2013 Annual Data Report
Nuiqsut Ambient Air Quality and Meteorological Monitoring Program

January 1, 2013 – December 31, 2013

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February 2014

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2013 Annual Data Report

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

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EXECUTIVE SUMMARY

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

On January 1, 2011, SLR assumed responsibility for the operation and management of the Nuiqsut monitoring station, which is one of three independent ambient air and meteorological monitoring programs operated by CPAI on the North Slope of Alaska. 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 2013 monitoring year, spanning from January 1, 2013, to December 31, 2013, 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 Conservation (ADEC) in September 2012. Table E-2 provides a summary of quarterly and annual measured data for the monitored pollutants and the respective ratios of measured pollutants to National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards (NAAQS/AAAQS). Tables E-3 and E-4 provide monthly, quarterly, and annual valid hours and percent data capture for the Nuiqsut meteorological monitoring station. Data not meeting QAPP and PSD precision and accuracy criteria were invalidated and are discussed in Section 2.

Table E-1: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
Ozone one-point QC check frequency.	In April 2013, frequency of one-point QC checks exceeded 14 days between checks but was within a nominal two week period. QC checks met acceptance criteria and all available information suggests data integrity was not impacted.	The ozone transfer standard was out for recertification and thus not available for one-point QC checks within a 14 day period.

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	1	0	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour[1]	1st Highest, 8-Hour Average	1	1	0	0	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	1	0	0	**1**	**11.1%**
Nitrogen Dioxide (**NO_2**)	100.0 ppb (190 µg/m^3)	1-Hour[2]	Daily Max 1-Hour Averages (98th Percentile)	-	-	-	-	**22.6**	**22.6%**
			1st Highest, 1-Hour Average	29.0	14.4	10.5	31.9	**31.9**	**31.9%**
			2nd Highest, 1-Hour Average	26.1	14.1	10.3	25.8	**29.0**	**29.0%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	2	1	1	2	**1**	**1.9%**
Ozone (**O_3**)	0.075 ppm (150 µg/m^3)	8-Hour[3]	4th Highest, 8-Hour Average	0.042	0.049	0.037	0.041	**0.049**	**65.3%**
			1st Highest, 8-Hour Average	0.042	0.049	0.037	0.041	**0.049**	**65.3%**
			2nd Highest, 8-Hour Average	0.042	0.049	0.037	0.041	**0.049**	**65.3%**

[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)	-	-	-	-	**1.1**	**1.5%**
			1st Highest, 1-Hour Average	2.2	0.8	1.1	1.4	**2.2**	**2.9%**
			2nd Highest, 1-Hour Average	2.0	0.8	1.0	1.2	**2.0**	**2.7%**
	500.0 ppb (1,300 μg/m^3)	3-Hour[5]	1st Highest, 3-Hour Average	2.0	0.7	0.8	1.1	**2.0**	**0.4%**
			2nd Highest, 3-Hour Average	1.8	0.7	0.8	1.1	**1.8**	**0.4%**
	140.0 ppb (365 μg/m^3)	24-Hour[5]	1st Highest, 24-Hour Average	1.3	0.6	0.7	0.8	**1.3**	**0.9%**
			2nd Highest, 24-Hour Average	0.7	0.6	0.7	0.7	**0.8**	**0.6%**
	30.0 ppb (80 μg/m^3)	Annual	Average of Period	0.1	0.3	0.0	0.0	**0.1**	**0.3%**

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

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

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Particulate Matter <2.5 microns ($PM_{2.5}$)	35 μg/m^3	24-Hour[6]	98th Percentile, 24-Hour Average	-	-	-	-	**6**	**17.1%**
			1st Highest, 24-Hour Average	7	11	4	10	**11**	**31.4%**
			2nd Highest, 24-Hour Average	7	6	4	8	**10**	**28.6%**
	15.0 μg/m^3	Annual[7]	Average of Period	2.7	1.6	1.0	1.8	**1.8**	**12.0%**
Particulate Matter <10 microns (PM_{10})	150 μg/m^3	24-Hour[8,9]	1st Highest, 24-Hour Average	10	40	50	10	**50**	**33.3%**
			2nd Highest, 24-Hour Average	10	20	30	10	**40**	**26.7%**

[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] 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.
[8] Not to be exceeded more than once per year on average over three years.
[9] 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 2013	687	687	687	738	738	738	738	738	742
February 2013	641	641	641	614	614	671	671	671	671
March 2013	731	731	731	715	715	742	742	742	742
1st Quarter	**2,059**	**2,059**	**2,059**	**2,067**	**2,067**	**2,151**	**2,151**	**2,151**	**2,155**
April 2013	718	718	718	718	718	718	718	718	716
May 2013	739	739	739	740	740	740	740	740	740
June 2013	720	720	720	720	720	720	720	720	720
2nd Quarter	**2,177**	**2,177**	**2,177**	**2,178**	**2,178**	**2,178**	**2,178**	**2,178**	**2,176**
July 2013	741	741	741	741	741	741	741	741	741
August 2013	744	744	744	744	744	744	744	744	744
September 2013	719	719	719	675	675	719	719	719	719
3rd Quarter	**2,204**	**2,204**	**2,204**	**2,160**	**2,160**	**2,204**	**2,204**	**2,204**	**2,204**
October 2013	726	726	726	710	710	744	744	744	741
November 2013	626	626	626	714	714	714	714	714	714
December 2013	644	731	731	741	741	741	741	741	741
4th Quarter	**1,996**	**2,083**	**2,083**	**2,165**	**2,165**	**2,199**	**2,199**	**2,199**	**2,196**
Annual	**8,436**	**8,523**	**8,523**	**8,570**	**8,570**	**8,732**	**8,732**	**8,732**	**8,731**

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 2013	92	92	92	99	99	99	99	99	100
February 2013	95	95	95	91	91	100	100	100	100
March 2013	98	98	98	96	96	100	100	100	100
1st Quarter	**95**	**95**	**95**	**96**	**96**	**100**	**100**	**100**	**100**
April 2013	100	100	100	100	100	100	100	100	99
May 2013	99	99	99	99	99	99	99	99	99
June 2013	100	100	100	100	100	100	100	100	100
2nd Quarter	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
July 2013	100	100	100	100	100	100	100	100	100
August 2013	100	100	100	100	100	100	100	100	100
September 2013	100	100	100	94	94	100	100	100	100
3rd Quarter	**100**	**100**	**100**	**98**	**98**	**100**	**100**	**100**	**100**
October 2013	98	98	98	95	95	100	100	100	100
November 2013	87[2]	87[2]	87[2]	99	99	99	99	99	99
December 2013	87[2]	98	98	97	97	100	100	100	100
4th Quarter	**90**	**94**	**94**	**98**	**98**	**100**	**100**	**100**	**99**
Annual	**96**	**97**	**97**	**98**	**98**	**100**	**100**	**100**	**100**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Horizontal wind speed, wind direction, and wind sigma theta failed to achieve 90 percent data recovery for the month of November and horizontal wind speed failed to achieve 90 percent data recovery for the month of December due to periodic rime ice build-up on the sensors. The quarterly 90 percent data capture objective was still achieved for all parameters during the fourth quarter.

1. INTRODUCTION

1.1 PROJECT SUMMARY

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

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

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

The Nuiqsut station collects the following ambient air data:

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

The Nuiqsut station measures the following meteorological parameters:

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

The Nuiqsut station calculates the following meteorological parameters:

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

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

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

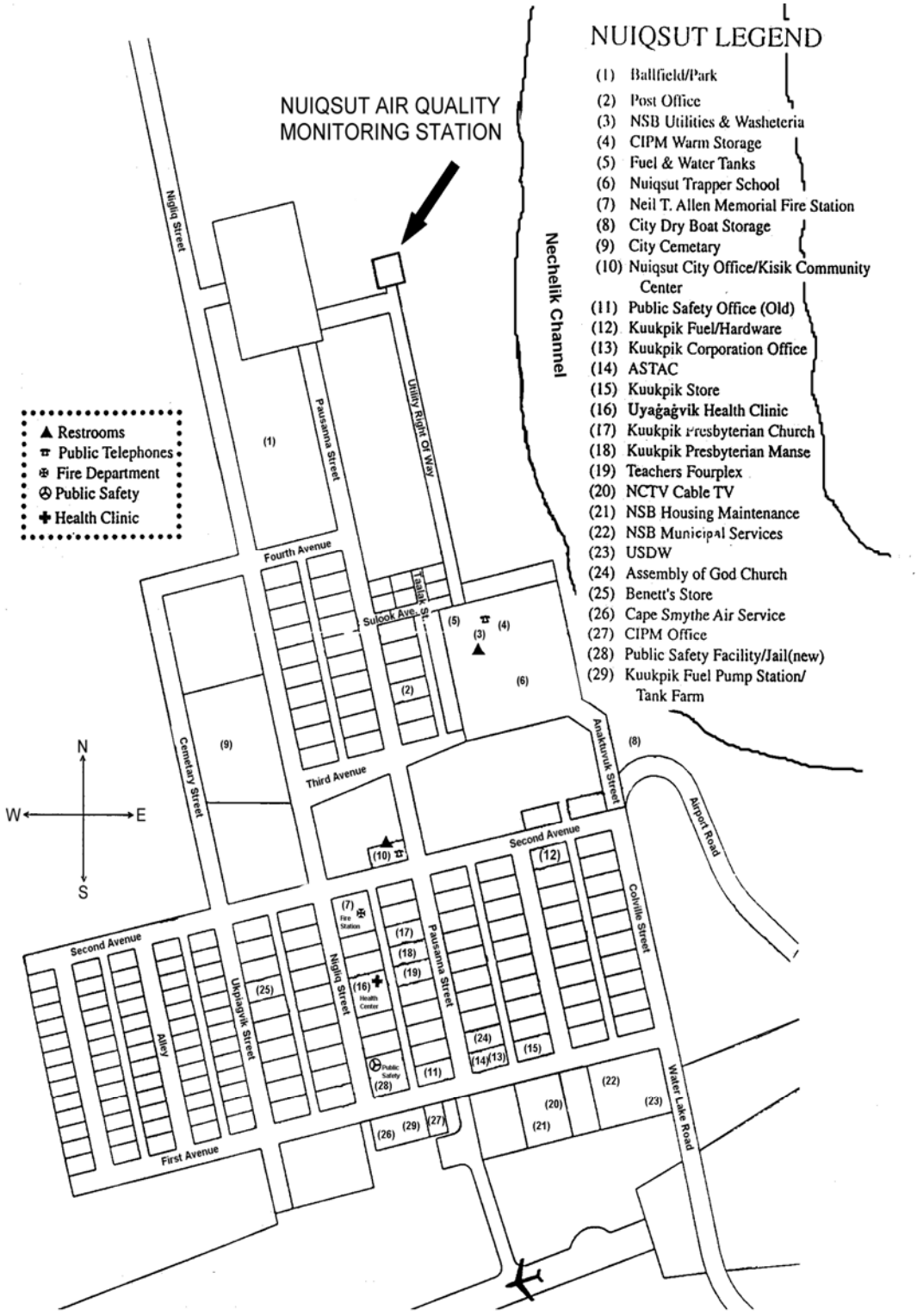


Figure 1-1: Local Map of Nuiqsut

Figure 1-2: Aerial Photo Showing Site Location

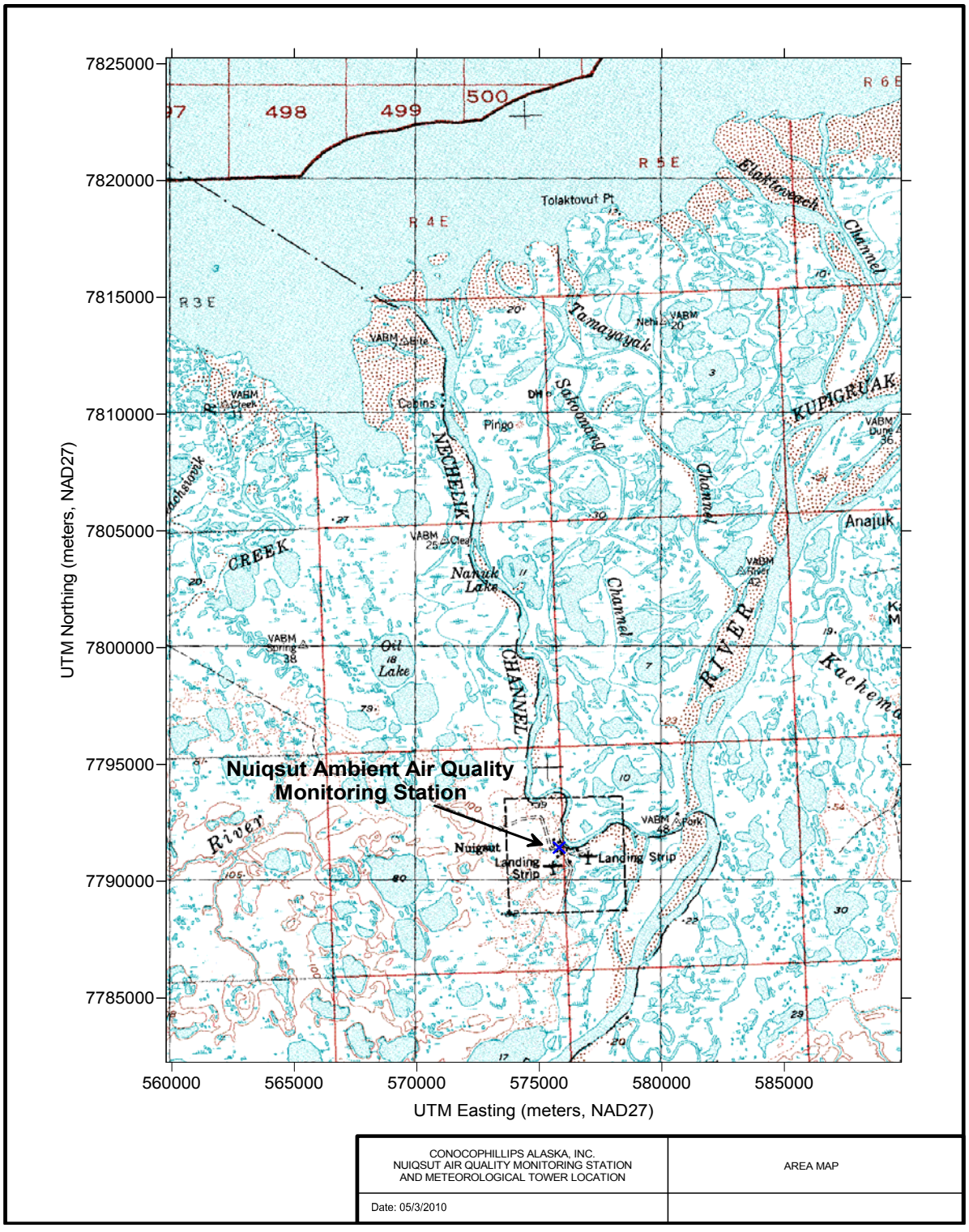


Figure 1-3: Map of Nuiqsut Project Area

1.2 MEASUREMENT METHODS TABLE

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

1.2.1 CONTINUOUS NO_2, O_3, CO AND SO_2 MONITORING

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

Table 1-1: Gaseous Pollutant Measurement Parameters

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

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

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

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

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

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

Table 1-2: PM Monitoring Measurement Parameters

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

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

1.2.3 METEOROLOGICAL MONITORING

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

Table 1-3: Meteorological Measurement Methods

Parameter	Measurement Method	Sensor Manufacturer/ Model Number	Range	Accuracy	Resolution	Sampling Frequency	Averaging Period
Ambient Temperature	Triple element thermistor	Climatronics Model 100093-2	-50 to +50°C	± 0.10°C	0.01	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	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	1 second	1 hour
Solar Radiation	Thermopile sensing element	Kipp & Zonen CMP 11	0 to 2,800 W/m^2	± 2%	10	1 second	1 hour

1.3 VARIATIONS FROM THE QAPP

During the 2013 monitoring year, the following variations from the approved Nuiqsut Ambient Air Quality and Meteorological Monitoring Quality Assurance Project Plan (QAPP) occurred:

Table 1-4: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
Ozone one-point QC check frequency.	In April 2013, frequency of one-point QC checks exceeded 14 days between checks but was within a nominal two week period. QC checks met acceptance criteria and all available information suggests data integrity was not impacted.	The ozone transfer standard was out for recertification and thus not available for one-point QC checks within a 14 day period.

The ozone transfer standard required recertification of accuracy in April 2013. A one-point QC check was performed on 4/11/2013 prior to removal. Due to delays in shipping, the subsequent one-point QC check after recertification was not completed until 4/26/2013, 15 days later. 40 CFR 58, Appendix A specifies the required frequency of one-point QC checks to be every two weeks. The 4/26/2013 check was completed within a nominal two week period since the previous check, but did exceed 14 days between checks. The QC check met acceptance criteria and all available information demonstrates that data integrity was not compromised by the slight delay.

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 2013 ambient air and meteorological monitoring year.

Table 2-1: Chronology of Significant Events

Date	Event
January 1, 2013	Start of the monitoring year.
January 1 – 2, 2013	Local station operator installed new bypass flow pump incorrectly resulting in 38 hours of invalid data for all gases.
January 1 – 2, 2013	Cross-arm with wind sensor blown off level due to high winds; 39 hours of horizontal wind speed, direction, and sigma data flagged invalid.
January 2, 2013	Particulate matter data flagged as invalid due to temperatures below the acceptable range of the instruments.
January 7, 2013	Monthly QC checks performed on PM samplers; all passed.
January 10, 2013	PM_{10} data flagged as invalid due to a 24-hour average concentration of less than -2 $\mu g/m^3$.
January 11, 21, and 23, 2013	Data from all continuous air quality analyzers were invalidated as a result of shelter temperature standard deviation exceeding daily 2 degree Celsius limit.
January 14 – 16, 2013	Particulate matter data invalidated periodically as a result of high winds and blowing snow.
January 16, 2013	Multipoint calibrations performed on all ambient air analyzers; all passed.
January 18 – 19, 2013	Horizontal wind data indicated episodes of rime ice build-up on sensor; 6 hours of horizontal wind data flagged invalid.
January 23 – February 3, 2013	The PM_{10} sampler failed on January 23, 2013. A replacement sampler was installed on January 28, QC checks performed, and repairs on the original sampler initiated. On January 29 the replacement sampler also failed. On February 3 the original sampler was repaired and put back into service.
January 24, 2013	Horizontal wind data indicated episodes of rime ice build-up on sensor; 6 hours of horizontal wind data flagged invalid.
January 28, 2013	QC check and multipoint calibration performed on PM_{10} sampler; passed.
January 29, 2013	$PM_{2.5}$ data flagged as invalid due to a 24-hour average concentration of less than -2 $\mu g/m^3$.
February 3 – 4, 2013	Monthly QC checks performed on PM samplers; all passed.
February 4, 2013	Multipoint calibrations performed on all ambient air analyzers; all passed.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
February 7, 2013	Independent performance audit of ambient air analyzers and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
February 10 – 12, 2013	Data from all continuous air quality analyzers were invalidated as a result of shelter temperature standard deviation exceeding daily 2 degree Celsius limit.
February 11 – 12, 2013	Wind data indicated episodes of rime ice build-up on horizontal and vertical wind sensors; 27 hours of vertical wind data and 9 hours of horizontal wind data flagged invalid.
February 17, 2013	Wind data indicated episodes of rime ice build-up on horizontal and vertical wind sensors; 13 hours of vertical wind data and 8 hours of horizontal wind data flagged invalid.
February 19, 2013	Vertical wind data indicated episodes of rime ice build-up on sensor; 15 hours of horizontal wind data flagged invalid.
February 26, 2013	Horizontal wind data indicated episodes of rime ice build-up on sensor; 13 hours of horizontal wind data flagged invalid.
March 1, 2013	Monthly QC checks performed on PM samplers; all passed.
March 1 – 2, 2013	Tape broken on $PM_{2.5}$ sampler; no data collected.
March 10, 2013	Horizontal wind data indicated episodes of rime ice build-up on sensor; 11 hours of horizontal wind data flagged invalid.
March 12 – 13, 2013	Vertical wind data indicated episodes of rime ice build-up on sensor; 27 hours of horizontal wind data flagged invalid.
March 17, 2013	PM_{10} data flagged as invalid due to a 24-hour average concentration of less than -2 $\mu g/m^3$.
April 1, 2013	Monthly QC checks performed on PM samplers; all passed.
April 1, 2013	PM_{10} data flagged invalid due to a 24-hour average concentration of less than -2 $\mu g/m^3$.
April 10, 2013	QC checks and multipoint calibrations performed on PM samplers; all passed.
April 11 – 16, 2013	Zero background check performed on PM_{10} sampler. No PM_{10} measurements were collected during this period.
April 11 – 26, 2013	Ozone transfer standard out for recertification; recertification took place on April 12, 2013.
April 26, 2013	Multipoint calibrations performed on ozone analyzer; passed.
May 3, 2013	Monthly QC checks performed on PM samplers; all passed.
May 16, 2013	$PM_{2.5}$ data flagged invalid due to a 24-hour average concentration of less than -2 $\mu g/m^3$.
May 29, 2013	Calibrations performed on all meteorological sensors and multipoint calibrations performed on all ambient air analyzers; all passed. Independent performance audit of ambient air analyzers, PM samplers, and meteorological sensors conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. New calibration and audit gas cylinders installed.
June 6, 2013	Monthly QC checks performed on PM samplers; all passed.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
June 12, 2013	PM_{10} data not collected due to a communication error with the sampler.
July 2, 2013	Monthly QC checks performed on PM samplers; all passed acceptance criteria
July 8 – 11, 2013	SO_2 data flagged as invalid due to high daily zero checks.
July 11, 2013	Multipoint calibrations performed on CO and SO_2 ambient air analyzers; all passed.
July 18, 2013	Multipoint calibrations performed on ozone ambient air analyzer; analyzer passed.
August 1, 2013	Ozone data not collected for 12 hours due to a communication error with the analyzer.
August 10, 2013	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
August 27, 2013	QC checks performed on PM samplers; all passed acceptance criteria.
August 27 – 28, 2013	PM_{10} data not collected due to a communication error with the sampler.
August 28, 2013	Multipoint calibrations performed on all ambient air analyzers; all passed.
August 29, 2013	Independent performance audit of ambient air analyzers and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. Spare ozone analyzer installed to replace existing analyzer due to intermittent stability warnings. Multipoint calibration performed on spare ozone analyzer; passed.
August 29 – September 5, 2013	Zero background check performed on $PM_{2.5}$ sampler. No $PM_{2.5}$ measurements were collected during this period.
August 29 – September 9, 2013	Ozone transfer standard out for recertification; recertification took place on September 3, 2013.
September 6 – 7, 2013	Tapes broken on $PM_{2.5}$ and PM_{10} samplers; no data collected.
September 11, 2013	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
September 17, 2013	QC checks performed on $PM_{2.5}$ sampler; sampler passed acceptance criteria.
September 28 – 29, 2013	Vertical wind data indicated episodes of rime ice build-up on sensor; 44 hours of vertical wind data flagged invalid.
October 2, 2013	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
October 3 – 4, 2013	Wind data indicated episodes of rime ice build-up on horizontal and vertical wind sensors; 28 hours of vertical wind data and 7 hours of horizontal wind data flagged invalid. Propeller on vertical wind sensor was damaged by local operator during ice cleaning and was replaced with new propeller.
October 16, 2013	PM_{10} data flagged as invalid due to a 24-hour average concentration of less than -2 $\mu g/m^3$.
October 24 – 25, 2013	Horizontal wind data indicated episodes of rime ice build-up on sensor; 11 hours of horizontal wind data flagged invalid.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
October 30 – 31, 2013	Vertical wind data indicated episodes of rime ice build-up on sensor; 6 hours of vertical wind data flagged invalid.
November 1, 2013	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
November 19 – 20, 2013	Calibrations performed on all meteorological sensors and multipoint calibrations performed on all ambient air analyzers; all passed. Independent performance audit of ambient air analyzers, PM samplers, and meteorological sensors conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
November 25 – 29, 2013	Horizontal wind data indicated episodes of rime ice build-up on sensor; 88 hours of horizontal wind data flagged invalid.
November 27 – 28, 2013	PM_{10} data flagged as invalid due to a 24-hour average concentration of less than -2 $\mu g/m^3$.
December 2, 2013	Monthly QC checks performed on PM samplers; all passed acceptance criteria.
December 5, 2013	Horizontal wind data indicated episodes of rime ice build-up on sensor; 10 hours of horizontal wind data flagged invalid.
December 9, 2013	Calibration performed on horizontal wind sensor; passed. Wind speed propeller damaged during calibration and replaced with new propeller. All meteorological data invalidated while tower was lowered for calibration.
December 10, 2013	QC checks performed on PM samplers; all passed acceptance criteria. Multipoint calibrations performed on ozone ambient air analyzer; analyzer passed.
December 15, 2013	$PM_{2.5}$ data flagged as invalid due to a 24-hour average concentration of less than -2 $\mu g/m^3$.
December 19, 2013	PM_{10} data flagged as invalid due to a 24-hour average concentration of less than -2 $\mu g/m^3$.
December 20 – 24, 2013	Horizontal wind speed data indicated episodes of rime ice build-up on sensor; 87 hours of horizontal wind speed data flagged invalid.
December 31, 2013	End of monitoring year.

2.2 MISSING, INVALID AND ADJUSTED DATA

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

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

Table 2-2: Percentage of Final Data Set Flagged

Parameter	Flagging Criteria[1]	Percent Flagged
Wind Speed	Value is < 0 m/s	0.0%
	Value is > 25 m/s	0.0%
	< 0.1 m/s variation for 3 consecutive hours	2.4%
	< 0.5 m/s variation for 12 consecutive hours	0.5%
Wind Direction	Value is < 0°, > 360°	0.0%
	< 1° variation over 3 consecutive hours	0.0%
	< 10° variation over 18 consecutive hours	2.6%
Temperature (2 meters)	> 5°C variation from previous hour	0.2%
	< 0.5°C variation for 12 consecutive hours	0.6%
	Value is > record high, < record low	0.0%
Temperature (10 meters)	> 5°C variation from previous hour	0.2%
	< 0.5°C variation for 12 consecutive hours	1.0%
	Value is > record high, < record low	0.0%
Temperature Difference, ΔT	Value is > 0.8°C during the daytime	1.1%
	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	0.0%
	Greater than the maximum possible value for date and latitude	0.2%

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

2.3 NETWORK DATA COMPLETENESS

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

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

Table 2-3: Ambient Air Quality Data Capture Percent

Period	Pollutants – Data Recovery[1]					
	CO	NO_2	O_3	SO_2	$PM_{2.5}$[2]	PM_{10}[2]
January 2013	83	83	84	83	87	58[3]
February 2013	88	88	88	88	100	89
March 2013	99	99	99	99	94	97
1st Quarter	**90**	**90**	**90**	**90**	**93**	**81**
April 2013	99	99	99	99	100	77[3]
May 2013	93	93	93	93	97	100
June 2013	99	99	99	99	100	97
2nd Quarter	**97**	**97**	**97**	**97**	**99**	**91**
July 2013	98	98	98	89	100	100
August 2013	98	98	96	98	90	94
September 2013	99	99	99	99	77[4]	93
3rd Quarter	**98**	**98**	**98**	**95**	**89**	**96**
October 2013	99	99	99	99	100	97
November 2013	98	98	98	98	100	93
December 2013	99	99	99	99	97	97
4th Quarter	**99**	**99**	**99**	**99**	**99**	**96**
Annual	**96**	**96**	**96**	**95**	**95**	**91**

[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] Although monthly data capture percent was below 80 due to a sampler malfunction, the quarterly goal of 80 percent data capture was met.
[4] Although monthly data capture percent was below 80 due to a zero background check, the quarterly goal of 80 percent data capture was met.

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 2013	92	92	92	99	99	99	99	99	100
February 2013	95	95	95	91	91	100	100	100	100
March 2013	98	98	98	96	96	100	100	100	100
1st Quarter	**95**	**95**	**95**	**96**	**96**	**100**	**100**	**100**	**100**
April 2013	100	100	100	100	100	100	100	100	99
May 2013	99	99	99	99	99	99	99	99	99
June 2013	100	100	100	100	100	100	100	100	100
2nd Quarter	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
July 2013	100	100	100	100	100	100	100	100	100
August 2013	100	100	100	100	100	100	100	100	100
September 2013	100	100	100	94	94	100	100	100	100
3rd Quarter	**100**	**100**	**100**	**98**	**98**	**100**	**100**	**100**	**100**
October 2013	98	98	98	95	95	100	100	100	100
November 2013	**87**[2]	**87**[2]	**87**[2]	99	99	99	99	99	99
December 2013	**87**[2]	98	98	97	97	100	100	100	100
4th Quarter	**90**	**94**	**94**	**98**	**98**	**100**	**100**	**100**	**99**
Annual	**96**	**97**	**97**	**98**	**98**	**100**	**100**	**100**	**100**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Horizontal wind speed, wind direction, and wind sigma theta failed to achieve 90 percent data recovery for the month of November and horizontal wind speed failed to achieve 90 percent data recovery for the month of December due to periodic rime ice build-up on the sensors. The quarterly 90 percent data capture objective was still achieved for all parameters during the fourth quarter.

2.4 PRECISION STATISTICS

2.4.1 MONITORING NETWORK PRECISION STATISTICS

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

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

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

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Jan-13	7.8	7.9	-1.3	14	1.00	1.66	4.25	-2.26	2.26	+2.00
4-Jan-13	7.9	7.9	0.0							
10-Jan-13	8.0	7.9	1.3							
17-Jan-13	7.9	7.9	0.0							
24-Jan-13	8.2	7.9	3.8							
31-Jan-13	8.1	7.9	2.5							
7-Feb-13	7.8	7.9	-1.3							
14-Feb-13	7.9	7.9	0.0							
21-Feb-13	7.9	7.9	0.0							
28-Feb-13	7.9	7.9	0.0							
7-Mar-13	8.0	7.9	1.3							
14-Mar-13	8.0	7.9	1.3							
21-Mar-13	8.1	7.9	2.5							
28-Mar-13	8.2	7.9	3.8							

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

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

Period	Analyzer Response (ppm)	Precision Gas Concentration[3] (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Apr-13	8.2	7.9	3.8	12	-0.62	3.26	5.77	-7.00	4.58	+/-3.62
11-Apr-13	7.7	7.9	-2.5							
18-Apr-13	7.7	7.9	-2.5							
25-Apr-13	7.8	7.9	-1.3							
2-May-13	7.8	7.9	-1.3							
9-May-13	7.8	7.9	-1.3							
16-May-13	7.9	7.9	0.0							
23-May-13	8.1	7.9	2.5							
6-Jun-13	8.3	7.8	6.4							
13-Jun-13	7.7	8.0	-3.8							
20-Jun-13	7.7	8.0	-3.8							
27-Jun-13	7.7	8.0	-3.8							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%
[3] New calibration gas installed on May 29, 2013.

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

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Jul-13	7.6	8.0	-5.0	13	0.11	1.74	3.52	-3.30	2.40	+1.74
11-Jul-13	7.8	7.8	0.0							
18-Jul-13	7.8	7.8	0.0							
25-Jul-13	7.8	7.8	0.0							
1-Aug-13	7.7	7.8	-1.3							
8-Aug-13	7.9	7.8	1.3							
15-Aug-13	7.8	7.8	0.0							
22-Aug-13	7.8	7.8	0.0							
29-Aug-13	7.9	7.8	1.3							
5-Sep-13	7.9	7.8	1.3							
12-Sep-13	7.9	7.8	1.3							
19-Sep-13	7.9	7.8	1.3							
26-Sep-13	7.9	7.8	1.3							

[1]Acceptance criteria: ≤ 10%
[2]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]	Bias Estimate[2]
3-Oct-13	8.0	7.8	2.6	13	2.37	1.37	5.05	-0.32	1.89	+3.04
10-Oct-13	7.9	7.8	1.3							
17-Oct-13	7.8	7.8	0.0							
24-Oct-13	7.9	7.8	1.3							
31-Oct-13	7.9	7.8	1.3							
7-Nov-13	8.0	7.8	2.6							
14-Nov-13	8.0	7.8	2.6							
21-Nov-13	7.9	7.8	1.3							
28-Nov-13	8.0	7.8	2.6							
5-Dec-13	8.0	7.8	2.6							
12-Dec-13	8.1	7.8	3.9							
19-Dec-13	8.1	7.8	3.9							
26-Dec-13	8.2	7.8	5.1							

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

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

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Jan-13	82.8	79.9	3.7	14	0.75	1.96	4.59	-3.09	2.66	+2.18
4-Jan-13	82.4	80.5	2.4							
10-Jan-13	82.2	81.8	0.5							
17-Jan-13	83.1	87.1	-4.6							
24-Jan-13	82.7	82.5	0.3							
31-Jan-13	82.2	82.4	-0.3							
7-Feb-13	83.2	80.9	2.8							
14-Feb-13	83.3	81.7	2.0							
21-Feb-13	82.8	82.6	0.2							
28-Feb-13	82.7	82.0	0.9							
7-Mar-13	82.8	81.3	1.8							
14-Mar-13	82.7	82.1	0.7							
21-Mar-13	81.9	81.5	0.5							
28-Mar-13	82.0	82.4	-0.4							

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

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

Period	Analyzer Response (ppb)	Precision Gas Concentration[3] (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Apr-13	83.0	83.5	-0.6	12	-2.67	1.15	-0.41	-4.92	1.61	-3.26
11-Apr-13	80.5	82.6	-2.6							
18-Apr-13	80.5	83.4	-3.4							
25-Apr-13	80.1	82.1	-2.5							
2-May-13	79.4	82.1	-3.3							
9-May-13	79.5	82.7	-3.9							
16-May-13	79.2	80.2	-1.3							
23-May-13	78.8	80.9	-2.6							
6-Jun-13	74.8	75.6	-1.1							
13-Jun-13	76.0	78.5	-3.2							
20-Jun-13	77.4	80.0	-3.3							
27-Jun-13	77.9	81.4	-4.3							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%
[3] New calibration gas installed on May 29, 2013.

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

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Jul-13	78.3	79.5	-1.5	13	-0.32	3.73	6.99	-7.63	5.15	+/-3.94
11-Jul-13	79.4	81.3	-2.3							
18-Jul-13	77.9	81.7	-4.7							
25-Jul-13	78.7	80.7	-2.5							
1-Aug-13	78.3	80.8	-3.1							
8-Aug-13	78.2	78.9	-0.9							
15-Aug-13	77.9	81.2	-4.0							
22-Aug-13	79.6	80.3	-0.9							
29-Aug-13	88.1	81.4	8.2							
5-Sep-13	87.0	82.1	6.0							
12-Sep-13	82.8	82.0	0.9							
19-Sep-13	83.2	82.7	0.7							
26-Sep-13	82.5	82.5	0.0							

[1]Acceptance criteria: ≤ 10%
[2]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]	Bias Estimate[2]
3-Oct-13	83.0	83.4	-0.5	13	-0.12	0.89	1.63	-1.86	1.23	+/-0.97
10-Oct-13	81.8	81.6	0.2							
17-Oct-13	82.5	83.9	-1.6							
24-Oct-13	83.4	83.7	-0.4							
31-Oct-13	82.6	81.6	1.2							
7-Nov-13	84.0	83.2	1.0							
14-Nov-13	81.8	82.0	-0.2							
21-Nov-13	83.3	83.4	-0.1							
28-Nov-13	82.4	81.6	1.0							
5-Dec-13	82.3	83.2	-1.1							
12-Dec-13	83.0	83.8	-1.0							
19-Dec-13	83.0	82.4	0.7							
26-Dec-13	83.0	83.6	-0.7							

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

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

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Jan-13	0.0903	0.0900	0.3	13	2.30	1.66	5.55	-0.96	2.29	+3.15
10-Jan-13	0.0886	0.0900	-1.6							
17-Jan-13	0.0931	0.0900	3.4							
24-Jan-13	0.0912	0.0900	1.3							
31-Jan-13	0.0926	0.0900	2.9							
7-Feb-13	0.0916	0.0900	1.8							
14-Feb-13	0.0920	0.0900	2.2							
21-Feb-13	0.0917	0.0900	1.9							
28-Feb-13	0.0920	0.0900	2.2							
7-Mar-13	0.0926	0.0900	2.9							
14-Mar-13	0.0937	0.0900	4.1							
21-Mar-13	0.0932	0.0900	3.6							
28-Mar-13	0.0943	0.0900	4.8							

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

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

Period	Analyzer Response (ppm)	Precision Gas Concentration[3] (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Apr-13	0.0932	0.0900	3.6							
11-Apr-13	0.0910	0.0900	1.1							
18-Apr-13[3]	-	-	-							
25-Apr-13[3]	-	-	-							
26-Apr-13	0.0820	0.0800	2.5							
2-May-13	0.0922	0.0900	2.4							
9-May-13	0.0919	0.0900	2.1	11	2.86	0.92	4.67	1.06	1.32	+3.37
16-May-13	0.0928	0.0900	3.1							
23-May-13	0.0932	0.0900	3.6							
6-Jun-13	0.0917	0.0900	1.9							
13-Jun-13	0.0933	0.0900	3.7							
20-Jun-13	0.0931	0.0900	3.4							
27-Jun-13	0.0937	0.0900	4.1							

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

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

Period	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Jul-13	0.0941	0.0900	4.6	12	0.85	2.25	5.26	-3.56	3.16	+/-2.46
11-Jul-13	0.0932	0.0900	3.6							
18-Jul-13	0.0946	0.0900	5.1							
25-Jul-13	0.0899	0.0900	-0.1							
8-Aug-13	0.0907	0.0900	0.8							
15-Aug-13	0.0899	0.0900	-0.1							
22-Aug-13	0.0901	0.0900	0.1							
29-Aug-13	0.0900	0.0900	0.0							
5-Sep-13[3]	-	-	-							
11-Sep-13	0.0891	0.0900	-1.0							
12-Sep-13	0.0892	0.0900	-0.9							
19-Sep-13	0.0886	0.0900	-1.6							
26-Sep-13	0.0898	0.0900	-0.2							

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

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

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Oct-13	0.0889	0.0900	-1.2	14	0.52	1.93	4.30	-3.27	2.62	+/-2.14
10-Oct-13	0.0884	0.0900	-1.8							
17-Oct-13	0.0909	0.0900	1.0							
24-Oct-13	0.0917	0.0900	1.9							
31-Oct-13	0.0914	0.0900	1.6							
7-Nov-13	0.0929	0.0900	3.2							
14-Nov-13	0.0922	0.0900	2.4							
19-Nov-13	0.0902	0.0900	0.2							
21-Nov-13	0.0888	0.0900	-1.3							
28-Nov-13	0.0879	0.0900	-2.3							
5-Dec-13	0.0880	0.0900	-2.2							
12-Dec-13	0.0914	0.0900	1.6							
19-Dec-13	0.0915	0.0900	1.7							
26-Dec-13	0.0923	0.0900	2.6							

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

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

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
3-Jan-13	77.6	78.0	-0.5	14	-0.01	1.03	2.01	-2.03	1.40	+/-1.09
4-Jan-13	77.7	78.0	-0.4							
10-Jan-13	77.4	78.0	-0.8							
17-Jan-13	83.0	85.0	-2.4							
24-Jan-13	83.7	84.5	-1.0							
31-Jan-13	85.4	84.5	1.1							
7-Feb-13	84.9	84.5	0.5							
14-Feb-13	84.7	84.5	0.2							
21-Feb-13	84.8	84.5	0.4							
28-Feb-13	86.1	84.5	1.9							
7-Mar-13	84.9	84.5	0.5							
14-Mar-13	84.9	84.5	0.5							
21-Mar-13	83.9	84.5	-0.7							
28-Mar-13	85.0	84.5	0.6							

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

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

Period	Analyzer Response (ppb)	Precision Gas Concentration[3] (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Apr-13	85.8	84.5	1.5	12	-0.51	2.25	3.90	-4.92	3.16	+/-2.5
11-Apr-13	82.7	84.5	-2.1							
18-Apr-13	82.2	84.5	-2.7							
25-Apr-13	82.5	84.5	-2.4							
2-May-13	82.8	84.5	-2.0							
9-May-13	83.4	84.5	-1.3							
16-May-13	83.0	84.5	-1.8							
23-May-13	81.8	84.5	-3.2							
6-Jun-13	78.2	78.0	0.3							
13-Jun-13	79.5	78.0	1.9							
20-Jun-13	80.5	78.0	3.2							
27-Jun-13	79.9	78.0	2.4							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%
[3] New calibration gas installed on May 29, 2013.

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

Period	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Jul-13	79.2	78.0	1.5	13	-0.65	1.12	1.54	-2.85	1.55	-1.41
11-Jul-13	79.0	78.0	1.3							
18-Jul-13	77.6	78.0	-0.5							
25-Jul-13	77.0	78.0	-1.3							
1-Aug-13	77.8	78.0	-0.3							
8-Aug-13	76.1	78.0	-2.4							
15-Aug-13	77.2	78.0	-1.0							
22-Aug-13	76.4	78.0	-2.1							
29-Aug-13	77.3	78.0	-0.9							
5-Sep-13	77.2	78.0	-1.0							
12-Sep-13	77.7	78.0	-0.4							
19-Sep-13	77.1	78.0	-1.2							

[1]Acceptance criteria: ≤ 10%
[2]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]	Bias Estimate[2]
3-Oct-13	78.0	78.0	0.0	13	-0.87	0.91	0.92	-2.65	1.26	-1.37
10-Oct-13	76.9	78.0	-1.4							
17-Oct-13	76.4	78.0	-2.1							
24-Oct-13	76.9	78.0	-1.4							
31-Oct-13	76.3	78.0	-2.2							
7-Nov-13	77.1	78.0	-1.2							
14-Nov-13	76.8	78.0	-1.5							
21-Nov-13	78.6	78.0	0.8							
28-Nov-13	77.5	78.0	-0.6							
5-Dec-13	77.7	78.0	-0.4							
12-Dec-13	78.1	78.0	0.1							
19-Dec-13	78.0	78.0	0.0							
26-Dec-13	76.9	78.0	-1.4							

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

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

Period	Samplers	Number of Collocated Samples[1]	Concentration Levels	Average Percent Difference	Standard Deviation[2] (µg/m³)	Precision[3] (µg/m³)	Bias[4] (µg/m³)
1st Quarter (January 1 – March 31, 2013)	Primary FEM against Collocated FEM	63	≥2 µg/m³	-36.8%	1.22	0.61	2.71
		74	All	-73.7%	1.49	0.74	2.91
	Primary FEM against Collocated FRM	11	≥2 µg/m³	63.0%	1.90	0.95	3.29
		12	All	68.6%	1.93	0.97	3.48
2nd Quarter (April 1 – June 30, 2013)	Primary FEM against Collocated FEM	55	≥2 µg/m³	-32.3%	1.19	0.59	2.21
		75	All	-43.1%	1.23	0.62	2.27
	Primary FEM against Collocated FRM	5	≥2 µg/m³	50.1%	1.69	0.85	2.22
		7	All	49.7%	1.53	0.76	1.86
3rd Quarter (July 1 – September 30, 2013)	Primary FEM against Collocated FEM	17	≥2 µg/m³	13.5%	0.98	0.49	1.07
		81	All	-78.0%	0.83	0.42	1.25
	Primary FEM against Collocated FRM	4	≥2 µg/m³	-13.9%	0.82	0.41	0.90
		13	All	-188.1%	1.07	0.53	1.45
4th Quarter (October 1 – December 31, 2013)	Primary FEM against Collocated FEM	38	≥2 µg/m³	10.0%	0.96	0.48	0.93
		82	All	31.4%	0.96	0.48	1.14
	Primary FEM against Collocated FRM	4	≥2 µg/m³	6.0%	0.68	0.34	1.09
		12	All	-64.2%	1.69	0.85	1.94
Year to Date (January 1 – December 31, 2013)	Primary FEM against Collocated FEM	**173**	**≥2 µg/m³**	**-20.1%**	**1.34**	**0.67**	**2.00**
		312	All	-39.9%	1.35	0.68	1.86
	Primary FEM against Collocated FRM	**24**	**≥2 µg/m³**	**38.0%**	**1.81**	**0.91**	**2.30**
		44	All	-46.5%	1.73	0.87	2.20

[1] $PM_{2.5}$ network precision statistics represent data from the Deadhorse monitoring station samplers.
[2] Standard deviation of the absolute concentration differences for the population.
[3] Standard deviation of the absolute concentration difference for the population divided by 2 with a goal of ≤ 3 µg/m³ per quarter.
[4] Average over the population of the absolute value of the individual pair concentration difference with a goal of ≤ 4 µg/m³ per quarter.

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 calibrations were performed on a daily basis on all gas pollutant analyzers throughout the monitoring year. The single-point calibrations 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 of the instrument's upper range limit (URL). If a single-point calibration 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 data for each parameter and parameter quality control (QC) performance statistics 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 2-30. 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 16, 2013	0.0	0.3	-	0.8	1.0084	0.0449	0.99995	Pass
	8.1	8.1	-0.5					
	17.8	17.7	-0.3					
	30.4	30.8	1.2					
	40.6	41.0	1.1					
	45.6	46.1	1.0					
February 4, 2013	0.0	0.3	-	2.2	1.0176	0.1559	0.99997	Pass
	7.9	8.1	2.2					
	17.4	17.7	1.6					
	29.7	30.5	2.7					
	39.7	40.6	2.1					
	44.7	45.7	2.2					
May 29, 2013	0.0	0.3	-	1.3	1.0092	0.1416	0.99996	Pass
	7.9	8.1	2.1					
	17.4	17.4	0.2					
	29.7	30.2	1.5					
	39.6	40.1	1.3					
	44.6	45.2	1.4					

[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]
July 11, 2013	0.0	0.0	-	0.9	0.9995	-0.1032	0.99998	Pass
	8.0	7.8	-2.2					
	17.5	17.2	-1.6					
	29.9	29.9	0.1					
	39.9	39.8	-0.2					
	44.9	44.7	-0.4					
August 28, 2013	0.0	0.0	-	1.5	0.9966	-0.1573	0.99997	Pass
	0.0	0.0	-					
	8.0	7.8	-2.9					
	17.5	17.1	-2.5					
	30.0	29.8	-0.7					
	40.0	39.7	-0.8					
November 19, 2013	0.0	0.2	-	2.9	1.0251	0.1202	0.99998	Pass
	8.0	8.2	3.2					
	17.5	17.9	2.4					
	30.0	31.0	3.4					
	40.0	41.1	2.7					
	45.0	46.3	2.8					

[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 2-23: 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 16, 2013	0	0	-	0.4	1.0021	-0.0001	0.99997	99.7%	Pass
	82	82	0.2						
	172	171	-0.4						
	300	301	0.2						
	387	390	0.7						
	420	419	-0.3						
February 4, 2013	0	0	-	1.2	1.0041	0.0011	0.99999	99.9%	Pass
	81	83	2.6						
	172	174	1.4						
	299	302	0.9						
	384	387	0.6						
	417	419	0.6						
May 29, 2013	0	0	-	2.2	0.9788	-0.0002	0.99998	100.3%	Pass
	83	81	-2.5						
	171	168	-1.7						
	300	292	-2.7						
	363	374	-2.2						
	411	404	-1.9						

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale
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]
August 28, 2013	0	0	-	3.1	0.9741	-0.0011	0.99988	99.7%	Pass
	80	79	-0.9						
	164	155	-5.6						
	291	280	-3.9						
	380	370	-2.4						
	438	427	-2.6						
November 19, 2013	0	0	-	0.5	1.0012	0.0002	0.99999	100.1%	Pass
	81	82	1.4						
	194	195	0.3						
	316	315	-0.3						
	402	403	0.2						
	430	431	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
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 16, 2013	0.000	0.000	-	3.4	0.9483	0.0027	0.99994	Pass
	0.081	0.080	-1.2					
	0.175	0.171	-2.5					
	0.301	0.290	-3.6					
	0.401	0.383	-4.6					
	0.452	0.429	-5.0					
February 4, 2013	-0.001	-0.001	-	1.5	0.9830	0.0033	0.99992	Pass
	0.080	0.083	3.3					
	0.175	0.177	0.9					
	0.301	0.303	0.6					
	0.401	0.397	-1.1					
	0.452	0.445	-1.5					
April 26, 2013	0.000	0.000	-	1.3	1.0127	-0.0004	0.99995	Pass
	0.080	0.082	2.8					
	0.175	0.176	0.8					
	0.300	0.302	0.4					
	0.400	0.403	0.8					
	0.450	0.458	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]
May 29, 2013	0.003	0.000	-	1.5	1.0256	-0.0023	0.99999	Pass
	0.083	0.083	-0.1					
	0.178	0.181	1.5					
	0.302	0.309	2.2					
	0.402	0.410	2.0					
	0.451	0.459	1.8					
July 18, 2013	0.000	0.000	-	0.5	0.9980	0.0001	0.99998	Pass
	0.080	0.081	0.8					
	0.175	0.175	0.2					
	0.300	0.298	-0.7					
	0.399	0.400	0.3					
	0.450	0.448	-0.3					
August 28, 2013	0.000	-0.001	-	0.2	1.0012	-0.0001	1.00000	Pass
	0.079	0.080	0.3					
	0.175	0.175	0.1					
	0.300	0.300	0.2					
	0.399	0.400	0.1					
	0.448	0.448	0.0					

[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 29, 2013 (replacement)	0.000	0.000	-	0.3	1.0061	-0.0004	0.99999	Pass
	0.080	0.080	0.0					
	0.174	0.174	-0.2					
	0.299	0.300	0.3					
	0.398	0.400	0.4					
	0.446	0.449	0.7					
November 19, 2013	0.000	0.000	-	2.9	1.0392	-0.0012	0.99996	Pass
	0.081	0.081	1.7					
	0.175	0.175	1.9					
	0.299	0.300	3.2					
	0.399	0.400	3.5					
	0.449	0.450	4.1					
December 10, 2013	0.000	0.000	-	0.3	1.0034	0.0001	1.00000	Pass
	0.079	0.079	0.0					
	0.174	0.175	0.5					
	0.299	0.299	0.2					
	0.398	0.400	0.4					
	0.448	0.450	0.4					

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

Table 2-25: Calibration Summary – SO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
January 16, 2013	0	0	-	1.1	0.9970	-0.0013	0.99997	Pass
	85	83	-2.0					
	185	182	-1.5					
	317	312	-1.5					
	422	421	-0.3					
	475	473	-0.4					
February 4, 2013	0	0	-	2.1	1.0278	-0.0009	0.99998	Pass
	83	84	1.0					
	181	185	2.0					
	309	315	1.8					
	414	426	2.9					
	465	478	2.7					
May 29, 2013	0.0	-0.1	-	1.5	1.0258	-0.0023	0.99993	Pass
	82.3	82.6	0.3					
	180.7	179.0	-0.9					
	309.4	314.0	1.5					
	411.9	422.0	2.5					
	463.8	474.0	2.2					

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

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]
July 11, 2013	0.0	0.0	-	0.9	1.0052	-0.0014	0.99995	Pass
	77.7	75.9	-2.4					
	170.3	168.8	-0.9					
	291.3	290.1	-0.4					
	388.8	392.2	0.9					
	437.4	437.2	-0.1					
August 28, 2013	0.0	0.5	-	1.2	0.9945	-0.0008	0.99997	Pass
	77.8	76.3	-2.0					
	170.9	168.2	-1.6					
	292.6	289.0	-1.2					
	390.2	386.2	-1.0					
	438.2	437.2	-0.2					
November 19, 2013	0.0	-0.1	-	0.8	1.0056	-0.0011	0.99997	Pass
	77.8	76.4	-1.8					
	170.7	169.6	-0.7					
	292.3	294.1	0.6					
	390.1	389.2	-0.2					
	438.6	441.3	0.6					

[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 2-26: 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
7-Jan-13	-28.8	-27.8	-1.0	754	749	5	09:46:10	09:44:24	00:01:46	16.7	16.70	0.0%
4-Feb-13	-29.5	-28.8	-0.7	759	760	-1	14:35:00	14:33:00	00:02:00	16.7	16.90	-1.2%
1-Mar-13	-19.7	-19.5	-0.2	758	757	1	12:50:20	12:49:49	00:00:31	16.7	16.70	0.0%
1-Apr-13	-15.3	-16.0	0.7	767	770	-3	11:39:00	11:37:21	00:01:39	16.7	16.70	0.0%
10-Apr-13[4]	-17.7	-18.2	0.5	748	748	0	10:02:00	10:00:34	00:01:26	16.7	16.70	0.0%
3-May-13	-10.9	-11.1	0.2	767	767	0	09:49:30	09:48:41	00:00:49	16.7	16.70	0.0%
6-Jun-13	1.1	1.2	-0.1	758	759	-1	11:32:15	11:32:10	00:00:05	16.7	16.60	0.6%
2-Jul-13	5.9	7.8	-1.9	749	749	0	12:33:10	12:34:42	-00:01:32	16.7	16.70	0.0%
10-Aug-13	7.9	8.9	-1.0	753	753	0	08:48:15	08:47:16	00:00:59	16.7	16.70	0.0%
28-Aug-13	0.6	1.2	-0.6	756	756	0	08:25:55	08:25:31	00:00:24	16.7	16.69	0.1%
11-Sep-13	13.0	14.3	-1.3	751	751	0	12:03:15	12:02:52	00:00:23	16.4	16.60	-1.2%
17-Sep-13[5]	-0.4	0.6	-1.0	758	758	0	-	-	-	16.7	16.70	0.0%
2-Oct-13	-5.3	-4.4	-0.9	763	762	1	12:14:30	12:14:21	00:00:09	16.7	16.70	0.0%
1-Nov-13	-11.7	-10.3	-1.4	760	767	-7	09:54:20	09:52:43	00:01:37	16.7	16.70	0.0%
20-Nov-13	-24.3	-24.4	0.1	782	772	10	14:23:00	14:22:00	00:01:00	16.7	16.92	-1.3%
2-Dec-13	-9.6	-9.0	-0.6	774	776	-2	13:29:10	13:28:05	00:01:05	16.6	16.60	0.0%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] Multi-point calibration performed; full calibration results are in Appendix C.
[5] Extra QC check following flow adjustment; time is not a critical validation criterion and was confirmed on 9/11/13.

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
7-Jan-13	-28.7	-27.8	-0.9	755	749	6	09:41:28	09:39:40	00:01:48	16.7	16.70	0.0%
28-Jan-13[4]	-32.4	-32.3	-0.1	771	771	0	12:20:00	12:20:00	00:00:00	16.7	16.70	0.0%
3-Feb-13[4]	-25.8	-26.1	0.3	753	754	-1	20:29:00	20:29:00	00:00:00	16.7	16.75	-0.3%
1-Mar-13	-19.5	-19.5	0.0	758	757	1	12:50:25	12:50:02	00:00:23	16.7	16.70	0.0%
1-Apr-13	-16.1	-16.1	0.0	767	769	-2	11:37:50	11:36:45	00:01:05	16.7	16.70	0.0%
10-Apr-13[4]	-17.7	-17.8	0.1	748	749	1	10:00:30	09:59:31	00:00:59	16.7	16.90	-1.2%
3-May-13	-11.2	-11.1	-0.1	767	768	-1	09:49:00	09:47:49	00:01:11	16.6	16.70	-0.6%
6-Jun-13	0.3	0.4	-0.1	759	759	0	11:31:45	11:31:28	00:00:17	16.6	16.70	-0.6%
2-Jul-13	6.1	7.5	-1.4	747	749	-2	12:32:15	12:34:19	-00:02:04	16.6	16.70	-0.6%
10-Aug-13	7.9	9.1	-1.2	753	753	0	08:49:30	08:46:42	00:02:48	16.6	16.70	-0.6%
28-Aug-13	0.8	1.2	-0.4	756	756	0	08:28:33	08:25:55	00:02:38	16.7	16.70	-0.3%
11-Sep-13	12.7	14.3	-1.6	752	751	1	12:02:45	12:02:06	00:00:39	16.6	16.60	0.0%
2-Oct-13	-5.4	-4.0	-1.4	756	762	-6	12:15:00	12:13:55	00:01:05	16.6	16.60	0.0%
1-Nov-13	-11.7	-10.4	-1.3	759	767	-8	09:53:40	09:52:10	00:01:30	16.6	16.60	0.0%
20-Nov-13	-24.4	-24.4	0.0	781	772	9	13:56:12	13:54:40	00:01:32	16.7	16.82	-0.7%
2-Dec-13	-9.6	-8.8	-0.8	774	776	-2	13:29:15	13:27:15	00:02:00	16.6	16.60	0.0%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] Multi-point calibration performed; full calibration results are in Appendix C.

Table 2-28: May 29, 2013 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Time	≤ ±05:00	mm:ss	00:05	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.35	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.32	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	0.2	Pass
Wind Direction Alignment	≤ ±5	Degree	1.1	Pass
Wind Direction Accuracy	≤ ±5	Degree	1.0	Pass
Wind Direction Linearity	≤ ±3	Degree	0.4	Pass
Wind Direction Torque	≤ 11.0	g-cm	5.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.20	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±5	%	0.7	Pass

Table 2-29: November 20, 2013 Meteorological Calibration Summary

Parameter	Limit	Units	Error	Status
Time	≤ ±5	mm:ss	00:00	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.33	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.36	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	0.3	Pass
Wind Direction Alignment	≤ ±5	Degree	2	Pass
Wind Direction Accuracy	≤ ±5	Degree	2.3	Pass
Wind Direction Linearity	≤ ±3	Degree	1.3	Pass
Wind Direction Torque	≤ 11.0	g-cm	6.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.11	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±10	W/m^2	0.1	Pass

Table 2-30: December 9, 2013 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	0.2	Pass
Wind Direction Alignment	≤ ±5	Degree	1	Pass
Wind Direction Accuracy	≤ ±5	Degree	1.2	Pass
Wind Direction Linearity	≤ ±3	Degree	1.2	Pass
Wind Direction Torque	≤ 11.0	g-cm	7.0	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 2-31 to 2-34.

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 2-35 and 2-36.

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 2-37 to 2-38.

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 2013 monitoring year this audit occurred at the CD1 and Nuiqsut monitoring stations. 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 2-39 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 2013 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 2-31: Performance Audit Summary – CO

Period	Audit Point	Audit Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail[1]
						Slope	Y-Intercept	R^2	
February 7, 2013	0	0.00	0.02	-	1.3	0.9901	-0.012	1.0000	Pass
	1	2.11	2.09	-1.0					
	2	6.87	6.73	-2.0					
	3	21.91	21.70	-1.0					
May 29, 2013	0	0.00	0.02	-	1.1	0.9895	0.062	1.000	Pass
	1	2.06	2.09	1.6					
	2	6.89	6.95	0.9					
	3	21.99	21.80	-0.9					
August 29, 2013	0	0.00	0.02	-	3.0	1.0336	-0.010	1.0000	Pass
	1	2.13	2.19	3.0					
	2	6.86	7.04	2.6					
	3	21.86	22.60	3.4					
November 20, 2013	0	0.00	0.01	-	1.4	1.0165	-0.069	1.0000	Pass
	1	2.07	2.03	-1.9					
	2	7.56	7.50	-0.8					
	3	21.77	22.10	1.5					

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

Table 2-32: Performance Audit Summary – NO_2

Period	Audit Point	Audit Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Converter Efficiency	Pass/Fail[(1)]
						Slope	Y-Intercept	R^2		
February 7, 2013	0	0	0	-	1.4	0.9759	0.552	0.9999	100.0%	Pass
	1	56	55	-1.2						
	2	81	81	-0.6						
	3	162	158	-2.4						
May 29, 2013	0	0	0	-	5.3	0.9379	0.596	1.0000	100.0%	Pass
	1	59	56	-6.1						
	2	84	81	-3.7						
	3	269	253	-6.1						
August 29, 2013	0	0	0	-	5.3	1.0428	0.640	1.0000	99.6%	Pass
	1	55	58	5.2						
	2	82	87	6.4						
	3	255	266	4.4						
November 20, 2013	0	0	0	-	2.2	0.9802	-0.167	1.0000	100.0%	Pass
	1	49	48	-2.0						
	2	73	71	-2.7						
	3	249	244	-2.0						

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

Table 2-33: Performance Audit Summary – O_3

Period	Audit Point	Audit Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail[1]
						Slope	Y-Intercept	R^2	
February 7, 2013	0	0.000	0.000	-	2.9	1.0195	0.401	1.0000	Pass
	1	0.022	0.023	4.5					
	2	0.074	0.076	2.7					
	3	0.174	0.178	2.3					
	4	0.396	0.404	2.0					
May 29, 2013	0	0.000	0.000	-	1.5	0.9991	0.922	1.0000	Pass
	1	0.030	0.031	3.3					
	2	0.075	0.076	1.3					
	3	0.175	0.177	1.1					
	4	0.411	0.411	0.0					
August 29, 2013	0	0.000	0.000	-	2.2	0.9598	1.273	1.0000	Pass
	1	0.032	0.032	0.0					
	2	0.077	0.076	-1.3					
	3	0.182	0.177	-2.7					
	4	0.414	0.398	-3.9					
November 20, 2013	0	0.000	0.000	-	1.4	0.9846	-0.412	1.0000	Pass
	1	0.028	0.028	0.0					
	2	0.073	0.071	-2.7					
	3	0.148	0.144	-2.7					
	4	0.396	0.390	-1.5					

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

Table 2-34: Performance Audit Summary – SO_2

Period	Audit Point	Audit Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail[1]
						Slope	Y-Intercept	R^2	
February 7, 2013	0	0	0	-	0.3	0.9911	0.294	1.0000	Pass
	1	38	38	0.0					
	2	75	75	0.0					
	3	245	243	-0.8					
May 29, 2013	0	0	0	-	2.2	0.9633	0.760	1.0000	Pass
	1	49	49	-0.9					
	2	75	73	-2.1					
	3	250	241	-3.5					
August 29, 2013	0	0	0	-	1.4	1.0105	-0.418	1.0000	Pass
	1	50	49	-1.9					
	2	75	76	1.3					
	3	249	251	0.9					
November 20, 2013	0	0	1	-	2.8	0.9685	0.544	1.0000	Pass
	1	37	36	-2.7					
	2	75	73	-2.7					
	3	274	266	-2.9					

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

Table 2-35: Performance Audit Summary – $PM_{2.5}$

Period	External Leak Check Error (LPM)	Ambient Temperature Error (°C)	Ambient Pressure Error (mmHg)	Flow Rate		Pass/Fail[(1)]
				Flow Rate Accuracy Percent Error (%)	Design Flow Test Percent Error (%)	
February 7, 2013	0.2	0.7	-8	-1.2	1.2	Pass
May 29, 2013	0.4	0.0	1	0.0	0.0	Pass
August 27, 2013	0.1	0.1	1	0.0	0.0	Pass
November 20, 2013	0.1	-0.2	-2	-0.6	0.6	Pass

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

Table 2-36: Performance Audit Summary – PM_{10}

Period	External Leak Check Error (LPM)	Ambient Temperature Error (°C)	Ambient Pressure Error (mmHg)	Flow Rate		Pass/Fail[(1)]
				Flow Rate Accuracy Percent Error (%)	Design Flow Test Percent Error (%)	
February 7, 2013	0.8	0.4	-7	-3.5	3.6	Pass
May 29, 2013	0.4	0.0	1	-0.6	0.6	Pass
August 27, 2013	0.1	0.2	1	0.6	-0.6	Pass
November 20, 2013	0.2	-0.2	-2	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 2-37: May 29, 2013 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 0.5	m/s	0.16	Pass
Wind Direction Accuracy	≤ ±5	Degree	1	Pass
Wind Direction Linearity	≤ ±3	Degree	1	Pass
Wind Direction Torque	≤ 0.5	m/s	0.33	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	-0.26	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.16	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.08	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.05	Pass
Air Temperature Difference	≤ ±0.10	°C	0.04	Pass
Solar Radiation Accuracy ≥ 200 W/m^2	≤ ±5	Mean % Error	2.2	Pass

Table 2-38: November 20, 2013 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 0.5	m/s	0.16	Pass
Wind Direction Accuracy	≤ ±5	Degree	2	Pass
Wind Direction Linearity	≤ ±3	Degree	1	Pass
Wind Direction Torque	≤ 0.5	m/s	0.40	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.08	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.16	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.14	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.17	Pass
Air Temperature Difference	≤ ±0.10	°C	-0.03	Pass
Solar Radiation Accuracy < 200 W/m^2	≤ ±10	W/m^2	0.3	Pass

Table 2-39: $PM_{2.5}$ PEP Audit Results

Date	BAM 1020 Results ($\mu g/m^3$)	PEP Audit Results ($\mu g/m^3$)	Difference ($\mu g/m^3$)	Bias[(1)] ($\mu g/m^3$)
23-Aug-2013	1.09	1.10	0.01	
24-Aug-2013	0.97	1.20	0.23	
25-Aug-2013	1.30	0.50	-0.80	-0.02
27-Aug-2013	1.25	1.90	0.65	
28-Aug-2013	1.50	1.30	-0.20	

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

3. MONITORING DATA NETWORK SUMMARY

3.1 AIR QUALITY DATA SUMMARY

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

Table 3-1: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Carbon Monoxide (**CO**)	35 ppm (40,000 µg/m^3)	1-Hour[(1)]	1st Highest, 1-Hour Average	1	1	0	1	**1**	**2.9%**
			2nd Highest, 1-Hour Average	1	1	0	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour[(1)]	1st Highest, 8-Hour Average	1	1	0	0	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	1	0	0	**1**	**11.1%**
Nitrogen Dioxide (**NO_2**)	100.0 ppb (190 µg/m^3)	1-Hour[(2)]	Daily Max 1-Hour Averages (98th Percentile)	-	-	-	-	**22.6**	**22.6%**
			1st Highest, 1-Hour Average	29.0	14.4	10.5	31.9	**31.9**	**31.9%**
			2nd Highest, 1-Hour Average	26.1	14.1	10.3	25.8	**29.0**	**29.0%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	2	1	1	2	**1**	**1.9%**
Ozone (**O_3**)	0.075 ppm (150 µg/m^3)	8-Hour[(3)]	4th Highest, 8-Hour Average	0.042	0.049	0.037	0.041	**0.049**	**65.3%**
			1st Highest, 8-Hour Average	0.042	0.049	0.037	0.041	**0.049**	**65.3%**
			2nd Highest, 8-Hour Average	0.042	0.049	0.037	0.041	**0.049**	**65.3%**

[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)	-	-	-	-	**1.1**	**1.5%**
			1st Highest, 1-Hour Average	2.2	0.8	1.1	1.4	**2.2**	**2.9%**
			2nd Highest, 1-Hour Average	2.0	0.8	1.0	1.2	**2.0**	**2.7%**
	500.0 ppb (1,300 μg/m^3)	3-Hour[5]	1st Highest, 3-Hour Average	2.0	0.7	0.8	1.1	**2.0**	**0.4%**
			2nd Highest, 3-Hour Average	1.8	0.7	0.8	1.1	**1.8**	**0.4%**
	140.0 ppb (365 μg/m^3)	24-Hour[5]	1st Highest, 24-Hour Average	1.3	0.6	0.7	0.8	**1.3**	**0.9%**
			2nd Highest, 24-Hour Average	0.7	0.6	0.7	0.7	**0.8**	**0.6%**
	30.0 ppb (80 μg/m^3)	Annual	Average of Period	0.1	0.3	0.0	0.0	**0.1**	**0.3%**

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

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

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Particulate Matter <2.5 microns ($PM_{2.5}$)	35 μg/m^3	24-Hour[6]	98th Percentile, 24-Hour Average	-	-	-	-	**6**	**17.1%**
			1st Highest, 24-Hour Average	7	11	4	10	**11**	**31.4%**
			2nd Highest, 24-Hour Average	7	6	4	8	**10**	**28.6%**
	15.0 μg/m^3	Annual[7]	Average of Period	2.7	1.6	1.0	1.8	**1.8**	**12.0%**
Particulate Matter <10 microns (PM_{10})	150 μg/m^3	24-Hour[8,9]	1st Highest, 24-Hour Average	10	40	50	10	**50**	**33.3%**
			2nd Highest, 24-Hour Average	10	20	30	10	**40**	**26.7%**

[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] 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.
[8] Not to be exceeded more than once per year on average over three years.
[9] 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.

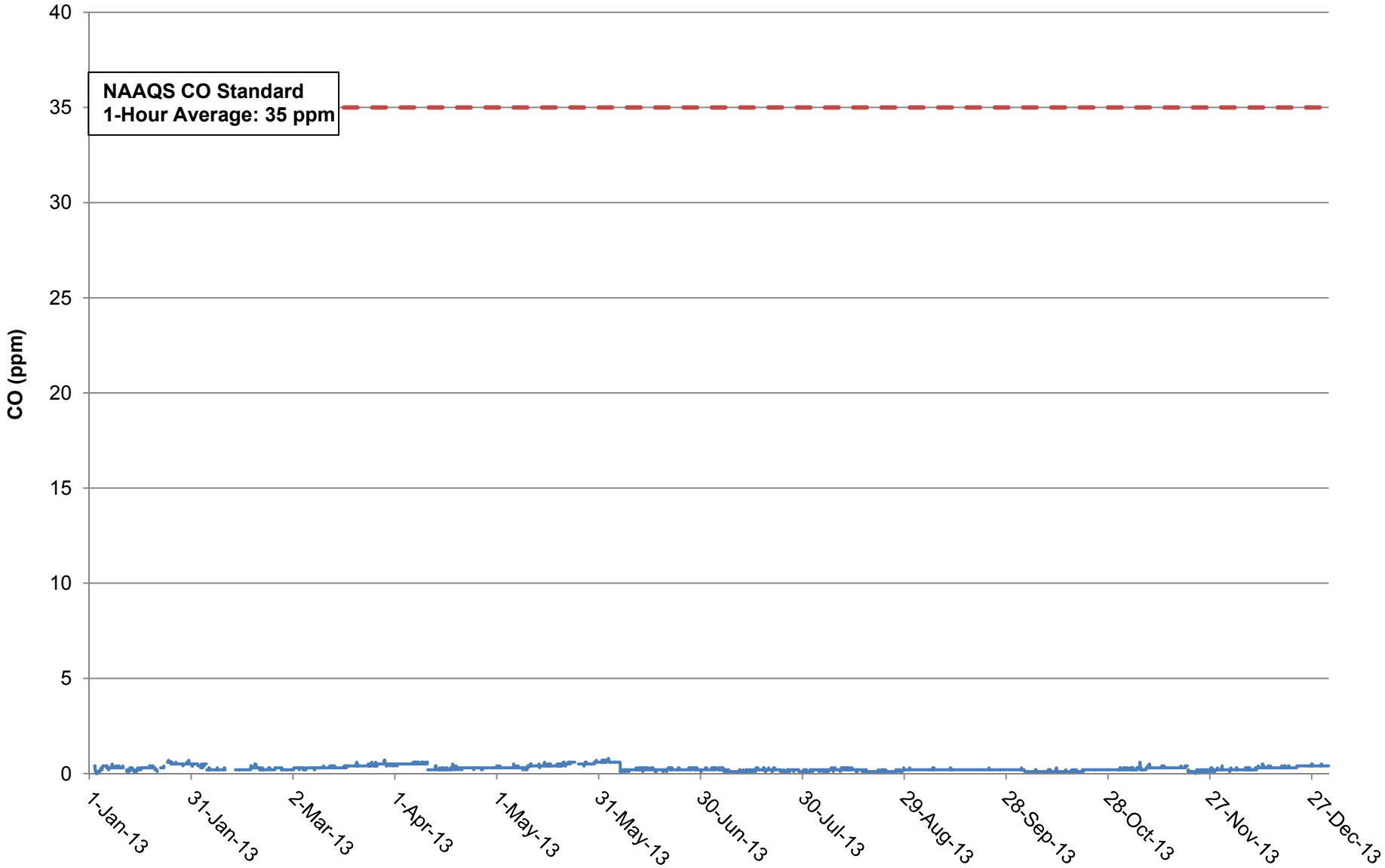


Figure 3-1: 1-Hour Average CO and NAAQS/AAAQS Standard

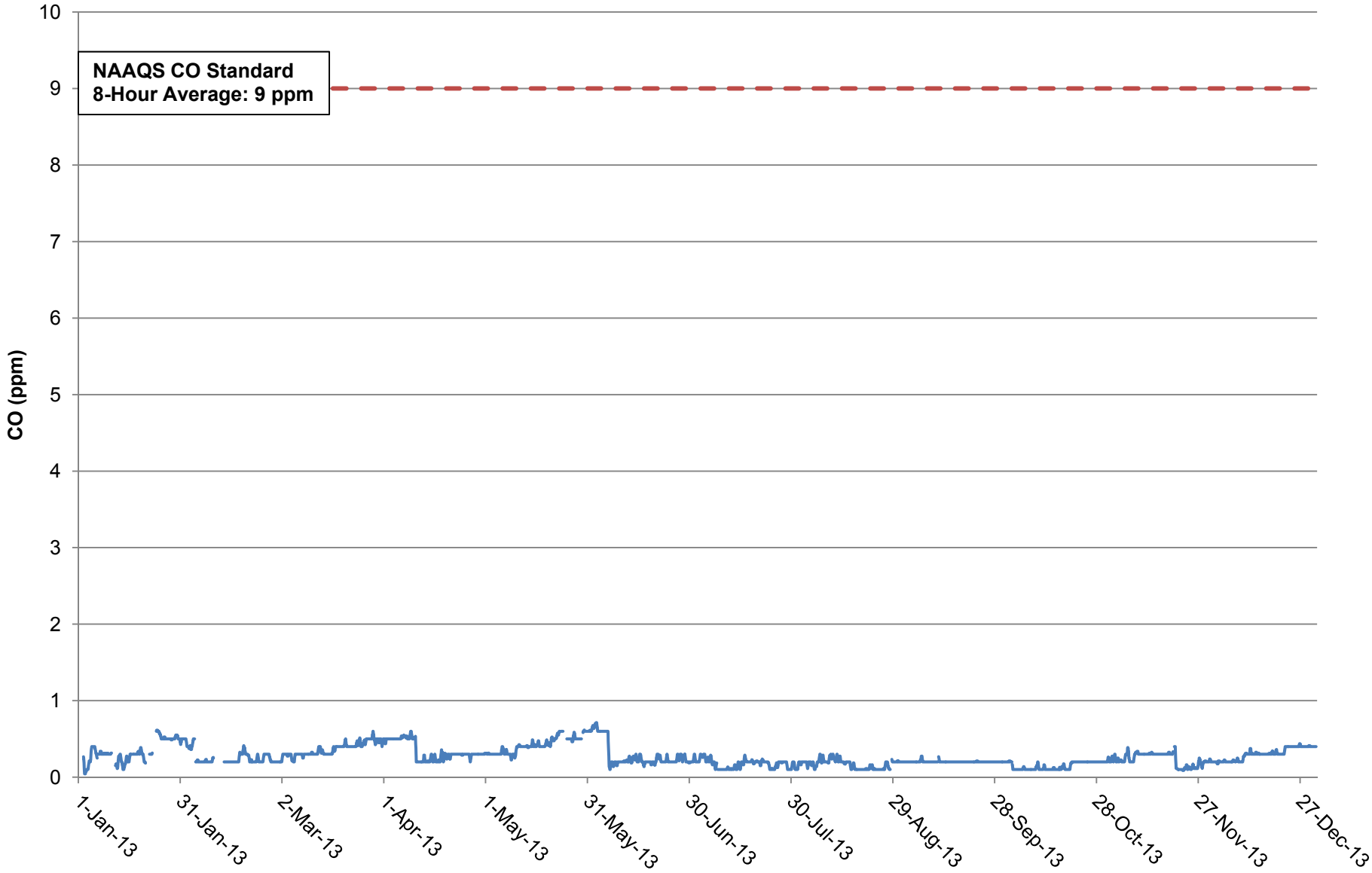


Figure 3-2: 8-Hour Average CO and NAAQS/AAAQS Standard

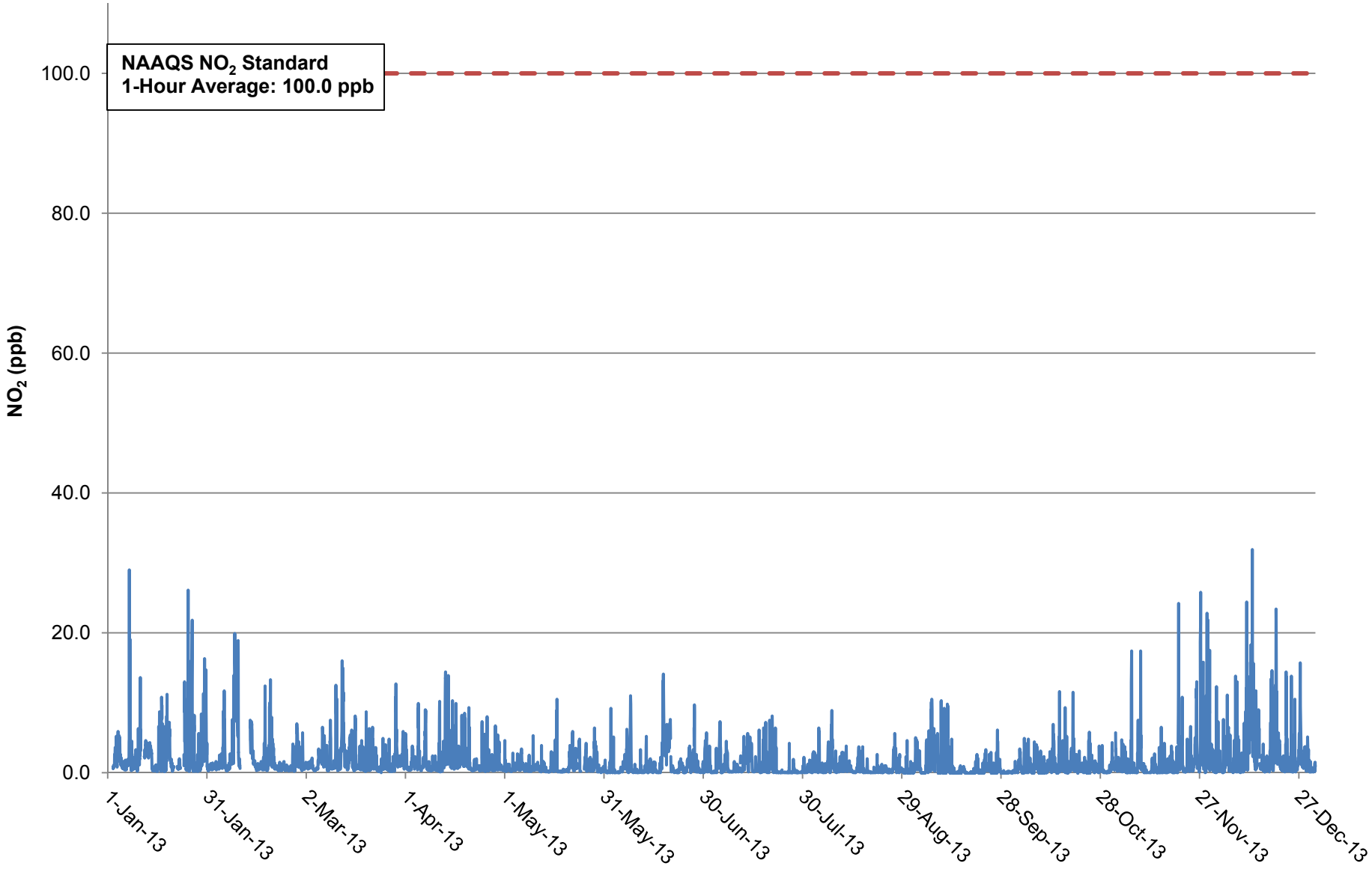


Figure 3-3: 1-Hour Average NO_2 and NAAQS Standard

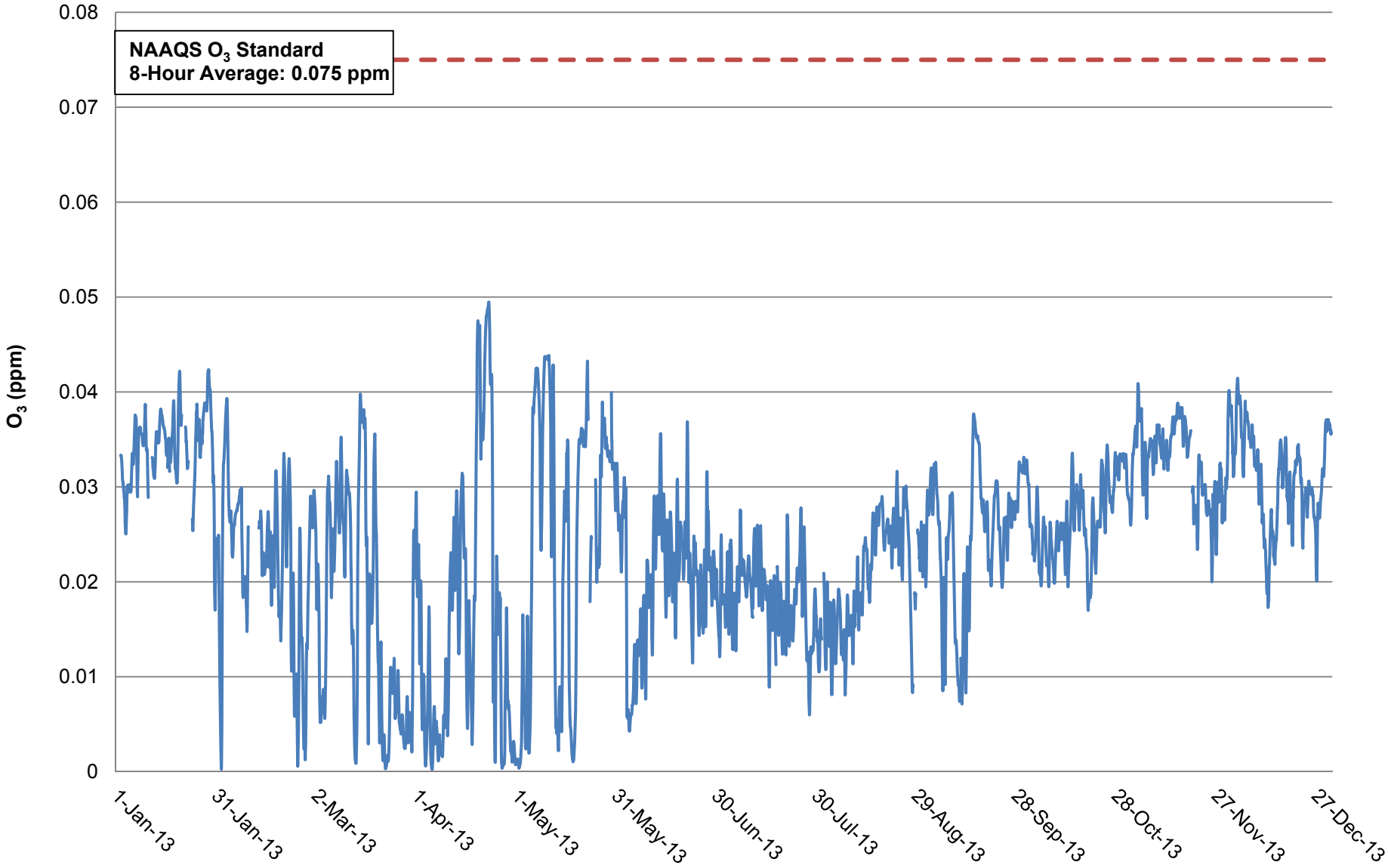


Figure 3-4: 8-Hour Average O_3 and NAAQS/AAAQS Standard

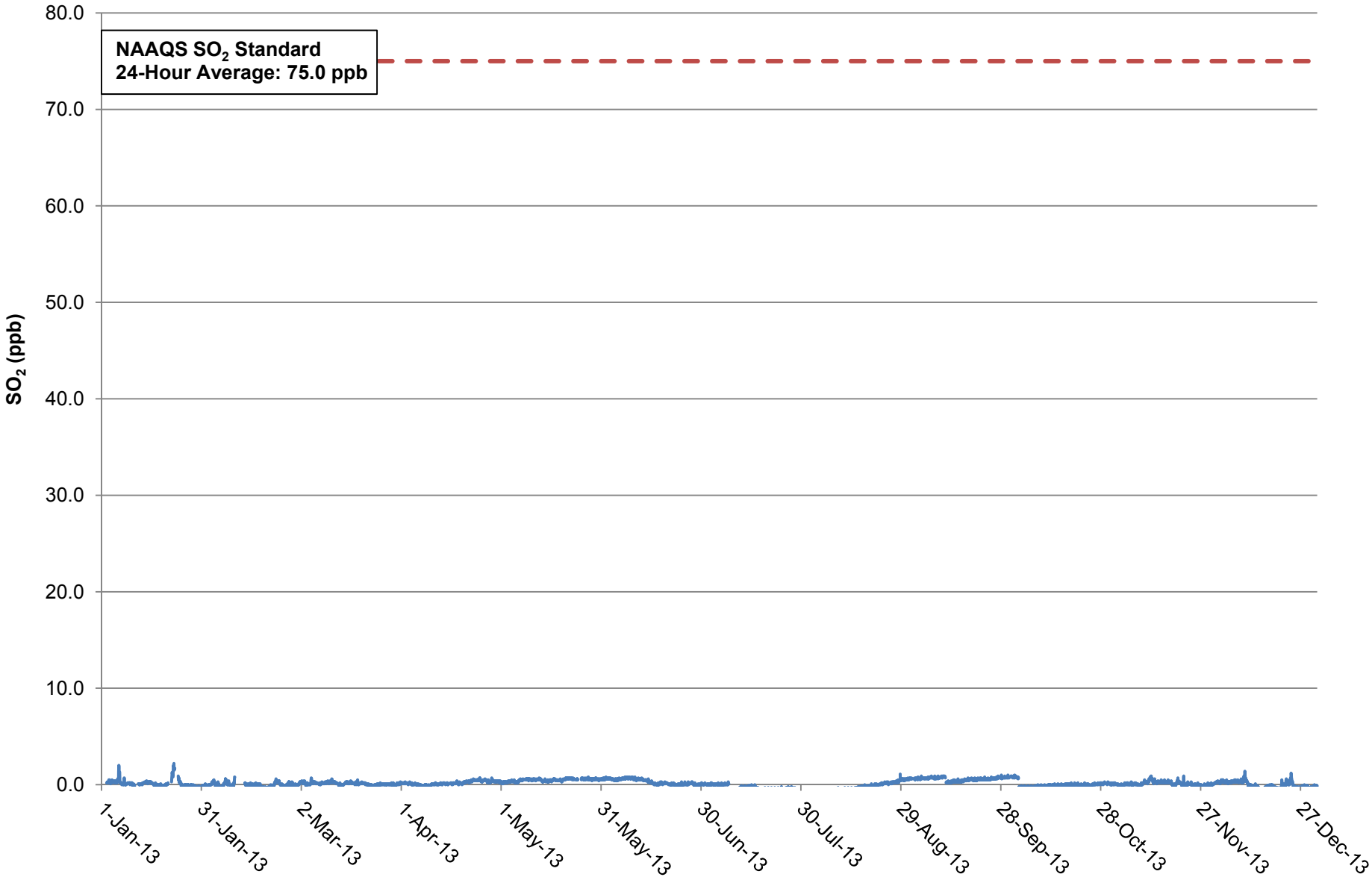


Figure 3-5: 1-Hour Average SO_2 and NAAQS/AAAQS Standard

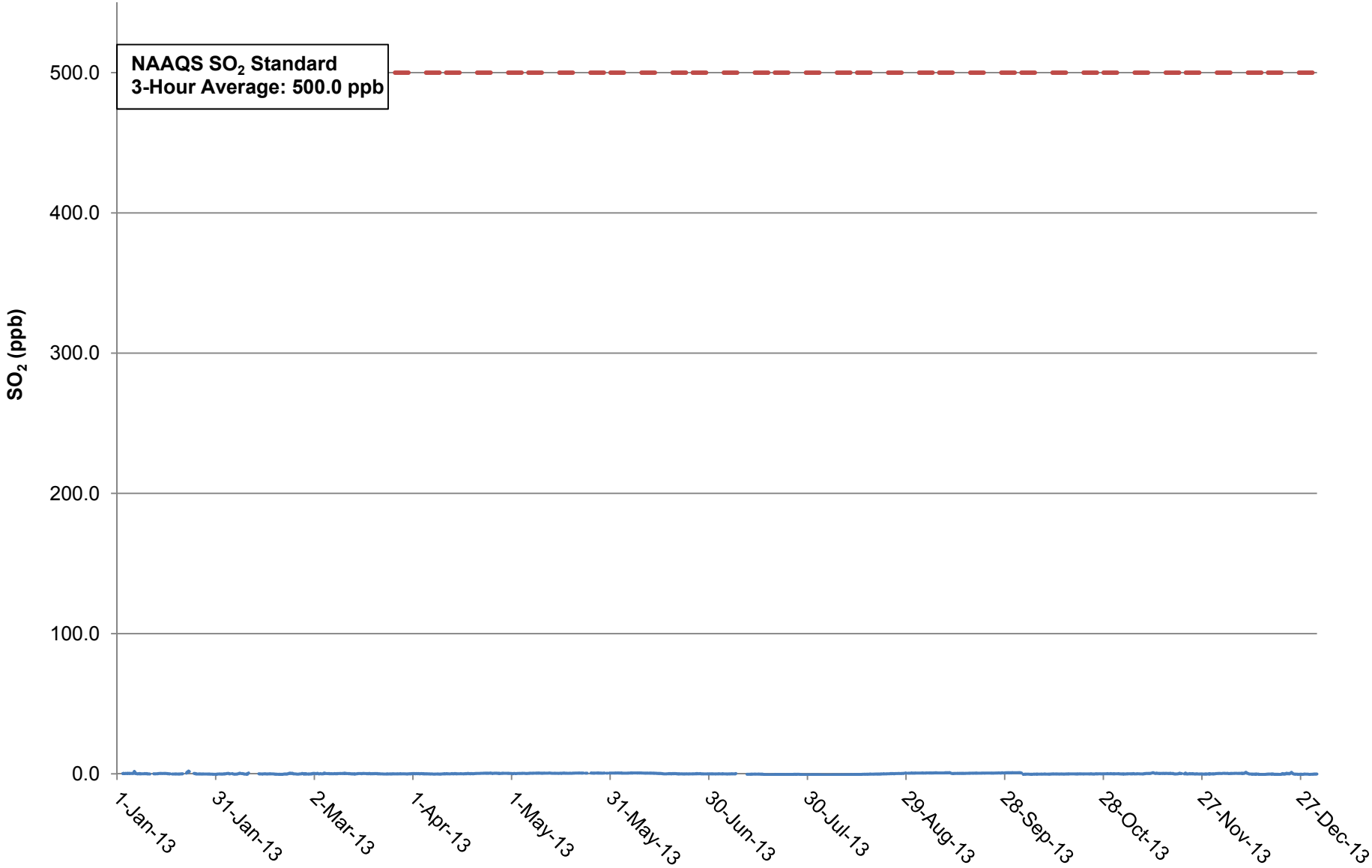


Figure 3-6: 3-Hour Average SO_2 and NAAQS/AAAQS Standard

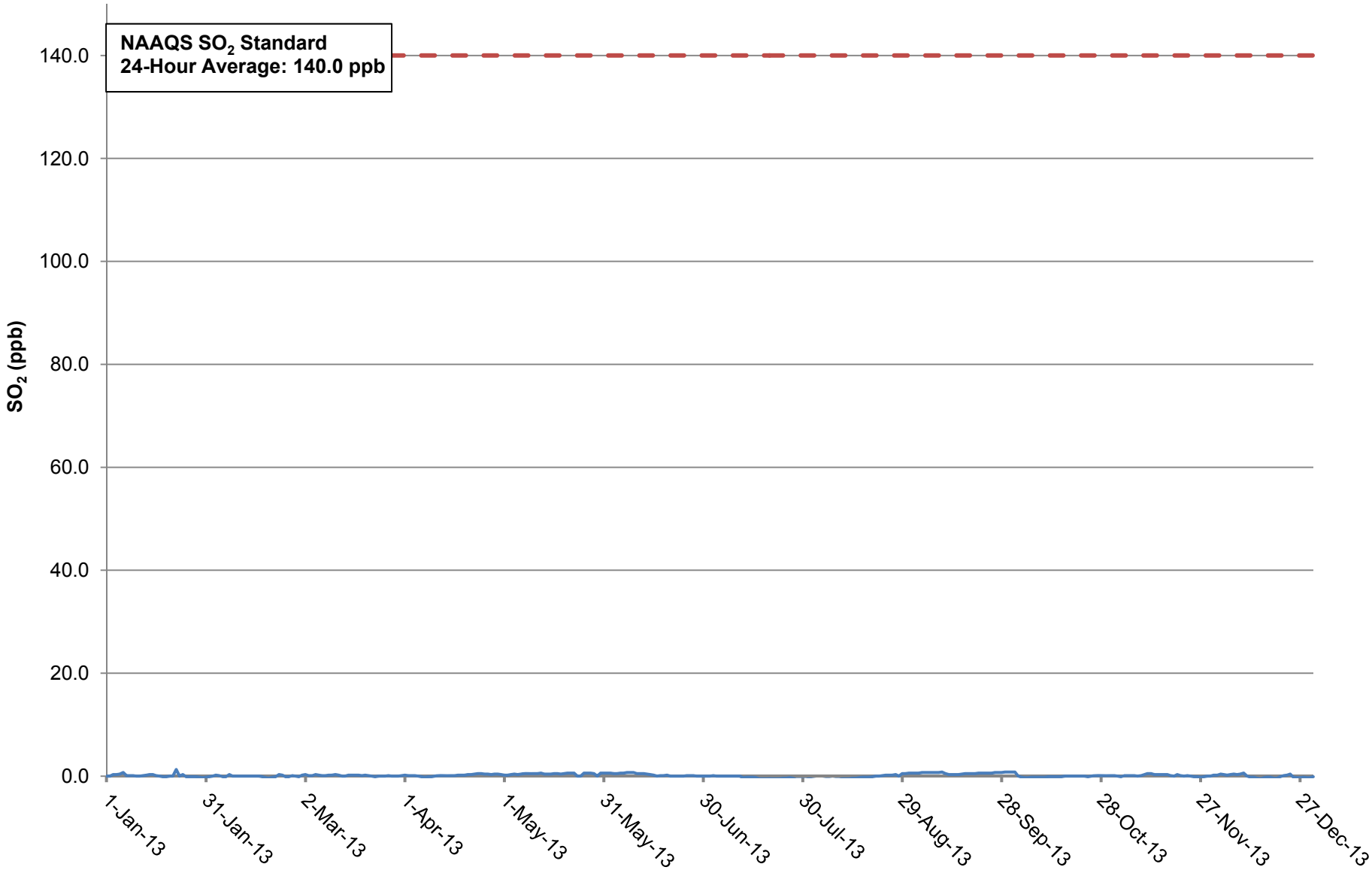


Figure 3-7: 24-Hour Average SO_2 and NAAQS/AAAQS Standard

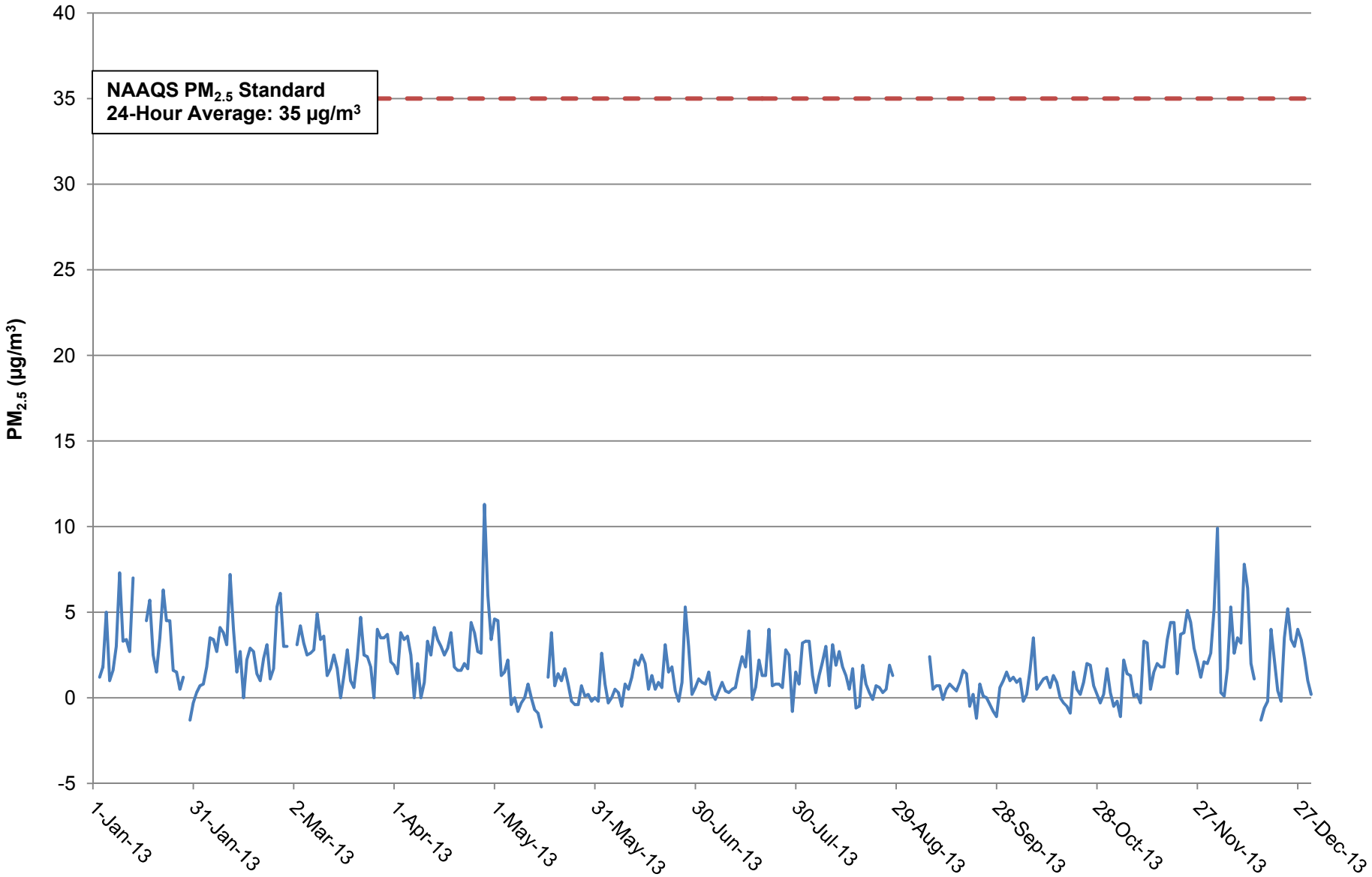


Figure 3-8: 24-Hour Average $PM_{2.5}$ and NAAQS/AAAQS Standard

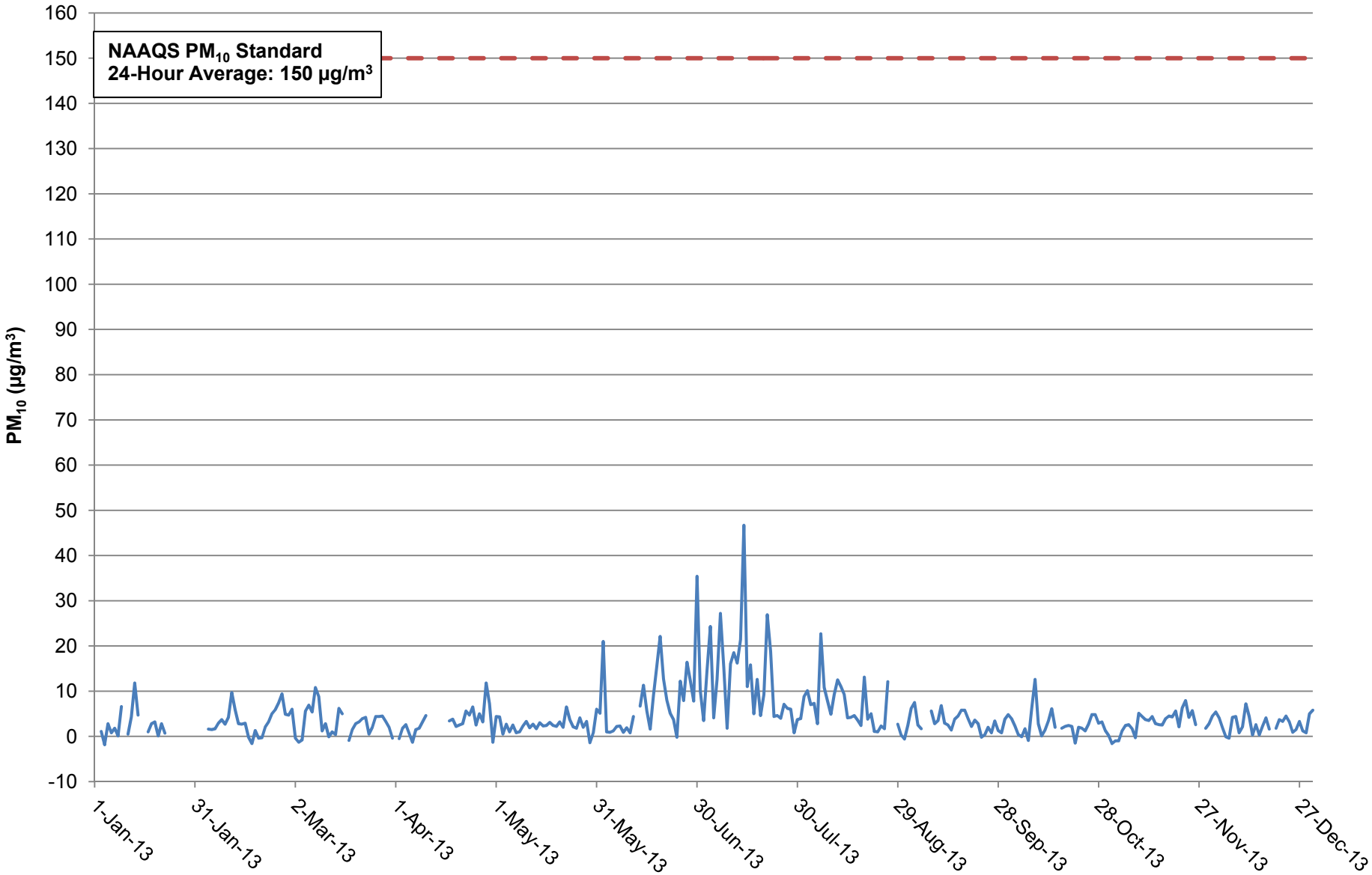


Figure 3-9: 24-Hour Average PM_{10} and NAAQS/AAAQS Standard

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 is for comparison purposes and can be contrasted with Table 3-3, which is a statistical summary of horizontal and vertical wind speed measurements during the meteorological monitoring year 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	5.7	20.6
2nd Quarter	4.2	15.4
3rd Quarter	4.2	12.3
4th Quarter	5.1	22.1
Monitoring Year	**4.8**	**22.1**

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	6.09	20.92	0.19	1.09
2nd Quarter	4.37	15.07	0.16	0.99
3rd Quarter	4.52	12.55	0.14	0.70
4th Quarter	4.87	21.65	0.29	2.07
Monitoring Year	**4.95**	**21.65**	**0.20**	**2.07**

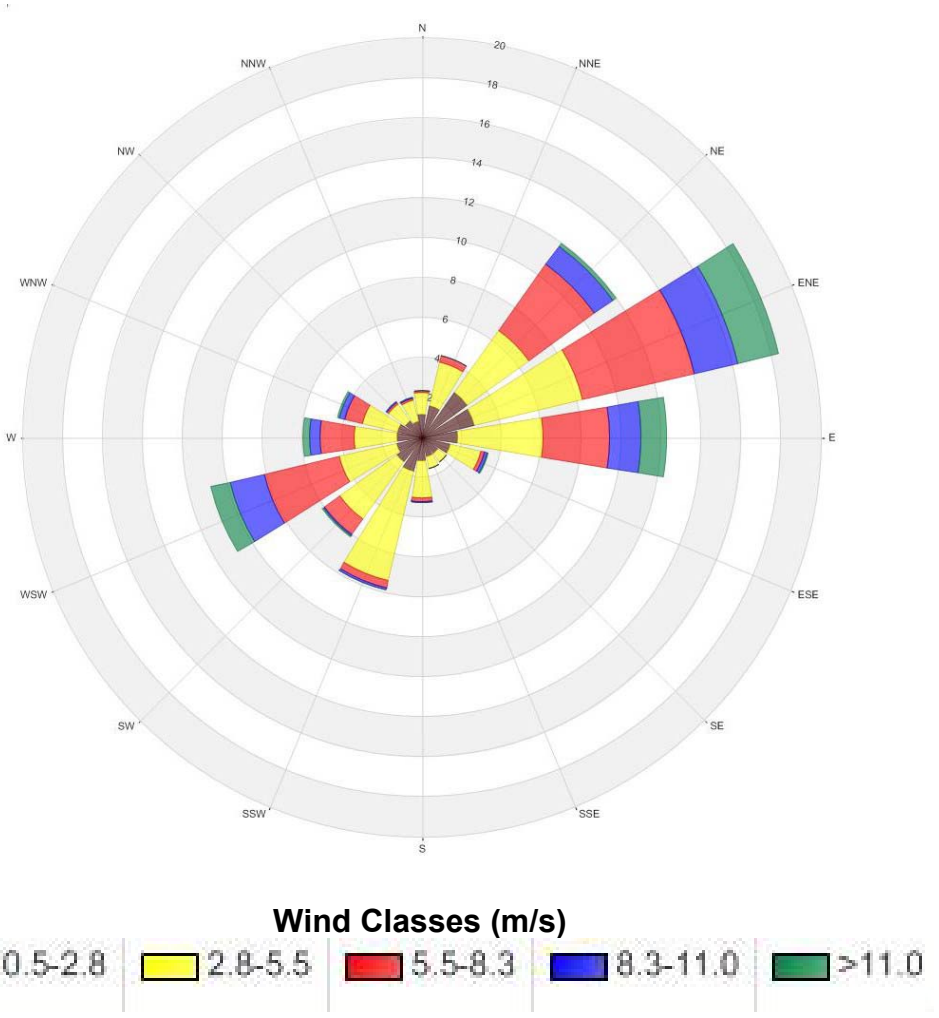
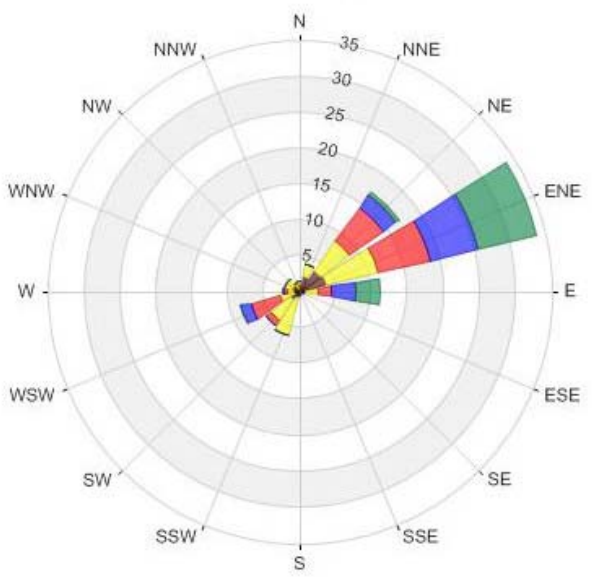
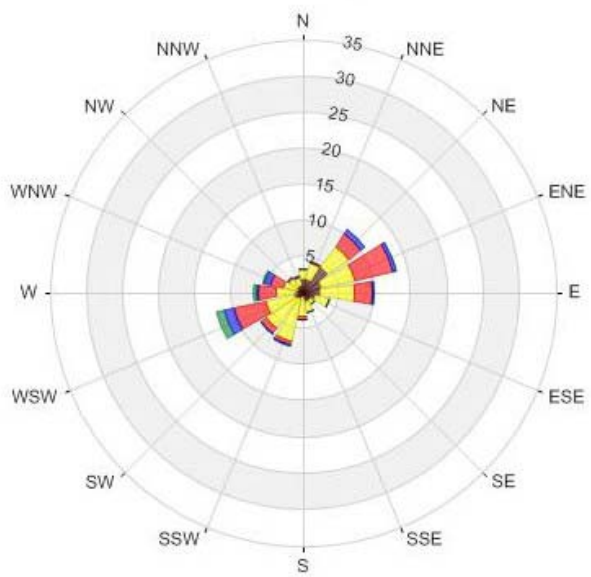


Figure 3-10: Nuiqsut Annual Wind Rose

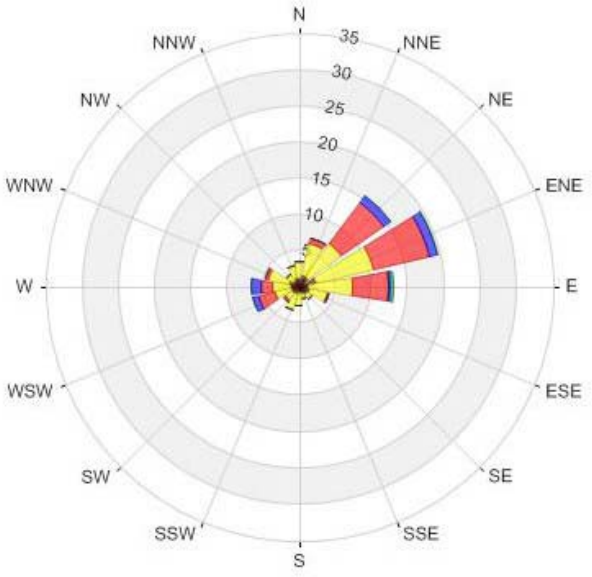
1st Quarter (1/1/13 – 3/31/13)



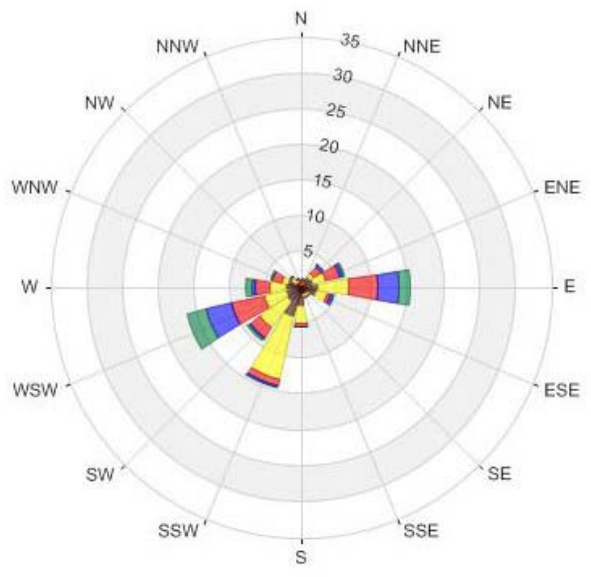
2nd Quarter (4/1/13 – 6/30/13)



3rd Quarter (7/1/13 – 9/30/13)



4th Quarter (10/1/13 – 12/31/13)



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	1.15	1.09	0.13	0.00	0.00	**2.37**
NNE	1.65	2.24	0.33	0.00	0.00	**4.22**
NE	2.80	3.79	4.07	1.13	0.18	**11.97**
ENE	2.71	5.58	5.74	2.22	2.13	**18.38**
E	1.81	4.27	3.32	1.61	1.28	**12.29**
ESE	1.47	1.56	0.21	0.13	0.04	**3.41**
SE	0.98	0.53	0.01	0.00	0.00	**1.52**
SSE	0.98	0.65	0.00	0.00	0.00	**1.63**
S	1.19	1.84	0.21	0.02	0.00	**3.26**
SSW	1.77	5.62	0.36	0.12	0.00	**7.87**
SW	1.53	3.53	0.94	0.07	0.08	**6.15**
WSW	1.32	2.92	3.88	1.77	0.96	**10.85**
W	1.24	2.17	1.70	0.51	0.33	**5.95**
WNW	1.28	1.80	0.91	0.28	0.06	**4.33**
NW	1.00	1.07	0.11	0.01	0.01	**2.20**
NNW	0.85	1.08	0.11	0.01	0.00	**2.05**
Summary	**23.73**	**39.74**	**22.03**	**7.88**	**5.07**	**98.45[(1)]**

[1] The remaining 1.55 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	0.97	0.49	0.00	0.00	0.00	**1.46**
NNE	2.23	1.70	0.00	0.00	0.00	**3.93**
NE	3.55	5.05	5.78	2.19	0.58	**17.15**
ENE	3.84	7.48	7.38	6.85	8.40	**33.95**
E	0.83	1.85	1.85	3.30	3.35	**11.18**
ESE	0.24	0.10	0.15	0.10	0.05	**0.64**
SE	0.15	0.05	0.00	0.00	0.00	**0.20**
SSE	0.24	0.00	0.00	0.00	0.00	**0.24**
S	0.58	0.19	0.00	0.00	0.00	**0.77**
SSW	0.87	5.49	0.00	0.00	0.00	**6.36**
SW	1.46	3.50	0.83	0.00	0.00	**5.79**
WSW	0.68	2.14	4.18	1.46	0.05	**8.51**
W	0.73	0.97	0.53	0.05	0.00	**2.28**
WNW	1.02	1.02	0.10	0.00	0.00	**2.14**
NW	1.02	1.02	0.05	0.00	0.00	**2.09**
NNW	0.34	0.87	0.00	0.00	0.00	**1.21**
Summary	**18.75**	**31.92**	**20.85**	**13.95**	**12.43**	**97.90[(1)]**

[1] The remaining 2.10 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	1.93	1.29	0.09	0.00	0.00	**3.31**
NNE	1.93	2.34	0.23	0.00	0.00	**4.50**
NE	4.36	3.54	2.07	0.69	0.00	**10.66**
ENE	2.76	4.64	5.37	0.51	0.00	**13.28**
E	2.57	4.64	2.48	0.18	0.00	**9.87**
ESE	1.79	2.02	0.00	0.00	0.00	**3.81**
SE	1.33	0.69	0.00	0.00	0.00	**2.02**
SSE	1.33	1.65	0.00	0.00	0.00	**2.98**
S	0.69	2.76	0.41	0.00	0.00	**3.86**
SSW	0.96	6.02	0.55	0.09	0.00	**7.62**
SW	1.10	5.05	0.92	0.05	0.00	**7.12**
WSW	1.29	4.04	4.41	1.42	1.10	**12.26**
W	1.01	2.71	2.53	0.28	0.37	**6.90**
WNW	0.78	2.02	1.88	0.96	0.18	**5.82**
NW	1.10	1.24	0.18	0.00	0.05	**2.57**
NNW	1.06	1.10	0.32	0.00	0.00	**2.48**
Summary	**25.99**	**45.75**	**21.44**	**4.18**	**1.70**	**99.06[(1)]**

[1] The remaining 0.94 percent of data were calms (below 0.5 m/s).

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

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	1.23	2.27	0.09	0.00	0.00	**3.59**
NNE	1.72	4.45	0.77	0.00	0.00	**6.94**
NE	1.63	5.63	7.08	1.23	0.00	**15.57**
ENE	2.40	8.17	7.89	1.18	0.09	**19.73**
E	1.45	5.99	4.99	0.27	0.32	**13.02**
ESE	1.63	2.50	0.23	0.00	0.00	**4.36**
SE	1.32	0.95	0.05	0.00	0.00	**2.32**
SSE	1.13	0.59	0.00	0.00	0.00	**1.72**
S	0.82	1.95	0.00	0.00	0.00	**2.77**
SSW	1.09	2.31	0.05	0.00	0.00	**3.45**
SW	1.18	1.13	0.32	0.00	0.00	**2.63**
WSW	1.18	2.31	2.31	0.77	0.00	**6.57**
W	1.23	2.50	1.68	1.18	0.14	**6.73**
WNW	1.41	3.09	0.36	0.09	0.00	**4.95**
NW	1.04	1.09	0.05	0.00	0.00	**2.18**
NNW	1.23	1.86	0.05	0.00	0.00	**3.14**
Summary	**21.69**	**46.79**	**25.92**	**4.72**	**0.55**	**100**

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	0.40	0.20	0.35	0.00	0.00	**0.95**
NNE	0.65	0.25	0.30	0.00	0.00	**1.20**
NE	1.60	0.75	1.15	0.40	0.15	**4.05**
ENE	1.85	1.80	2.05	0.45	0.25	**6.40**
E	2.40	4.46	3.91	2.91	1.60	**15.28**
ESE	2.20	1.55	0.50	0.45	0.10	**4.80**
SE	1.10	0.40	0.00	0.00	0.00	**1.50**
SSE	1.20	0.30	0.00	0.00	0.00	**1.50**
S	2.76	2.40	0.45	0.10	0.00	**5.71**
SSW	4.31	8.97	0.85	0.40	0.00	**14.53**
SW	2.45	4.56	1.75	0.25	0.35	**9.36**
WSW	2.15	3.16	4.71	3.56	2.81	**16.39**
W	2.05	2.45	2.00	0.50	0.85	**7.85**
WNW	1.95	0.95	1.30	0.05	0.05	**4.30**
NW	0.80	0.90	0.15	0.05	0.00	**1.90**
NNW	0.75	0.40	0.05	0.05	0.00	**1.25**
Summary	**28.62**	**33.50**	**19.52**	**9.17**	**6.16**	**96.97[(1)]**

[1] The remaining 3.03 percent of data were calms (below 0.5 m/s).

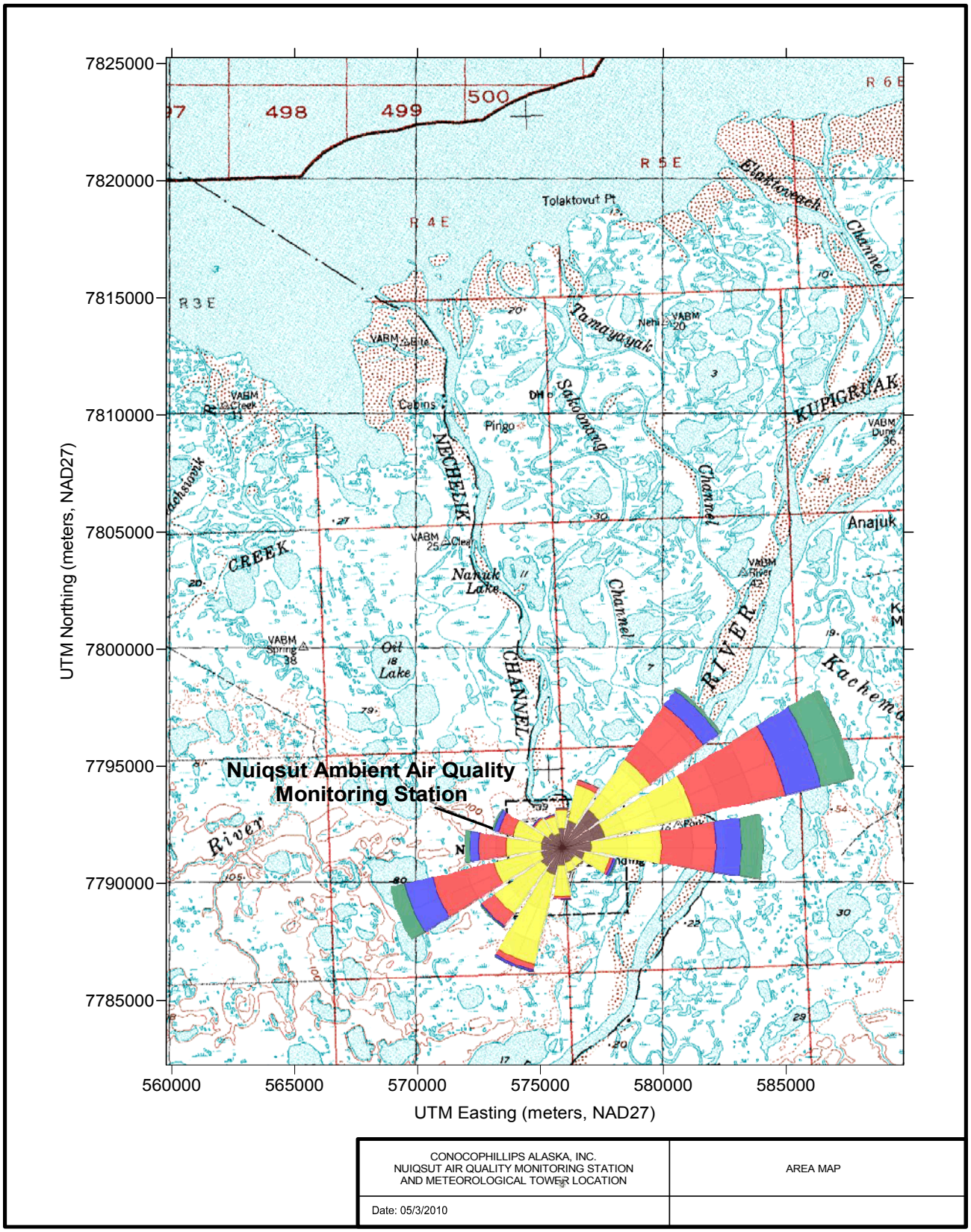


Figure 3-12: Annual Wind Rose Superimposed on Site Map

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 2013	-17.1	-37.7	-27.6	-14.9	-40.1
February 2013	-23.6	-41.3	-32.0	-21.2	-43.8
March 2013	-16.3	-31.4	-24.1	-12.6	-35.6
1st Quarter	**-16.3**	**-41.3**	**-27.8**	**-12.6**	**-43.8**
April 2013	-3.3	-32.9	-20.0	-2.2	-38.8
May 2013	1.3	-20.9	-6.0	5.2	-28.6
June 2013	16.2	-3.4	7.7	23.7	-4.3
2nd Quarter	**16.2**	**-32.9**	**-6.1**	**23.7**	**-38.8**
July 2013	17.2	4.0	10.6	21.2	0.2
August 2013	17.5	-0.3	7.6	24.1	-2.2
September 2013	6.7	-5.3	0.1	14.4	-9.4
3rd Quarter	**17.5**	**-5.3**	**6.2**	**24.1**	**-9.4**
October 2013	0.0	-13.0	-5.4	3.0	-19.3
November 2013	-3.3	-30.0	-16.0	2.3	-34.0
December 2013	-2.4	-35.2	-21.4	2.3	-39.0
4th Quarter	**0.0**	**-35.2**	**-14.2**	**3.0**	**-39.0**
Monitoring Year	**17.5**	**-41.3**	**-10.4**	**24.1**	**-43.8**

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 2013	-17.1	-36.7	-27.2	-14.9	-38.7
February 2013	-23.6	-41.0	-31.8	-21.5	-42.8
March 2013	-16.1	-31.4	-24.1	-13.2	-34.1
1st Quarter	**-16.1**	**-41.0**	**-27.6**	**-13.2**	**-42.8**
April 2013	-3.2	-32.7	-19.8	-2.2	-38.4
May 2013	1.8	-20.5	-5.9	5.4	-27.9
June 2013	16.0	-3.9	7.3	23.3	-4.8
2nd Quarter	**16.0**	**-32.7**	**-6.1**	**23.3**	**-38.4**
July 2013	17.1	3.7	10.3	20.9	0.0
August 2013	17.4	-0.5	7.4	23.8	-1.4
September 2013	6.6	-5.1	0.0	13.4	-9.2
3rd Quarter	**17.4**	**-5.1**	**6.0**	**23.8**	**-9.2**
October 2013	0.8	-11.6	-5.1	3.5	-17.5
November 2013	-3.0	-28.7	-15.7	2.5	-33.4
December 2013	-2.4	-34.7	-21.2	2.6	-38.7
4th Quarter	**0.8**	**-34.7**	**-14.0**	**3.5**	**-38.7**
Monitoring Year	**17.4**	**-41.0**	**-10.3**	**23.8**	**-42.8**

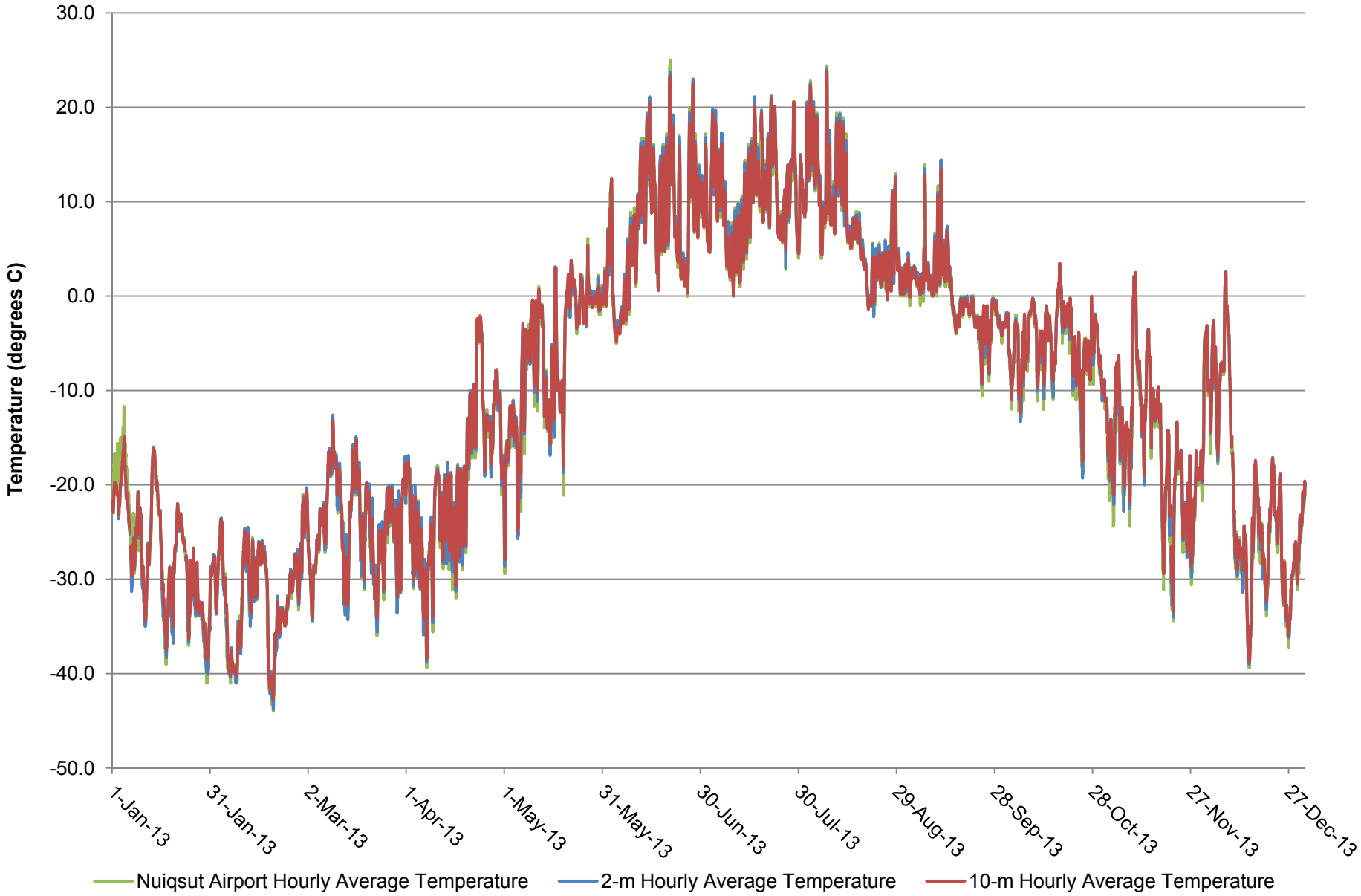


Figure 3-13: Hourly Average 2-Meter and 10-Meter Temperatures

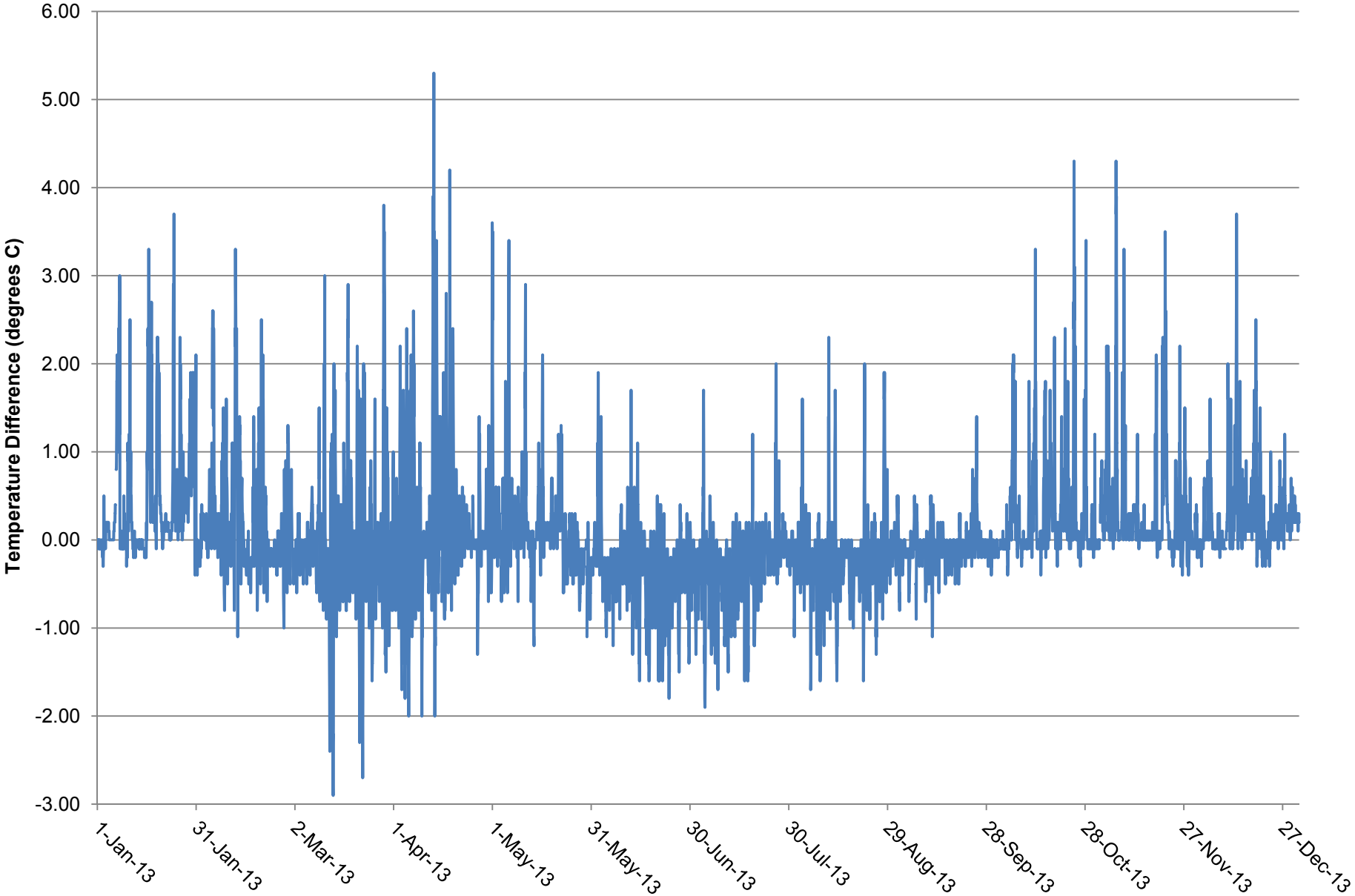


Figure 3-14: Hourly Average Vertical Temperature Difference

3.2.3 OTHER METEOROLOGICAL PARAMETERS

The other meteorological parameter measured at the Nuiqsut station is solar radiation. Table 3-11 provides a summary of this parameter for the 2013 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 2013	1	64
February 2013	17	185
March 2013	85	538
1st Quarter	**35**	**538**
April 2013	200	764
May 2013	259	743
June 2013	245	731
2nd Quarter	**235**	**764**
July 2013	194	705
August 2013	123	566
September 2013	60	444
3rd Quarter	**126**	**705**
October 2013	28	345
November 2013	3	85
December 2013	0	1
4th Quarter	**10**	**345**
Monitoring Year	**102**	**764**

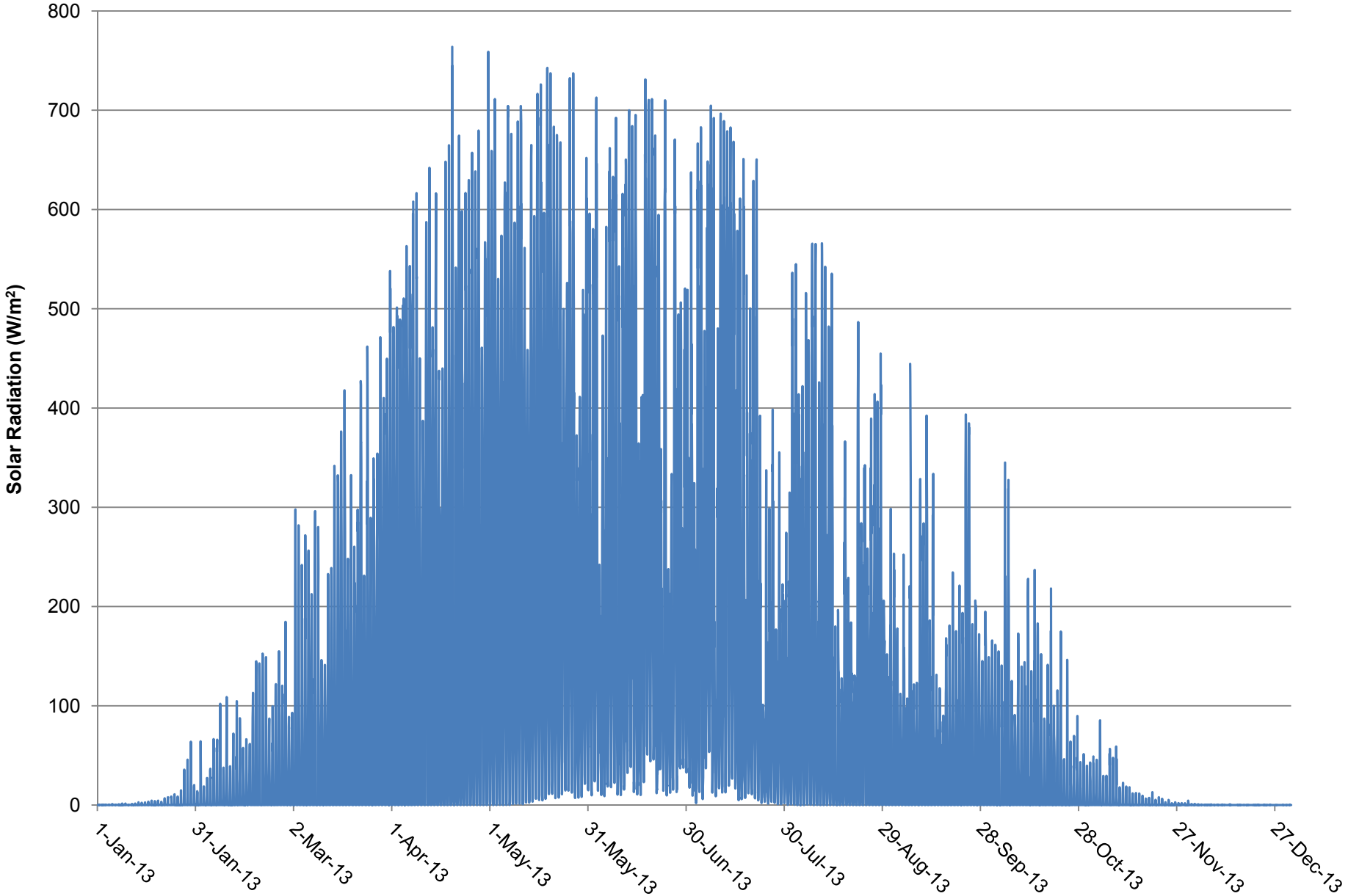


Figure 3-15: Hourly Average Solar Radiation

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