO_2, and O_3 had only one instance at MSP that exceeded the 2015 ozone AAQS value. At MSP, the highest hourly average NO_2 recorded during Q2 2024 was 22.0 ppb on April 12th. The maximum hourly average O_3 concentration at each

[1] Ramboll, Air Monitoring Network Assessment, 2020. Available by request.

[2] Id.

site was 68 ppb on May 14th at Hereford, 82 ppb on May 6th at Orchard, and 88 ppb on June 26th at MSP.

It is important to note that O_3 and NO_2 measurements have now been collected for three years, enabling measurements to be compared to AAQS. The measured concentrations are compared to AAQS for informational purposes.

Table 1. AAQS for O_3 and NO_2

Pollutant (Year)	Primary/Secondary	Averaging Time	Level	Form
O_3 (2015)	Primary & Secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentrations, averaged over 3 years
O_3 (2008)	Primary & Secondary	8 hours	0.075 ppm	Annual fourth-highest daily maximum 8-hour concentrations, averaged over 3 years
NO_2	Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary & Secondary	1 year	53 ppb	Annual Mean

Notes
O_3 ozone
NO_2 nitrogen dioxide
ppb parts per billion
ppm parts per million

Adapted from the NAAQS Table available here: https://www.epa.gov/criteria-air-pollutants/naaqs-table

2. SUMMARY OF MONITORING PROGRAM

2.1 Monitoring Station Locations

The three Weld County air quality station locations were guided by the *Weld County Air Monitoring Network Assessment*[3] which analyzed Weld County's monitoring objectives, existing monitoring stations, and emissions source locations to determine high priority areas to conduct monitoring. Final station locations were determined in consideration of logistical requirements such as accessibility, availability of power, and proximity of large emissions sources which could affect the representativeness of station measurements. Weld County's monitoring network consists of three stations:

- MSP is the primary monitoring station and is located northwest of Greeley, CO. MSP monitors O_3, oxides of nitrogen (NO_x), wet deposition via the National Trends Network (NTN), gaseous ammonia via the Ammonia Monitoring Network (AMoN), and meteorological parameters from a 10-meter (m) tower;
- Hereford is a secondary station located in north-central Weld County and monitors O_3 and meteorological parameters from a 10-m tower; and
- Orchard is also a secondary station located in eastern Weld County to monitor O_3, wet deposition via the NTN, ammonia via the AMoN, and meteorological parameters from a 10-m tower.

2.2 Monitoring Instrumentation

The installation, configuration, calibration, and integration of the monitoring network along with technical specifications for all equipment and monitoring systems are summarized in the *Weld County Ambient Air Monitoring Program Quality Assurance Project Plan* (QAPP), referred to hereafter as the QAPP[4]. Weld County's monitoring program is conducted in accordance with the QAPP.

Table 2 and **Table 3** summarize the key air quality and meteorological monitoring equipment and measurement specifications for the Weld County stations. The monitoring systems, sampling frequencies, quality assurance program, and data management aspects of the monitoring program are described in the QAPP.[5]

[3] Id.

[4] Ramboll, Weld County Ambient Air Monitoring Program Quality Assurance Project Plan (QAPP), September 18th 2023. Available by request.

[5] Id.

Table 2. Weld County Air Quality Monitoring Station Equipment Specifications

Measurement	Manufacturer	Model	Serial Number	Zero and Span Noise	Detection Limit	Drift Over 24-hour Period	Response Time	Units
Missile Site Park								
O_3	TAPI	T400	5986	<0.2 ppb @ 0 ppb & <0.5% reading above 100 ppb	<0.4 ppb	<1 ppb @ 0 ppb & <1% of reading @ span	<30 seconds to 95%	ppb, ppm, $\mu g/m^3$, mg/m^3
NO_x	TAPI	T200 (w/ sample conditioner; part number KIT000262)	6727	<0.1 ppb @ 0 ppb & <0.2% reading above 50 ppb	<0.2 ppb	<0.5 ppb @ 0 ppb & <0.5% of reading @ full scale	<80 seconds to 95%	ppb, ppm, $\mu g/m^3$, mg/m^3
Gas Dilution/O_3 Transfer Standard	TAPI	T700	4969	1% of reading (linearity)	N/A	<1.0 ppb @ 0 ppb	<20 seconds to 95% (photometer response)	N/A
NH_3	Radiello	N/A	N/A	N/A	0.083 mg/L (Network) 0.013 mg/L (Lab)	N/A	N/A	N/A

Measurement	Manufacturer	Model	Serial Number	Zero and Span Noise	Detection Limit	Drift Over 24-hour Period	Response Time	Units
National Trends Network	N/A	N/A	N/A	N/A	Ca (0.023 mg/L) Mg (0.006 mg/L) K (0.005 mg/L) Na (0.010 mg/L) Br (0.006 mg/L) NH_4 (0.017 mg/L) NO_3 (0.018 mg/L) Cl (0.018 mg/L) SO_4 (0.018 mg/L) PO_4 (0.010 mg/L) Conductance (µS/cm) pH	N/A	N/A	N/A
Orchard								
O_3	TAPI	T400	5985	<0.2 ppb @ 0 ppb & <0.5% reading above 100 ppb	<0.4 ppb	<1 ppb @ 0 ppb & <1% of reading @ span	<30 seconds to 95%	ppb, ppm, $\mu g/m^3$, mg/m^3
O_3 Transfer Standard	TAPI	T703	824	±1% of full scale (linearity)	N/A	<1 ppb @ 0 ppb (7 days) & <1% @ span	<20 seconds to 95% (photometer response)	N/A
NH_3	Radiello	N/A		N/A	0.083 mg/L (Network) 0.013 mg/L (Lab)	N/A	N/A	N/A

Measurement	Manufacturer	Model	Serial Number	Zero and Span Noise	Detection Limit	Drift Over 24-hour Period	Response Time	Units
National Trends Network	N/A	N/A	N/A	N/A	Ca (0.023 mg/L) Mg (0.006 mg/L) K (0.005 mg/L) Na (0.010 mg/L) Br (0.006 mg/L) NH_4 (0.017 mg/L) NO_3 (0.018 mg/L) Cl (0.018 mg/L) SO_4 (0.018 mg/L) PO_4 (0.010 mg/L) Conductance (µS/cm) pH	N/A	N/A	N/A
Hereford								
O_3	TAPI	T400	5984	<0.2 ppb @ 0 ppb & <0.5% reading above 100 ppb	<0.4 ppb	<1 ppb @ 0 ppb & <1% of reading @ span	<30 seconds to 95%	ppb, ppm, $\mu g/m^3$, mg/m^3
O_3 Transfer Standard	TAPI	T703	825	±1% of full scale (linearity)	N/A	<1 ppb @ 0 ppb (7 days) & <1% @ span	<20 seconds to 95% (photometer response)	N/A

Measurement	Manufacturer	Model	Serial Number	Zero and Span Noise	Detection Limit	Drift Over 24-hour Period	Response Time	Units

Notes:

O_3	Ozone	ppb	parts per billion	Mg	Magnesium	NH_4	Ammonium
NO_x	Oxides of nitrogen	ppm	parts per million	K	Potassium	NO3	Nitrate
NH_3	Ammonia	$\mu g/m^3$	Micrograms per meter cubed	Na	Sodium	Cl	Chloride
mg/m^3	Milligrams per meter cubed			Br	Bromide	SO_4	Sulfate
PO_4	Phosphate	Ca	Calcium	pH	Acidity	TAPI	Teledyne Advanced Pollution Instrumentation
		µS/cm	Micro-Siemens per centimeter				

Table 3. Weld County Meteorological Monitoring Station Equipment Specifications

Measurement	Count	Tower Location (m)	Manufacturer	Model	Serial Number	Accuracy	Range	Description
Missile Site Park								
Wind speed & direction	1	10	R.M. Young	05305V	180188	±0.2 m/s & ±3 degrees	0-50 m/s 0-355 deg	Wind monitor
Ambient temperature/Vertical temperature difference	2	2m and 10m	R.M. Young	41342VC	32951 (2 m) 32952 (10 m)	±0.1 °C	-50 to 50°C	Temperature probe with radiation shield
Relative humidity (RH)	1	2	Campbell Scientific/E+E Elektronik	EE181	20151600125038	±1.3% RH [1]	0-100%	Relative humidity and temperature sensor
Solar radiation	1	2	Hukseflux	LP02	48019	<0.15% per °C	0-2000 W/m^2	Thermal pyranometer
Barometric pressure	1	2	Setra	278	7563464	±1.5 hPa[2]	450-825 mmHg	Barometric pressure sensor
Precipitation	1	Ground	R.M. Young	52202	TB16137	2%-3% [3]	0-50 mm/hr	Heated tipping bucket rain gauge
Precipitation-NTN	1	Ground	ETI Instrument Systems	NOAH IV	4310	±0.254 mm	0-280 in/hour	Weight-based rain gauge
Collection bucket-NTN	1	Ground	N-CON	00-120-2N	60441	N/A	N/A	Wet deposition collection buckets
Orchard								
Wind speed & direction	1	10	R.M. Young	05305V	180186	±0.2 m/s & ±3 degrees	0-50 m/s 0-355 deg	Wind monitor
Ambient temperature/Vertical temperature difference	2	2m and 10m	R.M. Young	41342VC	32953 (2 m) 32954 (10 m)	±0.1 °C	-50 to 50°C	Temperature probe with radiation shield

Measurement	Count	Tower Location (m)	Manufacturer	Model	Serial Number	Accuracy	Range	Description
Relative humidity	1	2	Campbell Scientific/E+E Elektronik	EE181	201516001269F1	±1.3% RH [1]	0-100%	Relative humidity and temperature sensor
Solar radiation	1	2	Hukseflux	LP02	48014	<0.15% per °C	0-2000 W/m^2	Thermal pyranometer
Barometric pressure	1	2	Setra	278	7563445	±1.5 hPa [2]	450-825 mmHg	Barometric pressure sensor
Precipitation	1	Ground	R.M. Young	52202	TB16138	2% - 3% [3]	0-50 mm/hr	Heated tipping bucket rain gauge
Precipitation-NTN	1	Ground	ETI Instrument Systems	NOAH IV	4311	±0.254 mm	0-280 in/hour	Weight-based rain gauge
Collection bucket-NTN	1	Ground	N-CON	00-120-2N	60442	N/A	N/A	Wet deposition collection buckets
Hereford								
Wind speed & direction	1	10	R.M. Young	05305V	180187	±0.2 m/s & ±3 degrees	0-50 m/s 0-355 deg	Wind monitor
Ambient temperature/Vertical temperature difference	2	2m and 10m	R.M. Young	41342VC	32950 (2 m) 32869 (10 m)	±0.1 °C	-50 to 50°C	Temperature probe with radiation shield
Relative humidity	1	2	Campbell Scientific/E+E Elektronik	EE181	2015160012638F	±1.3% RH [1]	0-100%	Relative humidity and temperature sensor
Solar radiation	1	2	Hukseflux	LP02	48015	<0.15% per °C	0-2000 W/m^2	Thermal pyranometer
Barometric pressure	1	2	Setra	278	7573233	±1.5 hPa [2]	450-825 mmHg	Barometric pressure sensor
Precipitation	1	Ground	R.M. Young	52202	TB16139	2% - 3% [3]	0-50 mm/hr	Heated tipping bucket rain gauge

Notes:

%	Percent	m/s	Meters per second	W/m^2	Watts per meter squared
ºC	Degrees Celsius	RH	Relative humidity	mmHg	Millimeters of mercury
mm/hr	Millimeters per hour	deg	Degrees	in/hour	Inches per hour

[1] The manufacturer specifies an accuracy range based on a temperature range -15 to 40 °C and RH between 0 and 90%. Above 90% RH, the accuracy decreases to ±2.3% RH

[2] This accuracy range is achieved when the temperature is between -20 to 50 °C.

[3] This accuracy is 2% when the precipitation rate is 25 mm/hr or less and the accuracy is 3% when the precipitation rate is between 25 mm/hr and 50 mm/hr.

3. MONITORING METHODOLOGY

3.1 Data Collection, Management and Storage

All meteorological and gas analyzer data are collected on a continuous basis using a Campbell Scientific Inc. (Campbell) CR3000 data logger. Data are then output to files on 15-minute, 60-minute, and 24-hour frequency. Custom 1-minute and 15-minute tables are also stored by the logger for gaseous calibration tracking and public access of meteorology, respectively. Data files are stored on the CR3000. All three stations are programmed to automatically download and save files from the CR3000 to a Ramboll computer on a daily basis. Data files are also manually saved to a separate Ramboll computer several times per week.

Real-time meteorological data for all three stations are also available on the Weld County Public Health Department website. Plots on the Weld County website provide wind speed, maximum wind gusts, wind direction, surface temperature, and precipitation for 15-minute intervals. Data are shown for the previous three days and are updated every 30 minutes.

3.2 Quality Assurance/Quality Control

The quality assurance objectives for this monitoring program are documented in the QAPP. These objectives are designed to be consistent with those outlined in 40 CFR Part 58 Appendix A, *US EPA Quality Assurance Handbook for Air Pollution Measurement Systems Volume II: Ambient Air Monitoring Program*, and *US EPA Quality Assurance Handbook for Air Pollution Measurement Systems Volume IV: Meteorological Measurements* (together, the "QA Handbooks").[6][7] The QA Handbooks specify the minimum system requirements applicable to data collection and quality assurance requirements for ambient air quality pollutants and meteorological measurements.

3.2.1 Accuracy and Performance Audits

The audit procedures for this monitoring program include semi-annual audits in accordance with the QAPP.[8] Audits will be performed in calendar Quarters 2 and 4. Results from the Quarter 2 2024 audits and calibrations are available in **APPENDIX A**.

3.2.2 Calibration Protocol

The calibration procedures utilized for the project included automated routine calibration checks in accordance with the QAPP. For O_3 analyzers, calibration checks include Precision-Span-Zero checks at all three stations three times per week. For the NO_x analyzer at MSP, calibration checks include Precision-Span-Zero checks and gas-phase titration checks twice per week. Note that the Precision-Span-Zero check and titration checks occur on different days. Maintenance is performed as necessary in response to measured deviations during calibrations and as part of planned routine activities during

[6] USEPA, *Quality Assurance Handbook for Ambient Air Quality Monitoring Volume II: Ambient Air Quality Monitoring Program*, January 2017. Available at: https://www.epa.gov/sites/default/files/2020-10/documents/final_handbook_document_1_17.pdf. Accessed February 2024.

[7] USEPA, *Quality Assurance Handbook for Ambient Air Quality Monitoring Volume IV: Meteorological Measurements*, March 2008. Available at: https://www.epa.gov/sites/default/files/2021-04/documents/volume_iv_meteorological_measurements.pdf. Accessed July 2024.

[8] Ramboll, Weld County Ambient Air Monitoring Program Quality Assurance Project Plan (QAPP), September 18th 2023. Available by request.

station inspections. A summary of calibration data is available in **APPENDIX D**. All analyzers were within USEPA criteria for the entire quarter. More detail is provided in the next section.

3.2.3 Data Completeness and Significant Events

Data completeness is calculated as the amount of valid data divided by the amount of potential data possible over a specified period, expressed as a percentage. In accordance with the QAPP, data are reviewed to determine that data are valid. Any data that is affected by known and qualifiable instrument performance problems, periods of routine maintenance, power failures, and/or site visits, or calibration/audit checks are invalidated. Hours with invalid data are removed from the final valid dataset and lower the calculated data completeness statistics. Program activities conducted during Q2 2024 included data collection, equipment programming and calibrations, station inspections, routine maintenance, equipment troubleshooting and repair, routine data acquisition, data screening and validation, and report preparation. Significant events that resulted in invalidation of data are documented in **APPENDIX D. APPENDIX C** contains the site log.

Consistent with data completeness requirements specified in the QA Handbooks, the quarterly data completeness goals are greater than (≥) 75% for NO_2 data, and ≥ 90% for meteorological data. For O_3, the data completeness goals are ≥ 75% of the daily maximum 8-hour average O_3 during the O_3 season, which in Colorado is January to December[9]. However, over three consecutive ozone seasons the overall data completeness must be ≥ 90% on average, thus we have set a goal of ≥ 90%. A summary of data completeness targets and program results by month and for the quarter is presented in **Table 4** for all continuous monitoring systems. During Q2 2024, data losses occurred from regularly scheduled gas calibrations (483 hours), multi-point calibrations (115 hours), power outages (42 hours), manual gas calibrations (36 hours), instrument maintenance (24 hours), and other miscellaneous issues (281 hours).

Notable events that occurred during the quarter that resulted in data loss include: (1) MSP's NO_2 analyzer experienced a filter leak from 5/28 through 5/30 and (2) the inlet line at Orchard was contaminated by insects from 6/14 through 6/19. Despite these data losses, all data completeness goals were met at each of the three sites during Q2 2024. Data completeness for O_3 will be evaluated once the O_3 season is complete in December 2024 in accordance with the data completeness targets.

The QA Handbooks have also established goals for instrument accuracy and precision. **Figure 2** presents a graphic that depicts the importance of accuracy and precision. **Table 5** presents the instrument accuracy and precision targets and whether those targets were achieved by the instruments deployed at each station during the Q2 2024 semi-annual calibrations. Note that the wind speed at Orchard passed all audit points except the highest wind speed point of 25.6 m/s. All wind speed data below this value was considered valid during Q2; data points were invalidated in two instances when the measured wind speed exceeded this value. See **APPENDIX A** for more detail.

[9] USEPA Ozone Seasons, February 13 2024. Available at: https://aqs.epa.gov/aqsweb/documents/codetables/ozone_seasons.html. Accessed: February 2024.

Table 4. 2nd Quarter 2024 Data Completeness for Continuous Measurement Devices

Measurement	Time Period	Completeness Target	Site Completeness				Target Met? (Y/N)
			Apr	May	Jun	Q2 2024	
Missile Site Park							
NO_2[1]	Quarterly	≥75%	93%	89%	94%	92%	Yes
NO_x, NO[1]	N/A	N/A	93%	89%	94%	92%	N/A
O_3[1]	O_3 Season	≥90%	93%	100%	100%	98%	N/A
Wind Direction[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Wind Speed[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Temperature[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Delta Temperature[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Relative Humidity[2]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Solar Radiation[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Barometric Pressure[2]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Precipitation[2,3]	Quarterly	≥90%	100%	99%	100%	100%	Yes
Hereford							
O_3[1]	O_3 Season	≥90%	100%	97%	100%	99%	N/A
Wind Direction[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Wind Speed[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Temperature[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Delta Temperature[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Relative Humidity[2]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Solar Radiation[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Barometric Pressure[2]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Precipitation[2,3]	Quarterly	≥90%	100%	100%	99%	100%	Yes
Orchard							
O_3[1]	O_3 Season	≥90%	93%	100%	83%	92%	N/A
Wind Direction[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Wind Speed[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Temperature[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes

Measurement	Time Period	Completeness Target	Site Completeness				Target Met? (Y/N)
			Apr	May	Jun	Q2 2024	
Delta Temperature[2,3]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Relative Humidity[2]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Solar Radiation[2]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Barometric Pressure[2]	Quarterly	≥90%	100%	100%	100%	100%	Yes
Precipitation[2]	Quarterly	≥90%	100%	100%	99%	100%	Yes

Notes:

[1] USEPA Quality Assurance Handbook for Air Pollution Measurement Systems Volume II: Ambient Air Quality Monitoring Program, recommends three consecutive response concentrations be within +/- 15% of the audit concentration for quarterly audits. For bi-weekly QC checks acceptable monitor responses are +/-15.1% for NO_2 and 7.1% for O_3. The data completeness target for NO_2 is ≥75%; there is no data completeness target for NO or NO_x. For O_3, the data completeness target is met for a 3-year period with an average of 90% of daily maximum 8-hour averages available for a 3-year ozone season period. In Colorado, the Ozone season is January through December (https://aqs.epa.gov/aqsweb/documents/codetables/ozone_seasons.html).

[2] Table 0-9, USEPA Quality Assurance Handbook for Air Pollution Measurement Systems (Volume IV: Meteorological Measurements, Version 2.0).

[3] Table 0-10, USEPA Quality Assurance Handbook for Air Pollution Measurement Systems (Volume IV: Meteorological Measurements, Version 2.0). Temperature is measured at 2 meters above ground level.

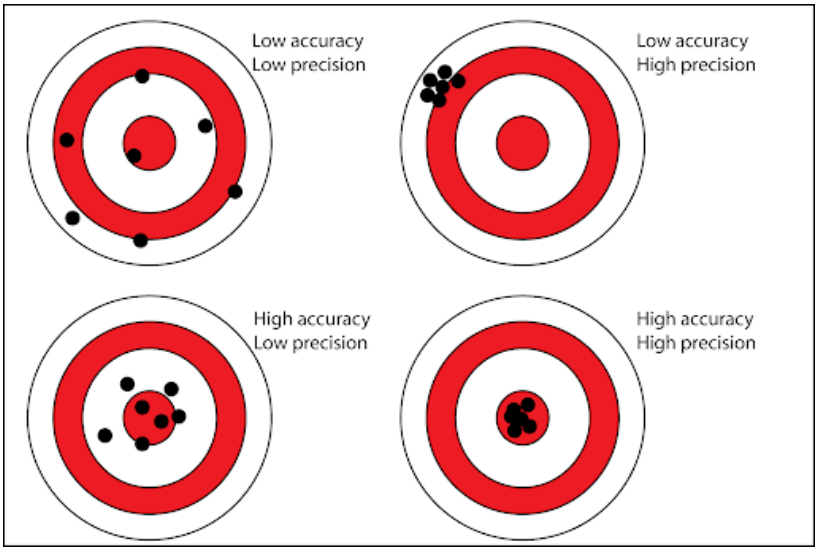


Figure 2. Graphical Representation of Accuracy and Precision

Table 5. 2nd Quarter 2024 Accuracy and Precision

Measurement	Target Accuracy	Target Precision	Q2 2024 Calibration Results[1]
Missile Site Park			
$NO_x/NO/NO_2$	±15%	±15.1%	PASS[2]
O_3	±15%	±7.1%	PASS
Wind Direction	±5°	±5°	PASS
Wind Speed	±0.2 m/s	±0.2 m/s	PASS
Temperature	±0.5 °C	±0.5 °C	PASS
Delta Temperature	±0.1 °C	±0.1 °C	PASS
Relative Humidity	±7%	±7%	PASS
Solar Radiation	±5%	±5%	PASS
Barometric Pressure	±2.25 mm Hg	±2.25 mm Hg	PASS
Precipitation	±10%	±10%	PASS
Hereford			
O_3	±15%	±7.1%	PASS
Wind Direction	±5°	±5°	PASS
Wind Speed	±0.2 m/s	±0.2 m/s	PASS
Temperature	±0.5 °C	±0.5 °C	PASS
Delta Temperature	±0.1 °C	±0.1 °C	PASS
Relative Humidity	±7%	±7%	PASS
Solar Radiation	±5%	±5%	PASS
Barometric Pressure	±2.25 mm Hg	±2.25 mm Hg	PASS
Precipitation	±10%	±10%	PASS
Orchard			
O_3	±15%	±7.1%	PASS
Wind Direction	±5°	±5°	PASS
Wind Speed	±0.2 m/s	±0.2 m/s	FAIL[3]
Temperature	±0.5 °C	±0.5 °C	PASS
Delta Temperature	±0.1 °C	±0.1 °C	PASS
Relative Humidity	±7%	±7%	PASS
Solar Radiation	±5%	±5%	PASS
Barometric Pressure	±2.25 mm Hg	±2.25 mm Hg	PASS
Precipitation	±10%	±10%	PASS

Notes:

[1] Results of calibrations are found in Appendix A of this report.

[2] The lowest flow set point on the low-flow mass flow controller (MFC) was found to be outside of acceptance criteria during the Q2 2024 audit check and was subsequently re-calibrated to be within specification. It was determined that this result did not impact data since this flow rate is outside the range of flows that the MFC operates in during all calibration checks.

[3] The highest wind speed audit point was found to be outside of the acceptance criteria during the Q2 2024 audit check and was subsequently re-calibrated to be within specification. Data points at or above this threshold were invalidated during the period, resulting in the loss of two hourly data points.

4. AIR QUALITY DATA SUMMARY

Air quality data collected includes O_3 at all three stations and $NO/NO_x/NO_2$ at the MSP station. In addition, wet deposition and gaseous ammonia are measured in accordance with the National Atmospheric Deposition Program (NADP) standard operating procedures at MSP and Orchard. Q2 2024 wet deposition and gaseous ammonia data from NADP are not yet available. When Q2 2024 wet deposition and gaseous ammonia data are available a separate memorandum will be issued. This section summarizes the O_3 and NO_2 data collected during Q2 2024.

4.1 Gaseous O_3 Data Summary

O_3 data collected for Q2 2024 at all three stations was compared against the 2008 O_3 AAQS (0.075 ppm) and 2015 ozone AAQS (0.070 ppm). Both the 2008 and 2015 ozone AAQS are based on the fourth highest daily maximum 8-hour ozone concentration averaged over 3 years. The daily maximum 8-hour average ozone concentrations measured at all three stations during Q2 2024 remained below the level of the 2008 AAQS value; there was one exceedance of the 2015 AAQS value at MSP on June 26th. The four highest daily maximum 8-hour average ozone concentrations at all three stations for Q2 2024 are presented in **Table 6.** The rolling 8-hour averaged ozone concentrations at MSP, Hereford, and Orchard are presented in **Figure 3**, **Figure 4**, and **Figure 5**, respectively. Compliance with the AAQS standard for 2024 will be determined at the conclusion of the calendar year.

4.1.1 MSP O_3 Data Summary

At MSP, measured daily maximum 8-hour average ozone concentrations remained below the 2008 standard, and exceeded the 2015 standard once on June 26th.

4.1.2 Hereford O_3 Data Summary

At Hereford, measured daily maximum 8-hour average ozone concentrations remained below the 2008 and 2015 standards.

4.1.3 Orchard O_3 Data Summary

At Orchard, measured daily maximum 8-hour average ozone concentrations remained below the 2008 and 2015 standards. Note, the gap in the data from June 13th through June 18th is due to an issue with insects clogging the airflow and is indicated by the annotation in **Figure 5.**

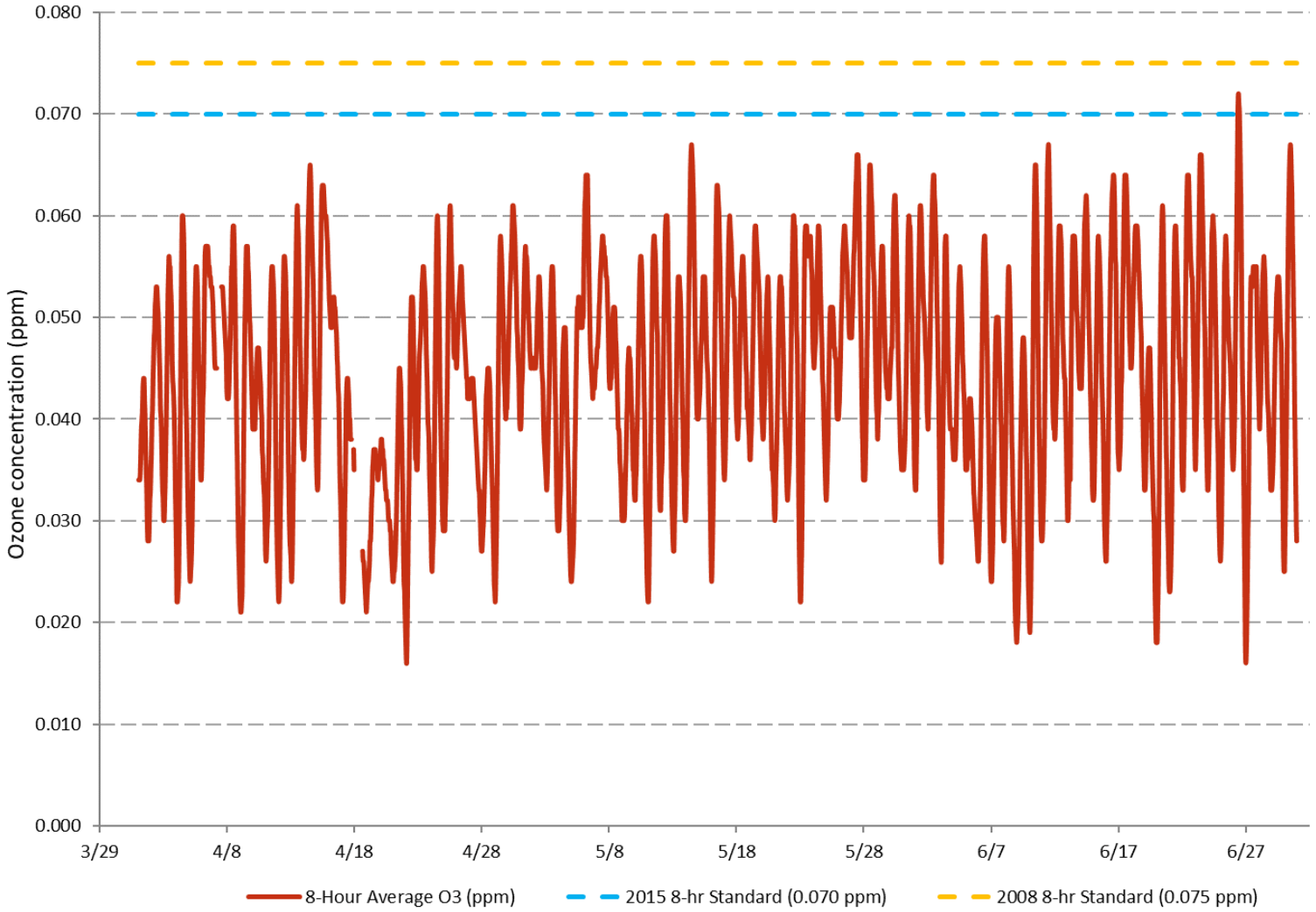


Figure 3. MSP Q2 2024 Rolling 8-hour averaged O_3

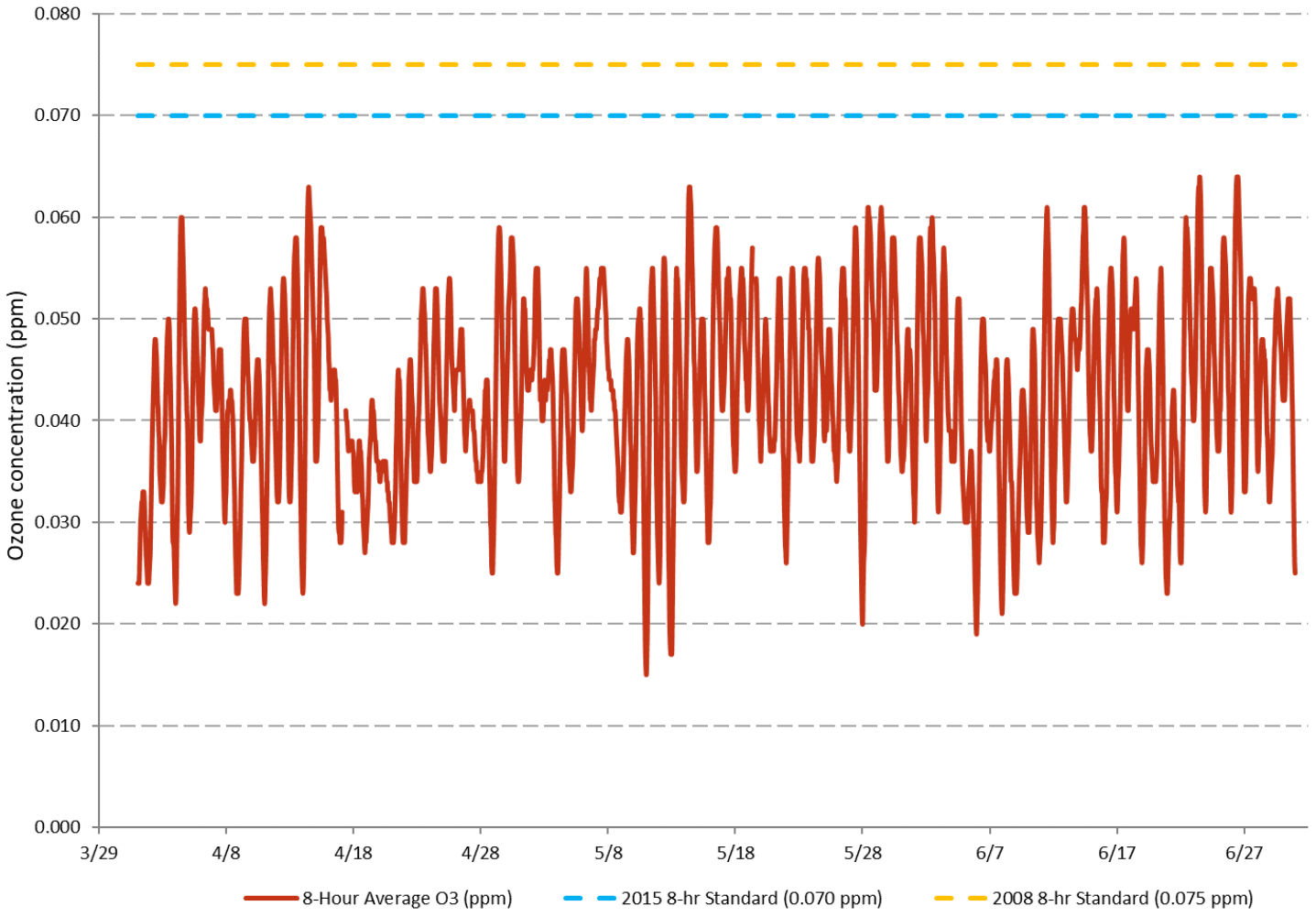


Figure 4. Hereford Q2 2024 Rolling 8-hour averaged O_3

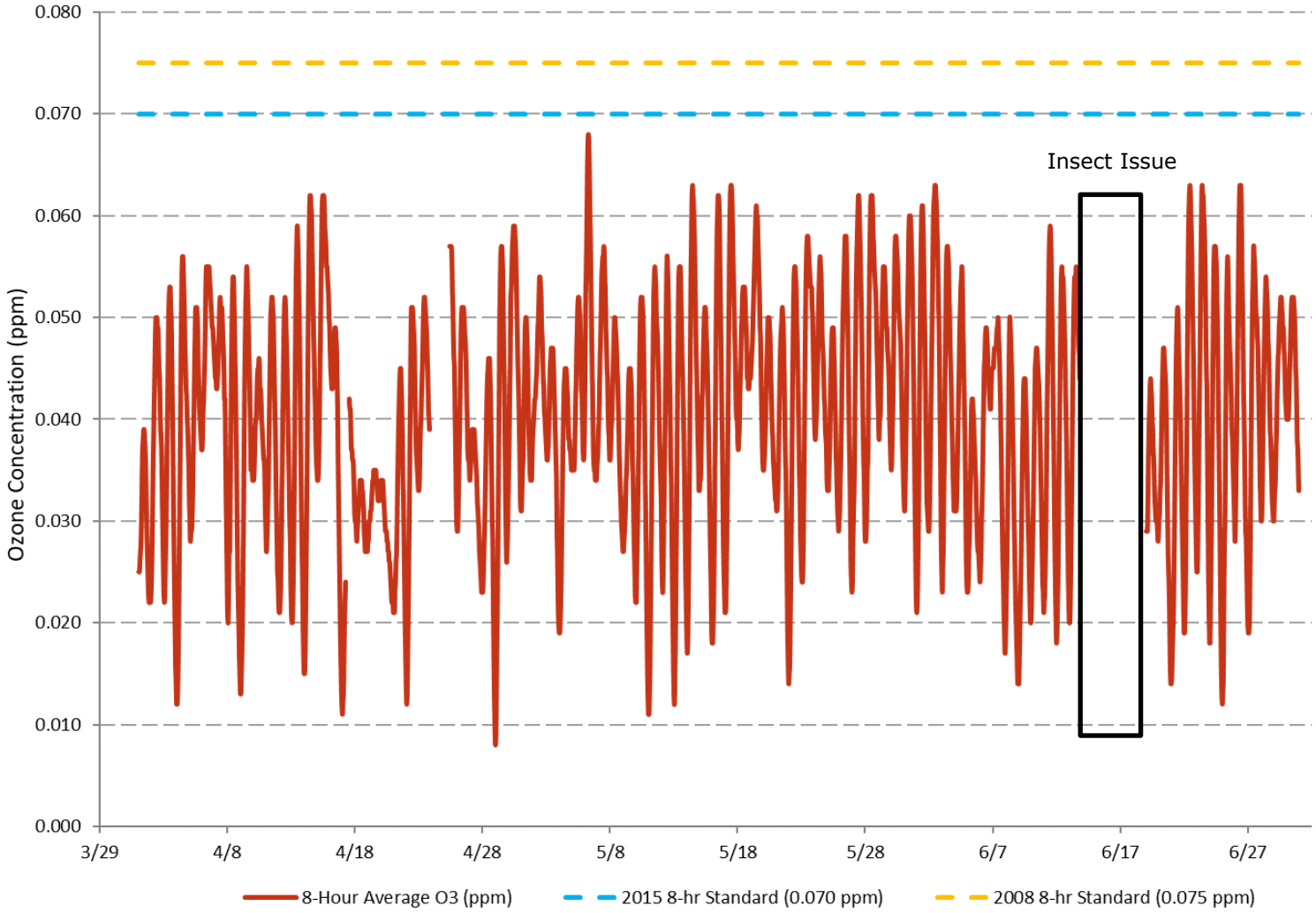


Figure 5. Orchard Q2 2024 Rolling 8-hour averaged O_3

Table 6. Weld County Network Q2 Highest Daily Maximum 8-hour Average O_3

Site Name	1st Max 8-Hour (ppm)	Date 1st Max 8-Hour	2nd Max 8-Hour (ppm)	Date 2nd Max 8-Hour	3rd Max 8-Hour (ppm)	Date 3rd Max 8-Hour	4th Max 8-Hour (ppm)	Date 4th Max 8-Hour	8-Hour Averages Exceeding the 2008 AAQS Value	8-Hour Averages Exceeding the 2015 AAQS Value
MSP	0.072	6/26/2024	0.067	5/14/2024	0.067	6/30/2024	0.066	5/27/2024	0	1
Hereford	0.064	6/23/2024	0.064	6/26/2024	0.063	4/14/2024	0.063	5/14/2024	0	0
Orchard	0.067	5/6/2024	0.063	5/14/2024	0.063	5/17/2024	0.063	6/2/2024	0	0

4.2 Gaseous NO_2 Data Summary

NO_2 data collected at MSP was compared against the AAQS standard for 1-hour averaged NO_2 (100 ppb). Once a full year of data has been collected, measurements will be compared to the annual standard (53 ppb). The 1-hour average NO_2 standard is based on the 98th percentile of 1-hour daily maximum concentrations, averaged over 3-years. The daily maximum 1-hour average concentration in Q2 2024 was 22.0 ppb, recorded on April 12th at 03:00 Mountain Daylight Time. A summary of NO_2 data is presented in **Figure 6**, **Table 7**, and **Table 8**. Note, data was invalidated between May 28th and May 31st due to a filter leak. See the annotation in **Figure 6**.

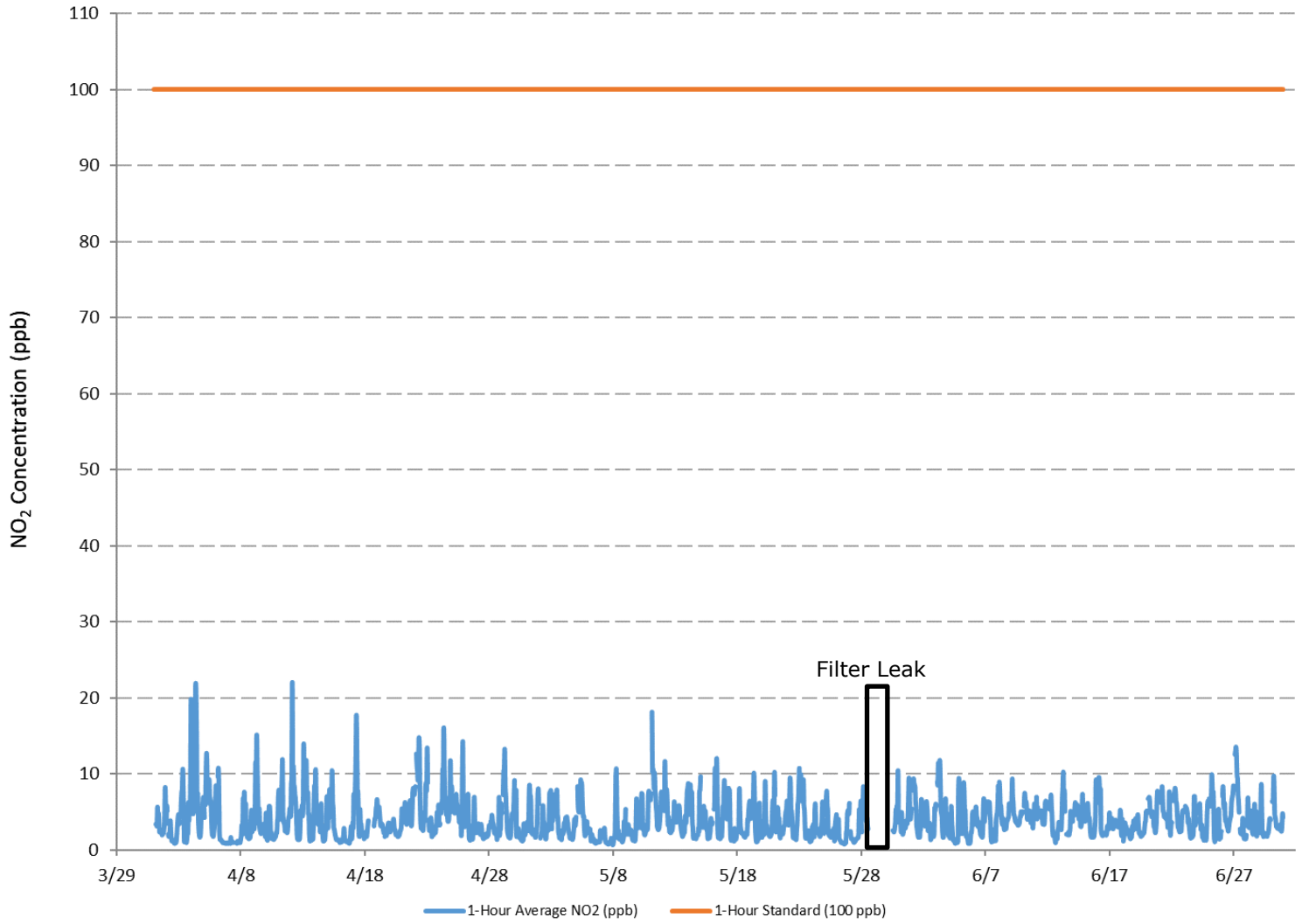


Figure 6. MSP Q2 2024 NO_2 1-Hour Summary

Table 7. MSP NO_2 1-hour average NAAQS comparison

Missile Site Park	1st Maximum	2nd Maximum	3rd Maximum	4th Maximum	5th Maximum	6th Maximum	7th Maximum	8th Maximum	Number of Exceedances of the 1-hour Standard[1]
2022 NO_2 (ppb)	67.2	63.4	62.0	58.0	57.4	56.9	54.5	54.5	0
2023 NO_2 (ppb)	64.9	58.3	52.4	51.7	51.5	51.2	50.2	49.4	0
2024 NO_2 (ppb)[2]	45.8	44.2	37.6	35.1	33.6	33	30.5	29.8	-[3]

Notes:

[1] The hourly NO_2 standard is based on the three-year average of the 98th percentile of 1-hour daily maximum concentrations averaged over 3-years.

[2] Values for 2024 represent year-to-date highest daily 1-hour maximum concentrations.

[3] Insufficient data is available to calculate the value. Compliance with the standard for 2024 will be evaluated at the conclusion of the calendar year.

Table 8. MSP NO_2 annual average NAAQS comparison

Missile Site Park	Q1 Quarterly Average	Q2 Quarterly Average	Q3 Quarterly Average	Q4 Quarterly Average	Annual Mean	Number of Exceedances of the Annual Standard[1]
2022 NO_2 (ppb)	13.6	4.3	5.7	10.3	8.5	0
2023 NO_2 (ppb)	13.4	4.8	4.8	9.7	8.0	0
2024 NO_2 (ppb)	8.6	3.9	-	-	-	-[2]

Notes:

[1] The annual NO_2 standard is based on the annual mean of 1-hour average NO2 concentrations.

[2] Insufficient data is available to calculate the value. Compliance with the standard for 2024 will be evaluated at the conclusion of the calendar year.

5. METEOROLOGICAL DATA SUMMARY

This section summarizes the meteorological data collected during Q2 2024.

5.1 Wind Data Summary

The Q2 2024 average wind speed at the three stations at 10-m above ground level (agl) was 3.64 meters per second (m/s), 5.37 m/s, and 4.19 m/s at MSP, Hereford, and Orchard, respectively. The maximum hourly average wind speed for Q2 2024 was 14.75 m/s at MSP, 20.43 m/s at Hereford, and 17.11 m/s at Orchard. **Figure 7** through **Figure 9** present wind rose plots for each station during Q2 2024. These wind roses are a graphical representation of how the wind speed and direction were distributed for Q2 2024. On each wind rose, the bars at 0 degrees (°) correspond to wind coming from the North and the bars at 180° correspond to wind coming from the South. The size of each bar is an indication of how frequently the wind comes from a particular direction. The color of the bars represents the corresponding wind speed when the wind was blowing from a particular direction. Each station had a unique wind profile during Q2 2024. At the MSP station, wind direction had no directional trend and came more or less equally from all directions. The fastest winds at MSP came from the northwest. At the Hereford station winds mostly came from the northwestern quadrant and were also the fastest from the north and west. At the Orchard station winds mostly came from the west and east and were the strongest from the northwest. Monthly average hourly and maximum wind speeds per month at each station are listed in **Table 9** along with all other measured meteorological parameters.

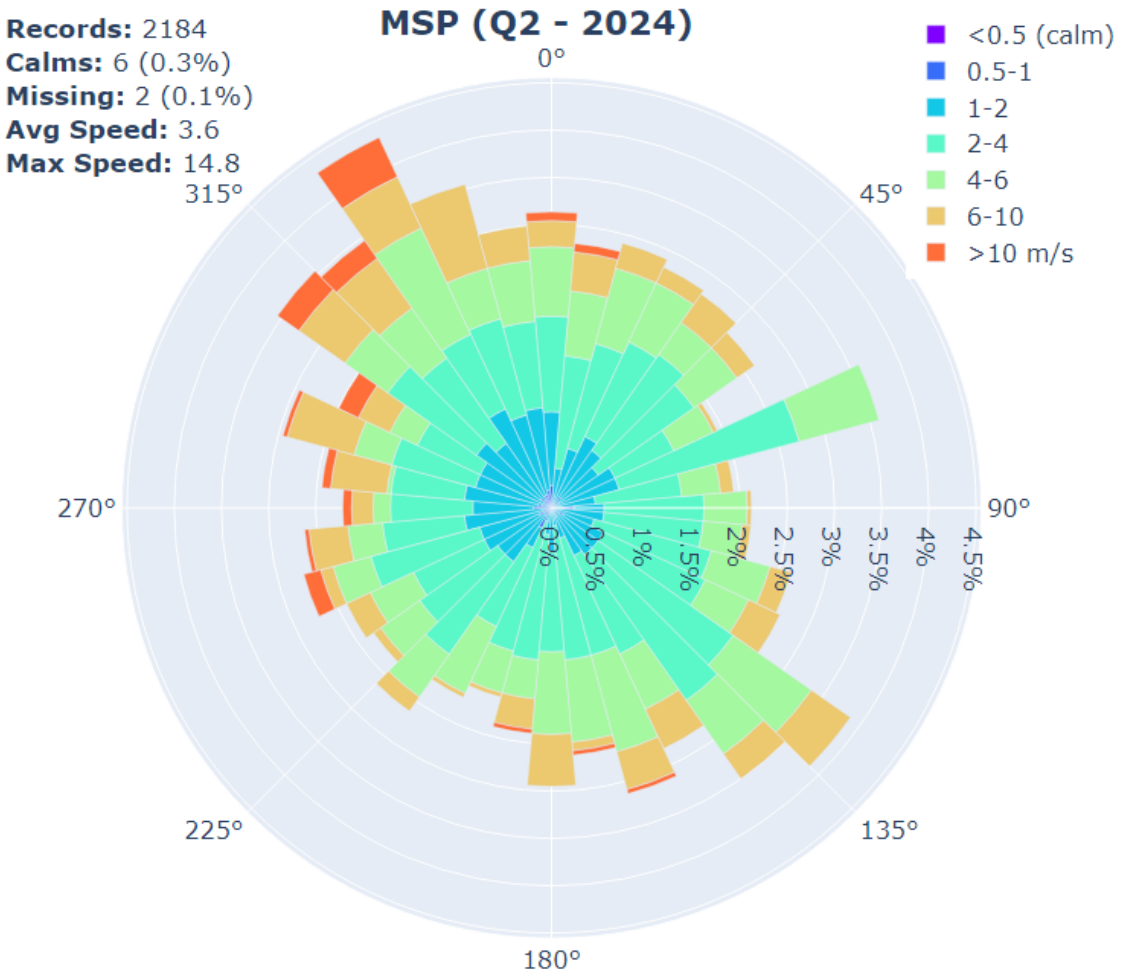


Figure 7. MSP Q2 2024 Wind Rose

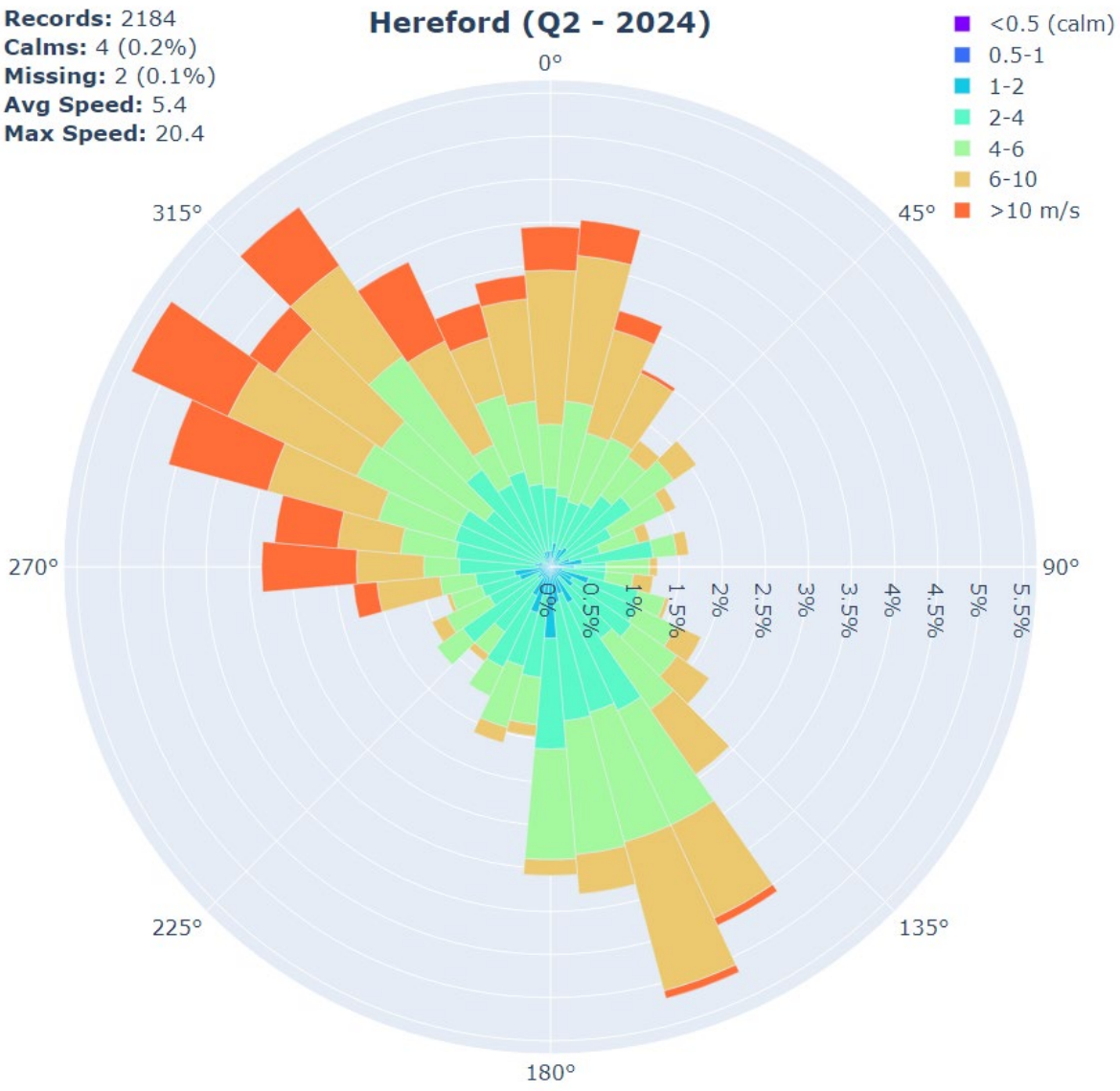


Figure 8. Hereford Q2 2024 Wind Rose

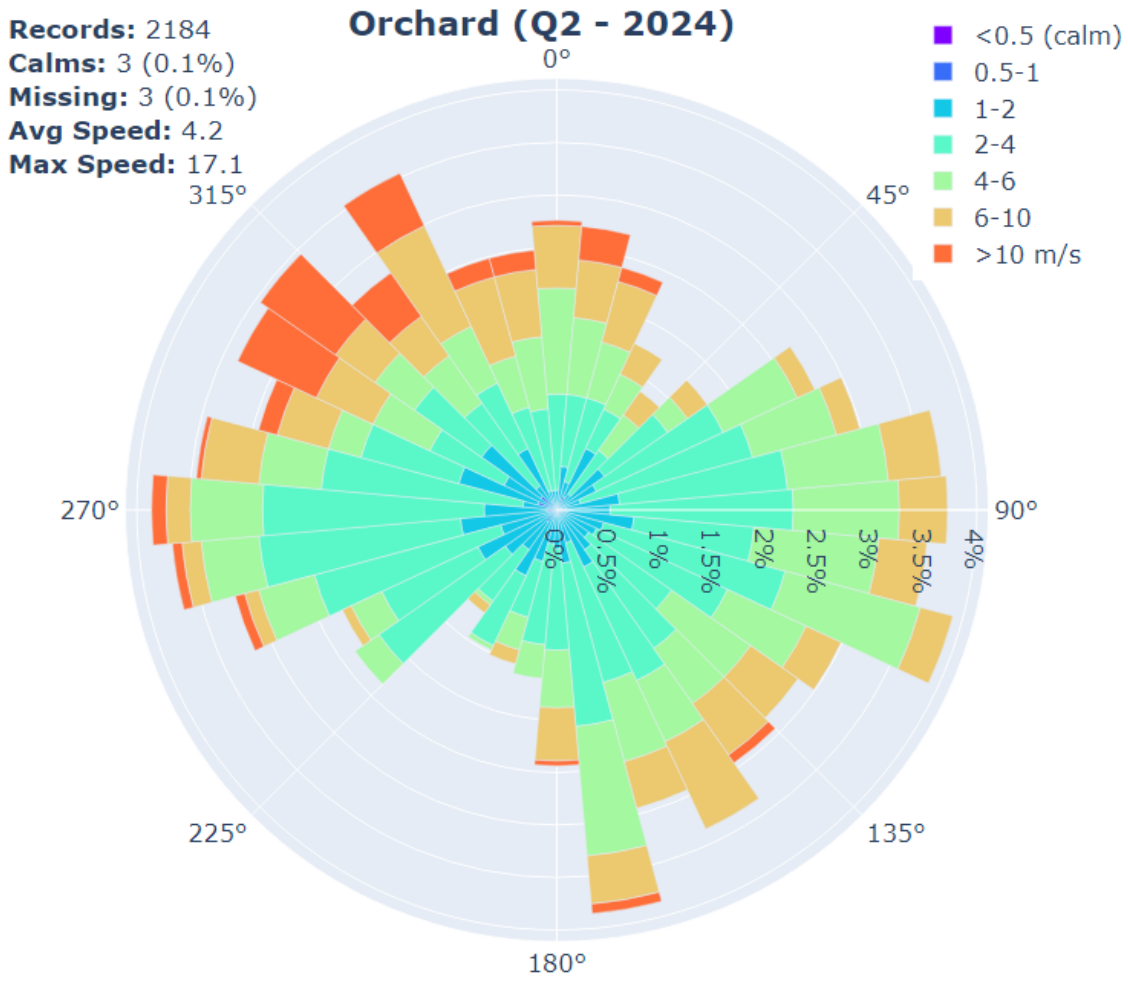


Figure 9. Orchard Q2 2024 Wind Rose

Table 9. Q2 2024 Meteorological Data Summary

Parameter	Units	Form	April	February	March
Missile Site Park					
2-M Temperature	°C	Monthly Average	10.17	14.20	22.33
		Maximum Hourly Average	27.22	27.74	35.95
		Minimum Hourly Average	-2.62	0.64	8.29
10-M Temperature	°C	Monthly Average	10.11	14.06	22.16
		Maximum Hourly Average	26.11	27.29	34.76
		Minimum Hourly Average	-2.20	1.24	8.45
Delta Temperature	°C	Monthly Average	-0.06	-0.13	-0.17
		Maximum Hourly Average	2.23	2.87	2.16
		Minimum Hourly Average	-1.55	-2.03	-2.06
10-M Horizontal Wind Speed	m/s	Monthly Average	3.98	3.83	3.11
		Maximum Hourly Average	14.75	12.76	9.74
2-M Relative Humidity	Percent	Monthly Average	52.90	48.28	51.03
		Maximum Hourly Average	100.00	95.10	100.00
Station Barometric Pressure	mm Hg	Monthly Average	633.62	633.30	635.12
		Maximum Hourly Average	643.78	642.33	642.59
Station Precipitation	in	Monthly Total	1.376	1.435	1.350
	in/hr	Maximum Hourly Total	0.102	0.599	0.394
2-M Solar Radiation	W/m^2	Monthly Average	233.8	281.4	308.4
		Maximum Hourly Average	1,058.0	1,077.0	1,074.0
Hereford					
2-M Temperature	°C	Monthly Average	7.74	11.88	20.02
		Maximum Hourly Average	24.96	28.73	34.16
		Minimum Hourly Average	-5.97	-4.27	3.75

Parameter	Units	Form	April	February	March
10-M Temperature	°C	Monthly Average	7.87	11.86	20.10
		Maximum Hourly Average	24.22	27.61	33.18
		Minimum Hourly Average	-4.71	-2.95	4.57
Delta Temperature	°C	Monthly Average	0.13	-0.02	0.08
		Maximum Hourly Average	7.47	4.18	4.55
		Minimum Hourly Average	-1.93	-2.10	-1.89
10-M Horizontal Wind Speed	m/s	Monthly Average	5.74	5.66	4.69
		Maximum Hourly Average	20.43	16.00	14.83
2-M Relative Humidity	Percent	Monthly Average	58.97	55.99	57.31
		Maximum Hourly Average	100.00	97.90	100.00
Station Barometric Pressure	mm Hg	Monthly Average	625.47	625.33	627.35
		Maximum Hourly Average	634.87	633.84	634.44
Station Precipitation	in	Monthly Total	1.352	1.622	3.059
	in/hr	Maximum Hourly Total	0.252	0.875	0.961
2-M Solar Radiation	W/m^2	Monthly Average	226.0	275.5	296.9
		Maximum Hourly Average	1,014.0	1,048.0	1,053.0
Orchard					
2-M Temperature	°C	Monthly Average	9.91	14.13	22.42
		Maximum Hourly Average	28.72	29.67	39.23
		Minimum Hourly Average	-7.72	-3.16	7.04
10-M Temperature	°C	Monthly Average	10.24	14.32	22.51
		Maximum Hourly Average	27.54	28.56	37.23
		Minimum Hourly Average	-3.87	-1.05	9.54
Delta Temperature	°C	Monthly Average	0.33	0.19	0.09
		Maximum Hourly Average	7.26	5.74	5.21
		Minimum Hourly Average	-1.92	-2.03	-2.22

Parameter	Units	Form	April	February	March
10-M Horizontal Wind Speed	m/s	Monthly Average	4.51	4.09	3.99
		Maximum Hourly Average	17.11	14.53	12.28
2-M Relative Humidity	Percent	Monthly Average	55.57	54.98	54.82
		Maximum Hourly Average	99.00	99.40	100.00
Station Barometric Pressure	mm Hg	Monthly Average	645.47	645.07	646.53
		Maximum Hourly Average	656.09	654.30	654.37
Station Precipitation	in	Monthly Total	1.271	0.981	1.562
	in/hr	Maximum Hourly Total	0.162	0.382	0.906
2-M Solar Radiation	W/m^2	Monthly Average	231.9	289.8	306.9
		Maximum Hourly Average	1,018.0	1,048.0	1,039.0

5.2 Precipitation Data Summary

Hourly precipitation data was collected at all three stations with a tipping bucket sensor at 1-m agl. June had the highest total monthly precipitation at Hereford and Orchard, while May had the highest total monthly precipitation at MSP. A summary of total monthly and maximum hourly precipitation for Q2 2024 at all three stations is presented in **Figure 10** - **Figure 12** and in **Table 9**.

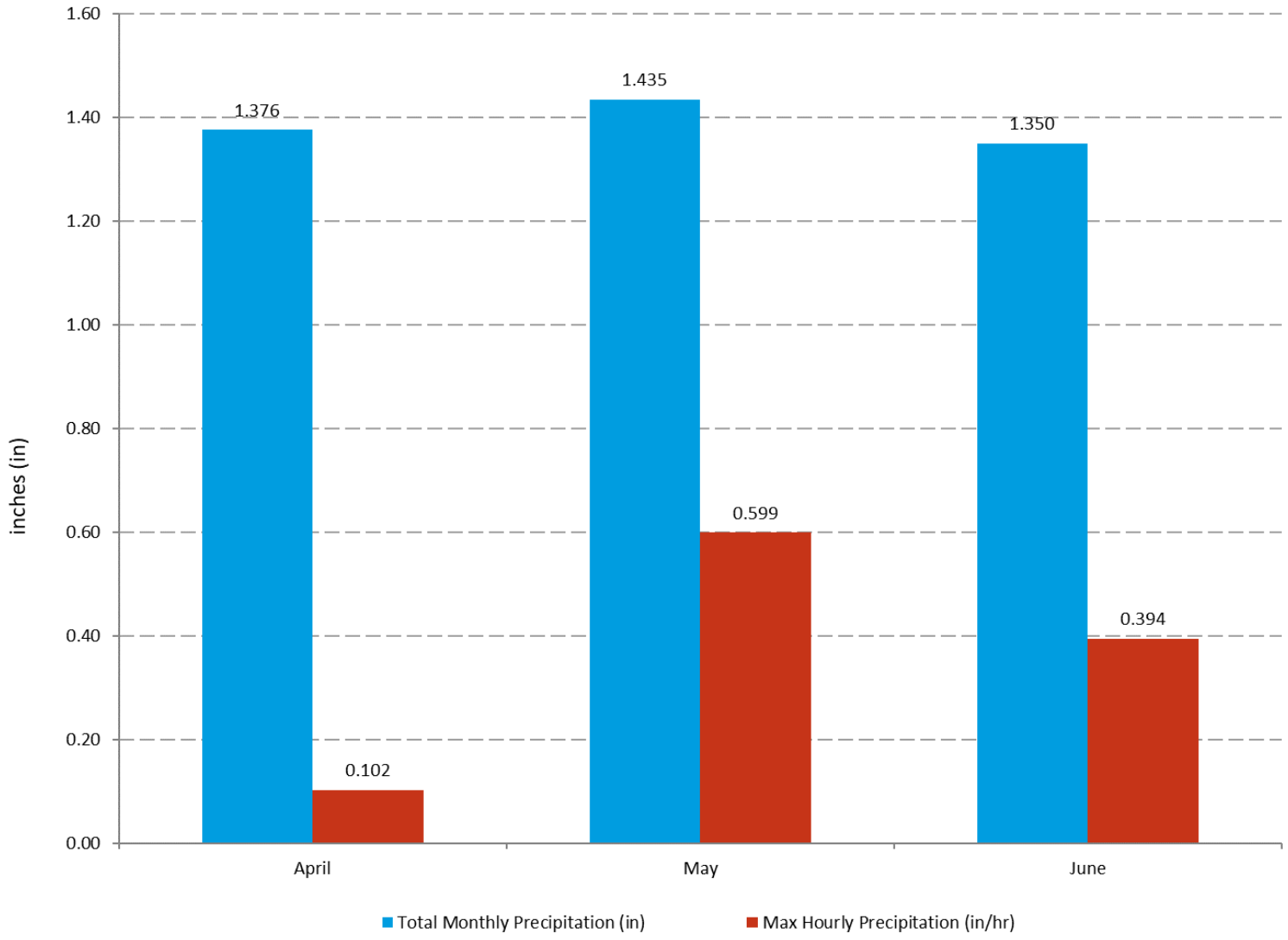


Figure 10. MSP Q2 2024 Precipitation Summary

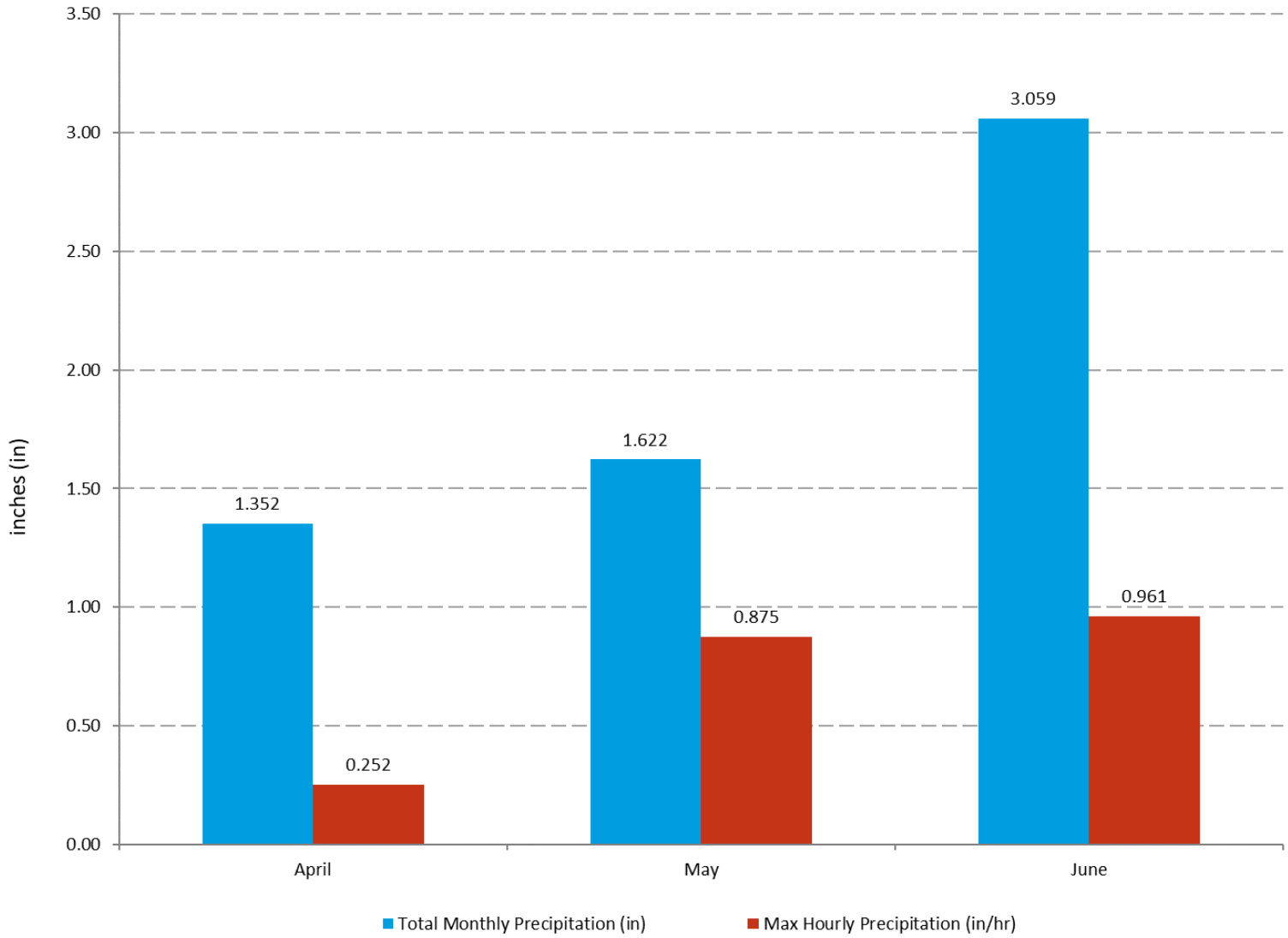


Figure 11. Hereford Q2 2024 Precipitation Summary

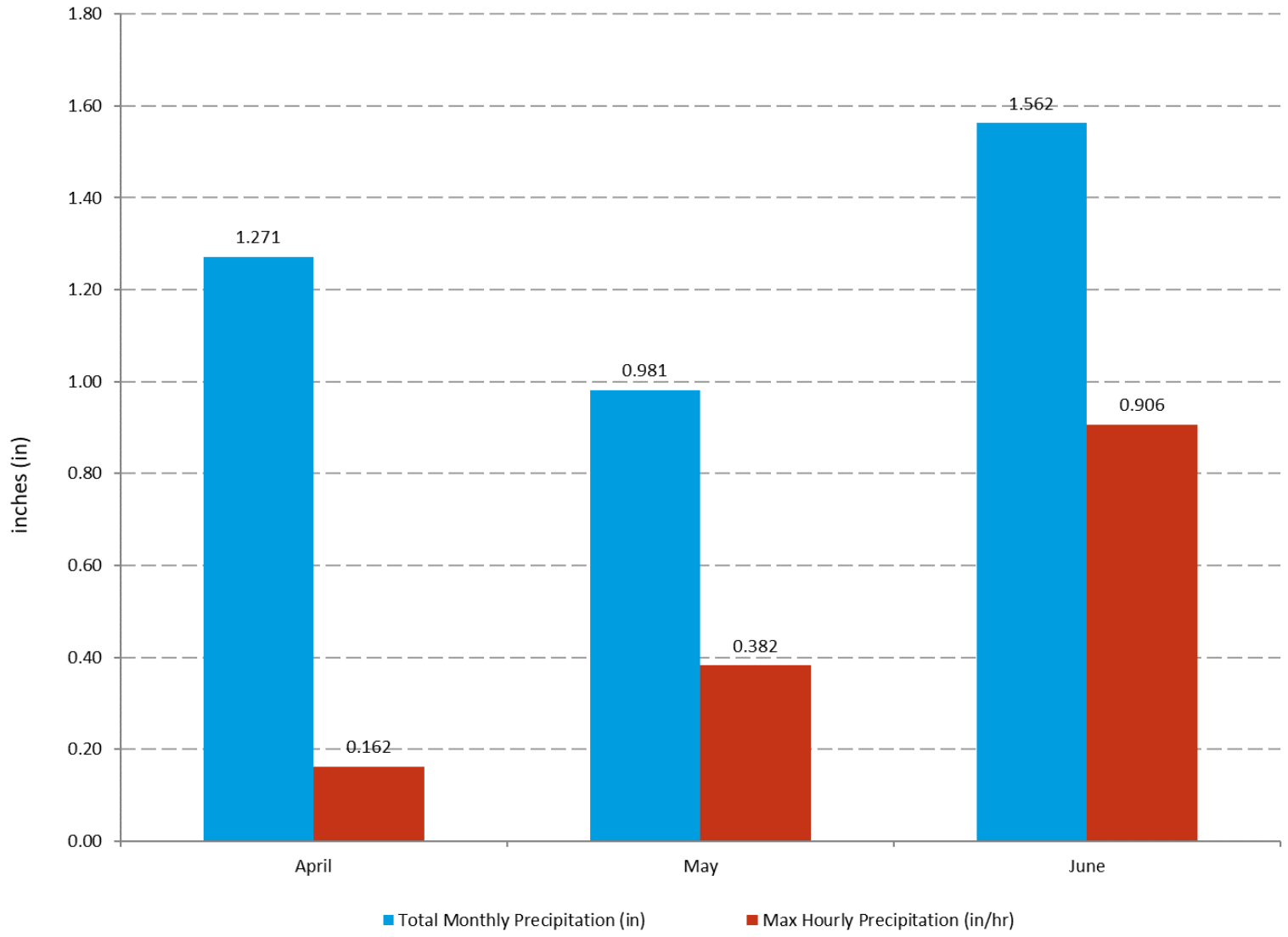


Figure 12. Orchard Q2 2024 Precipitation Summary

5.3 Temperature Data Summary

Temperature data was collected at all three stations at heights of 2-m and 10-m agl. The highest temperatures occurred in June for 2-m and 10-m agl at all three stations. The lowest temperatures occurred in April for 2-m and 10-m agl at all three stations. A summary of monthly average and hourly maximum and minimum temperatures (for both 2-m and 10-m probes) for Q2 2024 at all three stations is presented in **Figure 13** - **Figure 18** and **Table 9**.

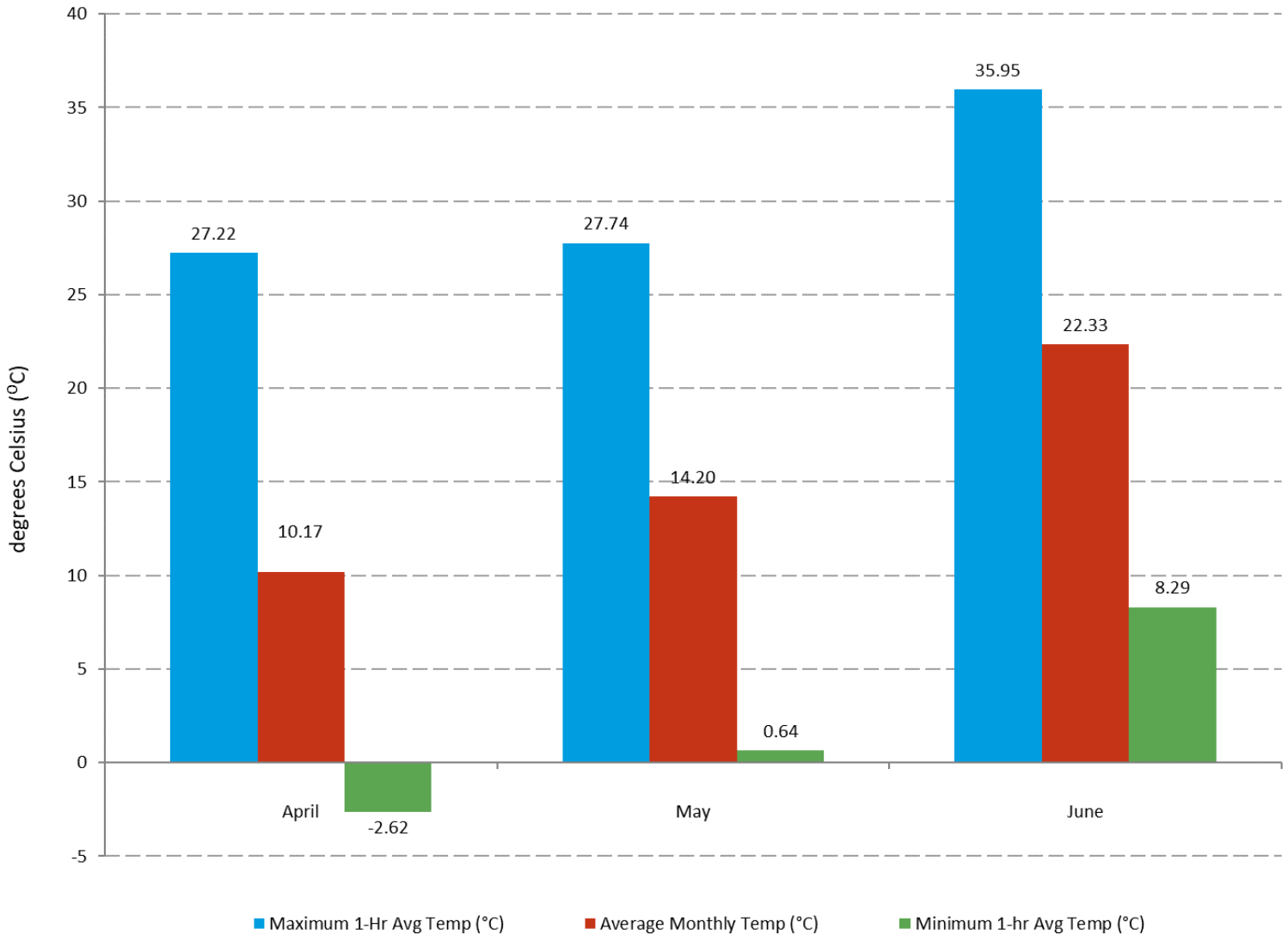


Figure 13. MSP Q2 2024 2-Meter Temperature Summary

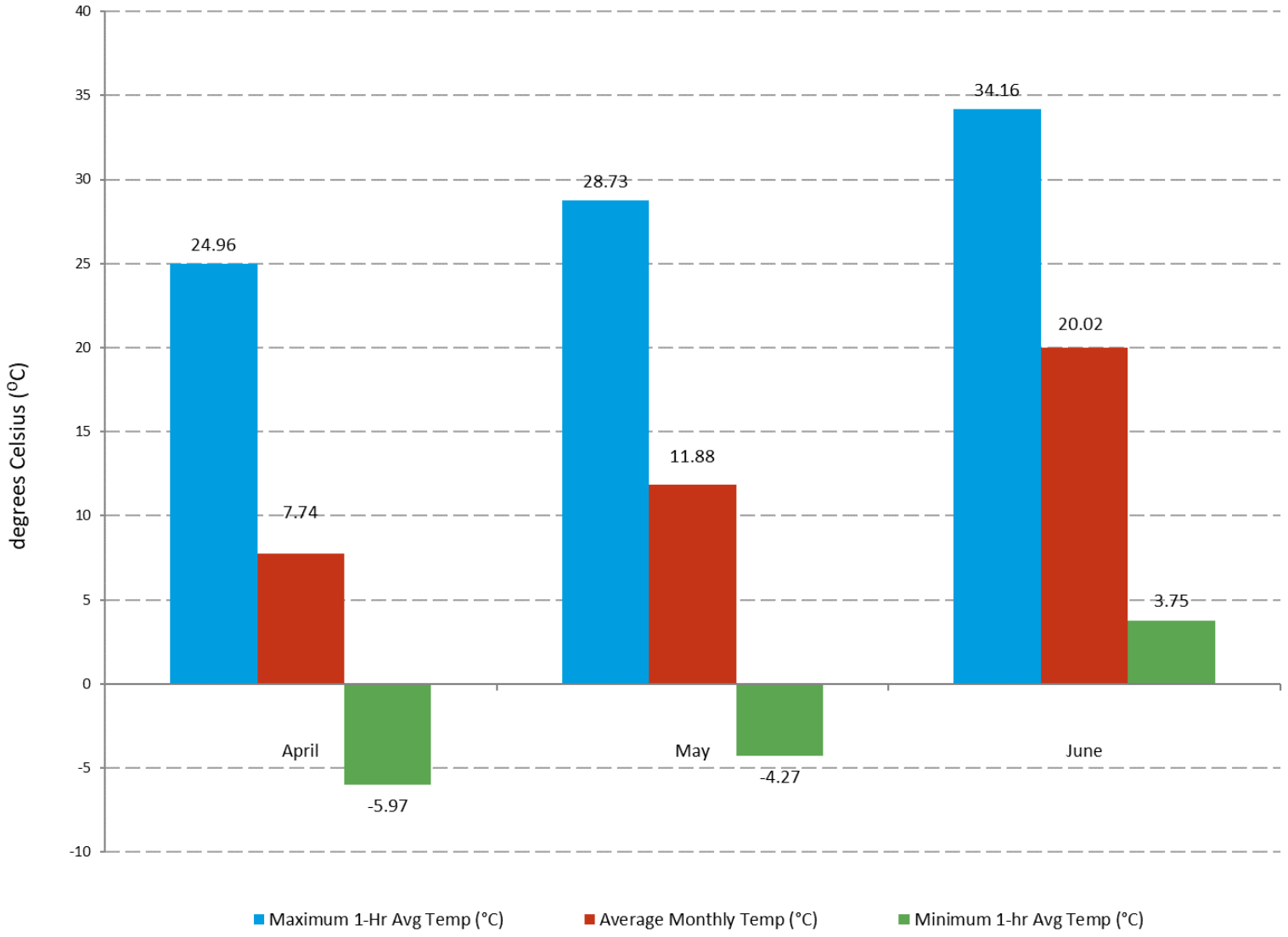


Figure 14. Hereford Q2 2024 2-Meter Temperature Summary

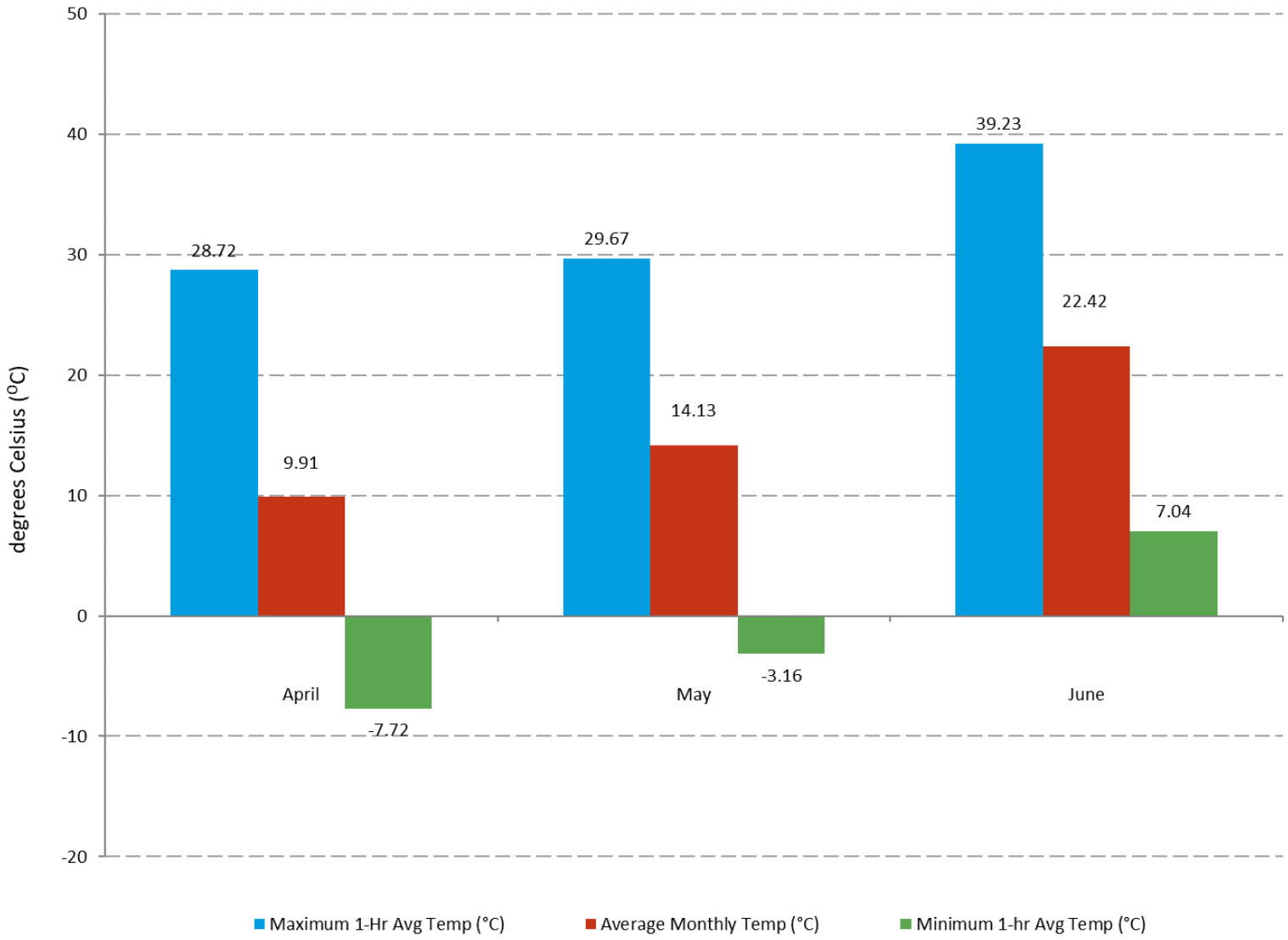


Figure 15. Orchard Q2 2024 2-Meter Temperature Summary

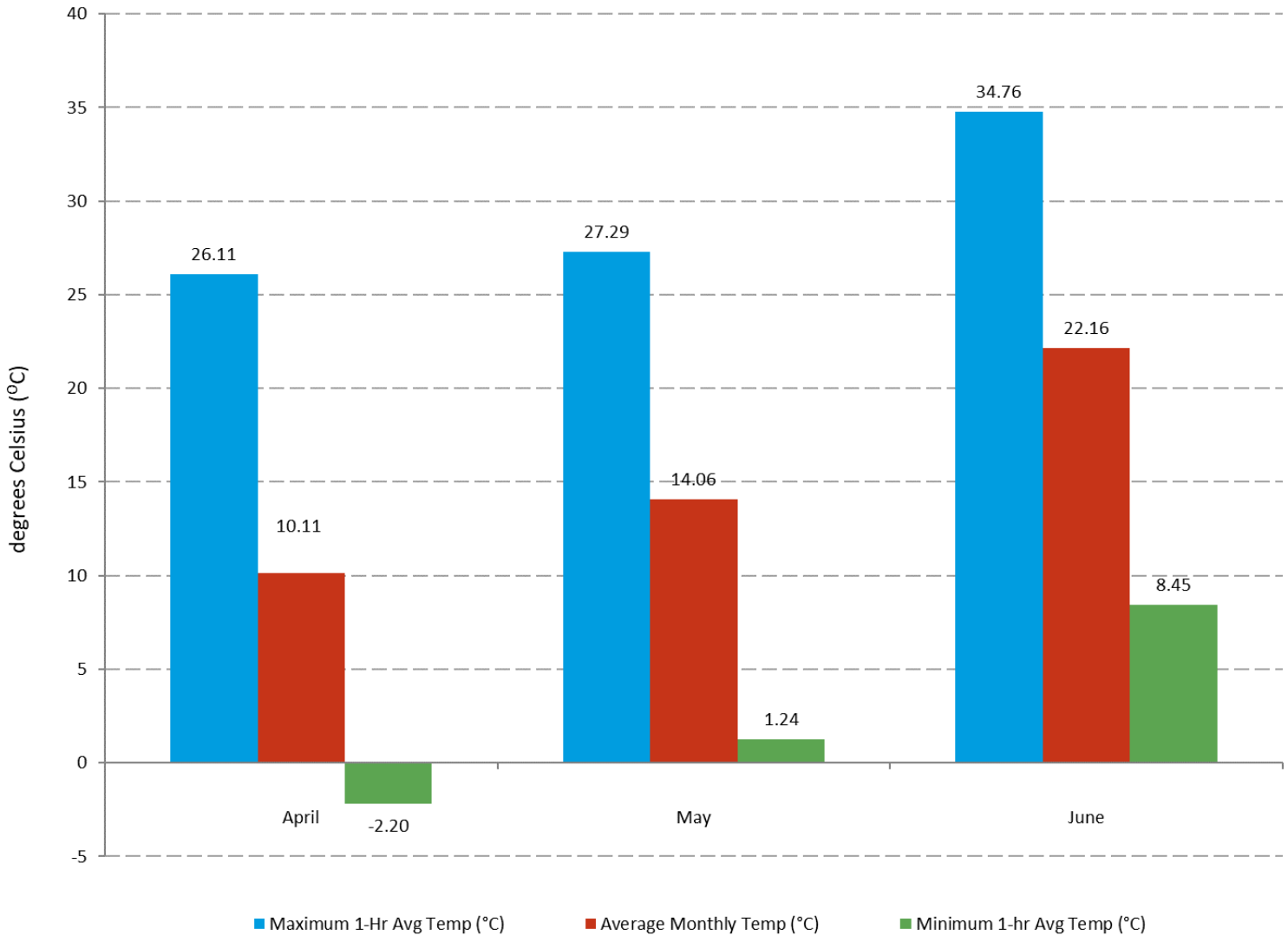


Figure 16. MSP Q2 2024 10-Meter Temperature Summary

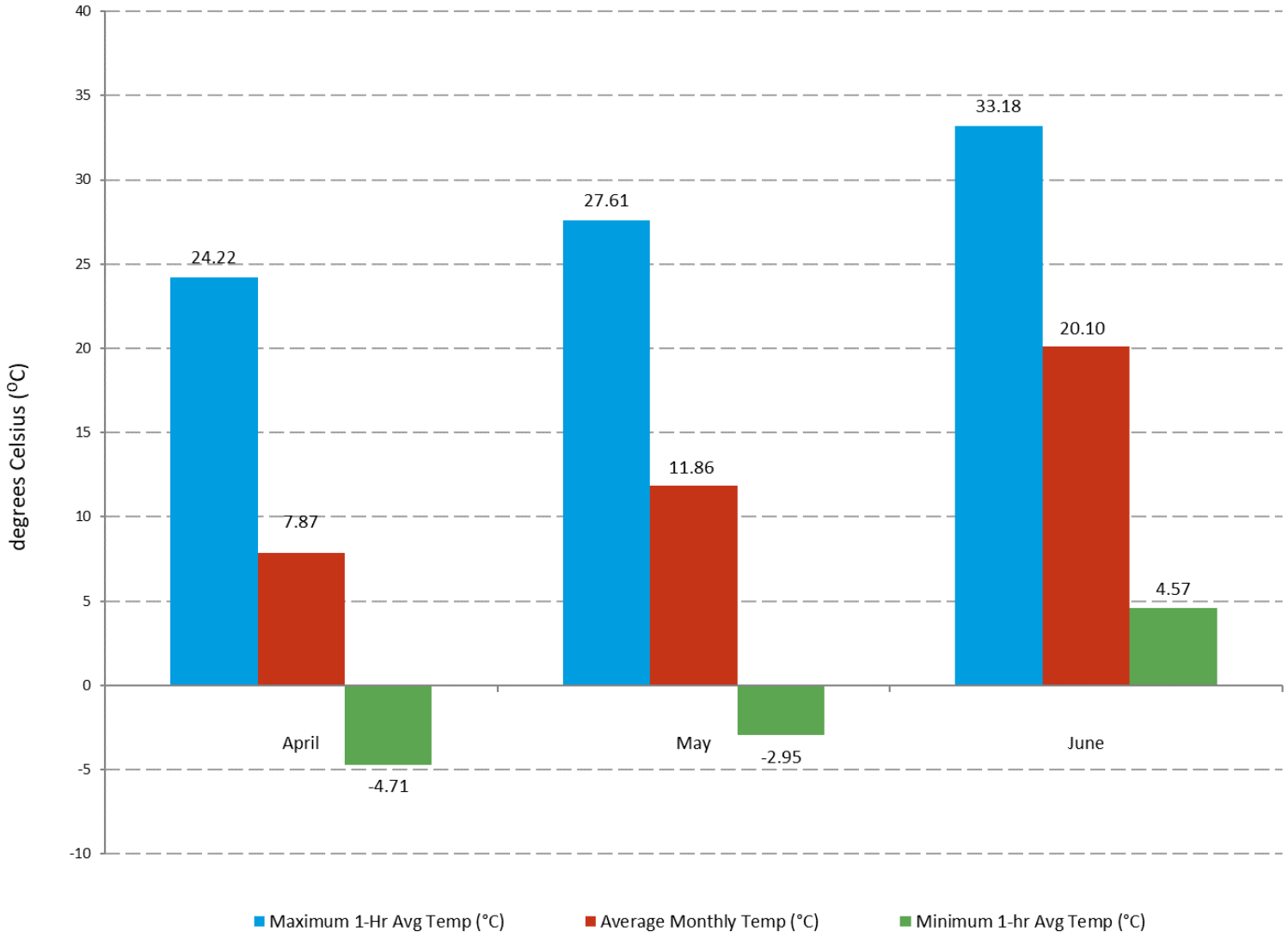


Figure 17. Hereford Q2 2024 10-Meter Temperature Summary

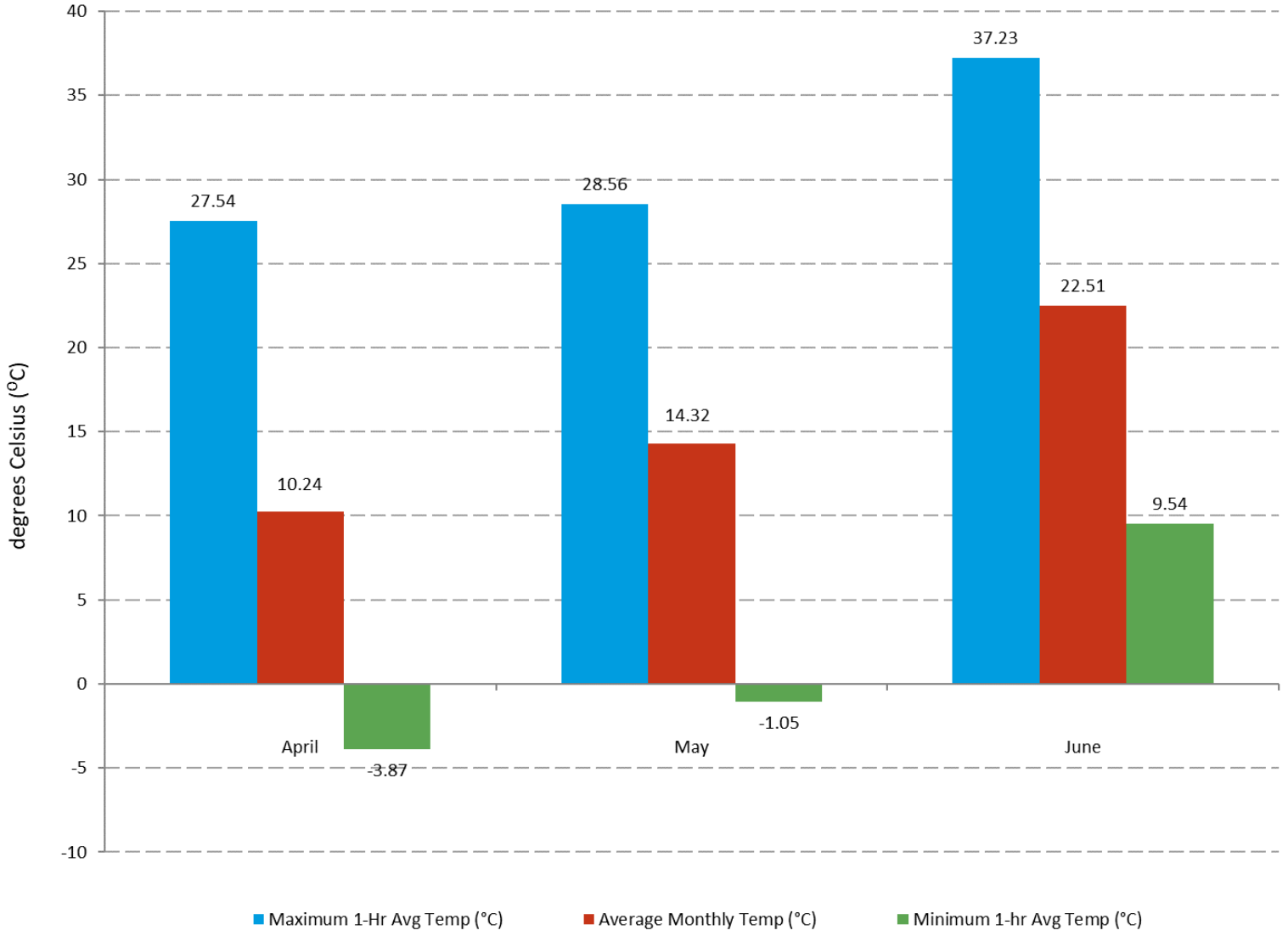


Figure 18. Orchard Q2 2024 10-Meter Temperature Summary

5.4 Delta Temperature Data Summary

Delta temperature is a calculated measurement made by subtracting the 2-m temperature probe reading from the 10-m temperature probe reading (10-m – 2-m). It is an indicator of atmospheric stability and is important for modeling purposes. The two most isolated stations (Hereford and Orchard) exhibited the largest positive delta temperature extremes compared to the more 'urban' station of MSP. A summary of monthly average and hourly maximum and minimum delta temperature for Q2 2024 at all three stations is presented in **Figure 19** - **Figure 21** and **Table 9**.

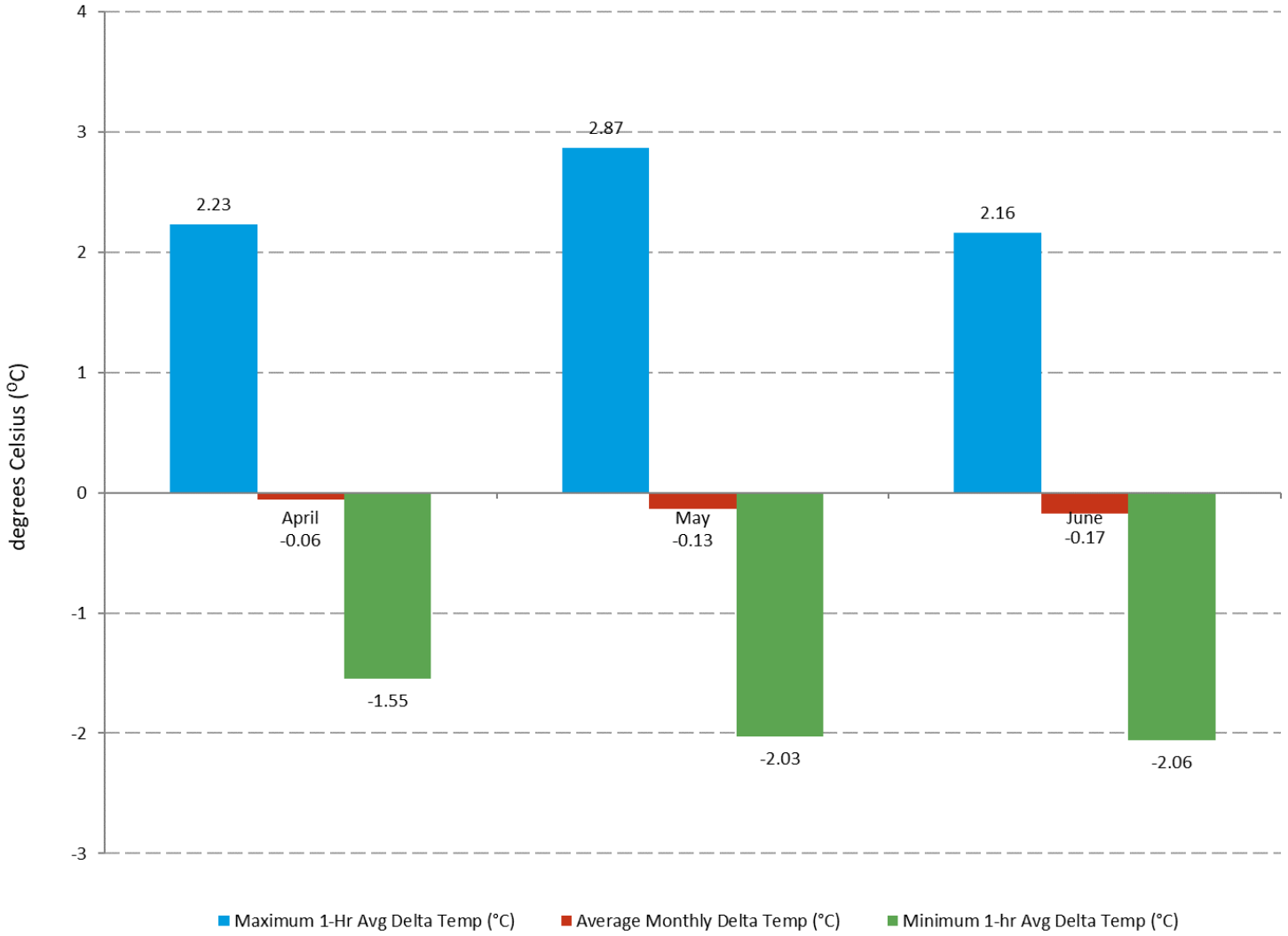


Figure 19. MSP Q2 2024 Delta Temperature Summary

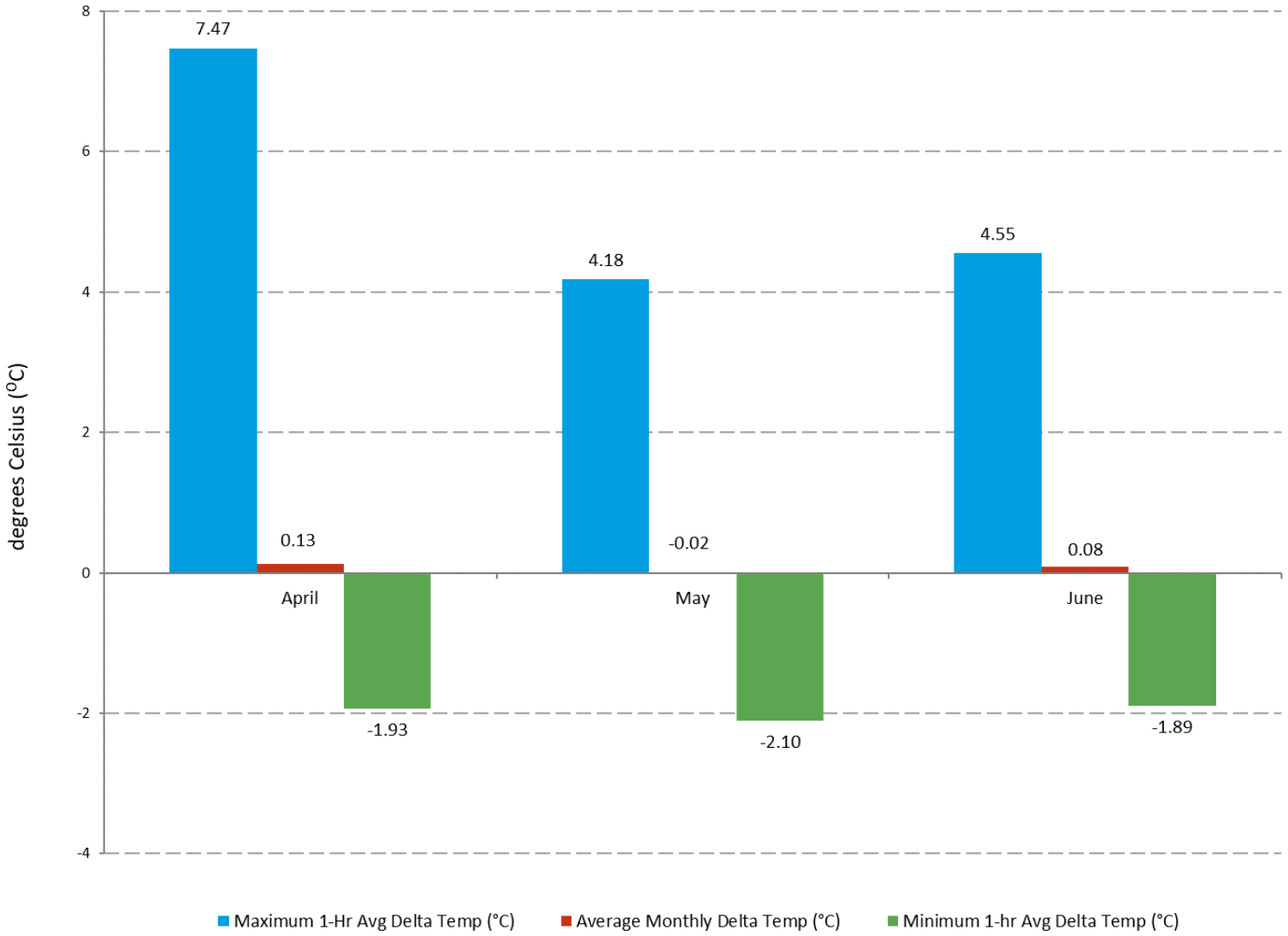


Figure 20. Hereford Q2 2024 Delta Temperature Summary

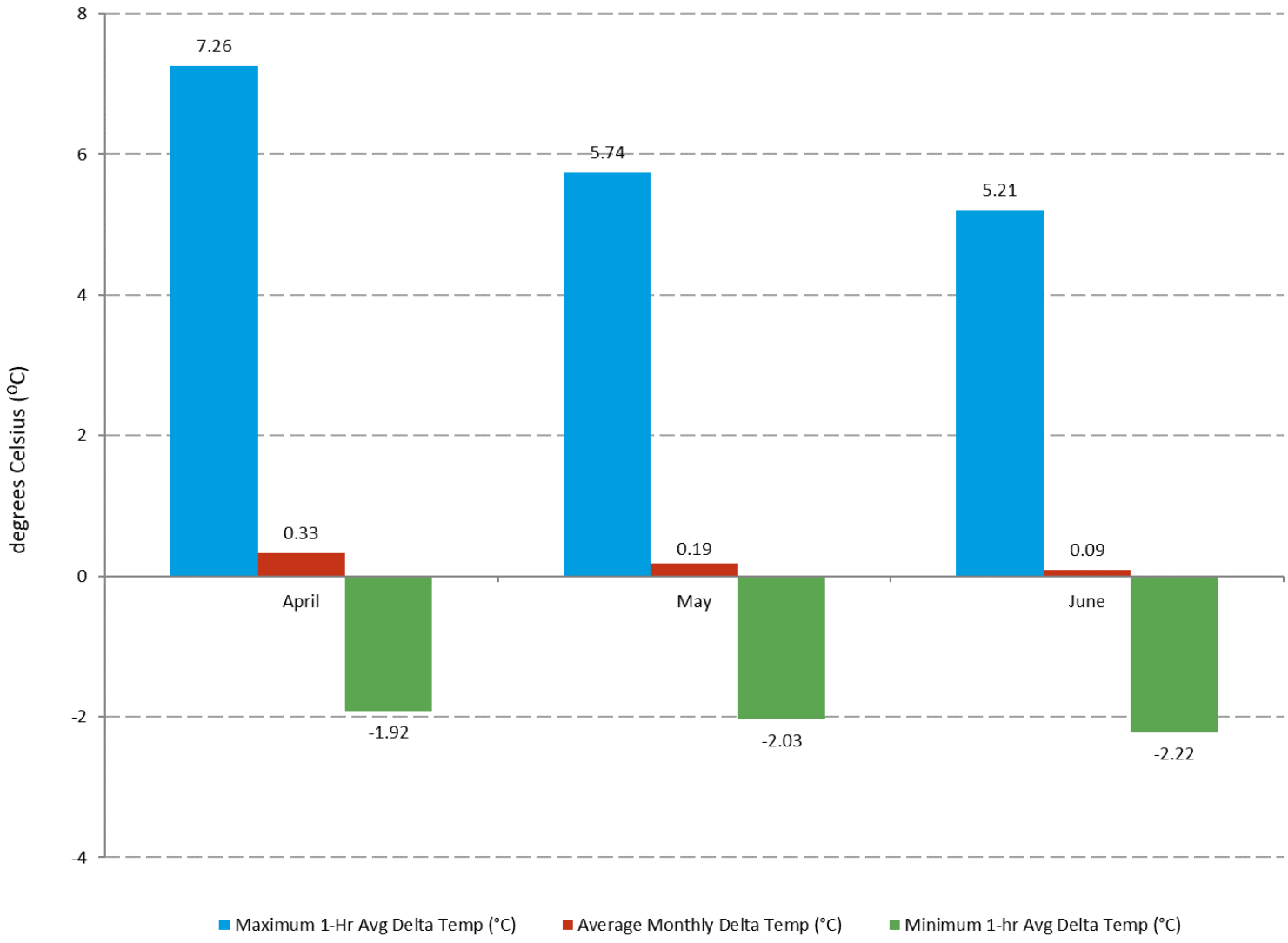


Figure 21. Orchard Q2 2024 Delta Temperature Summary

5.5 Barometric Pressure Data Summary

Barometric pressure data is collected using a barometric pressure sensor located inside each station shelter. The average monthly barometric pressure at each station was correlated with the elevation at each location, with the highest elevation station having the lowest monthly average barometric pressure (Hereford) and the lowest elevation station having the highest monthly average barometric pressure (Orchard). Maximum hourly average and monthly average barometric pressures for Q2 2024 at all three stations are summarized in **Figure 22** - **Figure 24** and **Table 9**.

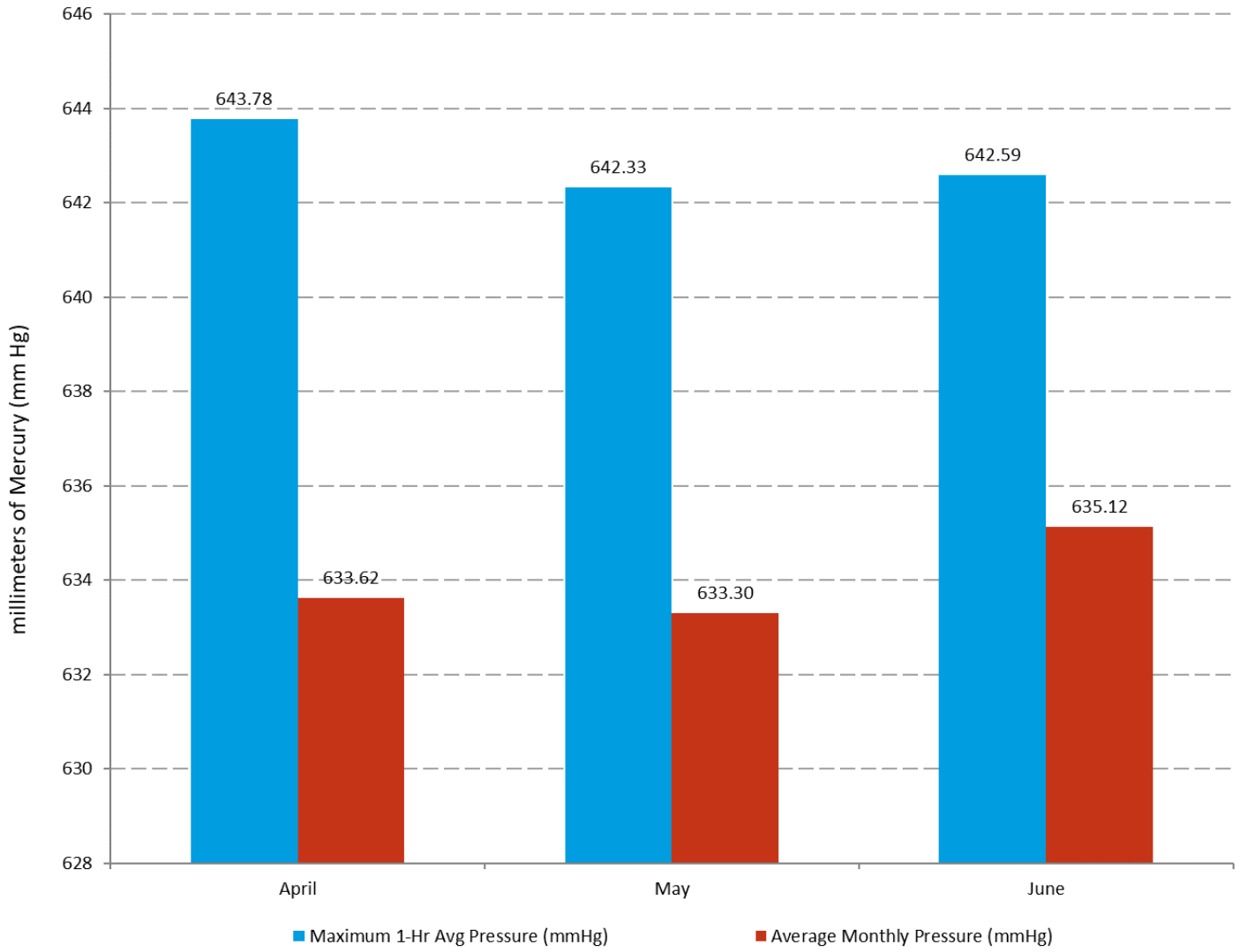


Figure 22. MSP Q2 2024 Barometric Pressure Summary

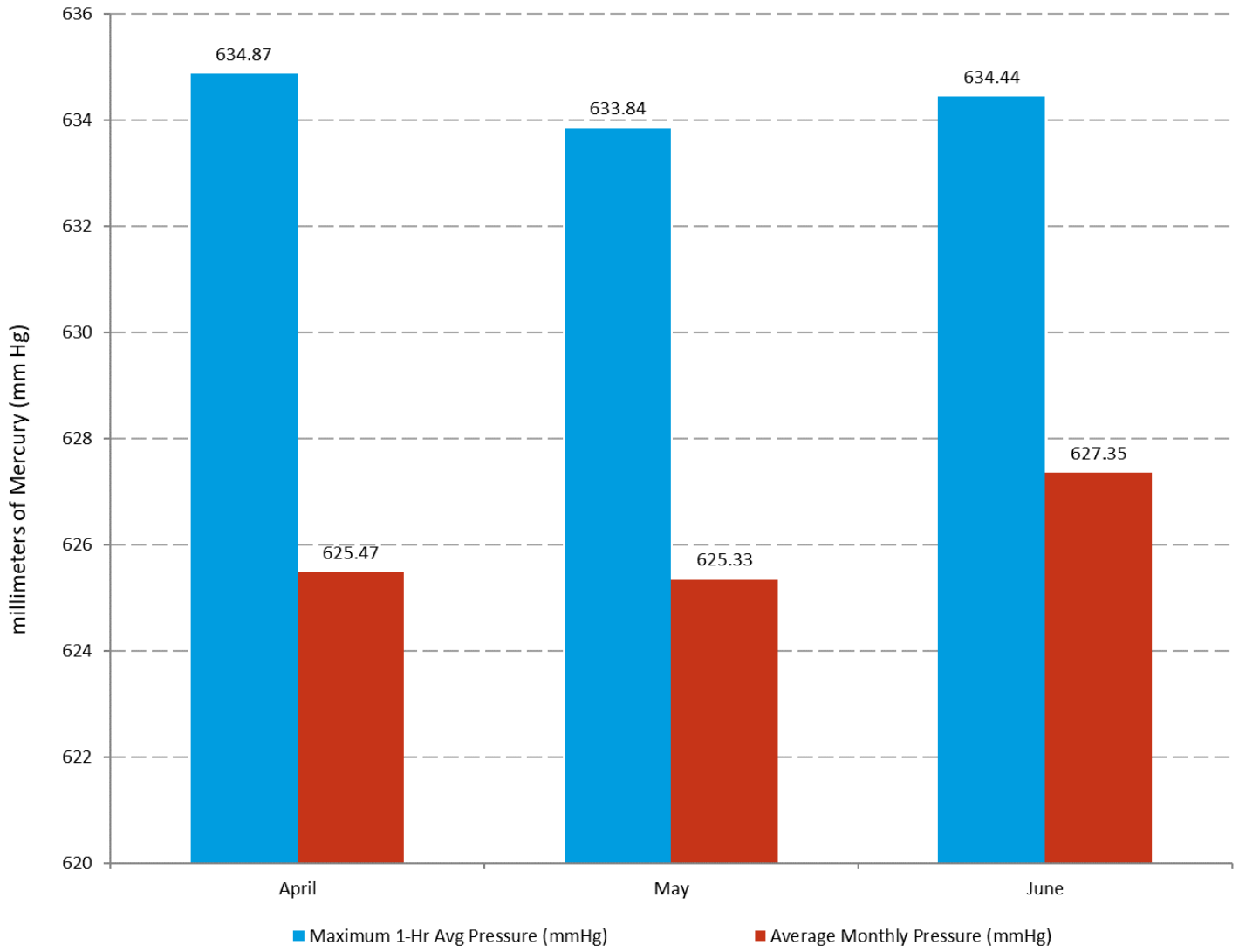


Figure 23. Hereford Q2 2024 Barometric Pressure Summary

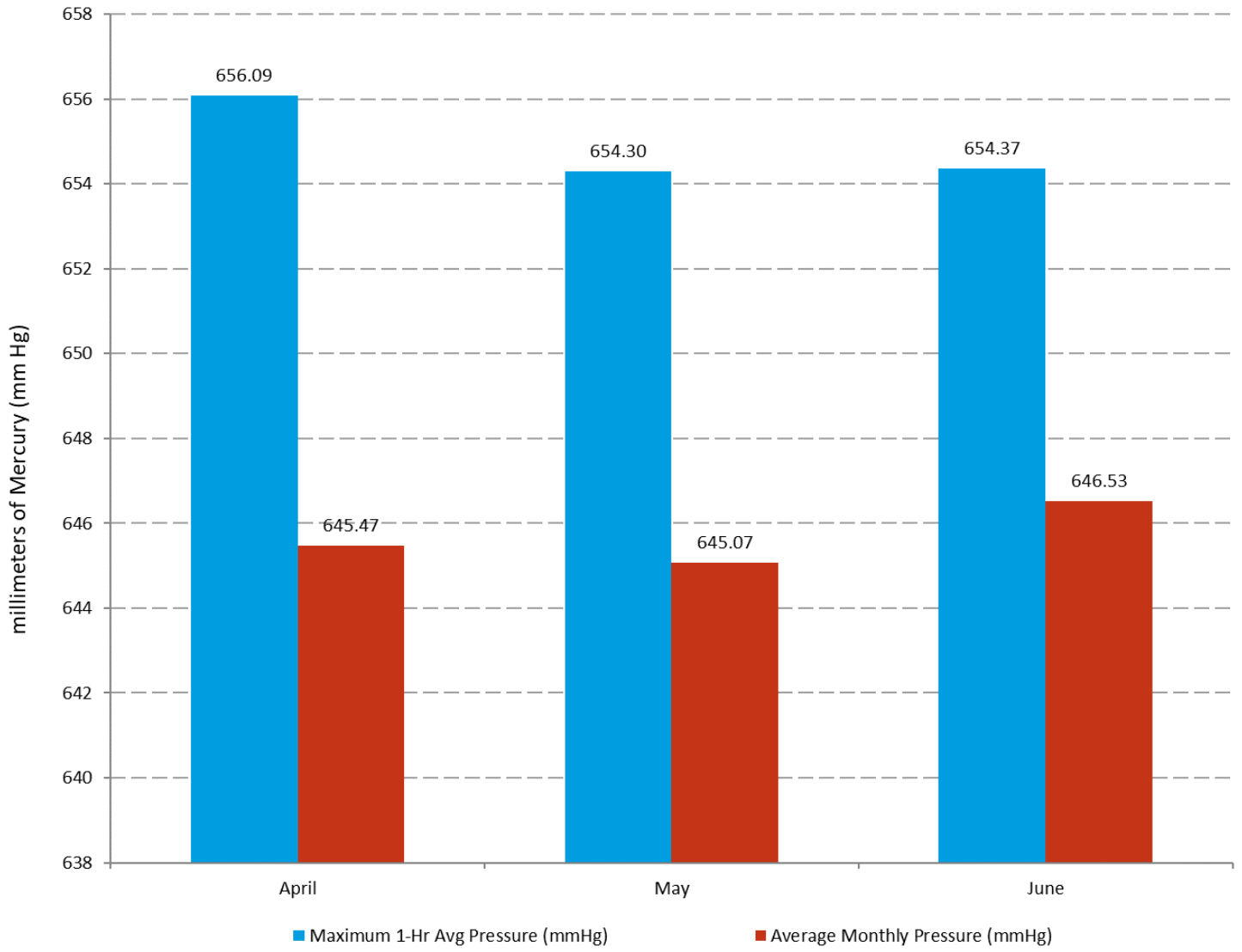


Figure 24. Orchard Q2 2024 Barometric Pressure Summary

5.6 Relative Humidity Data Summary

Relative humidity data was collected at all three stations at 2-m agl. The average monthly relative humidity at all three stations ranged between 48.28-58.97%. Maximum hourly average and monthly average relative humidity for Q2 2024 at all three stations is summarized in **Figure 25 - Figure 27** and **Table 9**.

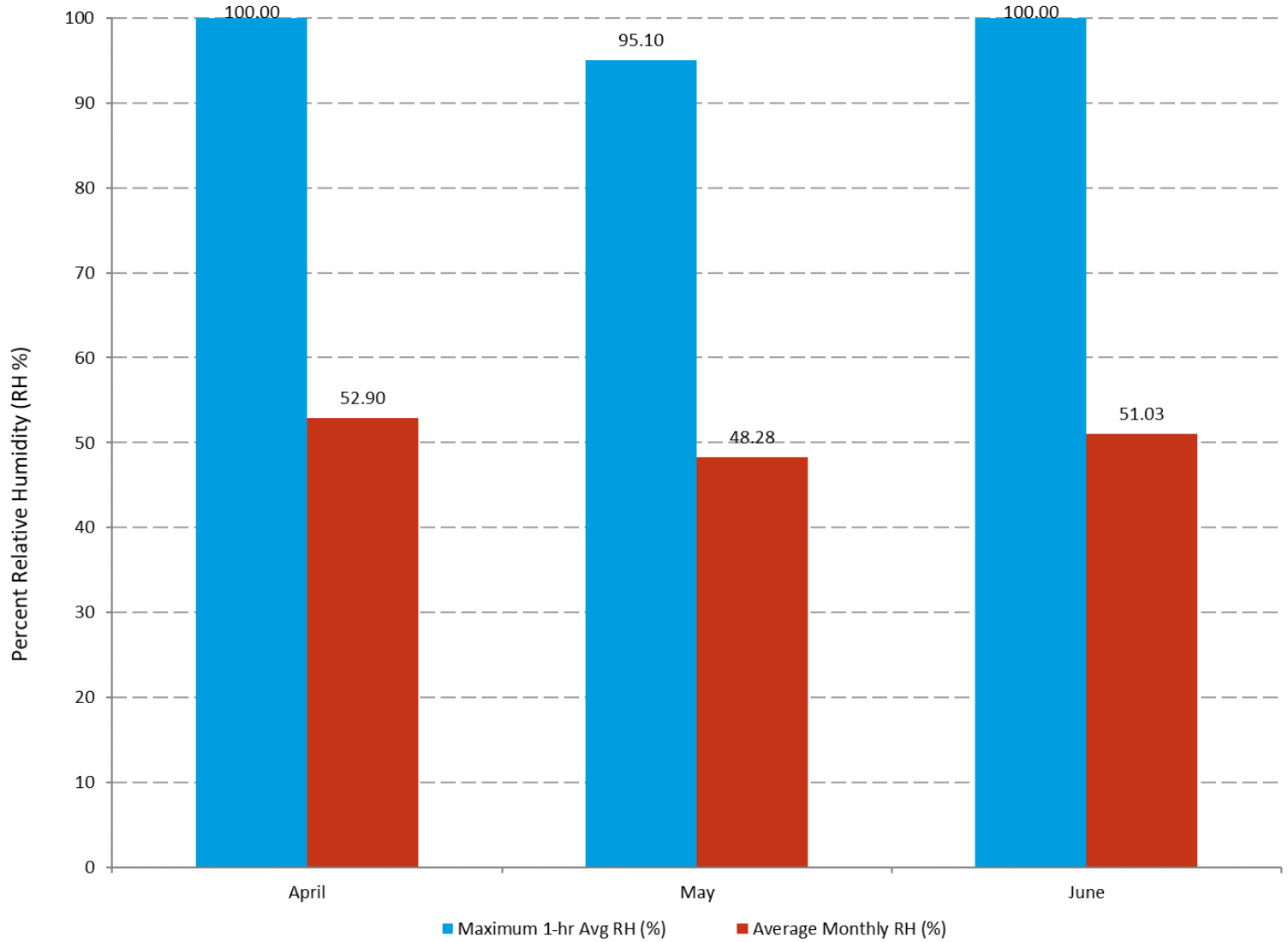


Figure 25. MSP Q2 2024 Relative Humidity Summary

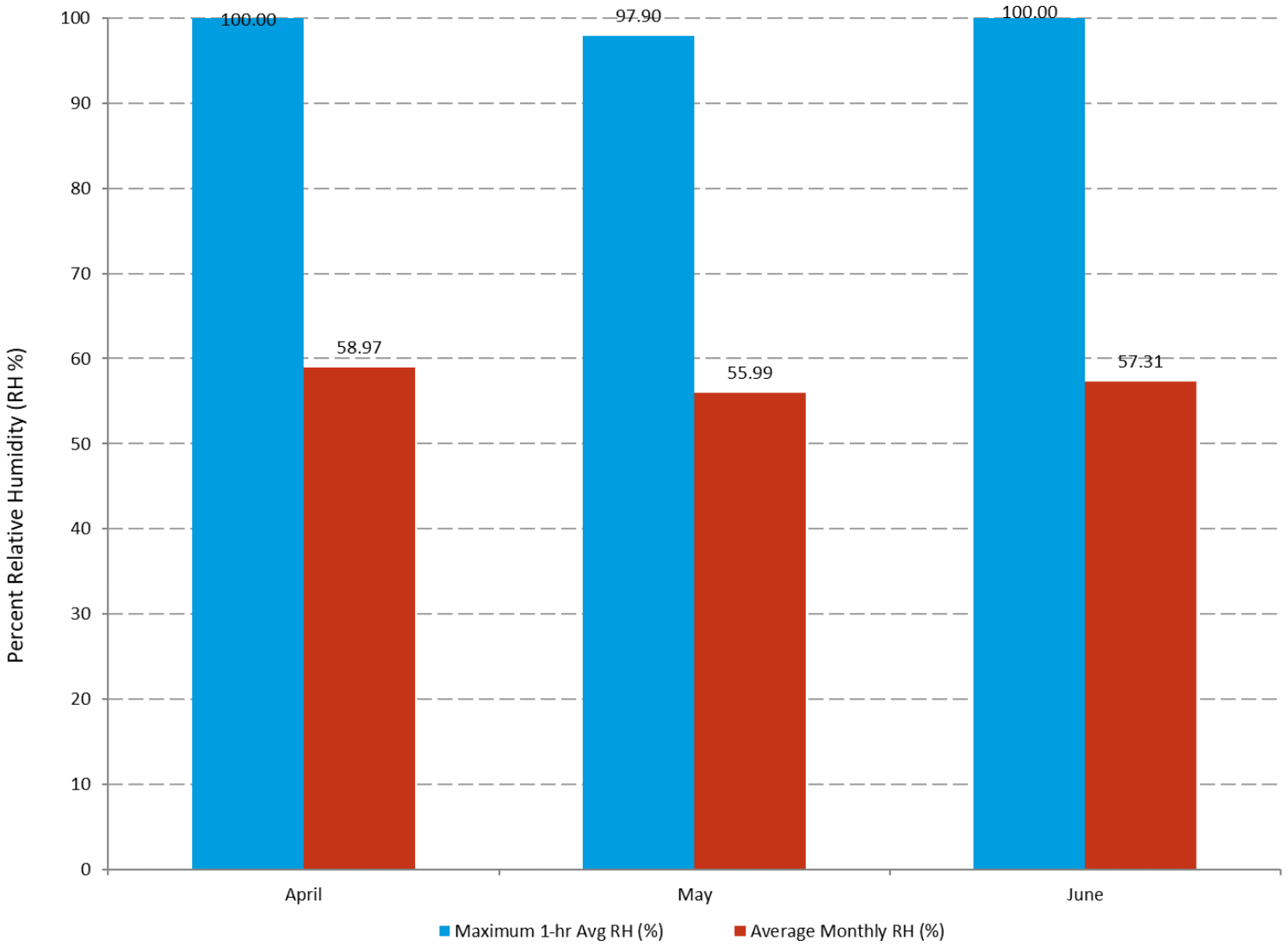


Figure 26. Hereford Q2 2024 Relative Humidity Summary

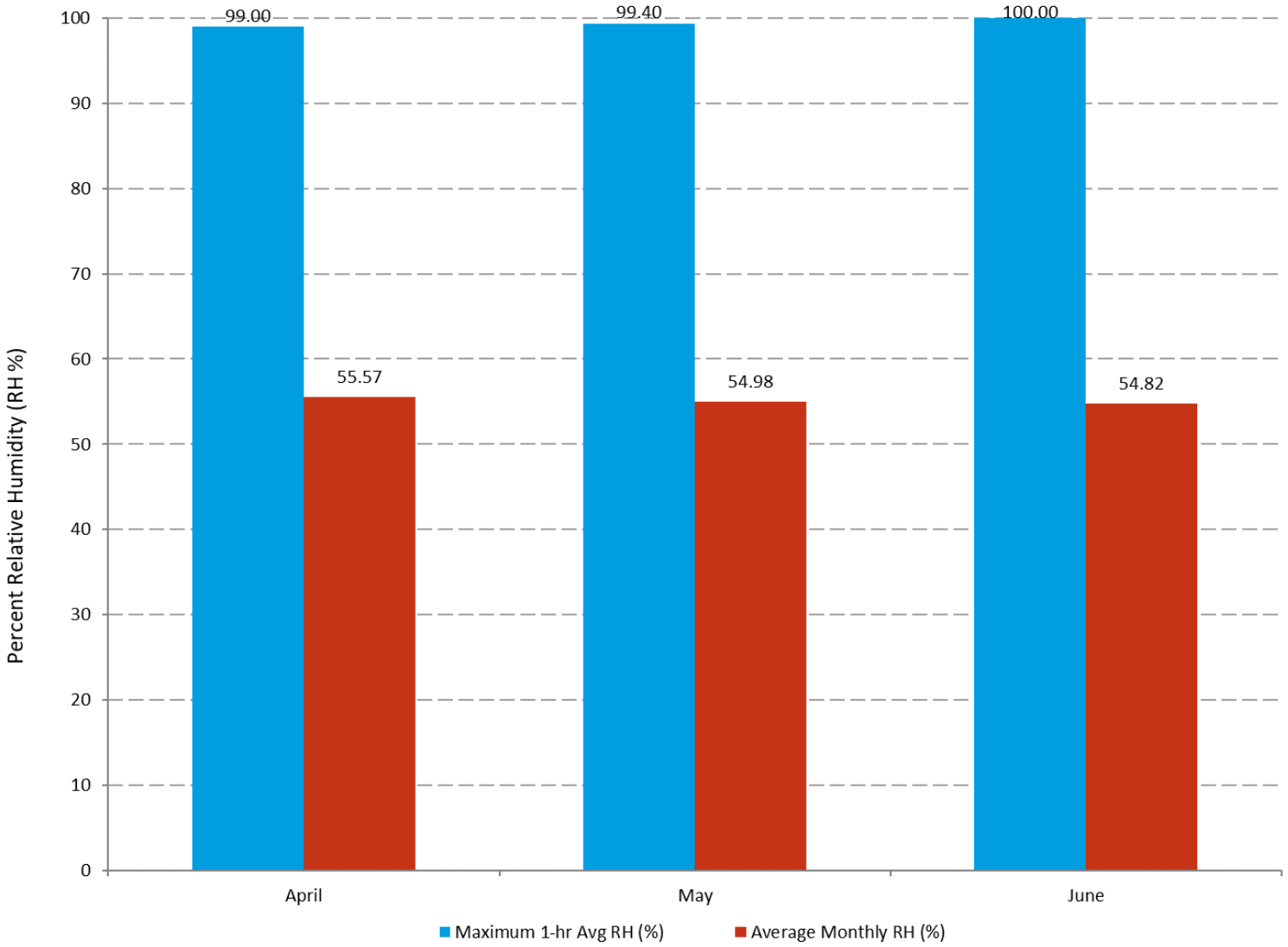


Figure 27. Orchard Q2 2024 Relative Humidity Summary

5.7 Solar Radiation Data Summary

Solar Radiation data was collected at 2-m agl at all three stations using a cross-arm mounted sensor on the meteorology tower. The average solar radiation increased from April to June at all three stations. The 1-hour maximum solar radiation peaked in May at MSP and Orchard and in June at Hereford. Maximum hourly average and monthly average solar radiation for Q2 2024 at all three stations is summarized in **Figure 28** - **Figure 30** and **Table 9**.

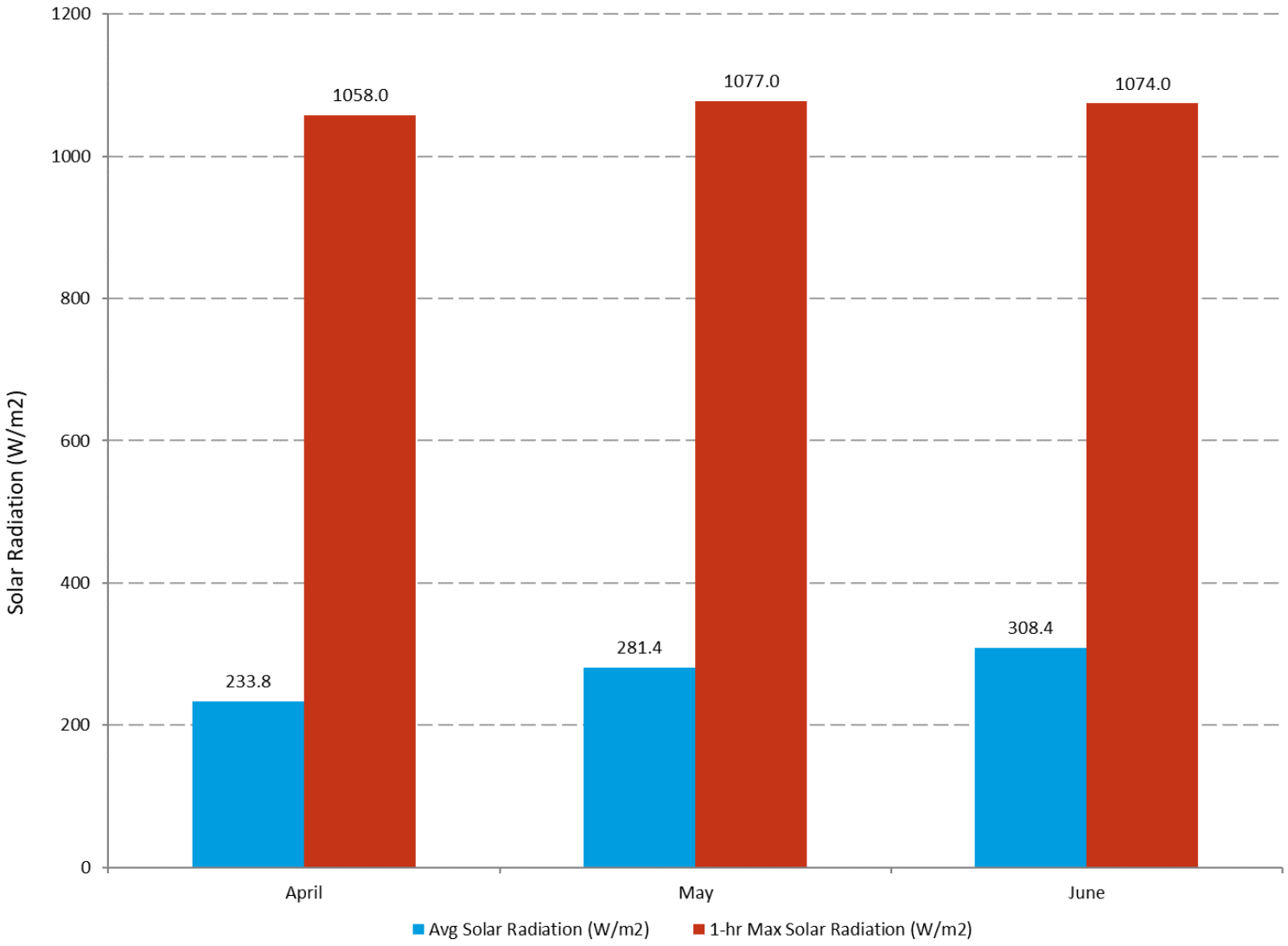


Figure 28. MSP Q2 2024 Solar Radiation Summary

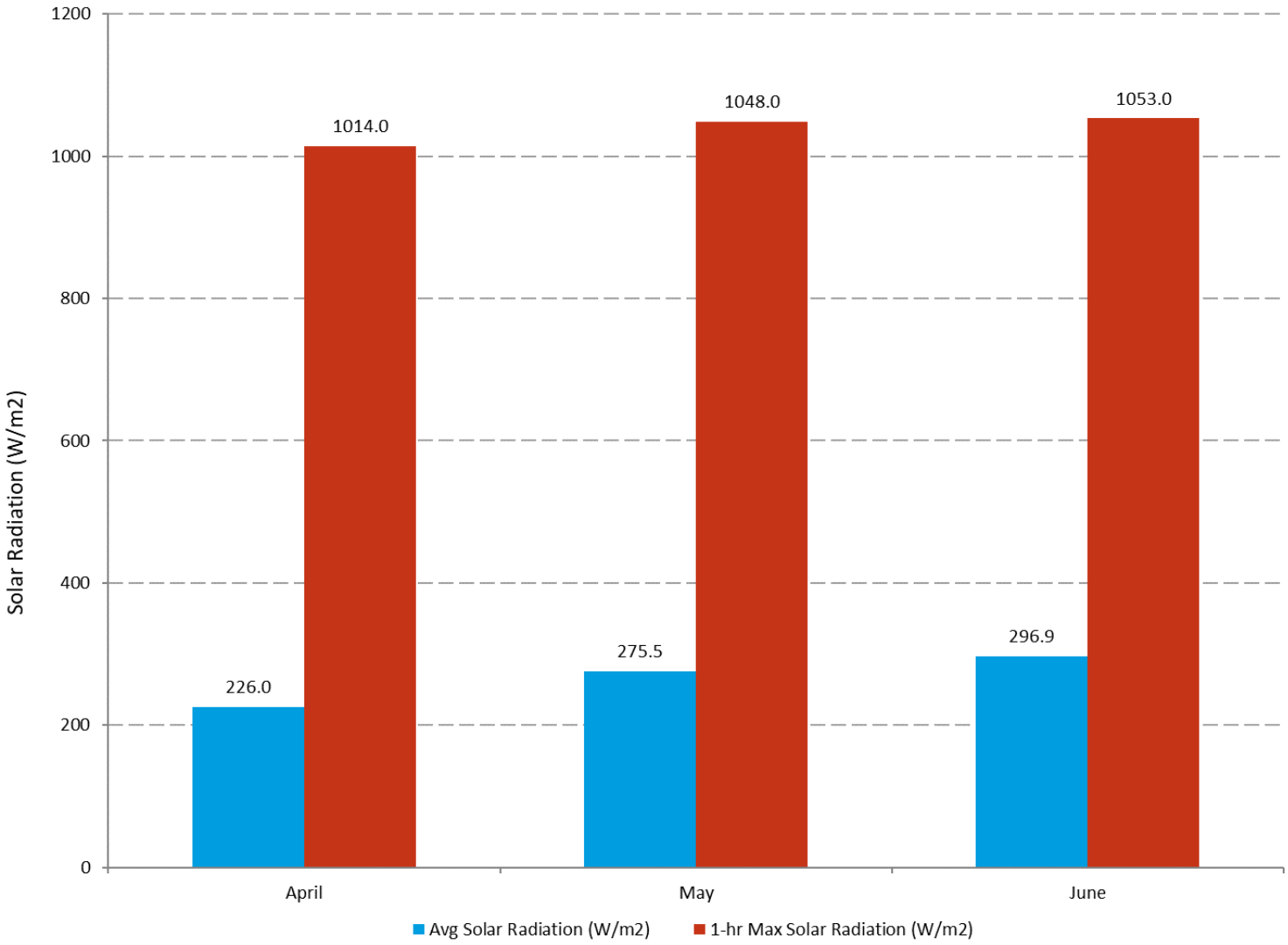


Figure 29. Hereford Q2 2024 Solar Radiation Summary

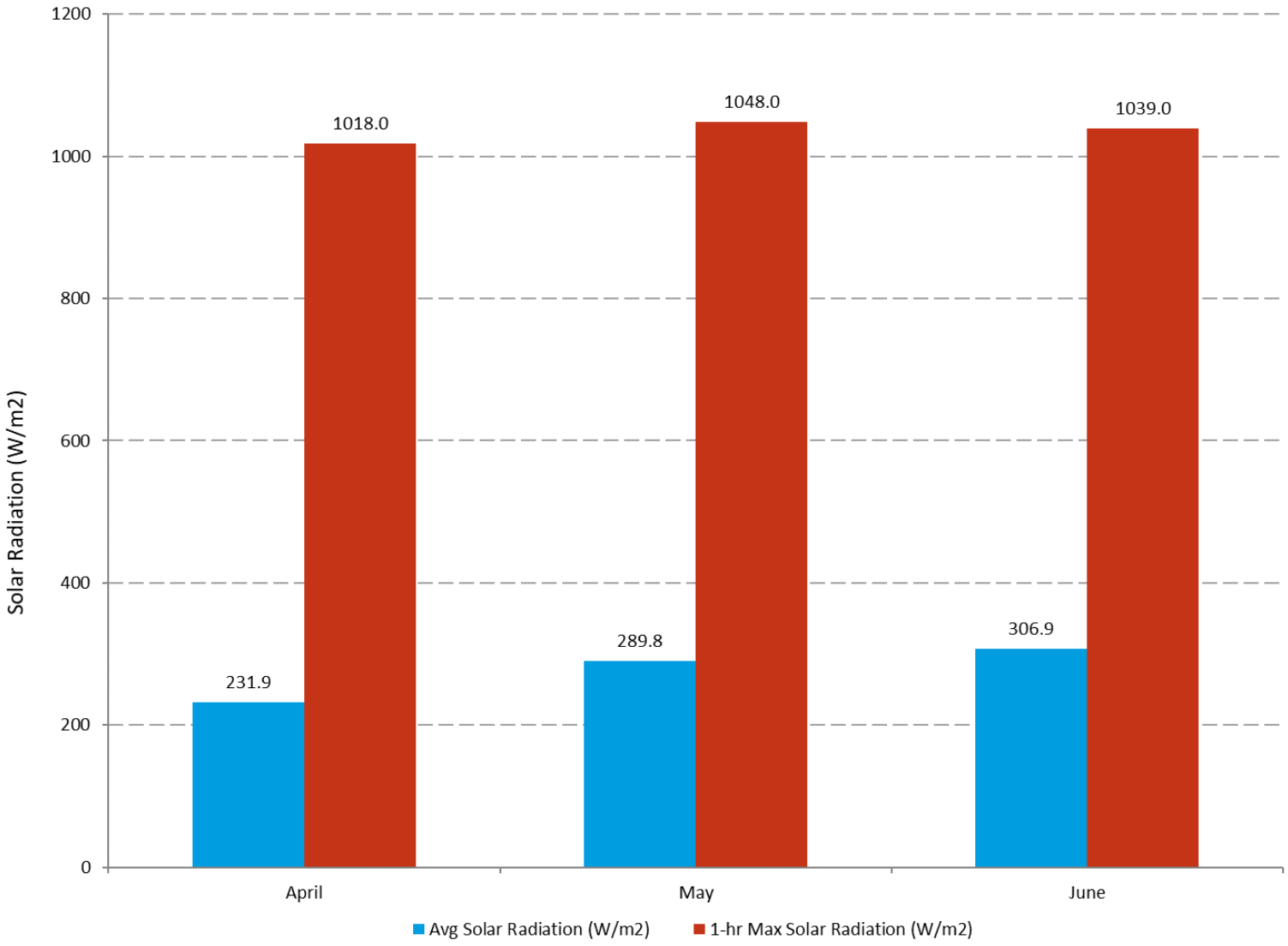


Figure 30. Orchard Q2 2024 Solar Radiation Summary

6. QUARTERLY REPORT DATA SUMMARY

Program activities conducted during Q2 2024 included data collection, equipment programming and calibrations, station inspections, routine maintenance, equipment troubleshooting and repair, routine data acquisition, data screening and validation, and report preparation. Data completeness goals were met for all parameters for all stations. Data completeness for O_3 will be evaluated once the O_3 season is complete in December 2024 in accordance with the data completeness targets.

Air quality data collected includes O_3 at all three stations and $NO/NO_x/NO_2$ at the MSP station. All daily maximum 8-hour average O_3 concentrations measured at Hereford and Orchard stations were below both the 2008 and the 2015 AAQS values for Q2 2024, and there was one exceedance of the 2015 AAQS value at MSP during Q2 2024. Compliance with the AAQS standard for 2024 will be determined at the conclusion of the ozone season.

The maximum 1-hour average concentration of NO_2 at MSP of 45.8 ppb, which occurred in Q1, was below the AAQS standard of 100 ppb. The 1-hour average NO_2 standard is based on the 98^{th} percentile of 1-hour daily maximum concentrations, averaged over 3-years. Compliance with the AAQS 1-hour (100 ppb) and annual (53 ppb) NO_2 standards for 2024 will be evaluated at the conclusion of the calendar year, after a full year of data has been collected.

The meteorological data was all within normal ranges for the area and season.

APPENDIX A: Q2 2024 CALIBRATION AND AUDIT RESULTS

APPENDIX A1: MSP CALIBRATION AND AUDIT RESULTS

TABLE A1-1

QUALITY ASSURANCE CALIBRATION RESULTS-AS FOUND
WELD COUNTY MONITORING NETWORK: MISSILE SITE PARK SITE
AUDIT DATE: 5/30/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

10-METER HORIZONTAL WIND SPEED/DIRECTION AUDIT

SENSOR MODEL: RM YOUNG 05305V
SENSOR SERIAL #: 180188
AUDIT DEVICE MODEL: RM Young 18802
AUDIT DEVICE SERIAL #: CA5458
AUDIT DEVICE EXPIRATION: 10/26/2024

PARAMETER	AUDIT METHOD	AUDIT VALUE	SENSOR RESPONSE	DIFFERENCE (M/S)	ACCEPTANCE CRITERIA	VALUE WITHIN ACCEPTANCE CRITERIA
HORIZONTAL WIND SPEED	DC MOTOR RPM	M/S	M/S	M/S	M/S	N/A
	0	0.000	0.004	0.00	0.20	YES
	200	1.024	1.041	-0.02	0.20	YES
	400	2.048	2.021	0.03	0.20	YES
	600	3.072	3.085	-0.01	0.20	YES
	800	4.096	4.099	0.00	0.20	YES
	1000	5.120	5.129	-0.01	0.20	YES
	2000	10.240	10.213	0.03	0.20	YES
	3000	15.360	15.335	0.02	0.20	YES
	4000	20.480	20.458	0.02	0.20	YES
	5000	25.600	25.577	0.02	0.20	YES
		TORQUE VERIFICATION	CW =	0.1	≤ 0.3 gm-cm	YES
			CCW =	0.1	≤ 0.3 gm-cm	YES
WIND DIRECTION	ALIGNMENT GAUGE	0	-0.73	0.73	5	YES
		30	29.31	0.69	5	YES
		60	60.25	0.25	5	YES
		90	90.74	0.74	5	YES
		120	121.26	1.26	5	YES
		150	151.17	1.16	5	YES
		180	180.47	0.47	5	YES
		210	210.01	0.00	5	YES
		240	239.50	0.50	5	YES
		270	269.82	0.18	5	YES
		300	299.23	0.77	5	YES
		330	328.99	1.01	5	YES
		360	358.60	1.40	5	YES
		TORQUE VERIFICATION	QUAD.#1 =	7	≤ 9.0 gm-cm	YES
			QUAD.#2 =	7	≤ 9.0 gm-cm	YES
°E CROSS ARM ALIGNMENT:	MAG DEC:	7.62		4 QUAD VANE ALIGNMENT:	N=	-1.58
	AS FOUND:	-1			E=	92.37
	TOLERANCE: +/- 5° (PASSED)				S=	179.59
					W=	268.61
WIND DIRECTION	TRANSIT ALIGNMENT		AUDIT =	-1		YES
			SENSOR =	-1	5.0 degrees	YES

KEY:

HWS	Horizontal wind speed
VWS	Vertical wind speed
WD	Wind direction
M/S	Meters per second
N/A	Not applicable
MAG. DEC.	Magnetic Declination
CW	Clockwise
CCW	Counter Clockwise

NOTES:

TABLE A1-2

QUALITY ASSURANCE CALIBRATION RESULTS-AS LEFT

WELD COUNTY MONITORING NETWORK: MISSILE SITE PARK SITE

AUDIT DATE: 5/30/24

AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

10-METER HORIZONTAL WIND SPEED/DIRECTION AUDIT

SENSOR MODEL: RM YOUNG 05305V
SENSOR SERIAL #: 180188
AUDIT DEVICE MODEL: RM Young 18802
AUDIT DEVICE SERIAL #: CA5458
AUDIT DEVICE EXPIRATION: 10/26/2024

PARAMETER	AUDIT METHOD	AUDIT VALUE	SENSOR RESPONSE	DIFFERENCE (M/S)	ACCEPTANCE CRITERIA	VALUE WITHIN ACCEPTANCE CRITERIA
HORIZONTAL WIND SPEED	DC MOTOR RPM	M/S	M/S	M/S	M/S	N/A
	0	0.000	0.004	0.00	0.20	YES
	200	1.024	0.975	0.05	0.20	YES
	400	2.048	1.985	0.06	0.20	YES
	600	3.072	3.079	-0.01	0.20	YES
	800	4.096	4.083	0.01	0.20	YES
	1000	5.120	5.090	0.03	0.20	YES
	2000	10.240	10.196	0.04	0.20	YES
	3000	15.360	15.302	0.06	0.20	YES
	4000	20.480	20.421	0.06	0.20	YES
	5000	25.600	25.541	0.06	0.20	YES
		TORQUE VERIFICATION	CW =	0.1	≤ 0.3 gm-cm	YES
			CCW =	0.1	≤ 0.3 gm-cm	YES
WIND DIRECTION	ALIGNMENT GAUGE	0	-0.73	0.73	5	YES
		30	29.31	0.69	5	YES
		60	60.25	0.25	5	YES
		90	90.74	0.74	5	YES
		120	121.26	1.26	5	YES
		150	151.17	1.16	5	YES
		180	180.47	0.47	5	YES
		210	210.01	0.00	5	YES
		240	239.50	0.50	5	YES
		270	269.82	0.18	5	YES
		300	299.23	0.77	5	YES
		330	328.99	1.01	5	YES
		360	358.60	1.40	5	YES
		TORQUE VERIFICATION	QUAD.#1 =	7	≤ 9.0 gm-cm	YES
			QUAD.#2 =	7	≤ 9.0 gm-cm	YES
°E CROSS ARM ALIGNMENT:	MAG DEC:	7.62		4 QUAD VANE ALIGNMENT:	N=	-1.58
	AS FOUND:	-1			E=	92.37
	TOLERANCE: +/- 5° (PASSED)				S=	179.59
					W=	268.61
WIND DIRECTION	TRANSIT ALIGNMENT		AUDIT =	-1		YES
			SENSOR =	-1	5.0 degrees	YES

KEY:

HWS	Horizontal wind speed
VWS	Vertical wind speed
WD	Wind direction
M/S	Meters per second
N/A	Not applicable
MAG. DEC.	Magnetic Declination
CW	Clockwise
CCW	Counter Clockwise

NOTES: WS sensor bearings (2) were replaced.

TABLE A1-3

QUALITY ASSURANCE CALIBRATION RESULTS
WELD COUNTY MONITORING NETWORK: MISSILE SITE PARK SITE
AUDIT DATE: 5/30/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

TEMPERATURE/DELTA TEMERATURE AUDIT

SENSOR MODEL:	RM YOUNG 41342VC
SENSOR SERIAL #:	032951 (2M)/032952 (10M)
AUDIT DEVICE:	Omega HH42A
AUDIT DEVICE SERIAL #:	23KMM02815
AUDIT DEVICE EXPIRATION:	11/21/2024

WATER BATH	AUDIT	2-M	2-M VS.	10-M	10-M VS.	ACCEPTANCE	DELTA T:	ACCEPTANCE	VALUE WITHIN
	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	N/A
ICE BATH	0.29	0.32	0.03	0.32	0.03	0.50	0.00	0.1	YES
AMBIENT BATH	22.66	22.65	-0.01	22.62	-0.04	0.50	-0.03	0.1	YES
HOT BATH	46.93	46.89	-0.04	46.86	-0.07	0.50	-0.03	0.1	YES

NOTES: Cleaned aspirator housing units.

TABLE A1-4

QUALITY ASSURANCE CALIBRATION RESULTS
WELD COUNTY MONITORING NETWORK: MISSILE SITE PARK SITE
AUDIT DATE: 5/30/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

RELATIVE HUMIDITY AUDIT

SENSOR MODEL: EE181
SENSOR SERIAL #: 20151600125038
AUDIT DEVICE MODEL: EE181
AUDIT DEVICE SERIAL #: 214116001537C1
AUDIT DEVICE EXPIRATION: 3/21/2025

RELATIVE HUMIDITY		AUDIT SENSOR VALUE	2-M SENSOR VALUE	ABSOLUTE % RH DIFF.	ACCEPTANCE CRITERIA (+/-)	VALUE WITHIN ACCEPTANCE CRITERIA
	UNITS	% RH	% RH	% RH	PERCENT	N/A
AVERAGE:		23.74	27.36	3.62	7.0	YES
		23.26	26.88	3.62	7.0	YES
		23.31	26.43	3.12	7.0	YES
		22.60	25.77	3.17	7.0	YES

NOTES:

BAROMETRIC PRESSURE AUDIT

SENSOR MODEL: Setra 278
SENSOR SERIAL #: 7563464
AUDIT DEVICE MODEL: BVC10
AUDIT DEVICE SERIAL #: 2972
AUDIT DEVICE EXPIRATION: 11/24/2024

BAROMETRIC PRESSURE		AUDIT SENSOR VALUE	2-M SENSOR VALUE	ABSOLUTE DIFF.	ACCEPTANCE CRITERIA (+/-)	VALUE WITHIN ACCEPTANCE CRITERIA
	UNITS	mm Hg	mm Hg	mm Hg	mm Hg	N/A
AVERAGE:		635.6	635.8	0.16	2.25	YES

NOTES:

PRECIPITATION AUDIT

SENSOR MODEL: RM Young Heated Rain Gauge Model 52202
SENSOR SERIAL: TB16137
AUDIT DEVICE MODEL: Drip Bottle
AUDIT DEVICE SERIAL #: N/A

PRECIPITATION		AUDIT S VALUE	2-M SENSOR	PERCENT DIFF.	ACCEPTANCE CRITERIA	VALUE WITHIN
As Found						
300 ML WATER = 150 TIPS/0.3"	*UNITS*	Inches	Inches	PERCENT	PERCENT	N/A
Volume 1000		1.968505	1.97	0.1%	10	YES
As Left						
300 ML WATER = 150 TIPS/0.3"	*UNITS*	Inches	Inches	PERCENT	PERCENT	N/A
Volume 1000		1.968505	2.073	5.3%	10	YES

NOTES: Cleared weeds and grasses around precip concrete pad. Adjusted tippers up 1/2 turn each.

PANEL TEMPERATURE AUDIT

SENSOR MODEL: Campbell Scientific CR3000
SENSOR SERIAL #: 13406
AUDIT DEVICE MODEL: Omega HH42A
AUDIT DEVICE SERIAL #: 23KMM02815
AUDIT DEVICE EXPIRATION: 11/21/2024

PANEL TEMPERATURE		AUDIT SENSOR VALUE	2-M SENSOR VALUE	ABSOLUTE DIFF.	ACCEPTANCE CRITERIA (+/-)	VALUE WITHIN ACCEPTANCE CRITERIA
	UNITS	DEG. C	DEG. C	DEG. C	ABS. DIFF	N/A
INSTANTANEOUS READING:		23.20	23.88	0.68	2.1	YES

NOTES:

Table A1-5

Solar Radiation Audit Data

Audit Date: 5/30/2024
Site Sensor: Hukeflux LP02; Serial # 48019
Audit Sensor: ; Serial # SR05-A1; 19771
Audit Sensor Expiration: 11/16/2024

Timestamp	Audit Sensor (w/m2)	Site Sensor (w/m2)
0930	865	846
0945	901	864
1000	916	923
1015	965	954
1030	990	976
1045	999	1008
AVG	939.3	928.5
	% DIFF=	1.15%

NOTES:

TABLE A1-6
MISSILE SITE PARK GAS Q2 AS FOUND REPORT

AUDIT DATE: 4/07/2024
SITE: MISSILE SITE PARK, WELD COUNTY, CO
AUDITED BY: JAKE ZARAGOZA, RAMBOLL

AUDIT DEVICE: TELEDYNE API T700 MULTI-GAS CALIBRATOR SERIAL NUMBER: 4969;
AUDIT GAS (30.5 PPM NO; 30.6 PPM NOx; CYLINDER SERIAL NUMBER: EB0136191)

NO Audit - TAPI T200 NO_X Analyzer Range = 0 - 500 PPB NO_X/Serial Number: 6727

Ouput Flow (slpm)		Audit Point	NO Audit Conc. (PPB)	NOx Audit Conc. (PPB)	NO (PPB)	NO % diff.	NO_X (PPB)	NO_X % diff.	NO_2 (PPB)	NO_2 % diff.	NO_X Pass/Fail
Audit Gas	Dilution										
0.0000	5.0140	Zero	0.0	0.0	0.7	N/A	0.4	N/A	0.2	N/A	N/A
0.0083	5.0120	2	50.6	50.8	48.2	-4.8	48.7	-4.2	0.4	N/A	PASS
0.0165	5.0020	3	100.2	100.5	97.7	-2.5	97.9	-2.6	0.1	N/A	PASS
0.0329	4.9840	4	200.1	200.8	196.8	-1.6	196.4	-2.2	0.2	N/A	PASS
0.0657	4.9500	5	399.4	400.7	395.2	-1.1	396.6	-1.0	0.3	N/A	PASS

NO_2 Audit (Gas Phase Titration) -TAPI T200 NO_X Analyzer Range = 0 - 500 PPB NO_X/Serial Number: 6727

Ouput Flow (slpm)		Audit Point	NO_2 Audit Conc. (PPB)	NO Audit Conc. (PPB)	NO Orig. (PPB)	NO rem. (PPB)	NO_X (PPB)	NO_2 (PPB)	NO_2 % diff.	Molybdenum Converter Efficiency (%) >96% = PASS	NO_2 Pass/Fail
Audit Gas	Dilution										
		Zero	0.0		N/A				N/A	N/A	N/A
0.0165	4.8990	1 (40 PPB O_3)	41.1	100.3	97.7	56.6	96.7	40.4	-1.7	98.76%	PASS
0.0329	4.8780	2 (80 PPB O_3)	79.7	200.1	196.8	117.1	196.7	79.8	0.1	100.1%	PASS
0.0657	4.8510	3 (160 PPB O_3)	157.7	399.3	395.2	237.5	396.3	158.6	0.6	99.9%	PASS

Ozone Audit- TAPI T400 O_3 Analyzer Range = 0 - 500 PPB O_3; Unit Serial Number: 5986

		Audit Point	Uncorrected Conc. (PPB O_3)	Corrected Conc. (PPB O_3)	O_3 (PPB)	O_3 % diff.	Pass/Fail	T400	T700	
Level III Slope	Level III Int.	Zero	0.00	-0.1584	0.69	N/A	N/A	Slope	Slope	
1.0130	-0.1584	1	59.90	60.5203	61.54	1.7	PASS	1.01	0.9870	
		2	99.90	101.0403	101.66	0.6	PASS	Offset	Offset	
		3	199.20	201.6312	200.16	-0.7	PASS	-0.60	0.4000	
		4	299.60	303.3364	300.70	-0.9	PASS			
		5	399.60	404.6364	399.16	-1.4	PASS			

Linear Regression					T200 Diagnostics					
	NO	NO_X	NO_2 (GPT)	O_3	T200 NO Slope	T200 NOx Slope	Box Temp (degC)	Rcell Temp (degC)	Moly Conv Temp (degC)	PMT Temp deg(C)
Slope	0.990	0.990	1.014	0.984	0.947	0.944	31.3	50	314.3	6.8
Intercept	-0.933	-1.115	-1.150	1.700	T200 NO Offset	T200 NOx Offset	Sample Flow (CC/M)	O3 Flow (CC/M)	Rcell Press (inHg)	Sample Press (inHg)
Correlation	1.0000	1.0000	1.0000	1.0000	-0.70	-0.50	512.00	81.00	3.30	23.30
Avg % diff.	-2.52	-2.49	-0.31	-0.13						

Notes:

%	Percent	NOX	Oxides of Nitrogen
TAPI	Teledyne Advanced Pollution Instrumentation	N/A	Not Applicable
Avg	Average	orig.	Original
Conc.	Concentration	O3	Ozone
diff.	Difference	PPB	Parts Per Billion
GPT	Gas Phase Titration	slpm	Standard liters per minute
NO	Nitrogen Oxide	rem.	Remaining
NO2	Nitrogen Dioxide		

	T400 Diag.	T700 Diag.
Box Temp	27.7	30.3
Sample Temp	36.4	40.2
Ph. Lamp Temp	58	58
Ozone Gen Lamp T	N/A	48
Sample Flow	665.3	N/A
Photo Flow	N/A	0.698
Sample Press	22.3	N/A
Photo Press	N/A	24
O3 Ref	4450.7	3863.6

TABLE A1-7
MISSILE SITE PARK GAS Q2 AS LEFT REPORT

AUDIT DATE: 4/18/24
SITE: MISSILE SITE PARK, WELD COUNTY, CO
AUDITED BY: JAKE ZARAGOZA/ABE DEARDEN/ADAM CHRISTMAN, RAMBOLL

AUDIT DEVICE: TELEDYNE API T700 MULTI-GAS CALIBRATOR SERIAL NUMBER: 4969;
AUDIT GAS (30.5 PPM NO; 30.6 PPM NOx; CYLINDER SERIAL NUMBER: EB0136191)

NO Audit - TAPI T200 NO_X Analyzer Range = 0 - 500 PPB NO_X/Serial Number: 6727

Ouput Flow (slpm)		Audit Point	NO Audit Conc. (PPB)	NOx Audit Conc. (PPB)	NO (PPB)	NO % diff.	NO_X (PPB)	NO_X % diff.	NO_2 (PPB)	NO_2 % diff.	NO_X Pass/Fail
Audit Gas	Dilution										
0.0000	5.0140	Zero	0.0	0.0	0.6	N/A	0.8	N/A	0.4	N/A	N/A
0.0083	5.1020	2	50.3	50.4	49.4	-1.7	50.1	-0.6	0.7	N/A	PASS
0.0329	4.9860	3	200.1	200.8	198.4	-0.8	199.2	-0.8	1.0	N/A	PASS
0.0494	4.9680	4	300.0	301.0	298.3	-0.6	299.6	-0.5	1.0	N/A	PASS
0.0657	4.9540	5	399.1	400.4	399.7	0.2	401.1	0.2	1.6	N/A	PASS

NO_2 Audit (Gas Phase Titration) -TAPI T200 NO_X Analyzer Range = 0 - 500 PPB NO_X/Serial Number: 6727

Ouput Flow (slpm)		Audit Point	NO_2 Audit Conc. (PPB)	NO Audit Conc. (PPB)	NO Orig. (PPB)	NO rem. (PPB)	NO_X (PPB)	NO_2 (PPB)	NO_2 % diff.	Molybdenum Converter Efficiency (%) >96% = PASS	NO_2 Pass/Fail
Audit Gas	Dilution										
0.0000	5.0140	Zero	0.0	0.0	N/A	0.6	0.8	0.4	N/A	N/A	N/A
		1 (40 PPB O_3)	40.3	200.1	198.4	158.1	199.5	41.8	3.7	100.2%	PASS
0.0493	4.8680	2 (80 PPB O_3)	79.9	300.0	298.3	218.4	300.7	82.4	3.1	100.4%	PASS
0.0657	4.8510	3 (160 PPB O_3)	163.6	399.2	399.7	236.1	400.1	163.9	0.2	99.7%	PASS

Ozone Audit- TAPI T400 O_3 Analyzer Range = 0 - 500 PPB O_3; Unit Serial Number: 5986

		Audit Point	Uncorrected Conc. (PPB O_3)	Corrected Conc. (PPB O_3)	O_3 (PPB)	O_3 % diff.	Pass/Fail	T400	T700	
Level III Slope	Level III Int.	Zero	0.00	0.1645	0.66	N/A	N/A	Slope	Slope	
1.0121	0.1645	1	49.80	50.56708	51.82	2.5	PASS	1.01	0.9870	
		2	99.70	101.07087	101.41	0.3	PASS	Offset	Offset	
		3	200.00	202.5845	202.74	0.1	PASS	-0.60	0.4000	
		4	300.50	304.30055	304.33	0.0	PASS			
		5	400.20	405.20692	403.19	-0.5	PASS			

Linear Regression					T200 Diagnostics					
	NO	NO_X	NO_2 (GPT)	O_3	T200 NO Slope	T200 NOx Slope	Box Temp (degC)	Rcell Temp (degC)	Moly Conv Temp (degC)	PMT Temp deg(C)
Slope	0.999	0.999	0.998	0.994	0.947	0.944	33.6	50	314.3	6.8
Intercept	-0.465	-0.127	1.279	1.095	T200 NO Offset	T200 NOx Offset	Sample Flow (CC/M)	O3 Flow (CC/M)	Rcell Press (inHg)	Sample Press (inHg)
Correlation	1.0000	1.0000	0.9999	1.0000	-0.70	-0.50	527.00	81.00	3.40	23.70
Avg % diff.	-0.74	-0.43	2.33	0.48						

Notes:

					T400 Diag.	T700 Diag.
%	Percent	NOX	Oxides of Nitrogen			
TAPI	Teledyne Advanced Pollution Instrumentation	N/A	Not Applicable	Box Temp		
Avg	Average	orig.	Original	Sample Temp		
Conc.	Concentration	O3	Ozone	Ph. Lamp Temp		N/A
diff.	Difference	PPB	Parts Per Billion	Ozone Gen Lamp	N/A	
GPT	Gas Phase Titration	slpm	Standard liters per minute	Sample Flow		N/A
NO	Nitrogen Oxide	rem.	Remaining	Photo Flow	N/A	
NO2	Nitrogen Dioxide			Sample Press		N/A
				Photo Press	N/A	
				O3 Ref		

TABLE A1-8

QUALITY ASSURANCE CALIBRATION RESULTS-AS FOUND

WELD COUNTY MONITORING NETWORK: MISSILE SITE PARK SITE

AUDIT DATE: 4/17/2024

AUDIT CONDUCTED BY: Adam Christman/Jake Zaragoza

HIGH FLOW MASS FLOW CONTROLLER AUDIT

SENSOR MODEL: Hastings HFC-212
SENSOR SERIAL #: 661178007
AUDIT DEVICE MODEL: Alicat Scientific MB-10SLPM-D
AUDIT DEVICE SERIAL #: 471381
AUDIT DEVICE EXPIRATION: 1/8/2025

	AUDIT METHOD	AUDIT VALUE	SENSOR RESPONSE	DIFFERENCE (%)	ACCEPTANCE CRITERIA	VALUE WITHIN ACCEPTANCE CRITERIA
	DRV	Ref. Flow (SLPM)	Inst. Flow (SLPM)	%	%	N/A
	0	0.001	0.000	N/A	1.00	N/A
START TIME 16:27	250	0.539	0.539	0.00%	1.00	YES
	500	1.073	1.078	0.47%	1.00	YES
	750	1.602	1.611	0.56%	1.00	YES
	1000	2.133	2.149	0.75%	1.00	YES
	1250	2.671	2.686	0.56%	1.00	YES
	1500	3.205	3.218	0.41%	1.00	YES
	1750	3.735	3.755	0.54%	1.00	YES
	2000	4.270	4.298	0.66%	1.00	YES
	2250	4.803	4.842	0.81%	1.00	YES
	2500	5.328	5.360	0.60%	1.00	YES
	2750	5.857	5.907	0.85%	1.00	YES
	3000	6.390	6.440	0.78%	1.00	YES
	3250	6.915	6.970	0.80%	1.00	YES
	3500	7.447	7.505	0.78%	1.00	YES
	3750	7.986	8.030	0.55%	1.00	YES
	4000	8.515	8.570	0.65%	1.00	YES
	4250	9.055	9.110	0.61%	1.00	YES
	4500	9.602	9.635	0.34%	1.00	YES
END TIME 17:10	4750	10.139	10.154	0.15%	1.00	YES
	5000	10.681	10.690	0.08%	1.00	YES

LOW FLOW MASS FLOW CONTROLLER AUDIT

SENSOR MODEL: Hastings HFC-212
SENSOR SERIAL #: 763637014
AUDIT DEVICE MODEL: Alicat Scientific MBS-200SCCM-D
AUDIT DEVICE SERIAL #: 471382
AUDIT DEVICE EXPIRATION: 1/8/2025

	AUDIT METHOD	AUDIT VALUE	SENSOR RESPONSE	DIFFERENCE (%)	ACCEPTANCE CRITERIA	VALUE WITHIN ACCEPTANCE CRITERIA
	DRV	Ref. Flow (SCCM)	Inst. Flow (SCCM)	%	%	N/A
	0	0.000	0.000	N/A	1.00	N/A
START TIME 17:57	250	5.520	5.600	1.45%	1.00	NO
	500	11.050	11.100	0.45%	1.00	YES
	750	16.520	16.600	0.48%	1.00	YES
	1000	22.020	22.100	0.36%	1.00	YES
	1250	27.520	27.600	0.29%	1.00	YES
	1500	32.970	33.000	0.09%	1.00	YES
	1750	38.410	38.500	0.23%	1.00	YES
	2000	43.820	43.800	-0.05%	1.00	YES
	2250	49.160	49.200	0.08%	1.00	YES
	2500	54.440	54.500	0.11%	1.00	YES
	2750	59.750	60.000	0.42%	1.00	YES
	3000	64.980	65.000	0.03%	1.00	YES
	3250	70.230	70.400	0.24%	1.00	YES
	3500	75.450	75.600	0.20%	1.00	YES
	3750	80.660	81.000	0.42%	1.00	YES
	4000	85.870	86.300	0.50%	1.00	YES
	4250	91.120	91.500	0.42%	1.00	YES
	4500	96.420	96.900	0.50%	1.00	YES
END TIME 18:37	4750	101.690	102.400	0.70%	1.00	YES
	5000	106.930	107.900	0.91%	1.00	YES

TABLE A1-9

QUALITY ASSURANCE CALIBRATION RESULTS-AS LEFT

WELD COUNTY MONITORING NETWORK: MISSILE SITE PARK SITE

AUDIT DATE: 4/17/2024

AUDIT CONDUCTED BY: Adam Christman/Jake Zaragoza

HIGH FLOW MASS FLOW CONTROLLER AUDIT

SENSOR MODEL: Hastings HFC-212
SENSOR SERIAL #: 661178007
AUDIT DEVICE MODEL: Alicat Scientific MB-10SLPM-D
AUDIT DEVICE SERIAL #: 471381
AUDIT DEVICE EXPIRATION: 1/8/2025

	AUDIT METHOD	AUDIT VALUE	SENSOR RESPONSE	DIFFERENCE (%)	ACCEPTANCE CRITERIA	VALUE WITHIN ACCEPTANCE CRITERIA
	DRV	Ref. Flow (SLPM)	Inst. Flow (SLPM)	%	%	N/A
	0	0.000	0.000	N/A	1.00	N/A
START TIME 17:13	250	0.538	0.539	0.19%	1.00	YES
	500	1.071	1.071	0.00%	1.00	YES
	750	1.599	1.602	0.19%	1.00	YES
	1000	2.137	2.133	-0.19%	1.00	YES
	1250	2.669	2.671	0.07%	1.00	YES
	1500	3.194	3.193	-0.03%	1.00	YES
	1750	3.732	3.735	0.08%	1.00	YES
	2000	4.262	4.270	0.19%	1.00	YES
	2250	4.796	4.803	0.15%	1.00	YES
	2500	5.321	5.328	0.13%	1.00	YES
	2750	5.855	5.857	0.03%	1.00	YES
	3000	6.395	6.390	-0.08%	1.00	YES
	3250	6.932	6.915	-0.25%	1.00	YES
	3500	7.464	7.447	-0.23%	1.00	YES
	3750	7.996	7.986	-0.13%	1.00	YES
	4000	8.529	8.515	-0.16%	1.00	YES
	4250	9.063	9.055	-0.09%	1.00	YES
	4500	9.602	9.635	0.34%	1.00	YES
END TIME 17:53	4750	10.125	10.154	0.29%	1.00	YES
	5000	10.652	10.690	0.36%	1.00	YES

LOW FLOW MASS FLOW CONTROLLER AUDIT

SENSOR MODEL: Hastings HFC-212
SENSOR SERIAL #: 763637014
AUDIT DEVICE MODEL: Alicat Scientific MBS-200SCCM-D
AUDIT DEVICE SERIAL #: 471382
AUDIT DEVICE EXPIRATION: 1/8/2025

	AUDIT METHOD	AUDIT VALUE	SENSOR RESPONSE	DIFFERENCE (%)	ACCEPTANCE CRITERIA	VALUE WITHIN ACCEPTANCE CRITERIA
	DRV	Ref. Flow (SCCM)	Inst. Flow (SCCM)	%	%	N/A
	0	0.000	0.000	N/A	1.00	N/A
START TIME 17:57	250	5.460	5.500	0.73%	1.00	YES
	500	11.050	11.100	0.45%	1.00	YES
	750	16.580	16.600	0.12%	1.00	YES
	1000	22.120	22.100	-0.09%	1.00	YES
	1250	27.570	27.600	0.11%	1.00	YES
	1500	32.980	33.000	0.06%	1.00	YES
	1750	38.400	38.500	0.26%	1.00	YES
	2000	43.780	43.800	0.05%	1.00	YES
	2250	49.100	49.200	0.20%	1.00	YES
	2500	54.370	54.500	0.24%	1.00	YES
	2750	59.670	59.700	0.05%	1.00	YES
	3000	64.870	65.000	0.20%	1.00	YES
	3250	70.100	70.400	0.43%	1.00	YES
	3500	75.330	75.600	0.36%	1.00	YES
	3750	80.560	80.600	0.05%	1.00	YES
	4000	85.830	85.900	0.08%	1.00	YES
	4250	91.050	91.500	0.49%	1.00	YES
	4500	96.280	96.400	0.12%	1.00	YES
END TIME 19:12	4750	101.480	101.700	0.22%	1.00	YES
	5000	106.680	106.900	0.21%	1.00	YES

APPENDIX A2: HEREFORD CALIBRATION AND AUDIT RESULTS

TABLE A2-1

QUALITY ASSURANCE CALIBRATION RESULTS-AS FOUND
WELD COUNTY MONITORING NETWORK: HEREFORD SITE
AUDIT DATE: 6/21/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

10-METER HORIZONTAL WIND SPEED/DIRECTION AUDIT

SENSOR MODEL: RM Young 05305V
SENSOR SERIAL #: 180187
AUDIT DEVICE MODEL: RM Young 18802
AUDIT DEVICE SERIAL #: CA5458
AUDIT DEVICE EXPIRATION: 10/26/2024

PARAMETER	AUDIT METHOD	AUDIT VALUE	SENSOR RESPONSE	DIFFERENCE (M/S)	ACCEPTANCE CRITERIA	VALUE WITHIN ACCEPTANCE CRITERIA
HORIZONTAL WIND SPEED	DC MOTOR RPM	M/S	M/S	M/S	M/S	N/A
	0	0.000	-0.007	0.01	0.20	YES
	200	1.024	0.950	0.07	0.20	YES
	400	2.048	2.060	-0.01	0.20	YES
	600	3.072	3.050	0.02	0.20	YES
	800	4.096	4.040	0.06	0.20	YES
	1000	5.120	5.090	0.03	0.20	YES
	2000	10.240	10.210	0.03	0.20	YES
	3000	15.360	15.320	0.04	0.20	YES
	4000	20.480	20.450	0.03	0.20	YES
	5000	25.600	25.580	0.02	0.20	YES
		TORQUE VERIFICATION	CW =	0.1	≤ 0.3 gm-cm	YES
			CCW =	0.1	≤ 0.3 gm-cm	YES
WIND DIRECTION	ALIGNMENT GAUGE	0	3.29	3.29	5	YES
		30	32.80	2.80	5	YES
		60	62.20	2.20	5	YES
		90	89.60	0.40	5	YES
		120	117.30	2.70	5	YES
		150	146.60	3.40	5	YES
		180	176.20	3.80	5	YES
		210	206.70	3.30	5	YES
		240	237.90	2.10	5	YES
		270	269.00	1.00	5	YES
		300	300.60	0.60	5	YES
		330	333.50	3.50	5	YES
		360	363.20	3.20	5	YES
		TORQUE VERIFICATION	QUAD.#1 =	7	≤ 9.0 gm-cm	YES
			QUAD.#2 =	7	≤ 9.0 gm-cm	YES
°E CROSS ARM ALIGNMENT:	MAG DEC:	7.37		4 QUAD VANE ALIGNMENT:	N=	357.4
	AS FOUND:	-1			E=	88.2
	TOLERANCE: +/- 5° (PASSED)				S=	176.6
					W=	267.8
WIND DIRECTION	TRANSIT ALIGNMENT		AUDIT =	-1		YES
			SENSOR =	-1	5.0 degrees	YES

KEY:

HWS	Horizontal wind speed
VWS	Vertical wind speed
WD	Wind direction
M/S	Meters per second
N/A	Not applicable
MAG. DEC.	Magnetic Declination
CW	Clockwise
CCW	Counter Clockwise

NOTES: No changes

TABLE A2-2

QUALITY ASSURANCE CALIBRATION RESULTS
WELD COUNTY MONITORING NETWORK: HEREFORD SITE
AUDIT DATE: 6/21/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

TEMPERATURE/DELTA TEMERATURE AUDIT

SENSOR MODEL: RM YOUNG 41342VC
SENSOR SERIAL #: 032950 (2M)/032869 (10M)
AUDIT DEVICE: Omega HH42A
AUDIT DEVICE SERIAL #: 23KMM02815
AUDIT DEVICE EXPIRATION: 11/21/2024

WATER BATH	AUDIT	2-M	2-M VS.	10-M	10-M VS.	ACCEPTANCE	DELTA T:	ACCEPTANCE	VALUE
	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	N/A
ICE BATH	0.20	0.29	0.09	0.33	0.13	0.50	0.04	0.1	YES
AMBIENT BATH	18.94	18.93	-0.02	18.99	0.05	0.50	0.07	0.1	YES
HOT BATH	47.59	47.66	0.07	47.63	0.04	0.50	-0.03	0.1	YES

NOTES: Cleaned aspirator housing units.

TABLE A2-3

QUALITY ASSURANCE CALIBRATION RESULTS
WELD COUNTY MONITORING NETWORK: HEREFORD SITE
AUDIT DATE: 6/21/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

RELATIVE HUMIDITY AUDIT

SENSOR MODEL: EE181
SENSOR SERIAL #: 2015160012638F
AUDIT DEVICE MODEL: EE181
AUDIT DEVICE SERIAL #: 214116001537C1
AUDIT DEVICE EXPIRATION: 3/21/2025

RELATIVE HUMIDITY		AUDIT SENSOR VALUE	2-M SENSOR VALUE	ABSOLUTE % RH DIFF.	ACCEPTANCE CRITERIA (+/-)	VALUE WITHIN ACCEPTANCE CRITERIA
UNITS		% RH	% RH	% RH	PERCENT	N/A
AVERAGE:		66.53	70.86	4.33	7.0	YES
		64.88	68.44	3.56	7.0	YES
		62.36	65.8	3.44	7.0	YES
		64.59	68.37	3.78		

NOTES:

BAROMETRIC PRESSURE AUDIT

SENSOR MODEL: Setra 278
SENSOR SERIAL #: 7573233
AUDIT DEVICE MODEL: BVC10
AUDIT DEVICE SERIAL #: 2972
AUDIT DEVICE EXPIRATION: 11/24/2024

BAROMETRIC PRESSURE		AUDIT SENSOR VALUE	2-M SENSOR VALUE	ABSOLUTE DIFF.	ACCEPTANCE CRITERIA (+/-)	VALUE WITHIN ACCEPTANCE CRITERIA
UNITS		mm Hg	mm Hg	mm Hg	mm Hg	N/A
AVERAGE:		629.21	629.16	-0.05	2.25	YES

NOTES:

PRECIPITATION AUDIT

SENSOR MODEL: RM Young Heated Rain Gauge Model 52202
SENSOR SERIAL: TB16139
AUDIT DEVICE MODEL: Drip Bottle
AUDIT DEVICE SERIAL #: N/A

PRECIPITATION		AUDIT S VALUE	2-M SENSOR	PERCENT DIFF.	ACCEPTANCE CRITERIA	VALUE WITHIN
As Found						
300 ML WATER = 150 TIPS/0.591"	*UNITS*	Inches	Inches	PERCENT	PERCENT	N/A
Volume	1000	1.968505	1.883	-4.3%	10	YES
As Left						
300 ML WATER = 150 TIPS/0.591"	*UNITS*	Inches	Inches	PERCENT	PERCENT	N/A
Volume	500	0.984253	0.981	-0.3%	10	YES

NOTES: Cleared weeds and grasses around precip concrete pad. Adjusted tippers up 1/2 turn each. Cleaned tippers and surrounds of spider debris and dirt.

PANEL TEMPERATURE AUDIT

SENSOR MODEL: Campbell Scientific CR3000
SENSOR SERIAL #: 13408
AUDIT DEVICE MODEL: Omega HH42A
AUDIT DEVICE SERIAL #: 23KMM02815
AUDIT DEVICE EXPIRATION: 11/21/2024

PANEL TEMPERATURE		AUDIT SENSOR VALUE	2-M SENSOR VALUE	ABSOLUTE DIFF.	ACCEPTANCE CRITERIA (+/-)	VALUE WITHIN ACCEPTANCE CRITERIA
	UNITS	DEG. C	DEG. C	DEG. C	ABS. DIFF	N/A
INSTANTANEOUS READING:		26.19	26.06	0.13	2.1	YES

NOTES:

Table A2-4

Solar Radiation Audit Data

Audit Date: 6/21/2024
Site Sensor: Hukseflux LP02; Serial # 48015
Audit Sensor: ; Serial # SR05-A1; 19771
Audit Sensor Expiration: 11/16/2024

Timestamp	Audit Sensor (w/m2)	Site Sensor (w/m2)
1030	965	938
1045	987	959
1100	1003	974
1115	1008	980
1130	1023	993
1145	1010	975
AVG	999.3	969.8
	% DIFF=	2.95%

NOTES:

TABLE A2-5
HEREFORD GAS Q2 AS FOUND REPORT

AUDIT DATE: 4/07/2024
SITE: HEREFORD, WELD COUNTY, CO
AUDITED BY: JAKE ZARAGOZA

AUDIT DEVICE: TELEDYNE API T703 OZONE CALIBRATOR SERIAL NUMBER: 825

Ozone Audit- TAPI T400 O_3 Analyzer Range = 0 - 500 PPB O_3; Unit Serial Number: 5984

		Audit Point	Uncorrected Conc. (PPB O_3)	Corrected Conc. (PPB O_3)	O_3 (PPB)	O_3 % diff.	Pass/Fail	T400	T700
Level III Slope	Level III Int.	Zero	0.00	-0.1997	0.79	N/A	N/A	Slope	Slope
1.0025	-0.1997	1	60.70	60.65205	60.29	-0.6	PASS	0.99	0.98
		2	100.30	100.35105	99.90	-0.4	PASS	Offset	Offset
		3	200.20	200.5008	199.48	-0.5	PASS	-3.10	-0.41
		4	300.10	300.65055	298.47	-0.7	PASS		
		5	400.30	401.10105	397.50	-0.9	PASS		

Linear Regression

	O_3	T400	Box Temp (degC)	Sample Temp (degC)	Photo Lamp Temp (degC)	Sample Flow (CC/M)	Sample Press (inHg)	Ozone Ref (mV)	
Slope	0.990		23.3	32.5	58	616.8	21.9	4402.5	
Intercept	0.713	T700	Box Temp (degC)	Sample Temp (degC)	Ozone Gen Lamp (degC)	Photo Flow (LPM)	Photo Press (inHg)	Ozone Ref (mV)	Output Flow (LPM)
Correlation	1.0000		26.00	34.60	48.00	0.66	23.60	3700.50	4.12
Avg % diff.	-0.64								

Notes:

%	Percent	rem.	Remaining
API	Advanced Pollution Instrumentation	N/A	Not Applicable
Avg	Average	orig.	Original
Conc.	Concentration	O3	Ozone
diff.	Difference	PPB	Parts Per Billion

TABLE A2-6
HEREFORD GAS Q2 AS LEFT REPORT

AUDIT DATE: 04/18/2024
SITE: HEREFORD, WELD COUNTY, CO
AUDITED BY: JAKE/ABE, RAMBOLL

AUDIT DEVICE: TELEDYNE API T703 OZONE CALIBRATOR SERIAL NUMBER: 825

Ozone Audit- TAPI T400 O_3 Analyzer Range = 0 - 500 PPB O_3; Unit Serial Number: 5984

		Audit Point	Uncorrected Conc. (PPB O_3)	Corrected Conc. (PPB O_3)	O_3 (PPB)	O_3 % diff.	Pass/Fail	T400	T700
Level III Slope	Level III Int.	Zero	0.00	-0.3105	0.89	N/A	N/A	Slope	Slope
1.0013	-0.3105	1	50.40	50.15502	52.50	4.7	PASS	0.99	0.98
		2	100.00	99.8195	102.83	3.0	PASS	Offset	Offset
		3	199.80	199.74924	203.057	1.7	PASS	-3.10	-0.41
		4	300.00	300.0795	303.44	1.1	PASS		
		5	400.20	400.40976	402.22	0.5	PASS		

Linear Regression

	O_3	T400	Box Temp (degC)	Sample Temp (degC)	Photo Lamp Temp (degC)	Sample Flow (CC/M)	Sample Press (inHg)	Ozone Ref (mV)	
Slope	1.002		23.9	32.8	58	632.9	22.5	4372.4	
Intercept	2.240	T700	Box Temp (degC)	Sample Temp (degC)	Ozone Gen Lamp (degC)	Photo Flow (LPM)	Photo Press (inHg)	Ozone Ref (mV)	Output Flow (LPM)
Correlation	1.0000		25.0	35.1	47.9	0.684	24.8	3697.2	4.983
Avg % diff.	2.18								

Notes:

%	Percent	rem.	Remaining
API	Advanced Pollution Instrumentation	N/A	Not Applicable
Avg	Average	orig.	Original
Conc.	Concentration	O3	Ozone
diff.	Difference	PPB	Parts Per Billion

APPENDIX A3: ORCHARD CALIBRATION AND AUDIT RESULTS

TABLE A3-1

QUALITY ASSURANCE CALIBRATION RESULTS-AS FOUND
WELD COUNTY MONITORING NETWORK: ORCHARD SITE
AUDIT DATE: 6/25/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

10-METER HORIZONTAL WIND SPEED/DIRECTION AUDIT

SENSOR MODEL: RM YOUNG 05305V
SENSOR SERIAL #: 180186
AUDIT DEVICE MODEL: RM Young 18802
AUDIT DEVICE SERIAL #: CA5458
AUDIT DEVICE EXPIRATION: 10/26/2024

PARAMETER	AUDIT METHOD	AUDIT VALUE	SENSOR RESPONSE	DIFFERENCE (M/S)	ACCEPTANCE CRITERIA	VALUE WITHIN ACCEPTANCE CRITERIA
HORIZONTAL WIND SPEED	DC MOTOR RPM	M/S	M/S	M/S	M/S	N/A
	0	0.000	-0.002	0.00	0.20	YES
	200	1.024	0.955	0.07	0.20	YES
	400	2.048	2.040	0.01	0.20	YES
	600	3.072	3.056	0.02	0.20	YES
	800	4.096	4.043	0.05	0.20	YES
	1000	5.120	5.040	0.08	0.20	YES
	2000	10.240	10.130	0.11	0.20	YES
	3000	15.360	15.210	0.15	0.20	YES
	4000	20.480	20.290	0.19	0.20	YES
	5000	25.600	25.380	0.22	0.20	NO
		TORQUE VERIFICATION	CW =	0.1	≤ 0.3 gm-cm	YES
			CCW =	0.1	≤ 0.3 gm-cm	YES
WIND DIRECTION	ALIGNMENT GAUGE	0	-0.55	0.55	5	YES
		30	28.64	1.36	5	YES
		60	58.17	1.83	5	YES
		90	88.33	1.67	5	YES
		120	118.08	1.92	5	YES
		150	148.36	1.64	5	YES
		180	178.12	1.88	5	YES
		210	208.76	1.24	5	YES
		240	237.07	2.93	5	YES
		270	268.69	1.31	5	YES
		300	298.05	1.95	5	YES
		330	329.72	0.28	5	YES
		360	359.99	0.01	5	YES
		TORQUE VERIFICATION	QUAD.#1 =	7	≤ 9.0 gm-cm	YES
			QUAD.#2 =	7	≤ 9.0 gm-cm	YES
°E CROSS ARM ALIGNMENT:	MAG DEC:	7.23		4 QUAD VANE ALIGNMENT:	N=	-1.34
	AS FOUND:	0			E=	90.14
	TOLERANCE: +/- 5° (PASSED)				S=	180.13
					W=	267.6
WIND DIRECTION	TRANSIT ALIGNMENT		AUDIT =	0		YES
			SENSOR =	0	5.0 degrees	YES

KEY:

HWS	Horizontal wind speed
VWS	Vertical wind speed
WD	Wind direction
M/S	Meters per second
N/A	Not applicable
MAG. DEC.	Magnetic Declination
CW	Clockwise
CCW	Counter Clockwise

NOTES:

TABLE A3-2

QUALITY ASSURANCE CALIBRATION RESULTS-AS LEFT
WELD COUNTY MONITORING NETWORK: ORCHARD SITE
AUDIT DATE: 6/25/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

10-METER HORIZONTAL WIND SPEED/DIRECTION AUDIT

SENSOR MODEL: RM YOUNG 05305V
SENSOR SERIAL #: 180186
AUDIT DEVICE MODEL: RM Young 18802
AUDIT DEVICE SERIAL #: CA5458
AUDIT DEVICE EXPIRATION: 10/26/2024

PARAMETER	AUDIT METHOD	AUDIT VALUE	SENSOR RESPONSE	DIFFERENCE (M/S)	ACCEPTANCE CRITERIA	VALUE WITHIN ACCEPTANCE CRITERIA
HORIZONTAL WIND SPEED	DC MOTOR RPM	M/S	M/S	M/S	M/S	N/A
	0	0.000	0.005	0.00	0.20	YES
	200	1.024	0.992	0.03	0.20	YES
	400	2.048	2.060	-0.01	0.20	YES
	600	3.072	3.050	0.02	0.20	YES
	800	4.096	4.060	0.04	0.20	YES
	1000	5.120	5.080	0.04	0.20	YES
	2000	10.240	10.220	0.02	0.20	YES
	3000	15.360	15.320	0.04	0.20	YES
	4000	20.480	20.430	0.05	0.20	YES
	5000	25.600	25.560	0.04	0.20	YES
		TORQUE VERIFICATION	CW =	0.1	≤ 0.3 gm-cm	YES
			CCW =	0.1	≤ 0.3 gm-cm	YES
WIND DIRECTION	ALIGNMENT GAUGE	0	-0.80	0.80	5	YES
		30	28.96	1.04	5	YES
		60	58.00	2.00	5	YES
		90	88.70	1.30	5	YES
		120	117.70	2.30	5	YES
		150	148.02	1.98	5	YES
		180	177.77	2.23	5	YES
		210	207.94	2.06	5	YES
		240	237.35	2.65	5	YES
		270	267.13	2.87	5	YES
		300	297.17	2.83	5	YES
		330	328.70	1.30	5	YES
		360	358.78	1.22	5	YES
		TORQUE VERIFICATION	QUAD.#1 =	7	≤ 9.0 gm-cm	YES
			QUAD.#2 =	7	≤ 9.0 gm-cm	YES
°E CROSS ARM ALIGNMENT:	MAG DEC:	7.23		4 QUAD VANE ALIGNMENT:	N=	-1.34
	AS FOUND:	0			E=	90.14
	TOLERANCE: +/- 5° (PASSED)				S=	180.13
					W=	267.6
WIND DIRECTION	TRANSIT ALIGNMENT		AUDIT =	0		YES
			SENSOR =	0	5.0 degrees	YES

KEY:

HWS	Horizontal wind speed
VWS	Vertical wind speed
WD	Wind direction
M/S	Meters per second
N/A	Not applicable
MAG. DEC.	Magnetic Declination
CW	Clockwise
CCW	Counter Clockwise

NOTES: WS bearings replaced. Increased logger slope scaling factor for WS by 0.744% (the average relative difference between the sensor response and the audit target values) from 0.019989099 to 0.020138933. Logger program was reloaded to system. No changes to WD.

TABLE A3-3

QUALITY ASSURANCE CALIBRATION RESULTS
WELD COUNTY MONITORING NETWORK: ORCHARD SITE
AUDIT DATE: 6/25/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

TEMPERATURE/DELTA TEMERATURE AUDIT

SENSOR MODEL: RM YOUNG 41342VC
SENSOR SERIAL #: 032953 (2M)/032954 (10M)
AUDIT DEVICE: Omega HH42A
AUDIT DEVICE SERIAL #: 23KMM02815
AUDIT DEVICE EXPIRATION: 11/21/2024

WATER BATH	AUDIT	2-M	2-M VS.	10-M	10-M VS.	ACCEPTANCE	DELTA T:	ACCEPTANCE	VALUE
	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	DEG. C	N/A
ICE BATH	0.23	0.33	0.10	0.30	0.07	0.50	-0.03	0.1	YES
AMBIENT BATH	20.42	20.53	0.11	20.51	0.09	0.50	-0.02	0.1	YES
HOT BATH	48.57	48.54	-0.03	48.59	0.02	0.50	0.05	0.1	YES

NOTES: Cleaned both aspirator housing units.

TABLE A3-4

QUALITY ASSURANCE CALIBRATION RESULTS
WELD COUNTY MONITORING NETWORK: ORCHARD SITE
AUDIT DATE: 6/25/24
AUDIT CONDUCTED BY: Jake Zaragoza/Adam Christman

RELATIVE HUMIDITY AUDIT

SENSOR MODEL: EE181
SENSOR SERIAL #: 201516001269F1
AUDIT DEVICE MODEL: EE181
AUDIT DEVICE SERIAL #: 214116001537C1
AUDIT DEVICE EXPIRATION: 3/21/2025

RELATIVE HUMIDITY		AUDIT SENSOR VALUE	2-M SENSOR VALUE	ABSOLUTE % RH DIFF.	ACCEPTANCE CRITERIA (+/-)	VALUE WITHIN ACCEPTANCE CRITERIA
UNITS		% RH	% RH	% RH	PERCENT	N/A
AVERAGE:		6.84	9.9	3.06	7.0	YES
		7.27	10.34	3.07	7.0	YES
		6.85	9.85	3.00	7.0	YES
		6.87	9.71	2.84		

NOTES:

BAROMETRIC PRESSURE AUDIT

SENSOR MODEL: Setra 278
SENSOR SERIAL #: 7563445
AUDIT DEVICE MODEL: BVC10
AUDIT DEVICE SERIAL #: 2972
AUDIT DEVICE EXPIRATION: 11/24/2024

BAROMETRIC PRESSURE		AUDIT SENSOR VALUE	2-M SENSOR VALUE	ABSOLUTE DIFF.	ACCEPTANCE CRITERIA (+/-)	VALUE WITHIN ACCEPTANCE CRITERIA
UNITS		mm Hg	mm Hg	mm Hg	mm Hg	N/A
AVERAGE:		646.68	647.03	0.35	2.25	YES

NOTES:

PRECIPITATION AUDIT

SENSOR MODEL: RM Young Heated Rain Gauge Model 52202
SENSOR SERIAL: TB16138
AUDIT DEVICE MODEL: Drip Bottle
AUDIT DEVICE SERIAL #: N/A

PRECIPITATION		AUDIT S VALUE	2-M SENSOR	PERCENT DIFF.	ACCEPTANCE CRITERIA	VALUE WITHIN
As Found						
300 ML WATER = 150 TIPS/0.591"	*UNITS*	Inches	Inches	PERCENT	PERCENT	N/A
Volume	1000	1.968505	1.818	-7.6%	10	YES
As Left						
300 ML WATER = 150 TIPS/0.591"	*UNITS*	Inches	Inches	PERCENT	PERCENT	N/A
Volume	1000	1.968505	2.065	4.9%	10	YES

NOTES: Cleaned tippers and surrounds. Heavy dirt buildup in drain cavity; drain hole had been blocked. Adjusted tipper buckets up 1/2 turn each.

PANEL TEMPERATURE AUDIT

SENSOR MODEL: Campbell Scientific CR3000
SENSOR SERIAL #: 13405
AUDIT DEVICE MODEL: Omega HH42A
AUDIT DEVICE SERIAL #: 23KMM02815
AUDIT DEVICE EXPIRATION: 11/21/2024

PANEL TEMPERATURE		AUDIT SENSOR VALUE	2-M SENSOR VALUE	ABSOLUTE DIFF.	ACCEPTANCE CRITERIA (+/-)	VALUE WITHIN ACCEPTANCE CRITERIA
	UNITS	DEG. C	DEG. C	DEG. C	ABS. DIFF	N/A
INSTANTANEOUS READING:		32.58	31.77	0.81	2.1	YES

NOTES:

Table A3-5

Solar Radiation Audit Data

Audit Date: 6/25/2024
Site Sensor: Hukseflux LP02; Serial # 48014
Audit Sensor: ; Serial # SR05-A1; 19771
Audit Sensor Expiration: 11/16/2024

Timestamp	Audit Sensor (w/m2)	Site Sensor (w/m2)
1045-1100	937	952
1100-1115	1112	1024
1115-1130	1089	1049
1130-1145	1079	1044
1145-1200	1083	1042
AVG	1060.0	1022.2
	% DIFF=	3.57%

NOTES:

TABLE A3-6
ORCHARD GAS Q2 AS FOUND REPORT

AUDIT DATE: 4/07/2024
SITE: ORCHARD, WELD COUNTY, CO
AUDITED BY: JAKE ZARAGOZA, RAMBOLL

AUDIT DEVICE: TELEDYNE API T703 OZONE CALIBRATOR SERIAL NUMBER: 824

Ozone Audit- TAPI T400 O_3 Analyzer Range = 0 - 500 PPB O_3; Unit Serial Number: 5985

		Audit Point	Uncorrected Conc. (PPB O_3)	Corrected Conc. (PPB O_3)	O_3 (PPB)	O_3 % diff.	Pass/Fail	T400	T700
Level III Slope	Level III Int.	Zero	0.00	-0.4262	0.28	N/A	N/A	Slope	Slope
1.0026	-0.4262	1	60.80	60.53188	61.57	1.7	PASS	0.99	0.98
		2	100.60	100.43536	101.57	1.1	PASS	Offset	Offset
		3	199.70	199.79302	200.40	0.3	PASS	-0.10	-0.73
		4	300.00	300.3538	300.14	-0.1	PASS		
		5	400.30	400.91458	400.28	-0.2	PASS		

Linear Regression

	O_3	T400	Box Temp (degC)	Sample Temp (degC)	Photo Lamp Temp (degC)	Sample Flow (CC/M)	Sample Press (inHg)	Ozone Ref (mV)	
Slope	0.996		24.7	33.2	58	708.3	22.6	3957.6	
Intercept	1.178	T700	Box Temp (degC)	Sample Temp (degC)	Ozone Gen Lamp (degC)	Photo Flow (LPM)	Photo Press (inHg)	Ozone Ref (mV)	Output Flow (LPM)
Correlation	1.0000		28.00	36.30	48.00	0.69	24.20	3526.80	3.86
Avg % diff.	0.58								

Notes:

%	Percent	rem.	Remaining
API	Advanced Pollution Instrumentation	N/A	Not Applicable
Avg	Average	orig.	Original
Conc.	Concentration	O3	Ozone
diff.	Difference	PPB	Parts Per Billion

TABLE A3-7
ORCHARD GAS Q2 AS LEFT REPORT

AUDIT DATE: 04/18/2024
SITE: ORCHARD, WELD COUNTY, CO
AUDITED BY: JAKE/ABE, RAMBOLL

AUDIT DEVICE: TELEDYNE API T703 OZONE CALIBRATOR SERIAL NUMBER: 824

Ozone Audit- TAPI T400 O_3 Analyzer Range = 0 - 500 PPB O_3; Unit Serial Number: 5985

		Audit Point	Uncorrected Conc. (PPB O_3)	Corrected Conc. (PPB O_3)	O_3 (PPB)	O_3 % diff.	Pass/Fail	T400	T700
Level III Slope	Level III Int.	Zero	0.00	-0.6714	0.31	N/A	N/A	Slope	Slope
1.0026	-0.6714	1	50.00	49.4586	51.35	3.8	PASS	0.990	0.976
		2	100.00	99.5886	100.47	0.9	PASS	Offset	Offset
		3	199.80	199.64808	200.66	0.5	PASS	-0.100	-0.728
		4	300.30	300.40938	300.13	-0.1	PASS		
		5	399.60	399.96756	398.76	-0.3	PASS		

Linear Regression

	O_3	T400	Box Temp (degC)	Sample Temp (degC)	Photo Lamp Temp (degC)	Sample Flow (CC/M)	Sample Press (inHg)	Ozone Ref (mV)	
Slope	0.994		22.8	31.2	58.0	736.2	23.3	3939.7	
Intercept	1.657	T700	Box Temp (degC)	Sample Temp (degC)	Ozone Gen Lamp (degC)	Photo Flow (LPM)	Photo Press (inHg)	Ozone Ref (mV)	Output Flow (LPM)
Correlation	1.0000		23.9	34.9	48.0	0.0	25.6	3529.5	4.99
Avg % diff.	0.96								

Notes:

%	Percent	rem.	Remaining
API	Advanced Pollution Instrumentation	N/A	Not Applicable
Avg	Average	orig.	Original
Conc.	Concentration	O3	Ozone
diff.	Difference	PPB	Parts Per Billion

APPENDIX B: Q2 2024 INVALIDATION PERIODS AND CORRECTIVE ACTION REPORTS

APPENDIX B1: INVALIDATION PERIODS

APPENDIX B1: PERIODS OF INVALID DATA AND QUALIFIER CODES

Data is presented by Month, Station Name, Parameter, Qualifier Code, Date and Time, Explanation

Qualifier Codes:

Code	Description
2	Operational Deviation: the standard deviation of shelter temperature was above 2.1°C for the previous 24 hours
AM	Miscellaneous Void
AK	Filter Leak
AT	Calibration
AV	Power Failure
AW	Wildlife Damage
BA	Maintenance/Routine Repairs
BD	Auto Calibration
BC	Multi-point Calibration
V	Value validated

- April
    - Missile Site Park
        - Ozone/NO/NO2/NOx
            - BD (04-01-24 02:00)
                - Overnight calibration
            - BD (04-02-24 02:00)
                - Overnight calibration
            - BD (04-03-24 02:00)
                - Overnight calibration
            - BD (04-04-24 01:00 through 02:00)
                - Overnight calibration
            - BD (04-05-24 02:00)
                - Overnight calibration
            - BD (04-06-24 02:00)
                - Overnight calibration
            - BD (04-07-24 01:00 through 02:00)
                - Overnight calibration
            - BC (04-07-24 10:00 through 14:00)
                - Multi-point ‘as found’ calibration
            - BD (04-08-24 02:00)
                - Overnight calibration
            - V (04-08-24 07:00)
                - Value validated. Partial hour due to filter change.
            - AM (04-08-24 08:00)

        - Filter change
    - V (04-08-24 09:00)
        - Value validated. Partial hour due to maintenance testing.
    - V (04-17-24 16:00)
        - Value validated. Partial hour due to maintenance testing.
    - V (04-17-24 20:00)
        - Value validated. Partial hour due to calibration testing.
    - AT (04-17-24 21:00)
        - Calibration testing
    - V (04-17-24 22:00)
        - Value validated. Partial hour due to calibration testing.
    - BD (04-18-24 01:00 through 02:00)
        - Overnight calibration
    - BA (04-18-24 07:00 through 10:00)
        - Gas analyzer maintenance
    - BC (04-18-24 11:00 through 16:00)
        - Multi-point 'as left' calibration
    - V (04-18-24 17:00)
        - Value validated. Partial hour due to multi-point calibration.
    - BD (04-19-24 02:00)
        - Overnight calibration
    - AT (04-19-24 13:00)
        - Calibration testing
    - BD (04-20-24 02:00)
        - Overnight calibration
    - BD (04-21-24 01:00 through 02:00)
        - Overnight calibration
    - BD (04-22-24 02:00)
        - Overnight calibration
    - BD (04-23-24 02:00)
        - Overnight calibration
    - BD (04-24-24 02:00)
        - Overnight calibration
    - BD (04-25-24 01:00 through 02:00)
        - Overnight calibration
    - BD (04-26-24 02:00)
        - Overnight calibration
    - BD (04-27-24 02:00)
        - Overnight calibration
    - BD (04-28-24 01:00 through 02:00)
        - Overnight calibration
    - BD (04-29-24 02:00)
        - Overnight calibration
    - BD (04-30-24 02:00)

        - Overnight calibration
    - AM (04-30-24 12:00 through 13:00)
        - Filter change
- Hereford
    - Ozone
        - BD (04-01-24 02:00)
            - Overnight calibration
        - BD (04-03-24 02:00)
            - Overnight calibration
        - 2 (04-03-24 20:00 through 04-04-24 09:00)
            - Standard deviation of shelter temperature greater than 2.1°C
        - 2 (04-04-24 13:00 through 04-05-24 02:00)
            - Standard deviation of shelter temperature greater than 2.1°C
        - BD (04-05-24 02:00)
            - Overnight calibration
        - 2 (04-05-24 11:00 through 16:00)
            - Standard deviation of shelter temperature greater than 2.1°C
        - 2 (04-06-24 15:00)
            - Standard deviation of shelter temperature greater than 2.1°C
        - BC (04-07-24 10:00 through 11:00)
            - Multi-point 'as found' calibration
        - BD (04-08-24 02:00)
            - Overnight calibration
        - AM (04-08-24 14:00)
            - Filter change
        - V (04-08-24 15:00)
            - Value validated. Partial hour due to filter change.
        - 2 (04-12-24 20:00 through 04-13-24 03:00)
            - Standard deviation of shelter temperature greater than 2.1°C
        - 2 (04-13-24 19:00 through 20:00)
            - Standard deviation of shelter temperature greater than 2.1°C
        - 2 (04-14-24 03:00 through 16:00)
            - Standard deviation of shelter temperature greater than 2.1°C
        - 2 (04-14-24 22:00 through 04-15-24 03:00)
            - Standard deviation of shelter temperature greater than 2.1°C
        - 2 (04-15-24 10:00 through 04-16-24 13:00)
            - Standard deviation of shelter temperature greater than 2.1°C
        - V (04-16-24 05:00)
            - Value validated. Partial hour due to power failure.
        - AV (04-16-24 06:00 through 07:00)
            - Power failure
        - BA (04-17-24 08:00 through 10:00)
            - Gas analyzer maintenance
        - V (04-17-24 11:00)

        - Value validated. Partial hour due to gas analyzer maintenance.
    - 2 (04-17-24 15:00 through 04-18-24 14:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - V (04-18-24 09:00)
        - Value validated. Partial hour due to multi-point calibration.
    - BC (04-18-24 10:00 through 11:00)
        - Multi-point 'as left' calibration
    - BD (04-19-24 02:00)
        - Overnight calibration
    - BD (04-22-24 02:00)
        - Overnight calibration
    - 2 (04-22-24 23:00 through 04-24-24 06:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - BD (04-24-24 02:00)
        - Overnight calibration
    - BD (04-26-24 02:00)
        - Overnight calibration
    - 2 (04-26-24 10:00 through 04-27-24 05:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - BD (04-29-24 02:00)
        - Overnight calibration
    - 2 (04-29-24 20:00 through 05-01-24 00:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - AM (04-30-24 09:00 through 10:00)
        - Filter change
- Orchard
    - Wind Speed ONLY
        - V (04-06-24 13:00)
            - Value validated. Periods with wind gusts above 25.6 m/s invalidated and removed due to poor calibration results. 75% of hour still valid, new value calculated.
    - Ozone
        - BD (04-01-24 02:00)
            - Overnight calibration
        - BD (04-03-24 02:00)
            - Overnight calibration
        - BD (04-05-24 02:00)
            - Overnight calibration
        - BC (04-07-24 10:00 through 11:00)
            - Multi-point 'as found' calibration
        - BD (04-08-24 02:00)
            - Overnight calibration
        - V (04-08-24 10:00)
            - Value validated. Partial hour due to filter change.

    - AM (04-08-24 11:00)
        - Filter change
    - V (04-08-24 12:00)
        - Value validated. Partial hour due to maintenance testing.
    - BA (04-17-24 12:00 through 14:00)
        - Gas analyzer maintenance
    - V (04-18-24 08:00)
        - Value validated. Partial hour due to multi-point calibration.
    - BC (04-18-24 09:00 through 10:00)
        - Multi-point 'as left' calibration
    - BD (04-19-24 02:00)
        - Overnight calibration
    - 2 (04-21-24 22:00 through 04-22-24 04:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - BD (04-22-24 02:00)
        - Overnight calibration
    - AV (04-24-24 02:00 through 04-25-24 11:00)
        - Power failure
    - 2 (04-26-24 01:00 through 04:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - BD (04-26-24 02:00)
        - Overnight calibration
    - 2 (04-28-24 23:00 through 04-29-24 01:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - BD (04-29-24 02:00)
        - Overnight calibration
    - V (04-30-24 10:00)
        - Value validated. Partial hour due to filter change.
    - AM (04-30-24 11:00)
        - Filter change

- May
    - Missile Site Park
        - Wind Speed & Direction
            - BC (05-30-24 08:00 through 09:00)
                - Quarter 2 calibration
        - 2 m, 10 m, & Delta Temperature
            - BC (05-30-24 08:00 through 09:00)
                - Quarter 2 calibration
        - Relative Humidity & Air Temperature (non-regulatory)
            - BC (05-30-24 08:00 through 09:00)
                - Quarter 2 calibration
        - Solar Radiation
            - BC (05-30-24 08:00 through 09:00)
                - Quarter 2 calibration

- Precipitation
  - BC (05-30-24 08:00 through 11:00)
    - Quarter 2 calibration
- Ozone/NO/NO2/NOx
  - BD (05-01-24 02:00)
    - Overnight calibration
  - BD (05-02-24 01:00 through 02:00)
    - Overnight calibration
  - BD (05-03-24 02:00)
    - Overnight calibration
  - V (05-03-24 15:00 through 16:00)
    - Value validated. Partial hours due to calibration testing.
  - BD (05-04-24 02:00)
    - Overnight calibration
  - BD (05-05-24 01:00 through 02:00)
    - Overnight calibration
  - BD (05-06-24 02:00)
    - Overnight calibration
  - BD (05-07-24 02:00)
    - Overnight calibration
  - BD (05-08-24 02:00)
    - Overnight calibration
  - BD (05-09-24 01:00 through 02:00)
    - Overnight calibration
  - BD (05-10-24 02:00)
    - Overnight calibration
  - BD (05-11-24 02:00)
    - Overnight calibration
  - BD (05-12-24 01:00 through 02:00)
    - Overnight calibration
  - BD (05-13-24 02:00)
    - Overnight calibration
  - BD (05-14-24 02:00)
    - Overnight calibration
  - BD (05-15-24 02:00)
    - Overnight calibration
  - BD (05-16-24 01:00 through 02:00)
    - Overnight calibration
  - BD (05-17-24 02:00)
    - Overnight calibration
  - BD (05-18-24 02:00)
    - Overnight calibration
  - BD (05-19-24 01:00 through 02:00)
    - Overnight calibration

- BD (05-20-24 02:00)
  - Overnight calibration
- V (05-20-24 11:00)
  - Value validated. Partial hour due to calibration testing.
- AT (05-20-24 12:00)
  - Calibration testing.
- V (05-20-24 13:00)
  - Value validated. Partial hour due to calibration testing.
- BD (05-21-24 02:00)
  - Overnight calibration
- BD (05-22-24 02:00)
  - Overnight calibration
- BD (05-23-24 01:00 through 02:00)
  - Overnight calibration
- BD (05-24-24 02:00)
  - Overnight calibration
- BD (05-25-24 02:00)
  - Overnight calibration
- BD (05-26-24 01:00 through 02:00)
  - Overnight calibration
- BD (05-27-24 02:00)
  - Overnight calibration
- BD (05-28-24 02:00)
  - Overnight calibration
- V (05-28-24 13:00)
  - Value validated. Partial hour due to filter change.
- AM (05-28-24 14:00) **OZONE ONLY**
  - Filter change
- AK (05-28-24 14:00 through 05-30-24 10:00) **NO/NO2/NOx ONLY**
  - Filter leak
- BD (05-29-24 02:00)
  - Overnight calibration
- BD (05-30-24 01:00 through 02:00)
  - Overnight calibration
- AT (05-30-24 11:00 through 12:00)
  - Calibration testing
- BD (05-31-24 02:00)
  - Overnight calibration

- Hereford
  - Ozone
    - 2 (05-01-24 01:00)
      - Standard deviation of shelter temperature greater than 2.1°C
    - BD (05-01-24 02:00)
      - Overnight calibration

- 2 (05-02-24 09:00 through 16:00)
  - Standard deviation of shelter temperature greater than 2.1°C
- BD (05-03-24 02:00)
  - Overnight calibration
- BD (05-06-24 02:00)
  - Overnight calibration
- 2 (05-06-24 13:00 through 05-07-24 00:00)
  - Standard deviation of shelter temperature greater than 2.1°C
- BD (05-08-24 02:00)
  - Overnight calibration
- BD (05-10-24 02:00)
  - Overnight calibration
- 2 (05-10-24 21:00 through 05-11-24 01:00)
  - Standard deviation of shelter temperature greater than 2.1°C
- BD (05-13-24 02:00)
  - Overnight calibration
- BD (05-15-24 02:00)
  - Overnight calibration
- BD (05-17-24 02:00)
  - Overnight calibration
- AV (05-19-24 14:00 through 16:00)
  - Power failure
- BD (05-20-24 02:00)
  - Overnight calibration
- AV (05-21-24 00:00 through 01:00)
  - Power failure
- 2 (05-21-24 04:00 through 12:00)
  - Standard deviation of shelter temperature greater than 2.1°C
- BD (05-22-24 02:00)
  - Overnight calibration
- 2 (05-22-24 18:00 through 05-23-24 01:00)
  - Standard deviation of shelter temperature greater than 2.1°C
- BD (05-24-24 02:00)
  - Overnight calibration
- 2 (05-24-24 02:00 through 14:00)
  - Standard deviation of shelter temperature greater than 2.1°C
- 2 (05-24-24 19:00 through 05-25-24 07:00)
  - Standard deviation of shelter temperature greater than 2.1°C
- V (05-25-24 16:00)
  - Value validated. Partial hour due to power failure.
- BD (05-27-24 02:00)
  - Overnight calibration
- AM (05-28-24 10:00 through 11:00)
  - Filter change

        - BD (05-29-24 02:00)
            - Overnight calibration
        - BD (05-31-24 02:00)
            - Overnight calibration
    - Orchard
        - Ozone
            - BD (05-01-24 02:00)
                - Overnight calibration
            - BD (05-03-24 02:00)
                - Overnight calibration
            - BD (05-06-24 02:00)
                - Overnight calibration
            - BD (05-08-24 02:00)
                - Overnight calibration
            - BD (05-10-24 02:00)
                - Overnight calibration
            - BD (05-13-24 02:00)
                - Overnight calibration
            - BD (05-15-24 02:00)
                - Overnight calibration
            - BD (05-17-24 02:00)
                - Overnight calibration
            - BD (05-20-24 02:00)
                - Overnight calibration
            - BD (05-22-24 02:00)
                - Overnight calibration
            - BD (05-24-24 02:00)
                - Overnight calibration
            - BD (05-27-24 02:00)
                - Overnight calibration
            - V (05-28-24 11:00)
                - Value validated. Partial hour due to filter change.
            - AM (05-28-24 12:00)
                - Filter change
            - BD (05-29-24 02:00)
                - Overnight calibration
            - BD (05-31-24 02:00)
                - Overnight calibration
- June
    - Missile Site Park
        - Ozone/NO/NO2/NOx
            - BD (06-01-24 02:00)
                - Overnight calibration
            - BD (06-02-24 01:00 through 02:00)

        - Overnight calibration
    - BD (06-03-24 02:00)
        - Overnight calibration
    - BD (06-04-24 02:00)
        - Overnight calibration
    - BD (06-05-24 02:00)
        - Overnight calibration
    - BD (06-06-24 01:00 through 02:00)
        - Overnight calibration
    - BD (06-07-24 02:00)
        - Overnight calibration
    - BD (06-08-24 02:00)
        - Overnight calibration
    - BD (06-09-24 01:00 through 02:00)
        - Overnight calibration
    - BD (06-10-24 02:00)
        - Overnight calibration
    - BD (06-11-24 02:00)
        - Overnight calibration
    - BD (06-12-24 02:00)
        - Overnight calibration
    - BD (06-13-24 01:00 through 02:00)
        - Overnight calibration
    - AT (06-13-24 11:00 through 12:00)
        - Calibration testing
    - BD (06-14-24 02:00)
        - Overnight calibration
    - BD (06-15-24 02:00)
        - Overnight calibration
    - BD (06-16-24 01:00 through 02:00)
        - Overnight calibration
    - BD (06-17-24 02:00)
        - Overnight calibration
    - V (06-17-24 12:00)
        - Value validated. Partial hour due to calibration testing.
    - AT (06-17-24 13:00)
        - Calibration testing
    - BD (06-18-24 02:00)
        - Overnight calibration
    - BD (06-19-24 02:00)
        - Overnight calibration
    - BD (06-20-24 01:00 through 02:00)
        - Overnight calibration
    - BD (06-21-24 02:00)

        - Overnight calibration
    - BD (06-22-24 02:00)
        - Overnight calibration
    - BD (06-23-24 01:00 through 02:00)
        - Overnight calibration
    - BD (06-24-24 02:00)
        - Overnight calibration
    - BD (06-25-24 02:00)
        - Overnight calibration
    - AM (06-25-24 13:00)
        - Filter change
    - V (06-25-24 14:00)
        - Value validated. Partial hour due to filter change.
    - BD (06-26-24 02:00)
        - Overnight calibration
    - BD (06-27-24 01:00 through 02:00)
        - Overnight calibration
    - AT (06-27-24 12:00)
        - Calibration testing
    - BD (06-28-24 02:00)
        - Overnight calibration
    - BD (06-29-24 02:00)
        - Overnight calibration
    - BD (06-30-24 01:00 through 02:00)
        - Overnight calibration
- Hereford
    - Wind Speed & Direction
        - BC (06-21-24 09:00 through 10:00)
            - Quarter 2 calibration
    - 2-meter, 10-meter, & Delta Temperature
        - BC (06-21-24 09:00 through 10:00)
            - Quarter 2 calibration
    - Relative Humidity & Air Temperature (non-regulatory)
        - BC (06-21-24 09:00 through 10:00)
            - Quarter 2 calibration
    - Solar Radiation
        - BC (06-21-24 09:00 through 10:00)
            - Quarter 2 calibration
    - Precipitation
        - BC (06-21-24 10:00 through 13:00)
            - Quarter 2 calibration
    - Ozone
        - BD (06-03-24 02:00)
            - Overnight calibration

- BD (06-05-24 02:00)
  - Overnight calibration
- BD (06-07-24 02:00)
  - Overnight calibration
- BD (06-10-24 02:00)
  - Overnight calibration
- AV (06-10-24 16:00)
  - Power failure
- V (06-10-24 17:00 through 18:00)
  - Value validated. Partial hour to due power failure.
- BD (06-12-24 02:00)
  - Overnight calibration
- BD (06-14-24 02:00)
  - Overnight calibration
- BD (06-17-24 02:00)
  - Overnight calibration
- BD (06-19-24 02:00)
  - Overnight calibration
- BD (06-21-24 02:00)
  - Overnight calibration
- 2 (06-22-24 05:00 through 18:00)
  - Standard deviation of shelter temperature greater than 2.1°C
- 2 (06-22-24 22:00 through 23:00)
  - Standard deviation of shelter temperature greater than 2.1°C
- BD (06-24-24 02:00)
  - Overnight calibration
- AM (06-25-24 10:00)
  - Filter change
- V (06-25-24 11:00)
  - Value validated. Partial hour due to filter change.
- BD (06-26-24 02:00)
  - Overnight calibration
- BD (06-28-24 02:00)
  - Overnight calibration

- Orchard
  - Wind Speed & Direction
    - V (06-08-24 15:00) **Wind Speed ONLY**
      - Value validated. Periods with wind gusts above 25.6 m/s invalidated and removed due to failing calibration results. 75% of hour still valid, new value calculated.
    - BC (06-25-24 09:00 through 11:00)
      - Quarter 2 calibration
  - 2-meter, 10-meter, & Delta Temperature
    - BC (06-25-24 09:00 through 11:00)

        - Quarter 2 calibration
- Relative Humidity & Air Temperature (non-regulatory)
    - BC (06-25-24 09:00 through 11:00)
        - Quarter 2 calibration
- Solar Radiation
    - BC (06-25-24 09:00 through 11:00)
        - Quarter 2 calibration
- Precipitation
    - BC (06-25-24 08:00 through 13:00)
        - Quarter 2 calibration
- Ozone
    - BD (06-03-24 02:00)
        - Overnight calibration
    - BD (06-05-24 02:00)
        - Overnight calibration
    - BD (06-07-24 02:00)
        - Overnight calibration
    - 2 (06-07-24 16:00 through 06-08-24 18:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - BD (06-10-24 02:00)
        - Overnight calibration
    - BD (06-12-24 02:00)
        - Overnight calibration
    - 2 (06-12-24 17:00 through 06-13-24 18:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - BD (06-14-24 02:00)
        - Overnight calibration
    - AW (06-14-24 03:00 through 06-19-24 01:00)
        - Insects in inlet
    - BD (06-19-24 02:00)
        - Overnight calibration
    - V (06-19-24 08:00)
        - Value validated. Partial hour due to maintenance.
    - BA (06-19-24 09:00 through 10:00)
        - Maintenance – removal of insects.
    - V (06-19-24 11:00)
        - Value validated. Partial hour due to maintenance.
    - BD (06-21-24 02:00)
        - Overnight calibration
    - 2 (06-23-24 15:00 through 06-29-24 18:00)
        - Standard deviation of shelter temperature greater than 2.1°C
    - BD (06-24-24 02:00)
        - Overnight calibration
    - V (06-25-24 11:00)

        - Value validated. Partial hour due to filter change.
    - AM (06-25-24 12:00)
        - Filter change
    - BD (06-26-24 02:00)
        - Overnight calibration
    - BD (06-28-24 02:00)
        - Overnight calibration
    - 2 (06-30-24 18:00 through 07-01-24 00:00)
        - Standard deviation of shelter temperature greater than 2.1°C

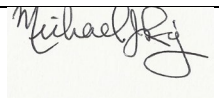
APPENDIX B2: CORRECTIVE ACTION REPORT 24

CORRECTIVE ACTION REPORT NO.: 24

To **Dan Joseph**
From **Abe Dearden and Jake Zaragoza**
Copy to **Courtney Taylor and Kaitlyn Elkind**

Problem Identification		
Site (Location):	**Orchard**	
System or Instrumentation:	**Teledyne T400**	
Estimated start date/time	**6/14/2024**	
Problem identified by:	**Blake Himes / Abraham Dearden**	
Problem definition: • **Parameter (s) affected**	**Ozone nightly calibration failed. Abnormal flows seen in the instrument during a manual calibration check. Suspect insects trapped in the inlet.** • **Ozone**	
Planned corrective actions (if necessary):	**Clean inlet.**	
	Expected Completion Date:	**06/19/2024**

Problem Resolution		
Date corrective action taken:	**06/19/2024**	
Action taken by:	**Adam Christman**	
Corrective action taken:	**Cleaned sample inlet, filter holder, and nafion T's.**	
Effectiveness of corrective actions:	☒ **Yes, it was resolved**	☐ **No, it was NOT resolved**

Corrective Action Report Author & Date	Signature
Prepared by: Abraham Dearden **Date: 07/24/2024**	
QA Officer: Michael Ring **Date: 7/26/2024**	

APPENDIX B3: CORRECTIVE ACTION REPORT 25

RAMBOLL

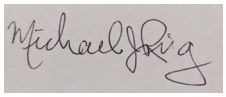
ENVIRONMENT
& HEALTH

CORRECTIVE ACTION REPORT NO.: 25

To **Dan Joseph**
From **Abe Dearden and Jake Zaragoza**
Copy to **Courtney Taylor and Kaitlyn Elkind**

Problem Identification		
Site (Location):	**Orchard**	
System or Instrumentation:	**RM Young 05305V Wind Speed**	
Estimated start date/time	**11/28/2023**	
Problem identified by:	**Adam Christman / Jake Zaragoza**	
Problem definition: • **Parameter (s) affected**	**Final point of multi-point wind speed check on 6/25 failed.** • **Horizontal Wind Speed**	
Planned corrective actions (if necessary):	**Re-scale wind speed channel and adjust data as necessary.**	
	Expected Completion Date:	**06/25/2024 & 07/03/2024**

Problem Resolution		
Date corrective action taken:	**06/25/2024 & 07/03/2024**	
Action taken by:	**Jake Zaragoza**	
Corrective action taken:	**On 06/25 the wind speed channel was re-scaled, and a second multi-point check was performed. All points passed the second check. On 07/03 the data between the last passing multi-point check (11/28/2023) and the 06/25 check were reviewed for wind speed gust values at or above 25.6 meters per second (the failing value). Two instances were found (4/6/2024 and 6/8/2024). The hourly values were re-calculated with the wind speed gust values at or above 25.6 meters per second removed.**	
Effectiveness of corrective actions:	☒ **Yes, it was resolved**	☐ **No, it was NOT resolved**

Corrective Action Report Author & Date	Signature
Prepared by: Jake Zaragoza **Date: 07/03/2024**	
QA Officer: Michael Ring **Date: 07/05/2024**	

APPENDIX C: Q2 2024 SITE VISITATION LOGS

Missile Site Park Site Access Log								
Name	**Date**	**Arrival**	**Departure**	**Last Filter change**		**Pump off**	**Pump on**	**Notes**
				NOx	Ozone			
Zaragoza (remote)	4/7/2024	9:32	13:55					As found 2nd quarter calibration check
Zaragoza	4/8/2024	6:47	8:20	4/8/2024	4/8/2024	6:50	7:10	On site to remove calibrator for recertification. Filter change for ozone and NOx performed. Zero-span check for ozone and NOx performed to condition new filters. Zero-span check occurred from 7:09 to 7:42. Zero air line, gas cylinder lines removed and capped. Gas cylinder closed. Calibration line removed and plugged. Ozone pump replacement head screws tested (pump turned off and turned back on twice; pump off times no longer than 2 minutes) between 7:42 and 8:15.
Zaragoza/Christman	4/17/2024	14:52	18:20					On site to reinstall calibrator. Back pressure comp started 15:12 to 15:19. MFC checks from 15:30 to 18:18. Ozone Zero/Span/Precision from 19:51 to 20:21. NO/NO2/NOx Zero/Span/Precision from 20:21 to 21:05. Zero/Span/Precisions performed remotely. Gases down from 15:12 to 15:19 and from 19:51 to 21:05.
Christman	4/18/2024	7:18	11:20					On site to rebuild O3 and Nox pumps & install new Nafion tubing in T200; systems down for maintenance from 06:26 to 10:14; both systems leak check good after maintenance; Z/S O3 good; Z/S Nox slower to stabilize but okay after conditioning
Dearden	4/18/2024	10:33	16:12					Remote multi-point as-left calibration. Gas analyzers offline 10:33-16:12
Zaragoza (remote)	4/19/2024	12:33	12:58					Remote ZSP to doublecheck ozone response. T400 zero response = .586, T700 zero = 0. T400 span response: 398.74, T700 span = 399.5. T400 precision = 61.26, T700 precision 60.2.
Garcia	4/30/2024	12:07	12:30	4/30/2024	4/30/2024	12:19	12:22	NOx/AMoN/NADP Sample swapped and retrieved
Dearden (Remote)	5/3/2024	14:46	15:10					Remote ZSP check for ozone. Passing results. Instrument offline 14:46 through 15:10 MST.
Dearden (Remote)	5/20/2024	10:49	12:00					Remote GPT Span check. Passing results.
Gacia	5/28/2024	13:22	13:58	5/21/2024	5/28/2024	13:46	13:52	NOx and NADP sample swapped and retrieved; WCDPHE training of new site operator, Alex Clemments
Zaragoza / Christman	5/30/2024	7:35	12:20					On site for semiannual calibration of met equipment. Tower down at 07:23, tower up at 08:51. RNF checks from ~07:15 to 10:15. Tightened loose filter cover on T200 at 10:13.
Dearden (Remote)	5/30/2024	11:22	12:20					Manual GPT precision check, post filter leak correction. Passing results in minute data. Gasses invalid 11:22 - 12:20 MDT
Dearden (Remote)	6/13/2024	10:27	11:27					Manual GPT Precision check, passing results in minute data file.
Dearden (Remote)	6/17/2024	11:51	12:33					Manual Ozone PSZ check, passing results in minute data file.
Dearden (Remote)	6/27/2024	11:01	11:51					Manual GPT Precision check, passing results in minute data file.

Hereford Site Access Log							
Name	**Date**	**Arrival**	**Departure**	**Last Filter change**	**Pump off**	**Pump on**	**Notes**
				Ozone			
Zaragoza (remote)	4/7/2024	9:34	10:38				As found 2nd quarter calibration check
Zaragoza	4/8/2024	13:01	14:35	4/8/2024	13:02	13:04	On site for calibrator removal for recertification. Ozone filter replaced and zero-span performed for filter conditioning. Zero-span performed between 13:04 and 13:29. T703 PM and charcoal filters replaced. T703 compressor rebuilt. Output flow increased from 4.17 LPM to 5.12 LPM. Desiccant removed and plumbed to itself. Calibration line removed and plugged. Left site at 14:35
Zaragoza/Christman	4/17/2024	6:58	9:57				On site for calibrator reinstall and site maintenance. Back pressure compensation performed at 7:25. Zero/Span/Prec performed at 7:31, end time not recorded. Inlet replaced at 8:05. Ozone pump rebuilt around 8:10. Ozone down from 7:25 to ~10:05
Dearden	4/18/2024	8:59	10:42				Remote multi-point as-left calibrations. Ozone offline 8:59 - 10:42
Garcia	4/30/2024	9:28	9:40	4/30/2024	9:31	9:37	Dessicant, NOx/O3 filter change
Garcia	5/28/2024	10:13	10:33	5/28/2024	10:20	10:30	Dessicant, NOx/O3 filter change; WCDPHE training new site operator, Alex Clemments
Zaragoza/Christman	6/21/2024	8:34	13:43				On site for semiannual calibration of met equipment. Tower down at 09:00-10:50 MDT. RNF checks from 10:58-13:30 MDT.

Orchard Site Access Log							
Name	**Date**	**Arrival**	**Departure**	**Last Filter change**	**Pump off**	**Pump on**	**Notes**
				Ozone			
Zaragoza (remote)	4/7/2024	9:33	10:36				As found 2nd quarter calibration check
Zaragoza	4/8/24	9:44	11:30	4/8/24	9:46	9:48	On site to remove calibrator for recertification. Ozone filter replaced and zero-span performed to condition filter. Zero-span occurred from 9:46 to 10:15. T703 PM and charcoal filters replaced. T703 compressor rebuilt. Output flow increased from 4.04 LPM to 5.27 LPM. Desiccant removed and looped to itself, calibration line removed and plugged. Left site at11:30
Zaragoza/Christman	4/17/24	11:00	13:35				On site to reinstall calibrator. Backpressure compensation started at 11:28. Zero/Span/Prec started at 11:33 and ended at 11:58. Ozone inlet replaced and ozone pump replaced right after. Times not recorded. Ozone down from 11:28 to ~13:35
Dearden	4/18/24	7:54	9:30				Remote multi-point as-left calibrations. Ozone offline 7:54 - 9:30
Garcia	4/30/24	10:48	11:04	4/30/24	10:56	11:02	Dessicant, NOx/O3; NADP Sample retrieved
Garcia	5/28/24	11:37	12:10	5/28/24	11:59	12:06	Dessicant, NOx/O3; NADP Sample retrieved; WCDPHE training new site operator, Alex Clemments
Christman	6/19/24	8:35	11:36		10:20	10:35	Emergency visit to investigate low/inconsistent calibration checks on T400 & T703. No disconnects or obstructions found with pneumatics. As found ZSP checked good and issue could not be replicated. Diagnostics checked good. T703 produced sufficient flows and achieved targets quickly without issue. A few small mite flies were found in the sample filter holder and 1 more noted upstream of the first Nafion tube tee. Dessicant was also found fully consumed. Cleaned sample filter holder, back panel sample inlet, and nafion tubing tee's. Ozone down from 8:55-11:08 MDT
Zaragoza/Christman	6/25/24	8:42	14:15				On site for semiannual calibration of met equipment. Tower down from 09:02-11:40 MDT. RNF checks from 07:56-12:45 logger time.

APPENDIX D: Q2 2024 CALIBRATION STATISTICS

APPENDIX D: Q2 2024 CALIBRATION STATISTICS

CONTENTS

Figures

Tables

D.1 PREFACE

Appendix D of the Quality Assurance Handbook Volume II (https://www.epa.gov/sites/default/files/2020-10/documents/app_d_validation_template_version_03_2017_for_amtic_rev_1.pdf) specifies the frequency and allowable ranges of the one-point quality control (precision), zero, and span checks for ozone and NO/NO_2/NOx, which are based on the Code of Federal Regulations (CFR). These allowable ranges are mostly percent differences between a measured point and the audit point. At each site, the measured point was taken as a 3-minute average of a stable analyzer reading while receiving calibration gas. The audit point is a preset calibration target that the on-site calibrators produce. For both ozone and NO/NOx, the precision check is 60 ppb and the span check is 400 ppb. For NO_2, the target output concentrations from the calibrator are 48 ppb and 160 ppb for precision and span checks, respectively. Since the calibrator only indirectly calculates NO_2 concentration, the actual target NO_2 output is calculated as the difference in NO between the gas phase titration zero (GPTZ) and the gas phase titration (GPT) phases. The analyzer is then challenged against these actual target NO_2 concentrations[1]. Each figure below highlights the percent difference between the measured point and the audit point, with the upper and lower lines representing the allowable upper and lower limits. NO_2 has an additional requirement for calculation of the converter efficiency in converting NO_2 to NO. Each converter efficiency check is plotted for it.

Additionally, each table below represents the results of the calculations detailed in 40CFR58, Appendix A, Section 4 'Calculations for Data Quality Assessments' (https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-58). They are provided only for informational purposes.

D.2 MISSILE SITE PARK SITE

Ozone (O_3)

Figure D - 1 and **Figure D - 2** below show the calibration span and precision percent differences for ozone at the Missile Site Park site. **Table D - 1** highlights the assessment statistics detailed in 40CFR58, Appendix A, Section 4. These values are estimated from a sample of the entire dataset at the site. The calibrator was removed from April 8th through 17th for recertification.

[1] Previous reporting of the NO_2 span and precision results utilized constant target values of 48 ppb and 160 ppb, respectively. The procedure has been updated based on the CFR guidance, however both methods are acceptable.

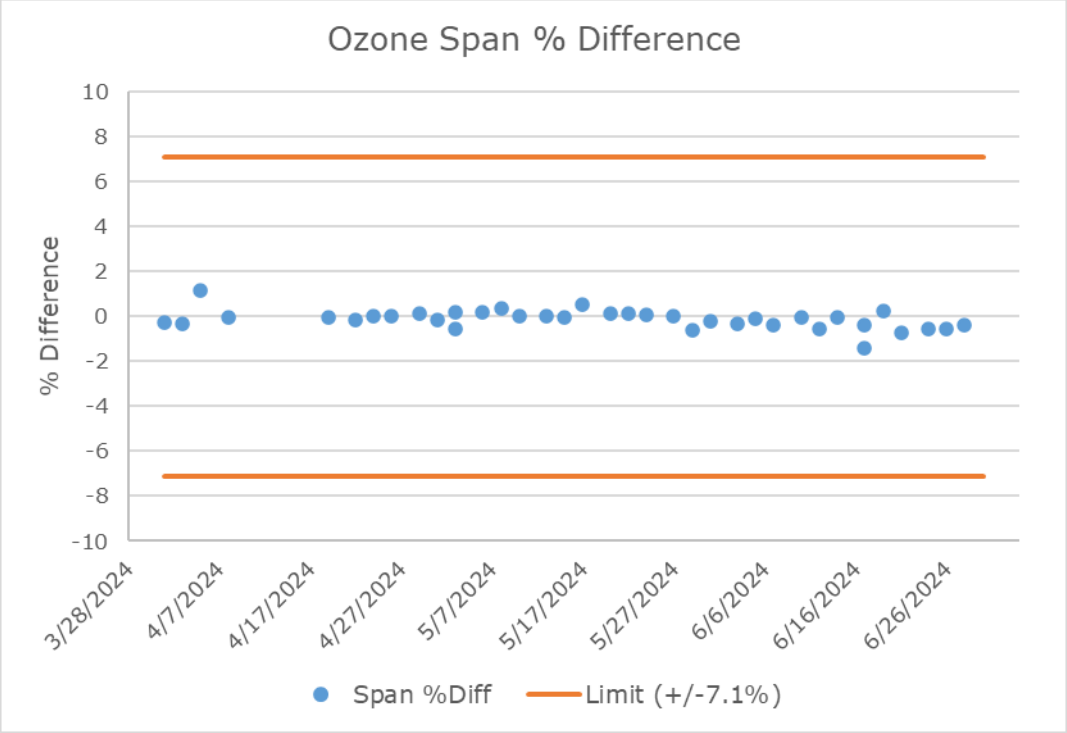


Figure D - 1. 2024 Q2 Calibration span percent difference for O_3 at Missile Site Park.

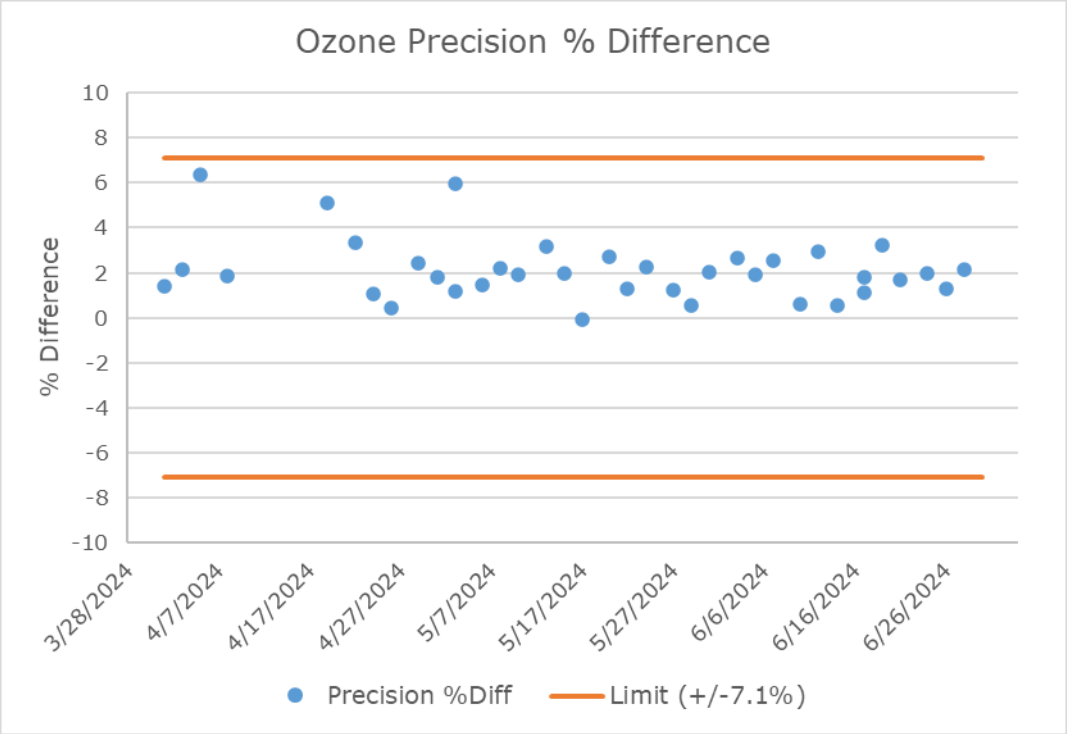


Figure D - 2. 2024 Q2 Calibration precision percent difference for O_3 at Missile Site Park.

Table D - 1. Summary of 2024 Q2 calibration statistics for O_3 at Missile Site Park.

Formula	Precision	Span
STDEV	1.38	0.42
Count	37	37
Chi^2, 0.1, n-1	25.64	25.64
CV	1.64	0.50
Bias	2.50	0.39
Bias (+/-/U)	+	U
AB	2.12	0.30
AS	1.38	0.32
$t_{0.95}$, n-1	1.69	1.69
25^{th}	1.27	-0.39
75^{th}	2.57	0.07

Nitric Oxide (NO)

Figure D - 3 and **Figure D - 4** below show the calibration span and precision percent differences for NO at the Missile Site Park site. The calibrator was removed from April 8^{th} through 17^{th} for recertification. During the Q2 semi-annual calibration and audit checks, the sample filter housing was discovered to be loose. This occurred between regularly scheduled calibration checks and the issue was resolved while Ramboll staff were on site for calibration checks. As a result, data has been invalidated between May 28^{th} and May 30^{th} from the time of the previous sample filter change until the time at which the issue was resolved. **Table D - 2** highlights the assessment statistics detailed in 40CFR58, Appendix A, Section 4.

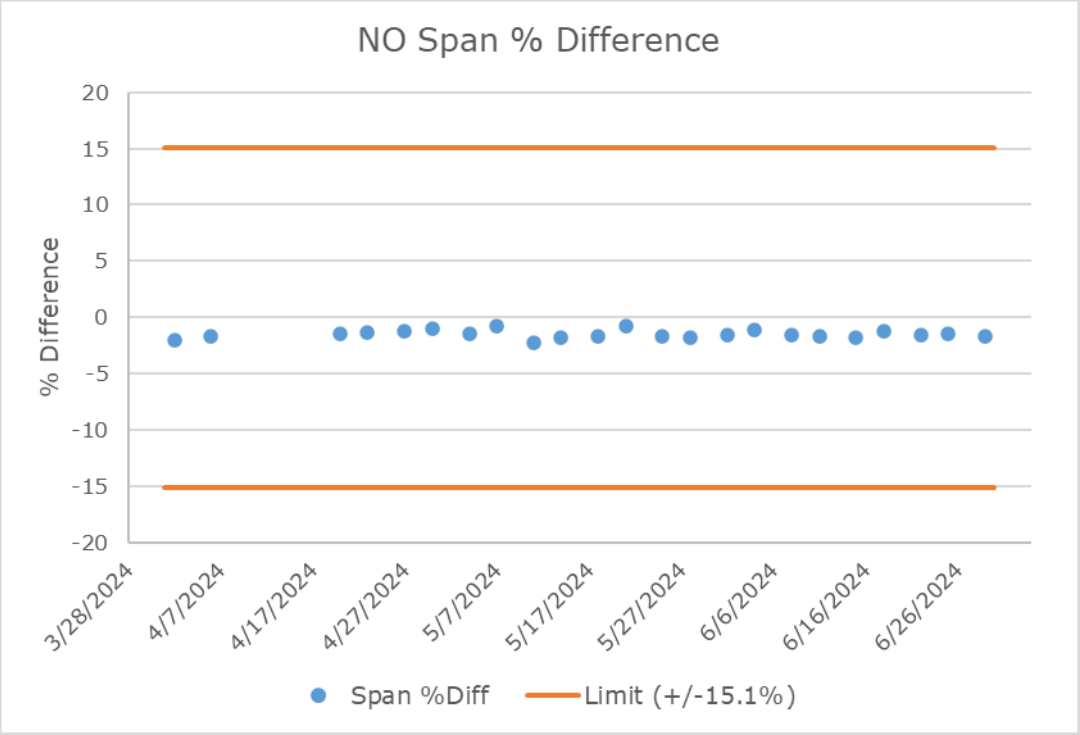


Figure D - 3. 2024 Q2 Calibration span percent difference for NO at Missile Site Park.

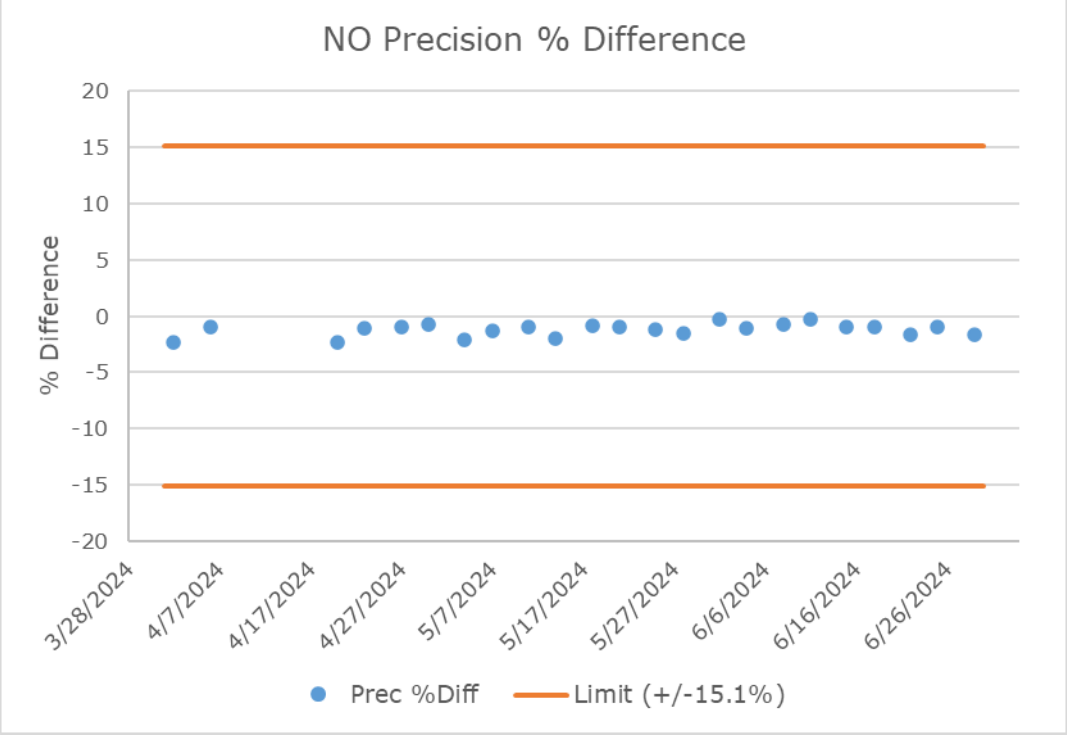


Figure D - 4. 2024 Q2 Calibration precision percent difference for NO at Missile Site Park.

Table D - 2. Summary of 2024 Q2 calibration statistics for NO at Missile Site Park.

Formula	Precision	Span
STDEV	0.57	0.38
Count	23	23
Chi^2, 0.1, n-1	14.04	14.04
CV	0.71	0.47
Bias	1.41	1.67
Bias (+/-/U)	-	-
AB	1.21	1.53
AS	0.57	0.38
$t_{0.95}$, n-1	1.72	1.72
25th	-1.58	-1.73
75th	-0.93	-1.33

Nitrogen Dioxide (NO_2)

Beginning March 3rd, 2024, nightly NO_2 calibrations were updated to challenge a span concentration once a week (160 ppb) in addition to the precision concentration, which was reduced in frequency to once per week to accommodate the new span calibrations. **Figure D - 5** below shows the converter efficiency during both precision (shown in blue) and span (shown in gold) calibrations for NO_2. **Figure D - 6** and **Figure D - 7** below show the calibration percent difference for NO_2 during precision and span calibrations, respectively. The calibrator was removed from April 8th through 17th for recertification. During the Q2 semi-annual calibration and audit checks, the sample filter housing was discovered to be loose. This occurred between regularly scheduled calibration checks and the issue was resolved while Ramboll staff were on site for calibration checks. As a result, data has been invalidated between May 28th and May 30th from the time of the previous sample filter change until the time at which the issue was resolved. **Table D - 3** highlights the assessment statistics detailed in 40CFR58, Appendix A, Section 4.

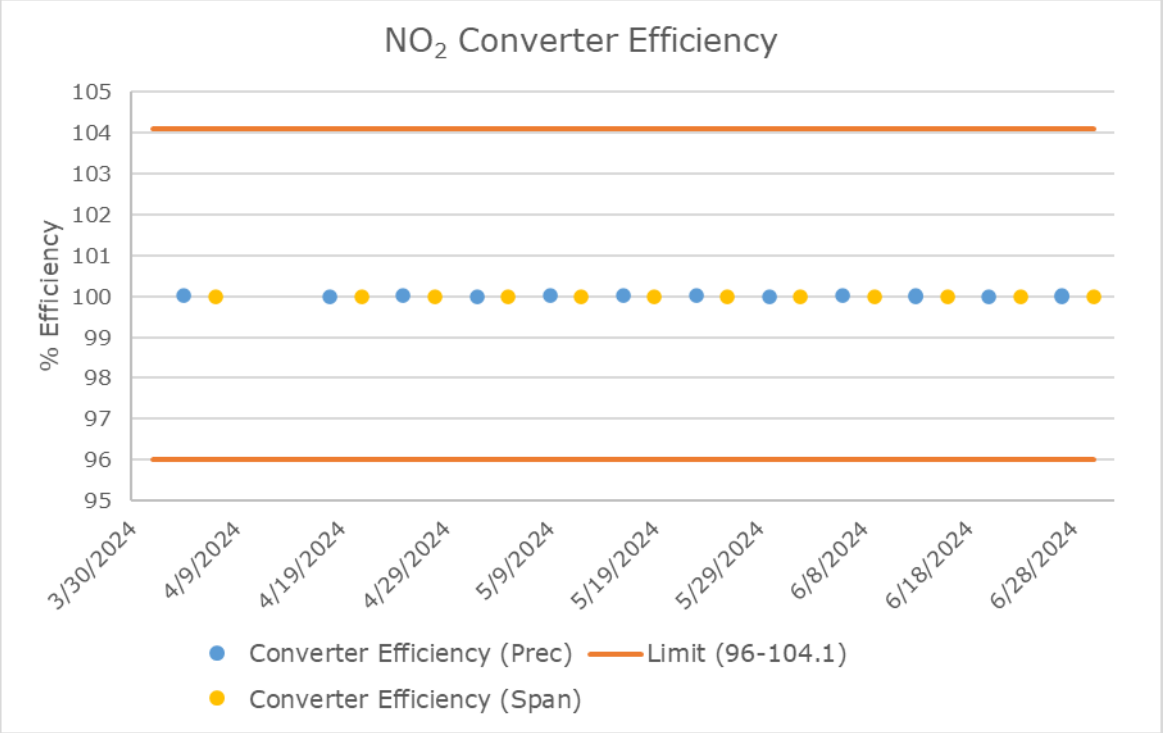


Figure D - 5. 2024 Q2 Converter efficiency for NO_2 at Missile Site Park.

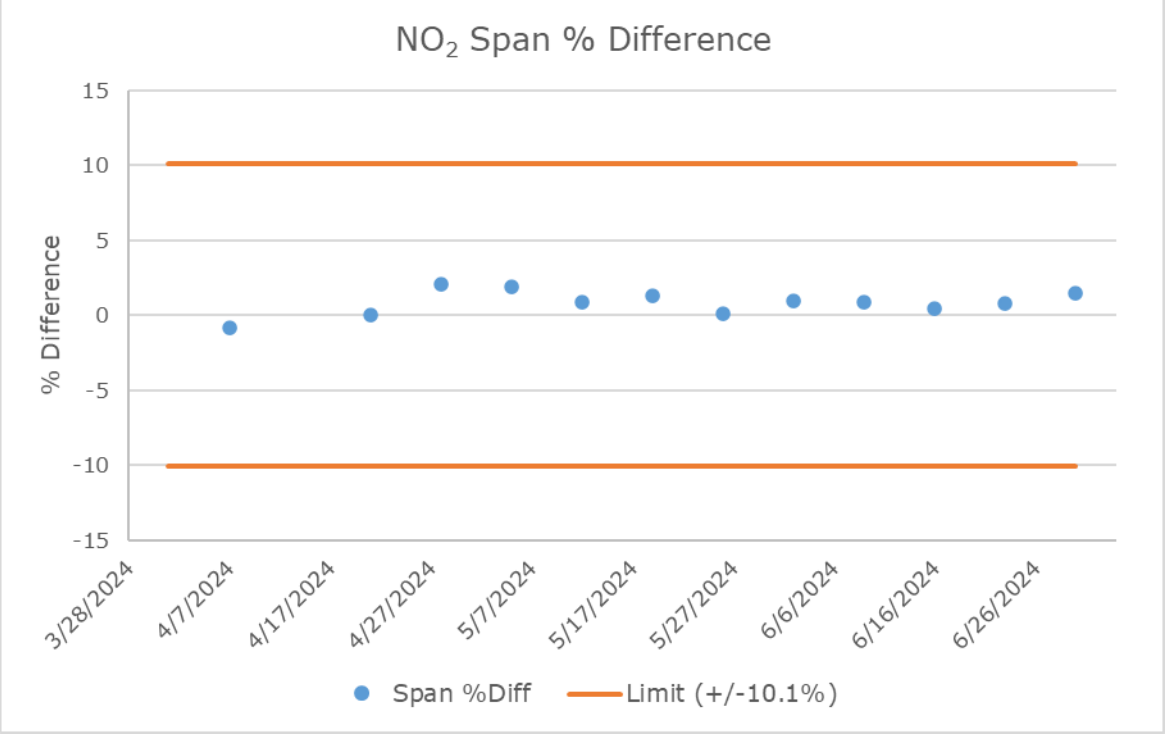


Figure D - 6. 2024 Q2 Calibration span percent difference for NO_2 at Missile Site Park.

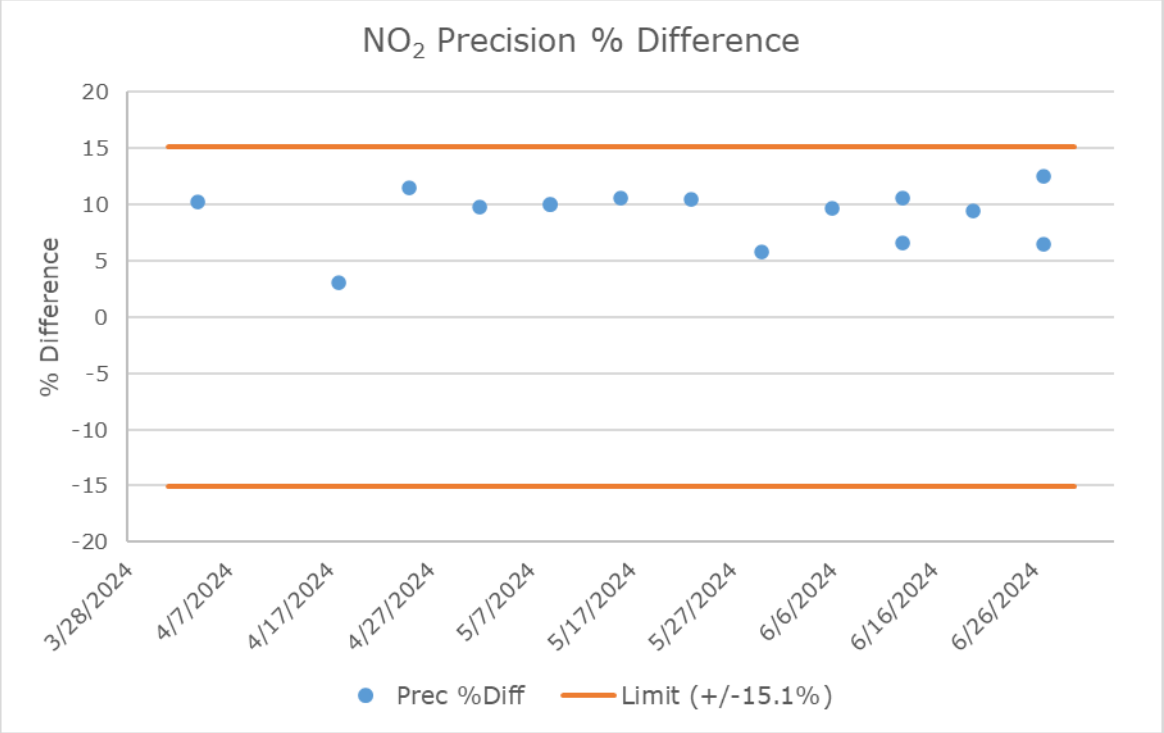


Figure D - 7. 2024 Q2 Calibration precision percent difference for NO_2 at Missile Site Park.

Table D - 3. Summary of 2024 Q2 calibration statistics for NO_2 at Missile Site Park.

Formula	Precision	Span
STDEV	2.60	0.83
Count	14	12
Chi^2, 0.1, n-1	7.04	5.58
CV	3.53	1.17
Bias	10.29	1.32
Bias (+/-/U)	+	+
AB	9.06	0.99
AS	2.60	0.63
$t_{0.95}$, n-1	1.77	1.80
25^{th}	7.29	0.36
75^{th}	10.57	1.39

Nitrogen Oxides (NOx)

Figure D - 8 and **Figure D - 9** below show the calibration span and precision percent differences for NOx at the Missile Site Park site. The calibrator was removed from April 8th through 17th for recertification. During the Q2 semi-annual calibration and audit checks, the sample filter housing was discovered to be loose. This occurred between regularly scheduled calibration checks and the issue was resolved while Ramboll staff were on site for calibration checks. As a result, data has been invalidated between May 28th and May 30th from the time of the previous sample filter change until the time at which the issue was resolved. **Table D - 4** highlights the assessment statistics detailed in 40CFR58, Appendix A, Section 4.

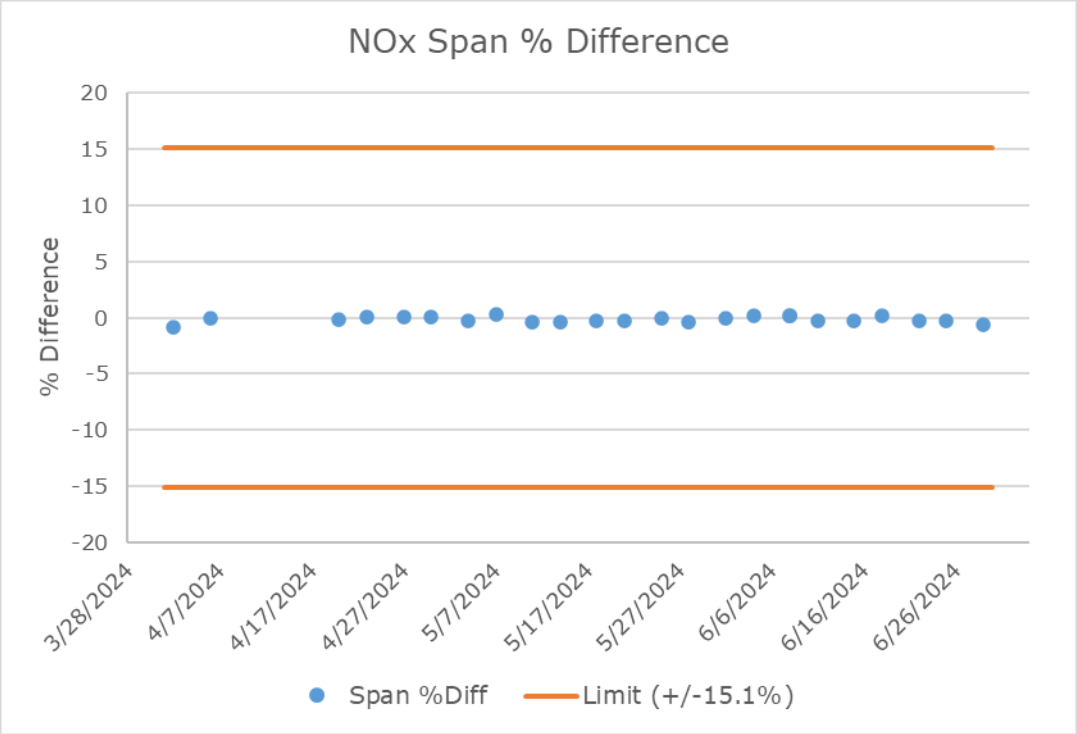


Figure D - 8. 2024 Q2 Calibration span percent difference for NOx at Missile Site Park.

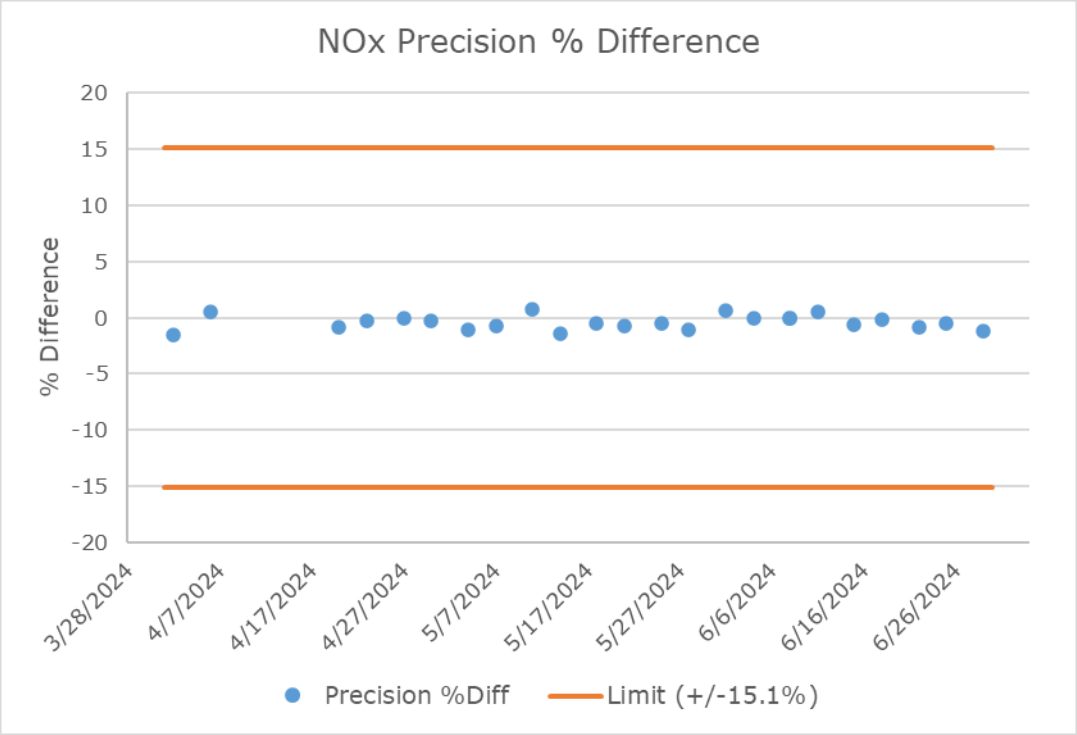


Figure D - 9. 2024 Q2 Calibration precision percent difference for NOx at Missile Site Park.

Table D - 4. Summary of 2024 Q2 calibration statistics for NOx at Missile Site Park.

Formula	Precision	Span
STDEV	0.64	0.26
Count	23	23
Chi^2, 0.1, n-1	14.04	14.04
CV	0.80	0.32
Bias	0.78	0.31
Bias (+/-/U)	-	U
AB	0.64	0.24
AS	0.41	0.19
$t_{0.95}$, n-1	1.72	1.72
25^{th}	-0.79	-0.30
75^{th}	-0.06	0.03

D.3 HEREFORD SITE

Ozone (O_3)

Figure D - 10 and **Figure D - 11** below show the calibration span and precision percent differences for ozone at Hereford site. Each check is within the upper and lower bounds specified in Appendix D of the Quality Assurance Handbook Volume II. **Table D – 5** highlights the assessment statistics detailed in 40CFR58, Appendix A, Section 4. The calibrator was removed from April 8th through 17th for recertification.

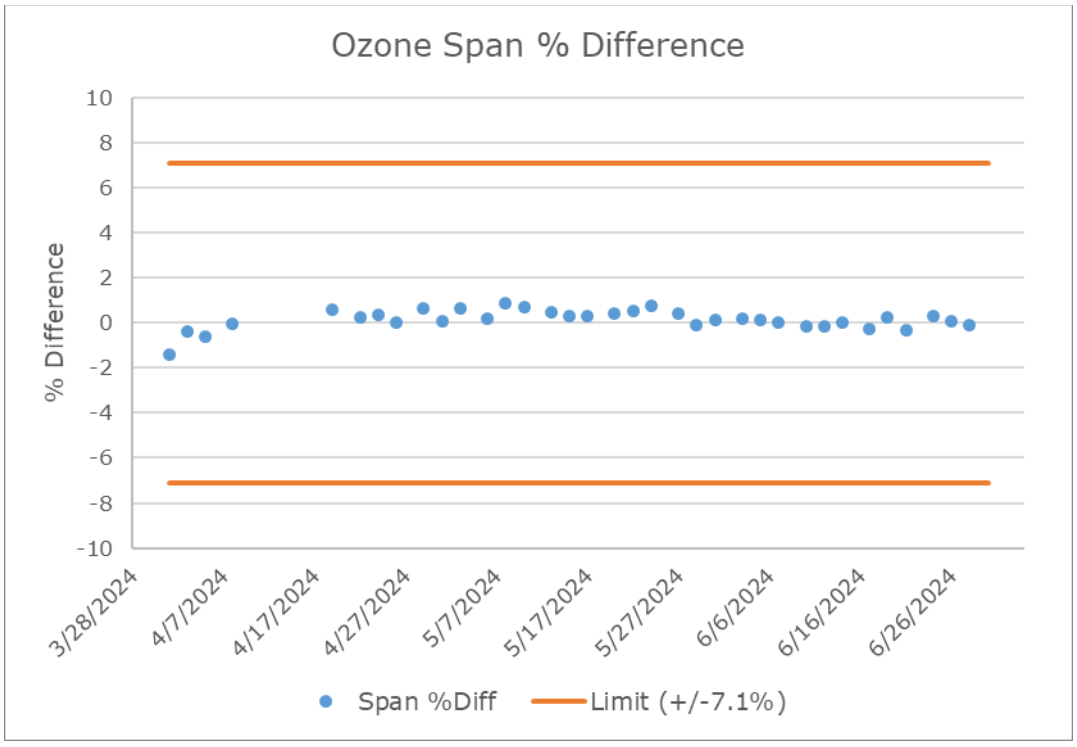


Figure D - 10. 2024 Q2 Calibration span percent difference for O_3 at Hereford.

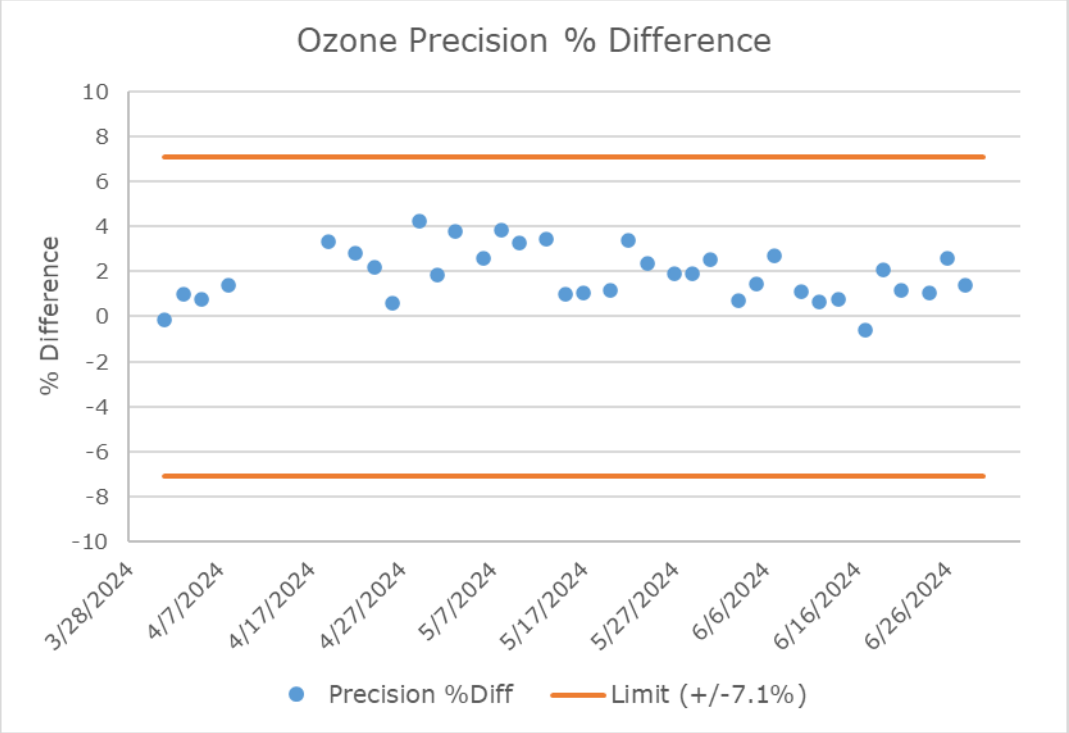


Figure D - 11. 2024 Q2 Calibration precision percent difference for O_3 at Hereford.

Table D – 5. Summary of 2024 Q2 calibration statistics for O_3 at Hereford.

Formula	Precision	Span
STDEV	1.18	0.44
Count	35	35
Chi^2, 0.1, n-1	23.95	23.95
CV	1.41	0.52
Bias	2.22	0.43
Bias (+/-/U)	+	U
AB	1.91	0.35
`AS	1.11	0.29
$t_{0.95}$, n-1	1.69	1.69
25^{th}	1.03	-0.07
75^{th}	2.66	0.40

D.4 ORCHARD SITE

Ozone (O_3)

Figure D - 12 and **Figure D - 13** below show the calibration span and precision percent differences for ozone at Orchard. Each check is within the upper and lower bounds specified in Appendix D of the Quality Assurance Handbook Volume II except the calibration check that occurred on June 17th 2024, indicated by the red points in **Figure D - 12** and **Figure D - 13**. Troubleshooting revealed that insects had migrated into the sample line at some point between this calibration check and the previous successful check on June 14th 2024. Data has been invalidated from June 14th through June 19th 2024 between the time of the last known successful calibration check and subsequent successful calibration check. The calibrator was removed from April 8th through 17th for recertification, and there was an unsuccessful calibration due to a power failure on April 24th. **Table D - 6** highlights the assessment statistics detailed in 40CFR58, Appendix A, Section 4 and does not include calibration data from periods that were invalidated or during which the analyzer was offline.

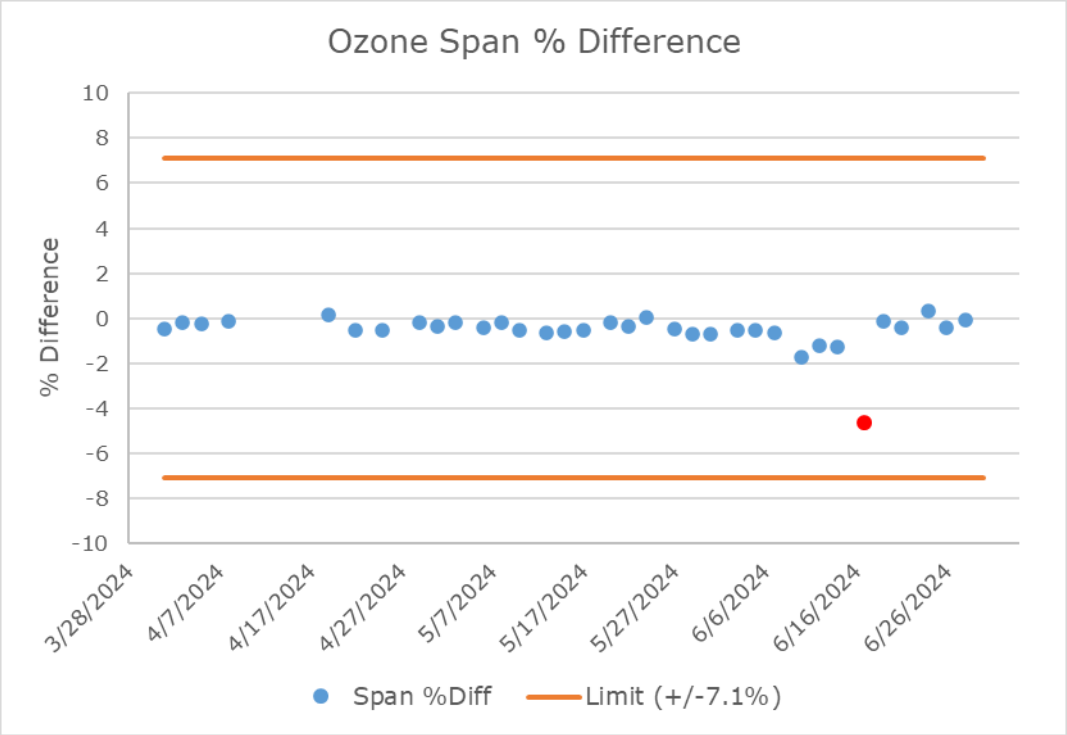


Figure D - 12. 2024 Q2 Calibration span percent difference for O_3 at Orchard.

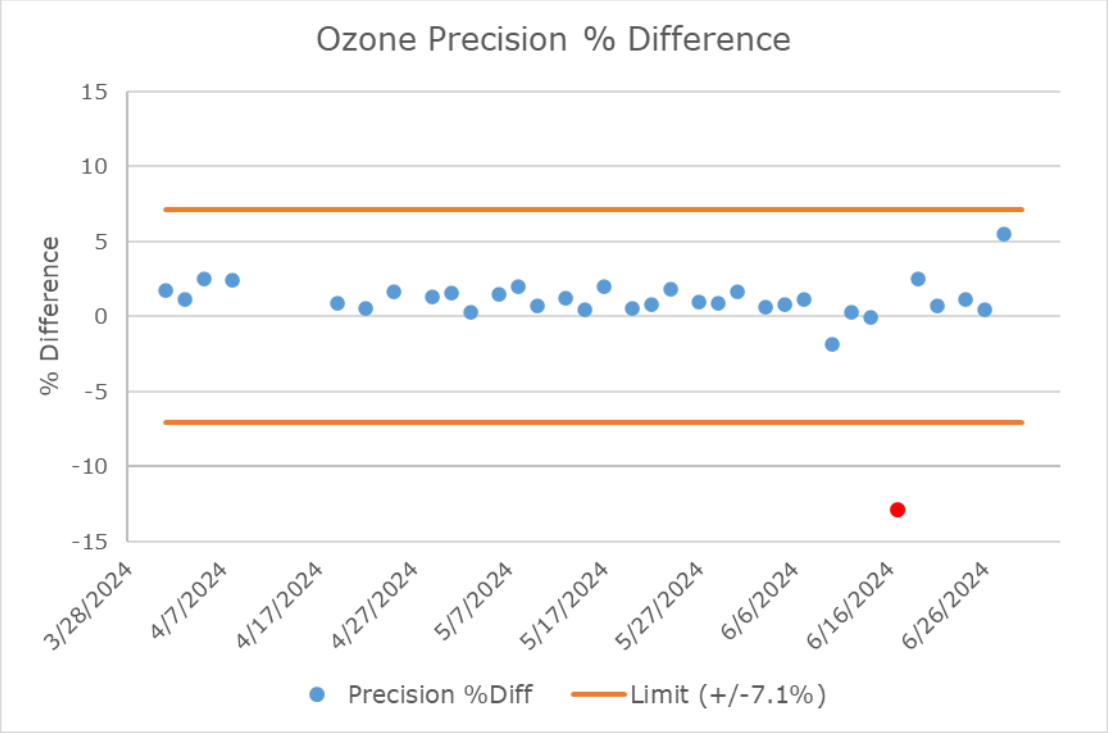


Figure D - 13. 2024 Q2 Calibration precision percent difference for O_3 at Orchard.

Table D - 6. Summary of 2024 Q2 calibration statistics for O_3 at Orchard.

Formula	Precision	Span
STDEV	1.14	0.40
Count	33	33
Chi^2, 0.1, n-1	22.27	22.27
CV	1.37	0.48
Bias	1.60	0.58
Bias (+/-/U)	+	-
AB	1.30	0.48
AS	1.00	0.36
$t_{0.95}$, n-1	1.69	1.69
25^{th}	0.64	-0.55
75^{th}	1.67	-0.20