2011 Annual Data Report
Nuiqsut Ambient Air Quality and Meteorological Monitoring Program

January 1, 2011 – December 31, 2011

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2011 Annual Data Report

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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 International Corporation (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 2011 monitoring quarter, spanning from January 1, 2011 to December 31, 2011, at the Nuiqsut monitoring station.

Table E-1 details Quality Assurance Project Plan (QAPP) variations documented for this project during the monitoring year. QAPP variations are explained in more detail in Section 1. The Nuiqsut QAPP Revision 2.0 was submitted to USEPA Region 10 in July, 2011. 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). Table E-3 provides monthly and annual valid 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
The Nuiqsut Ambient Air Quality and Meteorological Monitoring Station QAPP submitted by AECOM in August 2010 stated that PM_{10} sampling is conducted using a Rupprecht & Patashnick Model 1400ab TEOM.	On March 3, 2011, the PM_{10} TEOM sampler was replaced with a Met One Instruments, Inc. BAM-1020 Beta Attenuation Mass Monitor.	The TEOM PM_{10} sampler was 12 years old and near the end of its life expectancy. The BAM-1020 PM_{10} sampler was chosen as a replacement for ease of operation and consistency among other SLR monitoring stations.
In the Nuiqsut QAPP submitted by SLR to ADEC in July 2011, it is stated that meteorological parameters to be measured would include relative humidity and barometric pressure.	Meteorological data for relative humidity and barometric pressure were not collected during the 2011 monitoring year.	The Nuiqsut station was not configured with relative humidity and barometric pressure sensors during the 2011 monitoring year. These parameters are not required for dispersion modeling.

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	2	1	1	1	**2**	**5.7%**
			2nd Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour[1]	1st Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
Nitrogen Dioxide (**NO_2**)	100.0 ppb (190 µg/m^3)	1-Hour[2]	Daily Max 1-Hour Averages (98th Percentile)	-	-	-	-	**20.9**	**20.9%**
			1st Highest, 1-Hour Average	27.0	13.4	13.8	46.5	**46.5**	**46.5%**
			2nd Highest, 1-Hour Average	26.0	13.1	13.6	25.6	**27.0**	**27.0%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	3	1	1	2	**2**	**3.8%**
Ozone (**O_3**)	0.075 ppm (150 µg/m^3)	8-Hour[3]	4th Highest, 8-Hour Average	0.050	0.052	0.031	0.038	**0.052**	**69.3%**
			1st Highest, 8-Hour Average	0.051	0.053	0.032	0.038	**0.053**	**70.7%**
			2nd Highest, 8-Hour Average	0.051	0.053	0.032	0.038	**0.053**	**70.7%**

[1] Not to be exceeded more than once each year.
[2] To attain this standard, the 3-year average of the 98th percentile of the annual daily maximum 1-hour average must not exceed 100 ppb. This standard is only an NAAQS, not an AAAQS.
[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 (**SO2**)	75.0 ppb (196 µg/m^3)	1-Hour[1]	Daily Max 1-Hour Averages (99th Percentile)	-	-	-	-	**4.7**	**6.3%**
			1st Highest, 1-Hour Average	6.0	40.9	12.7	4.5	**40.9**	**54.5%**
			2nd Highest, 1-Hour Average	5.0	4.5	6.0	2.6	**12.7**	**16.9%**
	500.0 ppb (1,300 µg/m^3)	3-Hour[2]	1st Highest, 3-Hour Average	3.7	13.3	4.2	4.2	**13.3**	**2.7%**
			2nd Highest, 3-Hour Average	3.3	1.2	2.7	2.7	**4.2**	**0.8%**
	140.0 ppb (365 µg/m^3)	24-Hour[2]	1st Highest, 24-Hour Average	3.0	1.2	1.1	0.8	**3.0**	**2.1%**
			2nd Highest, 24-Hour Average	2.5	0.1	0.3	0.8	**2.5**	**1.9%**
	30.0 ppb (80 µg/m^3)	Annual	Average of Period	0.3	-0.4	0.1	0.2	**0.0**	**0.0%**

[1] 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.
[2] 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 ($PM_{2.5}$)	35.0 µg/m^3	24-Hour[1]	98th Percentile, 24-Hour Average	-	-	-	-	**6.3**	**18.0%**
			1st Highest, 24-Hour Average	6.0	6.4	4.9	14.4	**14.4**	**41.1%**
			2nd Highest, 24-Hour Average	5.6	6.3	4.6	10.1	**10.1**	**28.9%**
	15.0 µg/m^3	Annual[2]	Average of Period	1.9	1.9	0.4	1.4	**1.4**	**9.3%**
Particulate Matter <10 microns[1] (PM_{10})	150 µg/m^3	24-Hour[3]	1st Highest, 24-Hour Average	10	220(4)	120	10	**220**	**146.7%**(4)
			2nd Highest, 24-Hour Average	10	40	40	10	**120**	**80.0%**

[1] 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.
[2] 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.
[3] Not to be exceeded more than once per year on average over three years.
[4] The 1st highest reading of 220 µg/m^3 is not an exceedance according to this standard. High PM_{10} concentrations were measured on June 28, 2011 during a period of high winds from the east northeast direction. The average wind speeds were 10-12 m/s with wind directions between 53-77 degrees (clockwise from north) during the period of high PM_{10} concentrations. These ENE winds were likely to have transported dust from the Colville River delta, since there was no snow cover at this time. Conditions were also quite dry at the time, as the nearby Deadhorse airport recorded only a trace of precipitation between June 16 and June 28, 2011.

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

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-T	Solar Radiation
January 2011	721	722	722	240	240	743	743	743	720
February 2011	583	582	582	581	581	634	668	634	657
March 2011	644	644	644	677	677	0	733	0	731
1st Quarter	**1,948**	**1,948**	**1,948**	**1,498**	**1,498**	**1,377**	**2,144**	**1,377**	**2,108**
April 2011	716	711	711	691	691	0	716	0	713
May 2011	688	681	681	668	668	0	688	0	742
June 2011	665	665	665	683	683	683	683	683	714
2nd Quarter	**2,069**	**2,057**	**2,042**	**2,042**	**2,070**	**683**	**2,087**	**683**	**2,169**
July 2011	744	743	742	742	744	744	744	744	744
August 2011	695	694	695	695	695	695	695	695	694
September 2011	720	718	717	717	720	720	720	720	710
3rd Quarter	**2,159**	**2,155**	**2,154**	**2,154**	**2,159**	**2,159**	**2,159**	**2,159**	**2,148**
October 2011	743	743	743	541	541	743	743	743	730
November 2011	567	710	710	666	666	710	710	709	700
December 2011	741	741	741	293	293	741	741	741	735
4th Quarter	**2,051**	**2,194**	**2,194**	**1,500**	**1,500**	**2,194**	**2,194**	**2,193**	**2,165**
Year to Date	**8,227**	**8,354**	**8,354**	**7,194**	**7,194**	**6,413**	**8,584**	**6,412**	**8,590**

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-T	Solar Radiation
January 2011	97	97	97	32	32	100	100	100	97
February 2011	87	87	87	86	86	94	99	94	98
March 2011	87	87	87	91	91	0	99	0	98
1st Quarter	**90**	**90**	**90**	**69[2]**	**69[2]**	**64[3]**	**99**	**64[3]**	**98**
April 2011	99	99	99	96	96	0	99	0	99
May 2011	92	92	92	90	90	0	92	0	100
June 2011	92	92	92	95	95	95	95	95	99
2nd Quarter	**95**	**94**	**94**	**94**	**94**	**31[3]**	**96**	**31[3]**	**99**
July 2011	100	100	100	100	100	100	100	100	100
August 2011	93	93	93	93	93	93	93	93	93
September 2011	100	100	100	100	100	100	100	100	99
3rd Quarter	**98**	**98**	**98**	**98**	**98**	**98**	**98**	**98**	**97**
October 2011	100	100	100	73	73	100	100	100	98
November 2011	79	99	99	93	93	99	99	98	97
December 2011	100	100	100	39	39	100	100	100	99
4th Quarter	**93**	**99**	**99**	**68[2]**	**68[2]**	**99**	**99**	**99**	**98**
Year to Date	**94**	**95**	**95**	**82[2]**	**82[2]**	**73[3]**	**98**	**73[3]**	**98**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Quarterly data recovery was less than 90 percent during the first and fourth quarters due to episodes of rime ice build-up on sensor. Parameters are not mandatory inputs for dispersion modeling.
[3] First and second quarter data capture and annual data capture for 2-meter temperature and delta T were less than 90 =due to a failed 2-meter aspirator fan. Problem was not resolved until June 1, 2011.

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 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. Figure 1-2 shows an aerial image of Nuiqsut and depicts the location of the monitoring station. 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:

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

The Nuiqsut station measures the following meteorological parameters:

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

The Nuiqsut station calculates the following meteorological parameters:

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

Data review and validation procedures and monitoring program data and measurement quality objectives (DQO and MQA) are provided in the Nuiqsut Ambient Air Quality and Meteorological Monitoring Station Quality Assurance Project Plans prepared by AECOM (August 2010) and a Nuiqsut QAPP submitted by SLR to ADEC in July 2011.

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

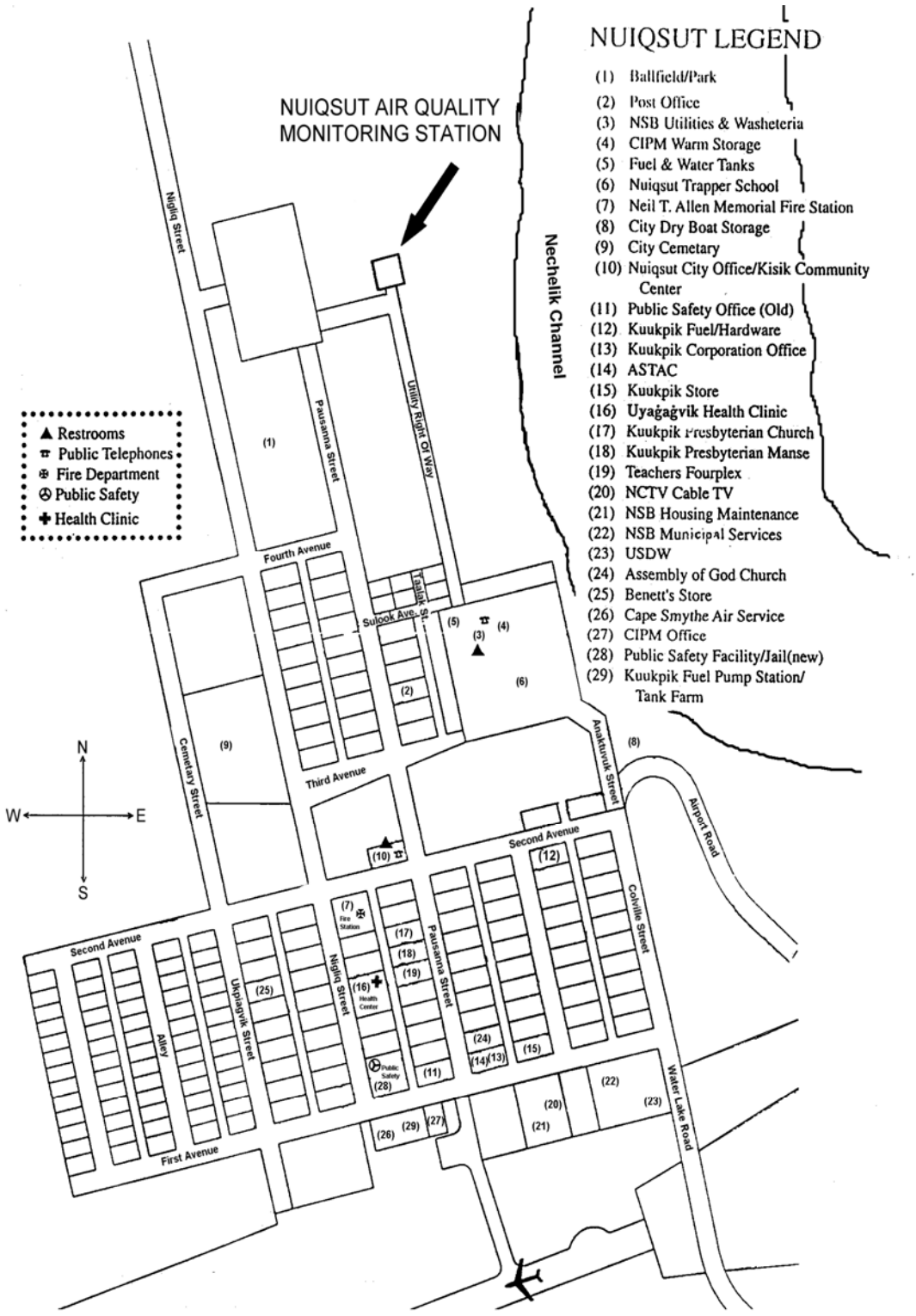


Figure 1-1: Local Map of Nuiqsut

Figure 1-2: Aerial Photo Showing Site Location

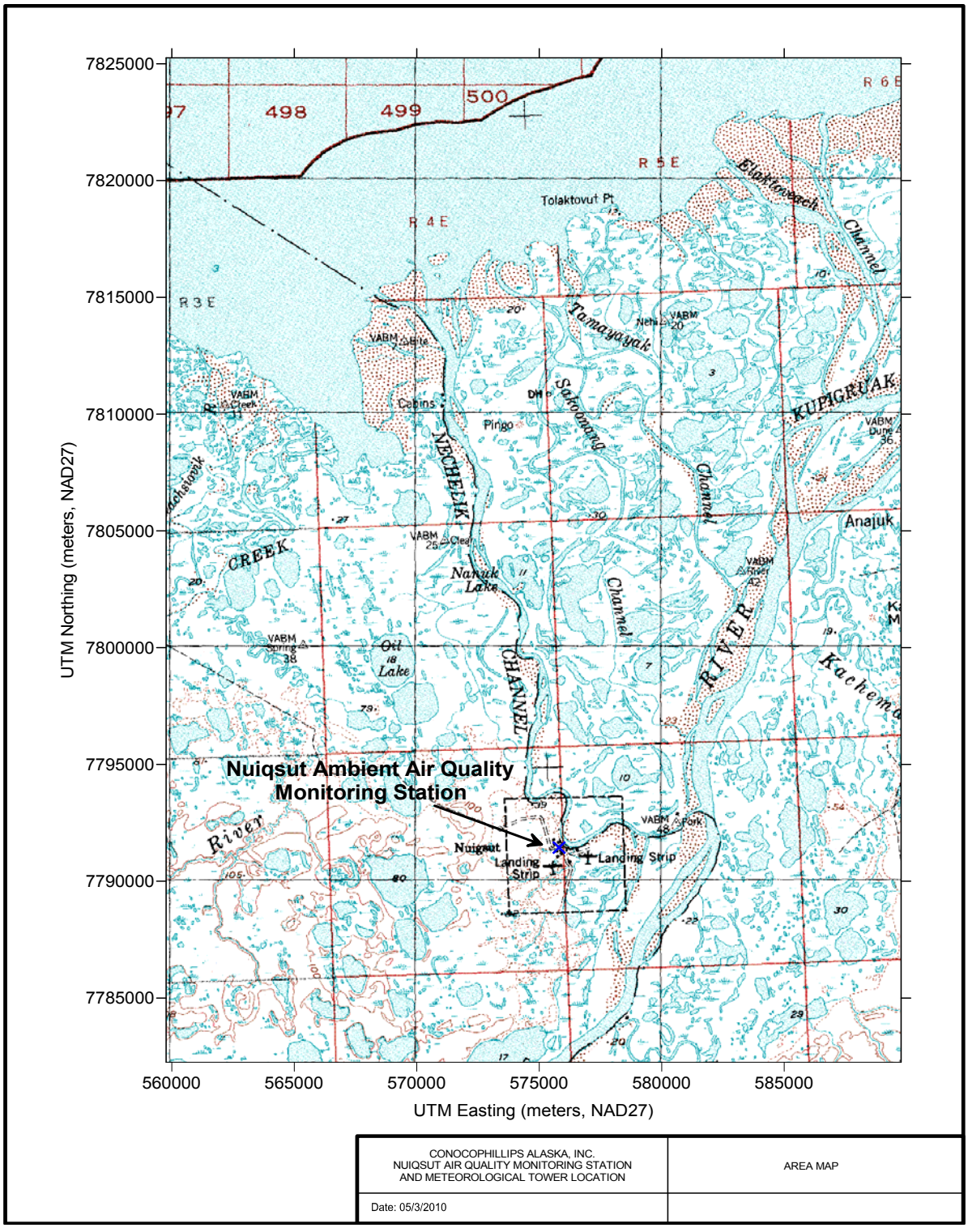


Figure 1-3: Area Map

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

[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. Prior to March 3, 2011, the PM_{10} monitoring was conducted using a Rupprecht & Patashnick Model 1400ab TEOM. The US EPA designation for this unit is FEM EQPM-1090-079. After March 3, 2011, both PM_{10} and $PM_{2.5}$ monitoring were conducted using the 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_{10}[1]	Micrograms per cubic meter ($\mu g/m^3$)	Continuous	1-Hour[2]	24-Hour (Average)[2]
$PM_{2.5}$	Micrograms per cubic meter ($\mu g/m^3$)	Continuous	1-Hour[2]	24-Hour (Average)[2]
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] Applicable to both TEOM and BAM-1020 PM_{10} samplers.
[2] 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 met or exceeded 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	Sensor Manufacturer/ Model Number	Measurement Method	Range	Accuracy	Sampling Frequency	Averaging Period
Ambient Temperature	Climatronic Model 100093-2	Triple element thermistor	-50 to +50°C	± 0.1°C	1 second	1 hour
Horizontal Wind Speed	RM Young Co. 05305-AQ	Propeller, magnetically induced AC sine wave	0 to 50 m/s	±(0.2 m/s + 5% of actual)	1 second	1 hour
Wind Direction	RM Young Co. 05305-AQ	Light-weight vane, Low torque potentiometer	0 to 360°	± 3°	1 second	1 hour
Vertical Wind Speed	RM Young Co. 27106	Propeller anemometer	-25 to 25 m/s	±(0.2 m/s + 5% of actual)	1 second	1 hour
Solar Radiation	Eppley PSP	Precision thermopile pyranometer	0 to 1,400 W/m^2	± 2%	1 second	1 hour

1.3 VARIATIONS FROM THE QAPP

During the 2010 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
The Nuiqsut Ambient Air Quality and Meteorological Monitoring Station QAPP submitted by AECOM in August 2010 stated that PM_{10} sampling is conducted using a Rupprecht & Patashnick Model 1400ab TEOM.	On March 3, 2011, the PM_{10} TEOM sampler was replaced with a Met One Instruments, Inc. BAM-1020 Beta Attenuation Mass Monitor.	The TEOM PM_{10} sampler was 12 years old and near the end of its life expectancy. The BAM-1020 PM_{10} sampler was chosen as a replacement for ease of operation and consistency among other SLR monitoring stations.
In the Nuiqsut QAPP submitted by SLR to ADEC in July 2011, it is stated that meteorological parameters to be measured would include relative humidity and barometric pressure.	Meteorological data for relative humidity and barometric pressure were not collected during the 2011 monitoring year.	The Nuiqsut station was not configured with relative humidity and barometric pressure sensors during the 2011 monitoring year. These parameters are not required for dispersion modeling.

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 2011 ambient air and meteorological monitoring year.

Table 2-1: Chronology of Significant Events

Date	Event
January 1, 2011	Start of monitoring year.
January 2, 2011	High winds affect PM_{10} and $PM_{2.5}$ instrument readings. 2 hours of PM_{10} data and 6 hours of $PM_{2.5}$ data flagged invalid.
January 10-31, 2011	Vertical wind speed data indicate the sensor froze from January 10 through January 31, 2011. Approximately 500 hours of data flagged invalid. Horizontal wind data indicate intermittent sensor freezing resulting in approximately 20 hours of data invalid.
January 31, 2011	QC check performed on PM_{10}.
February 15, 2011	Vertical wind speed data indicate sensor froze. 13 hours of vertical wind speed data flagged invalid.
February 17, 2011	Multipoint calibrations performed on all ambient air analyzers; all passed. Rental NO_X analyzer replaced with repaired station NO_X analyzer.
February 17-March 10,2011	No valid precision checks for NO_X analyzer result in data invalidation.
February 18, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
February 18-23, 2011	Zero air generator remained activated for six days. 118 hours of ambient gas data flagged invalid.
February 24, 2011	Station calibrator malfunction results in invalid precision and span/zero checks for all gas analyzers.
February 25-March 4, 2011	High winds damage vertical and horizontal wind sensors; repaired/replaced on March 4, 2011. Approximately 184 hours of horizontal wind data and 79 hours of vertical wind data flagged invalid.
February 27-June 1, 2011	Two meter temperature and vertical temperature difference (Delta T) data indicate faulty two meter temperature aspirator. Aspirator not repaired until May 31, 2011. 2-meter temperature data are flagged invalid from February 27 through June 1, 2011, approximately 2,250 hours.
March 3, 2011	New Ozone (O_3) monitor, ozone calibrator, and Envidas data acquisition system (DAS) installed. Station PM_{10} analyzer (TEOM) was replaced with a new PM_{10} (BAM 1020 PM_{10}) monitor.
March 4, 2011	Calibrations of horizontal and vertical wind sensors and solar radiation sensor.
March 3-10, 2011	No shelter temperature data resulting in approximately 175 hours of invalid ambient gas data for each analyzer.
March 10, 2011	Multipoint calibrations performed on all ambient air analyzers; all passed. QC check performed on $PM_{2.5}$ and PM_{10}.
March 12-13, 2011	Ozone calibration malfunction results in 41 hours of invalid ozone data and invalid daily zero check.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
March 16, 2011	Independent performance audit of ambient air analyzers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
March 17-April 1, 2011	Ozone transfer standard was removed for recertification at SLR Anchorage. No ozone precision or span/zero checks were performed during this period. Six-day ozone transfer standard recertification performed at SLR Anchorage. Ozone transfer standard shipped back to Nuiqsut station and re-installed on April 1, 2011. Ozone calibration conducted; passed.
April 2, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
April 5-12, 2011	Approximately 170 hours of PM_{10} and 75 hours of $PM_{2.5}$ data lost due to BAM-1020 communication problems.
April 13, 2011	O_3 calibrations did not properly execute due to O_3 calibrator communication problems resulting in 16 hours of invalid data.
April 28, 2011	NO_X calibration; passed.
May 5-9, 2011	Approximately 70 hours of PM_{10} data invalidated due to readings below sampler detection limits.
May 23, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
May 29- June 1, 2011	Elevator installed on meteorological tower resulting in approximately 75 hours of invalid data for all meteorological sensors. Calibrations performed on all gas analyzers and meteorological instruments; all passed. Aspirated shields replaced on temperature sensors to correct temperature measurement problem.
June 2-3, 2011	Independent performance audit of all ambient air analyzers and meteorological sensors conducted by AMS Tech, LLC. All instruments were found to be operating within EPA PSD measurement quality limits.
June 13-19, 2011	Ozone analyzer pump failure resulting in approximately 146 hours of invalid data. Analyzer returned to service June19 and calibration conducted; passed.
June 28, 2011	High PM_{10} concentrations were measured on June 28, 2011 during a period of high winds from the east northeast direction. The average wind speeds were 10-12 m/s with wind directions between 53-77 degrees (clockwise from north) during the period of high PM_{10} concentrations. These ENE winds were likely to have transported dust from the Colville River delta, since there was no snow cover at this time. Conditions were also quite dry at the time, as the nearby Deadhorse airport recorded only a trace of precipitation between June 16 and June 28. Calibration performed on CO and SO_2 analyzers; both passed.
July 1, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
July 5, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
July 1-5, 2011	Background check performed on BAM 1020-2243 resulting in a loss of data from 1200 hours July 1 to 1300 hours July 5.
July 23, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
August 1, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
August 18, 2011	Calibration verification performed on all ambient air analyzers; all passed. Independent performance audit of ambient air analyzers conducted by AMS Tech, LLC. All instruments were found to be operating within EPA PSD measurement quality limits.
August 26-29, 2011	Connection on equipment temporarily failed due to power outage. QC check performed on $PM_{2.5}$ and PM_{10}; all passed.
September 2, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
September 11, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
September 20, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
September 23, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
September 26, 2011	QC check performed on $PM_{2.5}$ and PM_{10}.
October 4, 2011	Ozone calibration performed; passed.
October 3 - 12, 2011	Vertical wind sensor frozen resulting in the loss of approximately 200 hours of data.
November 7 - 8, 2011	Independent performance audit of all ambient air analyzers and meteorological sensors conducted by AMS Tech, LLC. All instruments were found to be operating within EPA PSD measurement quality limits. Shelter temperature dropped below 20° C, resulting in invalidation of gas analyzer data.
November 8, 2011	Annual maintenance on BAM PM sensors and calibration of all gas analyzers; all passed.
November 18 - 22, 2011	Horizontal wind sensor frozen resulting in the loss of approximately 85 hours of data.
November 26 - 28, 2011	Horizontal wind data invalidated due to Envidas error resulting in the loss of approximately 46 hours of data.
November 27, 2011	Approximately 14 hours of PM_{10} data invalidated due to readings below sampler detection limits.
November 30 - December 19, 2011	Propeller on vertical wind sensor broken, resulting in a loss of approximately 484 hours of data. New propeller installed.
December 4 - 5, 2011	SO_2 pump failure, resulting in a loss of data.
December 28, 2011	Technical systems audit conducted by AMS Tech, LLC.; all aspects of the monitoring project were in order.
December 31, 2011	End of monitoring year.

2.2 MISSING, INVALID AND ADJUSTED DATA

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	2.7%
	< 0.5 m/s variation for 12 consecutive hours	1.6%
Wind Direction	Value is < 0°, > 360°	0.0%
	< 1° variation over 3 consecutive hours	0.0%
	< 10° variation over 18 consecutive hours	1.1%
Temperature (2 meters)	> 5°C variation from previous hour	0.2%
	< 0.5°C variation for 12 consecutive hours	0.4%
	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	0.8%
	Value is > record high, < record low	0.0%
Temperature Difference, ΔT	Value is > 0.8°C during the daytime	0.3%
	Value is < -0.8°C during the night	0.0%
	Value is > 5°C, < -3°C	0.0%
Solar Radiation	> 0 w/m^2 at night	1.3%
	Greater than the maximum possible value for date and latitude	0.1%

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

2.3 NETWORK DATA COMPLETENESS

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

The Nuiqsut ambient air and meteorological monitoring station met all PSD requirements during the monitoring year with the following notable exceptions:

- First quarter data recovery for NO_2 was less than eighty percent due to analyzer down time during station rebuild and a failure to meet PSD precision check acceptance criteria between February 17, 2011 and March 11, 2011. The NO_2 analyzer was recalibrated and restored to proper operation on March 10, 2011. Valid NO_2 data was established with the passing March 11, 2011 calibrations.
- Vertical wind speed and vertical wind speed standard deviation (sigma omega) data recovery was less than ninety percent during the first and fourth quarters of the monitoring year due to episodes of rime ice build-up on the sensor. These parameters are not mandatory inputs for regulatory dispersion modeling.
- First and second quarter data recovery for two-meter temperature and delta temperature was less than ninety percent due to a faulty aspirator fan in the two-meter temperature sensor. This problem was not resolved until June 1, 2011.

Annual and quarterly 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]					
	NO_2	SO_2	CO	O_3	$PM_{2.5}$	PM_{10}
January 2011	99	99	99	99	100	100
February 2011	57	81	81	81	100	100
March 2011	66	75	75	69	94	81
1st Quarter	**74[2]**	**85**	**85**	**83**	**98**	**93**
April 2011	98	98	98	96	87	70
May 2011	98	98	98	98	100	81
June 2011	98	98	98	77	100	97
2nd Quarter	**98**	**98**	**98**	**91**	**96**	**82**
July 2011	99	99	99	99	100	84
August 2011	90	82	85	86	100	100
September 2011	98	91	98	98	100	97
3rd Quarter	**96**	**91**	**94**	**94**	**100**	**93**
October 2011	99	90	99	99	94	90
November 2011	95	91	95	95	100	70
December 2011	95	90	95	95	90	90
4th Quarter	**97**	**90**	**97**	**96**	**95**	**84**
Monitoring Year	**91**	**91**	**94**	**91**	**97**	**88**

[1] EPA PSD-quality ambient air monitoring standards require data capture of 80 percent or greater per quarter for four consecutive quarters.

[2] Quarterly data recovery for NO_2 was less than 80 percent during the first quarter due to analyzer down time during station rebuild and a failure to meet PSD precision check acceptance criteria between 2/17/2011 and 3/11/2011. The NO_2 analyzer was recalibrated and restored to proper operation on 3/10/2011. Valid NO_2 data was established with 3/11/2011 calibrations.

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-T	Solar Radiation
January 2011	97	97	97	32	32	100	100	100	97
February 2011	87	87	87	86	86	94	99	94	98
March 2011	87	87	87	91	91	0	99	0	98
1st Quarter	**90**	**90**	**90**	**69[2]**	**69[2]**	**64[3]**	**99**	**64[3]**	**98**
April 2011	99	99	99	96	96	0	99	0	99
May 2011	92	92	92	90	90	0	92	0	100
June 2011	92	92	92	95	95	95	95	95	99
2nd Quarter	**95**	**94**	**94**	**94**	**94**	**31[3]**	**96**	**31[3]**	**99**
July 2011	100	100	100	100	100	100	100	100	100
August 2011	93	93	93	93	93	93	93	93	93
September 2011	100	100	100	100	100	100	100	100	99
3rd Quarter	**98**	**98**	**98**	**98**	**98**	**98**	**98**	**98**	**97**
October 2011	100	100	100	73	73	100	100	100	98
November 2011	79	99	99	93	93	99	99	98	97
December 2011	100	100	100	39	39	100	100	100	99
4th Quarter	**93**	**99**	**99**	**68[2]**	**68[2]**	**99**	**99**	**99**	**98**
Year to Date	**94**	**95**	**95**	**82[2]**	**82[2]**	**73[3]**	**98**	**73[3]**	**98**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Quarterly data recovery was less than 90 percent during the first and fourth quarters due to episodes of rime ice build-up on sensor. Parameters are not mandatory inputs for dispersion modeling.
[3] First and second quarter data capture and annual data capture for 2-meter temperature and delta T were less than 90 =due to a failed 2-meter aspirator fan. Problem was not resolved until June 1, 2011.

2.4 PRECISION STATISTICS

2.4.1 MONITORING NETWORK PRECISION STATISTICS

Precision statistics were determined using the methods outlined in 40 Code of Federal Regulation, Part 58 (40 CFR 58), Appendix A. Valid precision data for ambient air monitors (O_3, SO_2, NO_2, CO) were collected at least once every two weeks, meeting the critical validation criteria outlined in the monitoring program QAPP. Continuous low-volume $PM_{2.5}$ and PM_{10} samplers are not required to have collocated precision comparisons. Quarterly precision statistics for each criteria pollutant are provided in Tables 2-5 through 2-20.

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 µg/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 µg/m^3. Quarterly network PM precision statistics are presented in Table 2-21.

Table 2-5: 1st Quarter O_3 Precision Statistics Summary

Period	Type of Precision Check	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-10	auto	0.0841	0.0848	-0.83	20	0.70	0.96	2.58	-1.18	1.23	+1.18
6-Jan-11	auto	0.0864	0.0856	0.93							
9-Jan-11	auto	0.0834	0.0828	0.72							
12-Jan-11	auto	0.0851	0.0838	1.55							
15-Jan-11	auto	0.0808	0.0807	0.12							
18-Jan-11	auto	0.0800	0.0798	0.25							
21-Jan-11	auto	0.0839	0.0836	0.36							
24-Jan-11	auto	0.0814	0.0818	-0.49							
27-Jan-11	auto	0.0861	0.0858	0.35							
30-Jan-11	auto	0.0829	0.0828	0.12							
2-Feb-11	auto	0.0856	0.0837	2.27							
5-Feb-11	auto	0.0851	0.0848	0.35							
8-Feb-11	auto	0.0851	0.0848	0.35							
11-Feb-11	auto	0.0820	0.0808	1.49							
14-Feb-11	auto	0.0841	0.0838	0.36							
17-Feb-11	auto	0.0834	0.0829	0.60							
21-Feb-11	auto	0.0868	0.0855	1.52							
27-Feb-11	auto	0.0812	0.0815	-0.37							
2-Mar-11	auto	0.0844	0.0835	1.08							
12-Mar-11	auto	0.0826	0.0800	3.25							

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

Table 2-6: 2nd Quarter O_3 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Apr-11	auto	0.0927	0.0900	3.00	12	3.25	0.42	4.08	2.42	0.60	+3.47
9-Apr-11	auto	0.0925	0.0900	2.78							
16-Apr-11	auto	0.0927	0.0900	3.00							
23-Apr-11	auto	0.0925	0.0900	2.78							
30-Apr-11	auto	0.0927	0.0900	3.00							
7-May-11	auto	0.0930	0.0900	3.33							
14-May-11	auto	0.0930	0.0900	3.11							
21-May-11	auto	0.0929	0.0900	3.22							
28-May-11	auto	0.0936	0.0900	4.00							
4-Jun-11	auto	0.0928	0.0900	3.11							
11-Jun-11	auto	0.0936	0.0900	4.00							
25-Jun-11	auto	0.0933	0.0900	3.67							

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

Table 2-7: 3rd Quarter O_3 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Jul-11	auto	0.0934	0.0900	3.78							
9-Jul-11	auto	0.0934	0.0900	3.78							
16-Jul-11	auto	0.0938	0.0900	4.22							
23-Jul-11	auto	0.0934	0.0900	3.78							
30-Jul-11	auto	0.0934	0.0900	3.78							
6-Aug-11	auto	0.0929	0.0900	3.22							
13-Aug-11	auto	0.0933	0.0900	3.67	13	3.96	0.56	5.07	2.86	0.77	+4.24
23-Aug-11	auto	0.0930	0.0900	3.33							
3-Sep-11	auto	0.0935	0.0900	3.89							
10-Sep-11	auto	0.0939	0.0900	4.33							
17-Sep-11	auto	0.0940	0.0900	4.44							
22-Sep-11	auto	0.0935	0.0900	3.86							
29-Sep-11	auto	0.0949	0.0900	5.42							

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

Table 2-8: 4th Quarter O_3 Precision Statistics Summary

Period	Type of Precision Check	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]
6-Oct-11	auto	0.0908	0.0900	1.47	14	-0.09	1.56	2.98	-3.15	2.12	1.68
13-Oct-11	auto	0.0911	0.0900	1.31							
20-Oct-11	auto	0.0913	0.0900	1.72							
25-Oct-11	auto	0.0912	0.0900	1.47							
27-Oct-11	auto	0.0916	0.0900	-0.94							
3-Nov-11	auto	0.0913	0.0900	-1.92							
10-Nov-11	auto	0.0892	0.0900	-1.94							
17-Nov-11	auto	0.0883	0.0900	-2.39							
24-Nov-11	auto	0.0883	0.0900	-1.94							
1-Dec-11	auto	0.0879	0.0900	1.19							
8-Dec-11	auto	0.0883	0.0900	-0.08							
15-Dec-11	auto	0.0911	0.0900	-1.19							
22-Dec-11	auto	0.0899	0.0900	1.47							
29-Dec-11	auto	0.0889	0.0900	1.31							

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

Table 2-9: 1st Quarter SO_2 Precision Statistics Summary

Period	Type of Precision Check	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-10	auto	0.0890	0.0940	-5.32	22	-3.80	1.66	-0.55	-7.05	2.09	-4.41
6-Jan-11	auto	0.0920	0.0940	-2.13							
9-Jan-11	auto	0.0900	0.0940	-4.26							
12-Jan-11	auto	0.0910	0.0940	-3.19							
15-Jan-11	auto	0.0930	0.0940	-1.06							
18-Jan-11	auto	0.0910	0.0950	-4.21							
21-Jan-11	auto	0.0900	0.0940	-4.26							
24-Jan-11	auto	0.0920	0.0940	-2.13							
27-Jan-11	auto	0.0900	0.0940	-4.26							
30-Jan-11	auto	0.0910	0.0940	-3.19							
2-Feb-11	auto	0.0920	0.0940	-2.13							
5-Feb-11	auto	0.0920	0.0940	-2.13							
8-Feb-11	auto	0.0890	0.0940	-5.32							
11-Feb-11	auto	0.0890	0.0940	-5.32							
14-Feb-11	auto	0.0910	0.0940	-3.19							
17-Feb-11	auto	0.0920	0.0940	-2.13							
21-Feb-11	auto	0.0850	0.0910	-6.59							
27-Feb-11	auto	0.0840	0.0910	-7.69							
2-Mar-11	auto	0.0860	0.0910	-5.49							
12-Mar-11	auto	0.0780	0.0810	-3.70							
19-Mar-11	auto	0.0789	0.0810	-2.59							
26-Mar-11	auto	0.0783	0.0810	-3.33							

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

Table 2-10: 2nd Quarter SO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Apr-11	auto	0.0794	0.0810	-1.98	13	-3.32	1.40	-0.59	-6.06	1.93	-4.01
9-Apr-11	auto	0.0782	0.0810	-3.46							
16-Apr-11	auto	0.0787	0.0810	-2.84							
23-Apr-11	auto	0.0803	0.0810	-0.86							
30-Apr-11	auto	0.0799	0.0810	-1.36							
7-May-11	auto	0.0790	0.0810	-2.10							
14-May-11	auto	0.0780	0.0810	-3.58							
21-May-11	auto	0.0772	0.0810	-4.69							
28-May-11	auto	0.0774	0.0810	-4.44							
4-Jun-11	auto	0.0780	0.0810	-3.70							
11-Jun-11	auto	0.0776	0.0810	-4.20							
18-Jun-11	auto	0.0772	0.0810	-4.69							
25-Jun-11	auto	0.0767	0.0810	-5.31							

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

Table 2-11: 3rd Quarter SO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Jul-11	auto	0.0783	0.0810	-3.33	14	-3.29	0.99	-1.35	-5.23	1.35	-3.76
9-Jul-11	auto	0.0787	0.0810	-2.84							
16-Jul-11	auto	0.0766	0.0810	-5.43							
23-Jul-11	auto	0.0776	0.0810	-4.20							
30-Jul-11	auto	0.0784	0.0810	-3.21							
6-Aug-11	auto	0.0784	0.0810	-3.21							
13-Aug-11	auto	0.0785	0.0810	-3.09							
23-Aug-11	auto	0.0770	0.0810	-4.94							
31-Aug-11	auto	0.0791	0.0810	-2.35							
3-Sep-11	auto	0.0785	0.0810	-3.09							
10-Sep-11	auto	0.0796	0.0810	-1.73							
17-Sep-11	auto	0.0790	0.0810	-2.47							
22-Sep-11	auto	0.0788	0.0810	-2.76							
29-Sep-11	auto	0.0782	0.0810	-3.46							

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

Table 2-12: 4th Quarter SO_2 Precision Statistics Summary

Period	Type of Precision Check	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]
6-Oct-11	auto	0.0777	0.0810	-4.06	14	-3.03	1.17	-0.73	-5.33	1.60	-3.58
13-Oct-11	auto	0.0779	0.0810	-3.83							
20-Oct-11	auto	0.0785	0.0810	-3.07							
25-Oct-11	auto	0.0796	0.0810	-1.79							
27-Oct-11	auto	0.0778	0.0810	-3.94							
3-Nov-11	auto	0.0775	0.0810	-4.31							
10-Nov-11	auto	0.0807	0.0810	-0.39							
17-Nov-11	auto	0.0791	0.0810	-2.36							
24-Nov-11	auto	0.0794	0.0810	-2.00							
1-Dec-11	auto	0.0784	0.0810	-3.27							
8-Dec-11	auto	0.0774	0.0810	-4.41							
15-Dec-11	auto	0.0789	0.0810	-2.55							
22-Dec-11	auto	0.0777	0.0810	-4.07							
29-Dec-11	auto	0.0791	0.0810	-2.35							

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

Table 2-13: 1st Quarter NO_2 Precision Statistics Summary

Period	Type of Precision Check	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-10	auto	0.0990	0.1050	-5.71	19	-3.96	1.99	-0.06	-7.85	2.56	-4.75
6-Jan-11	auto	0.0980	0.1030	-4.85							
9-Jan-11	auto	0.1000	0.1040	-3.85							
12-Jan-11	auto	0.1010	0.1050	-3.81							
15-Jan-11	auto	0.1010	0.1050	-3.81							
18-Jan-11	auto	0.1010	0.1050	-3.81							
21-Jan-11	auto	0.1010	0.1040	-2.88							
24-Jan-11	auto	0.1000	0.1040	-3.85							
27-Jan-11	auto	0.0990	0.1040	-4.81							
30-Jan-11	auto	0.1010	0.1040	-2.88							
2-Feb-11	auto	0.1000	0.1060	-5.66							
5-Feb-11	auto	0.1000	0.1050	-4.76							
8-Feb-11	auto	0.1010	0.1030	-1.94							
11-Feb-11	auto	0.1000	0.1040	-3.85							
14-Feb-11	auto	0.1020	0.1050	-2.86							
17-Feb-11	auto	0.1010	0.1030	-1.94							
2-Mar-11	auto	0.1130	0.1260	-10.32							
12-Mar-11	auto	0.0915	0.0924	-0.97							
26-Mar-11	auto	0.0814	0.0836	-2.63							

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

Table 2-14: 2nd Quarter NO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Apr-11	auto	0.0835	0.0841	-0.71	13	0.21	1.90	3.92	-3.51	2.62	±2.00
9-Apr-11	auto	0.0838	0.0846	-0.95							
16-Apr-11	auto	0.0898	0.0884	1.58							
23-Apr-11	auto	0.0887	0.0890	-0.34							
30-Apr-11	auto	0.0879	0.0883	-0.45							
7-May-11	auto	0.0870	0.0870	0.58							
14-May-11	auto	0.0880	0.0930	-5.17							
21-May-11	auto	0.0880	0.0871	1.03							
28-May-11	auto	0.0880	0.0874	0.67							
4-Jun-11	auto	0.0748	0.0737	1.47							
11-Jun-11	auto	0.0751	0.0735	2.15							
18-Jun-11	auto	0.0748	0.0737	1.48							
25-Jun-11	auto	0.0751	0.0741	1.36							

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

Table 2-15: 3rd Quarter NO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Jul-11	auto	0.0735	0.0734	0.23	13	0.94	0.70	2.32	-0.43	0.97	+1.30
9-Jul-11	auto	0.0751	0.0746	0.66							
16-Jul-11	auto	0.0732	0.0726	0.82							
23-Jul-11	auto	0.0737	0.0731	0.82							
30-Jul-11	auto	0.0740	0.0722	2.49							
6-Aug-11	auto	0.0742	0.0732	1.38							
13-Aug-11	auto	0.0745	0.0735	1.44							
23-Aug-11	auto	0.0695	0.0687	1.09							
31-Aug-11	auto	0.0722	0.0711	1.47							
3-Sep-11	auto	0.0710	0.0706	0.61							
10-Sep-11	auto	0.0733	0.0725	1.10							
17-Sep-11	auto	0.0747	0.0743	0.53							
29-Sep-11	auto	0.0748	0.0751	-0.41							

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

Table 2-16: 4th Quarter NO_2 Precision Statistics Summary

Period	Type of Precision Check	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]
6-Oct-11	auto	0.0749	0.0727	2.98	14	3.62	1.12	5.81	1.43	1.52	+4.15
13-Oct-11	auto	0.0760	0.0738	2.93							
20-Oct-11	auto	0.0762	0.0747	2.03							
25-Oct-11	auto	0.0757	0.0733	3.31							
27-Oct-11	auto	0.0758	0.0739	2.61							
3-Nov-11	auto	0.0771	0.0752	2.63							
10-Nov-11	auto	0.0755	0.0728	3.72							
17-Nov-11	auto	0.0798	0.0768	3.96							
24-Nov-11	auto	0.0774	0.0750	3.27							
1-Dec-11	auto	0.0771	0.0749	2.97							
8-Dec-11	auto	0.0772	0.0737	4.70							
15-Dec-11	auto	0.0789	0.0756	4.37							
22-Dec-11	auto	0.0791	0.0752	5.17							
29-Dec-11	auto	0.0785	0.0741	6.05							

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

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

Period	Type of Precision Check	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-10	auto	7.13	6.89	3.47	22	4.65	4.85	14.16	-4.85	6.11	+7.03
6-Jan-11	auto	7.17	6.89	4.11							
9-Jan-11	auto	7.19	6.90	4.16							
12-Jan-11	auto	7.20	6.90	4.29							
15-Jan-11	auto	7.23	6.90	4.80							
18-Jan-11	auto	7.30	6.92	5.54							
21-Jan-11	auto	7.33	6.90	6.25							
24-Jan-11	auto	7.41	6.91	7.31							
27-Jan-11	auto	7.43	6.90	7.67							
30-Jan-11	auto	7.47	6.91	8.18							
2-Feb-11	auto	7.53	6.90	9.07							
5-Feb-11	auto	7.54	6.91	9.18							
8-Feb-11	auto	7.55	6.89	9.55							
11-Feb-11	auto	7.62	6.89	10.58							
14-Feb-11	auto	7.58	6.89	10.05							
17-Feb-11	auto	7.67	6.89	11.32							
21-Feb-11	auto	8.91	9.25	-3.68							
27-Feb-11	auto	9.01	9.25	-2.59							
2-Mar-11	auto	9.05	9.26	-2.27							
12-Mar-11	auto	8.01	8.24	-2.71							
19-Mar-11	auto	8.12	8.24	-1.36							
26-Mar-11	auto	8.19	8.24	-0.56							

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

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

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Apr-11	auto	8.2060	8.2350	-0.35	13	1.36	2.57	6.40	-3.68	3.55	+3.17
9-Apr-11	auto	8.2710	8.2350	0.44							
16-Apr-11	auto	8.2880	8.2350	0.64							
23-Apr-11	auto	8.3340	8.2350	1.20							
30-Apr-11	auto	8.4120	8.2350	2.15							
7-May-11	auto	8.4830	8.2350	3.01							
14-May-11	auto	8.4850	8.2350	3.04							
21-May-11	auto	7.9560	8.2350	-3.39							
28-May-11	auto	7.9000	8.2000	-3.66							
4-Jun-11	auto	8.5000	8.2000	3.66							
11-Jun-11	auto	8.5000	8.2000	3.66							
18-Jun-11	auto	8.5000	8.2000	3.66							
25-Jun-11	auto	8.5000	8.2000	3.66							

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

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

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
2-Jul-11	auto	7.9000	8.2000	-3.66	14	-0.65	2.84	4.91	-6.21	3.85	±3.10
9-Jul-11	auto	7.9000	8.2000	-3.66							
16-Jul-11	auto	7.9000	8.2000	-3.66							
23-Jul-11	auto	8.0000	8.2000	-2.44							
30-Jul-11	auto	7.9000	8.2000	-3.66							
6-Aug-11	auto	7.9000	8.2000	-3.66							
13-Aug-11	auto	8.0000	8.2000	-2.44							
23-Aug-11	auto	8.3000	8.2000	1.22							
31-Aug-11	auto	8.3000	8.2000	1.22							
3-Sep-11	auto	8.4000	8.2000	2.44							
10-Sep-11	auto	8.4000	8.2000	2.44							
17-Sep-11	auto	8.3000	8.2000	1.22							
22-Sep-11	auto	8.4590	8.2350	2.72							
29-Sep-11	auto	8.4660	8.2350	2.81							

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

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

Period	Type of Precision Check	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]
6-Oct-11	auto	8.5	8.0	3.78	14	-0.18	2.77	5.26	-5.61	3.77	±2.97
13-Oct-11	auto	8.7	8.0	5.08							
20-Oct-11	auto	7.9	8.2	-3.61							
25-Oct-11	auto	8.0	8.2	-2.53							
27-Oct-11	auto	8.0	8.2	-2.42							
3-Nov-11	auto	8.2	8.2	-1.03							
10-Nov-11	auto	8.4	8.2	1.87							
17-Nov-11	auto	8.4	8.2	2.50							
24-Nov-11	auto	7.9	8.2	-3.97							
1-Dec-11	auto	8.0	8.2	-2.42							
8-Dec-11	auto	8.2	8.2	-0.97							
15-Dec-11	auto	8.2	8.2	-0.27							
22-Dec-11	auto	8.3	8.2	0.23							
29-Dec-11	auto	8.3	8.2	1.30							

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

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

Period	Samplers	Number of Collocated Samples	Concentration Levels	Average Percent Difference	Standard Deviation[1, 2] (µg/m³)	Precision[1, 3] (µg/m³)	Bias[1, 4] (µg/m³)
1st Quarter (January 1 – March 31, 2011)	Primary FEM against Collocated FEM	56	≥2 µg/m³	0.2%	0.55	0.27	0.71
		90	All	7.0%	0.62	0.31	0.74
	Primary FEM against Collocated FRM	9	≥2 µg/m³	5.3%	0.23	0.12	0.57
		17	All	-14.1%	0.62	0.31	0.79
2nd Quarter (April 1 – June 30, 2011)	Primary FEM against Collocated FEM	44	≥2 µg/m³	15.3%	0.98	0.49	1.21
		77	All	-49.9%	0.89	0.45	1.35
	Primary FEM against Collocated FRM	7	≥2 µg/m³	-9.8%	1.41	0.70	1.64
		12	All	-118.4%	1.45	0.72	1.87
3rd Quarter (July 1 – September 30, 2011)	Primary FEM against Collocated FEM	9	≥2 µg/m³	20.4%	0.69	0.34	1.21
		71	All	-61.2%	0.74	0.37	1.54
	Primary FEM against Collocated FRM	5	≥2 µg/m³	-43.9%	1.07	0.53	1.96
		16	All	95.7%	1.06	0.53	1.95
4th Quarter (October 1 – December 31, 2011)	Primary FEM against Collocated FEM	58	≥2 µg/m³	4.5%	1.67	0.84	0.96
		85	All	-24.1%	1.40	0.70	0.93
	Primary FEM against Collocated FRM	10	≥2 µg/m³	-7.2%	0.80	0.40	1.18
		15	All	-100.8%	1.66	0.83	1.59
Annual (January 1 – December 31, 2011)	Primary FEM against Collocated FEM	**167**	**≥2 µg/m³**	**6.7%**	**1.17**	**0.59**	**0.96**
		323	All	-29.7%	1.01	0.51	1.11
	Primary FEM against Collocated FRM	**31**	**≥2 µg/m³**	**-10.0%**	**1.03**	**0.51**	**1.23**
		60	All	-27.4%	1.22	0.61	1.52

[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.

Table 2-22 through Table 2-30 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.

Tables 2-22 and 2-23 summarize the quarterly 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.

Multi-point calibrations were performed during the initialization of the monitoring year and 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.

Table 2-22: Quality Control Checks $PM_{2.5}$

Date	Ambient Temperature[1] (˚C)			Barometric Pressure[2] (mm Hg)			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
31-Jan-11	-18.8	-19.4	0.6	752	752	0	13:05:00	13:06:00	-00:01:00	16.7	17.21	-3.0%
18-Feb-11	-16.2	-16.8	0.6	754	758	-4	-	-	-	16.7	16.70	0.0%
10-Mar-11	-22.2	-21.7	-0.5	762	760	2	20:30:35	20:29:15	00:01:20	16.7	16.60	0.6%
2-Apr-11	-26.1	-27.8	1.7	759	754	5	09:33:00	09:31:00	00:02:00	16.7	16.50	1.2%
14-Apr-11	-19.9	-19.8	-0.1	774	776	-2	02:08:00	02:10:00	-00:02:00	16.7	16.70	0.0%
12-May-11	-4.9	-4.9	0.0	771	771	0	13:10:00	13:11:00	-00:01:00	16.7	16.70	0.0%
30-May-11[(4)]	-2.2	-2.5	0.3	760	763	-3	07:45:45	07:46:07	-00:00:22	16.7	16.84	-0.8%
20-Jun-11	9.1	9.3	-0.2	763	763	0	09:22:30	09:21:16	00:01:14	16.7	16.72	-0.1%
21-Jun-11	4.9	5.6	-0.7	753	753	0	14:13:00	14:13:23	-00:00:23	16.7	16.57	0.8%
1-Jul-11	9.1	10.0	-0.9	755	755	0	11:25:15	11:25:37	-00:00:22	16.7	16.58	0.7%
5-Jul-11	14.5	15.6	-1.1	743	744	-1	12:32:00	12:32:47	-00:00:47	16.7	16.62	0.5%
23-Jul-11	12.8	13.7	-0.9	762	762	0	13:55:20	13:55:51	-00:00:31	16.7	16.54	1.0%
1-Aug-11	13.1	14.1	-1.0	742	742	0	12:10:50	12:11:37	-00:00:47	16.7	16.55	0.9%
17-Aug-11	5.2	6.1	-0.9	764	763	1	12:23:00	12:22:10	00:00:50	16.7	16.60	0.6%
29-Aug-11	10.3	10.2	0.1	757	757	0	16:03:00	16:04:00	-00:01:00	16.7	16.70	0.0%
2-Sep-11	7.3	7.3	0.0	756	756	0	15:27:00	15:27:00	00:00:00	16.7	16.70	0.0%
11-Sep-11	12.6	12.6	0.0	760	760	0	15:40:00	15:40:00	00:00:00	16.7	16.70	0.0%
20-Sep-11	2.8	2.8	0.0	744	744	0	14:49:00	14:49:00	00:00:00	16.7	16.70	0.0%
23-Sep-11	-0.3	-0.3	0.0	753	754	-1	13:17:00	13:17:00	00:00:00	16.7	16.70	0.0%
26-Sep-11	0.1	0.2	-0.1	755	754	1	14:39:00	14:39:00	00:00:00	16.7	16.70	0.0%
4-Oct-11	-2.0	-2.0	0.0	750	750	0	15:30:00	15:30:00	00:00:00	16.7	16.70	0.0%
17-Oct-11	-0.9	-0.9	0.0	759	759	0	14:59:00	14:59:00	00:00:00	16.7	16.70	0.0%
7-Nov-11	-10.5	-9.6	-0.9	750	748	2	08:02:28	08:01:30	00:00:58	16.7	16.52	1.1%
9-Nov-11[(4)]	-19.3	-18.6	-0.7	747	747	2	-	-	-	16.7	16.63	0.4%
18-Nov-11	-26.0	-26.0	0.0	771	771	0	14:51:00	14:53:00	-00:02:00	16.7	16.70	0.0%
21-Nov-11	-31.2	-30.0	-1.2	757	757	0	17:11:35	17:12:33	-00:00:58	16.7	16.70	0.0%
28-Nov-11	-27.5	-27.5	0.0	756	756	0	13:03:02	13:04:13	-00:01:11	16.7	16.70	0.0%
19-Dec-11	-29.7	-29.6	-0.1	747	747	0	16:43:00	16:44:00	-00:01:00	16.7	16.70	0.0%
Average Difference	**-0.2**			**0.1**			**-00:00:16**			**0.14**		
Standard Deviation	**0.6**			**1.6**			**00:00:58**			**0.77**		

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] Multi-point calibration performed

Table 2-23: 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
18-Feb-11[4]	-	-	-	-	-	-	-	-	-	16.7	16.70	0.0%
10-Mar-11[5]	-22.2	-21.4	-0.8	762	757	5	17:27:00	17:27:00	00:00:00	16.7	17.00	-1.8%
2-Apr-11	-27.5	-27.8	0.3	758	755	3	08:33:00	08:31:00	00:02:00	16.7	16.50	1.2%
6-May-11	-11.4	-11.4	0.0	751	750	1	02:04:00	02:05:00	-00:01:00	16.7	16.70	0.0%
30-May-11[5]	0.3	0.0	0.3	760	763	-3	-	-	-	16.7	16.48	1.3%
20-Jun-11	9.1	9.4	-0.3	763	763	0	09:24:30	09:24:42	-00:00:12	16.7	16.74	-0.2%
21-Jun-11	5.2	5.6	-0.4	753	753	0	14:15:20	14:15:08	00:00:12	16.7	16.79	-0.5%
1-Jul-11	9.7	10.0	-0.3	755	755	0	11:21:30	11:21:37	-00:00:07	16.7	16.81	-0.7%
5-Jul-11	15.9	15.6	0.3	744	744	0	12:35:40	12:36:27	-00:00:47	16.7	16.89	-1.1%
23-Jul-11	13.9	13.7	0.2	762	762	0	13:52:23	13:52:50	-00:00:27	16.7	16.78	-0.5%
1-Aug-11	14.7	14.1	0.6	742	742	0	12:12:15	12:13:28	-00:01:13	16.7	16.90	-1.2%
17-Aug-11	5.5	5.7	-0.2	763	763	0	12:28:00	12:25:59	00:02:01	16.7	16.68	0.1%
29-Aug-11	10.3	10.3	0.0	758	758	0	16:06:00	16:06:00	00:00:00	16.7	16.70	0.0%
2-Sep-11	7.2	7.2	0.0	755	755	0	15:17:00	15:18:00	-00:01:00	16.7	16.70	0.0%
11-Sep-11	12.9	12.9	0.0	758	758	0	15:33:00	15:34:00	-00:01:00	16.7	16.70	0.0%
20-Sep-11	2.8	2.8	0.0	743	743	0	14:50:00	14:50:00	00:00:00	16.7	16.70	0.0%
23-Sep-11	-0.5	-0.5	0.0	753	753	0	13:11:00	13:11:00	00:00:00	16.7	16.70	0.0%
26-Sep-11	0.3	0.3	0.0	754	754	0	14:34:00	14:34:00	00:00:00	16.7	16.70	0.0%
4-Oct-11	-1.8	-1.8	0.0	750	750	0	15:28:00	15:29:00	-00:01:00	16.7	16.70	0.0%
17-Oct-11	0.9	0.9	0.0	758	758	0	14:57:00	14:57:00	00:00:00	16.7	16.70	0.0%
7-Nov-11	-10.5	-9.5	-1.0	750	748	2	08:02:02	08:02:30	-00:00:28	16.7	16.67	0.2%
9-Nov-11[4]	-19.4	-18.6	-1.2	749	747	2	-	-	-	16.7	16.72	-0.1%
18-Nov-11	-26.0	-26.0	0.0	771	770	1	15:05:00	15:06:00	-00:01:00	16.7	16.70	0.0%
21-Nov-11	-31.6	-31.6	0.0	758	758	0	17:11:35	17:12:33	-00:00:58	16.7	16.70	0.0%
28-Nov-11	-27.2	-27.1	-0.1	756	755	1	12:55:03	12:56:33	-00:01:30	16.7	16.70	0.0%
19-Dec-11	-29.9	-29.9	0.0	748	749	-1	16:56:00	16:57:00	-00:01:00	16.7	16.70	0.0%
Average Difference	-0.1			0.4			-00:00:20			-0.13		
Standard Deviation	0.4			1.4			00:00:53			0.62		

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] Calibration of TEOM PM_{10} sampler
[5] Multi-point calibration performed

Table 2-24: Calibration Summary – SO_2

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
February 17, 2011	0.0000	-0.0004	-	1.9	1.0304	-0.0016	0.9999	Pass
	0.0884	0.0891	0.8					
	0.1665	0.1669	0.2					
	0.2448	0.2520	2.9					
	0.3903	0.4040	3.5					
	0.4408	0.4500	2.1					
March 10, 2011	0.0000	-0.0005	-	1.4	1.0138	0.0001	0.9999	Pass
	0.0785	0.0791	0.8					
	0.1715	0.1737	1.3					
	0.2935	0.3007	2.5					
	0.3916	0.3997	2.1					
	0.4402	0.4424	0.5					
May 30, 2011	0.0000	0.0002	-	0.5	1.0012	0.0007	0.99995	Pass
	0.0782	0.0789	0.9					
	0.1711	0.1714	0.1					
	0.2935	0.2982	1.6					
	0.3914	0.3917	0.1					
	0.4403	0.4403	0.0					
June 28, 2011	0.0008	0.0008	-	0.5	0.9971	0.0005	0.99996	Pass
	0.0787	0.0792	0.7					
	0.1712	0.1720	0.5					
	0.2944	0.2910	-1.1					
	0.3911	0.3910	0.0					
	0.4405	0.4410	0.1					

Table 2-24 Continued: Calibration Summary – SO_2

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
August 18, 2011	0.0000	0.0003	-	0.8	1.0047	0.0005	0.99993	Pass
	0.0791	0.0790	-0.1					
	0.1725	0.1746	1.2					
	0.2953	0.3000	1.6					
	0.3943	0.3932	-0.3					
	0.4433	0.4470	0.8					
November 8, 2011	0.0000	0.0003	-	1.0	1.0056	-0.0009	0.99993	Pass
	0.0789	0.0779	-1.3					
	0.1725	0.1696	-1.7					
	0.2957	0.2995	1.3					
	0.3940	0.3963	0.6					
	0.4435	0.4435	0.0					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale

Table 2-25: Calibration Summary – CO

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
February 17, 2011	0.0	0.0	-	1.0	1.0113	-0.0515	0.99997	Pass
	9.0	8.9	-0.9					
	16.9	17.0	0.5					
	24.8	25.2	1.5					
	39.6	40.1	1.3					
	44.7	45.0	0.7					
March 10, 2011	0.000	0.494	-	5.5	1.0305	0.5010	0.99995	Pass
	7.959	8.611	8.2					
	17.388	18.370	5.6					
	29.757	31.500	5.9					
	39.712	41.423	4.3					
	44.639	46.310	3.7					
May 30, 2011	0.0	0.1	-	1.0	0.9996	-0.0545	0.99979	Pass
	8.0	7.9	-1.2					
	17.5	17.3	-1.0					
	30.0	30.0	0.0					
	39.9	39.3	-1.6					
	43.6	44.1	1.1					
June 28, 2011	0.0	0.0	-	0.3	0.9973	0.0496	0.99997	Pass
	8.0	8.0	0.2					
	17.4	17.4	0.0					
	29.9	30.0	0.5					
	39.7	39.7	0.1					
	44.7	44.4	-0.6					

Table 2-25 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]
August 18, 2011	0.0	0.1	-	1.1	1.0033	0.1564	0.99996	Pass
	8.0	8.2	1.8					
	17.5	17.7	1.1					
	30.0	30.4	1.6					
	39.9	40.3	1.0					
	44.9	45.0	0.2					
November 8, 2011	0.0	0.3	-	2.3	1.0052	0.3562	0.99993	Pass
	8.0	8.3	4.0					
	17.5	17.9	2.5					
	30.0	30.9	3.0					
	40.0	40.6	1.5					
	44.9	45.3	0.7					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale

Table 2-26: Calibration Summary – O_3

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
February 17, 2011	-0.001	0.000	-	1.2	1.0068	0.0012	1.00000	Pass
	0.080	0.081	1.8					
	0.175	0.178	1.4					
	0.300	0.304	1.2					
	0.400	0.404	0.9					
	0.450	0.454	0.9					
March 10, 2011	0.001	0.001	-	2.2	0.9979	-0.0026	0.99995	Pass
	0.080	0.076	-5.6					
	0.175	0.170	-2.7					
	0.300	0.297	-1.2					
	0.400	0.397	-0.8					
	0.451	0.448	-0.8					
April 1, 2011	0.000	0.000	-	1.9	1.0100	0.0013	0.99999	Pass
	0.080	0.083	3.8					
	0.175	0.179	2.1					
	0.301	0.305	1.4					
	0.401	0.406	1.3					
	0.451	0.456	1.2					
May 30, 2011	0.000	0.000	-	2.0	1.0326	-0.0044	1.00000	Pass
	0.080	0.083	3.2					
	0.175	0.179	2.2					
	0.300	0.305	1.6					
	0.400	0.406	1.4					
	0.451	0.457	1.3					

Table 2-26 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]
June 19, 2011	0.000	0.000	-	1.4	0.9990	0.0022	0.99992	Pass
	0.082	0.084	2.8					
	0.179	0.182	1.6					
	0.300	0.304	1.5					
	0.395	0.399	0.9					
	0.450	0.448	-0.4					
August 18, 2011	0.000	0.000	-	1.6	1.0129	0.0003	1.00000	Pass
	0.080	0.082	2.6					
	0.175	0.177	1.2					
	0.300	0.304	1.2					
	0.400	0.406	1.4					
	0.451	0.457	1.4					
October 4, 2011	-0.001	0.009	-	2.4	0.9981	0.0066	0.99993	Pass
	0.080	0.084	4.5					
	0.175	0.180	2.8					
	0.300	0.305	1.8					
	0.400	0.407	1.7					
	0.450	0.457	1.5					
November 8, 2011	0.001	-0.004	-	0.5	1.0026	-0.0024	0.99997	Pass
	0.081	0.080	-1.0					
	0.175	0.175	-0.2					
	0.301	0.300	-0.3					
	0.401	0.399	-0.5					
	0.450	0.448	-0.4					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale

Table 2-27: Calibration Summary – NO_2

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Converter Efficiency	Pass/Fail[1]
February 17, 2011	0.000	0.001	-	0.9	0.9995	0.0016	0.99999	99.1%	Pass
	0.082	0.084	2.2						
	0.169	0.171	1.1						
	0.296	0.297	0.4						
	0.349	0.352	0.8						
	0.394	0.394	0.1						
March 10, 2011	0.000	-0.001	-	2.9	1.0318	-0.0008	0.99997	99.9%	Pass
	0.089	0.091	2.4						
	0.177	0.184	3.6						
	0.306	0.314	2.3						
	0.401	0.412	2.7						
	0.418	0.432	3.4						
April 28, 2011	0.000	0.000	-	1.1	1.0021	0.0010	0.99997	99.4%	Pass
	0.084	0.087	4.1						
	0.176	0.177	0.3						
	0.300	0.301	0.3						
	0.383	0.384	0.4						
	0.414	0.417	0.7						
May 30, 2011	0.000	0.000	-	0.9	1.0065	0.0002	0.99999	99.7%	Pass
	0.088	0.089	2,1						
	0.179	0.179	0.0						
	0.309	0.311	0.8						
	0.391	0.394	0.7						
	0.425	0.428	0.7						

Table 2-27 Continued: Calibration Summary – NO_2

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Converter Efficiency	Pass/Fail[1]
August 18, 2011	0.000	0.000	-	1.3	0.9854	0.0009	0.99998	99.5%	Pass
	0.069	0.071	1.9						
	0.151	0.149	-1.0						
	0.266	0.262	-1.2						
	0.337	0.333	-1.3						
	0.366	0.362	-1.1						
November 8, 2011	0.000	0.000	-	3.8	1.0355	0.0003	1.00000	100.2%	Pass
	0.076	0.079	4.0						
	0.165	0.171	3.9						
	0.291	0.302	3.7						
	0.376	0.390	3.6						
	0.404	0.419	3.7						

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale
5. Converter efficiency ≥ 96.0%

Table 2-28: March 5, 2011 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Low Wind Speed Accuracy (≤ 5 m/s)	≤ ±0.20	m/s	0.00	Pass
High Wind Speed Accuracy (> 5 m/s)	≤ 5	% input	0.00	Pass
Wind Speed Torque	≤ 1.0	gm-cm	0.30	Pass
Wind Direction Accuracy	≤ ±5	Degree	1.4	Pass
Wind Direction Linearity	≤ ±3	Degree	0.8	Pass
Wind Direction Torque	≤ 11	gm-cm	6.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.34	Pass
Vertical Wind Speed Torque	≤ 0.30	gm-cm	0.30/0.20	Pass
Solar Radiation Accuracy	≤ ±10	mean W/m^2	4.9	Pass

Table 2-29: May 29, 2011 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Time	≤ ±5	mm:ss	03:02	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.10	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.10	Pass
Air Temperature Difference	≤ ±0.10	°C	0.02	Pass
Low Wind Speed Accuracy (≤ 5 m/s)	≤ ±0.20	m/s	0.00	Pass
High Wind Speed Accuracy (> 5 m/s)	≤ 5	% input	0.00	Pass
Wind Speed Torque	≤ 1.0	gm-cm	0.10	Pass
Wind Direction Alignment	≤ ±5	Degree	3.0	Pass
Wind Direction Linearity	≤ ±3	Degree	0.9	Pass
Wind Direction Torque	≤ 11	gm-cm	5.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.8	Pass
Vertical Wind Speed Torque	≤ 0.20	gm-cm	0.15	Pass
Solar Radiation Accuracy	≤ ±5	% input	3.1	Pass

Table 2-30: November 7, 2011 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Time	≤ ±5	mm:ss	00:02	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.06	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.12	Pass
Air Temperature Difference	≤ ±0.10	°C	0.09	Pass
Low Wind Speed Accuracy (≤ 5 m/s)	≤ ±0.20	m/s	0.10	Pass
High Wind Speed Accuracy (> 5 m/s)	≤ 5	% input	0.00	Pass
Wind Speed Torque	≤ 1.0	gm-cm	0.10	Pass
Wind Direction Alignment	≤ ±5	Degree	4.0	Pass
Wind Direction Linearity	≤ ±3	Degree	1.8	Pass
Wind Direction Torque	≤ 11	gm-cm	4.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.40	Pass
Vertical Wind Speed Torque	≤ 0.31	gm-cm	0.10	Pass
Solar Radiation Accuracy	≤ ±10	W/m^2	0.3	Pass

2.5.2 INDEPENDENT QUALITY ASSURANCE AUDITS

Gas analyzer performance audits involve challenging the analyzer with known concentrations of pollutants. For each concentration challenge, the difference between the audit gas concentration and analyzer response is assessed and compared to PSD limits. Results of the gas analyzer audits conducted during the monitoring year are presented in Tables 2-31 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, SO_2, NO, NO_X, and NO_2 and equal to or less than 10 percent for O_3. Linear regression acceptance criteria of the best-fit line of individual pollutant parameter audit points are: a) the slope is greater than or equal to 0.85 and less than or equal to 1.15, b) the y-intercept is less than or equal to 3 percent of the full scale of the analyzer, and c) the R-squared value is greater than or equal to 0.995.

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} are conducted using an audit orifice transfer standard (BGI Delta Cal or equivalent).

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 gaseous 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 meet the 40 CFR Part 58, Appendix A, Section 3.2.7, the Deadhorse station is within a network “Performance Evaluation Program (PEP)-like” audits program performed by an independent auditor. During the 2011 monitoring year this audit occurred at the Wainwright monitoring station. This “PEP-like” audit is designed to satisfy the intent of the requirements to obtain an independent assessment of system bias and is a comparable program to that of the PEP audit program. Results of the PEP audit at Wainwright station 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 2011 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 – 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	
March 16, 2011	0	0	0	-	2.7	0.9860	-1.175	1.0000	Pass
	1	71	68	-4.2					
	2	210	205	-2.4					
	3	454	447	-1.5					
June 2, 2011	0	0	-1	-	3.0	0.9801	-1.349	1.0000	Pass
	1	76	73	-3.9					
	2	211	205	-2.8					
	3	446	436	-2.2					
August 18, 2011	0	0	-2	-	9.2	0.9523	-4.496	0.9999	Pass
	1	80	69	-13.8					
	2	148	136	-8.1					
	3	443	418	-5.6					
November 7, 2011	0	0	0	-	1.4	0.9883	-0.271	1.0000	Pass
	1	73	72	-1.4					
	2	245	241	-1.6					
	3	441	436	-1.1					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale

Table 2-32: 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	
March 16, 2011	0	0.00	0.02	-	0.28	1.0339	-0.069	1.0000	Pass
	1	2.00	2.00	0.0					
	2	5.90	5.92	0.3					
	3	33.03	34.10	3.2					
June 2, 2011	0	0.00	0.55	-	4.3	1.0092	0.324	0.9999	Pass
	1	2.53	2.68	5.9					
	2	6.60	6.93	5.0					
	3	32.70	33.35	2.0					
August 18, 2011	0	0.00	0.19	-	2.3	1.0112	0.111	1.0000	Pass
	1	2.23	2.31	3.6					
	2	12.45	12.65	1.6					
	3	27.78	28.23	1.6					
November 7, 2011	0	0.00	0.29	-	7.5	1.0508	0.184	1.0000	Pass
	1	2.04	2.25	10.3					
	2	12.09	12.80	5.9					
	3	21.47	22.80	6.2					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale

Table 2-33: Performance Audit Summary – O_3

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	
March 16, 2011	0	0	1	-	2.4	0.9838	-0.779	1.0000	Pass
	1	70	68	-2.9					
	2	133	129	-3.0					
	3	212	206	-2.8					
	4	455	448	-1.5					
June 3, 2011	0	0	2	-	1.6	0.9903	0.081	1.0000	Pass
	1	71	69	-2.8					
	2	152	150	-1.3					
	3	231	228	-1.3					
	4	415	412	-0.7					
August 18, 2011	0	0	0	-	1.7	0.9899	-0.708	1.0000	Pass
	1	86	84	-2.3					
	2	145	143	-1.4					
	3	231	227	-1.7					
	4	472	467	-1.1					
November 7, 2011	0	0	-1	-	1.3	0.9985	-1.527	1.0000	Pass
	1	76	74	-2.6					
	2	147	145	-1.4					
	3	253	251	-0.8					
	4	463	461	-0.4					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale

Table 2-34: 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		
March 16, 2011	0	0	-1	-	1.3	1.0243	-2.218	1.0000	100.0%	Pass
	1	69	68	-1.4						
	2	195	196	0.5						
	3	430	439	2.1						
June 2, 2011	0	0	-1	-	1.6	0.9821	-0.238	1.0000	99.7%	Pass
	1	78	77	-1.3						
	2	178	175	-1.7						
	3	416	408	-1.9						
August 18, 2011	0	0	-1	-	2.1	0.9774	-0.274	1.0000	100.0%	Pass
	1	58	57	-1.7						
	2	182	178	-2.2						
	3	419	409	-2.4						
November 7, 2011	0	0	0	-	0.9	1.0017	0.477	1.0000	99.7%	Pass
	1	50	51	2.0						
	2	190	191	0.5						
	3	387	388	0.3						

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale
5. Converter efficiency ≥ 96.0%

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 (%)	
March 16, 2011	0.1	-0.3	-2	0.6	0.2	Pass
June 3, 2011	0.2	-1.4	-1	1.2	-1.2	Pass
August 18, 2011	0.4	-0.3	-1	0.0	0.0	Pass
November 8, 2011	0.3	0.6	-3	-1.2	1.2	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 (%)	
March 16, 2011	0.3	-0.8	-2	0.0	0.8	Pass
June 3, 2011	0.2	0.0	-2	0.0	0.0	Pass
August 18, 2011	0.4	-1.8	-2	0.0	0.0	Pass
November 8, 2011	0.0	0.7	-4	-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 2-37: June 2, 2011 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.41	Pass
Wind Speed Torque	≤ 0.5	m/s	0.16	Pass
Wind Direction Accuracy	≤ ±5	Degree	1	Pass
Wind Direction Linearity	≤ ±3	Degree	2	Pass
Wind Direction Torque	≤ 0.5	m/s	0.39	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.39	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.20	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.07	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.10	Pass
Air Temperature Difference	≤ ±0.10	°C	0.03	Pass
Solar Radiation Accuracy ≤ 200 W/m^2	≤ ±10	W/m^2	2	Pass
Solar Radiation Accuracy > 200 W/m^2	≤ ±5	Mean % error	1.5	Pass

Table 2-38: November 7, 2011 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.41	Pass
Wind Speed Torque	≤ 0.5	m/s	0.16	Pass
Wind Direction Accuracy	≤ ±5	Degree	4	Pass
Wind Direction Linearity	≤ ±3	Degree	2	Pass
Wind Direction Torque	≤ 0.5	m/s	0.32	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.32	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.24	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.08	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.11	Pass
Air Temperature Difference	≤ ±0.10	°C	0.05	Pass
Solar Radiation Accuracy ≤ 200 W/m^2	≤ ±10	W/m^2	6	Pass
Solar Radiation Accuracy > 200 W/m^2	≤ ±5	Mean % error	-	Pass

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

Date	BAM 1020 Results (µg/m^3)	PEP Audit Results (µg/m^3)	Difference (µg/m^3)	Bias[1] (µg/m^3)
2-Oct-2011	3.2	1.02	2.18	1.74
3-Oct-2011	3.2	1.53	1.67	
4-Oct-2011	2.4	0.43	1.97	
5-Oct-2011	2.7	1.11	1.59	
6-Oct-2011	2.4	0.77	1.63	
7-Oct-2011	2.3	0.92	1.38	

[1] Average over the population of the absolute value of the individual pair concentration differences with a goal of ≤ 4 µg/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, 2011 through December 31, 2011 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 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	2	1	1	1	**2**	**5.7%**
			2nd Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour[1]	1st Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
Nitrogen Dioxide (**NO_2**)	100.0 ppb (190 µg/m^3)	1-Hour[2]	Daily Max 1-Hour Averages (98th Percentile)	-	-	-	-	**20.9**	**20.9%**
			1st Highest, 1-Hour Average	27.0	13.4	13.8	46.5	**46.5**	**46.5%**
			2nd Highest, 1-Hour Average	26.0	13.1	13.6	25.6	**27.0**	**27.0%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	3	1	1	2	**2**	**3.8%**
Ozone (**O_3**)	0.075 ppm (150 µg/m^3)	8-Hour[3]	4th Highest, 8-Hour Average	0.050	0.052	0.031	0.038	**0.052**	**69.3%**
			1st Highest, 8-Hour Average	0.051	0.053	0.032	0.038	**0.053**	**70.7%**
			2nd Highest, 8-Hour Average	0.051	0.053	0.032	0.038	**0.053**	**70.7%**

[1] Not to be exceeded more than once each year.
[2] To attain this standard, the 3-year average of the 98th percentile of the annual daily maximum 1-hour average must not exceed 100 ppb. This standard is only an NAAQS, not an AAAQS.
[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 (**SO2**)	75.0 ppb (196 μg/m^3)	1-Hour[1]	Daily Max 1-Hour Averages (99th Percentile)	-	-	-	-	**4.7**	**6.3%**
			1st Highest, 1-Hour Average	6.0	40.9	12.7	4.5	**40.9**	**54.5%**
			2nd Highest, 1-Hour Average	5.0	4.5	6.0	2.6	**12.7**	**16.9%**
	500.0 ppb (1,300 μg/m^3)	3-Hour[2]	1st Highest, 3-Hour Average	3.7	13.3	4.2	4.2	**13.3**	**2.7%**
			2nd Highest, 3-Hour Average	3.3	1.2	2.7	2.7	**4.2**	**0.8%**
	140.0 ppb (365 μg/m^3)	24-Hour[2]	1st Highest, 24-Hour Average	3.0	1.2	1.1	0.8	**3.0**	**2.1%**
			2nd Highest, 24-Hour Average	2.5	0.1	0.3	0.8	**2.5**	**1.9%**
	30.0 ppb (80 μg/m^3)	Annual	Average of Period	0.3	-0.4	0.1	0.2	**0.0**	**0.0%**

[1] 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.
[2] 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 ($PM_{2.5}$)	35.0 µg/m^3	24-Hour[1]	98th Percentile, 24-Hour Average	-	-	-	-	**6.3**	**18.0%**
			1st Highest, 24-Hour Average	6.0	6.4	4.9	14.4	**14.4**	**41.1%**
			2nd Highest, 24-Hour Average	5.6	6.3	4.6	10.1	**10.1**	**28.9%**
	15.0 µg/m^3	Annual[2]	Average of Period	1.9	1.9	0.4	1.4	**1.4**	**9.3%**
Particulate Matter <10 microns[1] (PM_{10})	150 µg/m^3	24-Hour[3]	1st Highest, 24-Hour Average	10	220[(4)]	120	10	**220**	**146.7%**[(4)]
			2nd Highest, 24-Hour Average	10	40	40	10	**120**	**80.0%**

[1] 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.
[2] 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.
[3] Not to be exceeded more than once per year on average over three years.
[4] The 1st highest reading of 220 µg/m^3 is not an exceedance according to this standard. High PM_{10} concentrations were measured on June 28, 2011 during a period of high winds from the east northeast direction. The average wind speeds were 10-12 m/s with wind directions between 53-77 degrees (clockwise from north) during the period of high PM_{10} concentrations. These ENE winds were likely to have transported dust from the Colville River delta, since there was no snow cover at this time. Conditions were also quite dry at the time, as the nearby Deadhorse airport recorded only a trace of precipitation between June 16 and June 28, 2011.

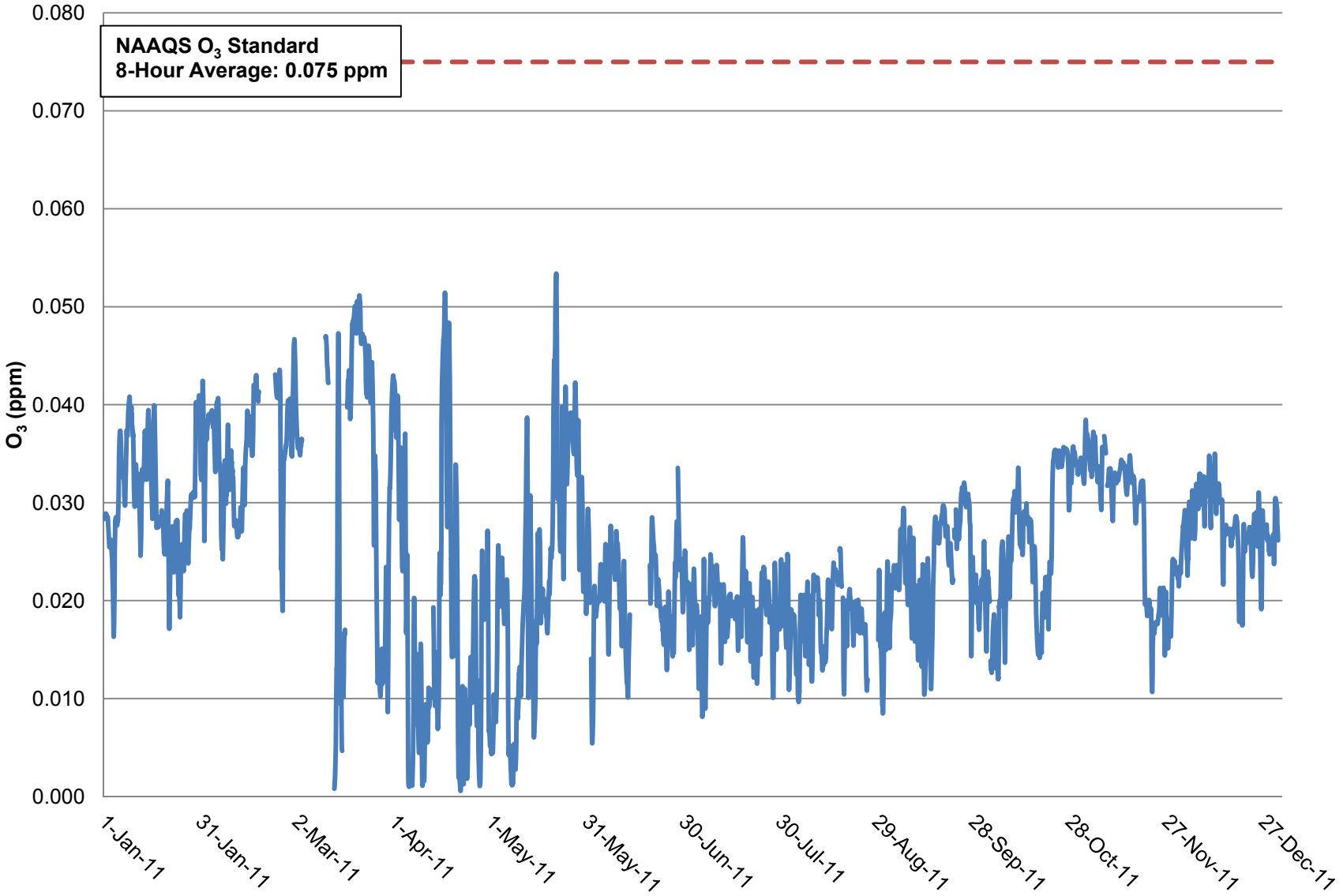


Figure 3-1: 8-Hour Average O_3 and NAAQS/AAAQS Standard

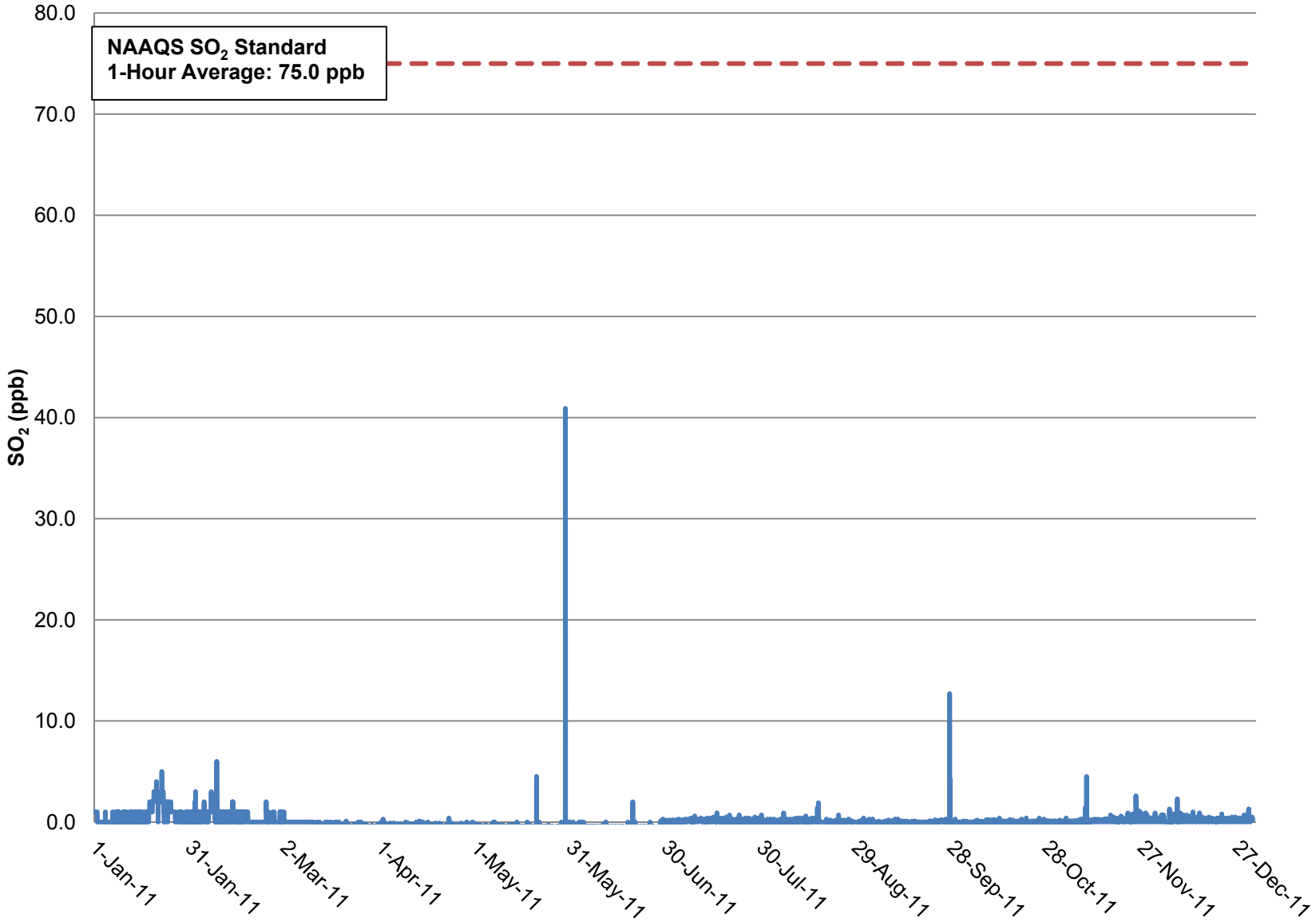


Figure 3-2: 1-Hour Average SO_2 and NAAQS/AAAQS Standard

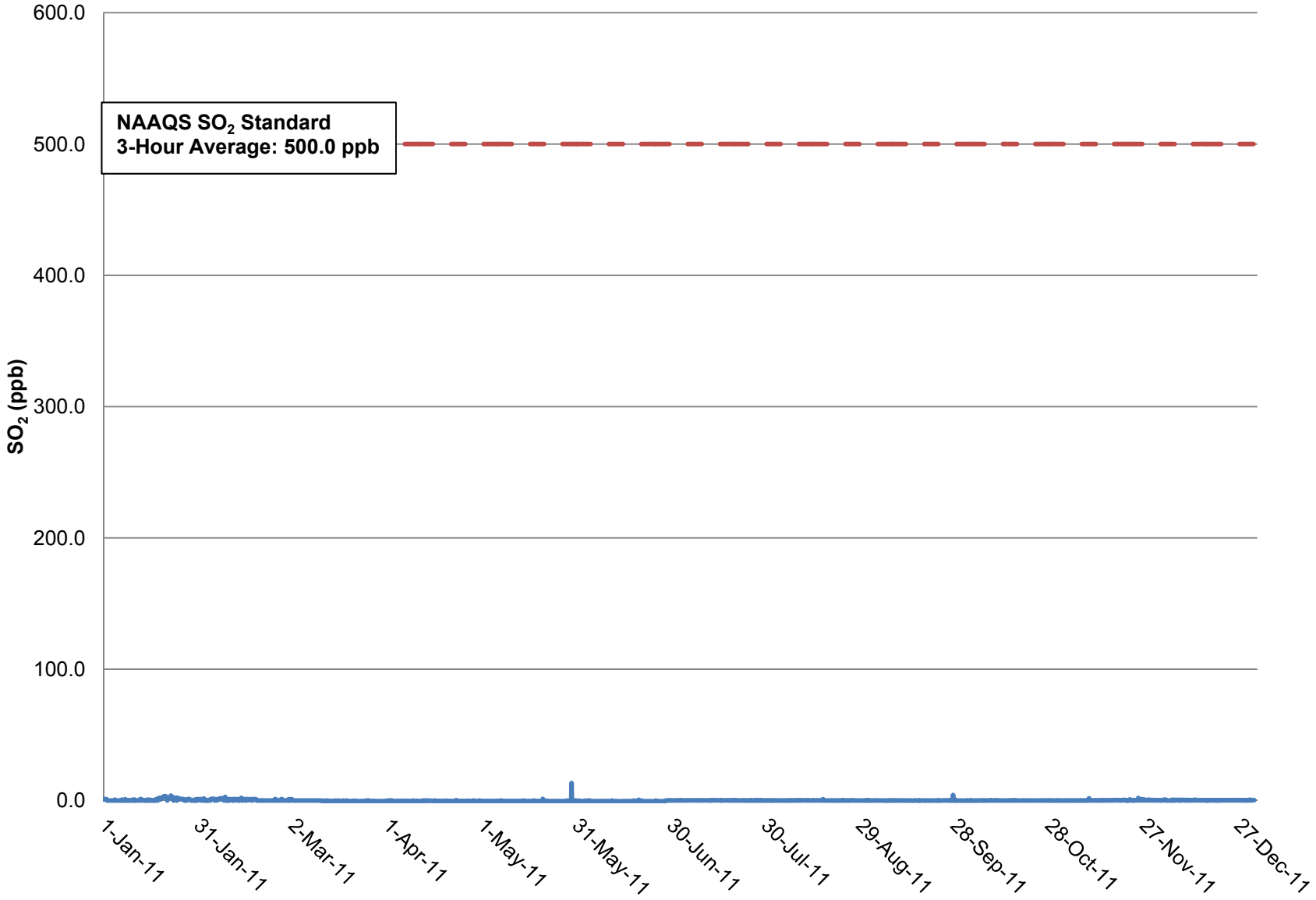


Figure 3-3: 3-Hour Average SO_2 and NAAQS/AAAQS Standard

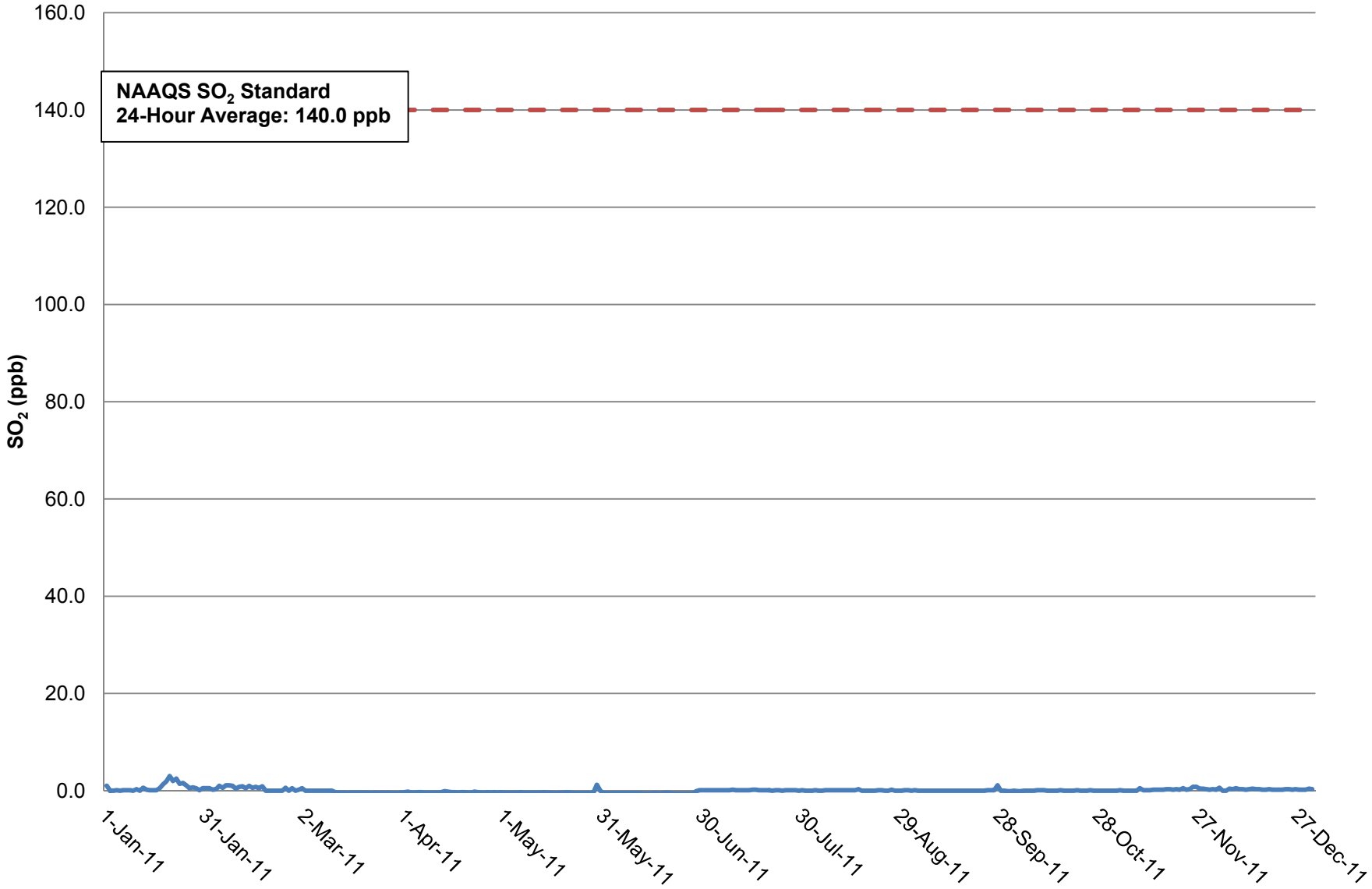


Figure 3-4: 24-Hour Average SO_2 and NAAQS/AAAQS Standard

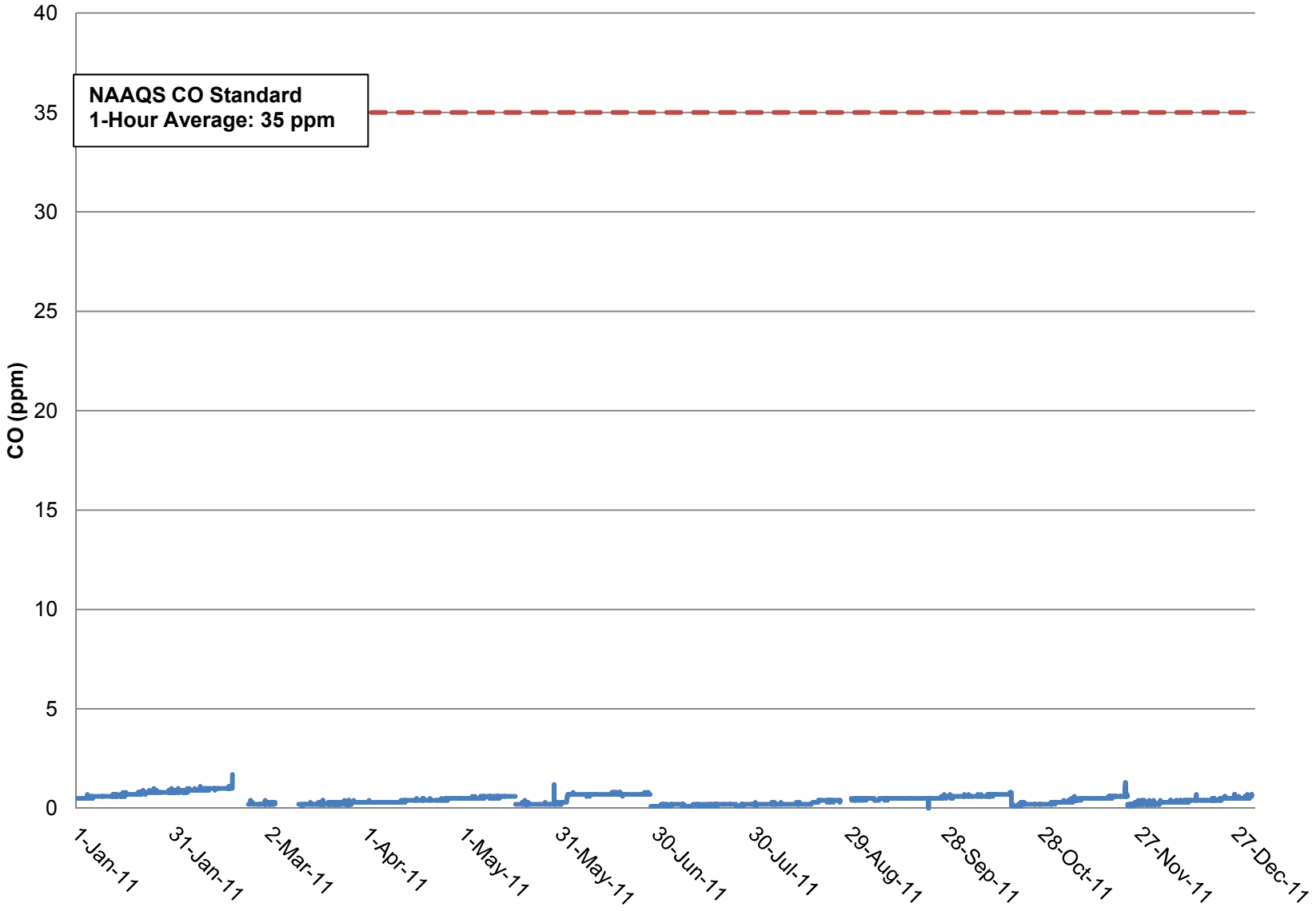


Figure 3-5: 1-Hour Average CO and NAAQS/AAAQS Standard

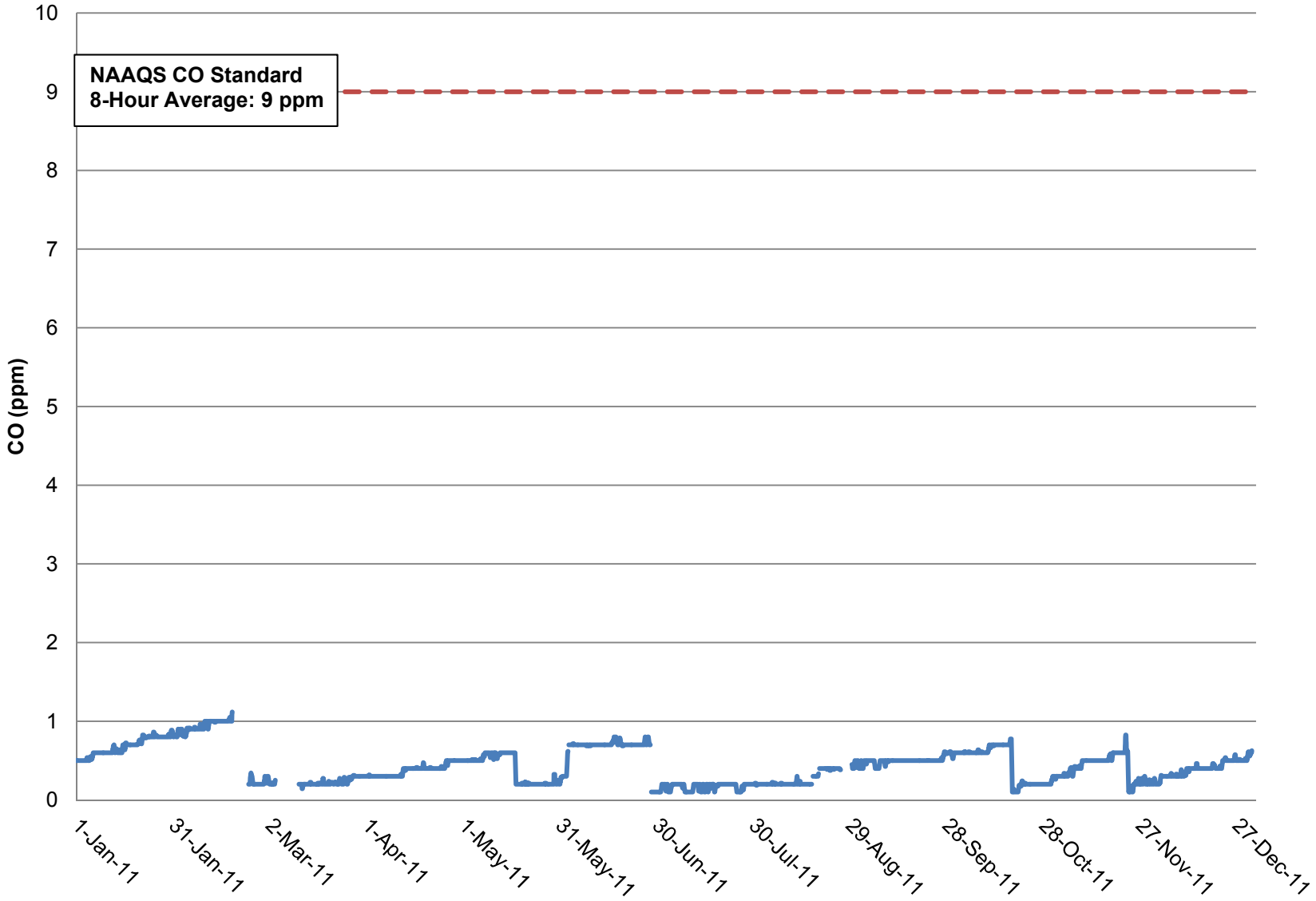


Figure 3-6: 8-Hour Average CO and NAAQS/AAAQS Standard

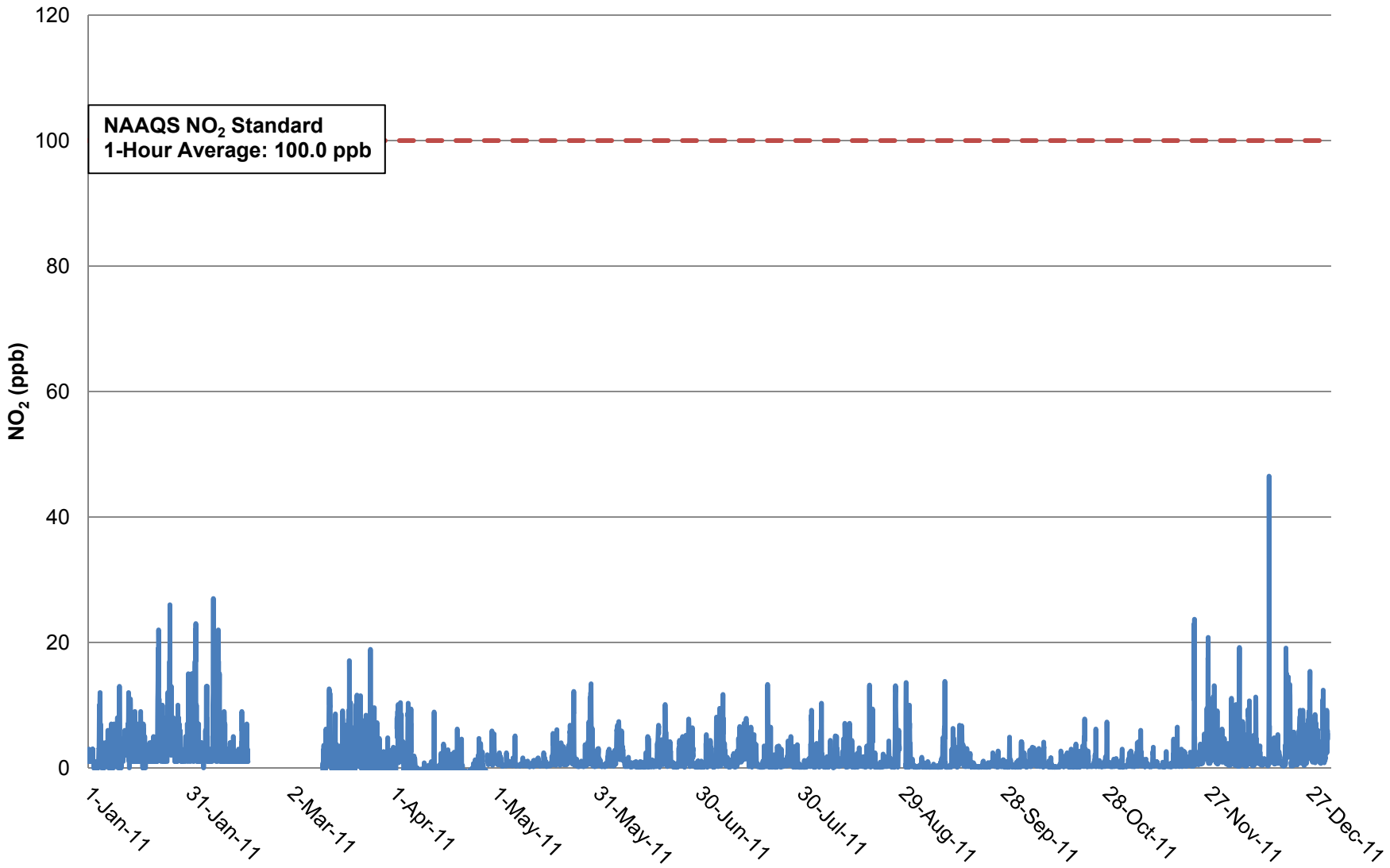


Figure 3-7: 1-Hour Average NO_2 and NAAQS Standard[1]

[1]No valid precision checks from February 17 to March 10, 2011 resulted in data invalidation and the gap seen in the graph.

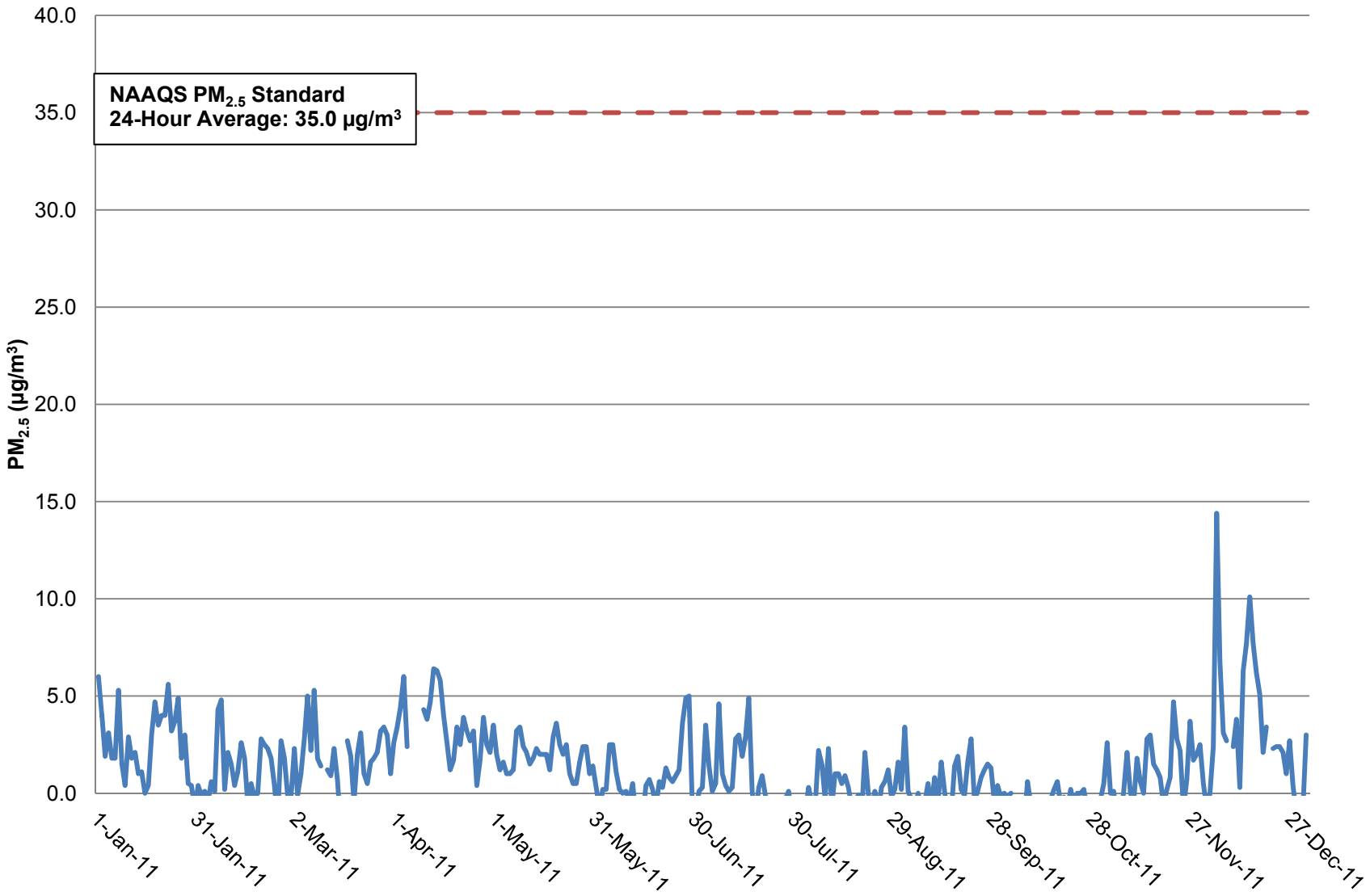


Figure 3-8: 24-Hour Average $PM_{2.5}$ and NAAQS/AAAQS Standard

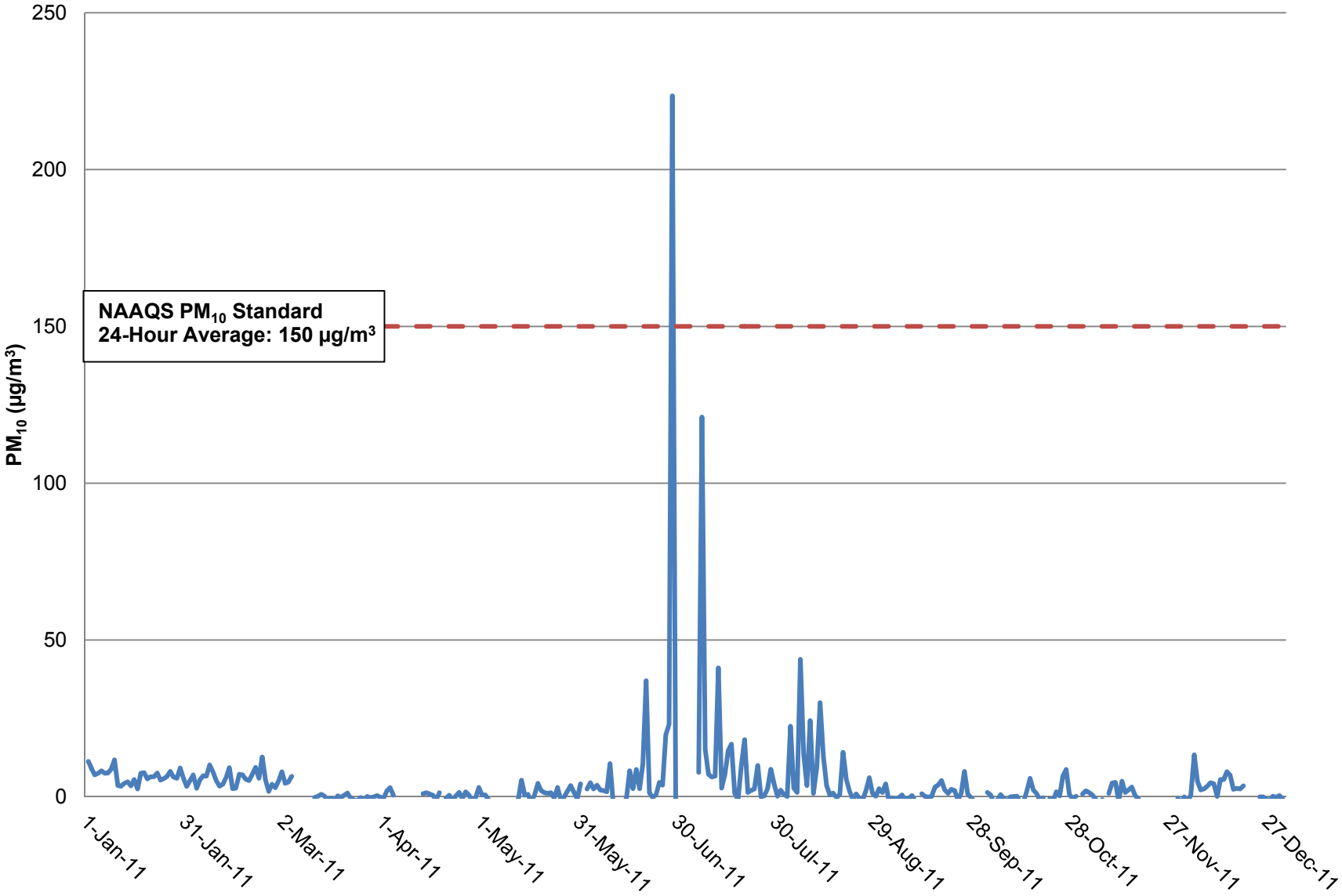


Figure 3-9: 24-Hour Average PM_{10} and NAAQS/AAAQS Standard

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 Kuparuk meteorological station, located approximately 50 miles northeast of Nuiqsut. 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. Winds were predominantly from the east-northeast with other minor wind components. 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 Kuparuk

Monitoring Period	Mean Hourly Average Wind Speed (m/s)	Maximum Hourly Average Wind Speed (m/s)
1st Quarter	5.0	23.1
2nd Quarter	5.4	14.4
3rd Quarter	5.2	11.3
4th Quarter	4.6	14.9
Monitoring Year	**5.1**	**23.1**

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

Monitoring Period	Mean Hourly Average Horizontal Wind Speed (m/s)	Mean Hourly Average Vertical Wind Speed (m/s)	Maximum Hourly Average Horizontal Wind Speed (m/s)	Maximum Hourly Average Vertical Wind Speed (m/s)
1st Quarter	4.29	0.22	18.77	1.19
2nd Quarter	4.84	0.35	13.13	1.78
3rd Quarter	4.91	0.28	12.17	0.87
4th Quarter	4.39	0.25	16.76	1.23
Monitoring Year	**4.62**	**0.28**	**18.77**	**1.78**

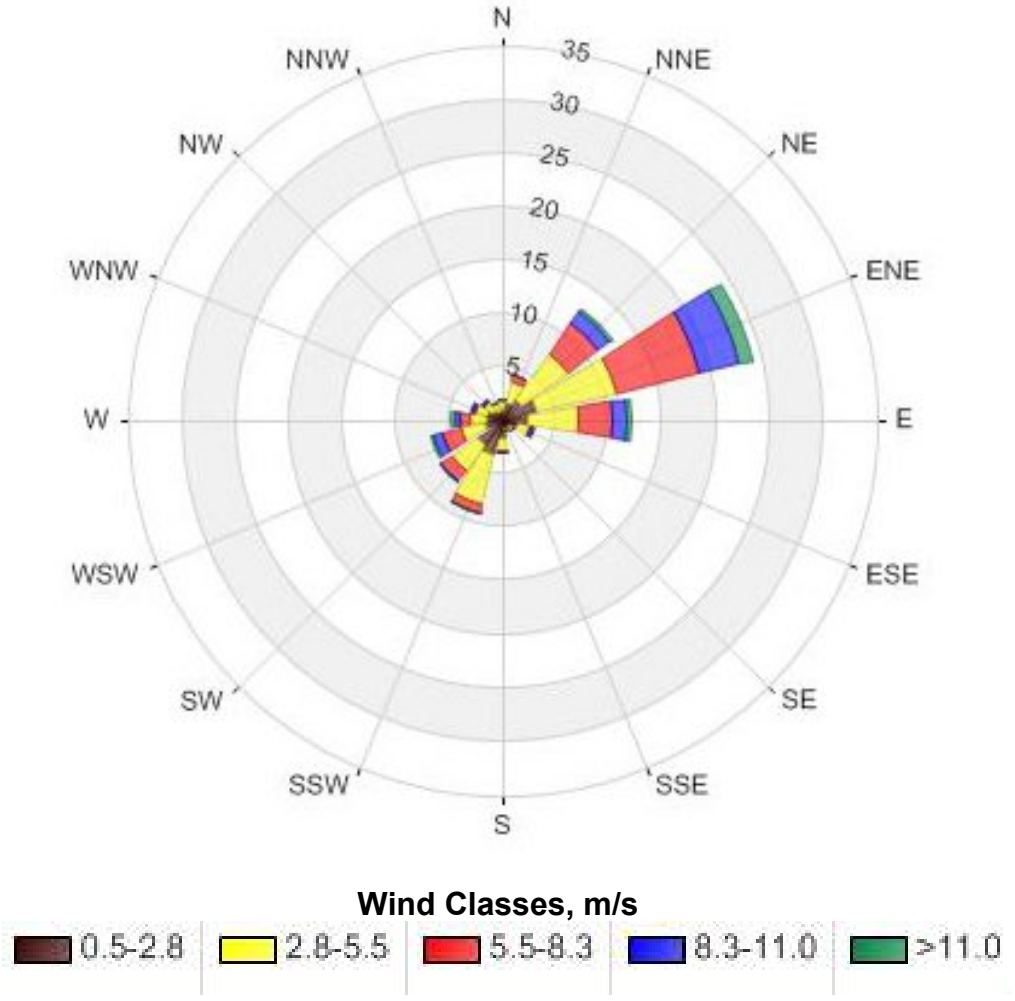
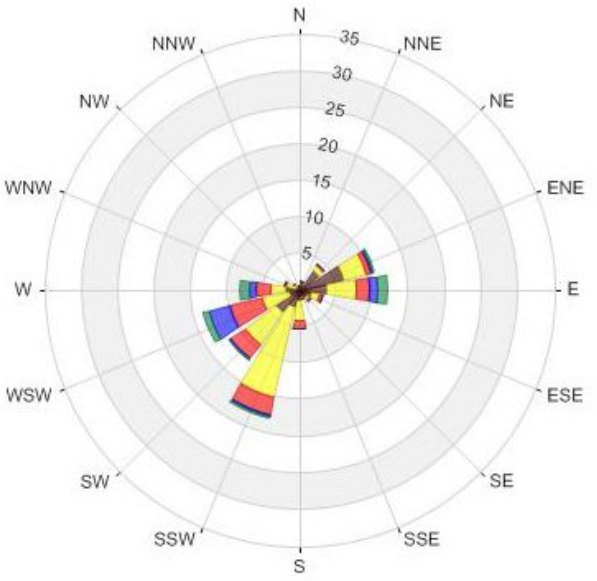
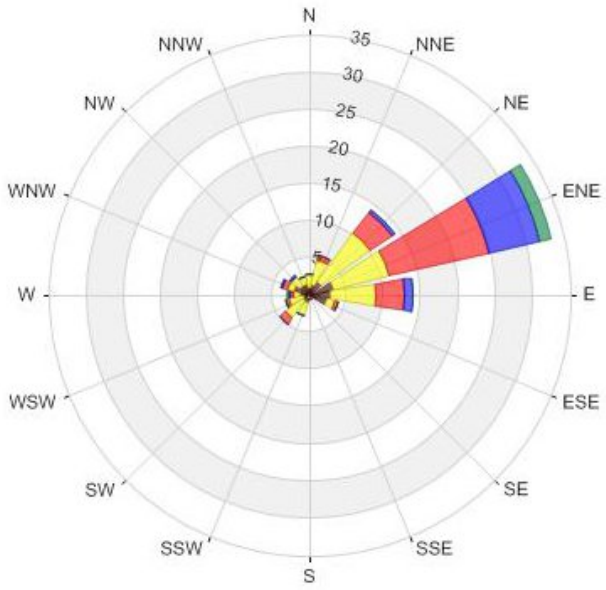


Figure 3-10: Nuiqsut Annual Wind Rose

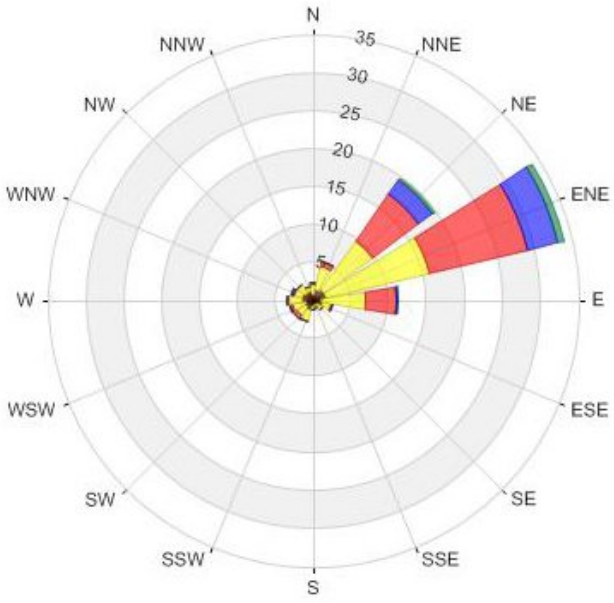
1st Quarter (1/1/11 – 3/31/11)



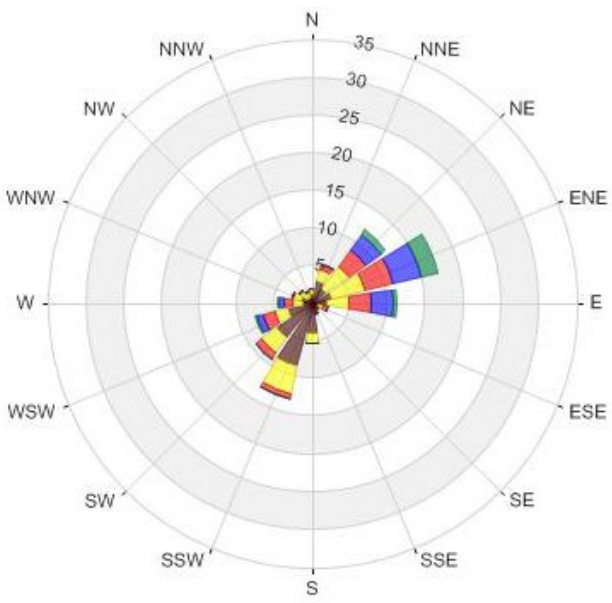
2nd Quarter (4/1/11 – 6/30/11)



3rd Quarter (7/1/11 – 9/30/11)



4th Quarter (10/1/11 – 12/31/11)



Wind Classes, m/s

Figure 3-11: Nuiqsut Quarterly Wind Roses

Table 3-4: Annual Wind Rose Frequency Distribution Percentage

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	0.91	0.94	0.09	0.00	0.00	**1.94**
NNE	1.75	2.08	0.52	0.00	0.00	**4.35**
NE	2.34	5.27	3.55	1.35	0.29	**12.80**
ENE	3.43	7.57	8.02	3.87	1.20	**24.09**
E	2.48	4.76	3.19	1.30	0.44	**12.17**
ESE	1.66	1.03	0.35	0.06	0.00	**3.10**
SE	0.83	0.43	0.04	0.00	0.00	**1.30**
SSE	0.93	0.22	0.00	0.00	0.00	**1.15**
S	1.70	1.17	0.27	0.02	0.01	**3.17**
SSW	3.41	4.73	0.82	0.06	0.07	**9.09**
SW	2.90	2.96	1.24	0.06	0.02	**7.18**
WSW	1.62	2.30	1.73	0.95	0.24	**6.84**
W	1.44	1.55	0.90	0.50	0.45	**4.84**
WNW	1.44	1.07	0.38	0.06	0.02	**2.97**
NW	0.99	1.12	0.12	0.06	0.00	**2.29**
NNW	0.89	0.72	0.06	0.00	0.00	**1.67**
Summary	**28.72**	**37.92**	**21.28**	**8.29**	**2.74**	**98.95**

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

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	0.46	0.05	0.00	0.00	0.00	**0.51**
NNE	1.13	0.10	0.00	0.00	0.00	**1.23**
NE	3.29	0.82	0.21	0.05	0.00	**4.37**
ENE	6.21	3.23	0.72	0.15	0.31	**10.62**
E	3.95	4.00	1.80	1.08	1.39	**12.22**
ESE	1.90	1.13	0.26	0.15	0.00	**3.44**
SE	1.33	0.51	0.15	0.00	0.00	**1.99**
SSE	1.08	0.21	0.00	0.00	0.00	**1.29**
S	1.59	2.67	1.08	0.10	0.05	**5.49**
SSW	2.57	12.58	2.41	0.26	0.31	**18.13**
SW	3.85	5.34	2.36	0.26	0.10	**11.91**
WSW	1.49	3.80	4.52	3.03	0.77	**13.61**
W	1.85	2.10	1.95	1.08	1.33	**8.31**
WNW	0.62	1.23	0.26	0.00	0.00	**2.11**
NW	0.31	0.67	0.05	0.00	0.00	**1.03**
NNW	0.10	0.15	0.00	0.00	0.00	**0.25**
Summary	**31.73**	**38.59**	**15.77**	**6.16**	**4.26**	**96.51**

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

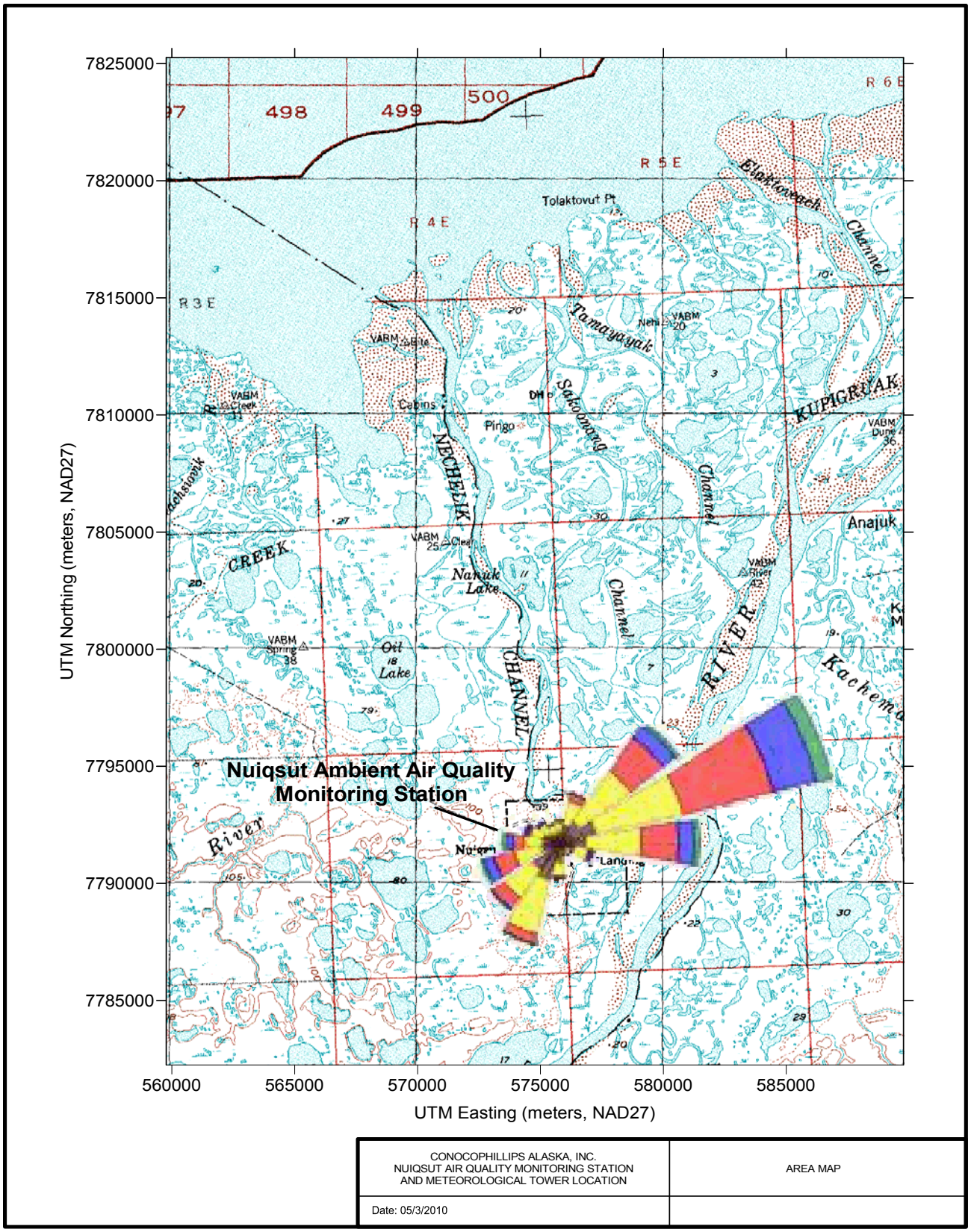
Frequency Distribution (Percent)						
Direction	Speed (m/s)					
	0.5-2.8	2.8-5.5	5.5-8.3	8.3-11.0	>11.0	Total
N	1.12	1.75	0.00	0.00	0.00	**2.87**
NNE	1.41	3.35	0.68	0.00	0.00	**5.44**
NE	2.09	8.16	3.45	0.49	0.00	**14.19**
ENE	3.30	7.82	13.61	7.09	1.51	**33.33**
E	2.96	6.07	3.94	0.92	0.00	**13.89**
ESE	2.38	1.31	0.29	0.00	0.00	**3.98**
SE	0.34	0.19	0.00	0.00	0.00	**0.53**
SSE	0.39	0.19	0.00	0.00	0.00	**0.58**
S	0.24	0.44	0.05	0.00	0.00	**0.73**
SSW	1.07	1.80	0.15	0.00	0.00	**3.02**
SW	0.97	2.96	1.02	0.00	0.00	**4.95**
WSW	0.68	2.14	0.44	0.10	0.00	**3.36**
W	1.17	0.92	0.44	0.29	0.34	**3.16**
WNW	2.14	0.92	0.63	0.15	0.10	**3.94**
NW	1.36	1.60	0.15	0.10	0.00	**3.21**
NNW	1.41	1.26	0.00	0.00	0.00	**2.67**
Summary	**23.03**	**40.88**	**24.85**	**9.14**	**1.95**	**100.00**

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

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	0.88	1.16	0.32	0.00	0.00	**2.36**
NNE	1.44	3.15	0.65	0.00	0.00	**5.24**
NE	1.76	7.92	7.50	2.27	0.37	**19.82**
ENE	1.76	14.03	13.25	4.26	0.69	**33.99**
E	1.07	5.88	4.03	0.42	0.00	**11.40**
ESE	1.39	1.07	0.19	0.09	0.00	**2.74**
SE	0.60	0.93	0.00	0.00	0.00	**1.53**
SSE	0.69	0.46	0.00	0.00	0.00	**1.15**
S	0.97	0.37	0.00	0.00	0.00	**1.34**
SSW	1.39	1.44	0.14	0.00	0.00	**2.97**
SW	1.16	1.34	0.65	0.00	0.00	**3.15**
WSW	0.97	1.76	0.42	0.05	0.00	**3.20**
W	1.48	1.76	0.28	0.00	0.00	**3.52**
WNW	1.39	1.16	0.32	0.09	0.00	**2.96**
NW	1.34	1.25	0.05	0.00	0.00	**2.64**
NNW	1.16	0.79	0.05	0.00	0.00	**2.00**
Summary	**19.45**	**44.47**	**27.85**	**7.18**	**1.06**	**100.00**

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

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	1.17	0.73	0.00	0.00	0.00	**1.90**
NNE	3.02	1.56	0.73	0.00	0.00	**5.31**
NE	2.29	3.80	2.68	2.49	0.78	**12.04**
ENE	2.68	4.63	3.85	3.75	2.29	**17.20**
E	2.10	2.97	2.88	2.83	0.44	**11.22**
ESE	0.98	0.63	0.68	0.00	0.00	**2.29**
SE	1.07	0.05	0.00	0.00	0.00	**1.12**
SSE	1.56	0.00	0.00	0.00	0.00	**1.56**
S	4.05	1.32	0.00	0.00	0.00	**5.37**
SSW	8.68	3.71	0.68	0.00	0.00	**13.07**
SW	5.75	2.39	1.02	0.00	0.00	**9.16**
WSW	3.36	1.61	1.76	0.78	0.24	**7.75**
W	1.27	1.41	1.02	0.68	0.20	**4.58**
WNW	1.56	0.98	0.29	0.00	0.00	**2.83**
NW	0.88	0.93	0.24	0.15	0.00	**2.20**
NNW	0.83	0.63	0.20	0.00	0.00	**1.66**
Summary	**41.25**	**27.35**	**16.03**	**10.68**	**3.95**	**99.26**



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

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

3.2.2 TEMPERATURE CLIMATOLOGY

Tables 3-9 and 3-10 give 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 as well as hourly average temperatures at the nearby Kuparuk station. 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 2011	-3.2	-43.6	-25.7	0.2	-46.3
February 2011	-2.0	-33.4	-21.9	-0.5	-36.5
March 2011	NA[1]	NA[1]	NA[1]	NA[1]	NA[1]
1st Quarter	**-2.0**	**-43.6**	**-24.0**	**0.2**	**-46.3**
April 2011	NA[1]	NA[1]	NA[1]	NA[1]	NA[1]
May 2011	NA[1]	NA[1]	NA[1]	NA[1]	NA[1]
June 2011	13.7	-1.0	4.5	21.3	-3.7
2nd Quarter	**13.7**	**-1.0**	**4.5**	**21.3**	**-3.7**
July 2011	15.7	4.0	9.8	20.4	0.9
August 2011	14.4	3.1	7.4	18.3	-1.4
September 2011	9.0	-2.7	2.5	14.3	-6.1
3rd Quarter	**15.7**	**-2.7**	**6.6**	**20.4**	**-6.1**
October 2011	-0.6	-17.1	-5.3	0.2	-21.1
November 2011	-5.4	-37.5	-22.3	-3.5	-39.3
December 2011	-10.3	-35.9	-26.8	-6.7	-39.6
4th Quarter	**-0.6**	**-37.5**	**-18.1**	**0.2**	**-39.6**
Monitoring Year	**15.7**	**-43.6**	**-8.6**	**21.3**	**-46.3**

[1]No data due to aspirator failure on the two meter temperature sensor.

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 2011	-3.0	-43.1	-25.4	0.4	-46.5
February 2011	-1.9	-33.4	-21.8	-0.5	-36.7
March 2011	-13.4	-32.5	-22.7	-9.9	-35.7
1st Quarter	**-1.9**	**-43.1**	**-23.3**	**0.4**	**-46.5**
April 2011	-7.0	-27.0	-19.9	-4.1	-31.9
May 2011	3.2	-15.7	-6.0	7.3	-20.5
June 2011	13.2	-1.5	4.0	20.3	-3.9
2nd Quarter	**13.2**	**-27.0**	**-7.5**	**20.3**	**-31.9**
July 2011	15.5	3.7	9.5	19.8	0.8
August 2011	14.3	2.8	7.2	17.5	-1.4
September 2011	9.2	-2.7	2.5	13.7	-5.6
3rd Quarter	**15.5**	**-2.7**	**6.4**	**19.8**	**-5.6**
October 2011	-0.6	-16.1	-5.1	0.1	-20.9
November 2011	-5.3	-37.7	-22.1	-3.6	-39.5
December 2011	-10.2	-35.7	-26.6	-6.3	-39.3
4th Quarter	**-0.6**	**-37.7**	**-17.9**	**0.1**	**-39.5**
Monitoring Year	**15.5**	**-43.1**	**-10.6**	**20.3**	**-46.5**

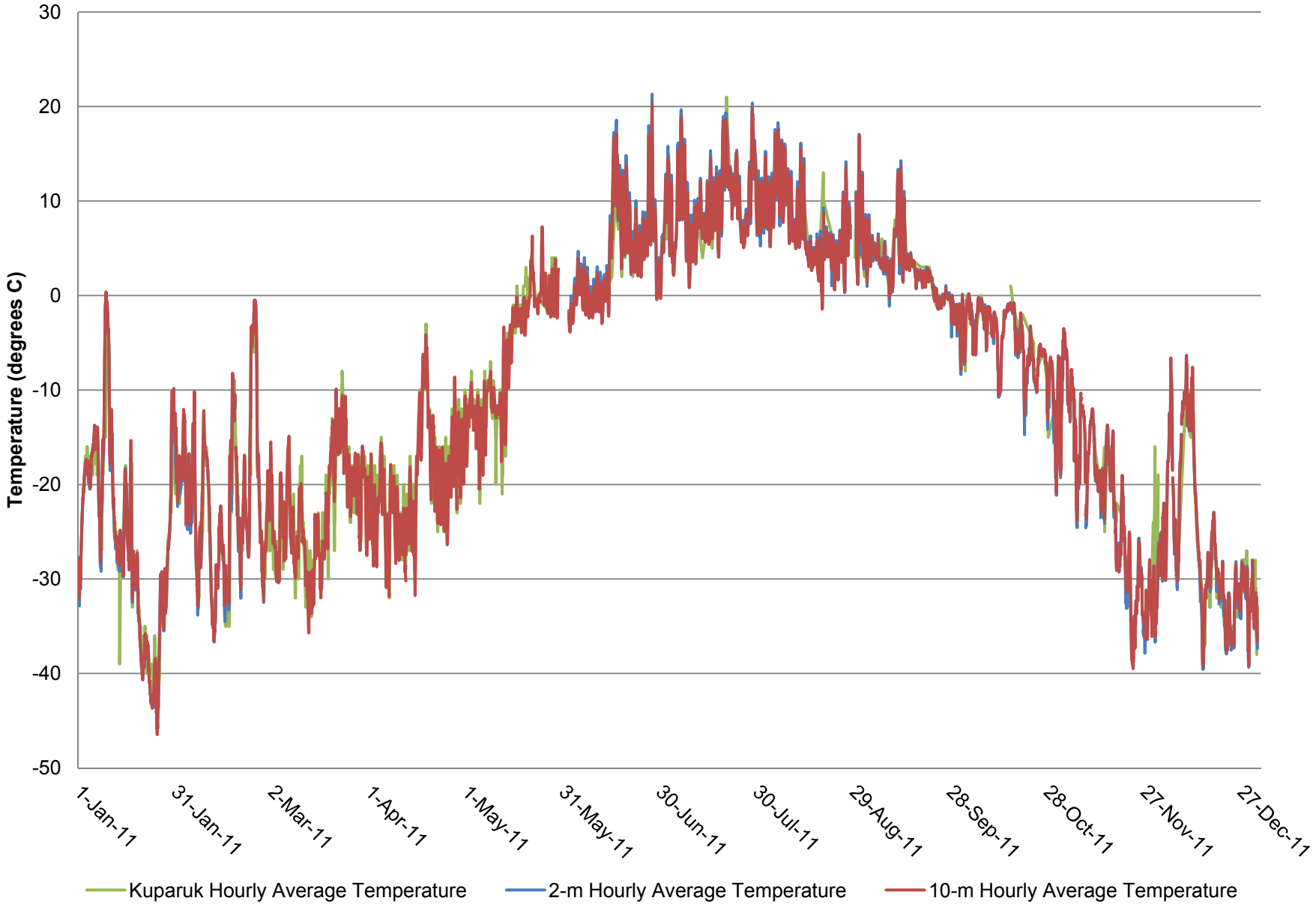


Figure 3-13: Hourly Average 2-Meter and 10-Meter Temperatures

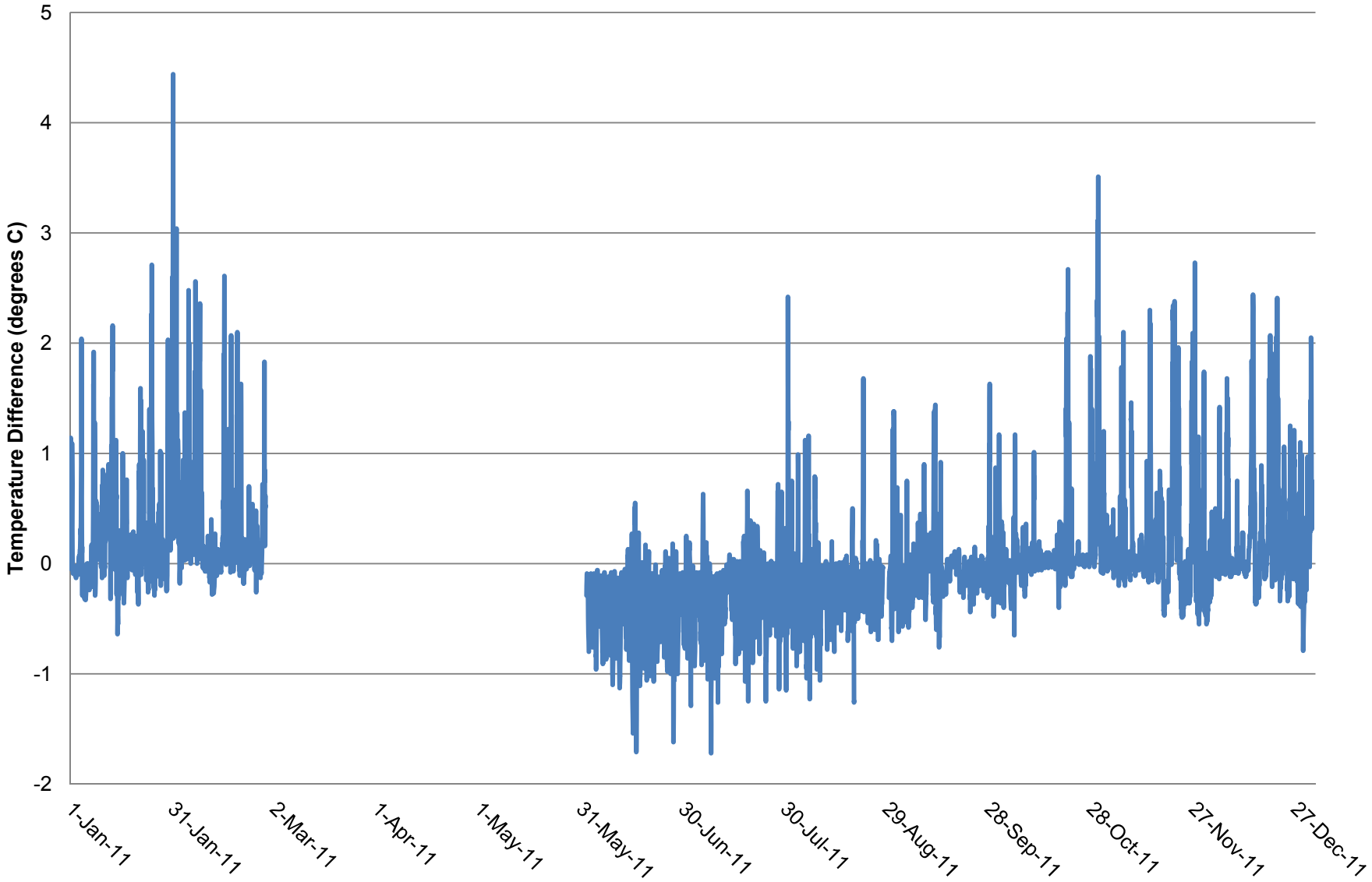


Figure 3-14: Hourly Average Vertical Temperature Difference[1]

[1]Aspirator malfunction on the two meter temperature sensor from February 27 to June 1, 2011resulted in invalid data and the gap seen in the graph.

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 2011 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 2011	1	24
February 2011	19	258
March 2011	94	535
1st Quarter	**39**	**535**
April 2011	206	722
May 2011	257	724
June 2011	257	727
2nd Quarter	**240**	**727**
July 2011	203	697
August 2011	141	617
September 2011	49	438
3rd Quarter	**132**	**697**
October 2011	23	314
November 2011	3	63
December 2011	0	2
4th Quarter	**9**	**314**
Monitoring Year	**105**	**727**

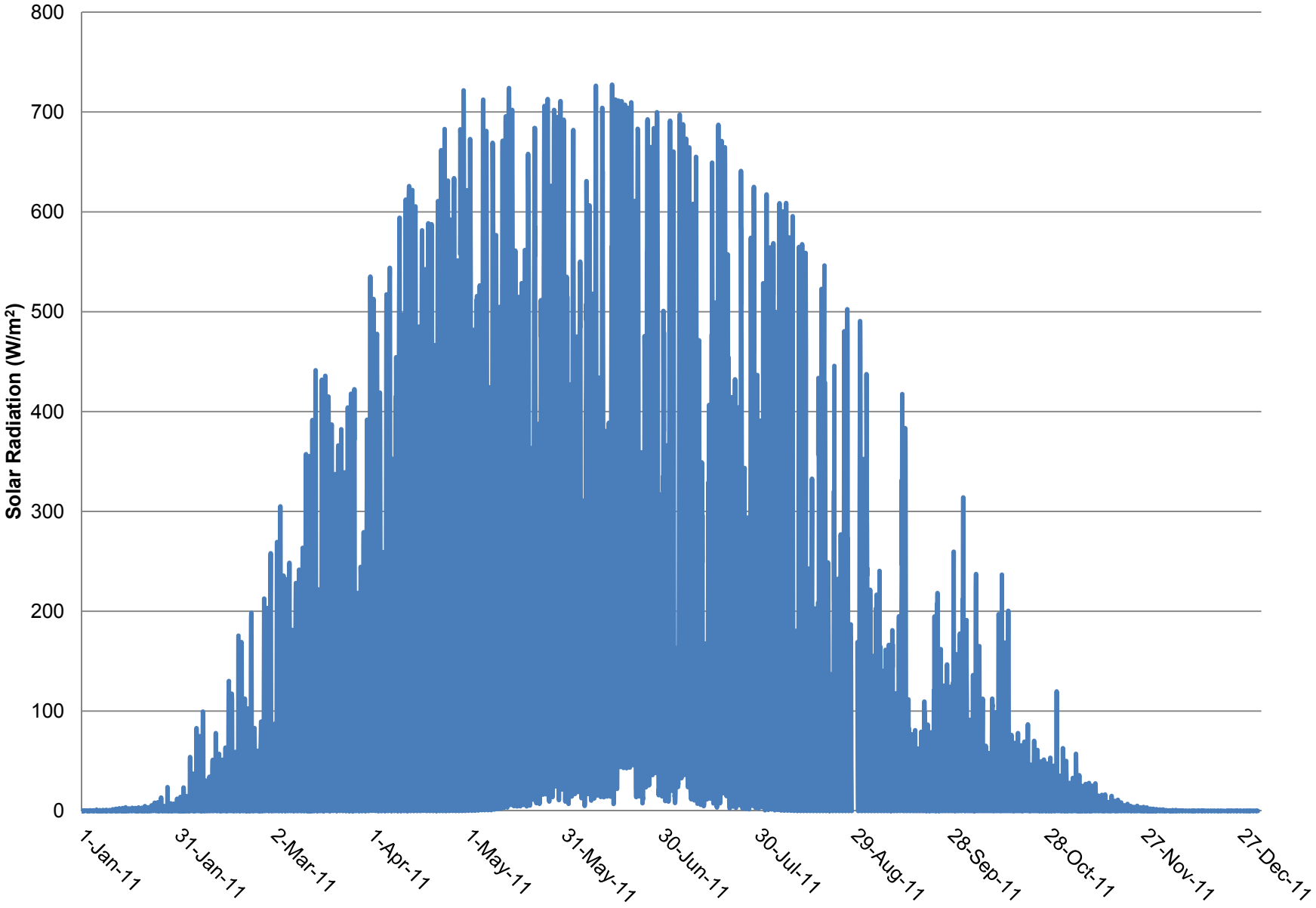


Figure 3-15: Hourly Average Solar Radiation

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