2015 Annual Data Report
Nuiqsut Ambient Air Quality and Meteorological Monitoring Program

January 1, 2015 – December 31, 2015

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2015 Annual Data Report

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This document has been prepared by SLR International Corporation (SLR). 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 Corporation (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 2015 monitoring year, spanning from January 1, 2015, to December 31, 2015, 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
During the monitoring period there were no variations from the approved procedures and criteria specified in the Nuiqsut Ambient Air Quality and Meteorological Monitoring Program Quality Assurance Project Plan.		

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	0	1	**1**	**2.9%**
			2nd Highest, 1-Hour Average	1	0	0	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour [1]	1st Highest, 8-Hour Average	1	0	0	1	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	0	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)	-	-	-	-	**23.6**	**23.6%**
			1st Highest, 1-Hour Average	33.9	26.2	14.3	29.1	**33.9**	**33.9%**
			2nd Highest, 1-Hour Average	26.0	22.4	11.4	18.0	**29.1**	**29.1%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	3	1	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	0.042	0.034	0.039	**0.045**	**60.0%**
			1st Highest, 8-Hour Average	0.046	0.043	0.035	0.042	**0.046**	**61.3%**
			2nd Highest, 8-Hour Average	0.046	0.043	0.035	0.040	**0.046**	**61.3%**

[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)	-	-	-	-	**1.2**	**1.6%**
			1st Highest, 1-Hour Average	0.5	2.3	0.9	1.3	**2.3**	**3.1%**
			2nd Highest, 1-Hour Average	0.4	1.7	0.9	1.2	**1.7**	**2.3%**
	0.5 ppm (1,300 μg/m^3)	3-Hour [5]	1st Highest, 3-Hour Average	0.0	0.0	0.0	0.0	**0.0**	**0.0%**
			2nd Highest, 3-Hour Average	0.0	0.0	0.0	0.0	**0.0**	**0.0%**
	0.14 ppm (365 μg/m^3)	24-Hour [5]	1st Highest, 24-Hour Average	0.00	0.00	0.00	0.00	**0.00**	**0.0%**
			2nd Highest, 24-Hour Average	0.00	0.00	0.00	0.00	**0.00**	**0.0%**
	0.030 ppm (80 μg/m^3)	Annual	Average of Period	0.000	0.000	0.000	0.001	0.000	**0.0%**

[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	-	-	-	-	**10**	**28.6%**
			1st Highest, 24-Hour Average	13	9	17	12	**17**	**48.9%**
			2nd Highest, 24-Hour Average	11	7	8	7	**13**	**36.0%**
	15.0 μg/m^3	Annual [7,8]	Average of Period	4.0	2.6	2.2	2.2	**2.8**	**23.3%**
Particulate Matter <10 microns (**PM_{10}**)	150 μg/m^3	24-Hour [9,10]	1st Highest, 24-Hour Average	20	40	150	10	**150**	**100.0%**
			2nd Highest, 24-Hour Average	10	40	100	10	**100**	**66.7%**

[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 2015	725	725	725	641[1]	641[1]	744	744	744	735
February 2015	667	667	667	667	667	672	672	672	672
March 2015	743	743	743	743	743	743	743	743	742
1st Quarter	**2,135**	**2,135**	**2,135**	**2,051**	**2,051**	**2,159**	**2,159**	**2,159**	**2,149**
April 2015	716	716	716	705	705	720	720	720	717
May 2015	583[2]	583[2]	583[2]	560[2]	560[2]	583[2]	583[2]	583[2]	586[2]
June 2015	720	720	720	720	720	720	720	720	720
2nd Quarter	**2,019**	**2,019**	**2,019**	**1,985**	**1,985**	**2,023**	**2,023**	**2,023**	**2,023**
July 2015	742	742	742	742	742	742	742	742	742
August 2015	742	742	742	742	742	742	742	742	742
September 2015	718	718	718	718	718	718	718	718	718
3rd Quarter	**2,202**	**2,202**	**2,202**	**2,202**	**2,202**	**2,202**	**2,202**	**2,202**	**2,202**
October 2015	738	738	738	733	733	738	738	738	738
November 2015	663	663	663	719	719	719	719	719	719
December 2015	744	744	744	744	744	744	744	744	744
4th Quarter	**2,145**	**2,145**	**2,145**	**2,196**	**2,196**	**2,201**	**2,201**	**2,201**	**2,201**
Annual	**8,501**	**8,501**	**8,501**	**8,434**	**8,434**	**8,585**	**8,585**	**8,585**	**8,575**

[1] Vertical wind data were invalidated due to the buildup of snow and ice on the sensor. Despite the data loss, DQOs were met for the first quarter.
[2] A station power outage resulted in the loss of all meteorological data 5/14/2015 – 5/22/2015. Despite the data loss, DQOs were met for the second quarter for all parameters.

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 2015	97	97	97	86[2]	86[2]	100	100	100	99
February 2015	99	99	99	99	99	100	100	100	100
March 2015	100	100	100	100	100	100	100	100	100
1st Quarter	**99**	**99**	**99**	**95**	**95**	**100**	**100**	**100**	**100**
April 2015	99	99	99	98	98	100	100	100	100
May 2015	78[3]	78[3]	78[3]	75[3]	75[3]	78[3]	78[3]	78[3]	79[3]
June 2015	100	100	100	100	100	100	100	100	100
2nd Quarter	**92**	**92**	**92**	**91**	**91**	**93**	**93**	**93**	**93**
July 2015	100	100	100	100	100	100	100	100	100
August 2015	100	100	100	100	100	100	100	100	100
September 2015	100	100	100	100	100	100	100	100	100
3rd Quarter	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
October 2015	99	99	99	99	99	99	99	99	99
November 2015	92	92	92	100	100	100	100	100	100
December 2015	100	100	100	100	100	100	100	100	100
4th Quarter	**97**	**97**	**97**	**99**	**99**	**100**	**100**	**100**	**100**
Annual	**97**	**97**	**97**	**96**	**96**	**98**	**98**	**98**	**98**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Vertical wind data were invalidated due to the buildup of snow and ice on the sensor. Despite the data loss, DQOs were met for the first quarter.
[3] A station power outage resulted in the loss of all meteorological data 5/14/2015 – 5/22/2015. Despite the data loss, DQOs were met for the second quarter for all parameters.

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.

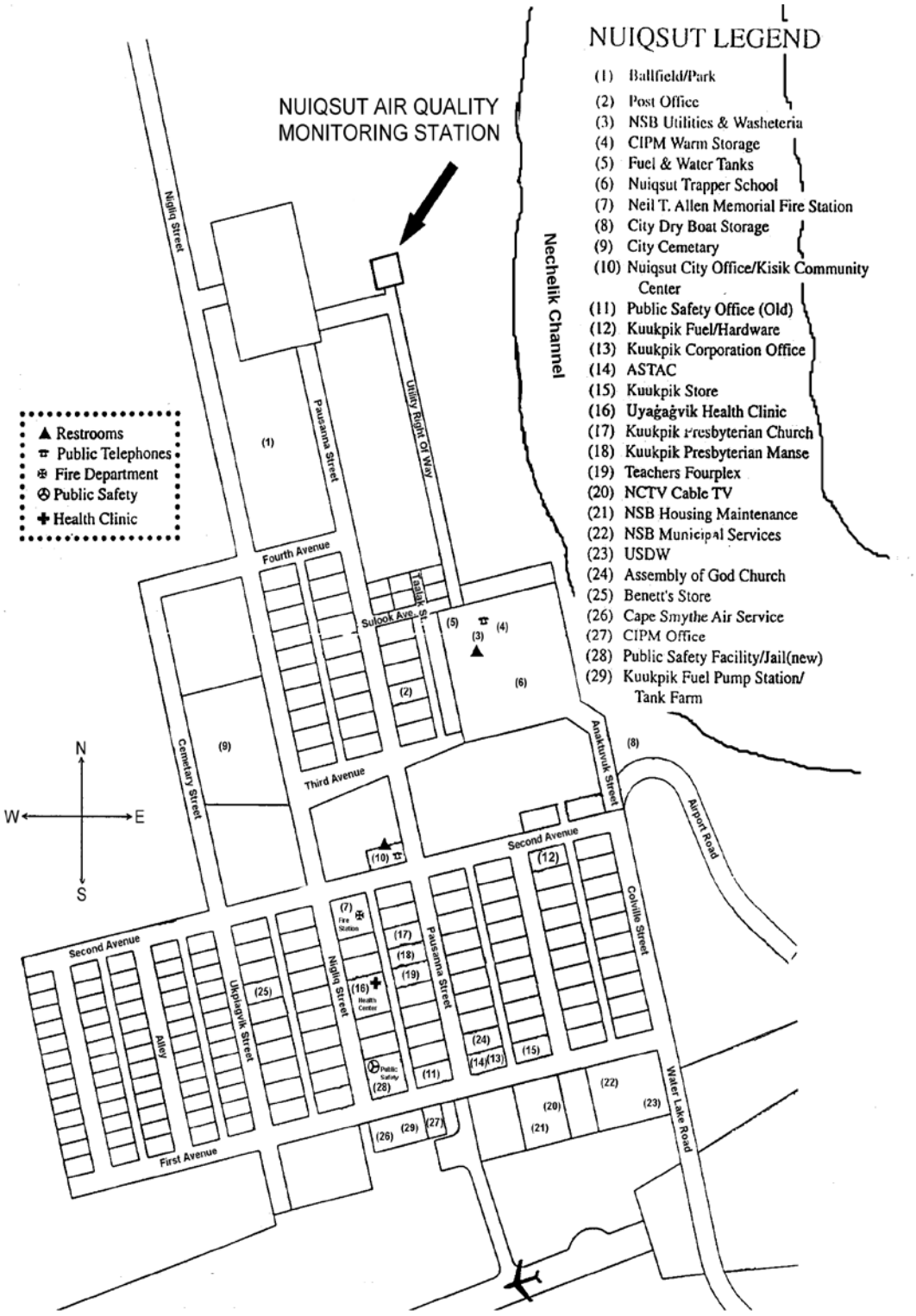


Figure 1-1: Local Map of Nuiqsut

Figure 1-2: Aerial Photo Showing Site Location

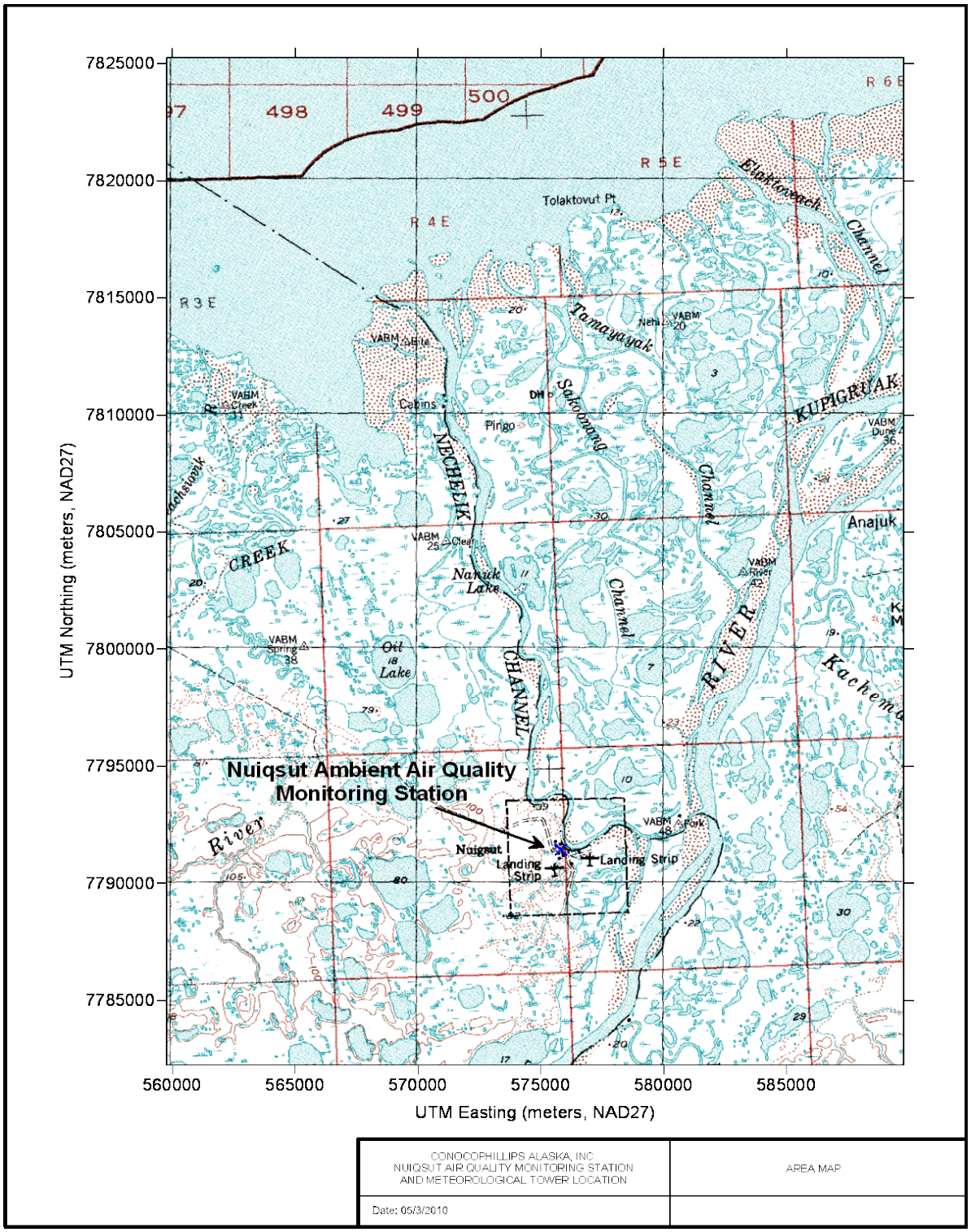


Figure 1-3: Map of Nuiqsut Project Area

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 reference method RFCA-0981-054	Parts per million (ppm)	Continuous	1-hour
Nitrogen Dioxide (NO_2)[1,2]	Thermo Scientific 42i Chemiluminescent NO_X gas analyzer	EPA reference method RFNA-1289-074	Parts per billion (ppb)		
	API T200U Chemiluminescent NO_X gas analyzer	EPA reference method RFNA-1194-099			
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.
[2] Thermo instrument was used January 1- May 29, 2015 and November 24-December 31, 2015. API instrument was used May 29-November 24, 2015.

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 2015 monitoring year, no variations from the approved Nuiqsut Ambient Air Quality and Meteorological Monitoring Quality Assurance Project Plan (QAPP) occurred. Any QAPP variations that have occurred throughout the monitoring year are discussed in Table 1-4 and below.

Table 1-4: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
During the monitoring period there were no variations from the approved procedures and criteria specified in the Nuiqsut Ambient Air Quality and Meteorological Monitoring Program Quality Assurance Project Plan.		

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 2015 ambient air and meteorological monitoring year.

Table 2-1: Chronology of Significant Events

Date	Event
January 1, 2015	Start of the monitoring year.
January 3 – 7, 2015	Vertical wind data indicated episodes of rime ice build-up on sensor; 103 hours of vertical wind speed and sigma omega data invalidated from 9:00 am January 3, 2015 – 3:00 pm January 7, 2015.
January 6 – 7, 2015	Horizontal wind speed and direction data indicated episodes of rime ice build-up on sensor; 11 hours of horizontal wind speed, direction, and sigma theta data flagged invalid.
January 9, 2015	Horizontal wind direction data indicated episodes of rime ice build-up on sensor; 8 hours of horizontal wind speed, direction, and sigma theta data flagged invalid.
January 12 – 13, 2015	PM_{10} data flagged as invalid due to a 24-hour average concentration less than -2 µg/m^3.
January 15, 2015	QC performed on PM samplers; both passed. Multipoint calibrations performed on all ambient air gas analyzers; all passed. Independent performance audit of ambient air gas analyzers and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. 4 hours of PM data and 6 hours of gas data invalidated during calibration/audit activities.
January 23, 2015	PM_{10} data flagged as invalid due to a 24-hour average concentration less than -2 µg/m^3.
February 12 – 14, 2015	PM_{10} data flagged as invalid due to a 24-hour average concentration less than -2 µg/m^3.
February 13, 2015	Horizontal and vertical wind speed and direction data indicated episodes of rime ice build-up on sensor; 5 hours of all wind data flagged invalid.
February 19, 2015	Ozone transfer standard SN# 262 out for recertification; replaced with SN# 85. Monthly QC checks performed on PM samplers; all passed acceptance criteria.
February 23, 2015	Shelter temperature daily standard deviation was greater than 2°C degrees; 24 hours of gas data invalidated.
March 25, 2015	Monthly QC checks performed on both PM samplers; PM_{10} failed leak check and flow rate criteria. 818 hours invalidated from 2:00 pm February 19, 2015 – 3:00 pm March 25 2015.
April 13, 2015	Remote ozone calibration performed; sampler passed acceptance criteria.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
April 19, 2015	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
April 21-23, 2015	Data from all continuous air quality analyzers invalidated as a result of shelter temperature exceeding 2 degree Celsius standard deviation; 55 hours of data invalidated.
April 28-29, 2015	Horizontal wind speed data indicated episodes of rime ice build-up on sensor; 4 hours of horizontal wind data flagged invalid. Vertical wind speed data indicated episodes of rime ice build-up on sensor; 15 total hours of vertical wind data flagged invalid.
May 4, 2015	Vertical wind speed data indicated episodes of rime ice build-up on sensor; 17 total hours of vertical wind data flagged invalid.
May 10, 2015	Vertical wind speed data indicated episodes of rime ice build-up on sensor; 6 total hours of vertical wind data flagged invalid.
May 14-22, 2015	Station experienced power outage from 5/14/2015 at 11:00pm through 5/22/2015 at 2:00pm. 204 hours gas, 158 hours Meteorological and 184 hours PM data invalidated.
May 22-23, 2015	Monthly QC checks performed on PM samplers; all passed acceptance criteria. NOx sampler off-line for repair; 18 hours of data invalidated. Multipoint calibration performed on CO, SO_2, and O_3 analyzer.
May 28, 2015	Semi-annual calibrations performed on all meteorological sensors; 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. 7 hours of NOx data and 5 hours of CO, SO_2, and O_3 data were invalidated during calibration activities.
May 29, 2015	Replaced and calibrated NOx sampler. Multipoint calibrations performed on all ambient air analyzers; all passed
May 30-June 1, 2015	59 hours of SO_2 data invalidated due to equipment failure.
June 10, 2015	6 hours of PM and 7 hours of gaseous pollutant data was not collected because of station power disruption.
June 14-15, 2015	Data from all continuous air quality analyzers invalidated as a result of shelter temperature exceeding 30 degree Celsius limit; 13 hours invalidated.
June 20-21, 2015	Data from all continuous air quality analyzers invalidated as a result of shelter temperature exceeding 2 degree Celsius standard deviation; 38 hours invalidated.
June 22, 2015	Remote NOx calibration and multipoint performed; sampler passed acceptance criteria.
June 24, 2015	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
June 25, 2015	A temporary power outage resulted in the loss of 3 hours of gaseous pollutant and PM data.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
July 7 – 8, 2015	PM_{10} data were invalidated and flagged as an exceptional event due to blowing dust from the Colville River Delta. See Section 2.2 and Appendix F for more discussion regarding this event.
July 10, 2015	Shelter temperature daily standard deviation was greater than 2°C; 24 hours of gas data invalidated.
July 13, 2015	Shelter temperature daily standard deviation was greater than 2°C and exceeded 30°C acceptance criteria; 24 hours of gas data invalidated.
July 14, 2015	Shelter temperature exceeded 30°C acceptance criteria; 13 hours of gas data invalidated.
July 15 – 16, 2015	Shelter temperature daily standard deviation was greater than 2°C; 48 hours of gas data invalidated.
July 17, 2015	An unscheduled additional ambient precision check was performed to ensure analyzer accuracy; all passed.
July 23, 2015	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
July 30, 2015	The scheduled ozone precision check produced an unacceptable result due to an unstable photometer response. A make-up precision check was run later in the day and passed.
August 4, 2015	Multipoint calibration performed on ozone analyzer; all passed.
August 6, 2015	The scheduled ozone precision check produced an unacceptable result due to an unstable photometer response. A make-up precision check was run later in the day and passed. A new transfer standard was dispatched to the site.
August 11, 2015	Ozone transfer standard S/N 85 was replaced with S/N 220. Additional precision check run to verify analyzer accuracy; all passed.
August 18, 2015	Multipoint calibration performed on ozone analyzer; all passed.
August 26 – 27, 2015	Monthly QC checks performed on PM samplers; all passed acceptance criteria. Independent performance audit of ambient air analyzers, PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. 17 hours of PM data and 6 hours of gas data invalidated.
August 28 – 30, 2015	Gas pollutant samplers were periodically taken off-line for calibration system maintenance.
September 21, 2015	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
September 21-25, 2015	Zero background check was performed on $PM_{2.5}$. 98 hours invalidated.
September 25, 2015	Multipoint calibration performed on all ambient gas analyzers; all passed.
October 3-5, 2015	61 hours of NOx data invalidated due to failed zero/span checks. 5 hours of data on other gases invalidated while re-calibration was performed.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
October 15, 2015	Calibrations performed on gas analyzers; 5 hours of data invalidated.
October 22, 2015	Vertical wind speed data indicated episodes of rime ice build-up on sensor; 5 hours of vertical wind data flagged invalid.
October 29, 2015	Monthly QC checks performed on PM samplers; all passed acceptance criteria. Multipoint calibration performed on all ambient gas analyzers; all passed. Semi-annual calibrations performed on all meteorological sensors and quarterly multipoint calibrations performed on all ambient air analyzers; all passed. Independent performance audit of ambient air analyzers, PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. 6 hours of meteorological data and 8 hours of gas data invalidated during calibration/audit activities.
October 30-31, 2015	PM_{10} data flagged as invalid due to a 24-hour average concentration less than -2 µg/m^3.
November 11-13, 2015	Horizontal wind speed data indicated episodes of rime ice build-up on sensor; 56 hours of vertical wind data flagged invalid.
November 13, 2015	Five hours of PM_{10} data flagged as invalid for low raw concentrations beyond the measurement error range of the instrument.
November 19, 2015	Performed multipoint calibration on NO_x analyzer. 6 hours of ambient gas data invalidated.
November 20, 2015	Monthly QC checks performed on PM samplers; all passed acceptance criteria. Maintenance performed on NO_x analyzer. 5 hours of ambient gas data invalidated.
November 20 - 24, 2015	Teledyne API T200 NO_x analyzer, SN: 194 replaced with a Thermo 42i, SN: 1008241339 after instrument failure. NO_x data invalidated between 6:00 PM AST November 20 to 12:00 PM AST November 24, 2015. An additional 5 hours of ambient gas data were invalidated for multipoint calibrations.
December 6, 10, and 11, 2015	PM_{10} data flagged as invalid due to a 24-hour average concentration less than -2 µg/m^3.
December 15, 2015	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
December 29, 2015	Performed remote calibration of CO and O_3 analyzers. 3 hours of ambient gas data invalidated.
December 31, 2015	End of the 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.

Periods of 4 or fewer records that were invalidated are considered to be due to routine operations and maintenance activities and are generally not described in detail. Events impacting larger periods of time are described above in Table 2-1: Chronology of Significant Events. Additionally, those events meriting more detailed explanation of data validation decisions are as follows:

- Some of the calibration certificates provided by Mesa Labs indicated the "as-received" condition of the BIOS flow meters was "Out of Tolerance". This notation on the Mesa Labs certificates was determined to have no impact on data validity.

  The acceptance criteria used by Mesa Labs for flow accuracy is more stringent than EPA requirements. EPA acceptance criteria for gas dilution flow accuracy is +/-2% while Mesa uses an acceptable limit of 1% to assess "as received" acceptability. Mesa Lab is unwilling to change their evaluation criteria to match EPA requirements leading to more apparent out of tolerance notations than is really the case. The "As Received" calibration variation observed for serial number 114239 and 114339 on May 8, 2015.were within 2% EPA acceptable variation and as such should be considered acceptable. Serial number 114239 on May 8, 2014 was found out of EPA criteria on only the highest of the three flow points evaluated, with the average flow of the three points remaining below 2 percent.

  The devices were calibrated and documented within acceptable criteria at the time it was sent out to SLR for use. Upon arrival at SLR, flow measurements are compared to other devices in SLR's inventory to ensure they were received without damage. Instrument shipment and handling is tightly controlled while in SLR's possession to prevent damage. Handling of the devices after leaving SLR's possession for recertification is uncontrolled. Damage to the instrument during shipment to Mesa Labs could be a valid explanation for the out of tolerance finding.

  Multiple audits by an independent third party auditor demonstrated that the calibration gas flows generated by the 146i calibrator accurately provided acceptable, accurate concentrations to all the associated samplers because each passed accuracy audit criteria at multiple concentration levels.

  Subsequent assessment of the monitoring station's gas dilution calibrator demonstrated acceptable "as found" performance of flow controllers with newly certified or different transfer devices. This indirectly demonstrates that the apparently questionable transfer standards were within acceptable performance criteria at the time of use or some level of a potentially unacceptable bias would have been observed on the subsequent assessments.

Table 2-1 Continued: Chronology of Significant Events

- On July 7 through July 8, 2015, high winds transported dust from the Colville River delta and caused apparent NAAQS exceedances of 24-hour average PM_{10} at the Nuiqsut air quality monitoring station. During this time, recorded PM_{10} concentrations exceeded the measurement range of the particulate matter analyzer and are inconsistent with historically measured concentrations and other comparison sources. During data validation, SLR determined that the exceedances measured during this event were the result of natural events that were not reasonably controllable or preventable. Characteristics of the event were consistent with EPA criteria to classify the event as an Exceptional Event and suggest data collected should be invalidated. See Appendix F Supporting Information for a full Exceptional Event Demonstration package that provides the rationale for invalidating PM_{10} data during the event.

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	2.1%
	< 0.5 m/s variation for 12 consecutive hours	0.6%
Wind Direction	Value is < 0°, > 360°	0.0%
	< 1° variation over 3 consecutive hours	0.0%
	< 10° variation over 18 consecutive hours	2.9%
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	0.0%
Temperature (10 meters)	> 5°C variation from previous hour	0.1%
	< 0.5°C variation for 12 consecutive hours	1.5%
	Value is > record high, < record low	0.0%
Temperature Difference, ΔT	Value is > 0.8°C during the daytime	0.8%
	Value is < -0.8°C during the night	0.0%
	Value is > 5°C, < -3°C	0.0%
Solar Radiation	> 0 w/m^2 at night	1.1%
	Greater than the maximum possible value for date and latitude	0.1%

[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 except for PM_{10} in the first quarter of 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 2015	98	98	98	98	100	90
February 2015	96	96	95	96	100	54[4]
March 2015	99	99	99	99	100	19[4]
1st Quarter	**98**	**98**	**98**	**98**	**100**	55[4]
April 2015	91	91	89	91	100	100
May 2015	71[3]	69[3]	71[3]	65[3]	74[3]	74[3]
June 2015	91	88	91	89	100	100
2nd Quarter	**84**	**82**	**83**	**81**	**91**	**91**
July 2015	84	82	84	84	100	94
August 2015	96	95	96	96	94	94
September 2015	98	96	98	98	83	100
3rd Quarter	**93**	**91**	**93**	**93**	**92**	**96**
October 2015	96	88	96	96	100	94
November 2015	97	84	97	97	100	97
December 2015	99	99	99	99	100	90
4th Quarter	**97**	**91**	**97**	**97**	**100**	**93**
Annual	**93**	**90**	**93**	**92**	**96**	**84**

[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.
[3] A station power outage resulted in the loss of all ambient air and particulate matter data 5/14/2015 – 5/22/2015. Despite the data loss, DQOs were met for the second quarter for all parameters.
[4] The PM_{10} sampler failed the QC check on March 25, 2015 and all PM_{10} data were invalidated back to the last passing QC check on February 19, 2015. Due to the data loss, DQOs for PM_{10} were not met during the first quarter.

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 2015	97	97	97	86[2]	86[2]	100	100	100	99
February 2015	99	99	99	99	99	100	100	100	100
March 2015	100	100	100	100	100	100	100	100	100
1st Quarter	**99**	**99**	**99**	**95**	**95**	**100**	**100**	**100**	**100**
April 2015	99	99	99	98	98	100	100	100	100
May 2015	78[3]	78[3]	78[3]	75[3]	75[3]	78[3]	78[3]	78[3]	79[3]
June 2015	100	100	100	100	100	100	100	100	100
2nd Quarter	**92**	**92**	**92**	**91**	**91**	**93**	**93**	**93**	**93**
July 2015	100	100	100	100	100	100	100	100	100
August 2015	100	100	100	100	100	100	100	100	100
September 2015	100	100	100	100	100	100	100	100	100
3rd Quarter	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
October 2015	99	99	99	99	99	99	99	99	99
November 2015	92	92	92	100	100	100	100	100	100
December 2015	100	100	100	100	100	100	100	100	100
4th Quarter	**97**	**97**	**97**	**99**	**99**	**100**	**100**	**100**	**100**
Annual	**97**	**97**	**97**	**96**	**96**	**98**	**98**	**98**	**98**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Vertical wind data were invalidated due to the buildup of snow and ice on the sensor. Despite the data loss, DQOs were met for the first quarter.
[3] A station power outage resulted in the loss of all meteorological data 5/14/2015 – 5/22/2015. Despite the data loss, DQOs were met for the second quarter for all parameters.

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, 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 $PM_{2.5}$ 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)
1-Jan-15	8.4	7.8	-7.7	13	4.73	2.84	10.30	-0.83	3.92
8-Jan-15	8.5	7.8	-9.0						
15-Jan-15	7.7	7.8	1.3						
22-Jan-15	8.0	7.8	-2.6						
29-Jan-15	8.1	7.8	-3.8						
5-Feb-15	8.1	7.8	-3.8						
12-Feb-15	8.1	7.8	-3.8						
19-Feb-15	8.2	7.8	-5.1						
26-Feb-15	8.2	7.8	-5.1						
5-Mar-15	8.3	7.8	-6.4						
12-Mar-15	8.3	7.8	-6.4						
19-Mar-15	8.4	7.8	-7.7						
26-Mar-15	7.9	7.8	-1.3						

[1]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]
2-Apr-15	8.1	7.8	3.9	12	4.17	1.24	6.60	1.74	1.74
9-Apr-15	8.1	7.8	3.9						
16-Apr-15	8.1	7.8	3.9						
23-Apr-15	8.3	7.8	6.4						
30-Apr-15	8.2	7.8	5.1						
7-May-15	8.1	7.8	3.9						
14-May-15	8.1	7.8	3.9						
21-May-15 [2]	-	-	-						
28-May-15	8.0	7.8	2.6						
4-Jun-15	8.1	7.8	3.9						
11-Jun-15	8.1	7.8	3.9						
18-Jun-15	8.0	7.8	2.6						
25-Jun-15	8.3	7.8	6.4						

[1] Acceptance criteria: ≤ 10%
[2] No precision check due to station power outage.

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)]
2-Jul-15	8.2	7.8	5.1	14	5.22	1.17	7.51	2.93	1.59
9-Jul-15	8.2	7.8	5.1						
16-Jul-15	8.4	7.8	7.7						
17-Jul-15	8.2	7.8	5.1						
23-Jul-15	8.2	7.8	5.1						
30-Jul-15	8.3	7.8	6.4						
6-Aug-15	8.2	7.8	5.1						
13-Aug-15	8.2	7.8	5.1						
20-Aug-15	8.3	7.8	6.4						
27-Aug-15	8.3	7.8	6.4						
3-Sep-15	8.1	7.8	3.9						
10-Sep-15	8.1	7.8	3.9						
17-Sep-15	8.1	7.8	3.9						
24-Sep-15	8.1	7.8	3.9						

[1]Acceptance criteria: ≤ 10%

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]
1-Oct-15	8.1	7.8	3.9	16	5.77	1.62	8.95	2.59	2.15
8-Oct-15	8.2	7.8	5.1						
9-Oct-15	8.2	7.8	5.1						
15-Oct-15	8.2	7.8	5.1						
16-Oct-15	8.2	7.8	5.1						
22-Oct-15	8.3	7.8	6.4						
5-Nov-15	8.4	7.8	7.7						
12-Nov-15	8.4	7.8	7.7						
19-Nov-15	8.5	7.8	9.0						
24-Nov-15	8.1	7.8	3.9						
26-Nov-15	8.1	7.8	3.9						
3-Dec-15	8.2	7.8	5.1						
10-Dec-15	8.3	7.8	6.4						
17-Dec-15	8.3	7.8	6.4						
24-Dec-15	8.4	7.8	7.7						
31-Dec-15	8.1	7.8	3.9						

[1]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]
1-Jan-15	81.2	81.9	-0.8	13	-0.65	0.86	1.04	-2.33	1.19
8-Jan-15	81.0	83.0	-2.4						
15-Jan-15	81.1	81.2	-0.1						
22-Jan-15	96.8	97.3	-0.5						
29-Jan-15	81.5	81.6	-0.2						
5-Feb-15	81.0	82.2	-1.5						
12-Feb-15	80.9	81.5	-0.7						
19-Feb-15	80.6	80.4	0.3						
26-Feb-15	80.5	81.0	-0.6						
5-Mar-15	80.5	80.9	-0.5						
12-Mar-15	81.4	83.1	-2.0						
19-Mar-15	80.8	80.4	0.5						
26-Mar-15	80.2	80.1	0.2						

[1]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]
2-Apr-15	80.3	81.4	-1.3	12	0.43	4.10	8.47	-7.61	5.76
9-Apr-15	80.1	80.9	-1.0						
16-Apr-15	80.1	80.9	-1.0						
23-Apr-15	74.3	76.5	-2.9						
30-Apr-15	73.1	76.2	-4.1						
7-May-15	72.7	76.2	-4.6						
14-May-15	74.2	76.3	-2.8						
21-May-15 [2]	-	-	-						
28-May-15	80.2	79.4	1.0						
4-Jun-15	83.3	78.3	6.5						
11-Jun-15	83.3	78.3	6.4						
18-Jun-15	82.6	77.8	6.2						
25-Jun-15	79.4	77.1	2.9						

[1] Acceptance criteria: ≤ 10%
[2] No precision check due to station power outage.

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)]
2-Jul-15	78.6	77.3	1.7	14	2.68	2.25	7.09	-1.73	3.06
9-Jul-15	78.1	78.3	-0.3						
16-Jul-15	80.3	76.8	4.5						
17-Jul-15	78.1	74.9	4.3						
23-Jul-15	78.2	76.8	1.9						
30-Jul-15	78.9	78.0	1.2						
6-Aug-15	78.3	77.3	1.3						
13-Aug-15	78.0	76.6	1.8						
20-Aug-15	78.7	77.8	1.1						
27-Aug-15	76.7	77.3	-0.8						
3-Sep-15	81.0	77.0	5.3						
10-Sep-15	80.8	76.4	5.8						
17-Sep-15	80.3	77.6	3.4						
24-Sep-15	81.6	76.8	6.3						

[1]Acceptance criteria: ≤ 10%

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)]
1-Oct-15	81.1	79.1	2.5	16	3.17	4.71	12.40	-6.06	6.24
8-Oct-15	84.5	78.2	8.0						
9-Oct-15	83.7	78.0	7.3						
15-Oct-15	85.4	78.5	8.8						
16-Oct-15	69.3	65.2	6.4						
22-Oct-15	65.3	63.0	3.6						
5-Nov-15	84.2	79.3	6.2						
12-Nov-15	85.0	78.1	8.9						
19-Nov-15	89.1	81.5	9.3						
24-Nov-15[(2)]	79.1	77.6	1.9						
26-Nov-15	78.8	79.3	-0.7						
3-Dec-15	77.8	81.0	-3.9						
10-Dec-15	79.0	80.1	-1.4						
17-Dec-15	77.1	78.9	-2.3						
24-Dec-15	77.4	79.5	-2.7						
31-Dec-15	77.8	78.8	-1.3						

[1]Acceptance criteria: ≤ 10%
[2]Check run on Thermo NOx analyzer after its installation following the failure of the API NOx analyzer.

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]
1-Jan-15	0.0915	0.0900	1.7	13	3.23	1.12	5.43	1.04	1.55
8-Jan-15	0.0921	0.0900	2.3						
15-Jan-15	0.0932	0.0900	3.6						
22-Jan-15	0.0926	0.0900	2.9						
29-Jan-15	0.0920	0.0900	2.2						
5-Feb-15	0.0914	0.0900	1.6						
12-Feb-15	0.0934	0.0900	3.8						
19-Feb-15	0.0923	0.0900	2.6						
26-Feb-15	0.0938	0.0900	4.2						
5-Mar-15	0.0930	0.0900	3.3						
12-Mar-15	0.0943	0.0900	4.8						
19-Mar-15	0.0941	0.0900	4.6						
26-Mar-15	0.0941	0.0900	4.6						

[1]Acceptance criteria: ≤ 7%

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]
2-Apr-15	0.0952	0.0900	5.8	12	-0.02	3.41	6.67	-6.70	4.79
9-Apr-15	0.0958	0.0900	6.4						
16-Apr-15	0.0893	0.0900	-0.8						
23-Apr-15	0.0899	0.0900	-0.1						
30-Apr-15	0.0905	0.0900	0.6						
7-May-15	0.0906	0.0900	0.7						
14-May-15	0.0920	0.0900	2.2						
21-May-15 [2]	-	-	-						
28-May-15	0.0872	0.0900	-3.1						
4-Jun-15	0.0869	0.0900	-3.4						
11-Jun-15	0.0875	0.0900	-2.8						
18-Jun-15	0.0868	0.0900	-3.6						
25-Jun-15	0.0881	0.0900	-2.1						

[1] Acceptance criteria: ≤ 7%
[2] No precision check due to station power outage.

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]
2-Jul-15	0.0860	0.0900	-4.4	15	-0.70	3.76	6.67	-8.07	5.04
9-Jul-15	0.0849	0.0900	-5.7						
16-Jul-15	0.0859	0.0900	-4.6						
17-Jul-15	0.0846	0.0900	-6.0						
23-Jul-15	0.0878	0.0900	-2.4						
30-Jul-15[2]	0.0863	0.0900	-4.1						
6-Aug-15[2]	0.0936	0.0900	4.0						
11-Aug-15	0.0946	0.0900	5.1						
13-Aug-15	0.0946	0.0900	5.1						
20-Aug-15	0.0891	0.0900	-1.0						
27-Aug-15	0.0901	0.0900	0.1						
3-Sep-15	0.0900	0.0900	0.0						
10-Sep-15	0.0906	0.0900	0.7						
17-Sep-15	0.0912	0.0900	1.3						
24-Sep-15	0.0913	0.0900	1.4						

[1]Acceptance criteria: ≤ 7%
[2]Extra precision check performed after problems with the automatically-scheduled precision check due to unstable photometer response.

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)]
1-Oct-15	0.0921	0.0900	2.3	14	2.96	1.22	5.35	0.57	1.66
8-Oct-15	0.0920	0.0900	2.2						
15-Oct-15	0.0919	0.0900	2.1						
22-Oct-15	0.0922	0.0900	2.4						
29-Oct-15	0.0930	0.0900	3.3						
5-Nov-15	0.0927	0.0900	3.0						
12-Nov-15	0.0935	0.0900	3.9						
19-Nov-15	0.0939	0.0900	4.3						
26-Nov-15	0.0944	0.0900	4.9						
3-Dec-15	0.0929	0.0900	3.2						
10-Dec-15	0.0934	0.0900	3.8						
17-Dec-15	0.0928	0.0900	3.1						
24-Dec-15	0.0927	0.0900	3.0						
31-Dec-15	0.0898	0.0900	-0.2						

[1]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]
1-Jan-15	77.4	78.0	-0.8	13	-0.35	0.54	0.70	-1.41	0.75
8-Jan-15	77.1	78.0	-1.2						
15-Jan-15	77.3	78.0	-0.9						
22-Jan-15	77.6	78.0	-0.5						
29-Jan-15	78.2	78.0	0.3						
5-Feb-15	78.2	78.0	0.3						
12-Feb-15	77.7	78.0	-0.4						
19-Feb-15	77.6	78.0	-0.5						
26-Feb-15	77.8	78.0	-0.3						
5-Mar-15	77.8	78.0	-0.3						
12-Mar-15	77.3	78.0	-0.9						
19-Mar-15	77.8	78.0	-0.3						
26-Mar-15	78.6	78.0	0.8						

[1]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]
2-Apr-15	77.4	78.0	-0.8	12	1.58	1.61	4.74	-1.57	2.26
9-Apr-15	78.5	78.0	0.6						
16-Apr-15	78.2	78.0	0.3						
23-Apr-15	77.8	78.0	-0.3						
30-Apr-15	79.6	78.0	2.1						
7-May-15	78.3	78.0	0.4						
14-May-15	80.1	78.0	2.7						
21-May-15 [2]	-	-	-						
28-May-15	78.6	78.0	0.8						
4-Jun-15	80.9	78.0	3.7						
11-Jun-15	81.2	78.0	4.1						
18-Jun-15	80.3	78.0	3.0						
25-Jun-15	79.9	78.0	2.4						

[1] Acceptance criteria: ≤ 10%
[2] No precision check due to station power outage.

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)]
2-Jul-15	79.3	78.0	1.7	14	2.28	0.92	4.08	0.48	1.25
9-Jul-15	79.5	78.0	1.9						
16-Jul-15	79.3	78.0	1.7						
17-Jul-15	80.0	78.0	2.6						
23-Jul-15	79.9	78.0	2.4						
30-Jul-15	80.1	79.0	1.4						
6-Aug-15	80.4	78.0	3.1						
13-Aug-15	81.3	78.0	4.2						
20-Aug-15	80.1	78.0	2.7						
27-Aug-15	81.0	78.0	3.9						
3-Sep-15	79.3	78.0	1.7						
10-Sep-15	79.6	78.0	2.1						
17-Sep-15	79.0	78.0	1.3						
24-Sep-15	79.1	78.0	1.4						

[1]Acceptance criteria: ≤ 10%

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]
1-Oct-15	80.4	78.0	3.1	16	2.38	1.06	4.46	0.30	1.40
8-Oct-15	80.7	78.0	3.5						
9-Oct-15	79.7	78.0	2.2						
15-Oct-15	80.1	78.0	2.7						
16-Oct-15	80.6	78.0	3.3						
22-Oct-15	80.0	78.0	2.6						
5-Nov-15	80.5	78.0	3.2						
12-Nov-15	79.4	78.0	1.8						
19-Nov-15	79.5	78.0	1.9						
24-Nov-15	81.1	78.0	4.0						
26-Nov-15	79.7	78.0	2.2						
3-Dec-15	80.0	78.0	2.6						
10-Dec-15	78.1	78.0	0.1						
17-Dec-15	79.9	78.0	2.4						
24-Dec-15	78.1	78.0	0.1						
31-Dec-15	79.9	78.0	2.4						

[1]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/m^3)	Precision[3] (µg/m^3)	Bias[4] (µg/m^3)
1st Quarter (January 1 – March 31, 2015)	Primary FEM against Collocated FEM	73	≥2 µg/m^3	-18.1	1.28	0.64	1.42
		78	All[4]	-20.3	1.26	0.63	1.39
	Primary FEM against Collocated FRM	11	≥2 µg/m^3	-2.5	0.77	0.38	1.19
		12	All[4]	-16.6	0.82	0.41	1.30
2nd Quarter (April 1 – June 30, 2015)	Primary FEM against Collocated FEM	58	≥2 µg/m^3	6.5	1.80	0.90	1.64
		73	All[4]	8.9	1.64	0.82	1.60
	Primary FEM against Collocated FRM	9	≥2 µg/m^3	-6.2	5.64	2.82	3.93
		11	All[4]	-27.1	5.47	2.73	4.37
3rd Quarter (July 1 – September 30, 2015)	Primary FEM against Collocated FEM	13	≥2 µg/m^3	2.1	1.24	0.62	1.02
		80	All[4]	-0.5	1.07	0.54	1.32
	Primary FEM against Collocated FRM	5	≥2 µg/m^3	-23.4	1.43	0.72	2.04
		15	All[4]	-25.9	1.25	0.63	1.71
4th Quarter (October 1 – December 31, 2015)	Primary FEM against Collocated FEM	45	≥2 µg/m^3	35.4	1.37	0.69	2.54
		78	All[4]	58.8	1.38	0.69	2.53
	Primary FEM against Collocated FRM	11	≥2 µg/m^3	11.2	4.29	2.15	2.56
		12	All[4]	7.4	4.14	2.07	2.39
Year to Date (January 1 – December 31, 2015)	Primary FEM against Collocated FEM	**189**	**≥2 µg/m^3**	3.6	1.54	0.77	1.18
		309	All[5]	11.7	1.43	0.72	1.36
	Primary FEM against Collocated FRM	**36**	**≥2 µg/m^3**	-2.1	3.75	1.87	2.06
		50	All[5]	-15.9	3.44	1.72	2.06

[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/m^3 per quarter.
[4] Average over the population of the absolute value of the individual pair concentration difference with a goal of ≤ 4 µg/m^3 per quarter.
[5] BAM concentrations can be slightly negative and still be valid, however these results are excluded from the precision statistics calculations.

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.

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]
January 15, 2015	0.0	0.0	-	0.9	0.9996	-0.0854	0.99997	Pass
	8.1	7.8	-2.6					
	17.5	17.3	-1.2					
	30.0	30.1	0.3					
	40.0	40.0	0.1					
	48.0	47.7	-0.5					
May 22, 2015	0.0	0.2	-	0.4	0.9975	0.1349	0.99998	Pass
	8.0	8.1	0.8					
	17.5	17.5	-0.3					
	30.0	30.2	0.7					
	40.0	40.1	0.3					
	45.0	44.9	-0.2					
May 28, 2015	0.0	0.0	-	0.8	0.9981	0.1245	0.99995	Pass
	8.0	8.1	1.5					
	17.5	17.6	0.7					
	29.9	30.3	1.3					
	40.2	40.2	0.1					
	45.2	45.0	-0.4					

[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)]
September 25, 2015	0.0	0.0	-	0.7	1.0028	0.0672	0.99994	Pass
	8.0	8.0	0.7					
	17.5	17.6	0.7					
	29.9	30.4	1.6					
	40.2	40.4	0.5					
	45.2	45.1	-0.1					
October 29, 2015	0.0	0.1	-	2.1	1.0097	0.1929	0.9999	Pass
	8.0	8.3	4.1					
	17.5	17.7	1.3					
	30.0	30.8	2.9					
	40.2	40.8	1.5					
	45.2	45.6	0.9					
December 29, 2015	0.0	0.0	-	0.8	0.9988	0.1111	0.9998	Pass
	8.0	8.1	0.8					
	17.5	17.6	0.6					
	30.0	30.4	1.4					
	40.0	40.2	0.5					
	45.2	44.9	-0.7					

[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)]
January 15,2015	0.000	0.000		1.6	0.9773	0.0014	0.99998	99.3%	Pass
	0.079	0.079	0.9%						
	0.170	0.167	-1.7%						
	0.298	0.295	-1.2%						
	0.400	0.392	-2.0%						
	0.441	0.432	-2.2%						
May 22, 2015	0	0	-	0.5	1.0047	0.0000	1.00000	99.9%	Pass
	76	77	0.7						
	184	184	0.1						
	310	312	0.7						
	407	409	0.4						
	443	445	0.4						
May 28, 2015	0	0	-	1.8	1.0185	-0.0002	0.99998	101.7%	Pass
	78	80	2.7						
	190	194	1.7						
	281	284	0.9						
	427	435	1.9						
	462	472	2.0						

[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]
June 22, 2015	0	0	-	1.1	1.0123	-0.0001	0.99996	101.5	Pass
	81	81	0.8						
	186	188	1.0						
	316	321	1.7						
	412	414	0.5						
	451	457	1.5						
September 25, 2015	0	0	-	2.3	0.9866	0.0026	0.99981	99.6	Pass
	72	78	8.0						
	184	185	0.5						
	318	312	-1.9						
	411	406	-1.1						
	444	444	0.0						
October 15, 2015	0	0	-	6.4	1.0591	0.0003	0.99997	105.3	Pass
	78	85	8.2						
	187	198	5.4						
	273	290	6.3						
	407	430	5.6						
	426	453	6.3						

[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
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]
October 29, 2015	0	0	-	0.4	0.9929	0.0009	0.99992	99.9	Pass
	80	80	0.2						
	178	178	0.2						
	296	296	0.0						
	399	400	0.2						
	434	428	-1.4						
November 19, 2015	0	0	-	4.8	1.0483	0.0003	0.99999	105.0	Pass
	79	82	4.1						
	169	178	5.2						
	283	296	4.6						
	377	396	5.1						
	408	428	4.9						
November 24, 2015	0	0	-	1.4	0.9785	0.0011	0.99997	98.2	Pass
	79	79	0.0						
	169	166	-1.4						
	330	324	-1.8						
	383	378	-1.4						
	416	406	-2.4						

[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]
January 15, 2015	0.000	0.000		1.2	1.0153	-0.0006	1.00000	Pass
	0.080	0.081	1.0					
	0.175	0.177	0.9					
	0.300	0.304	1.3					
	0.400	0.405	1.3					
	0.450	0.457	1.6					
April 13, 2015	0.000	0.000	-	0.9	0.9975	-0.0009	1.00000	Pass
	0.081	0.079	-2.2					
	0.176	-	-					
	0.300	0.298	-0.6					
	0.400	0.399	-0.4					
	0.451	0.449	-0.5					
May 22, 2015	0.000	0.000	-	2.5	0.9828	-0.0011	0.99999	Pass
	0.081	0.078	-3.7					
	0.176	0.171	-2.8					
	0.300	0.293	-2.3					
	0.400	0.392	-2.0					
	0.451	0.443	-1.8					

[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]
August 4, 2015	0.000	0.000	-	2.6	1.0428	-0.0047	0.99963	Pass
	0.081	0.080	-1.1					
	0.177	0.173	-2.4					
	0.301	0.309	2.6					
	0.405	0.414	2.1					
	0.457	0.478	4.7					
August 18, 2015	0.000	0.002	-	0.5	1.0066	-0.0001	0.99998	Pass
	0.080	0.079	-0.6					
	0.176	0.176	0.0					
	0.299	0.300	0.2					
	0.399	0.402	0.8					
	0.449	0.452	0.8					
September 25, 2015	0.000	0.000	-	1.8	1.0144	0.0005	0.99998	Pass
	0.080	0.082	1.9					
	0.175	0.179	2.1					
	0.300	0.306	1.9					
	0.400	0.407	1.8					
	0.450	0.455	1.2					

[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)]
October 29, 2015	0.000	0.000	-	2.5	1.0287	-0.0004	1.0000	Pass
	0.080	0.081	1.6					
	0.175	0.179	2.5					
	0.300	0.308	2.7					
	0.400	0.411	2.7					
	0.450	0.463	2.9					
December 29, 2015	0.000	0.000	-	0.2	0.9994	0.0004	1.0000	Pass
	0.080	0.080	0.6					
	0.175	0.175	0.3					
	0.299	0.300	0.2					
	0.400	0.400	0.0					
	0.450	0.450	0.0					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±7%
2. Slope ≥ 0.93 and ≤ 1.07
3. R^2 ≥ 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)]
January 15, 2015	0.000	0.0		0.2	1.0014	-0.0004	1.00000	Pass
	78.5	78.2	-0.3					
	171.0	170.2	-0.5					
	292.6	292.5	0.0					
	389.6	389.6	0.0					
	467.5	468.1	0.1					
May 22, 2015	0.0	-1.0	-	0.8	1.0008	0.0000	0.99996	Pass
	78.3	80.0	2.1					
	171.0	172.0	0.6					
	292.3	290.0	-0.8					
	389.9	390.0	0.0					
	438.5	440.0	0.4					
May 28, 2015	0.0	1.2	-	2.3	1.0180	0.0010	0.99996	Pass
	77.8	80.2	3.1					
	170.4	172.9	1.4					
	291.6	299.9	2.8					
	391.4	400.7	2.4					
	440.3	447.5	1.6					

[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)]
September 25, 2015	0.0	0.0	-	1.2	0.9999	0.0032	0.99997	Pass
	78.0	79.0	1.5					
	170.0	173.0	1.7					
	292.0	295.0	1.1					
	392.0	394.0	0.7					
	440.0	444.0	0.9					
October 29, 2015	0.0	0.0	-	1.1	1.0032	0.0010	1.0000	Pass
	78.0	81.0	3.7					
	170.0	171.0	0.2					
	292.0	293.0	0.5					
	392.0	394.0	0.6					
	441.0	444.0	0.7					

[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
15-Jan-15	-23.2	-23.1	-0.1	748	749	-1	12:06:29	12:04:30	00:01:59	16.7	16.83	-0.8%
19-Feb-15	-8.4	-8.2	-0.2	760	758	2	13:28:05	13:26:00	00:02:05	16.7	16.81	-0.7%
25-Mar-15[4]	-20.5	-21.7	1.2	757	753	4	13:49:27	13:47:45	00:01:42	16.7	16.86	-0.9%
19-Apr-15	-7.8	-7.4	-0.4	750	748	2	14:42:30	14:40:30	00:02:00	16.7	16.91	-1.2%
22-May-15[4]	5.7	5.7	0.0	767	766	1	18:03:00	18:01:30	00:01:30	16.7	16.83	-0.8%
24-Jun-15	19.8	19.9	-0.1	751	752	-1	08:20:00	08:21:00	-00:01:00	16.7	16.71	0.1%
23-Jul-15	5.2	5.2	0.0	758	757	1	14:34:22	14:32:27	00:01:55	16.7	16.76	-0.4%
26-Aug-15	7.9	8.3	-0.4	746	745	1	15:31:37	15:29:10	00:02:27	16.7	16.65	0.3%
21-Sep-15	-1.2	0.0	-1.2	767	765	2	16:01:40	16:01:00	00:00:40	16.7	16.88	-1.1%
29-Oct-15	-7.7	-7.1	-0.6	754	754	0	16:28:00	16:26:00	00:02:00	16.7	16.86	-0.9%
20-Nov-15	-18.5	-17.6	-0.9	749	747	2	15:12:00	15:10:35	00:01:25	16.7	16.62	0.5%
15-Dec-15	-15.7	-15.9	0.2	757	754	3	13:20:15	13:18:00	00:02:15	16.7	16.95	-1.5%

[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
15-Jan-15	-23.2	-23.9	0.7	748	748	0	12:07:52	12:05:45	00:02:07	16.7	16.80	-0.6%
19-Feb-15	-8.7	-7.8	-0.9	759	758	1	13:30:02	13:28:00	00:02:02	16.7	16.62	0.5%
25-Mar-15 (As-Found)	-22.1	-21.8	-0.3	756	752	4	13:04:51	13:02:30	00:02:21	16.7	**15.59**	**7.1%**
25-Mar-15[4] (As-Left)	-22.0	-21.6	-0.4	754	754	0	13:30:02	13:28:00	00:02:02	16.7	16.73	-0.2%
19-Apr-15	-8.4	-7.8	-0.6	749	748	1	14:41:52	14:40:00	00:01:52	16.7	16.76	-0.4%
22-May-15[4]	5.1	5.5	-0.4	766	766	0	18:03:25	18:01:00	00:02:25	16.7	16.83	-0.8%
24-Jun-15	20.0	19.9	0.1	752	752	0	08:38:40	08:40:18	-00:01:38	16.7	16.71	-0.1%
23-Jul-15	5.4	5.2	0.2	757	757	0	14:29:17	14:30:15	-00:00:58	16.7	16.80	-0.6%
26-Aug-15	7.9	8.3	-0.4	745	745	0	15:28:10	15:25:58	00:02:12	16.7	16.75	-0.3%
21-Sep-15	-0.9	0.0	-0.9	764	765	-1	16:02:50	16:00:00	00:02:50	16.7	16.88	-1.1%
29-Oct-15	-7.5	-7.1	-0.4	754	754	0	16:27:00	16:25:00	00:02:00	16.7	16.91	-1.2%
20-Nov-15	-18.2	-17.6	-0.6	748	747	1	15:12:27	15:10:35	00:01:52	16.7	16.98	-1.6%
15-Dec-15	-15.6	-15.9	0.3	754	753	1	13:23:07	13:21:00	00:02:07	16.7	16.85	-0.9%

[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 2-28: May 28, 2015 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Time	≤ ±05:00	mm:ss	00:00	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.44	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.40	Pass
Air Temperature Difference	≤ ±0.10	°C	0.04	Pass
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	0.1	Pass
Wind Direction Alignment	≤ ±5	Degree	1.4	Pass
Wind Direction Accuracy	≤ ±5	Degree	4.0	Pass
Wind Direction Linearity	≤ ±3	Degree	2.3	Pass
Wind Direction Torque	≤ 11.0	g-cm	6.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.18	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±2	%	0.7	Pass

Table 2-29: October 29, 2015 Meteorological Calibration Summary

Parameter	Limit	Units	Error	Status
Time	≤ ±5	mm:ss	00:00	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.08	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.08	Pass
Air Temperature Difference	≤ ±0.10	°C	0.06	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	Pass
Wind Direction Accuracy	≤ ±5	Degree	2.9	Pass
Wind Direction Linearity	≤ ±3	Degree	1.3	Pass
Wind Direction Torque	≤ 11.0	g-cm	8.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.33	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±10	W/m^2	0.2	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 2015 monitoring year this audit occurred at the Nuiqsut 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 December 2015 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	
January 15, 2015	0	0.00	0.01	-	1.4	0.9628	0.101	0.9999	Pass
	1	1.94	1.95	0.5					
	2	6.61	6.62	0.2					
	3	21.96	21.20	-3.5					
May 28, 2015	0	0.00	0.01	-	0.6	1.0003	-0.022	1.0000	Pass
	1	2.17	2.15	-0.9					
	2	6.92	6.85	-1.0					
	3	22.01	22.01	0.0					
August 27, 2015	0	0.00	0.12	-	0.4	0.9921	0.060	1.0000	Pass
	1	2.10	2.09	-0.5					
	2	6.84	6.83	-0.1					
	3	21.70	21.60	-0.5					
October 29, 2015	0	0.00	0.12	-	5.9	1.0470	0.087	1.0000	Pass
	1	2.23	2.37	6.3					
	2	6.85	7.28	6.3					
	3	24.56	25.80	5.0					

[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		
January 15, 2015	0	0	0	-	2.4	1.0212	0.152	1.0000	100.0%	Pass
	1	42	43	2.4						
	2	74	76	2.7						
	3	232	237	2.2						
May 28, 2015	0	0	0	-	2.6	0.9865	-0.663	1.0000	100.0%	Pass
	1	50	48	-4.0						
	2	85	83	-2.4						
	3	261	257	-1.5						
August 27, 2015	0	0	0	-	2.4	1.0134	-1.659	0.9999	100.0%	Pass
	1	51	49	-3.9						
	2	84	82	-2.4						
	3	211	213	0.9						
October 29, 2015	0	0	0	-	1.7	0.9954	-0.441	1.0000	100.0%	Pass
	1	31	30	-3.2						
	2	769	75	-1.3						
	3	159	158	-0.6						

[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	
January 15, 2015	0	0.000	0.001	-	2.8	1.0131	0.002	1.0000	Pass
	1	0.033	0.034	3.0					
	2	0.077	0.080	3.9					
	3	0.151	0.157	4.0					
	4	0.396	0.402	1.5					
May 28, 2015	0	0.000	0.001	-	3.0	0.9574	0.002	1.0000	Pass
	1	0.033	0.032	-3.0					
	2	0.076	0.076	0.0					
	3	0.149	0.146	-2.0					
	4	0.401	0.385	-4.0					
August 27, 2015	0	0.000	0.001	-	1.3	1.0006	-0.007	1.0000	Pass
	1	0.030	0.029	-3.3					
	2	0.076	0.074	-2.6					
	3	0.150	0.149	-0.7					
	4	0.395	0.395	0.0					
October 29, 2015	0	0.000	0.001	-	1.7	1.0028	0.001	1.0000	Pass
	1	0.030	0.031	3.3					
	2	0.075	0.076	1.3					
	3	0.150	0.152	1.3					
	4	0.401	0.403	0.5					

[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	
January 15, 2015	0	0	1	-	0.9	1.0115	-0.235	0.9999	Pass
	1	33	33	0					
	2	70	69	-1.4					
	3	240	243	1.3					
May 28, 2015	0	0	1	-	1.8	0.9954	-0.325	0.9999	Pass
	1	42	41	-2.4					
	2	76	74	-2.6					
	3	251	250	-0.4					
August 27, 2015	0	0	1	-	1.0	0.9804	0.772	1.0000	Pass
	1	40	40	0.0					
	2	73	72	-1.4					
	3	248	244	-1.6					
October 29, 2015	0	0	1	-	1.8	0.9909	0.055	1.0000	Pass
	1	30	29	-3.3					
	2	75	74	-1.3					
	3	248	246	-0.8					

[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 (%)	
January 15, 2015	0.1	-0.7	1	-1.8	1.8	Pass
May 28, 2015	0.1	-0.4	1	-0.6	0.6	Pass
August 31, 2015	0.1	-0.4	1	0.0	0.0	Pass
October 29, 2015	0.3	-0.1	0	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 (%)	
January 15, 2015	0.2	-0.4	-1	-1.2	1.2	Pass
May 28, 2015	0.0	-0.6	0	-1.2	1.2	Pass
August 31, 2015	0.0	-0.3	0	0.0	0.0	Pass
October 29, 2015	0.1	0.3	-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 2-36: May 28, 2015 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	0.23	Pass
Wind Direction Accuracy	≤ ±5	Degree	-1	Pass
Wind Direction Linearity	≤ ±3	Degree	1	Pass
Wind Direction Torque	≤ 0.5	m/s	0.46	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	-0.12	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.09	Pass
Air Temperature Difference	≤ ±0.10	°C	0.04	Pass
Solar Radiation Accuracy > 200 W/m^2	≤ 5%	%	0.5%	Pass

Table 2-37: October 29, 2015 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	0.28	Pass
Wind Direction Accuracy	≤ ±5	Degree	-2	Pass
Wind Direction Linearity	≤ ±3	Degree	2	Pass
Wind Direction Torque	≤ 0.5	m/s	0.43	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	-0.07	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	-0.09	Pass
Air Temperature Difference	≤ ±0.10	°C	0.03	Pass
Solar Radiation Accuracy < 200 W/m^2	≤ ±10	W/m^2	0.2	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] ($\mu g/m^3$)
25-Aug-2015	0.26	2.60	2.34	1.13
27-Aug-2015	1.54	2.00	0.46	
28-Aug-2015	0.25	1.60	1.35	
29-Aug-2015	0.12	1.20	1.08	
30-Aug-2015	1.54	2.00	0.46	

[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, 2015, through December 31, 2015, 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	0	1	**1**	**2.9%**
			2nd Highest, 1-Hour Average	1	0	0	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour [1]	1st Highest, 8-Hour Average	1	0	0	1	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	0	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)	-	-	-	-	**23.6**	**23.6%**
			1st Highest, 1-Hour Average	33.9	26.2	14.3	29.1	**33.9**	**33.9%**
			2nd Highest, 1-Hour Average	26.0	22.4	11.4	18.0	**29.1**	**29.1%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	3	1	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	0.042	0.034	0.039	**0.045**	**60.0%**
			1st Highest, 8-Hour Average	0.046	0.043	0.035	0.042	**0.046**	**61.3%**
			2nd Highest, 8-Hour Average	0.046	0.043	0.035	0.040	**0.046**	**61.3%**

[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)	-	-	-	-	**1.2**	**1.6%**
			1st Highest, 1-Hour Average	0.5	2.3	0.9	1.3	**2.3**	**3.1%**
			2nd Highest, 1-Hour Average	0.4	1.7	0.9	1.2	**1.7**	**2.3%**
	0.5 ppm (1,300 μg/m^3)	3-Hour [5]	1st Highest, 3-Hour Average	0.0	0.0	0.0	0.0	**0.0**	0.0%
			2nd Highest, 3-Hour Average	0.0	0.0	0.0	0.0	**0.0**	0.0%
	0.14 ppm (365 μg/m^3)	24-Hour [5]	1st Highest, 24-Hour Average	0.00	0.00	0.00	0.00	**0.00**	**0.0%**
			2nd Highest, 24-Hour Average	0.00	0.00	0.00	0.00	**0.00**	**0.0%**
	0.030 ppm (80 μg/m^3)	Annual	Average of Period	0.000	0.000	0.000	0.001	**0.000**	**0.0 %**

[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	-	-	-	-	**10**	**28.6%**
			1st Highest, 24-Hour Average	13	9	17	12	**17**	**48.9%**
			2nd Highest, 24-Hour Average	11	7	8	7	**13**	**36.0%**
	15.0 μg/m^3	Annual [7,8]	Average of Period	4.0	2.6	2.2	2.2	**2.8**	**23.3%**
Particulate Matter <10 microns (**PM_{10}**)	150 μg/m^3	24-Hour [9,10]	1st Highest, 24-Hour Average	20	40	150	10	**150**	**100.0%**
			2nd Highest, 24-Hour Average	10	40	100	10	**100**	**66.7%**

[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.

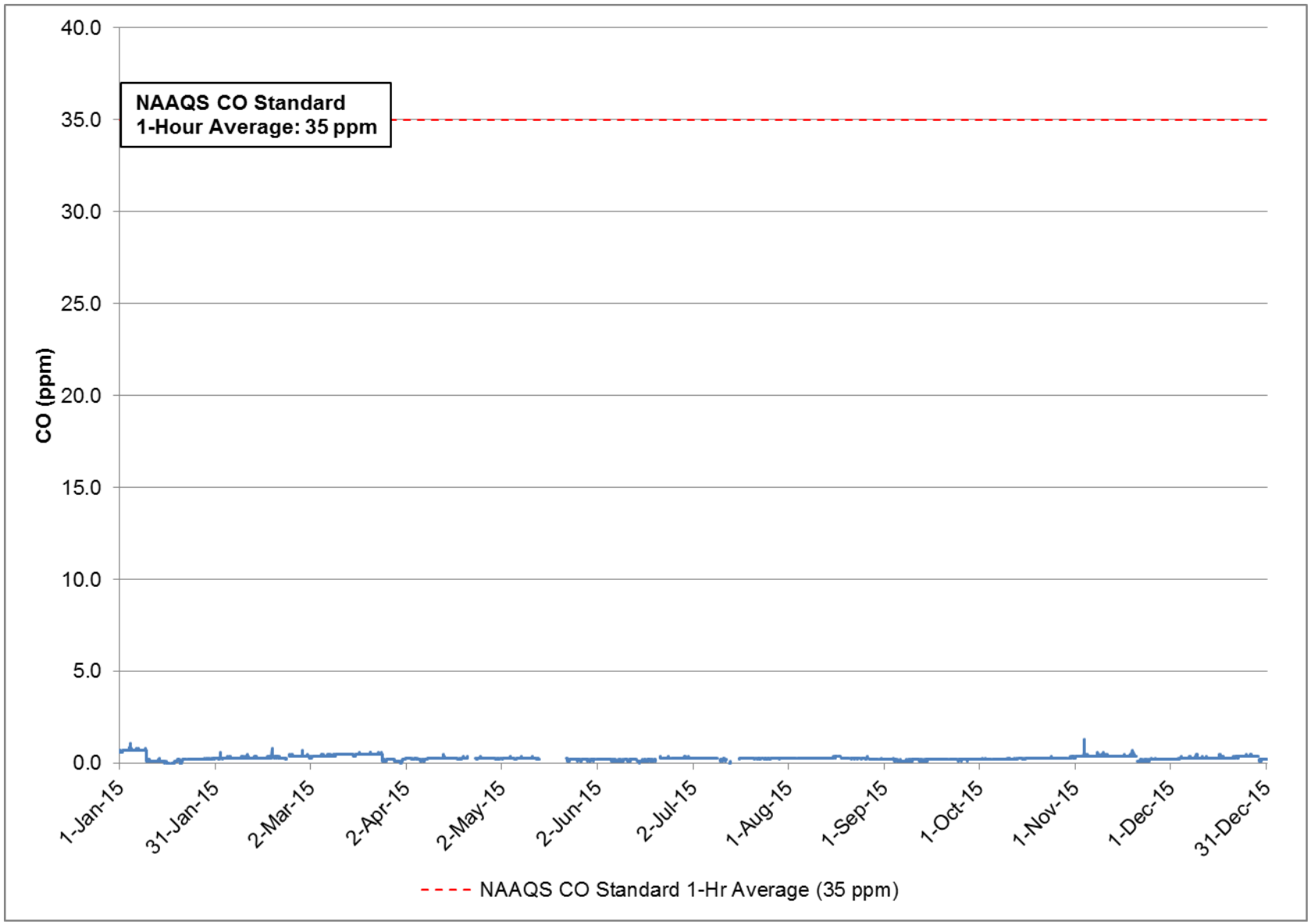


Figure 3-1: 1-Hour Average CO and NAAQS/AAAQS Standard

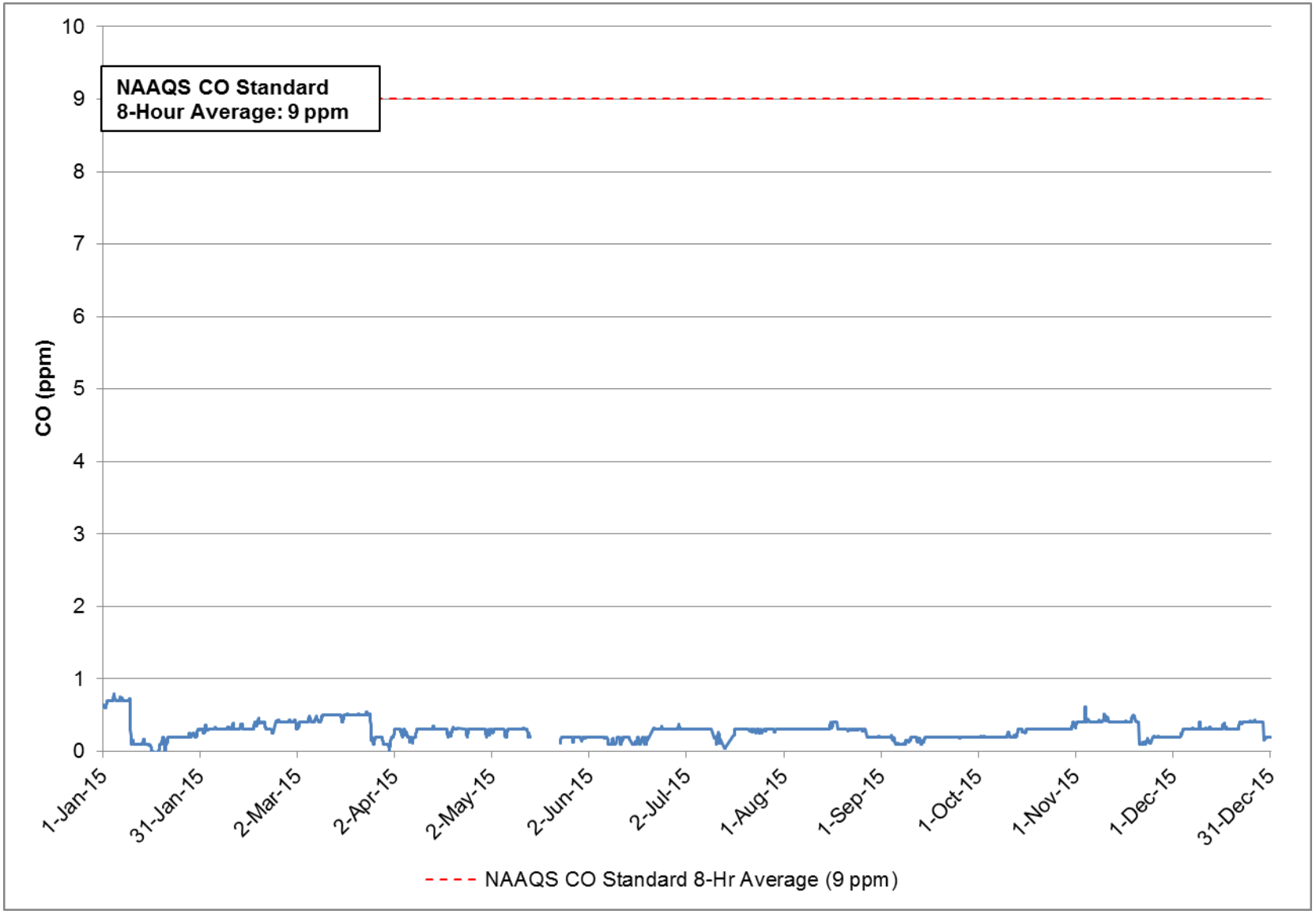


Figure 3-2: 8-Hour Average CO and NAAQS/AAAQS Standard

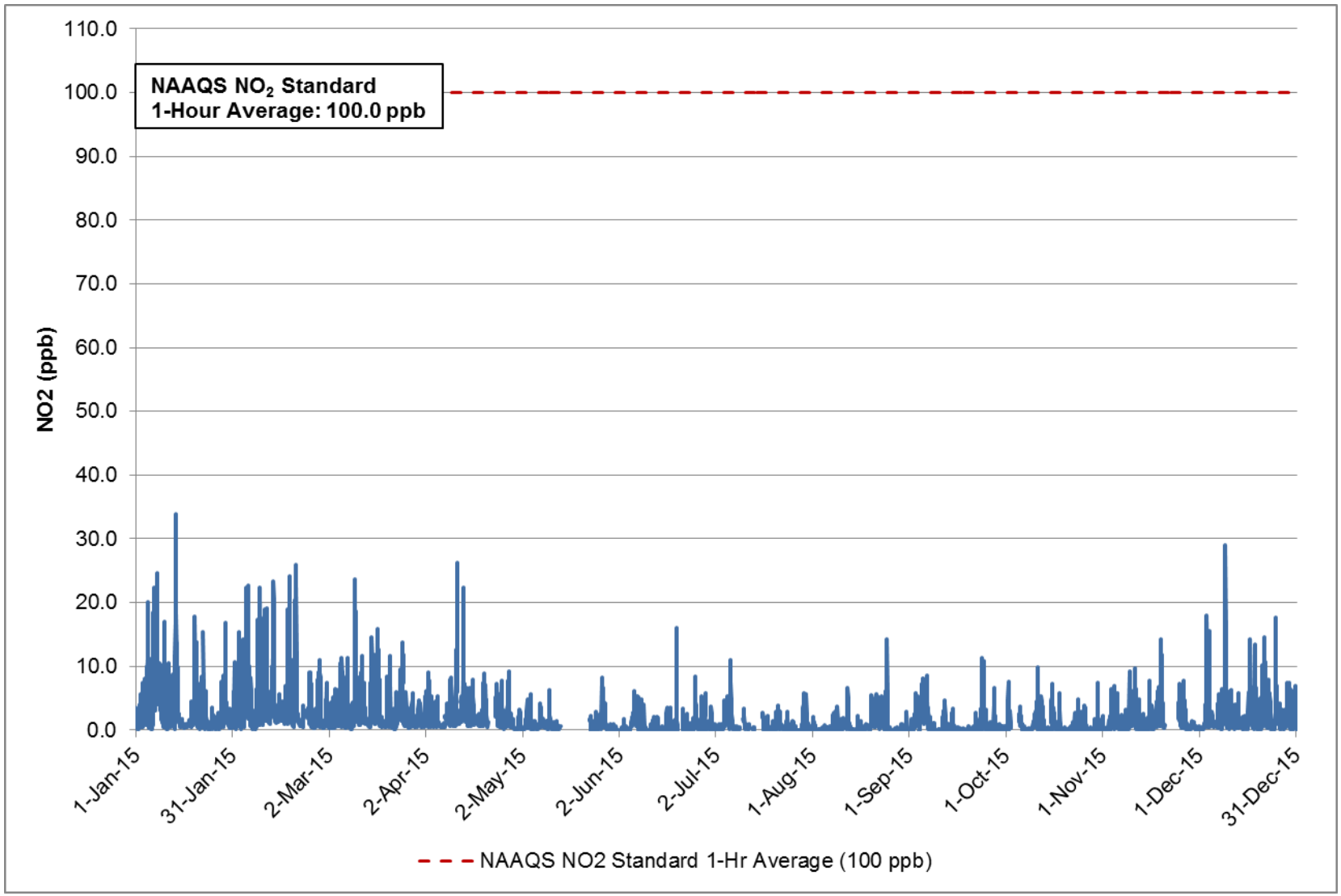


Figure 3-3: 1-Hour Average NO_2 and NAAQS Standard

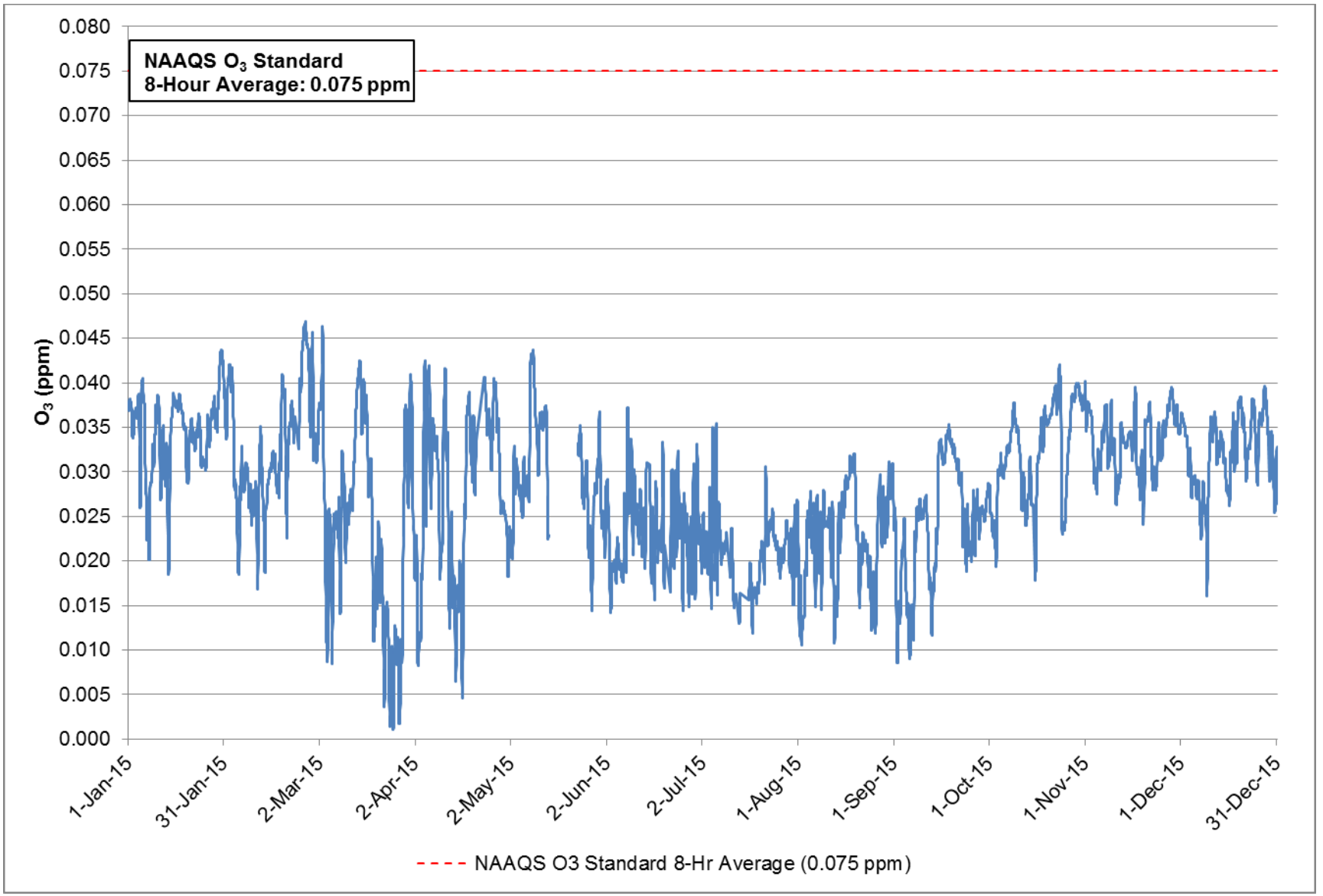


Figure 3-4: 8-Hour Average O_3 and NAAQS/AAAQS Standard

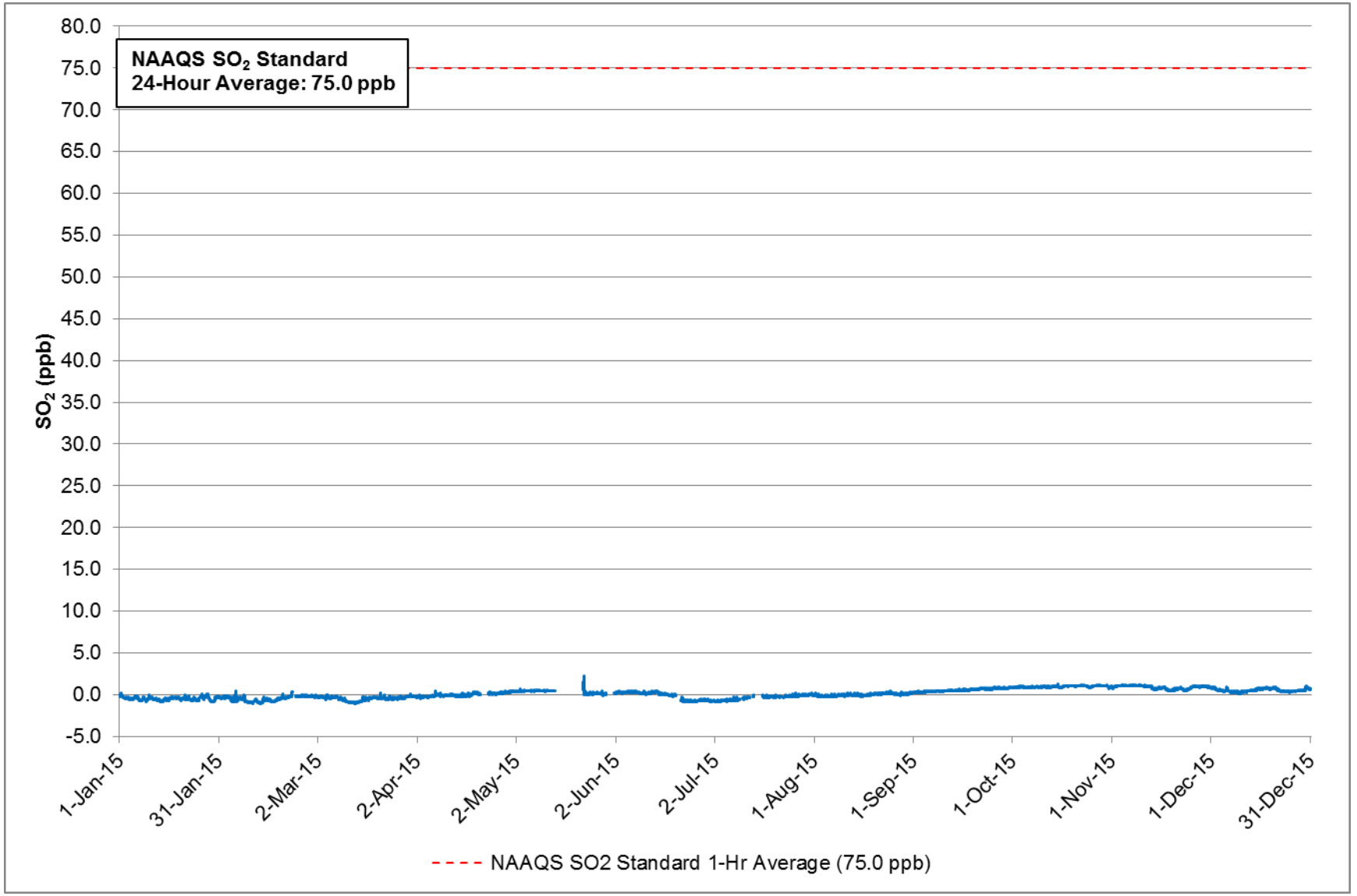


Figure 3-5: 1-Hour Average SO_2 and NAAQS/AAAQS Standard

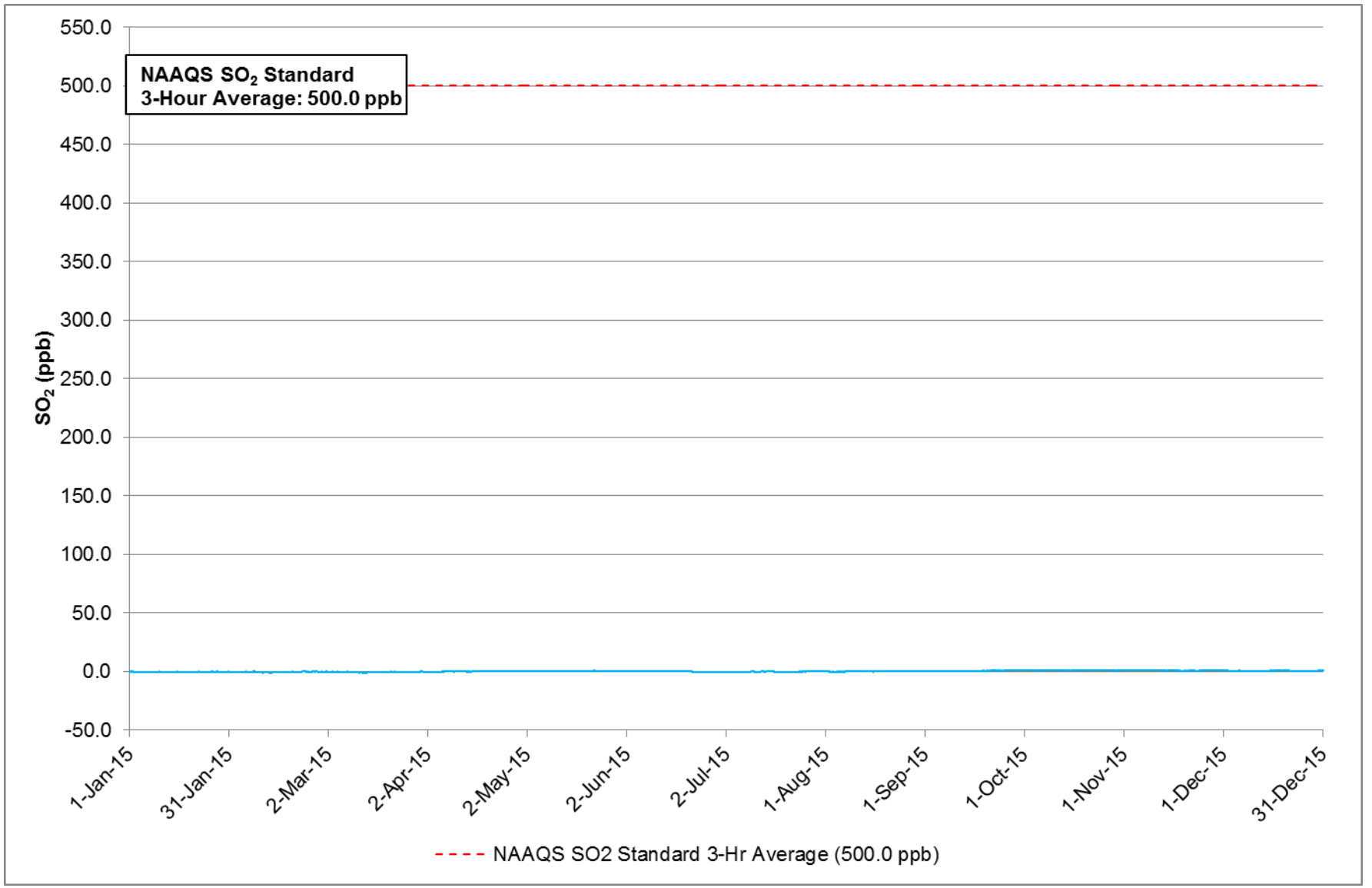


Figure 3-6: 3-Hour Average SO_2 and NAAQS/AAAQS Standard

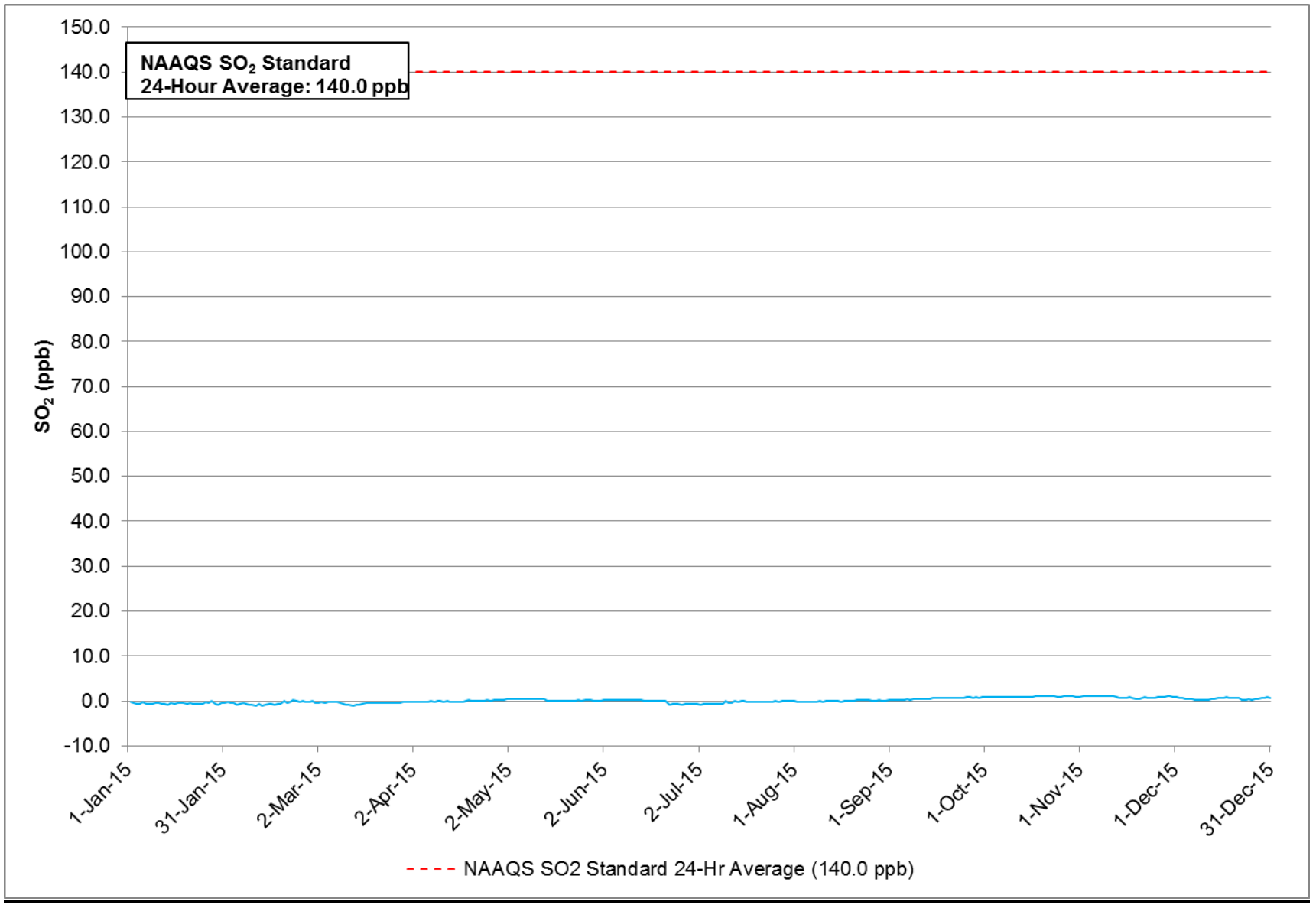


Figure 3-7: 24-Hour Average SO_2 and NAAQS/AAAQS Standard

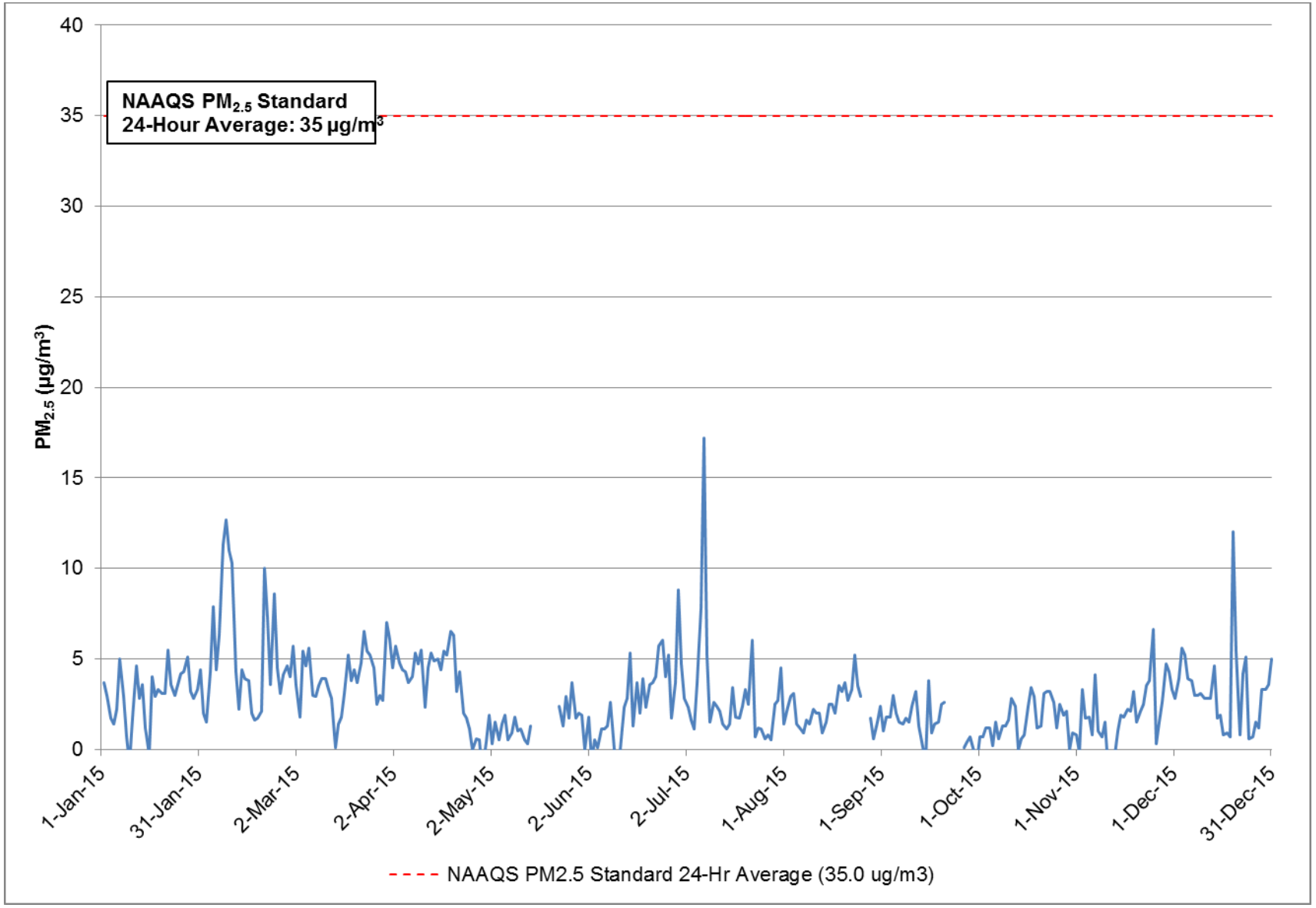


Figure 3-8: 24-Hour Average $PM_{2.5}$ and NAAQS/AAAQS Standard

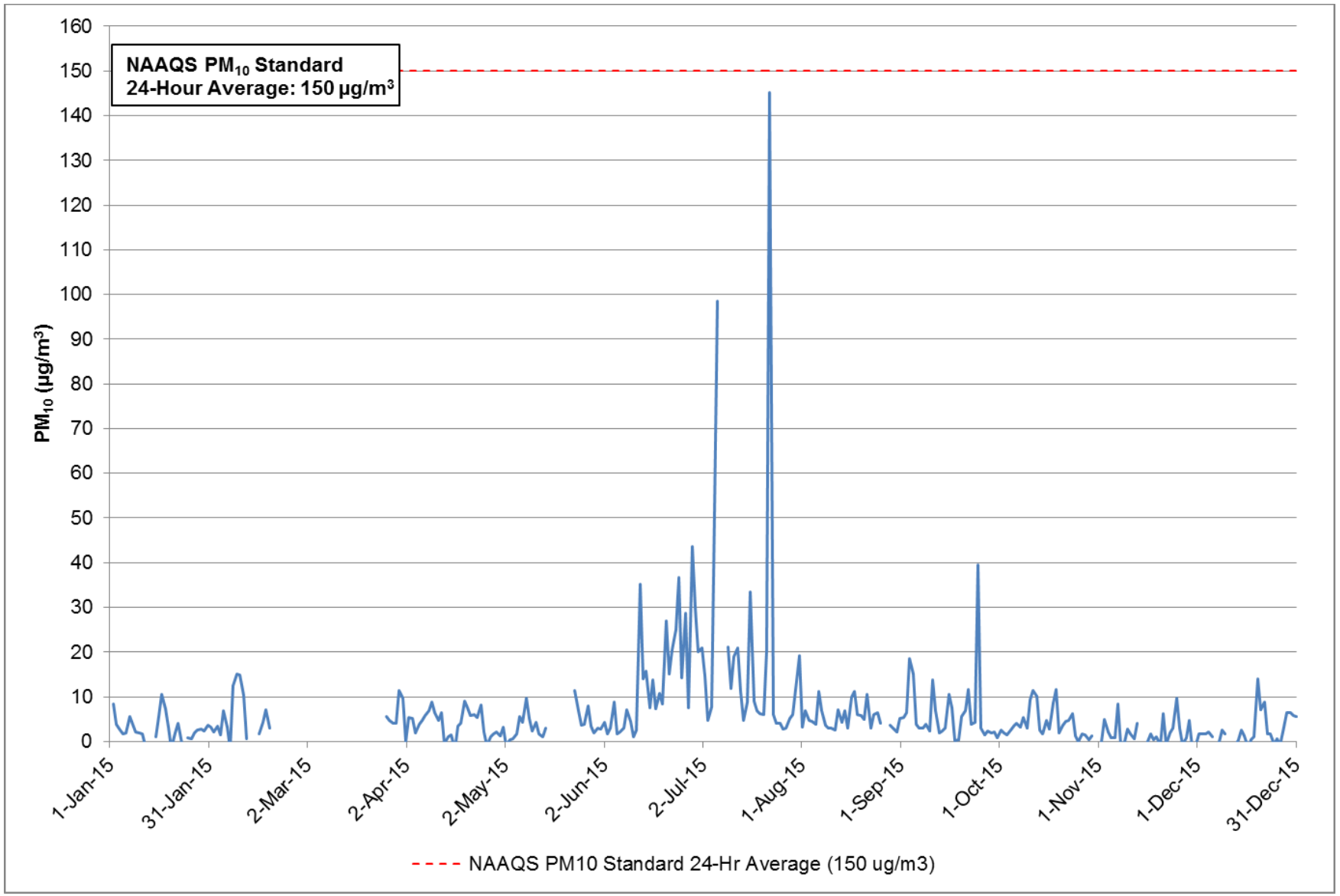


Figure 3-9: 24-Hour Average PM_{10} and NAAQS/AAAQS Standard

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	5.79	17.50
2nd Quarter	4.67	22.10
3rd Quarter	4.20	11.80
4th Quarter	5.18	15.40
Monitoring Year	**5.02**	**22.10**

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	5.20	22.42	0.24	1.94
2nd Quarter	4.62	17.80	0.16	1.03
3rd Quarter	4.68	12.18	0.17	0.60
4th Quarter	4.78	13.85	0.25	1.00
Monitoring Year	**4.82**	**22.42**	**0.20**	**1.94**

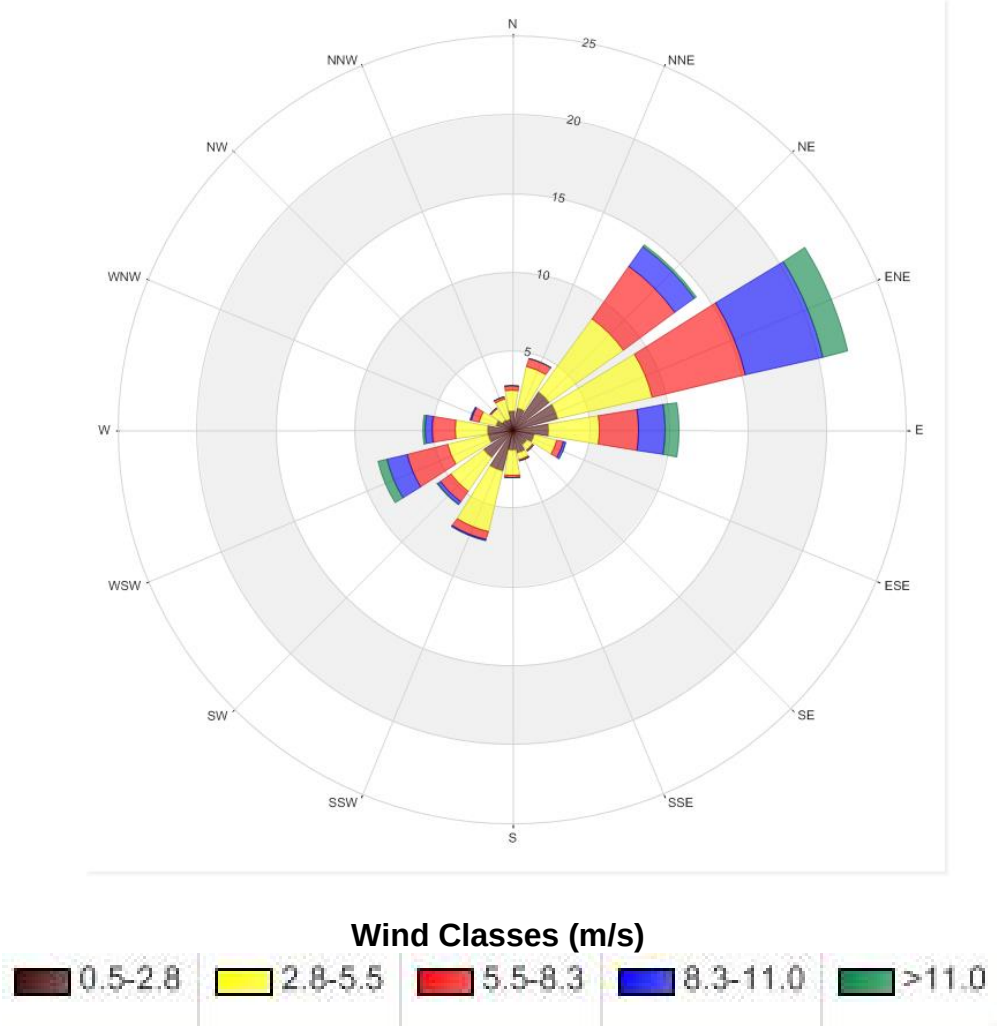
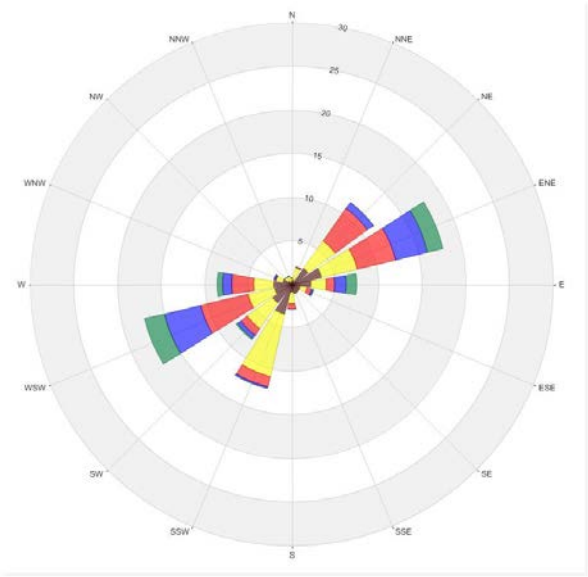
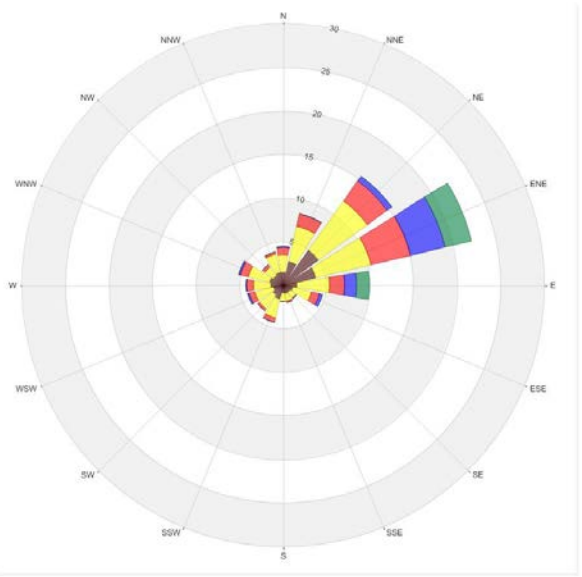


Figure 3-10: Nuiqsut Annual Wind Rose

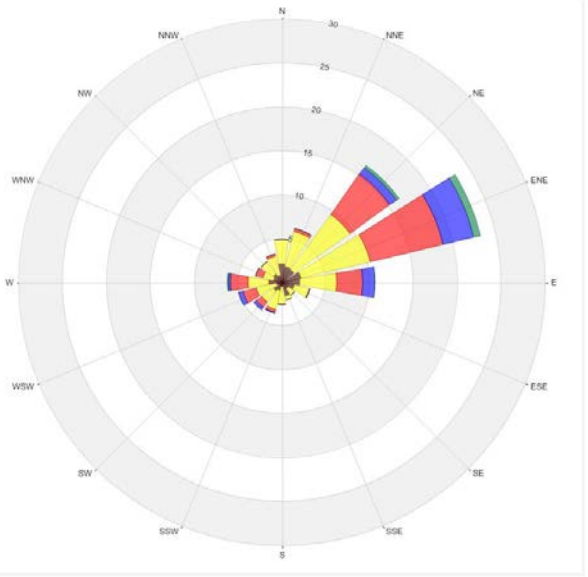
1st Quarter (1/1/15 – 3/31/15)



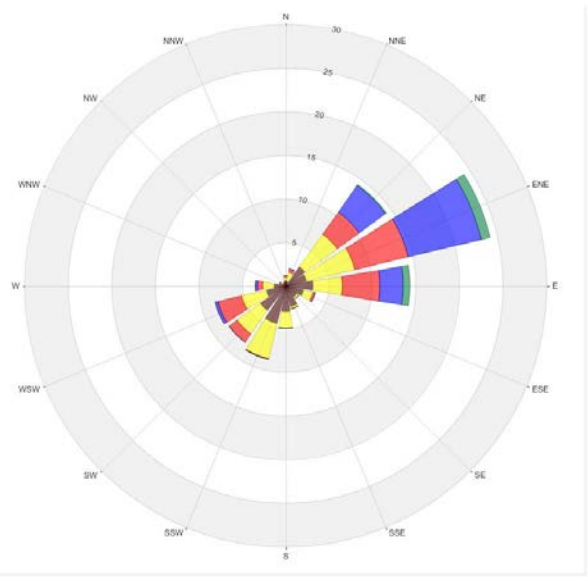
2nd Quarter (4/1/15 – 6/30/15)



3rd Quarter (7/1/15 – 9/30/15)



4th Quarter (10/1/15 – 12/31/15)



Wind Classes (m/s)

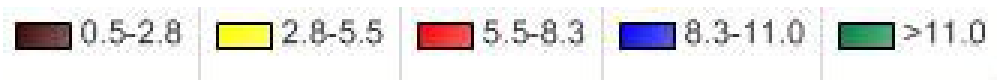


Figure 3-11: Nuiqsut Quarterly Wind Roses

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	1.20	1.32	0.27	0.01	0.00	**2.80**
NNE	1.44	2.66	0.58	0.00	0.00	**4.68**
NE	2.93	5.78	4.06	1.54	0.13	**14.44**
ENE	3.01	6.14	6.08	5.02	1.65	**21.90**
E	2.33	3.23	2.49	1.69	0.87	**10.61**
ESE	1.48	1.42	0.47	0.11	0.02	**3.50**
SE	1.15	0.48	0.04	0.00	0.00	**1.67**
SSE	1.56	0.42	0.04	0.00	0.00	**2.02**
S	1.35	1.56	0.16	0.00	0.00	**3.07**
SSW	2.68	3.98	0.53	0.08	0.00	**7.27**
SW	2.21	2.62	0.79	0.21	0.05	**5.88**
WSW	1.54	2.65	2.66	1.33	0.58	**8.76**
W	1.61	1.98	1.47	0.44	0.19	**5.69**
WNW	1.05	1.12	0.51	0.08	0.00	**2.76**
NW	0.80	0.86	0.09	0.00	0.00	**1.75**
NNW	0.73	1.29	0.13	0.00	0.00	**2.15**
Summary	**27.07**	**37.51**	**20.37**	**10.51**	**3.49**	**98.95[(1)]**

[1] The remaining 1.05 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	0.47	0.23	0.00	0.00	0.00	**0.70**
NNE	0.56	1.36	0.14	0.00	0.00	**2.06**
NE	2.34	3.84	4.54	0.84	0.00	**11.56**
ENE	3.56	4.17	4.54	3.79	1.83	**17.89**
E	2.30	1.69	0.94	1.31	1.26	**7.50**
ESE	1.03	0.80	0.52	0.14	0.09	**2.58**
SE	0.94	0.05	0.05	0.00	0.00	**1.04**
SSE	1.08	0.09	0.00	0.00	0.00	**1.17**
S	0.94	1.36	0.56	0.00	0.00	**2.86**
SSW	3.61	7.26	1.22	0.23	0.00	**12.32**
SW	2.72	3.56	0.94	0.47	0.19	**7.88**
WSW	2.06	3.09	5.57	4.31	2.30	**17.33**
W	2.15	2.25	2.48	1.08	0.66	**8.62**
WNW	1.08	0.80	0.05	0.19	0.00	**2.12**
NW	0.52	0.47	0.00	0.00	0.00	**0.99**
NNW	0.23	0.80	0.00	0.00	0.00	**1.03**
Summary	**25.59**	**31.82**	**21.55**	**12.36**	**6.33**	**97.65[(1)]**

[1] The remaining 2.35 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	1.54	1.93	0.94	0.05	0.00	**4.46**
NNE	2.82	4.11	1.49	0.00	0.00	**8.42**
NE	5.00	6.93	2.82	0.64	0.00	**15.39**
ENE	3.86	6.49	4.71	4.11	3.07	**22.24**
E	1.68	3.71	1.73	1.34	1.49	**9.95**
ESE	1.24	2.13	0.99	0.30	0.00	**4.66**
SE	1.04	0.74	0.10	0.00	0.00	**1.88**
SSE	1.04	0.89	0.15	0.00	0.00	**2.08**
S	0.94	0.94	0.05	0.00	0.00	**1.93**
SSW	1.68	2.18	0.54	0.00	0.00	**4.40**
SW	1.39	1.98	0.25	0.00	0.00	**3.62**
WSW	1.14	2.23	0.64	0.15	0.00	**4.16**
W	1.44	1.98	0.79	0.10	0.00	**4.31**
WNW	1.63	2.48	0.94	0.15	0.00	**5.20**
NW	1.34	1.19	0.35	0.00	0.00	**2.88**
NNW	1.54	2.13	0.30	0.00	0.00	**3.97**
Summary	**29.32**	**42.04**	**16.79**	**6.84**	**4.56**	**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	2.13	2.77	0.00	0.00	0.00	**4.90**
NNE	1.86	4.13	0.36	0.00	0.00	**6.35**
NE	1.77	7.77	5.63	0.91	0.36	**16.44**
ENE	2.23	8.13	8.58	3.54	0.77	**23.25**
E	2.09	4.22	2.91	1.41	0.00	**10.63**
ESE	1.50	1.68	0.14	0.00	0.00	**3.32**
SE	1.00	0.86	0.00	0.00	0.00	**1.86**
SSE	1.63	0.45	0.00	0.00	0.00	**2.08**
S	0.54	2.00	0.05	0.00	0.00	**2.59**
SSW	0.95	2.27	0.32	0.09	0.00	**3.63**
SW	1.18	1.63	0.77	0.36	0.00	**3.94**
WSW	0.64	2.36	1.54	0.54	0.00	**5.08**
W	1.50	2.41	1.95	0.27	0.09	**6.22**
WNW	1.04	1.18	0.91	0.00	0.00	**3.13**
NW	1.14	1.77	0.05	0.00	0.00	**2.96**
NNW	0.82	2.27	0.23	0.00	0.00	**3.32**
Summary	**22.02**	**45.90**	**23.44**	**7.12**	**1.22**	**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	0.65	0.33	0.19	0.00	0.00	**1.17**
NNE	0.56	1.07	0.37	0.00	0.00	**2.00**
NE	2.75	4.57	3.12	3.73	0.14	**14.31**
ENE	2.47	5.73	6.34	8.62	1.03	**24.19**
E	3.22	3.31	4.34	2.70	0.79	**14.36**
ESE	2.14	1.12	0.28	0.00	0.00	**3.54**
SE	1.63	0.28	0.00	0.00	0.00	**1.91**
SSE	2.47	0.28	0.00	0.00	0.00	**2.75**
S	2.98	1.91	0.00	0.00	0.00	**4.89**
SSW	4.48	4.15	0.05	0.00	0.00	**8.68**
SW	3.54	3.31	1.17	0.00	0.00	**8.02**
WSW	2.33	2.89	2.80	0.28	0.00	**8.30**
W	1.35	1.26	0.61	0.28	0.00	**3.50**
WNW	0.47	0.09	0.14	0.00	0.00	**0.70**
NW	0.23	0.00	0.00	0.00	0.00	**0.23**
NNW	0.37	0.00	0.00	0.00	0.00	**0.37**
Summary	**31.64**	**30.30**	**19.41**	**15.61**	**1.96**	**98.92[(1)]**

[1] The remaining 1.08 percent of data were calms (below 0.5 m/s).

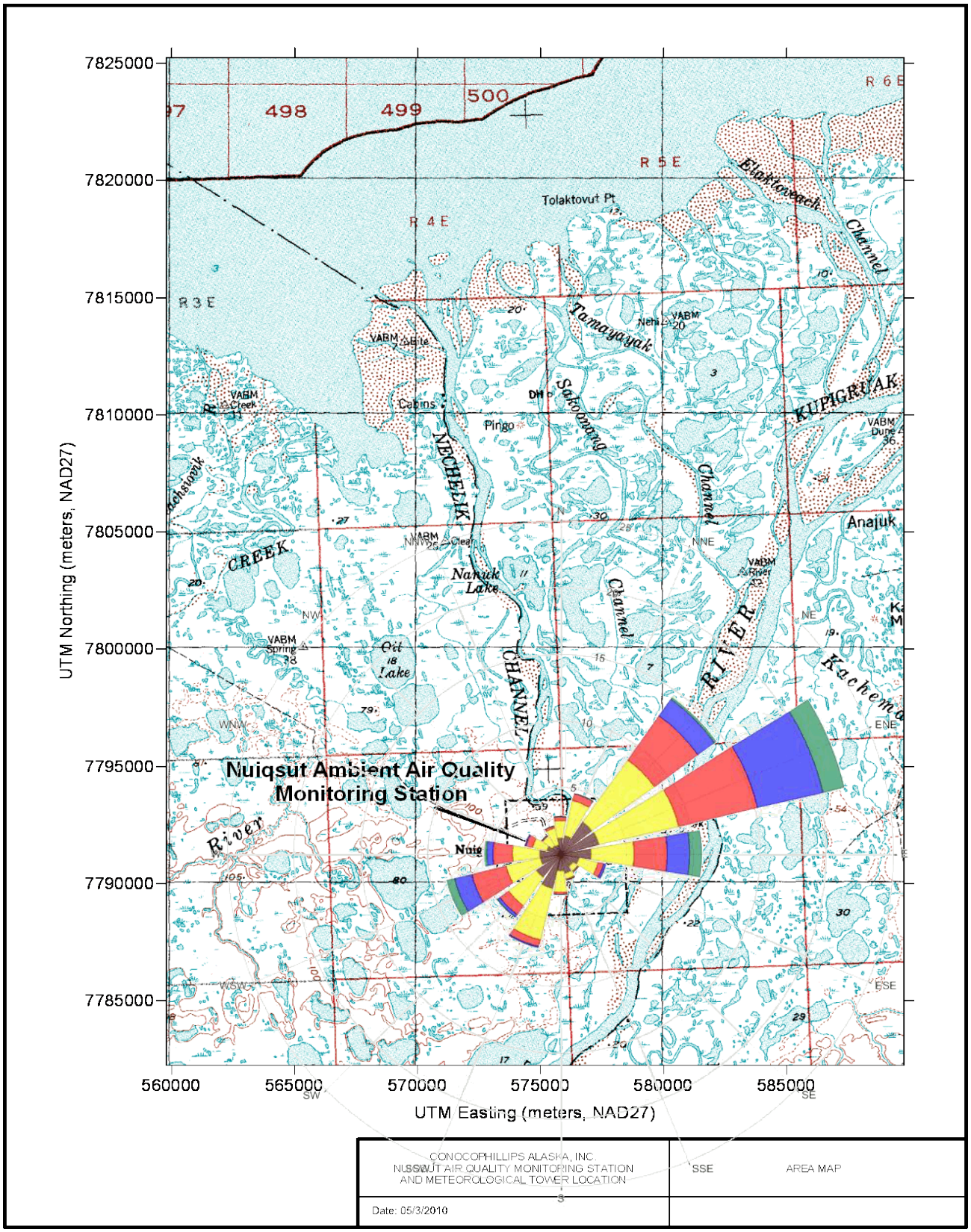


Figure 3-12: Annual Wind Rose Superimposed on Site Map

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 2015	-14.2	-33.1	-25.2	-8.2	-35.2
February 2015	-4.4	-36.8	-22.0	-0.4	-39.5
March 2015	-12.4	-38.9	-24.3	-4.6	-41.7
1st Quarter	**-4.4**	**-38.9**	**-23.9**	**-0.4**	**-41.7**
April 2015	-2.5	-21.3	-14.1	-1.0	-26.7
May 2015	4.2	-8.8	-1.6	8.5	-13.3
June 2015	19.1	-2.2	9.5	26.5	-3.9
2nd Quarter	**19.1**	**-21.3**	**-2.1**	**26.5**	**-26.7**
July 2015	16.6	3.7	7.8	23.7	-0.2
August 2015	12.4	0.9	5.4	15.4	-0.4
September 2015	3.7	-6.6	-0.7	8.1	-11.1
3rd Quarter	**16.6**	**-6.6**	**4.2**	**23.7**	**-11.1**
October 2015	-0.3	-17.9	-6.6	1.8	-27.0
November 2015	-5.7	-30.8	-17.4	-4.4	-34.8
December 2015	-15.6	-35.6	-26.2	-13.5	-37.4
4th Quarter	**-0.3**	**-35.6**	**-16.8**	**1.8**	**-37.4**
Monitoring Year	**19.1**	**-38.9**	**-9.7**	**26.5[(1)]**	**-41.7[(2)]**

[1] The maximum hourly average temperature occurred on June 20, 2015.
[2] The minimum hourly average temperature occurred on March 12, 2015.

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 2015	-14.1	-32.5	-24.8	-8.1	-34.7
February 2015	-4.3	-36.3	-21.7	-0.3	-38.8
March 2015	-12.4	-38.4	-24.1	-4.5	-41.3
1st Quarter	**-4.3**	**-38.4**	**-23.6**	**-0.3**	**-41.3**
April 2015	-2.1	-21.3	-14.0	-0.1	-26.1
May 2015	3.5	-8.9	-1.9	6.8	-13.1
June 2015	18.6	-2.7	9.1	25.9	-4.2
2nd Quarter	**18.6**	**-21.3**	**-2.3**	**25.9**	**-26.1**
July 2015	16.4	2.9	7.2	23.1	-0.3
August 2015	12.4	0.8	5.2	15.7	-0.5
September 2015	3.8	-6.6	-0.8	8.3	-11.0
3rd Quarter	**16.4**	**-6.6**	**3.9**	**23.1**	**-11.0**
October 2015	-0.2	-17.9	-6.6	1.7	-26.6
November 2015	-5.8	-30.5	-17.2	-4.1	-33.8
December 2015	-14.8	-35.6	-26.0	-12.8	-36.7
4th Quarter	**-0.2**	**-35.6**	**-16.6**	**1.7**	**-36.7**
Monitoring Year	**18.6**	**-38.4**	**-9.7**	**25.9(1)**	**-41.3(2)**

[1] The maximum hourly average temperature occurred on June 20, 2015.
[2] The minimum hourly average temperature occurred on March 12, 2015.

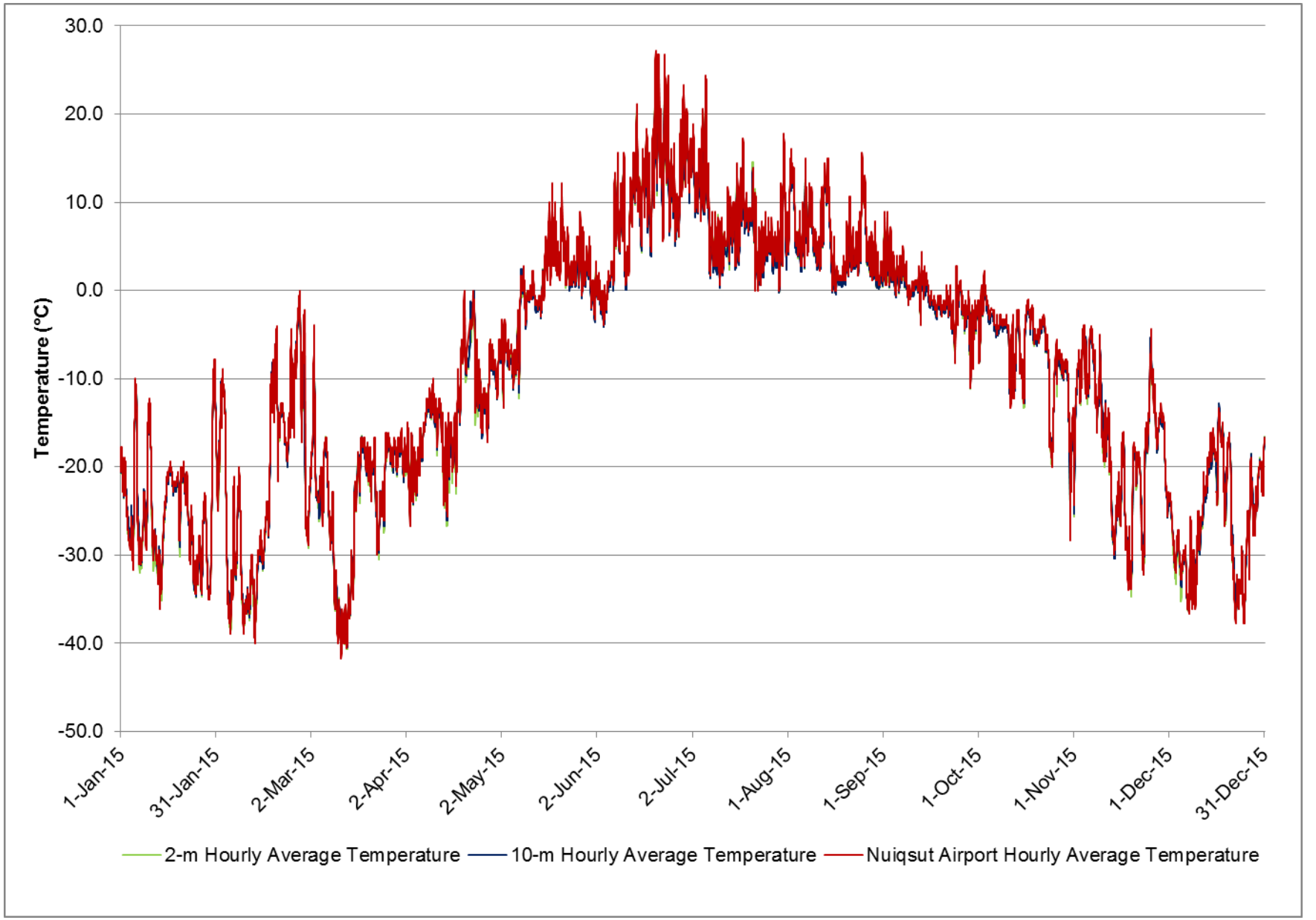


Figure 3-13: Hourly Average 2-Meter and 10-Meter Temperatures

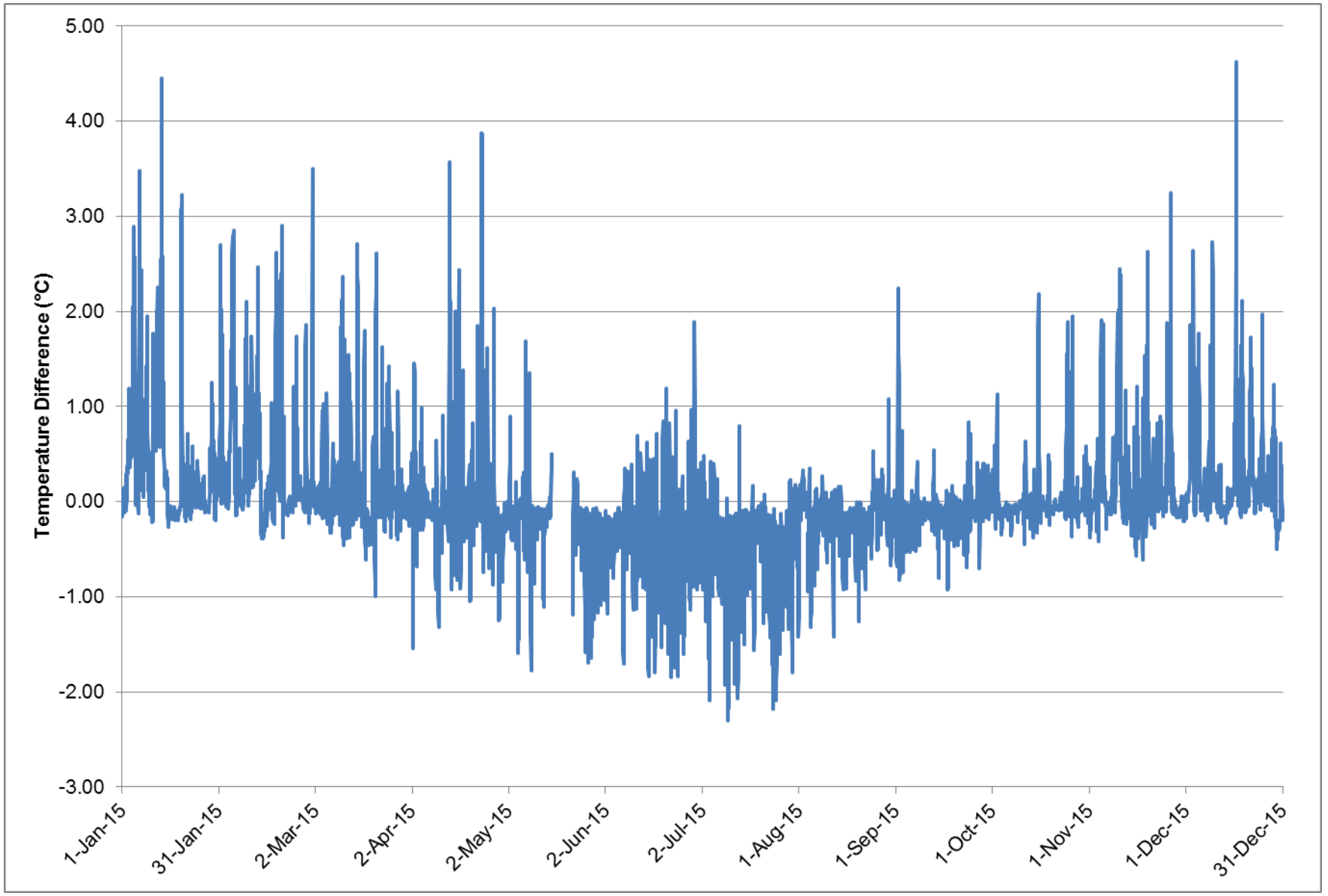


Figure 3-14: Hourly Average Vertical Temperature Difference

3.2.3 OTHER METEOROLOGICAL PARAMETERS

Table 3-11 provides a summary of solar radiation measurements obtained for the 2015 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 2015	1	19
February 2015	17	249
March 2015	81	506
1st Quarter	**33**	**506**
April 2015	170	748
May 2015	205	831
June 2015	230	709
2nd Quarter	**204**	**831**
July 2015	203	685
August 2015	95	615
September 2015	56	437
3rd Quarter	**121**	**685**
October 2015	21	252
November 2015	2	72
December 2015	0	1
4th Quarter	**8**	**254**
Monitoring Year	**90**	**831**

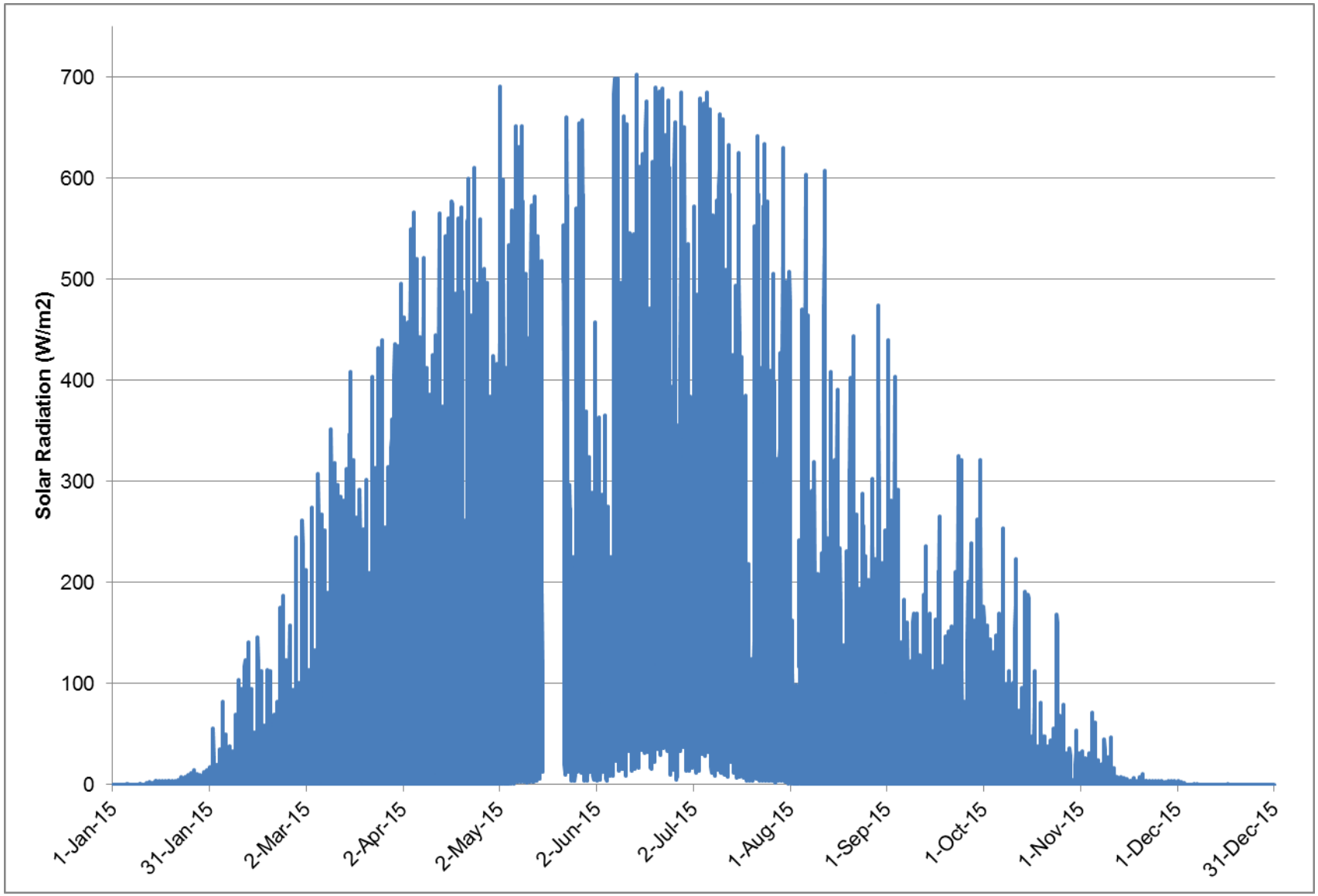


Figure 3-15: Hourly Average Solar Radiation

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