2014 Annual Data Report
Nuiqsut Ambient Air Quality and Meteorological Monitoring Program

January 1, 2014 – December 31, 2014

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2014 Annual Data Report

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This document has been prepared by SLR International Corp. The material and data in this report were prepared under the supervision and direction of the undersigned.

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EXECUTIVE SUMMARY

On behalf of ConocoPhillips Alaska, Inc. (CPAI), SLR International Corp (SLR) is collecting ambient air and meteorological data in the village of Nuiqsut, Alaska. Since April 9, 1999 (prior to construction of the Alpine Central Processing Facility), CPAI has operated an ambient air quality and dispersion meteorology monitoring station in Nuiqsut, Alaska, which is located on the Alaskan North Slope. The Nuiqsut Ambient Air Quality and Meteorological Monitoring Program is comprised of one station located at the northern edge of Nuiqsut approximately 400 meters north-northwest of the community electrical generators. Currently, the Nuiqsut Monitoring Program is being conducted on a voluntary basis to document air quality in Nuiqsut. The data may also be used to support various ambient air quality impact analyses conducted for oil field development in the Colville Delta region.

The Nuiqsut monitoring program is designed and operated in accordance with applicable EPA PSD regulations and guidance documents. This report provides details of ambient air and meteorological measurements collected from the 2014 monitoring year, spanning from January 1, 2014, to December 31, 2014, at the Nuiqsut monitoring station.

Table E-1 details Quality Assurance Project Plan (QAPP) variations documented for this project during the monitoring year. Any QAPP variations are explained in more detail in Section 1. The Nuiqsut QAPP Revision 2.1 was approved by the Alaska Department of Environmental Conservation (ADEC) in September 2012. Table E-2 provides a summary of quarterly and annual measured data for the monitored pollutants and the respective ratios of measured pollutants to National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards (NAAQS/AAAQS). Tables E-3 and E-4 provide monthly, quarterly, and annual valid hours and percent data capture for the Nuiqsut meteorological monitoring station. Data not meeting QAPP and PSD precision and accuracy criteria were invalidated and are discussed in Section 2.

Table E-1: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
Ozone precision check frequency.	In July 2014, frequency of ozone precision checks exceeded 14 days between checks but was within a nominal two week period. Precision checks met acceptance criteria and all available information suggests data integrity was not impacted. Daily QC checks were performed and met acceptance criteria throughout the period.	The ozone transfer standard failed to initiate the weekly precision checks several times due to communication issues with the station computer. The communication issues were later resolved.

Table E-2: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Carbon Monoxide (**CO**)	35 ppm (40,000 µg/m^3)	1-Hour(1)	1st Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
			2nd Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour(1)	1st Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	1	0	1	**1**	**11.1%**
Nitrogen Dioxide (**NO_2**)	100.0 ppb (190 µg/m^3)	1-Hour(2)	Daily Max 1-Hour Averages (98th Percentile)	-	-	-	-	**12.1**	**12.1%**
			1st Highest, 1-Hour Average	44.8	24.2	13.1	25.0	**44.8**	**44.8%**
			2nd Highest, 1-Hour Average	35.9	22.7	8.4	24.3	**35.9**	**35.9%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	4	2	1	1	**2**	**3.8%**
Ozone (**O_3**)	0.075 ppm (150 µg/m^3)	8-Hour(3)	4th Highest, 8-Hour Average	0.045	0.052	0.031	0.041	**0.052**	**79.3%**
			1st Highest, 8-Hour Average	0.050	0.054	0.032	0.042	**0.054**	**72.0%**
			2nd Highest, 8-Hour Average	0.046	0.053	0.031	0.042	**0.053**	**70.7%**

[1] Not to be exceeded more than once each year.
[2] To attain this standard, the 3-year average of the 98th percentile of the annual daily maximum 1-hour average must not exceed 100 ppb. The 1-hour daily standard is a federal standard (NAAQS), but has not been incorporated into the Alaska Ambient Air Quality Standards (AAAQS) yet.
[3] To attain this standard, the 3-year average of the annual fourth-highest daily maximum 8-hour average must not exceed 0.075 ppm.

Table E-2 (Continued): Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Sulfur Dioxide (SO_2)	75.0 ppb (196 μg/m^3)	1-Hour[4]	Daily Max 1-Hour Averages (99th Percentile)	-	-	-	-	**1.1**	**1.5%**
			1st Highest, 1-Hour Average	2.7	1.2	1.0	0.4	**2.7**	**3.6%**
			2nd Highest, 1-Hour Average	2.6	1.2	0.9	0.4	**2.6**	**3.4%**
	500.0 ppb (1,300 μg/m^3)	3-Hour[5]	1st Highest, 3-Hour Average	2.6	1.1	0.8	0.3	**2.6**	**0.5%**
			2nd Highest, 3-Hour Average	2.2	1.0	0.8	0.2	**2.2**	**0.4%**
	140.0 ppb (365 μg/m^3)	24-Hour[5]	1st Highest, 24-Hour Average	1.8	1.0	0.7	0.2	**1.8**	**1.3%**
			2nd Highest, 24-Hour Average	1.8	1.0	0.7	0.2	**1.7**	**1.2%**
	30.0 ppb (80 μg/m^3)	Annual	Average of Period	0.3	0.4	0.0	-0.1	**-0.1**	**-0.3%**

[4] To attain this standard, the 3-year average of the 99th percentile of the annual daily maximum 1-hour average must not exceed 75.0 ppb.
[5] Not to be exceeded more than once each year.

Table E-2 (Continued): Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Particulate Matter <2.5 microns (**$PM_{2.5}$**)	35 μg/m^3	24-Hour[6]	98th Percentile, 24-Hour Average	7	4	4	6	**6**	**17.1%**
			1st Highest, 24-Hour Average	8	7	4	6	**8**	**22.8%**
			2nd Highest, 24-Hour Average	7	4	4	6	**7**	**20.0%**
	15.0 μg/m^3	Annual[8]	Average of Period	2.4	1.9	1.2	2.7	**2.1**	**14.0%**
Particulate Matter <10 microns (**PM_{10}**)	150 μg/m^3	24-Hour[9,10]	1st Highest, 24-Hour Average	20	40	70	10	**70**	**46.7%**
			2nd Highest, 24-Hour Average	20	20	70	10	**70**	**46.7%**

[6] To attain this standard, the 3-year average of the 98th percentile of the 24-hour concentration must not exceed 35.0 μg/m^3.
[7] The AAAQS for $PM_{2.5}$ annual average is 15.0 μg/m^3, while the NAAQS for $PM_{2.5}$ annual average is 12.0 μg/m^3.
[8] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 15.0 μg/m^3.
[9] Not to be exceeded more than once per year on average over three years.
[10] 40 CFR Appendix K requires that reportable concentrations of PM_{10} be rounded to the nearest 10 μg/m^3; actual measurement results are within Appendix C.

Table E-3: Meteorological Data Capture – Valid Hours per Month

Period	Meteorological Parameters – Data Recovery								
	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January 2014	727	727	727	741	741	739	739	739	741
February 2014	671	647	647	668	668	671	671	671	664
March 2014	736	743	743	740	740	743	743	743	**643**
1st Quarter	**2,134**	**2,117**	**2,117**	**2,149**	**2,149**	**2,153**	**2,153**	**2,153**	**2,048**
April 2014	710	720	720	668	668	720	720	720	701
May 2014	697	735	735	670	670	731	731	731	739
June 2014	720	720	720	707	707	720	720	720	720
2nd Quarter	**2,127**	**2,175**	**2,175**	**2045**	**2045**	**2,171**	**2,171**	**2,171**	**2,160**
July 2014	744	744	744	744	744	744	744	744	744
August 2014	742	742	742	742	742	742	742	742	742
September 2014	715	715	715	715	715	715	715	715	715
3rd Quarter	**2,201**	**2,201**	**2,201**	**2201**	**2201**	**2,201**	**2,201**	**2,201**	**2,201**
October 2014	735	735	735	717	717	735	735	735	735
November 2014	706	720	720	720	720	720	720	720	706
December 2014	**571**	744	744	738	738	744	744	744	744
4th Quarter	**2012**	**2199**	**2199**	**2175**	**2175**	**2199**	**2199**	**2199**	**2185**
Annual	**8474**	**8692**	**8692**	**8570**	**8570**	**8724**	**8724**	**8724**	**8594**

Table E-4: Meteorological Data Capture – Percent Data Capture

Period	Meteorological Parameters – Data Recovery[1]								
	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January 2014	98	98	98	100	100	99	99	99	100
February 2014	100	96	96	99	99	100	100	100	99
March 2014	99	100	100	99	99	100	100	100	86[2]
1st Quarter	**99**	**98**	**98**	**99**	**99**	**100**	**100**	**100**	**95**
April 2014	99	100	100	93	93	100	100	100	97
May 2014	94	99	99	90	90	98	98	98	99
June 2014	100	100	100	98	98	100	100	100	100
2nd Quarter	**97**	**100**	**100**	**94**	**94**	**99**	**99**	**99**	**99**
July 2014	100	100	100	100	100	100	100	100	100
August 2014	100	100	100	100	100	100	100	100	100
September 2014	99	99	99	99	99	99	99	99	99
3rd Quarter	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
October 2014	99	99	99	96	96	99	99	99	99
November 2014	98	100	100	100	100	100	100	100	98
December 2014	77[3]	100	100	100	100	100	100	100	100
4th Quarter	**91**	**100**	**100**	**99**	**99**	**100**	**100**	**100**	**99**
Annual	**97**	**99**	**99**	**98**	**98**	**100**	**100**	**100**	**98**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Though solar radiation failed to achieve 90 percent data recovery for the month of March, the quarterly 90 percent data recovery objective was still achieved during the first quarter.
[3] Though horizontal wind speed failed to achieve 90 percent data recovery for the month of December, the quarterly 90 percent data recovery objective was still achieved during the fourth quarter.

1. INTRODUCTION

1.1 PROJECT SUMMARY

Since April 9, 1999 (prior to construction of the Alpine Central Processing Facility), CPAI has operated an ambient air quality and meteorology monitoring station in Nuiqsut, Alaska, which is located on the Alaska North Slope. The Nuiqsut Ambient Air Quality and Meteorological Monitoring Program is comprised of one station located at the northern edge of Nuiqsut approximately 400 meters north-northwest of the community electrical generators. Currently, the Nuiqsut Monitoring Program is being conducted on a voluntary basis to document air quality in Nuiqsut. The data may also be used to support various ambient air quality impact analyses conducted for oil field development in the Colville Delta region.

The monitoring program consists of an ambient air quality monitoring station and a meteorological monitoring tower directly mounted to the air quality monitoring structure. The program is designed and operated in accordance with applicable Prevention of Significant Deterioration (PSD) regulations and guidance documents. The specific project objectives of the Monitoring Program are to:

- Collect data to document Nuiqsut air quality and address community concerns related to regional oilfield development.
- Establish a monitoring system to measure, with known accuracy and precision, meteorological parameters at the project site from ground level up to 10 meters.
- Provide required and relevant optional meteorological data for American Meteorological Society/EPA Regulatory Model Improvement Committee Model (AERMOD) modeling system.
- Establish a monitoring system to measure, with known bias and precision, the ambient concentrations of the criteria air quality pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), and particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) to establish National Ambient Air Quality Standards (NAAQS) compliance status for the monitoring location.

The Nuiqsut station collects the following ambient air data:

- Carbon monoxide (CO)
- Oxides of nitrogen (NO_2, NO_X, and NO)
- Ozone (O_3)
- Sulfur dioxide (SO_2)
- Inhalable particulate matter less than 2.5 microns ($PM_{2.5}$)
- Inhalable particulate matter less than 10 microns (PM_{10})

The Nuiqsut station measures the following meteorological parameters:

- Horizontal wind speed (meters per second [m/s])
- Horizontal wind direction (degrees [°])
- Vertical wind speed (meters per second [m/s])
- Air temperature, two and ten meters above ground level (degrees Celsius [°C])
- Solar radiation (Watts per square meter [W/m^2])

The Nuiqsut station calculates the following meteorological parameters:

- Horizontal wind direction standard deviation (Sigma Theta [σ_θ])
- Vertical wind speed standard deviation (Sigma Omega [σ_ω])
- Temperature difference ((ΔT, "Delta T" (degrees Celsius [°C]), is calculated as temperature at 10 meters minus temperature at 2 meters)

Data review and validation procedures and monitoring program data and measurement quality objectives (MQO's) are provided in the Nuiqsut Ambient Air Quality and Meteorological Monitoring Station Quality Assurance Project Plan Revision 2.1 approved by ADEC in September 2012.

The community of Nuiqsut is located in the Colville River Delta region of the North Slope of Alaska. Figure 1-1 shows a detailed map of Nuiqsut while Figure 1-2 provides an aerial view of the Nuiqsut village and depicts the location of the monitoring station. Figure 1-3 depicts the general location of the project area.

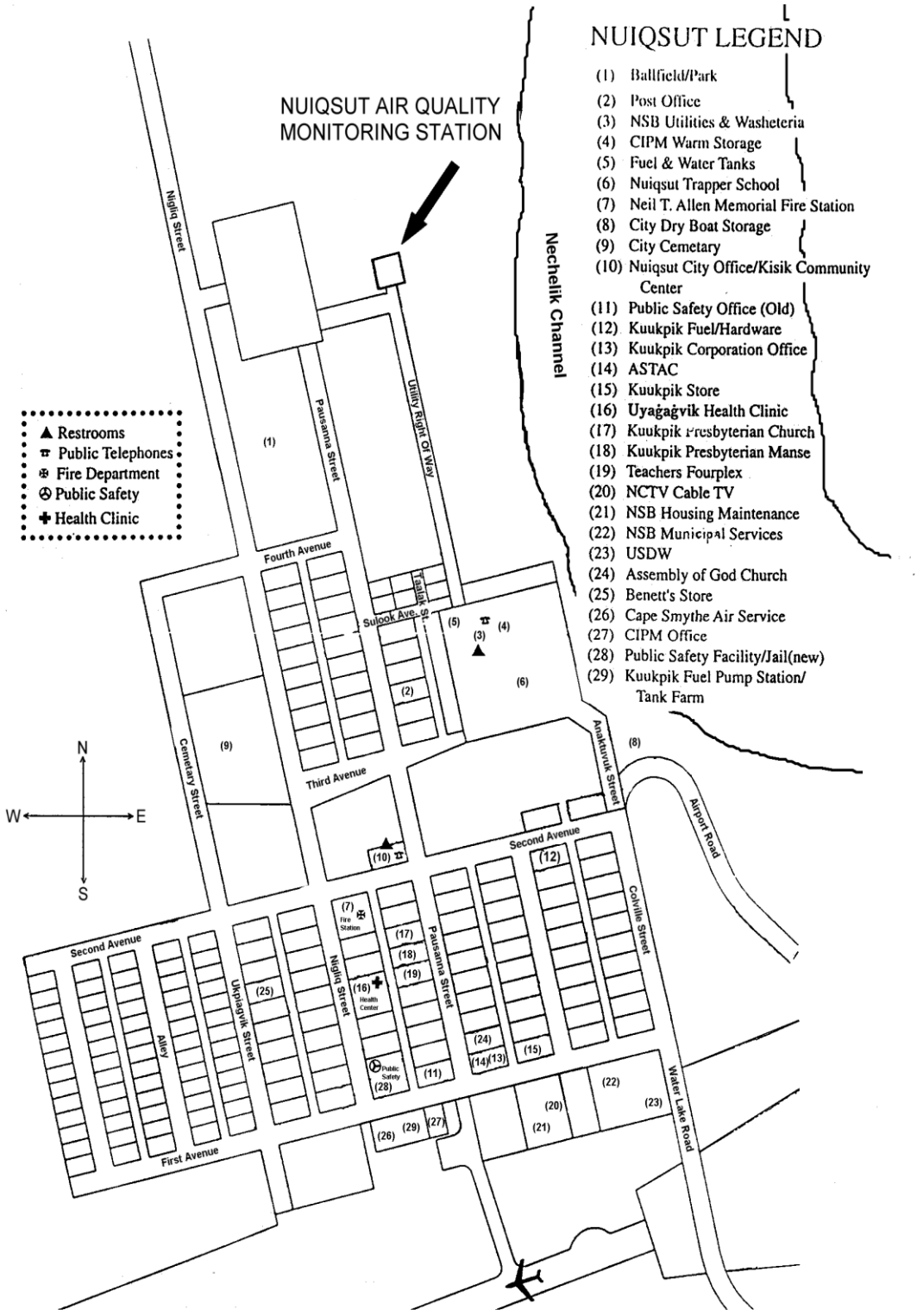


Figure 1-1: Local Map of Nuiqsut

Figure 1-2: Aerial Photo Showing Site Location

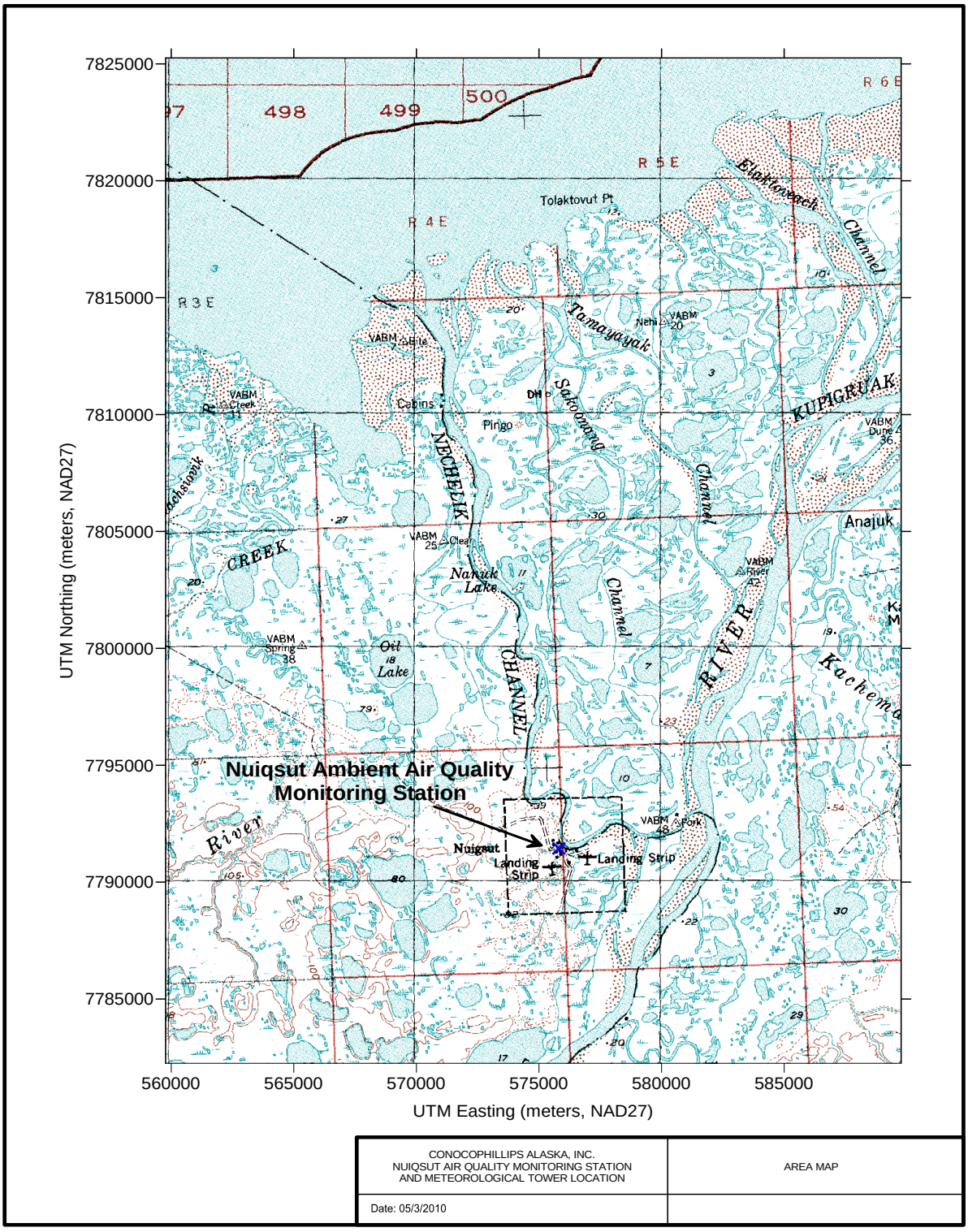


Figure 1-3: Map of Nuiqsut Project Area

1.2 MEASUREMENT METHODS TABLE

All instruments meet or exceed the U.S. Environmental Protection Agency (EPA) PSD requirements for range accuracies, thresholds, response times, resolutions, damping ratios, and other measures of instrument performance.

1.2.1 CONTINUOUS NO_2, O_3, CO AND SO_2 MONITORING

The gas analyzers used for the Nuiqsut Air Monitoring Station have been designated by EPA as either a Federal Equivalent Method (FEM) or Federal Reference Method (FRM) as defined in 40 CFR 53. Table 1-1 provides a summary of the measurement methods and parameters used for the Nuiqsut Ambient Air Monitoring Program.

Table 1-1: Gaseous Pollutant Measurement Parameters

Parameter	Instrument	References	Units	Sampling Frequency	Sample Averaging
Carbon Monoxide (CO)	Thermo 48i Gas filter correlation analyzer	EPA equivalent method RFCA-0981-054	Parts per million (ppm)	Continuous	1-hour
Nitrogen Dioxide (NO_2)[1]	Thermo Scientific 42i Chemiluminescent NO_X gas analyzer	EPA reference method RFNA-1289-074	Parts per billion (ppb)		
Ozone (O_3)	API T400 UV Photometric Ozone analyzer	EPA equivalent method EQOA-0992-087			
Sulfur Dioxide (SO_2)	Thermo 43i Pulsed fluorescence SO_2 gas analyzer	EPA equivalent method EQSA-0486-060			

[1] Total oxides of nitrogen (NO_X) and nitrogen oxide (NO) are also measured.

1.2.2 CONTINUOUS PM_{10} AND $PM_{2.5}$ MONITORING

Monitoring for PM_{10}/$PM_{2.5}$ data was conducted in accordance with the requirements and guidance in 40 CFR Parts 50, 53, and 58. PM_{10} and $PM_{2.5}$ monitoring were conducted using Met One Instruments, Inc. Model BAM-1020 Beta Attenuation Mass Monitors, which continuously measure ambient particulate concentrations using beta ray attenuation. The US EPA designations for these units are PM_{10}: FEM EQPM-0798-122 and $PM_{2.5}$ Class III FEM EQPM-0308-170. For EPA reference method sampling, the $PM_{2.5}$ sampler inlet system was configured with a BGI VSCC™ (Very Sharp Cut Cyclone) particle size separator.

CPAI participates in the North Slope air monitoring network that contains a $PM_{2.5}$ collocation station in Deadhorse, Alaska. As such, filter-based samplers for assessing precision were not run at Nuiqsut. Network precision statistics were evaluated using samples collocated at Deadhorse.

Block daily averages (24-hours) were obtained from the hourly measurements with the BAM-1020 samplers. Table 1-2 lists the particulate matter parameters measured and the frequency at which samples collected and recorded.

Table 1-2: PM Monitoring Measurement Parameters

Parameter	Units	Sampling Schedule	Sample Period	Averaging Time
$PM_{2.5}$	Micrograms per cubic meter ($\mu g/m^3$)	Continuous	1-Hour[(1)]	24-Hour (Average) [(1)]
PM_{10}	Micrograms per cubic meter ($\mu g/m^3$)	Continuous	1-Hour[(1)]	24-Hour (Average) [(1)]
Sample Volume	Cubic meters (m^3)	Every sampling event	Continuously up to 30 days (hourly checks)	Total volume over sample period
Flow Rate	Liters per min (LPM)			Average over sampling period
Ambient Temperature	Degrees Celsius (°C)			
Barometric Pressure	Millimeters of mercury (mm Hg)			

[1] 24-hour averages are obtained from the 1-hour measurements each day. A minimum of 18 hours must be available for a valid 24-hr average to be calculated.

1.2.3 METEOROLOGICAL MONITORING

The meteorological monitoring (wind speed, wind direction, vertical wind speed, ambient air temperature, and solar radiation) were conducted in a manner consistent with PSD criteria for surface meteorological data collection. The meteorological sensors meet or exceed the performance specifications stated in *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA-454/R-99-005). Table 1-3 lists the parameters measured, their reported units, sampling frequency, and sample averaging time.

Table 1-3: Meteorological Measurement Methods

Parameter	Measurement Method	Sensor Manufacturer/ Model Number	Range	Accuracy	Resolution	Sampling Frequency	Averaging Period
Ambient Temperature	Triple element thermistor	Climatronics Model 100093-2	-50 to +50°C	± 0.10°C	0.01°C	1 second	1 hour
Horizontal Wind Speed	Propeller, magnetically induced AC sine wave	RM Young Co. 05305-AQ	0 to 50 m/s	0.2 m/s and three upscale points over sensor range, ±(0.2 m/s + 5% of actual), Starting torque ≤0.25 m/s	0.1 m/s	1 second	1 hour
Wind Direction	Light-weight vane, Low torque potentiometer	RM Young Co. 05305-AQ	0 to 360°	Alignment within ±5°, Starting torque ≤0.5 m/s, Normalized linearity within ±3° (every 30 or 45 degrees)	1.0°	1 second	1 hour
Vertical Wind Speed	Propeller anemometer	Climatronics Model 102236-G0	0 to 49 m/s	±(0.2 m/s + 5% of actual), Starting torque ≤0.25 m/s	0.1 m/s	1 second	1 hour
Solar Radiation	Thermopile sensing element	Kipp & Zonen CMP 11	0 to 2,800 W/m^2	± 2%	10 W/m^2	1 second	1 hour

1.3 VARIATIONS FROM THE QAPP

During the 2014 monitoring year, the following variations from the approved Nuiqsut Ambient Air Quality and Meteorological Monitoring Quality Assurance Project Plan (QAPP) occurred:

Table 1-4: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
Ozone precision check frequency.	In July 2014, frequency of ozone precision checks exceeded 14 days between checks but was within a nominal two week period. Precision checks met acceptance criteria and all available information suggests data integrity was not impacted. Daily QC checks were performed and met acceptance criteria throughout the period.	The ozone transfer standard failed to initiate the precision sequences several times due to communication issues with the station computer. The communication issues were later resolved.

In July 2014, the frequency of ozone precision checks exceeded 14 days between checks. The project QAPP and 40 CFR 58, Appendix A, specify the required frequency of precision checks to be every two weeks. A precision check was performed on 7/10/2014 and again on 7/26/2014, within a nominal two week period, though exceeding 14 days. Both the 7/10/2014 and 7/26/2014 precision checks met acceptance criteria and all available information demonstrates that data integrity was not compromised by the delay. Daily one-point QC checks were performed throughout this period and met acceptance criteria.

Table 2-1 Continued: Chronology of Significant Events

2. STATION PERFORMANCE SUMMARY

2.1 SIGNIFICANT PROJECT EVENTS

Table 2-1 summarizes the significant events that occurred at the Nuiqsut station relevant to the 2014 ambient air and meteorological monitoring year.

Table 2-1: Chronology of Significant Events

Date	Event
January 1, 2014	Start of the monitoring year.
January 1, 2014	Monthly QC checks performed on PM samplers; all passed acceptance criteria. Six hours of $PM_{2.5}$ data flagged as invalid due to a communication error with the sampler.
January 17 – 18, 2014	Data from all continuous air quality analyzers invalidated as a result of shelter temperature standard deviation exceeding daily 2 degree Celsius limit.
January 29 – 30, 2014	Horizontal wind direction data indicated episodes of rime ice build-up on sensor; 16 hours of horizontal wind direction data flagged invalid. 4 hours of 2m temperature, 10m temperature, and delta T invalidated.
February 1, 2014	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
February 12, 2014	Horizontal wind direction data indicated episodes of rime ice build-up on sensor; 9 hours of horizontal wind direction data flagged invalid.
February 13, 2014	$PM_{2.5}$ data flagged as invalid due to a 24-hour average concentrations less than -2 µg/m^3.
February 18, 19, & 22, 2014	PM_{10} data flagged as invalid due to a 24-hour average concentrations less than -2 µg/m^3.
February 19, 2014	Horizontal wind direction data indicated episodes of rime ice build-up on sensor; 11 hours of horizontal wind direction data flagged invalid.
February 21, 2014	Multipoint calibrations performed on CO and SO_2 ambient air analyzers; all passed.
February 28, 2014	Multipoint calibrations performed on all ambient air analyzers; all passed. Independent performance audit of ambient air analyzers and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
February 28, 2014	Data from all continuous air quality analyzers invalidated as a result of shelter temperature standard deviation exceeding daily 2 degree Celsius limit.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
March 1 – 12, 2014	Ozone transfer standard out for recertification; recertification took place on March 5, 2014.
March 8 – 12, 2014	No $PM_{2.5}$ and PM_{10} data collected due to filter tape errors; 107 hours of $PM_{2.5}$ data flagged as invalid and 109 hours of PM_{10} data flagged as invalid.
March 12, 2014	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
March 22 – 25 & 31, 2014	Solar radiation data invalidated due to values exceeding theoretical maximum values for location and time; 100 total hours of solar radiation data flagged as invalid.
March 29, 2014	Horizontal wind speed data indicated episodes of rime ice build-up on sensor; 7 hours of horizontal wind direction data flagged invalid.
April 2, 2014	PM_{10} data flagged as invalid due to a 24-hour average concentrations less than -2 $\mu g/m^3$.
April 6 and 8, 2014	$PM_{2.5}$ data flagged as invalid due to a 24-hour average concentrations less than -2 $\mu g/m^3$.
April 22, 2014	Solar radiation data invalidated due to values exceeding theoretical maximum values for location and time; 18 total hours of solar radiation data flagged as invalid.
April 23, 2014	Monthly QC checks performed on PM samplers; all passed acceptance criteria. Multipoint calibrations performed on all ambient air analyzers; all passed.
April 24, 2014	Horizontal wind speed data indicated episodes of rime ice build-up on sensor; 7 hours of horizontal wind speed data flagged invalid.
April 17, 18, and 27, 2014	Vertical wind speed data indicated episodes of rime ice build-up on sensor; 52 total hours of vertical wind speed data flagged invalid.
May 17, 2014	Monthly QC checks performed on PM samplers; all passed acceptance criteria. Calibrations performed on all meteorological sensors and multipoint calibrations performed on all ambient air analyzers; all passed. Independent performance audit of ambient air analyzers, PM samplers, and meteorological sensors conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
May 19, 2014	$PM_{2.5}$ and PM_{10} data flagged as invalid due to a 24-hour average concentrations less than -2 $\mu g/m^3$.
May 19, and 23 – 25, 2014	Data from all continuous air quality analyzers invalidated due to shelter temperature exceeding 2 degree Celsius standard deviation.
May 29 – 30, 2014	Horizontal wind speed data indicated episodes of rime ice build-up on sensor; 38 hours of horizontal wind speed data flagged invalid.
May 29 – June 1, 2014	Vertical wind speed data indicated episodes of rime ice build-up on sensor; 78 hours of vertical wind speed data flagged invalid.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
June 1, 2014	Data from all continuous air quality analyzers invalidated as a result of shelter temperature exceeding 2 degree Celsius standard deviation.
June 4, 2014	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
June 3, 8, 9, 13, 14, and 19, 2014	No $PM_{2.5}$ data collected due to filter tape errors; 68 total hours of $PM_{2.5}$ data flagged as invalid.
July 8, 2014	Additional precision check run on CO, NO_X, and SO_2 ambient air analyzers to ensure analyzer accuracy; all passed.
July 9 – 14, 2014	108 hours of $PM_{2.5}$ data and 101 hours of PM_{10} data were lost due to the samplers running out of tape and local operator unavailable to replace it quickly. Tape was re-installed and samplers returned to normal operations by July 14.
July 23, 2014	Independent performance audit of ambient air analyzers, PM samplers, and meteorological sensors conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
July 29 – 30, 2014	Multipoint calibrations performed on all ambient air analyzers; all passed. Monthly QC checks performed on PM samplers; all passed acceptance criteria with the exception of the PM_{10} temperature sensor, though this is not a critical criterion. Temperature probes replaced on both PM samplers and multipoint calibrations performed; all passed acceptance criteria.
August 21, 2014	Ozone transfer standard replaced with recently re-certified transfer standard.
August 19 – 21, 2014	No $PM_{2.5}$ data collected due to a filter tape error; 47 total hours of $PM_{2.5}$ data flagged as invalid.
August 21, 2014	Monthly QC performed on PM samplers; all passed acceptance criteria.
September 15, 2014	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
September 15 – 20, 2014	Zero background check performed on the $PM_{2.5}$ sampler. No measurements were collected by the sampler during this period; 125 total hours of $PM_{2.5}$ data not collected as a result.
September 29, 2014	Multipoint calibrations and performed on CO and SO_2 ambient air analyzers; all passed.
October 30, 2014	Monthly QC checks performed on PM samplers; all passed acceptance criteria. Solar reference performed. Calibrations performed on all meteorological sensors and multipoint calibrations performed on all ambient air analyzers; all passed. Independent performance audit of ambient air analyzers, PM samplers, and meteorological sensors conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
November 1, 4, and 7, 2014	PM_{10} data flagged as invalid due to a 24-hour average concentrations less than -2 $\mu g/m^3$.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
November 16, 2014	Horizontal wind speed data indicated episodes of rime ice build-up on sensor; 13 hours of horizontal wind speed data flagged invalid.
November 17, 2014	Ozone transfer standard recertification
November 19, 2014	Monthly QC checks performed on $PM_{2.5}$ samplers; all passed acceptance criteria.
November 20-21, 2014	$PM_{2.5}$ data flagged as invalid due suspected interference from blowing snow and ice.
December 1-7, 2014	Horizontal wind speed data indicated episodes of rime ice build-up on sensor; 173 hours of horizontal wind speed data flagged invalid.
December 2, 2014	PM_{10} data flagged as invalid due to a 24-hour average concentrations less than -2 $\mu g/m^3$.
December 11, 2014	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
December 30, 2014	Data from all continuous air quality analyzers invalidated as a result of shelter temperature exceeding 2 degree Celsius standard deviation.
December 31, 2014	End of monitoring year.

2.2 MISSING, INVALID AND ADJUSTED DATA

The data collected at the Nuiqsut station were carefully reviewed during the quality assurance process. Some data were removed as a result of planned site activities, including data collected during station system and performance audits and calibrations. Data known or suspected to be invalid have been removed from the data set after verifying that the removed data values do not represent actual ambient air quality conditions at the sampling station.

Table 2-2 lists the quantities of data that were flagged according to EPA criteria, yet not removed from the refined final data set. All flagged data were carefully examined, but generally remained in the reduced data unless dictated by certain circumstances, including: values outside the normal range of variation; consecutive repetitive values recorded for an unidentified reason; maintenance activity at the site, and impairing damage to sensors.

Table 2-2: Percentage of Final Data Set Flagged

Parameter	Flagging Criteria[(1)]	Percent Flagged
Wind Speed	Value is < 0 m/s	0.0%
	Value is > 25 m/s	0.0%
	< 0.1 m/s variation for 3 consecutive hours	2.0%
	< 0.5 m/s variation for 12 consecutive hours	0.2%
Wind Direction	Value is < 0°, > 360°	0.0%
	< 1° variation over 3 consecutive hours	0.1%
	< 10° variation over 18 consecutive hours	2.2%
Temperature (2 meters)	> 5°C variation from previous hour	0.1%
	< 0.5°C variation for 12 consecutive hours	1.3%
	Value is > record high, < record low	2.0%
Temperature (10 meters)	> 5°C variation from previous hour	0.1%
	< 0.5°C variation for 12 consecutive hours	1.2%
	Value is > record high, < record low	1.5%
Temperature Difference, ΔT	Value is > 0.8°C during the daytime	1.0%
	Value is < -0.8°C during the night	0.1%
	Value is > 5°C, < -3°C	0.0%
Solar Radiation	> 0 w/m^2 at night	1.3%
	Greater than the maximum possible value for date and latitude	0.2%

[1] Based upon Table 8-4: Suggested Data Screening Criteria in *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA-454/R-99-005).

2.3 NETWORK DATA COMPLETENESS

Data completeness is a measure of the amount of data actually collected compared to the amount of data that could have been collected. Data completeness was calculated by dividing the number of valid hours of data by the total number of hours during the monitoring period. The data quality objective (DQO) for data completeness for air quality data is 80 percent per calendar quarter, and 90 percent for meteorological data per calendar quarter. The Nuiqsut ambient air and meteorological monitoring station met all PSD requirements during the monitoring year.

Quarterly and annual data completeness for ambient air and meteorological parameters are provided in Tables 2-3 and 2-4, respectively. Calculations for determining data completeness are provided in Appendix A. Fully validated data for all parameters are provided in Appendix D.

Table 2-3: Ambient Air Quality Data Capture Percent

Period	Pollutants – Data Recovery[1]					
	CO	NO_2	O_3	SO_2	$PM_{2.5}$[2]	PM_{10}[2]
January 2014	93	93	93	93	97	100
February 2014	96	96	96	96	93	86
March 2014	98	98	98	98	84	84
1st Quarter	**96**	**96**	**95**	**96**	**91**	**90**
April 2014	99	99	99	99	93	97
May 2014	84	84	84	84	94	94
June 2014	96	96	96	96	83	100
2nd Quarter	**93**	**93**	**93**	**93**	**90**	**97**
July 2014	97	97	98	97	84	84
August 2014	99	99	98	99	90	97
September 2014	98	98	98	98	80	100
3rd Quarter	**98**	**98**	**98**	**98**	**85**	**93**
October 2014	98	98	98	98	100	100
November 2014	99	99	99	99	93	90
December 2014	92	92	92	92	100	97
4th Quarter	**96**	**96**	**96**	**96**	**98**	**96**
Annual	**96**	**96**	**96**	**96**	**91**	**94**

[1] EPA PSD-quality ambient air monitoring standards require data capture of 80 percent or greater per quarter for four consecutive quarters.
[2] Data recovery for PM monitors is based on the number of valid 24-hour average particulate matter samples collected divided by the total number of 24-hour periods during the sampling period. 24-hour average data recovery percentages in Table 2-2 differ from the 1-hour average data recovery percentage summaries presented in Appendix C.

Table 2-4: Meteorological Data Capture Percent

Period	Meteorological Parameters – Data Recovery[1]								
	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January 2014	98	98	98	100	100	99	99	99	100
February 2014	100	96	96	99	99	100	100	100	99
March 2014	99	100	100	99	99	100	100	100	86[2]
1st Quarter	**99**	**98**	**98**	**99**	**99**	**100**	**100**	**100**	**95**
April 2014	99	100	100	93	93	100	100	100	97
May 2014	94	99	99	90	90	98	98	98	99
June 2014	100	100	100	98	98	100	100	100	100
2nd Quarter	**97**	**100**	**100**	**94**	**94**	**99**	**99**	**99**	**99**
July 2014	100	100	100	100	100	100	100	100	100
August 2014	100	100	100	100	100	100	100	100	100
September 2014	99	99	99	99	99	99	99	99	99
3rd Quarter	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
October 2014	99	99	99	96	96	99	99	99	99
November 2014	98	100	100	100	100	100	100	100	98
December 2014	77[3]	100	100	100	100	100	100	100	100
4th Quarter	**91**	**100**	**100**	**99**	**99**	**100**	**100**	**100**	**99**
Annual	**97**	**99**	**99**	**98**	**98**	**100**	**100**	**100**	**98**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Though solar radiation failed to achieve 90 percent data recovery for the month of March, the quarterly 90 percent data recovery objective was still achieved during the first quarter.
[3] Though horizontal wind speed failed to achieve 90 percent data recovery for the month of December, the quarterly 90 percent data recovery objective was still achieved during the first quarter.

2.4 PRECISION STATISTICS

2.4.1 MONITORING NETWORK PRECISION STATISTICS

Precision statistics were determined using the methods outlined in Title 40 Code of Federal Regulations, Part 58 (40 CFR 58), Appendix A. Valid precision data for ambient air monitors (CO, NO_2, O_3, and SO_2) were collected at least once every two weeks with the exception of the previously identified QAPP deviation, meeting the critical validation criteria outlined in the monitoring program QAPP. Quarterly precision statistics for each criteria pollutant are provided in Tables 2-5 through 2-20.

Continuous PM_{10} monitors are not required to have collocated precision comparisons. Precision statistics for the continuous $PM_{2.5}$ monitor were determined using the monitoring network QA station located in Deadhorse, Alaska. EPA recommends that precision statistics for $PM_{2.5}$ should only be calculated for collocated samples if both the collocated and the primary sample concentrations are greater than or equal to 3 $\mu g/m^3$. As proposed in the Deadhorse $PM_{2.5}$ Monitoring Program QAPP, precision statistics for this monitoring project were calculated for collocated samples if both the collocated and the primary sample concentrations were greater than or equal to 2 $\mu g/m^3$. Quarterly network PM precision statistics are presented in Table 2-21.

Table 2-5: 1st Quarter CO Precision Statistics Summary

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Jan-14	8.3	7.8	6.4	13	3.25	2.54	8.23	-1.72	3.50	+4.51
9-Jan-14	8.4	7.8	7.7							
16-Jan-14	8.0	7.8	2.6							
23-Jan-14	8.0	7.8	2.6							
30-Jan-14	8.1	7.8	3.9							
6-Feb-14	8.1	7.8	3.9							
13-Feb-14	8.2	7.8	5.1							
20-Feb-14	8.3	7.8	6.4							
27-Feb-14	7.9	7.8	1.3							
6-Mar-14	7.8	7.8	0.0							
13-Mar-14	7.9	7.8	1.3							
20-Mar-14	7.9	7.8	1.3							
27-Mar-14	7.8	7.8	0.0							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-6: 2nd Quarter CO Precision Statistics Summary

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Apr-14	7.8	7.8	0.0	13	1.97	2.20	6.28	-2.34	3.04	+3.15
10-Apr-14	7.9	7.8	1.3							
17-Apr-14	7.9	7.8	1.3							
24-Apr-14	8.1	7.8	3.9							
1-May-14	8.1	7.8	3.9							
8-May-14	8.2	7.8	5.1							
15-May-14	8.3	7.8	6.4							
22-May-14	7.8	7.8	0.0							
29-May-14	7.7	7.8	-1.3							
5-Jun-14	7.9	7.8	1.3							
12-Jun-14	7.9	7.8	1.3							
19-Jun-14	7.9	7.8	1.3							
26-Jun-14	7.9	7.8	1.3							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-7: 3rd Quarter CO Precision Statistics Summary

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Jul-14	7.9	7.8	1.3	13	4.54	3.16	10.73	-1.66	4.36	+6.13
8-Jul-14	7.9	8.0	-1.3							
10-Jul-14	7.9	7.8	1.3							
18-Jul-14	8.0	7.8	2.6							
26-Jul-14	8.0	7.8	2.6							
30-Jul-14	8.0	7.8	2.6							
7-Aug-14	8.3	7.8	6.4							
14-Aug-14	8.3	7.8	6.4							
21-Aug-14	8.3	7.8	6.4							
28-Aug-14	8.3	7.8	6.4							
4-Sep-14	8.4	7.8	7.7							
11-Sep-14	8.4	7.8	7.7							
18-Sep-14	8.5	7.8	9.0							
25-Sep-14[3]	-	-	-							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%
[3]No precision check due to calibrator communication issue.

Table 2-8: 4th Quarter CO Precision Statistics Summary

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Oct-14	8.3	7.8	6.4	13	5.03	2.98	10.87	-0.81	4.11	+6.51
9-Oct-14	8.3	7.8	6.4							
16-Oct-14	8.3	7.8	6.4							
23-Oct-14	8.4	7.8	7.7							
30-Oct-14	8.5	7.8	9.0							
6-Nov-14	7.7	7.8	-1.3							
13-Nov-14	7.9	7.8	1.3							
20-Nov-14	7.9	7.8	1.3							
27-Nov-14	8.1	7.8	3.9							
4-Dec-14	8.2	7.8	5.1							
11-Dec-14	8.2	7.8	5.1							
18-Dec-14	8.3	7.8	6.4							
25-Dec-14	8.4	7.8	7.7							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-9: 1st Quarter NO_2 Precision Statistics Summary

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[(1)]	Bias Estimate[(2)]
2-Jan-14	82.4	82.0	0.5	13	-1.11	1.56	1.95	-4.17	2.15	+/-2.05
9-Jan-14	82.4	82.8	-0.5							
16-Jan-14	82.8	82.4	0.5							
23-Jan-14	82.3	82.2	0.1							
30-Jan-14	82.1	82.6	-0.6							
6-Feb-14	81.6	82.1	-0.6							
13-Feb-14	82.8	83.9	-1.3							
20-Feb-14	82.8	84.1	-1.6							
27-Feb-14	83.0	82.1	1.0							
6-Mar-14	80.9	84.4	-4.1							
13-Mar-14	80.2	81.4	-1.5							
20-Mar-14	80.7	83.3	-3.2							
27-Mar-14	79.5	82.0	-3.1							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-10: 2nd Quarter NO_2 Precision Statistics Summary

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[(1)]	Bias Estimate[(2)]
3-Apr-14	80.2	81.7	-1.8	13	-3.00	0.86	-1.31	-4.69	1.19	-3.43
10-Apr-14	80.4	82.5	-2.6							
17-Apr-14	79.1	82.1	-3.7							
24-Apr-14	80.8	82.3	-1.8							
1-May-14	80.9	83.9	-3.6							
8-May-14	80.7	82.9	-2.7							
15-May-14	80.3	83.3	-3.6							
22-May-14	80.1	83.8	-4.4							
29-May-14	79.7	81.3	-2.0							
5-Jun-14	79.8	82.1	-2.9							
12-Jun-14	79.3	81.2	-2.4							
19-Jun-14	78.8	82.0	-3.8							
26-Jun-14	78.8	81.9	-3.8							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-11: 3rd Quarter NO_2 Precision Statistics Summary

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Jul-14	78.2	82.2	-4.9	11	0.13	2.07	4.18	-3.93	2.97	+/-2.23
10-Jul-14	82.2	82.4	-0.3							
18-Jul-14	81.2	81.5	-0.3							
26-Jul-14	82.0	81.2	1.0							
7-Aug-14	81.1	80.8	0.4							
14-Aug-14	80.6	80.0	0.7							
21-Aug-14	81.2	80.9	0.4							
28-Aug-14	80.7	78.6	2.7							
4-Sep-14	81.3	79.8	1.9							
11-Sep-14	81.6	80.2	1.8							
18-Sep-14	73.5	75.0	-1.9							
25-Sep-14[3]	-	-	-							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%
[3] No precision check due to calibrator communication issue.

Table 2-12: 4th Quarter NO_2 Precision Statistics Summary

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[(1)]	Bias Estimate[(2)]
2-Oct-14	75.8	77.6	-2.3	13	-0.10	0.97	1.80	-2.00	1.34	+/-1.02
9-Oct-14	76.8	77.8	-1.3							
16-Oct-14	78.9	79.2	-0.4							
23-Oct-14	80.1	79.8	0.4							
30-Oct-14	79.5	79.3	0.2							
6-Nov-14	81.2	81.1	0.1							
13-Nov-14	81.5	81.2	0.4							
20-Nov-14	80.4	80.2	0.3							
27-Nov-14	82.0	82.4	-0.5							
4-Dec-14	81.6	82.1	-0.6							
11-Dec-14	81.4	81.4	0.0							
18-Dec-14	82.2	81.2	1.3							
25-Dec-14	81.9	80.9	1.3							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-13: 1st Quarter O_3 Precision Statistics Summary

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[(1)]	Bias Estimate[(2)]
2-Jan-14	0.0921	0.0900	2.3	13	1.43	1.00	3.39	-0.53	1.38	+1.92
9-Jan-14	0.0901	0.0900	0.1							
16-Jan-14	0.0924	0.0900	2.7							
23-Jan-14	0.0901	0.0900	0.1							
30-Jan-14	0.0907	0.0900	0.8							
6-Feb-14	0.0902	0.0900	0.2							
13-Feb-14	0.0909	0.0900	1.0							
20-Feb-14	0.0927	0.0900	3.0							
27-Feb-14	0.0915	0.0900	1.7							
6-Mar-14[(3)]	-	-	-							
12-Mar-14	0.0911	0.0900	1.2							
13-Mar-14	0.0909	0.0900	1.0							
20-Mar-14	0.0918	0.0900	2.0							
27-Mar-14	0.0922	0.0900	2.4							

[1]Acceptance criteria: ≤ 7%
[2]Acceptance criteria: ≤ ±7%
[3] Ozone transfer standard out for recertification.

Table 2-14: 2nd Quarter O_3 Precision Statistics Summary

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Apr-14	0.0921	0.0900	2.3	13	1.03	1.15	3.29	-1.22	1.59	+1.65
10-Apr-14	0.0930	0.0900	3.3							
17-Apr-14	0.0912	0.0900	1.3							
24-Apr-14	0.0918	0.0900	2.0							
1-May-14	0.0918	0.0900	2.0							
8-May-14	0.0912	0.0900	1.3							
15-May-14	0.0907	0.0900	0.8							
22-May-14	0.0903	0.0900	0.3							
29-May-14	0.0900	0.0900	0.0							
5-Jun-14	0.0902	0.0900	0.2							
12-Jun-14	0.0904	0.0900	0.4							
19-Jun-14	0.0901	0.0900	0.1							
26-Jun-14	0.0893	0.0900	-0.8							

[1]Acceptance criteria: ≤ 7%
[2]Acceptance criteria: ≤ ±7%

Table 2-15: 3rd Quarter O_3 Precision Statistics Summary

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Jul-14	0.0904	0.0900	0.4	10	0.67	1.20	3.02	-1.69	1.76	+/-1.54
10-Jul-14	0.0894	0.0900	-0.7							
26-Jul-14	0.0916	0.0900	1.8							
7-Aug-14	0.0917	0.0900	1.9							
14-Aug-14	0.0919	0.0900	2.1							
21-Aug-14	0.0894	0.0900	-0.7							
27-Aug-14	0.0893	0.0900	-0.8							
6-Sep-14	0.0908	0.0900	0.9							
11-Sep-14	0.0898	0.0900	-0.2							
18-Sep-14	0.0917	0.0900	1.9							
25-Sep-14[3]	-	-	-							

[1]Acceptance criteria: ≤ 7%
[2]Acceptance criteria: ≤ ±7%
[3] Ozone transfer standard out for recertification.

Table 2-16: 4th Quarter O_3 Precision Statistics Summary

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Oct-14	0.0925	0.0900	2.8	13	1.98	0.70	3.35	0.61	0.97	+2.33
9-Oct-14	0.0922	0.0900	2.4							
16-Oct-14	0.0918	0.0900	2.0							
23-Oct-14	0.0909	0.0900	1.0							
30-Oct-14	0.0913	0.0900	1.4							
6-Nov-14	0.0927	0.0900	3.0							
13-Nov-14	0.0912	0.0900	1.3							
20-Nov-14	0.0918	0.0900	2.0							
27-Nov-14	0.0911	0.0900	1.2							
4-Dec-14	0.0910	0.0900	1.1							
11-Dec-14	0.0919	0.0900	2.1							
18-Dec-14	0.0924	0.0900	2.7							
25-Dec-14	0.0924	0.0900	2.7							

[1]Acceptance criteria: ≤ 7%
[2]Acceptance criteria: ≤ ±7%

Table 2-17: 1st Quarter SO_2 Precision Statistics Summary

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[(1)]	Bias Estimate[(2)]
2-Jan-14	77.6	78.0	-0.5	13	-1.67	1.16	0.61	-3.94	1.60	-2.24
9-Jan-14	76.3	78.0	-2.2							
16-Jan-14	76.7	78.0	-1.7							
23-Jan-14	76.6	78.0	-1.8							
30-Jan-14	77.9	78.0	-0.1							
6-Feb-14	76.8	78.0	-1.5							
13-Feb-14	74.9	78.0	-4.0							
20-Feb-14	77.2	78.0	-1.0							
27-Feb-14	78.0	78.0	0.0							
6-Mar-14	75.2	78.0	-3.6							
13-Mar-14	76.8	78.0	-1.5							
20-Mar-14	76.6	78.0	-1.8							
27-Mar-14	76.5	78.0	-1.9							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-18: 2nd Quarter SO_2 Precision Statistics Summary

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[(1)]	Bias Estimate[(2)]
3-Apr-14	76.1	78.0	-2.4	13	-1.36	1.01	0.62	-3.34	1.39	-1.87
10-Apr-14	76.4	78.0	-2.1							
17-Apr-14	76.1	78.0	-2.4							
24-Apr-14	77.3	78.0	-0.9							
1-May-14	76.5	78.0	-1.9							
8-May-14	77.7	78.0	-0.4							
15-May-14	77.9	78.0	-0.1							
22-May-14	78.1	78.0	0.1							
29-May-14	75.9	78.0	-2.7							
5-Jun-14	77.6	78.0	-0.5							
12-Jun-14	76.6	78.0	-1.8							
19-Jun-14	77.7	78.0	-0.4							
26-Jun-14	76.3	78.0	-2.2							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-19: 3rd Quarter SO_2 Precision Statistics Summary

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Jul-14	77.3	78.0	-0.9	13	2.30	3.46	9.08	-4.48	4.77	+/-4.54
8-Jul-14	75.6	79.0	-4.3							
10-Jul-14	76.6	78.0	-1.8							
18-Jul-14	77.0	78.0	-1.3							
26-Jul-14	77.9	78.0	-0.1							
30-Jul-14	81.6	79.0	3.3							
7-Aug-14	82.5	78.0	5.8							
14-Aug-14	81.7	78.0	4.7							
21-Aug-14	81.7	78.0	4.7							
28-Aug-14	81.2	78.0	4.1							
4-Sep-14	82.5	78.0	5.8							
11-Sep-14	81.9	78.0	5.0							
18-Sep-14	81.8	78.0	4.9							
25-Sep-14[3]	-	-	-							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%
[3]No precision check due to calibrator communication issue.

Table 2-20: 4th Quarter SO_2 Precision Statistics Summary

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Oct-14	82.4	78.0	5.6	13	1.84	3.00	7.72	-4.04	4.14	+/-3.7
9-Oct-14	83.1	78.0	6.5							
16-Oct-14	82.3	78.0	5.5							
23-Oct-14	81.5	78.0	4.5							
30-Oct-14	81.6	78.0	4.6							
6-Nov-14	77.7	78.0	-0.4							
13-Nov-14	77.8	78.0	-0.3							
20-Nov-14	79.1	78.0	1.4							
27-Nov-14	77.3	78.0	-0.9							
4-Dec-14	77.6	78.0	-0.5							
11-Dec-14	77.5	78.0	-0.6							
18-Dec-14	77.1	78.0	-1.2							
25-Dec-14	77.6	78.0	-0.5							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-21: Network $PM_{2.5}$ Monitoring Precision

Period	Samplers	Number of Collocated Samples[1]	Concentration Levels	Average Percent Difference	Standard Deviation[2] (µg/m³)	Precision[3] (µg/m³)	Bias[4] (µg/m³)
1st Quarter (January 1 – March 31, 2014)	Primary FEM against Collocated FEM	55	≥2 µg/m³	-10.5%	0.88	0.44	0.89
		81	All	-55.1%	1.17	0.58	1.18
	Primary FEM against Collocated FRM	9	≥2 µg/m³	-20.8%	0.89	0.45	0.86
		11	All	-22.8%	2.49	1.25	1.69
2nd Quarter (April 1 – June 30, 2014)	Primary FEM against Collocated FEM	27	≥2 µg/m³	6.9%	1.17	0.58	1.00
		81	All	-0.2%	1.60	0.80	1.40
	Primary FEM against Collocated FRM	5	≥2 µg/m³	-21.2%	1.62	0.81	1.75
		14	All	-130.5%	1.80	0.90	2.65
3rd Quarter (July 1 – September 30, 2014)	Primary FEM against Collocated FEM	13	≥2 µg/m³	14.4%	1.14	0.57	1.95
		48	All	-86.3%	0.93	0.47	1.44
	Primary FEM against Collocated FRM	1	≥2 µg/m³	-14.7%	NA[5]	NA[5]	0.93
		12	All	-332.6%	3.61	1.81	4.47
4th Quarter (October 1 – December 31, 2014)	Primary FEM against Collocated FEM	45	≥2 µg/m³	-13.2%	3.46	1.73	3.10
		79	All	-26.2%	2.97	1.48	3.04
	Primary FEM against Collocated FRM	10	≥2 µg/m³	13.1%	1.67	0.83	1.43
		11	All	26.3%	1.81	0.90	1.69
Year to Date (January 1 – December 31, 2014)	Primary FEM against Collocated FEM	**140**	**≥2 µg/m³**	**-5.7%**	**2.34**	**1.17**	**1.72**
		289	All	-37.0%	2.05	1.02	1.79
	Primary FEM against Collocated FRM	**25**	**≥2 µg/m³**	**-7.0%**	**1.37**	**0.68**	**1.27**
		48	All	-120.4%	2.69	1.35	2.67

[1] $PM_{2.5}$ network precision statistics represent data from the Deadhorse monitoring station samplers.
[2] Standard deviation of the absolute concentration differences for the population.
[3] Standard deviation of the absolute concentration difference for the population divided by 2 with a goal of ≤ 3 µg/m³ per quarter.
[4] Average over the population of the absolute value of the individual pair concentration difference with a goal of ≤ 4 µg/m³ per quarter.
[5] Standard deviation and precision cannot be calculated from a single measurement.

2.4.2 ANALYTICAL LABORATORY PRECISION STATISTICS

Not applicable.

2.4.3 ANALYTICAL LABORATORY PRECISION STATISTICS FOR LEAD ANALYSIS OF PARTICULATE SAMPLES

Not applicable.

2.5 ACCURACY STATISTICS

The ambient air and meteorological monitoring systems are subjected to periodic calibrations and independent quality assurance performance audits. All calibration and audit equipment are documented as traceable to authoritative standards. The purpose of these calibration and audit checks is to challenge the monitoring systems with known inputs or collocate traceable authoritative standards with them to verify that each instrument response is accurate to within established tolerances.

Tables 2-22 through 2-39 summarize the accuracy statistics obtained during the project.

2.5.1 INSTRUMENT CALIBRATION STATISTICS

Single-point calibration verifications were performed on a daily basis on all gas pollutant analyzers throughout the monitoring year. The single-point calibration verifications consisted of challenging each instrument response with air scrubbed of all pollutants ("zero air") and air containing a National Institute of Standards and Technology (NIST) traceable standard gas concentration equal to 80 percent (span check) of the instrument's upper range limit (URL). If zero or span drift limits are exceeded, ambient measurements are invalidated back to the most recent point in time where such measurements were known to be valid. Single-point calibration verification data for each parameter are provided in Appendix C.

Multi-point calibrations were performed on a biannual basis as recommended by the EPA (EPA-454/R-98-004). Additionally, multi-point calibrations were conducted under specific circumstances including: indication of analyzer malfunction, repairs or service that affected its calibration, and following significant interruptions in station operations. Multi-point calibrations consisted of challenging each instrument response with air scrubbed of all pollutants ("zero air") and at least four concentrations spanning 80 to 90 percent of the URL. The NO_2 converter efficiency was determined following the guidelines provided in the 40 CFR 50 – Appendix F.

Tables 2-22 through 2-25 include calibration statistical summaries for CO, NO_2, O_3, and SO_2 analyzers, respectively. Tables 2-26 and 2-27 summarize the monthly quality control checks of the particulate samplers. These manual QC checks are conducted by SLR or on-site personnel and the data are transmitted to the SLR Anchorage office.

Meteorological calibration is assessed at least semi-annually. Each sensor is assessed by collocating calibration sensors of NIST-traceable accuracy. Calibration results are presented in

Tables 2-28 through 2-29. Refer to Appendix C for detailed calibration records for meteorological sensors.

If calibration checks reveal a sampler is operating outside of established quality control criteria, data is invalidated as far back as the most recently passed calibration. Refer to Section 2 for a discussion of any data that was invalidated due to failing accuracy.

The July 29, 2014 “As-found” calibration check for the low flow Mass Flow Controller (MFC) on the gas dilution calibrator was initially found to be out of acceptance limits but was later determined to be an invalid calibration check. The flow transfer standard used to record flow control accuracy was later found to have a small piece of Teflon lodged inside the device intermittently affecting flow measurement accuracy. Prior to the calibration, independent verification by the auditor suggested that the MFCs were operating within acceptable variance just prior to the questionable July 29, 2014 calibration. Further, the “As-left” calibration was later confirmed to be accurate without adjustment to the calibrator. Despite the apparent failure, data validity and quality were determined to be unaffected.

Table 2-22: Calibration Summary – CO

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
February 21, 2014	0.0	0.0	-	0.6	1.0000	-0.0334	0.99998	Pass
	8.0	7.9	-1.2					
	17.5	17.4	-0.7					
	30.0	30.2	0.6					
	40.0	39.9	-0.2					
	45.0	44.9	-0.2					
February 28, 2014	0.0	0.0	-	2.4	0.9817	-0.0730	0.99997	Pass
	8.0	7.7	-3.7					
	17.5	17.0	-3.0					
	30.0	29.6	-1.4					
	40.1	39.3	-1.9					
	45.0	44.0	-2.2					
April 23, 2014	0.0	0.2	-	0.8	1.0021	0.1473	0.99998	Pass
	8.0	8.1	1.3					
	17.5	17.6	0.5					
	30.0	30.4	1.3					
	40.0	40.2	0.4					
	45.0	45.2	0.5					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

Table 2-22 Continued: Calibration Summary – CO

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
May 17, 2014	0.0	0.1	-	1.4	0.9879	0.0220	0.99997	Pass
	8.0	7.8	-2.3					
	17.5	17.2	-1.6					
	30.0	29.9	-0.4					
	40.0	39.6	-1.1					
	45.0	44.4	-1.4					
July 29, 2014	0.0	0.1	-	0.4	0.9964	0.0804	0.99998	Pass
	8.0	8.0	-0.1					
	17.5	17.4	-0.3					
	30.0	30.2	0.7					
	40.0	39.9	-0.2					
	45.0	44.8	-0.4					
September 29, 2014	0.0	0.0	-	1.3	1.0007	0.1585	0.99996	Pass
	8.0	8.3	3.9					
	17.5	17.6	0.6					
	30.0	30.4	1.4					
	39.9	40.1	0.4					
	44.9	45.0	0.1					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. R^2 ≥ 0.9955
4. Y-intercept ≤ ±2% of full scale

Table 2-22 Continued: Calibration Summary – CO

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[(1)]
October 30, 2014	0.0	0.2	-	0.4	0.9956	0.0577	0.99996	Pass
	8.0	8.0	0.0					
	17.5	17.3	-1.0					
	30.0	30.0	-0.1					
	40.0	39.7	-0.8					
	45.0	45.1	0.2					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. R^2 ≥ 0.9955
4. Y-intercept ≤ ±2% of full scale

Table 2-23: Calibration Summary – NO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Converter Efficiency	Pass/Fail[1]
February 28, 2014	0	0	-	2.8	0.9666	0.0007	1.00000	99.8%	Pass
	81	80	-1.5						
	194	189	-2.9						
	315	306	-3.0						
	402	389	-3.2						
	429	415	-3.2						
April 23, 2014	0	0	-	1.9	0.9801	-0.0001	0.99998	100.2%	Pass
	82	81	-0.9						
	197	192	-2.6						
	317	309	-2.5						
	402	395	-1.7						
	430	421	-1.9						
May 17, 2014	0	0	-	2.3	0.9745	0.0002	0.99999	99.8%	Pass
	80	79	-1.2						
	193	188	-2.6						
	314	305	-2.7						
	400	389	-2.7						
	428	419	-2.2						

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale
5. Converter efficiency ≥ 96.0%

Table 2-23 Continued: Calibration Summary – NO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Converter Efficiency	Pass/Fail[(1)]
July 29, 2014	0	0	-	0.5	0.9955	0.0001	0.99999	100.3%	Pass
	84	83	-1.0						
	195	195	0.1						
	314	313	-0.2						
	402	400	-0.4						
	432	429	-0.6						
October 30, 2014	0	0	-	3.8	0.9617	0.0000	0.99999	100.5%	Pass
	83	81	-3.2						
	199	191	-3.9						
	320	306	-4.4						
	408	393	-3.7						
	436	420	-3.7						

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale
5. Converter efficiency ≥ 96.0%

Table 2-24: Calibration Summary – O_3

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
February 28, 2014	-0.001	0.000	-	2.1	1.0202	0.0005	0.99999	Pass
	0.079	0.080	1.3					
	0.175	0.179	2.5					
	0.299	0.305	2.1					
	0.398	0.408	2.4					
	0.449	0.458	2.0					
April 23, 2014	0.000	0.001	-	0.9	1.0125	-0.0003	0.99999	Pass
	0.080	0.081	0.6					
	0.175	0.176	0.7					
	0.300	0.303	0.8					
	0.399	0.404	1.2					
	0.449	0.455	1.4					
May 17, 2014	0.000	0.000	-	1.2	1.0150	-0.0025	0.99996	Pass
	0.081	0.079	-2.9					
	0.175	0.174	-0.6					
	0.300	0.301	0.0					
	0.399	0.404	1.2					
	0.450	0.455	1.1					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±7%
2. Slope ≥ 0.93 and ≤ 1.07
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

Table 2-24 Continued: Calibration Summary – O_3

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
July 29, 2014	0.000	0.001	-	1.2	1.0034	0.0015	0.99998	Pass
	0.080	0.082	1.9					
	0.175	0.177	1.5					
	0.300	0.304	1.2					
	0.399	0.403	0.9					
	0.450	0.451	0.3					
October 30, 2014	0.000	-0.001	-	0.7	0.9959	-0.0006	0.99996	Pass
	0.081	0.080	-1.2					
	0.177	0.176	-0.6					
	0.303	0.303	-0.1					
	0.404	0.399	-1.2					
	0.454	0.453	-0.4					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±7%
2. Slope ≥ 0.93 and ≤ 1.07
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

Table 2-25: Calibration Summary – SO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
February 21, 2014	0.0	0.0	-	0.8	0.9967	-0.0006	0.99999	Pass
	77.9	76.9	-1.3					
	170.7	169.0	-1.0					
	292.6	291.0	-0.6					
	389.8	386.7	-0.8					
	438.5	437.8	-0.2					
February 28, 2014	0.0	0.5	-	2.6	0.9726	0.0004	0.99999	Pass
	78.0	75.6	-3.0					
	170.8	166.9	-2.3					
	292.7	285.7	-2.4					
	390.5	378.7	-3.0					
	438.7	427.8	-2.5					
April 23, 2014	0.0	0.6	-	1.6	0.9901	-0.0004	0.99998	Pass
	77.9	75.1	-3.6					
	170.7	169.0	-1.0					
	292.6	290.1	-0.8					
	390.1	384.5	-1.4					
	438.4	434.5	-0.9					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

Table 2-25 Continued: Calibration Summary – SO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
May 17, 2014	0.0	-0.1	-	1.5	0.9935	-0.0013	0.99996	Pass
	77.9	75.9	-2.5					
	170.6	167.5	-1.8					
	292.2	286.5	-1.9					
	390.4	388.0	-0.6					
	438.9	435.4	-0.8					
July 29, 2014	0.0	-0.1	-	0.5	0.9944	0.0001	0.99998	Pass
	77.9	77.7	-0.2					
	170.5	169.5	-0.6					
	292.7	293.0	0.1					
	389.5	387.0	-0.7					
	438.2	435.0	-0.7					
September 29, 2014	0.0	-0.2	-	1.6	1.0085	0.0007	0.99998	Pass
	77.8	80.9	3.9					
	170.5	172.4	1.1					
	292.4	294.3	0.7					
	389.2	393.5	1.1					
	438.1	442.9	1.1					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

Table 2-25 Continued: Calibration Summary – SO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[(1)]
October 30, 2014	0.0	-0.1	-	1.7	0.9832	0.0001	0.99995	Pass
	78.1	76.2	-2.4					
	170.8	168.9	-1.1					
	292.3	289.0	-1.1					
	390.0	380.6	-2.4					
	438.8	432.9	-1.4					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. R^2 ≥ 0.9955
4. Y-intercept ≤ ±2% of full scale

Table 2-26: Quality Control Checks $PM_{2.5}$

Date	Ambient Temperature[1] (˚C)			Barometric Pressure[2] (mmHg)			Time (hh:mm:ss)			Flow Rate[3] (L/min)		
	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff
1-Jan-14	-16.0	-15.5	-0.5	748	746	2	16:11:00	16:09:00	00:02:00	16.6	16.70	-0.6%
1-Feb-14	-7.2	-6.4	-0.8	767	770	-3	11:29:45	11:27:42	00:02:03	16.7	16.60	0.6%
12-Mar-14	-23.8	-24.2	0.4	744	744	0	11:04:00	11:02:00	00:02:00	16.7	16.72	-0.1%
23-Apr-14	-10.0	-9.6	-0.4	755	758	-3	11:55:00	11:56:23	-00:01:23	16.7	16.69	0.1%
17-May-14	2.7	3.4	-0.7	753	757	-4	09:12:25	09:14:00	-00:01:35	16.7	16.50	1.2%
4-Jun-14	3.3	3.5	-0.2	764	764	0	10:27:30	10:27:12	00:00:18	16.7	16.70	0.0%
29-Jul-14[4]	4.2	4.0	0.2	770	770	0	17:40:00	17:40:00	00:00:00	16.7	16.80	-0.6%
21-Aug-14	7.3	7.9	-0.6	765	765	0	10:10:30	10:11:00	-00:00:30	16.7	16.85	-0.9%
15-Sep-14	3.1	3.5	-0.4	752	752	0	17:01:59	17:00:20	00:01:39	16.7	16.90	-1.2%
10-Oct-14	-8.6	-7.6	-1.0	760	760	0	16:14:00	16:12:58	00:01:02	16.7	16.80	-0.6%
19-Nov-14	-4.7	-4.9	0.2	752	752	0	14:30:00	14:28:00	00:02:00	16.7	16.90	-1.2%
11-Dec-14	-26.6	-27	0.4	758	757	1	07:48:00	07:49:00	-01:00:00	16.7	16.80	-0.6%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] QC check and multipoint calibration performed; the multipoint form and results are included in Appendix C.

Table 2-27: Quality Control Checks PM_{10}

Date	Ambient Temperature[1] (˚C)			Barometric Pressure[2] (mmHg)			Time (hh:mm:ss)			Flow Rate[3] (L/min)		
	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff
1-Jan-14	-16.0	-15.3	-0.7	754	748	6	16:10:30	16:08:19	00:02:11	16.6	16.60	0.0%
1-Feb-14	-7.2	-6.5	-0.7	774	770	4	11:30:10	11:26:57	00:03:13	16.6	16.60	0.0%
12-Mar-14	-24.2	-24.2	0.0	744	744	0	11:03:30	11:02:00	00:01:30	16.7	16.80	-0.6%
23-Apr-14	-9.6	-9.9	0.3	758	756	2	11:55:00	11:56:02	-00:01:02	16.6	16.73	-0.8%
17-May-14	2.7	3.5	-0.8	754	757	-3	09:14:01	09:15:00	-00:00:59	16.6	16.70	-0.6%
4-Jun-14	3.6	3.5	0.1	764	767	-3	10:30:25	10:27:49	00:02:36	16.7	16.50	1.2%
29-Jul-14[4] (as-found)	5.0	8.5	**-3.5**[5]	770	770	0	16:35:00	16:35:00	00:00:00	16.7	16.50	1.2%
29-Jul-14 (as-left)	4.0	4.0	0.0	770	770	0	19:02:00	19:02:00	00:00:00	16.7	16.70	0.0%
21-Aug-14	7.0	7.6	-0.6	765	765	0	09:55:30	09:56:00	-00:00:30	16.7	16.80	-0.6%
15-Sep-14	3.2	3.5	-0.3	752	752	0	17:01:58	16:59:58	00:02:00	16.7	16.74	-0.2%
30-Oct-14	-8.4	-7.6	-0.8	759	760	-1	16:14:32	16:12:58	00:01:34	16.7	16.72	-0.1%
19-Nov-14	-5.6	-5.0	-0.6	752	752	0	14:32:00	14:30:00	00:02:00	16.7	16.70	0.0%
11-Dec-14	-27.5	-27.0	-0.5	757	757	0	07:41:00	07:40:00	00:01:00	16.7	16.8	-0.6%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] QC check and multipoint calibration performed; the multipoint form and results are included in Appendix B
[5] This is not a critical criterion for data validation. The temperature sensor was replaced and an as-left QC check was performed to verify performance. Given that the sampler flow control was within acceptable limits data were determined to be unaffected by the apparent failure.

Table 2-28: May 17, 2014 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Time	≤ ±05:00	mm:ss	00:45	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.24	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.17	Pass
Air Temperature Difference	≤ ±0.10	°C	0.07	Pass
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	0.2	Pass
Wind Direction Alignment	≤ ±5	Degree	-1.9	Pass
Wind Direction Accuracy	≤ ±5	Degree	-3.6	Pass
Wind Direction Linearity	≤ ±3	Degree	-2.4	Pass
Wind Direction Torque	≤ 11.0	g-cm	7.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.17	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±10	W/m^2	4.1	Pass

Table 2-29: October 30, 2014 Meteorological Calibration Summary

Parameter	Limit	Units	Error	Status
Time	≤ ±5	mm:ss	00:20	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.46	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.39	Pass
Air Temperature Difference	≤ ±0.10	°C	0.07	Pass
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	0.10	Pass
Wind Direction Alignment	≤ ±5	Degree	2.40	Pass
Wind Direction Accuracy	≤ ±5	Degree	1.90	Pass
Wind Direction Linearity	≤ ±3	Degree	-1.4	Pass
Wind Direction Torque	≤ 11.0	g-cm	9.00	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.21	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±10	W/m^2	0.3	Pass

2.5.2 INDEPENDENT QUALITY ASSURANCE AUDITS

Gas analyzer performance audits involve challenging the analyzer with known concentrations of pollutants. For each concentration challenge, the difference between the audit gas concentration and analyzer response is assessed and compared to PSD limits. Results of the gas analyzer audits conducted during the monitoring year are presented in Tables 2-30 to 2-33.

The gas analyzers performance audit acceptance criterion for an individual analyzer is that the mean absolute difference between the audit gas concentration and analyzer response is equal to or less than 15 percent for CO, NO_2, and SO_2 and equal to or less than 10 percent for O_3.

The performance audits of $PM_{2.5}$ and PM_{10} samplers challenge the flow rate of the monitors against independent instruments that are calibrated and traceable to National Institute of Standards and Technology (NIST) transfer standards. Audits of the $PM_{2.5}$ and PM_{10} samplers are conducted using an audit orifice transfer standard (BGI Delta Cal or equivalent). Results of the PM sampler audits are presented in Tables 2-34 and 2-35.

Meteorological performance audits involve challenging the sensors with known inputs or by using calibrated instruments collocated with the sensor. For each reading, the difference between the station value and the expected value is compared with established PSD limits to assess the accuracy of the sensor. Results of the meteorological audits conducted throughout the monitoring year are presented in Tables 2-36 to 2-37.

AMS Tech LLC completed performance audits on all station monitors. All meteorological sensors and ambient air analyzers were found to be operating within acceptable criteria throughout the monitoring year. Complete performance audit findings and details are provided in Appendix C.

In order to satisfy the $PM_{2.5}$ Performance Evaluation Program (PEP) audit requirements specified in Title 40 CFR Part 58, Appendix A, Section 3.2.7, the Nuiqsut station is associated with the ConocoPhillips North Slope air monitoring network. Within that network, special $PM_{2.5}$ quality assurance requirements such as $PM_{2.5}$ collocation sampling and PEP audits are satisfied at an alternate location. During the 2014 monitoring year this audit occurred at the Deadhorse monitoring station. This “PEP-like” audit is designed to satisfy the intent of the requirements to obtain an independent assessment of system bias and is a comparable program to that of the PEP audit program. Results of the PEP audit are summarized in Table 2-38 and the full audit report is available in Appendix C.

EPA recommends that a technical systems audit (TSA) be conducted to serve as a qualitative review of all aspects of a monitoring program. The systems audit includes a review of the program plan, station site, facilities, equipment, personnel, procedures, record keeping, data validation and data reporting. An annual TSA was performed in November 2014 at the Nuiqsut monitoring station. The audit indicated that the monitoring project is staffed with experienced personnel with a defined organization, and that the station is well-planned and properly sited according to criteria recommended by the EPA. Appendix C contains the complete technical systems audit report.

Table 2-30: Performance Audit Summary – CO

Period	Audit Point	Audit Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail[(1)]
						Slope	Y-Intercept	R^2	
February 28, 2014	0	0.00	0.01	-	2.1	1.0231	-0.011	1.0000	Pass
	1	2.07	2.12	2.4					
	2	6.89	6.99	1.5					
	3	21.99	22.50	2.3					
May 17, 2014	0	0.00	0.01	-	0.8	1.0033	0.012	1.0000	Pass
	1	2.04	2.08	2.0					
	2	6.89	6.90	0.1					
	3	22.11	22.20	0.4					
July 23, 2014	0	0.00	0.01	-	5.1	1.0341	0.052	1.0000	Pass
	1	2.03	2.17	6.9					
	2	6.75	7.07	4.7					
	3	21.72	22.50	3.6					
October 30, 2014	0	0.00	0.01	-	2.6	1.0111	0.043	1.0000	Pass
	1	2.08	2.18	4.8					
	2	6.77	6.89	1.8					
	3	21.72	22.00	1.3					

[1]Acceptance criteria: Measured and audit point difference ≤ ±15%

Table 2-31: Performance Audit Summary – NO_2

Period	Audit Point	Audit Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Converter Efficiency	Pass/Fail[(1)]
						Slope	Y-Intercept	R^2		
February 28, 2014	0	0	0	-	2.6	0.9665	0.369	1.0000	99.6%	Pass
	1	50	49	-2.0						
	2	76	74	-2.6						
	3	246	238	-3.3						
May 17, 2014	0	0	0	-	4.0	0.9593	0.035	1.0000	100.0%	Pass
	1	67	65	-3.0						
	2	82	78	-4.9						
	3	272	261	-4.0						
July 23, 2014	0	0	0	-	0.9	1.0164	-0.384	1.0000	100.0%	Pass
	1	53	53	0.0						
	2	84	85	1.2						
	3	261	265	1.5						
October 30, 2014	0	0	0	-	6.5	0.9320	0.145	1.0000	100.0%	Pass
	1	46	43	-6.5						
	2	79	74	-6.3						
	3	251	234	-6.8						

[1]Acceptance criteria: Measured and audit point difference ≤ ±15%

Table 2-32: Performance Audit Summary – O_3

Period	Audit Point	Audit Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail[(1)]
						Slope	Y-Intercept	R^2	
February 28, 2014	0	0.000	0.000	-	1.2	0.9819	-0.034	1.0000	Pass
	1	0.032	0.032	0.0					
	2	0.075	0.073	-2.7					
	3	0.149	0.146	-1.9					
	4	0.392	0.385	-1.8					
May 17, 2014	0	0.000	0.000	-	0.2	1.0052	-0.289	1.0000	Pass
	1	0.031	0.031	0.0					
	2	0.078	0.078	0.0					
	3	0.152	0.152	0.0					
	4	0.400	0.402	0.5					
July 23, 2014	0	0.000	0.001	-	1.6	1.0280	-0.430	1.0000	Pass
	1	0.032	0.032	0.0					
	2	0.076	0.077	1.3					
	3	0.148	0.151	2.0					
	4	0.393	0.404	2.8					
October 30, 2014	0	0.000	0.001	-	2.0	1.0097	0.530	1.0000	Pass
	1	0.033	0.032	-3.0					
	2	0.076	0.078	2.6					
	3	0.151	0.154	2.0					
	4	0.398	0.402	1.0					

[1]Acceptance criteria: Measured and audit point difference ≤ ±10%

Table 2-33: Performance Audit Summary – SO_2

Period	Audit Point	Audit Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail[(1)]
						Slope	Y-Intercept	R^2	
February 28, 2014	0	0	1	-	0.9	0.9898	0.458	1.0000	Pass
	1	50	49	-2.0					
	2	75	75	0.0					
	3	250	248	-0.8					
May 17, 2014	0	0	1	-	1.3	0.9534	2.084	0.9999	Pass
	1	48	48	0.0					
	2	74	74	0.0					
	3	250	240	-4.0					
July 23, 2014	0	0	1	-	0.3	1.0063	0.187	1.0000	Pass
	1	36	36	0.0					
	2	74	74	0.0					
	3	245	247	0.8					
October 30, 2014	0	0	1	-	3.8	0.9658	0.302	1.0000	Pass
	1	37	35	-5.4					
	2	75	73	-2.7					
	3	245	237	-3.3					

[1]Acceptance criteria: Measured and audit point difference ≤ ±15%

Table 2-34: Performance Audit Summary – $PM_{2.5}$

Period	External Leak Check Error (LPM)	Ambient Temperature Error (°C)	Ambient Pressure Error (mmHg)	Flow Rate		Pass/Fail[(1)]
				Flow Rate Accuracy Percent Error (%)	Design Flow Test Percent Error (%)	
February 28, 2014	0.2	-0.4	-3	0.6	-0.6	Pass
May 17, 2014	0.0	0.3	1	-0.6	0.6	Pass
July 23, 2014	0.0	0.2	1	0.6	-0.6	Pass
October 30, 2014	0.0	0.8	1	0.0	0.0	Pass

[1] Acceptance criteria:
1. Leak check ≤ ±1.0 LPM
2. Temperature ≤ ±2.0 °C
3. Pressure ≤ ± 10 mmHg
4. Flow rate error ≤ ± 4% audit standard
5. Design flow test ≤ ± 5% design flow rate

Table 2-35: Performance Audit Summary – PM_{10}

Period	External Leak Check Error (LPM)	Ambient Temperature Error (°C)	Ambient Pressure Error (mmHg)	Flow Rate		Pass/Fail[(1)]
				Flow Rate Accuracy Percent Error (%)	Design Flow Test Percent Error (%)	
February 28, 2014	0.2	-0.3	5	-0.6	0.6	Pass
May 17, 2014	0.1	0.5	0	-1.2	1.2	Pass
July 23, 2014	0.0	-0.1	1	2.5	-2.4	Pass
October 30, 2014	0.4	-0.1	0	-0.6	0.6	Pass

[1] Acceptance criteria:
1. Leak check ≤ ±1.0 LPM
2. Temperature ≤ ±2.0 °C
3. Pressure ≤ ± 10 mmHg
4. Flow rate error ≤ ± 4% audit standard
5. Design flow test ≤ ± 5% design flow rate

Table 2-36: May 17, 2014 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 0.5	m/s	0.16	Pass
Wind Direction Accuracy	≤ ±5	Degree	-2	Pass
Wind Direction Linearity	≤ ±3	Degree	1	Pass
Wind Direction Torque	≤ 0.5	m/s	0.37	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	-0.12	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.14	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.09	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.07	Pass
Air Temperature Difference	≤ ±0.10	°C	0.05	Pass
Solar Radiation Accuracy ≤ 200 W/m^2	≤ ±10	W/m^2	4.7	Pass

Table 2-37: October 30, 2014 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 0.5	m/s	0.16	Pass
Wind Direction Accuracy	≤ ±5	Degree	2	Pass
Wind Direction Linearity	≤ ±3	Degree	2	Pass
Wind Direction Torque	≤ 0.5	m/s	0.37	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.05	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.14	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.11	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.07	Pass
Air Temperature Difference	≤ ±0.10	°C	0.07	Pass
Solar Radiation Accuracy < 200 W/m^2	≤ ±10	W/m^2	1.0	Pass

Table 2-38: $PM_{2.5}$ PEP Audit Results

Date	PEP Audit Results ($\mu g/m^3$)	BAM 1020 Results ($\mu g/m^3$)	Difference ($\mu g/m^3$)	Bias[1] ($\mu g/m^3$)
15-Aug-2014	2.92	0.50	-2.42	
16-Aug-2014	5.55	3.00	-2.55	
17-Aug-2014	3.39	2.00	-1.99	-2.15
18-Aug-2014	3.72	2.20	-1.52	
19-Aug-2014	2.29	0.00	-2.29	

[1] Average over the population of the absolute value of the individual pair concentration differences with a goal of ≤ 4 $\mu g/m^3$ per quarter.

3. MONITORING DATA NETWORK SUMMARY

3.1 AIR QUALITY DATA SUMMARY

Table 3-1 provides quarterly and annual averages of the criteria pollutant concentrations measured from January 1, 2013, through December 31, 2013, and compared to national and Alaska air quality standards (NAAQS/AAAQS). The highest and second highest critical pollutant concentrations are also provided in Table 3-1 and compared to the respective primary and secondary air quality standards. Figures 3-1 through 3-9 provide plots of annual averages of the criteria pollutant concentrations at the Nuiqsut station along with respective NAAQS/AAAQS standards for comparison.

Table 3-1: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Carbon Monoxide (**CO**)	35 ppm (40,000 µg/m^3)	1-Hour(1)	1st Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
			2nd Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour(1)	1st Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	1	0	1	**1**	**11.1%**
Nitrogen Dioxide (**NO_2**)	100.0 ppb (190 µg/m^3)	1-Hour(2)	Daily Max 1-Hour Averages (98th Percentile)	-	-	-	-	**12.1**	**12.1%**
			1st Highest, 1-Hour Average	44.8	24.2	13.1	25.0	**44.8**	**44.8%**
			2nd Highest, 1-Hour Average	35.9	22.7	8.4	24.3	**35.9**	**35.9%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	4	2	1	1	**2**	**3.8%**
Ozone (**O_3**)	0.075 ppm (150 µg/m^3)	8-Hour(3)	4th Highest, 8-Hour Average	0.045	0.052	0.031	0.041	**0.052**	**79.3%**
			1st Highest, 8-Hour Average	0.050	0.054	0.032	0.042	**0.054**	**72.0%**
			2nd Highest, 8-Hour Average	0.046	0.053	0.031	0.042	**0.053**	**70.7%**

[1] Not to be exceeded more than once each year.
[2] To attain this standard, the 3-year average of the 98th percentile of the annual daily maximum 1-hour average must not exceed 100 ppb. The 1-hour daily standard is a federal standard (NAAQS), but has not been incorporated into the Alaska Ambient Air Quality Standards (AAAQS) yet.
[3] To attain this standard, the 3-year average of the annual fourth-highest daily maximum 8-hour average must not exceed 0.075 ppm.

Table 3-1 Continued: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Sulfur Dioxide (SO_2)	75.0 ppb (196 μg/m^3)	1-Hour[4]	Daily Max 1-Hour Averages (99th Percentile)	-	-	-	-	**1.1**	**1.5%**
			1st Highest, 1-Hour Average	2.7	1.2	1.0	0.4	**2.7**	**3.6%**
			2nd Highest, 1-Hour Average	2.6	1.2	0.9	0.4	**2.6**	**3.4%**
	500.0 ppb (1,300 μg/m^3)	3-Hour[5]	1st Highest, 3-Hour Average	2.6	1.1	0.8	0.3	**2.6**	**0.5%**
			2nd Highest, 3-Hour Average	2.2	1.0	0.8	0.2	**2.2**	**0.4%**
	140.0 ppb (365 μg/m^3)	24-Hour[5]	1st Highest, 24-Hour Average	1.8	1.0	0.7	0.2	**1.8**	**1.3%**
			2nd Highest, 24-Hour Average	1.8	1.0	0.7	0.2	**1.7**	**1.2%**
	30.0 ppb (80 μg/m^3)	Annual	Average of Period	0.3	0.4	0.0	-0.1	**-0.1**	**-0.3%**

[4] To attain this standard, the 3-year average of the 99th percentile of the annual daily maximum 1-hour average must not exceed 75.0 ppb.
[5] Not to be exceeded more than once each year.

Table 3-1 Continued: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Particulate Matter <2.5 microns (**$PM_{2.5}$**)	35 μg/m^3	24-Hour[6]	98th Percentile, 24-Hour Average	7	4	4	6	**6**	**17.1%**
			1st Highest, 24-Hour Average	8	7	4	6	**8**	**22.8%**
			2nd Highest, 24-Hour Average	7	4	4	6	**7**	**20.0%**
	15.0 μg/m^3	Annual[7,8]	Average of Period	2.4	1.9	1.2	2.7	**2.1**	**14.0%**
Particulate Matter <10 microns (**PM_{10}**)	150 μg/m^3	24-Hour[9,10]	1st Highest, 24-Hour Average	20	40	70	10	**70**	**46.7%**
			2nd Highest, 24-Hour Average	20	20	70	10	**70**	**46.7%**

[6] To attain this standard, the 3-year average of the 98th percentile of the 24-hour concentration must not exceed 35.0 μg/m^3.
[7] The AAAQS for $PM_{2.5}$ annual average is 15.0 μg/m^3, while the NAAQS for $PM_{2.5}$ annual average is 12.0 μg/m^3. Summary statistics are provided for the AAAQS.
[8] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 15.0 μg/m^3.
[9] Not to be exceeded more than once per year on average over three years.
[10] 40 CFR Appendix K requires that reportable concentrations of PM_{10} be rounded to the nearest 10 μg/m^3; actual measurement results are within Appendix C.

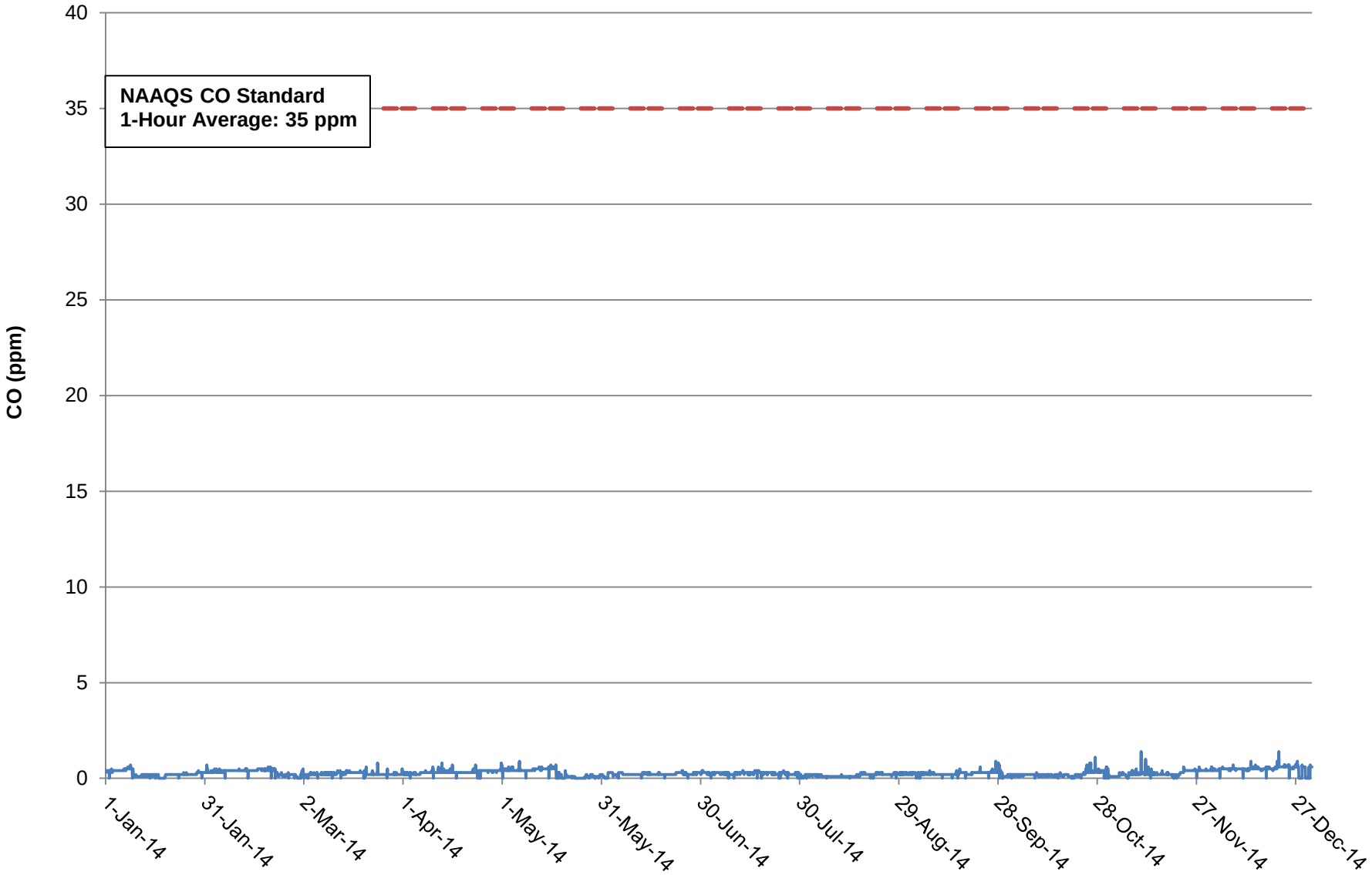


Figure 3-1: 1-Hour Average CO and NAAQS/AAAQS Standard

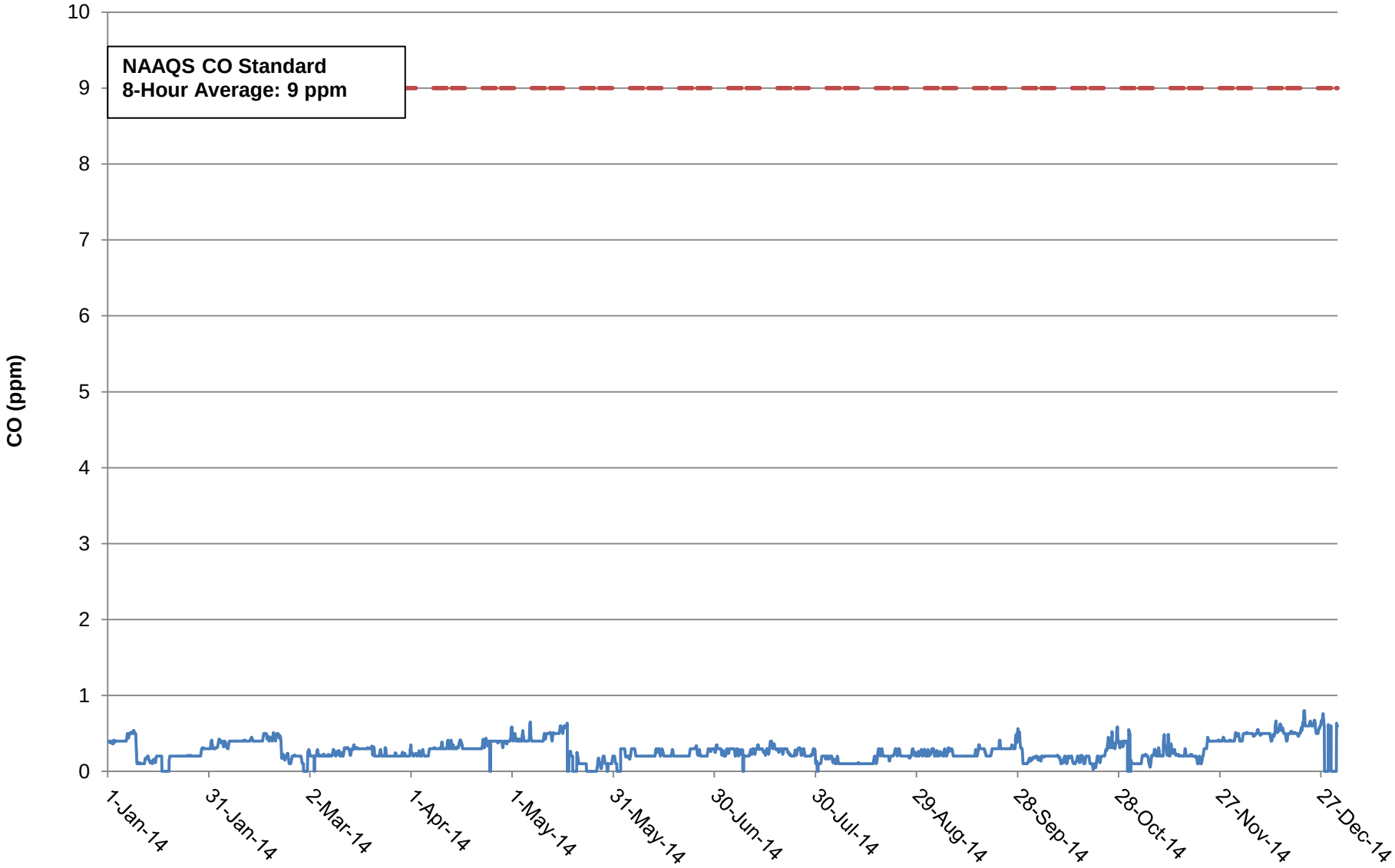


Figure 3-2: 8-Hour Average CO and NAAQS/AAAQS Standard

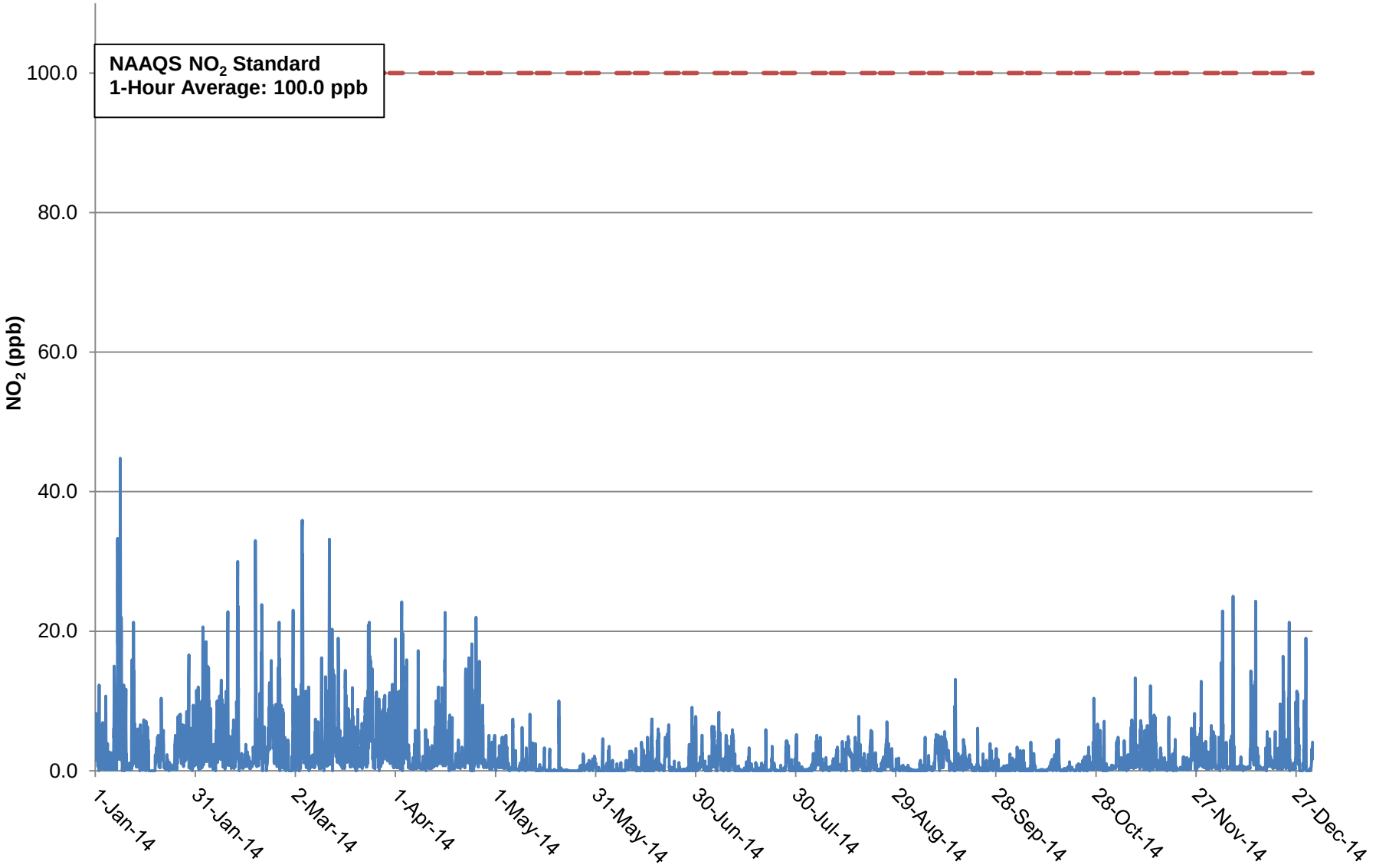


Figure 3-3: 1-Hour Average NO_2 and NAAQS Standard

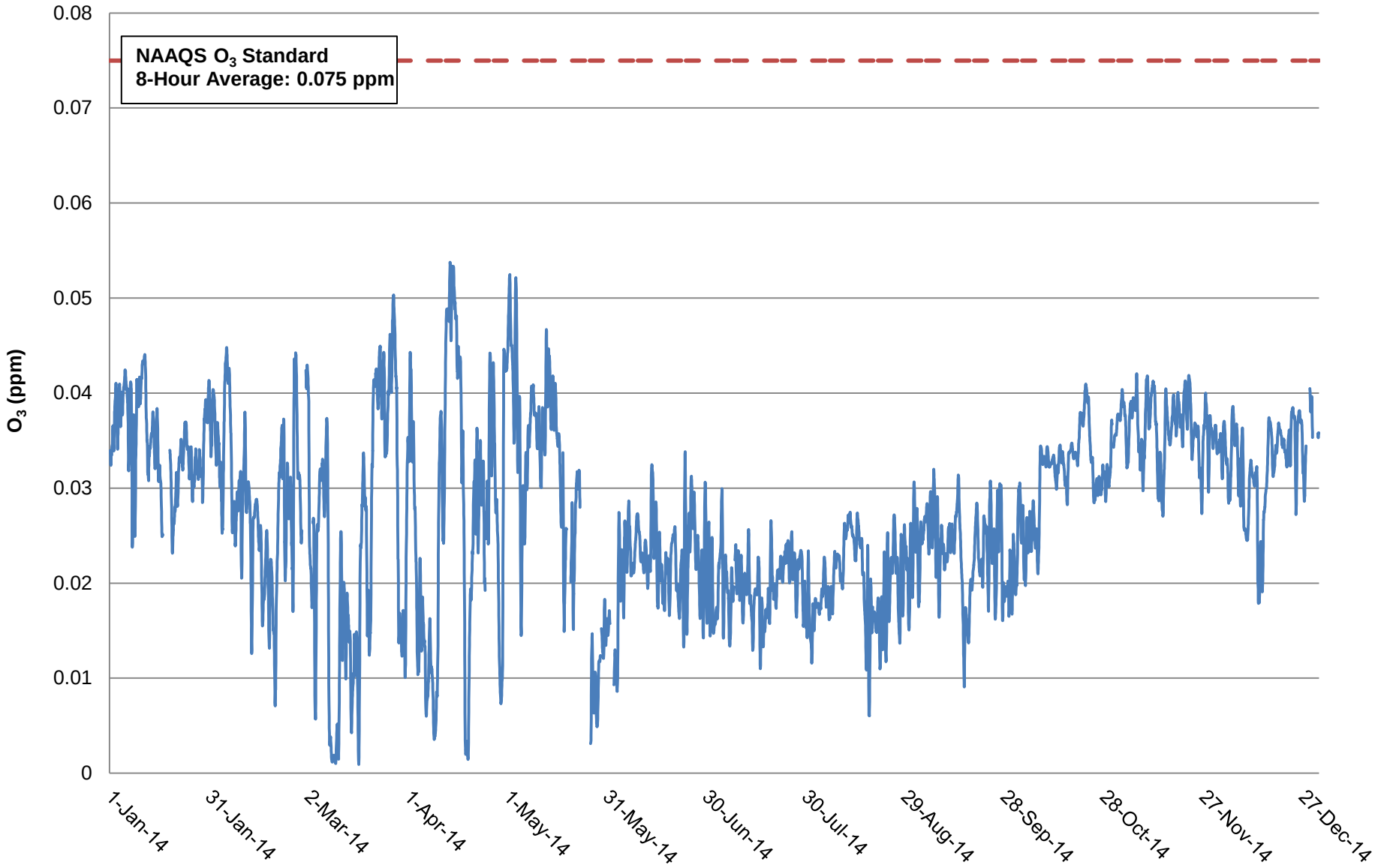


Figure 3-4: 8-Hour Average O_3 and NAAQS/AAAQS Standard

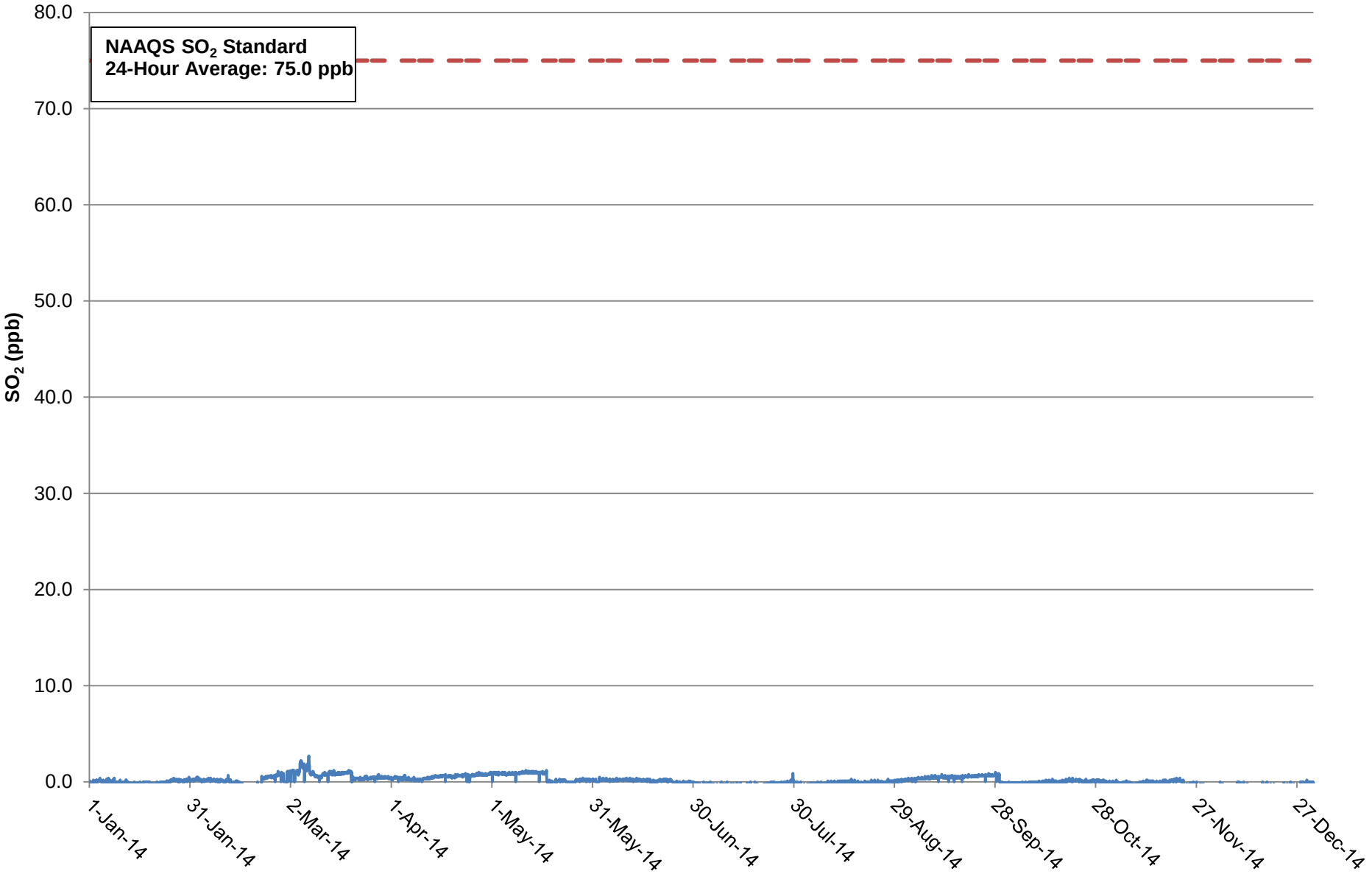


Figure 3-5: 1-Hour Average SO_2 and NAAQS/AAAQS Standard

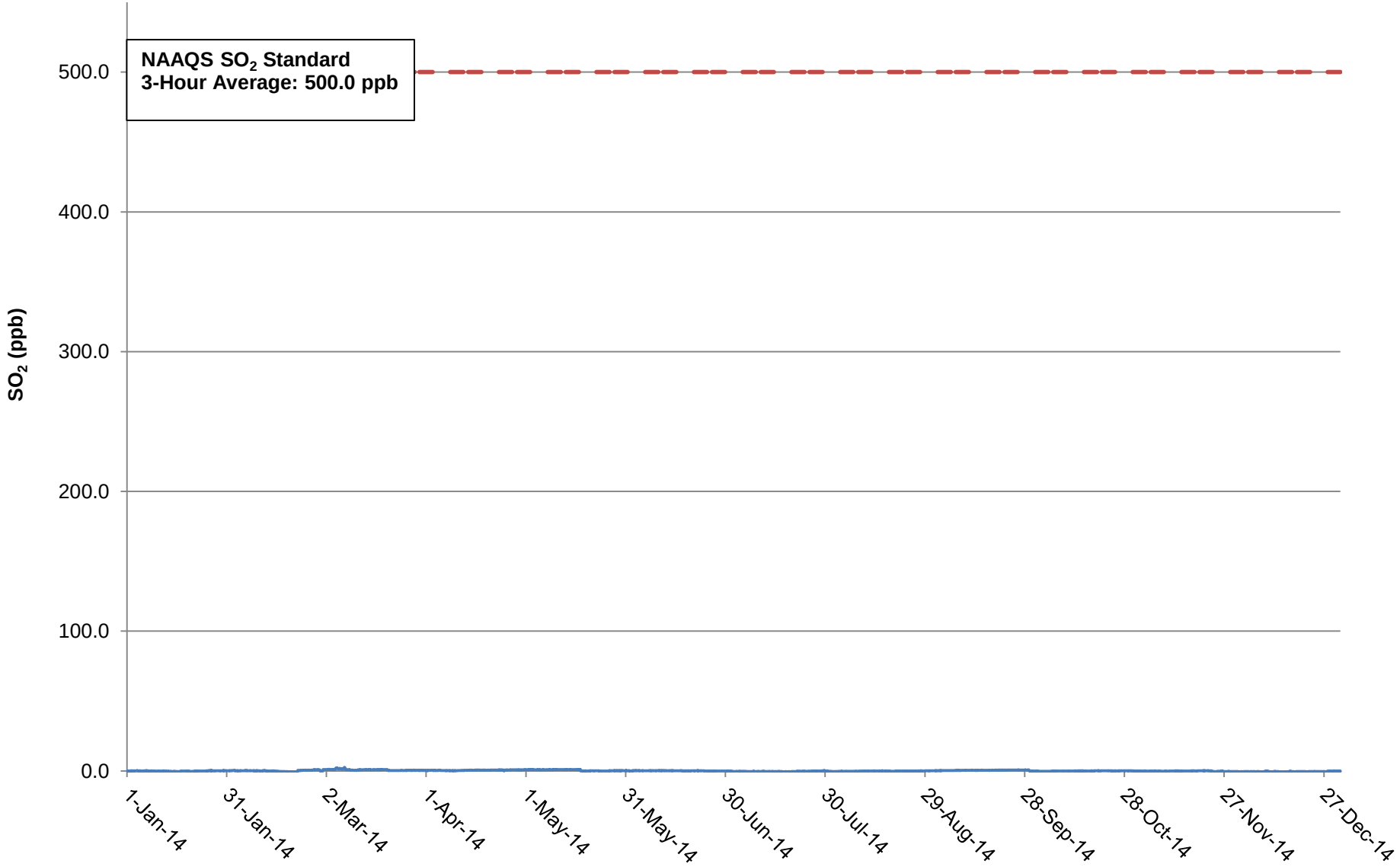


Figure 3-6: 3-Hour Average SO_2 and NAAQS/AAAQS Standard

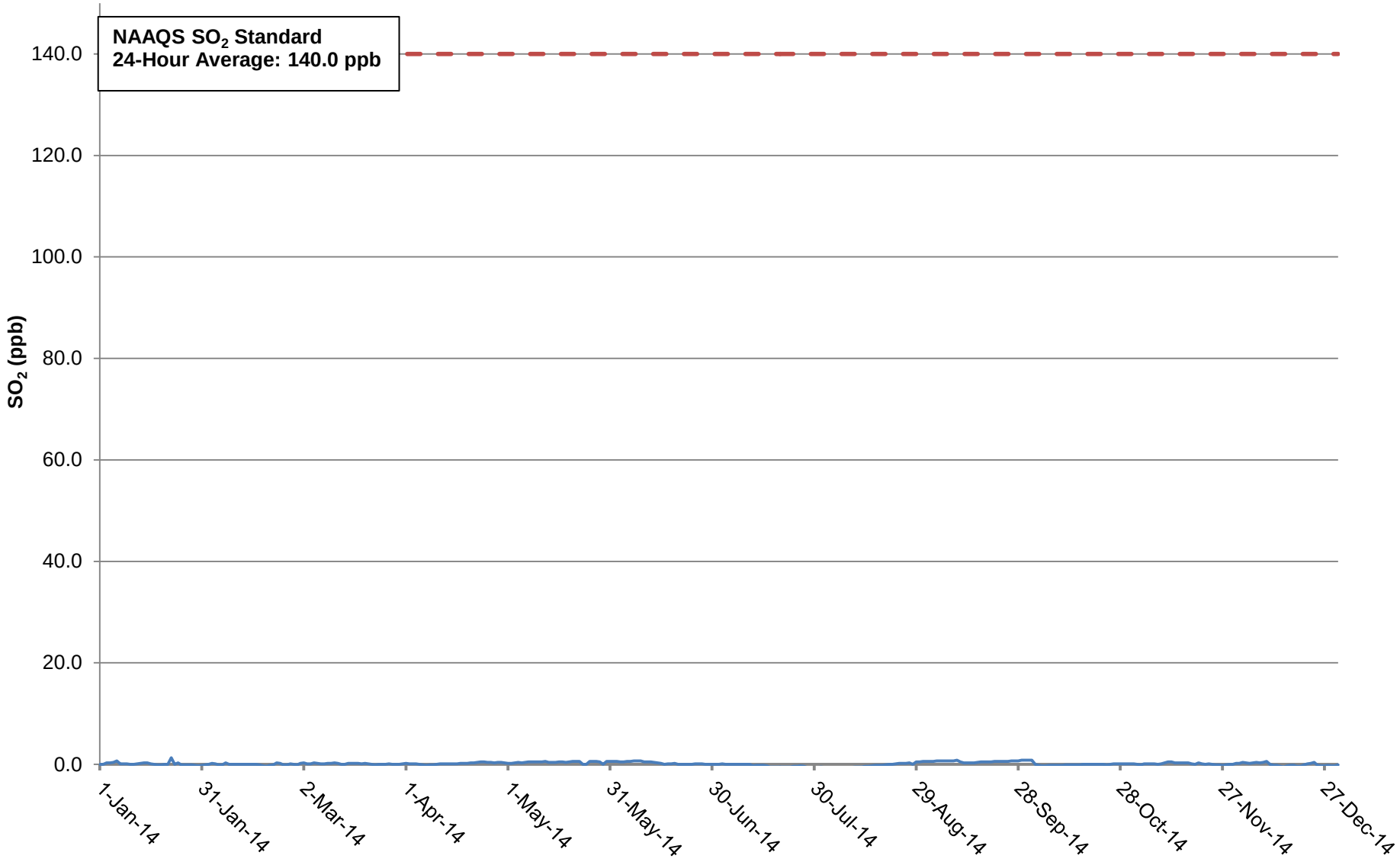


Figure 3-7: 24-Hour Average SO_2 and NAAQS/AAAQS Standard

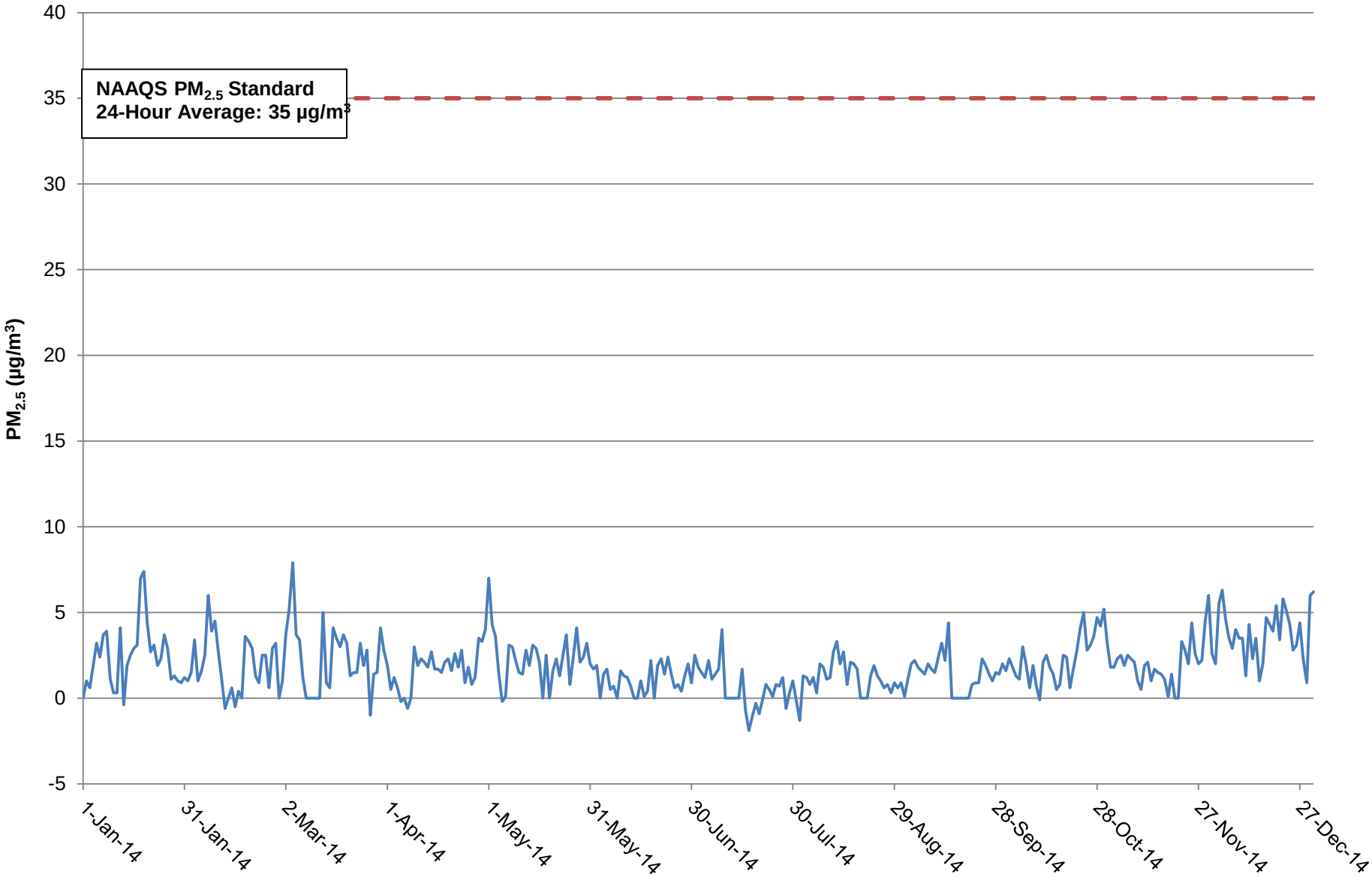


Figure 3-8: 24-Hour Average $PM_{2.5}$ and NAAQS/AAAQS Standard

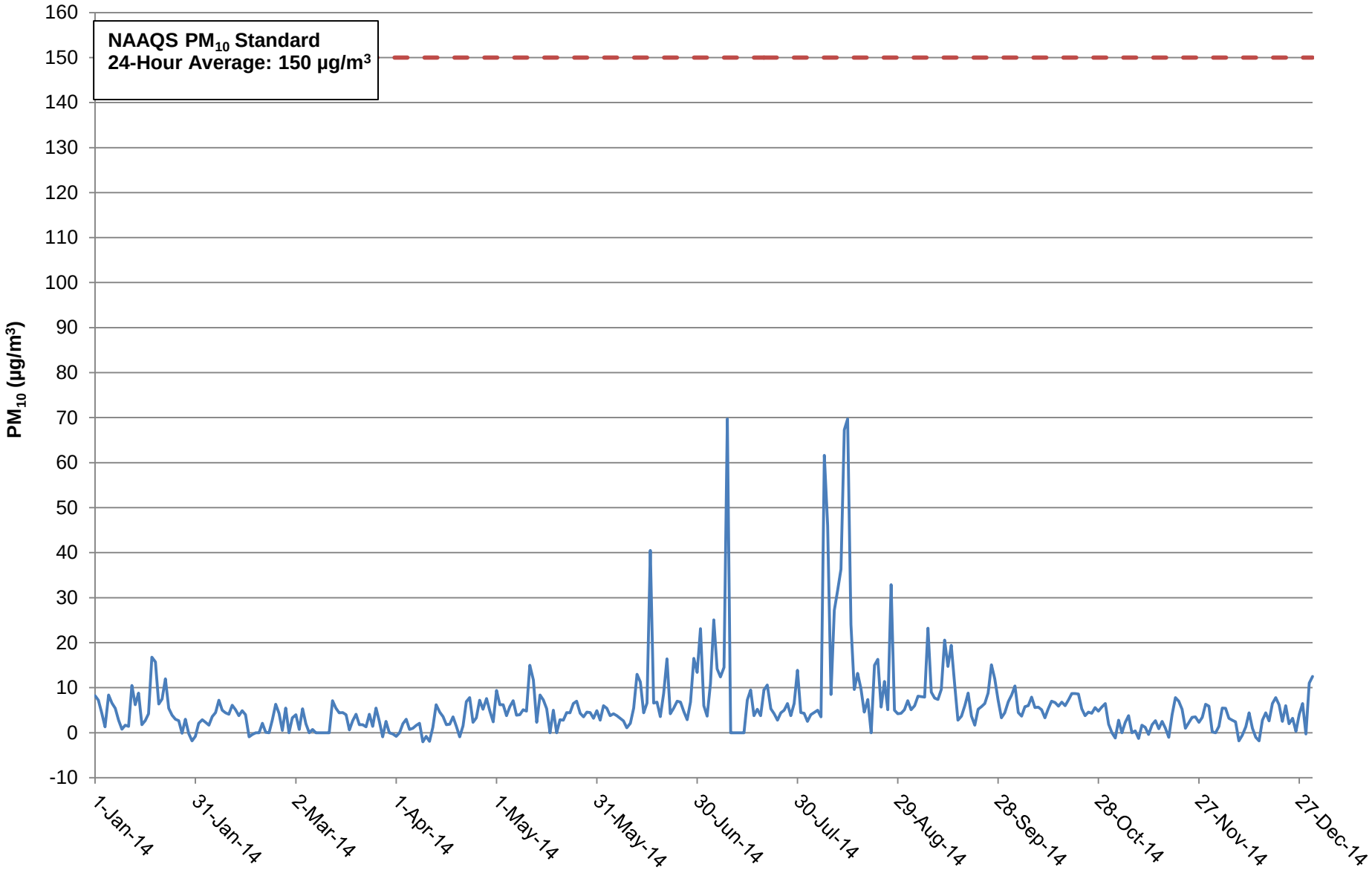


Figure 3-9: 24-Hour Average PM_{10} and NAAQS/AAAQS Standard

3.2 METEOROLOGICAL DATA SUMMARY

3.2.1 WIND SPEED (WS) AND WIND DIRECTION (WD) CLIMATOLOGY

Table 3-2 provides the mean and maximum hourly wind speeds at the nearby Nuiqsut Airport meteorological station, operated by the National Weather Service and located approximately one mile southwest of the Nuiqsut meteorological monitoring station. The summary in Table 3-2 provides summary statistics for data collected at the Nuiqsut airport. Table 3-3 provides a statistical summary of measurements obtained at the Nuiqsut station.

Figure 3-10 provides an annual wind rose for the Nuiqsut station and Figure 3-11 provides quarterly wind roses. Table 3-4 is the annual wind analysis table and Tables 3-5 to 3-8 are the quarterly wind analysis tables. Figure 3-12 provides the annual wind rose superimposed over a Nuiqsut area map, centered at the approximate location of the monitoring station.

Table 3-2: Average and Maximum Wind Speeds at the Nuiqsut Airport

Monitoring Period	Mean Hourly Average Wind Speed (m/s)	Maximum Hourly Average Wind Speed (m/s)
1st Quarter	5.4	17.5
2nd Quarter	4.8	15.9
3rd Quarter	4.9	13.9
4th Quarter	5.7	20.6
Monitoring Year	**5.2**	**20.6**

Table 3-3: Average and Maximum Wind Speeds at Nuiqsut Station

Monitoring Period	Mean Hourly Average Horizontal Wind Speed (m/s)	Maximum Hourly Average Horizontal Wind Speed (m/s)	Mean Hourly Average Vertical Wind Speed (m/s)	Maximum Hourly Average Vertical Wind Speed (m/s)
1st Quarter	4.91	14.79	0.22	1.32
2nd Quarter	4.54	14.91	0.17	0.85
3rd Quarter	5.15	13.36	0.22	0.86
4th Quarter	5.13	18.00	0.25	1.54
Monitoring Year	**4.93**	**18.00**	**0.22**	**1.54**

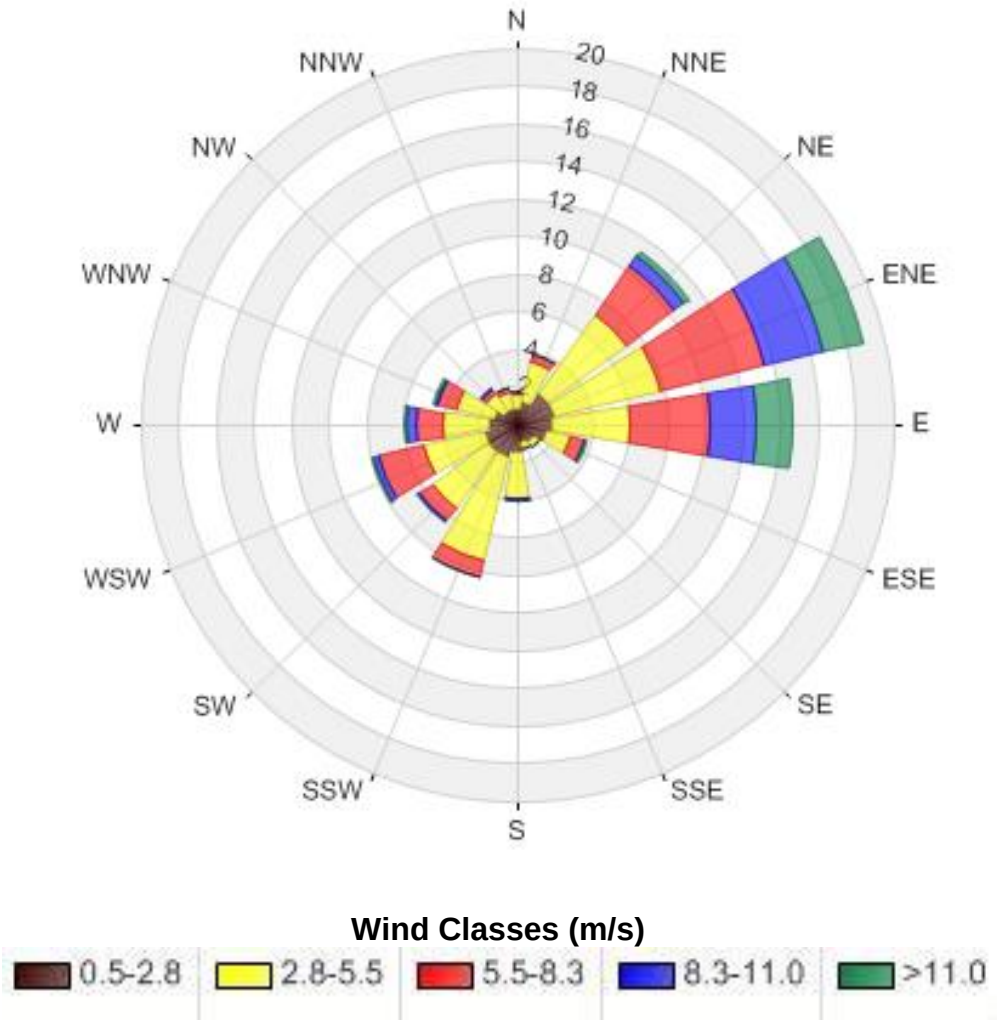
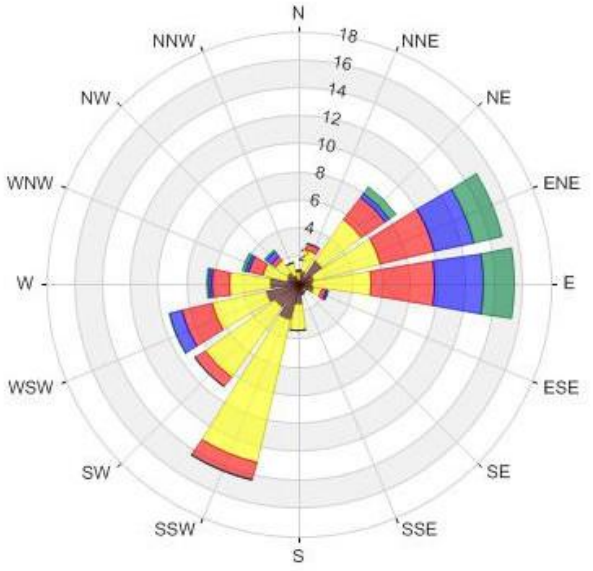
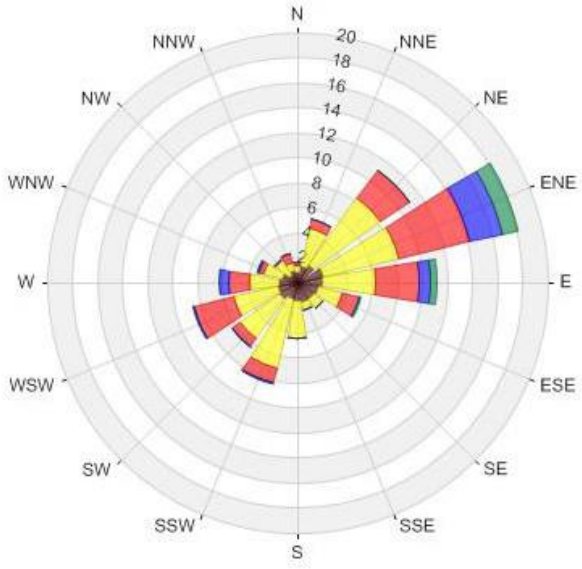


Figure 3-10: Nuiqsut Annual Wind Rose

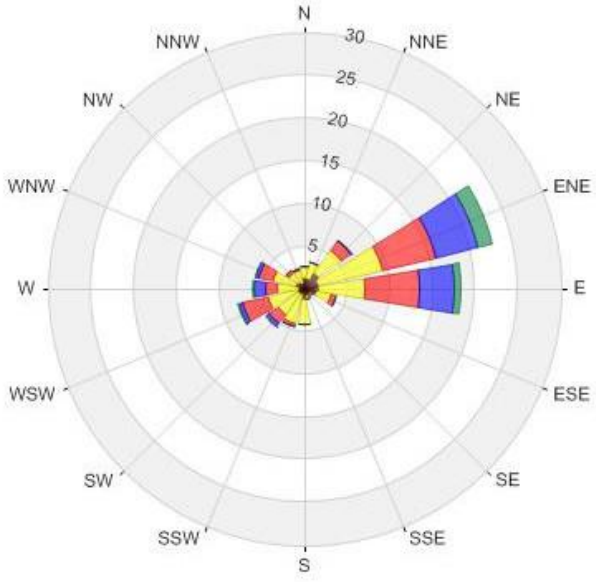
1st Quarter (1/1/14 – 3/31/14)



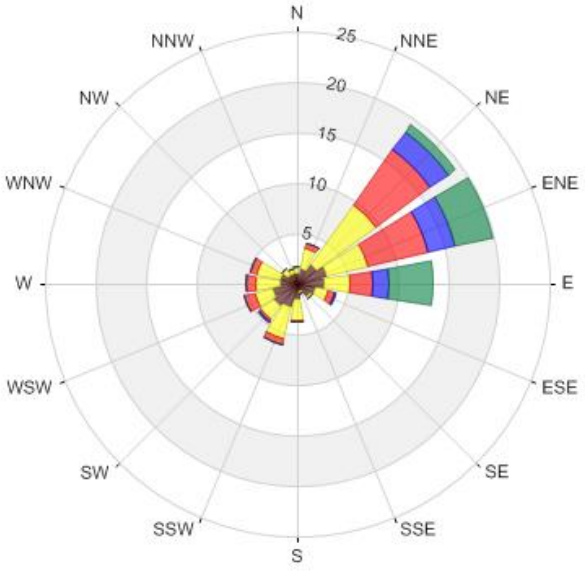
2nd Quarter (4/1/14 – 6/30/14)



3rd Quarter (7/1/14 – 9/30/14)



4th Quarter (10/1/14 – 12/31/14)



Wind Classes (m/s)

Figure 3-11: Nuiqsut Quarterly Wind Roses

Table 3-4: Annual Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	0.85	0.79	0.08	0.00	0.00	**1.72**
NNE	1.29	2.12	0.46	0.00	0.00	**3.87**
NE	2.06	5.14	3.17	0.60	0.37	**11.34**
ENE	2.01	5.80	5.75	3.23	2.17	**18.96**
E	1.89	4.13	4.25	2.49	1.98	**14.74**
ESE	1.62	1.38	0.72	0.06	0.04	**3.82**
SE	1.21	0.38	0.00	0.00	0.00	**1.59**
SSE	1.08	0.38	0.00	0.00	0.00	**1.46**
S	1.50	2.45	0.04	0.01	0.00	**4.00**
SSW	1.81	5.73	0.86	0.01	0.00	**8.41**
SW	1.82	3.68	0.84	0.14	0.00	**6.48**
WSW	1.80	3.27	2.43	0.34	0.05	**7.89**
W	1.47	2.53	1.36	0.57	0.06	**5.99**
WNW	1.20	2.09	1.01	0.19	0.06	**4.55**
NW	0.90	1.14	0.26	0.12	0.02	**2.44**
NNW	0.86	0.83	0.31	0.00	0.00	**2.00**
Summary	**23.37**	**41.84**	**21.54**	**7.76**	**4.75**	**99.26[(1)]**

[1] The remaining 0.74 percent of data were calms (below 0.5 m/s).

Table 3-5: First Quarter Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	0.33	0.52	0.14	0.00	0.00	**0.99**
NNE	0.95	1.52	0.47	0.00	0.00	**2.94**
NE	2.04	3.55	2.09	0.28	0.62	**8.58**
ENE	1.14	4.93	4.08	2.75	2.09	**14.99**
E	1.00	4.27	4.64	3.32	2.23	**15.46**
ESE	1.14	0.57	0.43	0.05	0.00	**2.19**
SE	0.57	0.09	0.00	0.00	0.00	**0.66**
SSE	0.81	0.05	0.00	0.00	0.00	**0.86**
S	1.47	1.94	0.00	0.00	0.00	**3.41**
SSW	2.65	10.47	1.33	0.00	0.00	**14.45**
SW	2.04	6.16	0.90	0.00	0.00	**9.10**
WSW	2.42	3.89	2.27	0.85	0.05	**9.48**
W	1.99	2.99	1.18	0.28	0.09	**6.53**
WNW	0.90	1.71	1.04	0.28	0.19	**4.12**
NW	1.04	0.95	0.38	0.47	0.09	**2.93**
NNW	0.66	0.85	0.09	0.00	0.00	**1.60**
Summary	**21.15**	**44.46**	**19.04**	**8.28**	**5.36**	**98.29[(1)]**

[1] The remaining 1.71 percent of data were calms (below 0.5 m/s).

Table 3-6: Second Quarter Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	0.80	0.56	0.19	0.00	0.00	**1.55**
NNE	1.41	3.06	0.75	0.00	0.00	**5.22**
NE	1.74	6.54	2.77	0.00	0.00	**11.05**
ENE	2.16	6.21	6.11	2.40	1.27	**18.15**
E	2.12	4.23	3.48	0.94	0.52	**11.29**
ESE	1.83	1.88	1.41	0.05	0.09	**5.26**
SE	1.69	0.89	0.00	0.00	0.00	**2.58**
SSE	1.65	0.71	0.00	0.00	0.00	**2.36**
S	1.60	2.91	0.00	0.05	0.00	**4.56**
SSW	1.36	5.69	1.27	0.05	0.00	**8.37**
SW	1.74	3.81	0.85	0.05	0.00	**6.45**
WSW	1.60	3.62	3.24	0.09	0.00	**8.55**
W	1.50	2.26	1.79	0.71	0.00	**6.26**
WNW	1.18	1.55	0.47	0.09	0.05	**3.34**
NW	0.66	1.41	0.19	0.00	0.00	**2.26**
NNW	0.94	0.61	0.85	0.00	0.00	**2.40**
Summary	**23.98**	**45.94**	**23.37**	**4.43**	**1.93**	**100.00**

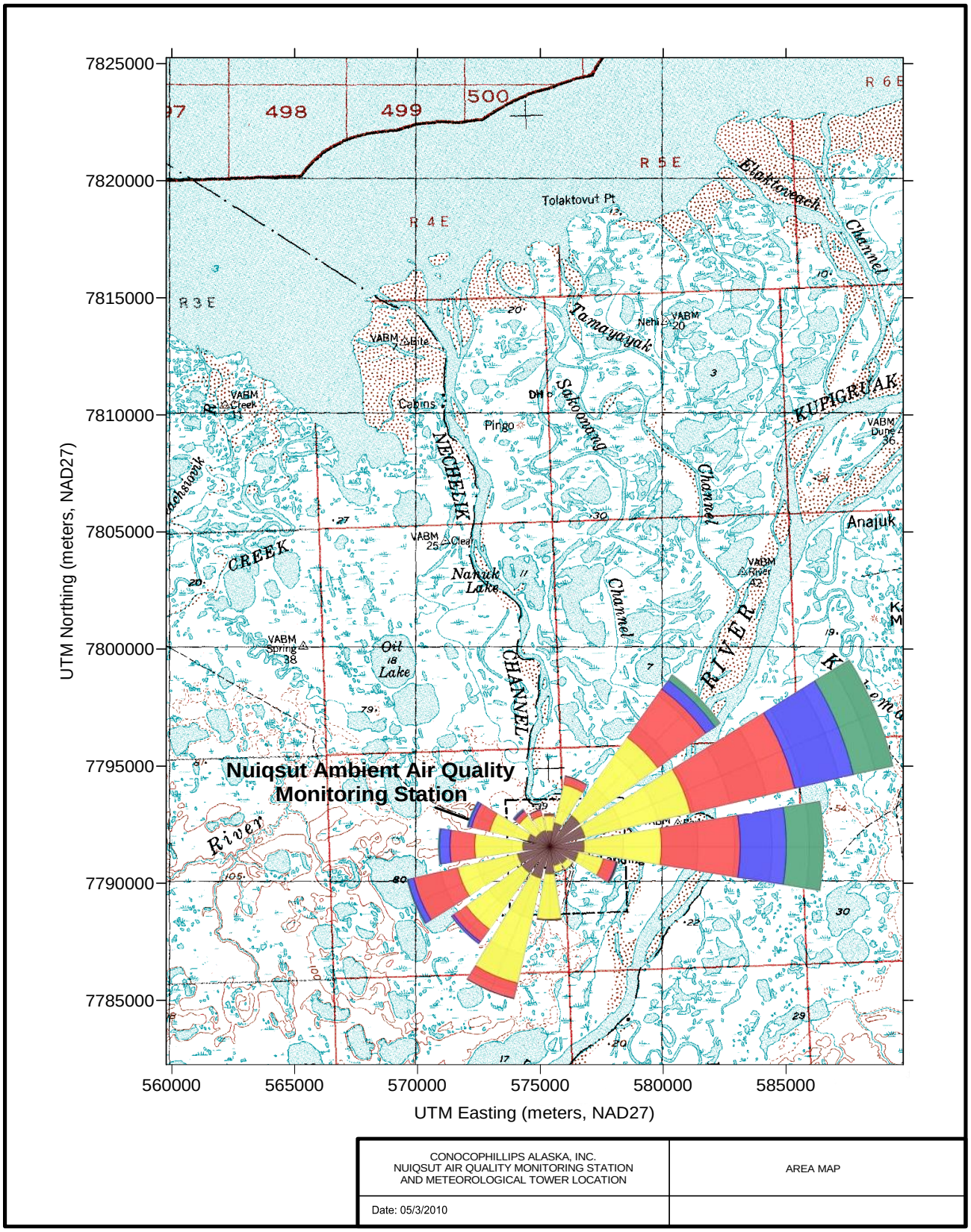
Table 3-7: Third Quarter Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	1.23	1.45	0.00	0.00	0.00	**2.68**
NNE	1.23	1.91	0.05	0.00	0.00	**3.19**
NE	2.14	3.36	1.32	0.09	0.00	**6.91**
ENE	1.68	7.77	6.63	4.91	1.68	**22.67**
E	1.73	5.41	6.45	3.95	0.91	**18.45**
ESE	1.59	1.73	0.50	0.00	0.00	**3.82**
SE	1.00	0.18	0.00	0.00	0.00	**1.18**
SSE	1.04	0.36	0.00	0.00	0.00	**1.40**
S	1.41	2.77	0.00	0.00	0.00	**4.18**
SSW	0.86	3.45	0.36	0.00	0.00	**4.67**
SW	0.82	3.04	1.32	0.41	0.00	**5.59**
WSW	0.82	3.63	3.00	0.41	0.14	**8.00**
W	0.73	2.41	1.59	1.23	0.14	**6.10**
WNW	1.04	2.68	1.91	0.36	0.00	**5.99**
NW	0.86	1.27	0.45	0.00	0.00	**2.58**
NNW	0.77	1.41	0.23	0.00	0.00	**2.41**
Summary	**18.95**	**42.83**	**23.81**	**11.36**	**2.87**	**100.00**

Table 3-8: Fourth Quarter Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	1.04	0.60	0.00	0.00	0.00	**1.64**
NNE	1.59	1.99	0.60	0.00	0.00	**4.18**
NE	2.34	7.26	6.76	2.14	0.89	**19.39**
ENE	3.13	4.13	6.16	2.78	3.73	**19.93**
E	2.78	2.49	2.24	1.64	4.42	**13.57**
ESE	1.94	1.34	0.55	0.15	0.05	**4.03**
SE	1.59	0.35	0.00	0.00	0.00	**1.94**
SSE	0.80	0.40	0.00	0.00	0.00	**1.20**
S	1.54	2.14	0.15	0.00	0.00	**3.83**
SSW	2.44	3.28	0.50	0.00	0.00	**6.22**
SW	2.78	1.64	0.25	0.10	0.00	**4.77**
WSW	2.44	1.84	1.09	0.00	0.00	**5.37**
W	1.69	2.49	0.84	0.00	0.00	**5.02**
WNW	1.69	2.44	0.55	0.00	0.00	**4.68**
NW	1.04	0.89	0.00	0.00	0.00	**1.93**
NNW	1.09	0.40	0.05	0.00	0.00	**1.54**
Summary	**29.92**	**33.68**	**19.74**	**6.81**	**9.09**	**99.24[(1)]**

[1] The remaining 0.76 percent of data were calms (below 0.5 m/s).



CONOCOPHILLIPS ALASKA, INC. NUIQSUT AIR QUALITY MONITORING STATION AND METEOROLOGICAL TOWER LOCATION	AREA MAP
Date: 05/3/2010	

Figure 3-12: Annual Wind Rose Superimposed on Site Map

3.2.2 TEMPERATURE CLIMATOLOGY

Tables 3-9 and 3-10 provide the maximum and minimum daily mean temperatures, monthly mean temperatures, and maximum and minimum hourly average temperatures for the 2-meter and 10-meter temperature measurements, respectively. Figure 3-13 provides a graph of the 2-meter and 10-meter hourly average temperatures at the Nuiqsut station, as well as temperature data from the Nuiqsut Airport for comparative purposes only. Figure 3-13 shows a plot of vertical temperature difference (the difference between 10-meter and 2-meter temperature values) during the monitoring year.

Table 3-9: 2-Meter Temperature Summary

Period	Maximum Daily Mean Temperature (°C)	Minimum Daily Mean Temperature (°C)	Mean Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)
January 2014	-12.5	-40.7	-23.1	-7.8	-43.0
February 2014	-7.5	-42.5	-25.4	-4.3	-44.0
March 2014	-14.3	-38.4	-23.4	-8.9	-40.1
1st Quarter	**-7.5**	**-42.5**	**-23.9**	**-4.3**	**-44.0**
April 2014	-3.2	-29.1	-15.8	1.7	-33.2
May 2014	3.2	-6.2	-1.5	5.8	-8.5
June 2014	13.9	-1.3	4.4	18.9	-3.3
2nd Quarter	**13.9**	**-29.1**	**-4.3**	**18.9**	**-33.2**
July 2014	14.0	2.2	7.9	19.6	-0.9
August 2014	11.5	1.6	5.9	20.1	-0.2
September 2014	3.2	-2.0	1.2	11.8	-6.2
3rd Quarter	**14.0**	**-2.0**	**5.0**	**20.1**	**-6.2**
October 2014	1.1	-11.9	-5.3	3.4	-15.1
November 2014	-3.6	-25.9	-14.2	1.0	-28.9
December 2014	-11.6	-31.6	-22.8	-5.3	-34.7
4th Quarter	**1.1**	**-31.6**	**-14.1**	**3.4**	**-34.7**
Monitoring Year	**14.0**	**-42.5**	**-9.3**	**20.1**	**-44.0**

Table 3-10: 10-Meter Temperature Summary

Period	Maximum Daily Mean Temperature (°C)	Minimum Daily Mean Temperature (°C)	Mean Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)
January 2014	-12.0	-39.7	-22.9	-7.5	-42.3
February 2014	-7.3	-42.2	-25.1	-4.2	-43.8
March 2014	-13.2	-37.7	-22.8	-8.7	-39.3
1st Quarter	**-7.3**	**-42.2**	**-23.6**	**-4.2**	**-43.8**
April 2014	-2.9	-28.4	-15.6	2.0	-32.6
May 2014	3.3	-6.6	-1.6	5.8	-8.4
June 2014	13.4	-1.5	4.0	18.3	-3.5
2nd Quarter	**13.4**	**-28.4**	**-4.4**	**18.3**	**-32.6**
July 2014	13.8	1.7	7.5	19.4	-1.0
August 2014	11.5	1.7	5.7	19.3	0.0
September 2014	3.4	-1.6	1.2	11.7	-5.6
3rd Quarter	**13.8**	**-1.6**	**4.8**	**19.4**	**-5.6**
October 2014	1.1	-12.1	-5.2	3.3	-14.4
November 2014	-2.8	-25.0	-13.8	2.2	-28.9
December 2014	-11.1	-30.9	-22.5	-5.0	-34.1
4th Quarter	**-1.1**	**-30.9**	**-13.9**	**3.3**	**-34.1**
Monitoring Year	**13.8**	**-42.2**	**-9.2**	**19.4**	**-43.8**

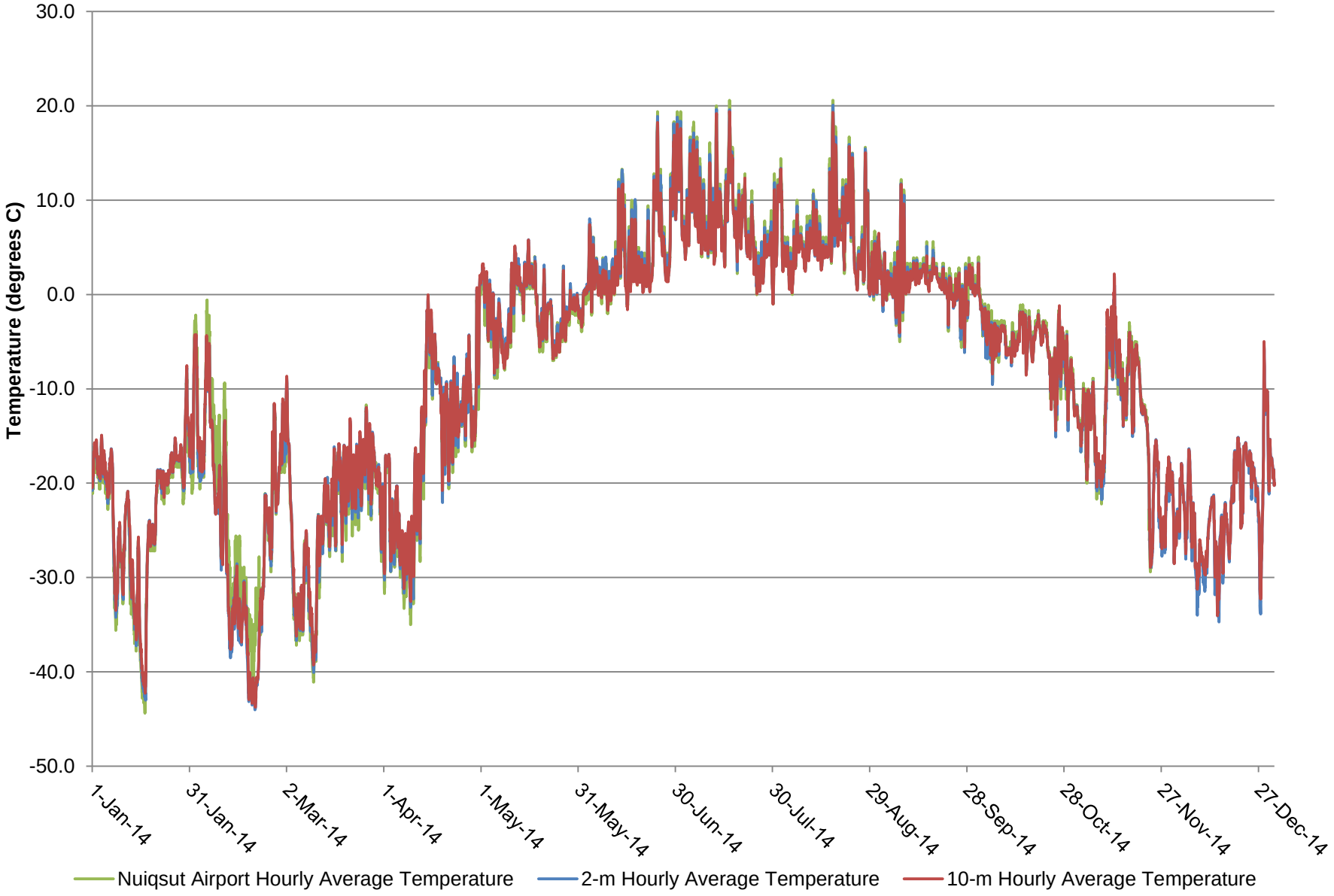


Figure 3-13: Hourly Average 2-Meter and 10-Meter Temperatures

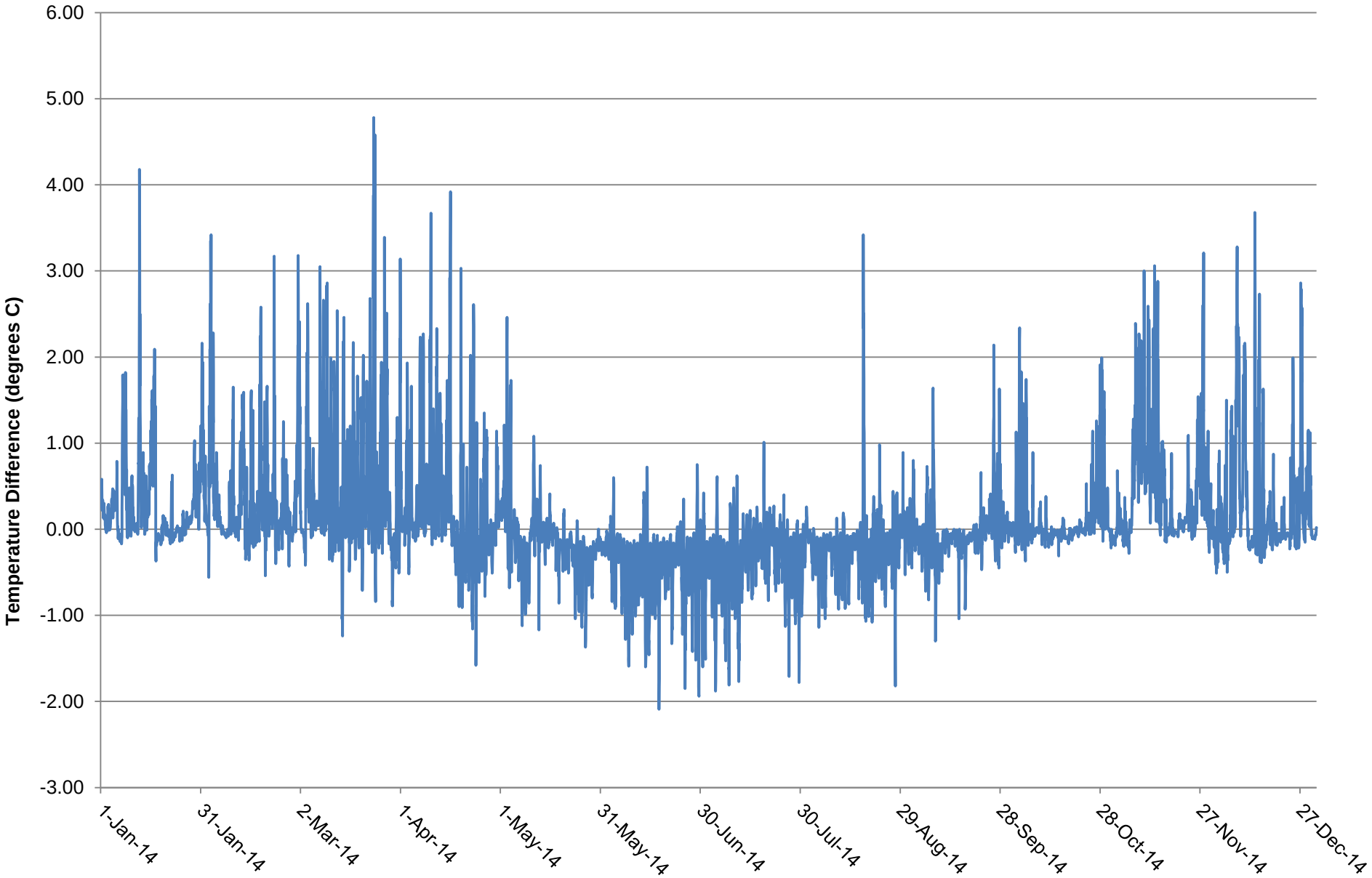


Figure 3-14: Hourly Average Vertical Temperature Difference

3.2.3 OTHER METEOROLOGICAL PARAMETERS

Table 3-11 provides a summary of solar radiation measurements obtained for the 2014 monitoring year. Figure 3-15 is a plot of annual hourly average solar radiation. The solar radiation data are available in monthly tabular format in Appendix D.

Table 3-11: Solar Radiation Summary

Period	Mean Solar Radiation (W/m^2)	Maximum Solar Radiation (W/m^2)
January 2014	1	57
February 2014	21	237
March 2014	77	446
1st Quarter	**31**	**446**
April 2014	173	697
May 2014	183	690
June 2014	201	741
2nd Quarter	**186**	**741**
July 2014	184	720
August 2014	114	566
September 2014	60	447
3rd Quarter	**120**	**720**
October 2014	22	281
November 2014	2	85
December 2014	0	1
4th Quarter	**8**	**281**
Monitoring Year	**87**	**741**

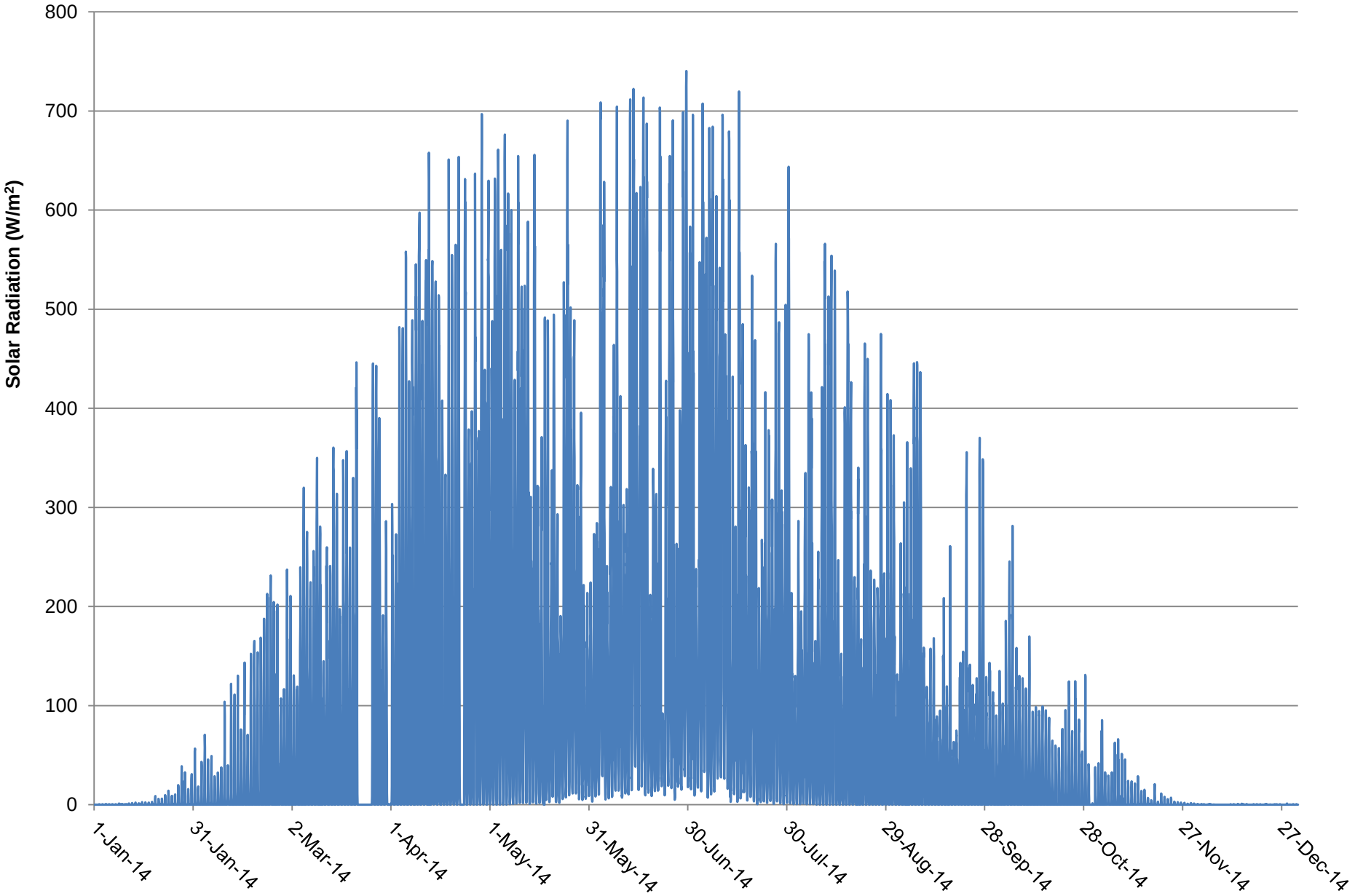


Figure 3-15: Hourly Average Solar Radiation

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