Environment

Submitted to:
ConocoPhillips Alaska, Inc.
Anchorage, Alaska

Submitted by:
AECOM
Fort Collins, Colorado

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Nuiqsut Ambient Air Quality Monitoring Program 2009 Monitoring Year Data Summary January 1, 2009 through December 31, 2009

Final

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Nuiqsut Ambient Air Quality Monitoring Program 2009 Monitoring Year Data Summary January 1, 2009 through December 31, 2009

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Contents

List of Appendices

List of Tables

List of Figures

Executive Summary

Since April 9, 1999 (prior to construction of the Alpine Central Processing Facility), ConocoPhillips Alaska, Inc. has operated an air quality and dispersion meteorology monitoring station in Nuiqsut, Alaska, (Nuiqsut Station) which is located on the Alaskan North Slope. This station is part of the Nuiqsut Ambient Air Quality and Meteorological Monitoring Program (Monitoring Program), which primarily is designed to characterize ambient air in Nuiqsut as regional oil field development continues. This Monitoring Program has been administered according to United States Environmental Protection Agency (USEPA) Prevention of Significant Deterioration (PSD) protocols; therefore, data collected is considered PSD quality.

Currently, the Monitoring Program is being conducted on a voluntary basis to document air quality in Nuiqsut. Monitoring Program data also is used to support various ambient air quality impact analyses conducted for oil field development in the Colville Delta region.

This report summarizes data collected at the Nuiqsut Station during the 2009 monitoring year (January 1, 2009 through December 31, 2009.

In July of 2009, the Nuiqsut monitoring station was refurbished. This refurbishment included the addition of a Thermo Electron model 48i CO analyzer and a Met One Instruments BAM 1020 $PM_{2.5}$ analyzer. The SO_2 and O_3 analyzers were replaced with like models, and an O_3 Transfer Standard was installed to replace the O_3 Primary Standard. In addition, an issue with the TEOM's clock was addressed and the station's cooling unit was fixed. In response to the repair of the station's cooling unit, the TEOM set-point values were reset back to their normal operating values, satisfying ADEC requirements.

The Nuiqsut Station is equipped to continuously measure ambient air quality (oxides of nitrogen [NO_X], sulfur dioxide [SO_2], carbon monoxide [CO], particulate matter with an aerodynamic diameter of 10 microns or less [PM_{10}], particulate matter with and aerodynamic diameter of 2.5 micron or less [$PM_{2.5}$], and ozone [O_3]) and dispersion meteorology parameters. Air quality and meteorology data collected at the Nuiqsut Station meet strict Quality Assurance (QA) and data capture requirements of the United States Environmental Protection Agency (USEPA) Prevention of Significant Deterioration program as administered by ADEC and other specific ADEC ambient monitoring QA requirements. Protocols used to collect data at the Nuiqsut Station are fully described in the project Monitoring and Quality Assurance Project Plan (QAPP).

The second quarter calibration of the air quality measurement system, air quality and meteorological measurement systems did not occur within the calendar quarter. The calibration was scheduled for late June, which would have been consistent with the QAPP, but had to be rescheduled to July due to lack of available lodging accommodations. This calibration trip included additional tasks including a general station refurbishment, and the installation of several new instruments. Although the second quarter calibration trip occurred two weeks into the third quarter, in general, QAPP QA goals were met for all parameters.

As shown in **Table ES-1**, air quality and meteorological quarterly data capture exceeded QAPP goals for all parameters except for fourth quarter horizontal wind speed, horizontal wind direction, horizontal wind direction standard deviation, horizontal wind speed standard deviation, vertical wind speed, and vertical wind speed standard deviation. This was due to frozen instruments.

Table ES-1 Recovery Statistics 2009, Annual Data Summary

Parameter	1st Quarter 2009 (%)	2nd Quarter 2009 (%)	3rd Quarter 2009 (%)	4th Quarter 2009 (%)	Required Capture Rates (%)
Meteorological					
10-meters (m) Horizontal Wind Speed	97.8	100.0	99.5	88.3	90
10-m Horizontal Sigma-u (σ_u)	97.8	100.0	99.5	88.3	
10-m Horizontal Wind Direction	97.8	100.0	99.5	88.3	
10-m Sigma-Theta (σ_θ)	97.8	100.0	99.5	88.3	
10-m Vertical Wind Speed	49.9	99.3	97.9	68.2	
10-m Vertical Sigma-w (σ_w)	49.9	99.3	97.9	68.2	
10-m Temperature	99.6	100.0	99.5	99.9	
2-m Temperature	99.6	100.0	99.5	99.9	
10-2m Temperature Lapse	99.6	100.0	99.5	99.9	
Total Solar Radiation	99.6	100.0	99.5	100.0	
Air Quality					
NO_2	97.4	97.7	95.2	97.2	80
SO_2	97.4	97.7	95.3	97.2	
O_3	97.1	97.7	94.7	97.1	
CO	N/A	N/A	94.9	97.2	
$PM_{2.5}$ (BAM)	N/A	N/A	87.6	93.9	
PM_{10} (TEOM)	30.0	97.8	98.4	98.9	

Tables ES-2 through **ES-7** summarize average nitrogen dioxide (NO_2), SO_2, PM_{10}, O_3, CO, and $PM_{2.5}$ concentrations measured during the monitoring year. Measured concentrations of NO_2, SO_2, O_3, and CO were well below Alaska Ambient Air Quality Standards (AAAQS), which are the same as the national standards for the pollutants measured.

The typical hourly NO_2 concentrations were just above instrument detection, and the annual average was well below applicable AAAQS. Concentrations measured this monitoring year were generally lower than historical measurements.

Measured SO_2 concentrations were at or below instrument detection the entire year. The low concentrations measured are consistent with an airshed containing relatively few and widely dispersed SO_2 sources. This trend has been typical of SO_2 measurements since monitoring began.

The annual average hourly PM_{10} concentrations were well below the applicable AAAQS and are consistent the global background levels.

O_3 concentrations measured during this monitoring year were typical of seasonal averages measured on the Alaskan North Slope (Prudhoe Bay, Kuparuk River Unit, and Barrow). In the absence of large combustion sources, frontal boundaries and high incoming solar radiation, ambient O_3 levels will be spatially homogenous and representative of a regional background.

CO measurements began in July 2009 and were below applicable AAAQS standards. Low concentrations measured are consistent with an airshed containing relatively few and widely dispersed CO sources.

$PM_{2.5}$ data collection began during the third quarter of the 2009 monitoring year. The average hourly $PM_{2.5}$ concentrations were well below the applicable AAAQS and are consistent with global background levels.

Table ES-2 Measured Nitrogen Dioxide, 2009 Annual Data Summary

Monitoring Period	Year	Period Mean (ppm)[1]	Number of Exceedances
1st Quarter	2009	0.003	None
2nd Quarter	2009	0.002	None
3rd Quarter	2009	0.001	None
4th Quarter	2009	0.002	None
Annual	2009	0.002	None

[1] Annual average.
NAAQS/AAAQS:
Annual - 0.053 parts per million (ppm) (100 micrograms per cubic meter [µg/m^3]) – Compared to the annual arithmetic mean.

Table ES-3 Measured Sulfur Dioxide, 2009 Annual Data Summary

Monitoring Period	Year	3-hour (ppm)[1]		24-hour (ppm)[2]		Period Mean (ppm)[3]	Number of Exceedances
		1st high	2nd high	1st high	2nd high		
1st Quarter	2009	.002	.002	.001	.001	.000	None
2nd Quarter	2009	.003	.003	.001	.001	.000	None
3rd Quarter	2009	.001	.001	.000	.000	.000	None
4th Quarter	2009	.001	.001	.001	.001	.000	None
Annual	2009	.003	.003	.001	.001	.000	None

[1] Rolling 3-hour average.
[2] Midnight-to-midnight 24-hour average.
[3] Annual average.
NAAQS/AAAQS:
3-hour - 0.5 ppm (1,300 µg/m^3) – Non-overlapping block averages starting at midnight not to be exceeded more than once per year.
24-hour - 0.14 ppm – Midnight to midnight average not to be exceeded more than once per year.
Annual - 0.03 ppm – Compared to the annual arithmetic mean.

Table ES-4 Measured PM_{10} Data, 2009 Annual Data Summary

Monitoring Period	Year	24-hour (µg/m³)[1]		Period Mean (µg/m³)[2]	Number of Exceedances
		1st high	2nd high		
1st Quarter	2009	9.5[1]	9.4[3]	6.4[3]	N/A
2nd Quarter	2009	30.9	24.5	9.0	None
3rd Quarter	2009	225.4	97.6	15.5	None
4th Quarter	2009	38.4	13.9	5.4	None
Annual	2009	225.4	97.6	9.6	None

[1]Midnight-to-midnight 24-hour average.
[2]Annual average.
[3]The PM_{10} Analyzer had 30 percent data recovery for the first quarter 2009
NAAQS/AAAQS:
24-hour – 150 µg/m³ – Not to be exceeded more than once per year measured from midnight to midnight at USEPA Standard Conditions.
Annual – 50 µg/m³ – Compared to the 3-year average of the weighted annual arithmetic mean concentration measured at USEPA Standard Conditions.

Table ES-5 Measured Ozone Data, 2009 Annual Data Summary

Monitoring Period	Year	8-hour (ppm)[1]			Period Mean (ppm)[2]	Number of Exceedances
		1st high	2nd high	4th high		
1st Quarter	2009	38.8	38.8	38.6	22.7	None
2nd Quarter	2009	42.2	42.1	42.1	18.6	None
3rd Quarter	2009	31.7	31.6	31.6	15.7	None
4th Quarter	2009	37.8	37.8	37.7	27.1	None
Annual	2009	42.2	42.1	42.1	21.0	None

[1] Rolling 8-hour average.
[2] Annual average.
NAAQS/AAAQS:
8-hour - 0.08 ppm – Compared to the 3-year average of the fourth-highest daily maximum rolling 8-hour average concentrations.

Table ES-6 Measured Carbon Monoxide, 2009 Annual Data Summary

Monitoring Period	Year	1-hour (ppm)[1]		8-hour (ppm)[2]		Period Mean (ppm)[3]	Number of Exceedances
		1st high	2nd high	1st high	2nd high		
1st Quarter	2009	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]
2nd Quarter	2009	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]
3rd Quarter	2009	0.8	0.7	0.7	0.7	0.20	None
4th Quarter	2009	0.3	0.3	0.2	0.2	0.10	None
Annual	2009	1.5	1.4	1.4	1.4	0.15	None

[1] Rolling 1-hour average.
[2] Rolling 8-hour average.
[3] CO data collection started during the 3rd quarter 2009
NAAQS/AAAQS:
1-hour - 35ppm (40 mg/m³).
8-hour - 9ppm(10 mg/m³)– Midnight to midnight average not to be exceeded more than once per year.

Table ES-7 Measured $PM_{2.5}$ Data, 2009 Annual Data Summary

Monitoring Period	Year	24-hour ($\mu g/m^3$)[1]		Period Mean ($\mu g/m^3$)[2]	Number of Exceedances
		1st high	2nd high		
1st Quarter	2009	N/A[3]	N/A[3]	N/A[3]	N/A[3]
2nd Quarter	2009	N/A[3]	N/A[3]	N/A[3]	N/A[1]
3rd Quarter	2009	83	32	4	None
4th Quarter	2009	8	6	2	None
Annual	2009	83	32	3	None

[1]Midnight-to-midnight 24-hour average.
[2]Annual average.
[3]$PM_{2.5}$ data collection started during the 3rd quarter 2009
NAAQS/AAAQS:
24-hour – 35 $\mu g/m^3$ – Not to be exceeded more than once per year measured from midnight to midnight at USEPA Standard Conditions.
Annual – 15 $\mu g/m^3$ – Compared to the 3-year average of the weighted annual arithmetic mean concentration measured at USEPA Standard Conditions.

1.0 Introduction

1.1 Project Summary

Since April 9, 1999 (prior to Alpine Central Processing Facility startup), ConocoPhillips Alaska, Inc. (CPAI) has operated an air quality and dispersion meteorology monitoring station in Nuiqsut, Alaska (Nuiqsut Station), which is located on the Alaskan North Slope. This station is part of the Nuiqsut Ambient Air Quality Monitoring Program (Monitoring Program), which primarily is designed to characterize ambient air in Nuiqsut as regional oilfield development continues. This Monitoring Program has been administered according to United States Environmental Protection Agency (USEPA) Prevention of Significant Deterioration (PSD) protocols; therefore, data collected are considered PSD quality. This report summarizes data collected at the Nuiqsut Station during the 2009 monitoring year (January 1, 2009 through December 31, 2009.

Currently, the Monitoring Program is being conducted on a voluntary basis to document air quality in Nuiqsut. Monitoring Program data also are used to support various ambient air quality impact analyses conducted for oilfield development in the Colville Delta region.

Since the beginning, the Monitoring Program has been modified to enhance Quality Assurance (QA) and Quality Control (QC) and increase program utility through the addition of monitored parameters. Major Monitoring Program modifications include:

- Collocated Federal Reference Method (FRM) particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) sampling initiated to evaluate the Monitoring Program Federal Equivalent Method sampling methodology (July 14, 2000). Collocated FRM PM_{10} sampling was discontinued in fall 2002.
- Enhanced dispersion meteorology characterization through the addition of 10-meter (m) temperature, vertical wind speed, and solar radiation monitoring (July 24, 2001).
- Expanded background air quality evaluation through the addition of ozone (O_3) monitoring (November 19, 2004).
- Expanded background air quality evaluations through the addition of carbon monoxide (CO) and particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) measurement systems (July 2009).

Since inception, the specific technical objectives of the Monitoring Program are to:

- Collect data meeting QA and data capture requirements of the USEPA PSD Program and other specific Alaska Department of Environmental Conservation (ADEC) ambient monitoring QA requirements (ADEC 1996);
- Document preconstruction air quality impacts at Nuiqsut prior to operation of Alpine (fulfilled);
- Document air quality conditions after Alpine is operational;
- Meet air quality and meteorological monitoring requirements listed in Alpine Permit No. 0073-AC060 (fulfilled); and
- Document dispersion meteorology conditions in Nuiqsut to support refined modeling of potential impacts in the region.

1.2 Measurement Methods

To meet project technical objectives the Nuiqsut Station is instrumented and equipped to continuously measure the parameters listed in **Table 1-1**. **Table 1-1** also details the methods and instruments used for measurement. A complete description of the Monitoring Program, including the QA plan, is contained in the ADEC approved Monitoring and Quality Assurance Project Plan (QAPP), which consists of:

- The original project monitoring plan (SECOR 2000), approved by ADEC in April 2000;
- The Partisol Addendum to the original monitoring plan (SECOR 2001), final ADEC approval pending;
- The draft Expanded Meteorology Addendum to the original monitoring plan (SECOR 2002), final ADEC approval pending; and
- The draft Ozone Monitoring Addendum to the original monitoring plan (SECOR 2004), final ADEC approval pending.

1.3 Variations from Quality Assurance Project Plan

The second quarter calibration was conducted two weeks after the end of the second quarter.

Table 1-1 Measurement Methods, Annual Data Summary

Parameter	Suggested Manufacturer/Model	Sample Frequency	Averaging Period	Measurement Range	Lower Detection Limit	Method
Nitrogen Oxides (NO_X, nitrogen dioxide [NO_2], NO)	Thermo Environmental Instruments (TECO) Model 42C	Continuous	1-hour	1-500 parts per billion (ppb)	0.5 ppb	Chemiluminescence (USEPA reference method RFNA-1289-074)
Sulfur Dioxide (SO_2)	Thermo Environmental Instruments (TECO) Model 43C	Continuous	1-hour	2–500 ppb	2 ppb	Pulsed Fluorescence (USEPA equivalent method EQSA-0486-060)
PM_{10}	Rupprecht & Patashnick (R&P) Model 1400ab TEOM PM_{10}	Continuous	1-hour	<5 micrograms per cubic meter (µg/m^3) to several g/m^3	<5 µg/m^3	Tapered Element Oscillating Microbalance (USEPA equivalent method EQPM-1090-079)
$PM_{2.5}$	Met One Instruments BAM 1020 $PM_{2.5}$	Continuous	1-hour	0-1000 µg/m^3	<4.8 µg/m$_3$ for 1-hour averages; and <1.0 µg/m^3 for 24-hour averages	Particulate Concentration by Beta Attenuation (USEPA Class III EPA EQPM-0308-170)
O_3	Thermo Environmental Model 49	Continuous	1-hour	0-1,000 ppb	2 ppb	Pulsed UV Photometric (USEPA equivalent method EQOA-0880-047)
CO	Thermo Environmental Model 48i	Continuous	1-hour	0-50 ppm	0.04 ppm	USEPA Designated Reference Method RFCA-0981-054
Horizontal Wind Speed (u) (10 m)	R.M. Young Wind Monitor AQ – 05305	Continuous	1-hour	0 to 50 m/s	0.4 meters per second (m/s)	Propeller/Magnetically Induced AC
Sigma-Theta (σ_θ) (10 m)	Campbell Scientific Model 23X	Continuous	1-hour	0 to 103.9 degrees	N.A.	Single Pass Estimator of Wind Direction Standard Deviation (Yamartino 1984)
Temperature (2 m)	YSI 44020	Continuous	1-hour	-50 degrees Celsius (°C) to 50°C	N.A.	Motor aspirated/shielded thermistor (triple-element)
Temperature (10 m)	YSI 44020	Continuous	1-hour	-50°C to 50°C	N.A.	Motor aspirated/shielded thermistor (triple-element)
10 m – 2 m Temperature Lapse (ΔT)	Campbell Scientific Model 23X	Continuous	1-hour	-100°C to 100°C	N.A.	Numerical Subtraction
Vertical Wind Speed (w) (10 m)	RM Young Propeller Anemometer Model 27106T	Continuous	1-hour	-35 m/s to 35 m/s	$\pm$0.25 m/s	Four blade helicoid propeller/AC
Sigma-w (σw) (10 m)	Campbell Scientific Model 23X	Continuous	1-hour	0 to 35 m/s	N.A.	Standard Deviation

N.A. = not applicable.

2.0 Station Performance Summary

2.1 Significant Project Events

Table 2 1 summarizes AECOM staff activity onsite during the year. Detailed discussions of project events affecting data capture are presented in **Table 2.2**.

Table 2-1 Calibrations, Audits, and Non-routine Trips to the Station

Date	Reason For Visit
3/2/09 through 3/3/09	First quarter calibration and quarterly audit
7/14/09 through 7/20/09	7/14/2009 through 7/15/09 - Second quarter calibration. 7/16/2009 through 7/19/2009 –Station refurbishment and instrument replacement. 7/20/2009 – Second quarter audit
9/29/09 through 10/1/09	Third quarter calibration and quarterly audit.
11/20/09 through 11/22/09	Fourth quarter calibration and quarterly audit.

Table 2-2 Significant Project Events, 2009 Annual Data Summary

Date	Event/Comment
1/1/09 through 12/31/09	Corrected all air quality data (SO_2, NO_X, NO_2, NO, O_3, and CO) to correct for zero drift of the instruments according to the procedure shown in Appendix A of the first quarter 1999 data report. Adjust all negative air quality data (except PM_{10}) to 0.0 following adjustments and corrections.
1/01/09 through 3/02/09	1/1/09 0100 through 3/2/09 1700 – All PM_{10} data are considered invalid due to a leak check device that was left installed during the 4th Quarter 2008 calibration.
1/09/09	1500 – All air quality analyzer data are invalid due to a power failure.
1/17/09 through 3/03/09	1/17/09 1500 through 3/3/09 1000 – Vertical wind speed and sigma-w data are invalid due to the sensor being frozen or severely damped by a build-up of fine particulate on the bearings that was discovered during the March 2009 calibration. The moisture likely entered the sensor, carrying particulate with it, when the temperatures had warmed above 0ºC on 1/17/09 at 1300. While the data quality issue was detectable in the data, it required AECOM personnel to perform the repair because the sensor is located on the tower and safety considerations do not allow the site technician to climb the tower. Because vertical wind speed is not required for AERMOD modeling it was not deemed worth a special trip to the station to perform repairs. The AECOM field technician was informed of the issue and brought the required materials during the March calibration trip to perform repairs. The sensor was left in a functional state after the calibration visit.
2/5/09	0600 – Horizontal wind speed, horizontal wind direction, sigma-u, and sigma-theta data are invalid due to a frozen sensor.
2/6/09	1800 – All gaseous pollutant analyzer data invalid due to a power failure. 1900 – O_3 analyzer data invalid due to a power failure.
2/13/09	1100 through 1300 – O_3 analyzer data are invalid due to a power failure.
2/25/09 through 2/26/09	2/25/09 0800 through 2/26/09 0700 – Horizontal wind speed, wind direction, sigma-u, and sigma-theta data are invalid due to a frozen sensor.
2/27/09	1700 – All gaseous pollutant analyzer data invalid due to a power failure.

Table 2-2 Significant Project Events, 2009 Annual Data Summary

Date	Event/Comment
3/02/09 through 3/03/09	3/2/09 2100 – All meteorological data are invalid due to quarterly calibration. 3/2/09 1800 through 3/3/09 0300 – All AQ analyzer data are invalid due to quarterly calibration. 3/3/09 0200 – All meteorological data are invalid due to quarterly calibration. 3/3/09 1100 through 1600 – All meteorological data are invalid due to quarterly calibration.
3/03/09	1600 through 1900 – All NO_X, NO, NO_2, and SO_2 data are invalid due to quarterly audit. 1600 through 2100 – All O_3 data are invalid due to quarterly audit. 1500 through 2200 – All PM_{10} data are invalid due to quarterly audit.
3/05/09 through 3/06/09	3/5/09 1300 through 3/6/09 1300 – PM_{10} data are invalid due to instrument interference that was the result of vibration caused by high winds.
3/06/09	1300 through 1500 – All gaseous pollutant data are invalid due to a power failure. 1400 through 1600 – All PM_{10} data are invalid due to a power failure.
3/07/09	0400 through 1600 – All horizontal wind speed, horizontal wind direction, sigma-u, and sigma-theta values are invalid due to a frozen sensor.
3/13/09	1600 through 1900 – All AQ analyzer data are invalid due to a power failure.
3/14/09	1300 – All gaseous pollutant data are invalid due to a power failure. 1300 through 1400 – All PM_{10} data are invalid due to a power failure.
3/21/09	0500 – Horizontal wind speed, horizontal wind direction, sigma-u, sigma-theta, vertical wind speed and, and sigma-w data are invalid due to frozen sensors.
3/25/09	1500 through 1600 – All air quality analyzer data are invalid due to a power failure. 2000 – All gaseous pollutant data are invalid due to a power failure. 2000 through 2100 – All PM_{10} data are invalid due to a power failure.
4/11/09	1100 – All gaseous pollutant analyzer data are invalid due to a power failure. 1100 through 1200 – All PM_{10} analyzer data are invalid due to a power failure.
4/23/09 through 4/24/09	4/23/09 1200 through 4/24/09 1400 – All PM_{10} analyzer data are invalid due to the site technician removing the inlet head to allow for some melting. Filter loading values were being reported erroneously in a higher-than-average 60% range. This was done to allow the filter loading values to return to the normal 30% range. At 1300 on 4/24/09, the inlet head was reinstalled. Data are invalid because the TEOM was sampling TSP and not PM_{10}. A few hours after the inlet head was reinstalled, the filter loading jumped back up to around 60%, which indicated that the filter loading and the shortly-to-follow low flow rates were being caused by the filter itself. During this time, the system remained within tolerance. The filter was replaced on 5/6/09.
5/02/09	0500 through 0800 – All vertical wind speed and sigma-w data are invalid due to a frozen sensor.
5/06/09	1300 – All PM_{10} analyzer data are invalid due to a filter replacement.
5/19/09 through 5/20/09	5/19/09 1300 through 5/20/09 0300 – All gaseous pollutant analyzer data are invalid due to a power failure. 5/19/09 1300 through 5/20/09 0400 – All PM_{10} data are invalid due to a power failure.
5/22/09	0100 through 1100 – All vertical wind speed and sigma-w data are invalid due to a frozen sensor.
6/05/09	1200 through 1300 – All PM_{10} data are invalid due to instrument reset following a setting change.
7/13/09 through 7/14/09	7/13/09 1300 through 2100 – All PM_{10} data are invalid due to the TEOM being offline during the station refurbishment. 7/13/09 1200 through 7/14/09 0700 – All NO_X, SO_2, O_3, and CO analyzer data invalid due to being offline during the station refurbishment.

Table 2-2 Significant Project Events, 2009 Annual Data Summary

Date	Event/Comment
7/14/09	0800 through 1000 – All meteorological and NO_X, SO_2, O_3, and CO analyzer data are invalid due to the station being offline. 1100 through 2100 – All NO_X, SO_2, and O_3 analyzer data are invalid due to calibration.
7/14/09 through 7/15/09	7/14/09 0700 through 7/15/09 1700 – All CO analyzer data invalid due to calibration.
7/14/09 through 7/15/09	7/14/09 2200 through 7/15/09 0600 – All O_3 analyzer data invalid due to the instrument being replaced.
7/15/09	0700 through 1000 – All O_3 analyzer data invalid due to quarterly calibration. 1000 through 1600 – All PM_{10} analyzer data are invalid due to quarterly calibration and subsequent instrument reset. 1500 – All meteorological and NO_X, SO_2, O_3, and CO analyzer data are invalid due to a power failure. 1600 through 1700 – All NO_X, SO_2, O_3, and CO analyzer data are invalid due to manual precision/GPT checks being conducted as a part of installation/calibration activities.
7/15/09 through 7/20/09	7/15/09 1700 through 7/20/09 0800 – All $PM_{2.5}$ data are invalid while a zero-air test was being conducted on the instrument.
7/16/06	1000 through 1300 – All NO_X, SO_2, O_3, and CO analyzer data are invalid due to manual precision/GPT checks being conducted as a part of installation/calibration activities.
7/19/09	1500 through 1700 – All meteorological data are invalid due to quarterly audit. 1900 through 2000 – All NO_X, SO_2, and CO analyzer data are invalid due to quarterly audit.
7/20/09	0700 through 0800 – All NO_X analyzer data invalid due to quarterly audit. 0800 – All O_3 analyzer data are invalid due to quarterly audit. 0700-0900 – All PM_{10} analyzer data are invalid due to quarterly audit. 0900 – All $PM_{2.5}$ analyzer data invalid due to quarterly audit.
7/28/09	2300 through 2400 – All PM_{10} analyzer data are invalid due to negative concentrations that are outside acceptable limits found in the Quality Assurance Project Plan (QAPP).
8/02/09	0300 – All NO_X, SO_2, O_3, and CO data are invalid due to automatic weekly precision and GPT checks being conducted.
8/01/09	0900 through 1000 – All PM_{10} data are invalid due to negative concentrations that are outside of acceptable limits listed in the QAPP.
8/02/09	0800 through 0900 – All PM_{10} data are invalid due to negative concentrations that are outside of acceptable limits listed in the QAPP.
8/08/09	1500 through 1600 – All PM_{10} data are invalid due to negative concentrations that are outside of acceptable limits listed in the QAPP.
8/09/09	1100 – All PM_{10} data are invalid due to negative concentrations that are outside of acceptable limits listed in the QAPP.
8/15/09	1100 through 1200 – All PM_{10} data are invalid due to negative concentrations that are outside of acceptable limits listed in the QAPP.
8/18/09	0700 – All NO_X, SO_2, O_3, and CO data are invalid due to a manual precision and GPT checks being conducted. 1300 – All NO_X, SO_2, O_3, and CO analyzer data are invalid due to zero and span adjustments being conducted on the analyzers.
8/18/09 through 8/19/09	8/18/09 1400 through 8/19/09 0200 – All NO_X, SO_2, O_3, and CO analyzer data are invalid due to the zero-air system remaining operational after the zero and span adjustments had been performed. 0700 – All NO_X, SO_2, O_3, and CO data are invalid due to manual precision and GPT checks being conducted.

Table 2-2 Significant Project Events, 2009 Annual Data Summary

Date	Event/Comment
8/22/09 through 8/26/09	8/22/09 0500 through 8/26/09 1600 – All $PM_{2.5}$ data are invalid due to the analyzer running out of filter tape.
8/29/09	0700 – All $PM_{2.5}$ data are invalid due to lint on the filter tape causing an erroneous mass measurement.
9/01/09	1100 through 1300 – All $PM_{2.5}$ data are invalid due to a filter tape change. 1700 – All $PM_{2.5}$ data are invalid due to lint on filter tape.
9/02/09	0300 and 0600 – All PM_{10} data are invalid due to negative concentrations that are outside of validation criteria as listed in the QAPP.
9/15/09	0100 through 0200 – All vertical wind speed and sigma-w data are invalid due to a frozen sensor. 0700 through 0800 – All vertical wind speed and sigma-w data are invalid due to a frozen sensor.
9/24/09 through 9/25/09	9/24/09 0300 through 9/25/09 0700 – All vertical wind speed and sigma-w data are invalid due to a frozen sensor.
9/24/09	1300 through 1700 – All NO_X, SO_2, O_3, and CO data are invalid due to quarterly audit. 1400 through 1700 – All PM_{10} data are invalid due to quarterly audit. 1600 – All $PM_{2.5}$ data are invalid due to quarterly audit.
9/29/09	0600 through 0700 – All vertical wind speed and sigma-w data are invalid due to a frozen sensor. 1200 through 1600 – All meteorological data are invalid due to quarterly calibration. 1700 – All O_3 data are invalid due to the O_3 Transfer Standard being replaced with an O_3 Primary Standard.
9/30/09	0700 through 1600 – All NO_X, SO_2, O_3, and CO data are invalid due to quarterly calibration. 1600 – All $PM_{2.5}$ data are invalid due to quarterly calibration.
10/01/09	0700 through 0800 – SO_2, NO_X, NO_2, NO, O_3, and CO data are invalid due to quarterly calibration. 0800 through 1700 – PM_{10} data are invalid due to quarterly calibration. 0900 through 1000 – $PM_{2.5}$ data are invalid due to quarterly calibration. 1100 – NO_X, NO_2, NO, SO_2, O_3, and CO data are invalid due to a manual precision and GPT check being conducted following calibration.
10/15/09 through 10/21/09	10/15/09 0800 through 10/21/09 1100 – Vertical wind speed and sigma-w data are invalid due to a frozen sensor.
10/16/09	2200 – PM_{10} data are invalid due to negative concentrations that are outside validation criteria as specified by the Quality Assurance Project Plan (QAPP).
10/24/09	0200 – PM_{10} data are invalid due to negative concentrations that are outside validation criteria as specified by the QAPP. 1200 through 2000 – Horizontal wind speed, sigma-u, horizontal wind direction, and sigma-theta data are invalid due to a frozen sensor.
10/25/09	0500 through 0800 and 1800 through 2000 – Horizontal wind speed, sigma-u, horizontal wind direction, and sigma-theta data are invalid due to a frozen sensor.
10/26/09	1700 – All SO_2, NO_X, NO_2, NO, O_3, and $PM_{2.5}$ data are invalid due to a power failure and subsequent instrument reset. 1700 through 1800 – All PM_{10} data are invalid due to a power failure and subsequent instrument reset.
11/03/09	1100 through 1200 – Horizontal wind speed, sigma-u, wind direction, sigma-theta, vertical wind speed, and sigma-w data are invalid due to the sensors being frozen.
11/05/09 through 11/09/0	11/5/09 2400 through 11/9/09 1200 – $PM_{2.5}$ data are invalid due to a breakage of the filter tape.

Table 2-2 Significant Project Events, 2009 Annual Data Summary

Date	Event/Comment
11/09/09	1200 – SO_2, NO_X, NO_2, NO, O_3, and CO are invalid due to a zero-adjust of the CO analyzer. 1900 through 2300 – $PM_{2.5}$ data are invalid due to a filter tape transport error.
11/10/09	0500 through 1400 – $PM_{2.5}$ data are invalid due to a breakage of the filter tape roll.
11/16/09	1900 –$PM_{2.5}$ data are invalid due to a power failure. 1900 through 2000 –SO_2, NO_X, NO_2, NO, O_3, and CO data are invalid due to a power failure. 2000 – PM_{10} data are invalid due to a power failure.
11/19/09 through 11/20/09	11/19/09 1700 through 11/20/09 0200 – SO_2, NO_X, NO_2, NO, O_3, and CO data invalid due to quarterly calibration.
11/20/09	0700 through 1000 – SO_2, NO_X, NO_2, NO, O_3, and CO invalid due to quarterly calibration activities. 1400 through 1500 –Horizontal wind speed, sigma-u, wind direction, and sigma-theta data are invalid due to semi-annual audit. 1600 through 2000 –PM_{10} data are invalid due to quarterly calibration.
11/20/09 through 11/21/09	11/20/09 1400 through 11/21/09 1400 – Vertical wind speed and sigma-w data are invalid due to semi-annual audit. 11/20/09 1200 through 11/21/09 1400 – $PM_{2.5}$ data are invalid due to quarterly calibration.
11/21/09	0800 through 1000 – SO_2, NO_X, NO_2, NO, and CO data are invalid due to quarterly audit. 0800 through 1100 – O_3 data are invalid due to quarterly audit. 1000 through 1200 – PM_{10} data are invalid due to quarterly audit. 1200 through 1300 – 2-m temperature, 10-m temperature, and 10-2 m delta-temperature data are invalid due to semi-annual audit. 1400 through 1600 – $PM_{2.5}$ data are invalid due to quarterly audit. 1500 through 1700 – SO_2, NO_X, NO_2, NO, and CO data are invalid due to quarterly calibration.
11/21/09	11/21/09 1200 through 12/31/09 2400 - The 10-2 meter temperature difference was invalidated due to a failed calibration check during the Q1 calibration visit.
11/22/09	1000 –PM_{10} data are invalid due to flow values that are outside of validation criteria as specified in the project QAPP. 2100 - Horizontal wind speed, sigma-u, horizontal wind direction, and sigma-theta data are invalid due to a frozen sensor.
11/23/09	0800 – NO_X, NO_2, NO, SO_2, O_3, and CO data are invalid due to manual precision and GPT checks being conducted.
11/24/09	1400 – NO_X, NO_2, NO, SO_2, O_3, and CO data are invalid due to manual precision and GPT checks being conducted.
11/25/09	0800 – NO_X, NO_2, NO, SO_2, O_3, and CO data are invalid due to manual precision and GPT checks being conducted.
12/09/09	0500 through 0700 – Horizontal wind speed, sigma-u, horizontal wind direction, sigma-theta, vertical wind speed, and sigma-w data are invalid due to frozen sensor.
12/10/09 through 12/31/09	12/10/09 0500 through 12/31/09 2400 –Vertical wind speed and sigma-w data are invalid due to a frozen sensor.
12/11/09	1000 – NO_X, NO_2, NO, SO_2, O_3, CO, PM_{10}, and $PM_{2.5}$ data are invalid due to power failure. 1100 – O_3 data invalid due to power failure.
12/11/09 through 12/21/09	12/11/09 1300 through 12/21/09 0500 – Horizontal wind speed, sigma-u, horizontal wind direction, sigma-theta is invalid due to a frozen sensor. Refer to section 1.2 for more details.
12/29/09	1300 – $PM_{2.5}$ data are invalid due to onsite activities.
12/31/09	1000 through 1100 - Horizontal wind speed, sigma-u, horizontal wind direction, sigma-theta is invalid due to a frozen sensor. Refer to section 1.2 for more details

2.2 Missing, Invalid and Adjusted Data

All hourly NO_X, SO_2, O_3, and CO data are routinely adjusted for instrument drift according to the procedure outlined in the USEPA Quality Assurance Handbook for Air Pollution Measurement Systems Vol. II: Pt. 1 (USEPA 1998) as presented in **Appendix A**, Section A.3. After instrument drift corrections are applied, all hourly NO_X, SO_2, O_3, and CO data less than 0.000 parts per million (ppm) have been investigated and then set to 0.000 ppm to conservatively remove any remaining negative bias.

The following table provides details pertaining to all invalidated data for each specific portion of the monitoring network. NO_X, SO_2, O_3, CO, PM_{10}, and $PM_{2.5}$ Data

2.3 Network Data Completeness

Table 2-3 provides a summary of quarterly data capture for each parameter during the monitoring year. Data capture rates for each continuous air quality and meteorological parameter have been calculated according to the procedure discussed in **Appendix A**, Section A.1. Quarterly network data capture rates for the year achieved QAPP goals for all parameters except horizontal wind speed, 10-m Sigma T, vertical wind speed, 10-m Sigma W, and O_3 measurements.

Table 2-3 Data Recovery Statistics, 2009 Annual Data Summary

Parameter	1st Quarter 2009 (%)	2nd Quarter 2009 (%)	3rd Quarter 2009 (%)	4th Quarter 2009 (%)	Required Capture Rates (%)
Meteorological					
10-meters (m) Horizontal Wind Speed	97.8	100.0	99.5	88.3[2]	90
10-m Horizontal Sigma-u (σ_u)	97.8	100.0	99.5	88.3[2]	
10-m Horizontal Wind Direction	97.8	100.0	99.5	88.3[2]	
10-m Sigma-Theta (σ_θ)	97.8	100.0	99.5	88.3[2]	
10-m Vertical Wind Speed	49.9	99.3	97.9	68.2[2]	
10-m Vertical Sigma-w (σ_w)	49.9	99.3	97.9	68.2[2]	
10-m Temperature	99.6	100.0	99.5	99.9	
2-m Temperature	99.6	100.0	99.5	99.9	
10-2m Temperature Lapse	99.6	100.0	99.5	99.9	
Total Solar Radiation	99.6	100.0	99.5	100.0	
Air Quality					
NO_2	97.4	97.7	95.2	97.2	80
SO_2	97.4	97.7	95.3	97.2	
O_3	97.1	97.7	94.7	97.1	
CO	N/A[1]	N/A[1]	94.9	97.2	
$PM_{2.5}$ (BAM)	N/A[1]	N/A[1]	87.6	93.9	
PM_{10} (TEOM)	30.0	97.8	98.4	98.9	

NA[1] The CO and $PM_{2.5}$ (BAM) instruments were added to the station July 2009. Therefore, data collection for both instruments didn't begin until the third quarter.

[2] Sensors frozen for extended periods of time.

All data losses were thoroughly detailed in Section 2.2. In summary the following events resulted in data capture rates below QAPP goals:

- First quarter vertical wind speed and sigma-w data losses were a result of the sensor being frozen or severely damped by a build-up of fine particulate on the sensor bearings. Note that the collection of vertical wind speed and sigma-w data are considered optional.
- First quarter PM_{10} data loses were due to a leak check device that was left installed during the 4th Quarter 2008 calibration.
- Fourth quarter vertical wind speed and sigma-w data losses were a result of the sensor being frozen. Note that the collection of vertical wind speed and sigma-w data is considered optional.

2.4 Precision Statistics

2.4.1 Monitoring Network Precision Statistics

Quarterly NO_2, NO, SO_2, O_3, and CO precision check statistics shown in **Tables 2-4** through **2-7** indicate all air quality systems were reporting measurements to within QAPP established tolerances. Precision statistics have been calculated for NO_2, NO, SO_2, O_3, and CO instruments based on USEPA methods, which are summarized in **Appendix A**, Section A.2. Individual results from each precision check conducted are listed in **Appendix B**, **Tables B 1** through **B 4**.

The remarks sections in **Tables 2-4** through **2-7** detail when scheduled precision checks were missed or invalid and if this resulted in precision checks being performed less frequently than required. Precision checks are scheduled to occur more frequently than required to account for this possibility.

Table 2-4 Precision and Bias Statistics Summary January through March 2009

	Analyzer					
Precision and Bias Estimates	**NO**	**NO_2**	**SO_2**	**O_3**	**CO**	**Goal[1]**
Number of Precision Checks (N)	29	21	29	29	N/A[3]	6
Coefficient of Variation (CV)	1.3	2.3	1.9	1.3	N/A[3]	±10 / ±7[2]
Bias (BA)	5.9	-2.0	5.8	6.0	N/A[3]	±10 / ±7[2]

[1] Precision goal is based on the number of precision checks possible per quarter in accordance with *40 CFR* 58 App. A Section 3.2.1.

[2] The project goal for O_3 is ±7 for CV and BA and ±10 for CV and BA for all other analyzers. CV and BA are evaluated on an annual basis for comparison to project goals; therefore, measurement system results represent a status update and are not used to assess data validity at this point.

[3] *The CO analyzer was not added to the station until July 2009.*

Remarks:

At least one valid precision check was conducted every 2 weeks for all gaseous pollutant measurement systems in accordance with *40 CFR 58 App. A Section 3.2.1*.

Six valid precision checks are required per quarter by the QAPP; 29 were performed and most were valid.

Table 2-5 Precision and Bias Statistics Summary April through May 2009

	Analyzer					
Precision and Bias Estimates	**NO**	**NO_2**	**SO_2**	**O_3**	**CO**	**Goal[1]**
Number of Precision Checks (N)	33	30	33	12	N/A[3]	6
Coefficient of Variation (CV)	1.9	4.7	1.2	3.2	N/A[3]	±10 / ±7[2]
Bias (BA)	5.2	-7.2	7.3	6.5	N/A[3]	±10 / ±7[2]

[1] Precision goal is based on the number of precision checks possible per quarter in accordance with *40 CFR* 58 App. A Section 3.2.1.

[2] The project goal for O_3 is ±7 for CV and BA and ±10 for CV and BA for all other analyzers. CV and BA are evaluated on an annual basis for comparison to project goals; therefore, measurement system results represent a status update and are not used to assess data validity at this point.

[3] *The CO analyzer was not added to the station until July 2009.*

Remarks:

At least one valid precision check was conducted every 2 weeks for all gaseous pollutant measurement systems in accordance with *40 CFR 58 App. A Section 3.2.1*.

Six valid precision checks are required per quarter by the QAPP; 33 were performed and most were valid.

Table 2-6 Precision and Bias Statistics Summary July through September 2009

Precision and Bias Estimates	Analyzer					Goal[1]
	NO	NO_2	SO_2	O_3	CO	
Number of Precision Checks (N)	35	33	35	30	30	6
Coefficient of Variation (CV)	4.7	7.5	7.6	1.5	2.1	±10 / ±7[2]
Bias (BA)	-6.9	-7.5	-7.7	±1.2[3]	-3.8	±10 / ±7[2]

[1] Precision goal is based on the number of precision checks possible per quarter in accordance with *40 CFR* 58 App. A Section 3.2.1.

[2] The project goal for O_3 is ±7 for CV and BA and ±10 for CV and BA for all other analyzers. CV and BA are evaluated on an annual basis for comparison to project goals; therefore, measurement system results represent a status update and are not used to assess data validity at this point.

[3] The +/- symbol indicates that per the methodology provided in *40 CFR* 58 App. A Section 4.1.3.1 that a sign could not be assigned to the bias estimate.

Remarks:

At least one valid precision check was conducted every 2 weeks for all gaseous pollutant measurement systems in accordance with *40 CFR 58 App. A Section 3.2.1*.

Six valid precision checks are required per quarter by the QAPP; 35 were performed and most were valid.

Table 2-7 Precision and Bias Statistics Summary July through September 2009

Precision and Bias Estimates	Analyzer					Goal[1]
	NO	NO_2	SO_2	O_3	CO	
Number of Precision Checks (N)	33	33	33	33	33	6
Coefficient of Variation (CV)	1.7	3.1	2.2	1.5	1.7	±10 / ±7[2]
Bias (BA)	-1.9	± 2.7[3]	-2.5	3.1	-2.8	±10 / ±7[2]

[1] Precision goal is based on the number of precision checks possible per quarter in accordance with *40 CFR* 58 App. A Section 3.2.1.

[2] The project goal for O_3 is ±7 for CV and BA and ±10 for CV and BA for all other analyzers. CV and BA are evaluated on an annual basis for comparison to project goals; therefore, measurement system results represent a status update and are not used to assess data validity at this point.

[3] The +/- symbol indicates that per the methodology provided in *40 CFR* 58 App. A Section 4.1.3.1 that a sign could not be assigned to the bias estimate.

Remarks:

At least one valid precision check was conducted every 2 weeks for all gaseous pollutant measurement systems in accordance with *40 CFR 58 App. A Section 3.2.1*.

Six valid precision checks are required per quarter by the QAPP; 33 were performed and most were valid.

2.5 Accuracy Statistics

Meteorological and ambient air quality measurement systems are subjected to periodic calibrations/QC checks and independent QA performance audits to document measurement system accuracy. All calibration/QC check and audit equipment is traceable to authoritative standards. The purpose of calibration/QC and audit checks is to challenge measurement systems with known inputs, verifying the response of each system is accurate to within USEPA established tolerances listed in the QAPP. A complete copy of all calibration/QC check data, independent QA performance audits, and technical systems audits is included in **Appendix C** and are summarized below.

2.5.1 Instrument Calibration Statistics

A description of quarterly calibration/QC checks is presented below by quarter. These quarterly calibration/QC check descriptions are summarized in **Tables 2-8** through **2-11** for each measurement parameter during the monitoring year. Summarized results characterize an as left instrument state. If as found results were significantly different or failed QA criteria, they are discussed below and as part of the summary table.

2.5.1.1 First Quarter 2009

The first quarter calibration was conducted by AECOM on March 2, 2009. Results of these QA activities are in **Table 2-8** which shows that all calibrated systems were reporting measurements to within acceptable limits. The TEOM leak check was found outside of AECOM-specific criteria. However, because it was within the manufacture specifications, data validity was not impacted by this finding.

Table 2-8 First Quarter 2009 Calibration Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Calibration March 2, 2009					
SO_2	Span	0.015 ppm	0.002 ppm	Pass	The calibration confirmed the air quality analyzers were reporting within acceptable limits
	Zero	0.075 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_X	Span	0.015 ppm	0.002 ppm	Pass	
	Zero	0.075 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO	Span	0.015 ppm	0.000 ppm	Pass	
	Zero	0.075 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_2	Converter Eff.	≥ 96%	101%	Pass	
O_3	Span	0.015 ppm	0.001	Pass	
	Zero	0.075 ppm	0.000	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
CO	Span	N/A	N/A	N/A	
	Zero	N/A	N/A	N/A	
	Linearity Check	N/A	N/A	N/A	
PM_{10}	Flow Compared to Nominal	16.67 lpm	16.91 lpm	Pass	
	Temperature	±1°C	-0.04 °C	Pass	
	Pressure	±1.5%	1.4%	Pass	
$PM_{2.5}$	Flow Compared to Nominal	16.17 lps	N/A	N/A	
	Temperature	±2°C	N/A	N/A	
	Pressure	±10%	N/A	N/A	

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Meteorological Calibration March 3, 2009					
10-m Horizontal Wind Speed	Accuracy	≤ ±5%	0.0%	Pass	The calibration confirmed the meteorological measurement systems were reporting measurements to within acceptable limits.
	Starting Torque	≤ 1 grams per centimeter (g-cm)	0.3 g-cm	Pass	
10-m Horizontal Wind Direction	Accuracy	≤ ±5 deg.	0.25 deg	Pass	
	Linearity	≤ ±3 deg.	0.0 deg.	Pass	
	Starting Torque	≤ 11.0 g-cm	9.0 g-cm	Pass	
10-m Vertical Wind Speed	Accuracy	≤ ±2.5 m/s	0.005 m/s	Pass	
	Starting Torque	≤ 1 g-cm	0.2 g-cm	Pass	
10-m Temperature	Accuracy	≤ ±0.5 °C	-0.08°C	Pass	
2-m Temperature	Accuracy	≤ ±0.5 °C	-0.04°C	Pass	
10-2m Temperature Lapse	Accuracy	≤ ±0.1 °C	-0.04°C	Pass	
Total Solar Radiation	Accuracy	≤ ±25 W/m^2	-7.6 W/m^2	Pass	

2.5.1.2 Second Quarter 2009

The semiannual calibration of the meteorological measurement systems were not scheduled during this quarter. The second quarter calibration of the air quality measurement system did not occur within the calendar quarter. The calibration was scheduled for late June which would have been consistent with the QAPP but had to be rescheduled to July due to lack of available lodging accommodations. This calibration trip included a general station refurbishment, and the installation of several new instruments. The rescheduled calibration occurred in July 2009 immediately following the refurbishment. Results of these QA activities are summarized in **Table 2-9** which shows all instruments passed the calibration and audit.

Table 2-9 Second Quarter 2009 Calibration Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Calibration July 14, 2009					
SO_2	Span	0.015 ppm	0.001 ppm	Pass	The calibration confirmed the air quality analyzers were reporting within acceptable limits
	Zero	0.075 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_X	Span	0.015 ppm	-0.005 ppm	Pass	
	Zero	0.075 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO	Span	0.015 ppm	-0.005 ppm	Pass	
	Zero	0.075 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_2	Converter Eff.	≥ 96%	101%	Pass	
O_3	Span	0.015 ppm	0.000 ppm	Pass	
	Zero	0.075 ppm	0.001 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
CO	Span	N/A	N/A	N/A	
	Zero	N/A	N/A	N/A	
	Linearity Check	N/A	N/A	N/A	
PM_{10}	Flow Compared to Nominal	16.67 lpm	16.46 lpm	Pass	
	Temperature	±1°C	-0.3°C	Pass	
	Pressure	±1.5%	0.9%	Pass	
$PM_{2.5}$	Flow Compared to Nominal	16.17 lpm	N/A	N/A	
	Temperature	±2°C	N/A	N/A	
	Pressure	±10%	N/A	N/A	

2.5.1.3 Third Quarter 2009

The third quarter air quality measurement systems calibration was conducted by AECOM on September 29 and 30, 2009. Results of these QA activities are summarized in **Table 2-10**, which shows that all calibrated systems except CO were reporting measurements to within acceptable limits. During an as-found calibration of the CO analyzer, a one-point QC check was out of tolerance. As a result, an adjustment was performed. This did not affect data validity and an as-left calibration confirmed the analyzer was reporting measurements to within acceptable limits The TEOM leak check was found to be outside of AECOM-specified criteria. However, because it was within the manufacturer specifications, data validity was not impacted by this finding. During this calibration, the O_3 transfer standard, which had been installed during the station refurbishment, was replaced with an O_3 Primary Standard.

Table 2-10 Third Quarter 2009 Calibration Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Calibration September 30, 2009					
SO_2	Span	0.015 ppm	0.003 ppm	Pass	The calibration confirmed the air quality analyzers were reporting within acceptable limits
	Zero	0.075 ppm	-0.001 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_X	Span	0.015 ppm	-0.009 ppm	Pass	
	Zero	0.075 ppm	0.001 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO	Span	0.015 ppm	-0.007ppm	Pass	
	Zero	0.075 ppm	0.001ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_2	Converter Eff.	≥ 96%	101%	Pass	
O_3	Span	0.015 ppm	0.002ppm	Pass	
	Zero	0.075 ppm	0.000ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
CO	Span	1.5 ppm	-0.030 ppm	Pass	
	Zero	7.5 ppm	0.020 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
PM_{10}	Flow vs. Nominal	16.67 lpm	16.94lpm	Pass	
	Temperature	±1°C	-0.22°C	Pass	
	Pressure	±1.5%	1.2%	Pass	
$PM_{2.5}$	Flow vs Nominal	16.17 lpm	16.69lpm	Pass	
	Temperature	±2°C	-0.02°C	Pass	
	Pressure	±10%	0.0%	Pass	

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Meteorological Calibration September 29, 2009					
10-m Horizontal Wind Speed	Accuracy	≤ ±5%	0.0%	Pass	The calibration confirmed the meteorological measurement systems were reporting measurements to within acceptable limits
	Starting Torque	≤ 1 grams per centimeter (g-cm)	0.3 g-cm	Pass	
10-m Horizontal Wind Direction	Accuracy	≤ ±5 deg.	-1.8 deg/	Pass	
	Linearity	≤ ±3 deg.	0.0 deg	Pass	
	Starting Torque	≤ 11.0 g-cm	6.0 g-cm	Pass	
10-m Vertical Wind Speed	Accuracy	≤ ±2.5 m/s	0.08 m/s	Pass	
	Starting Torque	≤ 1 g-cm	0.2 g-cm	Pass	
10-m Temperature	Accuracy	≤ ±0.5 °C	-0.01 °C	Pass	
2-m Temperature	Accuracy	≤ ±0.5 °C	-0.01 °C	Pass	
10-2m Temperature Lapse	Accuracy	≤ ±0.1 °C	0.01 °C	Pass	
Total Solar Radiation	Accuracy	≤ ±25 W/m^2	5.6 W/m^2	Pass	

2.5.1.4 Fourth Quarter 2009

The fourth quarter air quality measurement systems calibration was conducted by AECOM November 19 through November 20, 2009. Results of the fourth quarter calibration activity are summarized in **Table 2-11** which shows that all calibrated systems were reporting measurements to within acceptable limits.

Table 2-11 Fourth Quarter 2009 Calibration Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Calibration November 19, 2009					
SO_2	Span	0.015 ppm	0.002 ppm	Pass	The calibration confirmed the air quality analyzers were reporting within acceptable limits
	Zero	0.075 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_X	Span	0.015 ppm	0.000 ppm	Pass	
	Zero	0.075 ppm	-0.001 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO	Span	0.015 ppm	-0.00 ppm	Pass	
	Zero	0.075 ppm	0.00 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_2	Converter Eff.	≥ 96%	101%	Pass	
O_3	Span	0.015 ppm	0.005 ppm	Pass	
	Zero	0.075 ppm	-0.002 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
CO	Span	1.5 ppm	-0.010 ppm	Pass	
	Zero	7.5 ppm	0.033 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
PM_{10}	Flow vs Nominal	16.67 lpm	17.00 lpm	Pass	
	Temperature	±1°C	0.40°C	Pass	
	Pressure	±1.5%	1.1%	Pass	
$PM_{2.5}$	Flow vs Nominal	16.17 lpm	16.60lpm	Pass	
	Temperature	±2°C	-0.5 °C	Pass	
	Pressure	±10%	-0.1%	Pass	

2.5.2 Deviations from the QAPP

The second quarter calibration was conducted two weeks after the end of the second calendar quarter.

2.5.3 Independent Quality Assurance Audits

A written description of quarterly independent QA performance audits and the technical systems audit is presented below. Quarterly performance audit results are also summarized in **Tables 2-12** through **Table 2-15** for each measurement parameter.

2.5.3.1 First Quarter 2009

The first quarter performance audit of the air quality measurement systems was conducted by AMSTech March 3, 2009. Results of this QA activity are summarized in **Table 2-12** which shows that all audited systems were reporting measurements to within acceptable limits. Conducting a meteorological performance audit is only required semiannually and was conducted during the second and fourth quarters of 2009.

2.5.3.2 Second Quarter 2009

The second quarter independent audit of the air quality measurement system and air quality and meteorological measurement systems did not occur within the calendar quarter. The audit was scheduled for late June which would have been consistent with the QAPP, but had to be rescheduled to July due to lack of available lodging accommodations. The rescheduled audit occurred on July 20, 2009, and results of this audit are detailed in **Table 2-13**. All audited systems were reporting measurements to within acceptable limits.

2.5.3.3 Third Quarter 2009

The third quarter performance audit of the air quality and meteorological measurement systems was conducted by AMSTech on September 24, 2009. Results of this QA activity are summarized in **Table 2-14** which shows that all audited systems were reporting measurements to within acceptable limits.

2.5.3.4 Fourth Quarter 2009

The fourth quarter performance audit of the air quality and meteorological measurement systems was conducted by AMSTech on November 20th and 21st. Results of this QA activity are summarized in **Table 2-15** which shows that all audited systems were reporting measurements to within acceptable limits.

2.5.3.5 Technical Systems Audit

The annual Technical Systems Audit (TSA) of data handling, validation, processing, reporting procedures, and monitoring station siting and operation at the Nuiqsut Station and at the AECOM Air Resources Laboratory in Fort Collins, Colorado, was conducted during October 2009. TSA results showed the monitoring station has been installed and is operating in accordance with the QAPP and USEPA recommended guidelines. The audit also showed AECOM has the necessary organization, practical field experience, work facilities, and data processing procedures in place to accurately collect and report project ambient air quality and meteorological data.

Table 2-12 First Quarter 2009 Audit Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Audit March 3, 2009					
SO_2	Accuracy	≤15%	2.8%	Pass	The audit confirmed the air quality analyzers were reporting measurements to within acceptable limits.
NO_X	Accuracy	≤15%	1.5%	Pass	
NO	Accuracy	≤15%	1.0%	Pass	
NO_2	Accuracy	≤15%	3.7%	Pass	
O_3	Accuracy	≤15%	1.9%	Pass	
CO	Accuracy	≤15%	N/A	N/A	
PM_{10}	Main flow	≤10%	-6.0%	Pass	
	Aux flow	≤10%	-6.4%	Pass	
	Mass Determination	± 2.5%	1.5%	Pass	
$PM_{2.5}$			N/A	N/A	
			N/A	N/A	

Table 2-13 Second Quarter 2009 Audit Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Audit July 19-20, 2009					
SO_2	Accuracy	≤15%	2.3%	Pass	The audit confirmed the air quality analyzers were reporting measurements to within acceptable limits. .
NO_X	Accuracy	≤15%	2.0%	Pass	
NO	Accuracy	≤15%	2.1%	Pass	
NO_2	Accuracy	≤15%	2.0%	Pass	
O_3	Accuracy	≤15%	1.7%	Pass	
CO	Accuracy	≤15%	N/A	N/A	
PM_{10}	Flow Rate Accuracy	±4%	-0.3%	Pass	
	Inlet Flow Rate Test	±5%	4.0%	Pass	
	Mass Determination	±2.5% mean	1.8%	Pass	
$PM_{2.5}$	Flow Accuracy	±4%	N/A	N/A	
	Inlet Flow Rate Test	±5%	N/A	N/A	

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Meteorological Audit July 19-20, 2009					
10-m Horizontal Wind Speed	Accuracy	≤ ±5%	0.0	Pass	The semiannual audit of the meteorological measurement systems was conducted during this quarter. All measurement systems were reporting to within acceptable limits.
	Starting Torque	≤ 1 grams per centimeter (g-cm)	0.1 g-cm	Pass	
10-m Horizontal Wind Direction	Accuracy	≤ ±5 deg.	0.0	Pass	
	Linearity	≤ ±3 deg.	-0.25 deg	Pass	
	Starting Torque	≤ 11.0 g-cm	4.0 g-cm	Pass	
10-m Vertical Wind Speed	Accuracy	≤ ±2.5 m/s	0.10 m/s	Pass	
	Starting Torque	≤ 1 g-cm	0.3 g-cm	Pass	
10-m Temperature	Accuracy	≤ ±0.5 °C	0.06 °C	Pass	
2-m Temperature	Accuracy	≤ ±0.5 °C	0.04 °C	Pass	
10-2m Temperature Lapse	Accuracy	≤ ±0.1 °C	0.03 °C	Pass	
Total Solar Radiation	Accuracy	≤ ±25 W/m^2	5.6 W/m^2	Pass	

Table 2-14 Third Quarter 2009 Audit Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Audit September 24, 2009					
SO_2	Accuracy	≤15%	4.5%	Pass	The audit confirmed the air quality analyzers were reporting measurements to within acceptable limits.
NO_X	Accuracy	≤15%	4.1%	Pass	
NO	Accuracy	≤15%	3.2%	Pass	
NO_2	Accuracy	≤15%	1.6%	Pass	
O_3	Accuracy	≤15%	5.7%	Pass	
CO	Accuracy	≤15%	5.9%	Pass	
PM_{10}	Flow Rate Accuracy	±4%	-1.3%	Pass	
	Inlet Flow Rate Test	±5%	3.1%	Pass	
	Mass Determination	±2.5% mean	1.4%	Pass	
$PM_{2.5}$	Flow Accuracy	±4%	-2.3%	Pass	
	Inlet Flow Rate Test	±5%	2.6%	Pass	

Table 2-15 Fourth Quarter 2009 Audit Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Audit November 21, 2009					
SO_2	Accuracy	≤15%	6.6%	Pass	The audit confirmed the air quality analyzers were reporting measurements to within acceptable limits.
NO_X	Accuracy	≤15%	7.0%	Pass	
NO	Accuracy	≤15%	7.0%	Pass	
NO_2	Accuracy	≤15%	7.4%	Pass	
O_3	Accuracy	≤15%	2.4%	Pass	
CO	Accuracy	≤15%	6.0%	Pass	
PM_{10}	Flow Rate Accuracy	±4%	-1.0%	Pass	
	Inlet Flow Rate Test	±5%	-0.3%	Pass	
	Mass Determination	±2.5% mean	1.5%	Pass	
$PM_{2.5}$	Flow Accuracy	±4%	-0.6%	Pass	
	Inlet Flow Rate Test	±5%	0.8%	Pass	

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Meteorological Audit November 20, 2009					
10-m Horizontal Wind Speed	Accuracy	≤ ±5%	0.0	Pass	The audit confirmed the meteorological measurement systems were reporting measurements to within acceptable limits. Solar radiation values were too low to effectively measure during that time of year and at that latitude.
	Starting Torque	≤ 1 grams per centimeter (g-cm)	0.1 g-cm	Pass	
10-m Horizontal Wind Direction	Accuracy	≤ ±5 deg.	-1.3 deg	Pass	
	Linearity	≤ ±3 deg.	-0.4 deg	Pass	
	Starting Torque	≤ 11.0 g-cm	4.0 g-cm	Pass	
10-m Vertical Wind Speed	Accuracy	≤ ±2.5 m/s	0.12 m/s	Pass	
	Starting Torque	≤ 1 g-cm	0.1 g-cm	Pass	
10-m Temperature	Accuracy	≤ ±0.5 °C	0.07°C	Pass	
2-m Temperature	Accuracy	≤ ±0.5 °C	0.03 °C	Pass	
10-2m Temperature Lapse	Accuracy	≤ ±0.1 °C	0.07°C	Pass	
Total Solar Radiation	Accuracy	≤ ±25 W/m^2	N/A	Pass	

3.0 Monitoring Data Network Summary

3.1 Air Quality Data Summary

Criteria pollutants monitored as part of the Monitoring Program are NO_2, SO_2, O_3, respirable PM_{10}, CO, and respirable $PM_{2.5}$. Criteria pollutants are those air pollutants for which ADEC and USEPA have established standards that provide a threshold above which risk to public health and welfare becomes an issue. These standards are referred to as the Alaska Ambient Air Quality Standards (AAAQS) and are the same as the national standards for the pollutants measured. Applicable AAAQS, along with ambient concentrations measured at the Nuiqsut Station, are presented in **Tables 3-1** through **3-6** and summarized by pollutant below.

3.1.1 Nitrogen Dioxide

Table 3-1 shows the annual average NO_2 concentration was 0.002 ppm, and less than 4 percent of the annual NO_2 AAAQS of 0.053 ppm. The typical NO_2 concentrations are just above instrument detection level. The annual average measured this year is consistent with the historical Nuiqsut Station average of 0.004 ppm and equal to the annual average measured the previous year.

The distribution of average hourly NO_2 concentration by wind direction this year was typical of past years with the magnitude of the highest values is uniform with historical averages (**Figure 3-1**). This offset in magnitude is consistent with the difference between the historical and current year's annual average of the hourly concentrations. As shown in **Figure 3-1**, historically, the lowest concentrations are measured when winds transport background air to the Nuiqsut Station (west-southwest through east-southeast). Slightly higher concentrations occur for wind directions that place the station downwind of Nuiqsut (southeast through southwest wind directions). In general, measured NO_2 concentrations at Nuiqsut are extremely low.

Monthly average NO_2 concentrations are presented in **Figure 3-2**. For this monitoring year, the trend of monthly averaged measured concentrations showed very little seasonal variation. Historically, it is typical to observe increases in monthly averaged NO_2 concentrations during late winter. The pattern of higher measured concentrations in late winter has been attributed to differences in atmospheric dispersion characteristics between winter and summer, and potential changes in local emissions. Seasonal differences in atmospheric dispersion characteristics arise because in winter, there is an increase in stable and neutral atmospheric conditions. With the sun up in summer, solar radiation and heating of the surface induces more vertical mixing of the lower atmosphere than in winter, thereby increasing air pollution dispersion. In winter, without the benefit of solar energy, the atmosphere remains relatively stable reducing vertical pollution dispersion. In addition, the increased local use of heating systems and idling vehicles in winter contribute to the NO_2 load.

Table 3-1 Measured Nitrogen Dioxide Data Summary, 2009 Annual Data Summary

Monitoring Period	Year	Period Mean (ppm)	Number of Exceedances
1st Quarter	2009	0.003	None
2nd Quarter	2009	0.002	None
3rd Quarter	2009	0.001	None
4th Quarter	2009	0.002	None
Annual	2009	0.002	None

NAAQS/AAAQS: Annual - 0.053 ppm (100 µg/m^3) – Compared to the annual arithmetic mean.

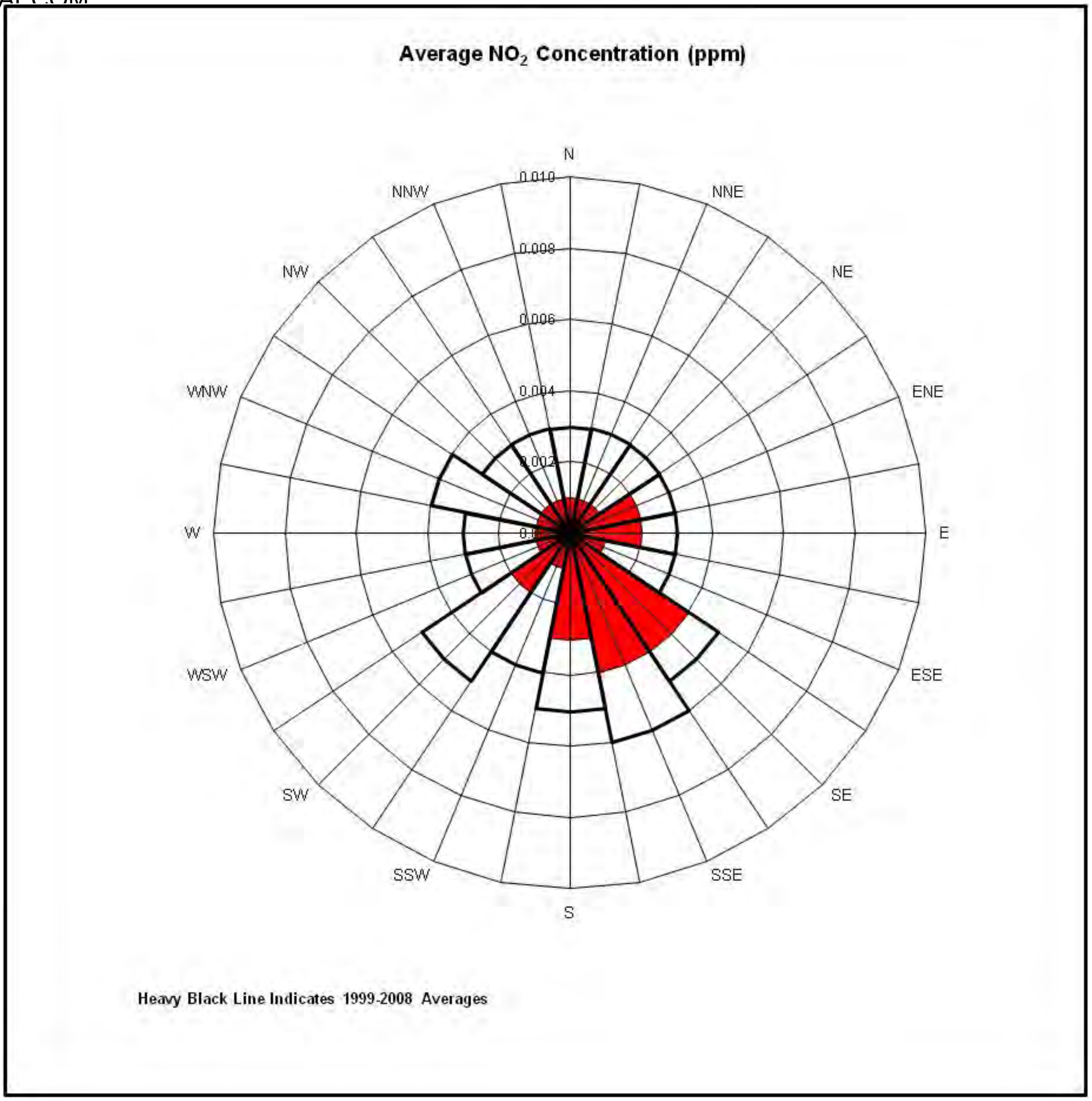


Figure 3-1 Average NO_2 Concentration by Wind Direction, 2009 Annual Data Summary

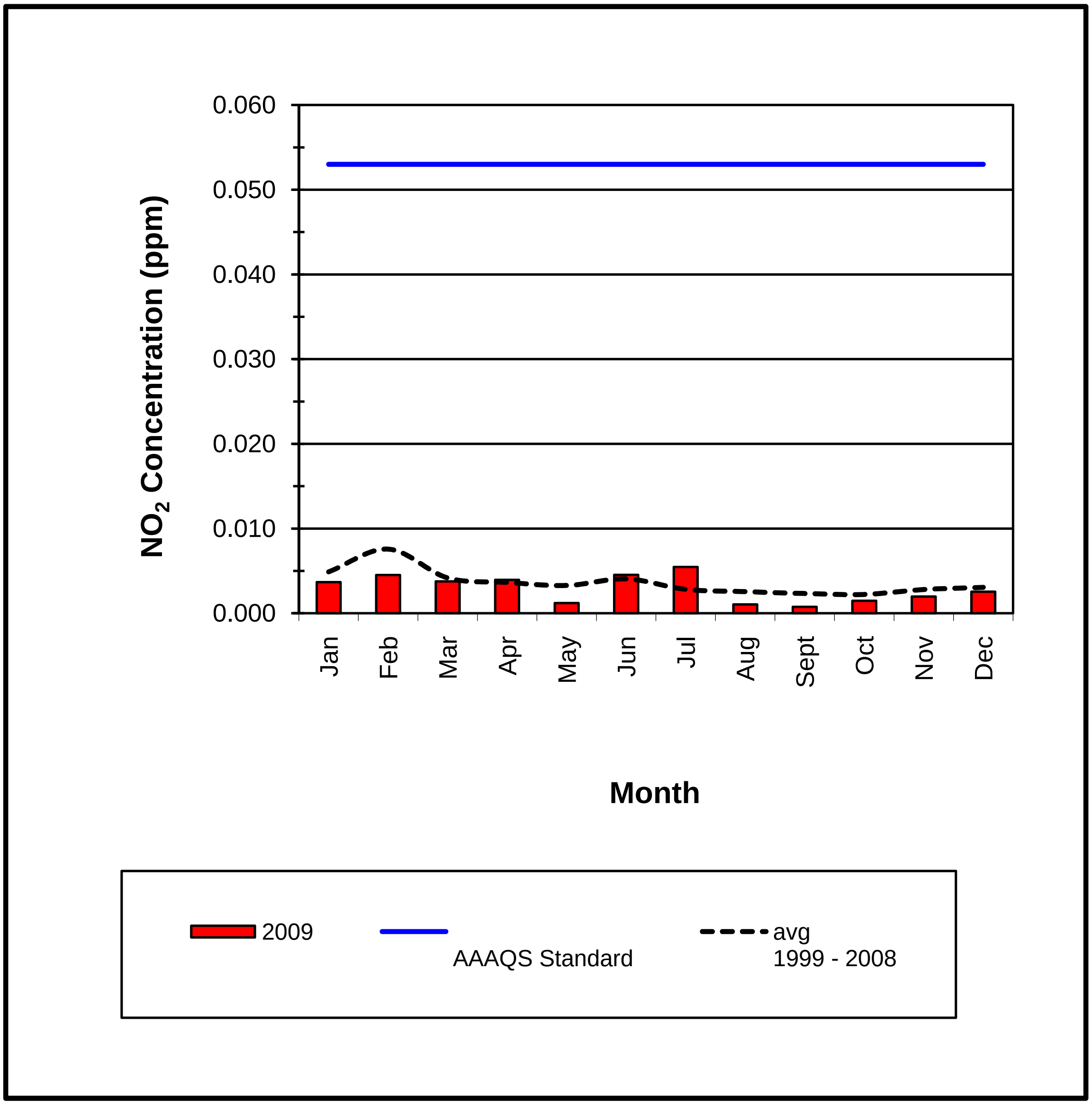


Figure 3-2 Average NO_2 Concentration by Month, 2009 Annual Data Summary

3.1.2 Sulfur Dioxide

Table 3-2 lists measured maximum 3-hour (running), 24-hour (midnight-to-midnight), and the annual average hourly SO_2 concentrations measured this monitoring year. Concentrations for all averaging periods were near or below instrument detection limit and well below applicable Alaska Ambient Air Quality Standards (AAAQS). Measured SO_2 concentrations were typical of historical (1999-2008) values.

Table 3-2 Measured Sulfur Dioxide Data Summary 2009 Annual Data Summary

Monitoring Period	Year	3-hour (ppm)[1]		24-hour (ppm)[2]		Period Mean (ppm)[3]	Number of Exceedances
		1st high	2nd high	1st high	2nd high		
1st Quarter	2009	.002	.002	.001	.001	.000	None
2nd Quarter	2009	.003	.003	.001	.001	.000	None
3rd Quarter	2009	.001	.001	.000	.000	.000	None
4th Quarter	2009	.001	.001	.001	.001	.000	None
Annual	2009	.003	.003	.001	.001	.000	None

NAAQS/AAAQS:

3-hour - 0.5 ppm (1,300 µg/m^3) – Rolling average not to be exceeded more than once per year.

24-hour - 0.14 ppm – Midnight to midnight average not to be exceeded more than once per year.

Annual - 0.03 ppm – Compared to the annual arithmetic mean.

Measured 3-hour average SO_2 concentrations were less than 0.003 ppm throughout the monitoring year. The majority of measured SO_2 concentrations were just above the instrument detection limit making it difficult to discuss significant trends. Simply, there was no single near-field or far-field measurable SO_2 source observed in the data collected this year. Without identifiable sources, measured concentrations are representative of a regional or global background signature. The low average concentrations measured are consistent with an airshed containing relatively few and widely distributed sources. This trend has been typical of SO_2 measurements since monitoring began.

3.1.3 Respirable Particulate Matter (PM_{10})

Throughout the monitoring project history, the majority of elevated measured PM_{10} concentrations appear to result from naturally occurring windblown fugitive dust from exposed or disturbed areas local to the Nuiqsut Station. Exposed areas identified in the program are:

- The exposed bank of the Nechelik Channel north-northeast through east-southeast of the station;
- The exposed gravel mining area southeast of the station;
- Disturbed ground due to residential construction along the utility right-of-way and road southeast through south-southeast of the station; and
- To a lesser degree, disturbed ground associated with dirt roads within Nuiqsut south through west-southwest of the station.

In addition to these local fugitive sources, elevated particulate has also been measured from wild fires. The PM_{10} exceedance on July 14 was associated with windblown dust as observed by the AECOM field technician.

Respirable particulate matter less than 10 micrometer (µm) in diameter (PM_{10}) measured at USEPA standard temperature and pressure, has a 24-hour and annual AAAQS of 150 µg/m^3 and 50 µg/m^3, respectively. As listed in **Table 3-3**, the maximum 24-hour PM_{10} concentration measured during the monitoring year was 225.4 µg/m^3. The yearly average PM_{10} concentration was 9.6 µg/m^3. This is well below the annual AAAQS of 50 µg/m^3, and consistent with the historical Nuiqsut Station average of 7.6 µg/m^3.

Table 3-3 Measured PM_{10} Data Summary, 2009 Annual Data Summary

Monitoring Period	Year	24-hour (µg/m³)[3]		Period Mean (µg/m³)[2]	Number of Exceedances
		1st high	2nd high		
1st Quarter	2009	9.5[1]	9.4[1]	6.4[1]	N/A
2nd Quarter	2009	30.9	24.5	9.0	None
3rd Quarter	2009	225.4	97.6	15.5	None
4th Quarter	2009	38.4	13.9	5.4	None
Annual	2009	225.4	97.6	9.6	None

NAAQS/AAAQS:

24-hour – 150 µg/m3 – Not to be exceeded more than once per year measured from midnight to midnight at USEPA Standard Conditions.

Annual – 50 µg/m3 – Compared to the 3-year average of the weighted annual arithmetic mean concentration measured at USEPA Standard Conditions.

Figure 3-3 shows annual average hourly PM_{10} concentrations by wind direction measured this year compared to the historical trend. Except for concentrations associated with northeasterly through easterly wind directions, concentrations for all wind directions were similar to historical annual averages and approximately half the overall annual average. Directional dependence is related to influence of local fugitive dust sources discussed previously. Anomalously high PM_{10} averages associated with northeasterly through easterly wind directions appear to be related to the dust events previously discussed.

Figure 3-4 compares the monthly average hourly PM_{10} concentrations measured this year to Nuiqsut Station historical monthly average PM_{10} concentrations. Historical trends show the fourth and first calendar quarters (October through March) typically experience the lowest average hourly PM_{10} concentrations reflecting snow covered conditions that suppress fugitive dust. In contrast, the second and third calendar quarters (April through September) record higher average hourly concentrations as fugitive dust sources become exposed and active. Average hourly concentrations reported by month this year generally followed this trend. In July, concentrations from the dust events previously discussed caused anomalously high hourly concentrations as compared to previous years. The variability seen throughout this year and compared to previous years is expected considering PM_{10} concentrations are highly dependent on the interplay of many meteorological characteristics such as wind speed and frequency, precipitation, and temperature.

3.1.4 Ozone

Table 3-4 lists 8-hour and annual average hourly O_3 concentrations measured during the monitoring year. The AAAQS for O_3 is based on the 3-year average of the fourth highest measured daily maximum 8-hour average O_3 concentration. Since the maximum 8-hour average O_3 concentration measured was just over half the AAAQS, it is anticipated that concentrations measured at the Nuiqsut Station will remain well below the AAAQS.

O_3 concentrations measured this year are typical of seasonal averages measured on the Alaskan North Slope (Prudhoe Bay, Kuparuk River Unit, and Barrow). In the absence of large combustion sources, strong frontal passages and high solar radiation, ambient O_3 levels are spatially homogenous and representative of a regional background.

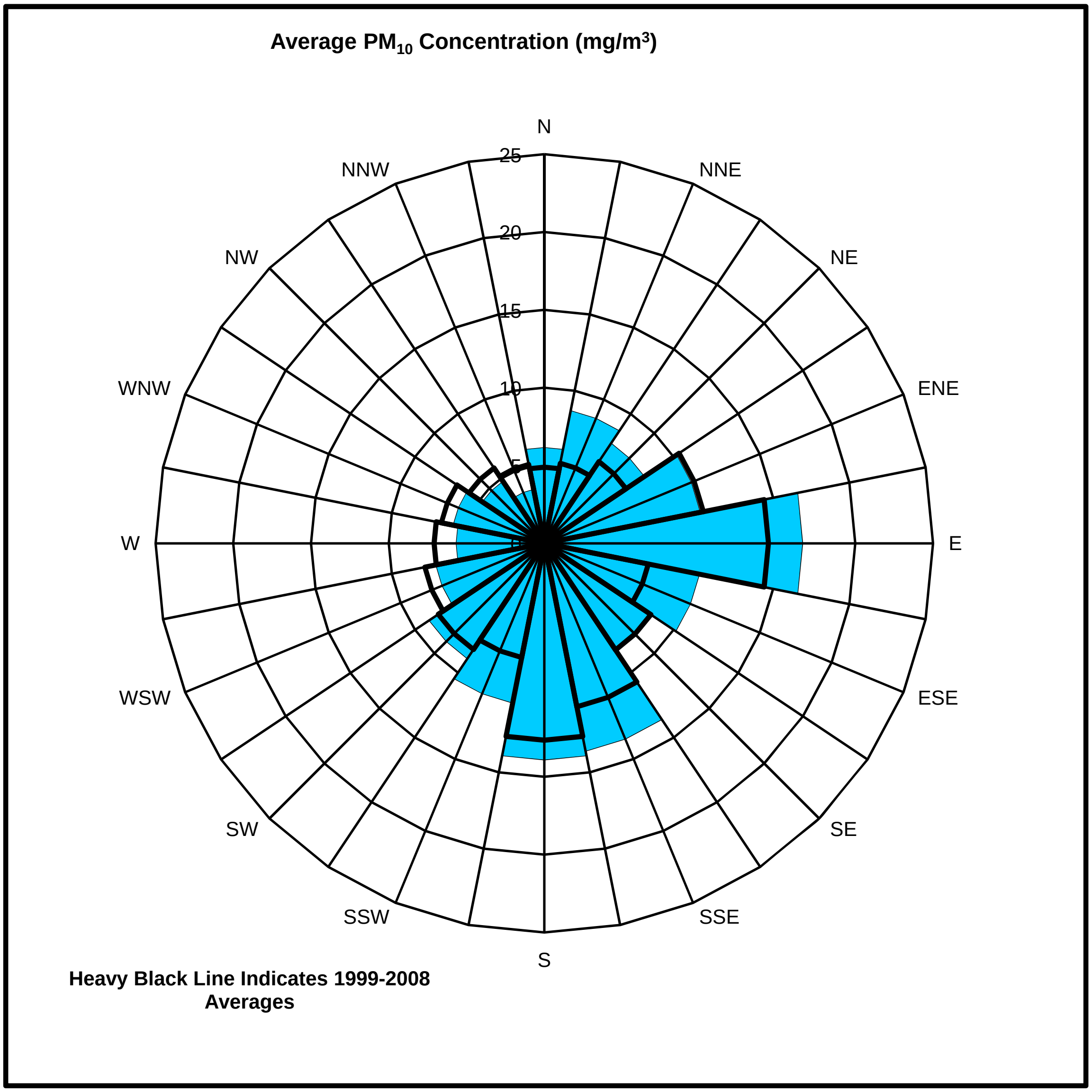
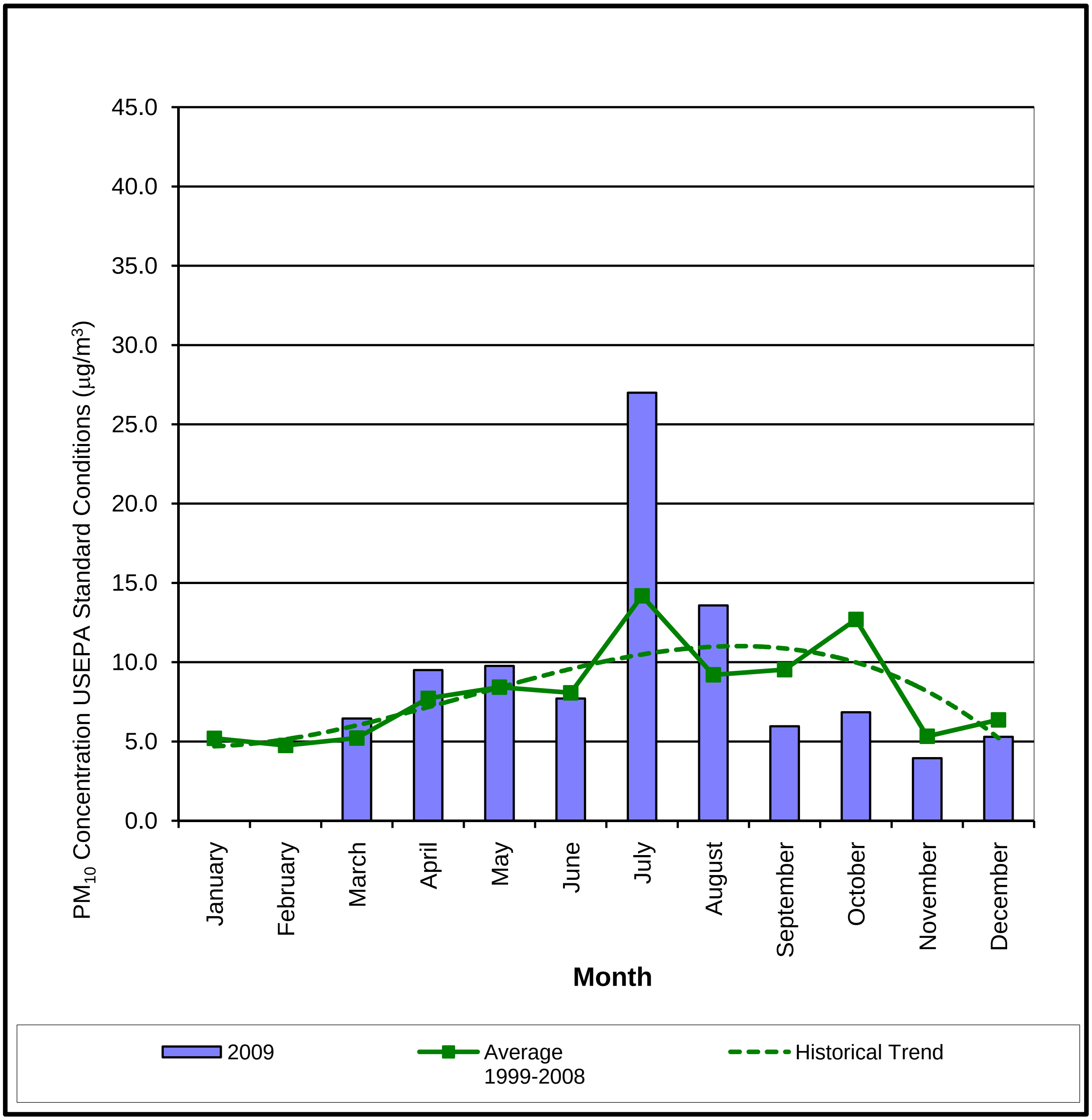


Figure 3-3 Average PM_{10} Concentration by Wind Direction, 2009 Annual Data Summary



Average annual concentration obtained from 153 rural sites in the contiguous United States as summarized in the National Air Quality and Emissions Trends Report, 1999 (USEPA 2001)

Figure 3-4 Average PM_{10} Concentration by Month, 2009 Annual Data Summary

Table 3-4 Measured Ozone Data Summary, 2009 Annual Data Summary

Monitoring Period	Year	8-hour (ppm)[1]			Period Mean (ppm)[2]	Number of Exceedances
		1st high	2nd high	4th high		
1st Quarter	2009	38.8	38.8	38.6	22.7	None
2nd Quarter	2009	42.2	42.1	42.1	18.6	None
3rd Quarter	2009	31.7	31.6	31.6	15.7	None
4th Quarter	2009	37.8	37.8	37.7	27.1	None
Annual	2009	42.2	42.1	42.1	21.0	None

NAAQS/AAAQS:

8-hour - 0.08 ppm – Compared to the 3-year average of the fourth-highest daily maximum rolling 8-hour average concentrations.

3.1.5 CO

Table 3-5 lists measured 1-hour, 8-hour (rolling average), and annual average concentrations of CO from the time the instrument was installed (July 14, 2009) through the end of the year. Concentrations for all averaging periods were near or below instrument detection limit and well below applicable Alaska Ambient Air Quality Standards (AAAQS).

Table 3-5 Measured Carbon Monoxide, 2009 Annual Data Summary

Monitoring Period	Year	1-hour (ppm)[1]		8-hour (ppm)[2]		Period Mean (ppm)[3]	Number of Exceedances
		1st high	2nd high	1st high	2nd high		
1st Quarter	2009	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]
2nd Quarter	2009	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]
3rd Quarter	2009	0.8	0.7	0.7	0.7	0.20	None
4th Quarter	2009	0.3	0.3	0.2	0.2	0.10	None
Annual	2009	0.8	0.7	0.7	0.7	0.15	None

[1] Rolling 1-hour average.

[2] Rolling 8-hour average.

[3] CO data collection started during the 3rd quarter 2009

NAAQS/AAAQS:

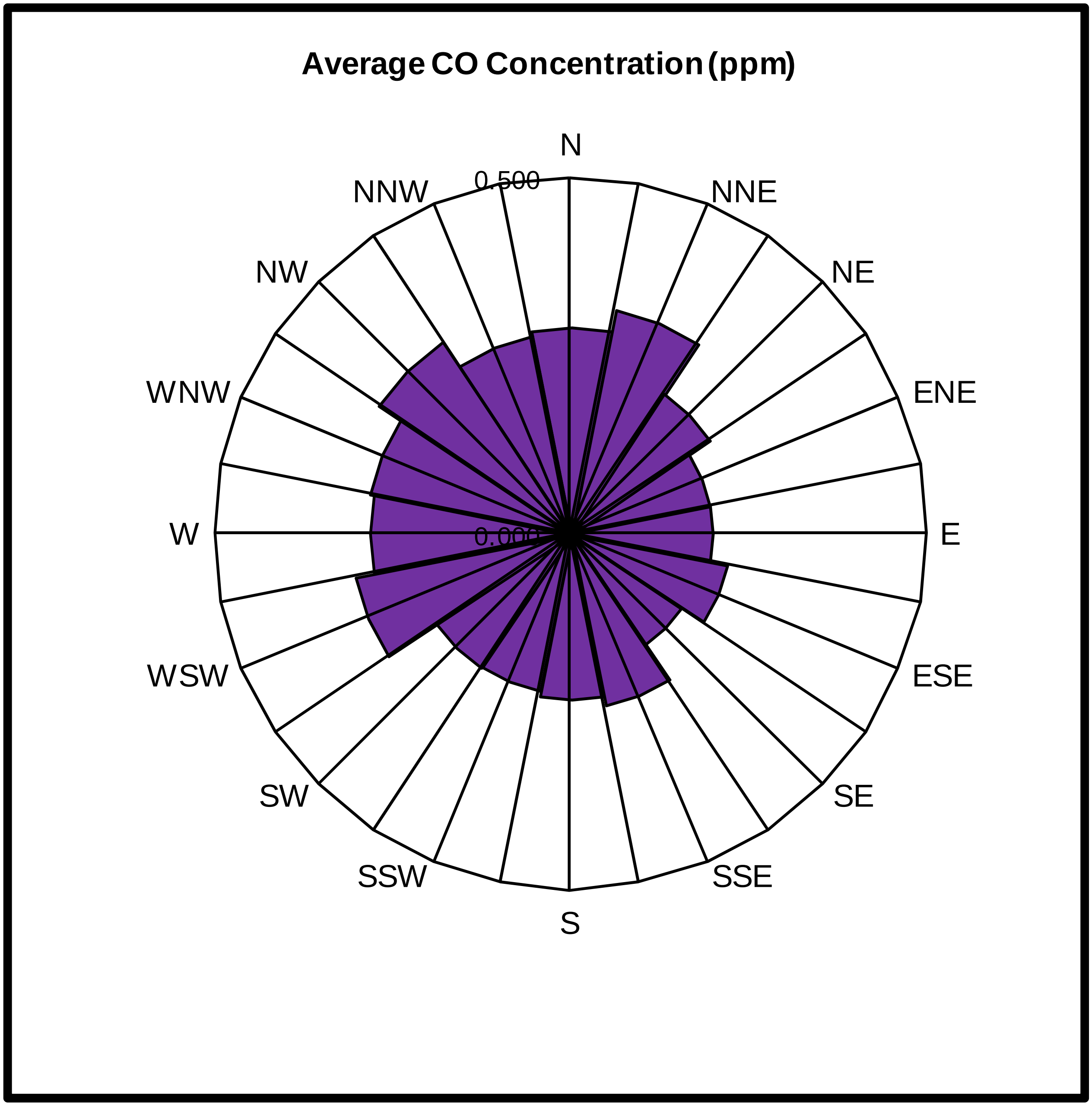
1-hour - 35ppm (40 mg/m^3).

8-hour - 9ppm(10 mg/m^3)– Midnight to midnight average not to be exceeded more than once per year.

Measured period averages for CO concentrations were less than 0.30 ppm throughout the monitoring year. The majority of measured CO concentrations were just above the instrument detection limit making it difficult to discuss significant trends. Simply, there was no single near-field or far-field measurable CO source observed in the data collected this year. Without identifiable sources, measured concentrations are representative of a regional or global background signature. The low average concentrations measured are consistent with an airshed containing relatively few and widely distributed sources.

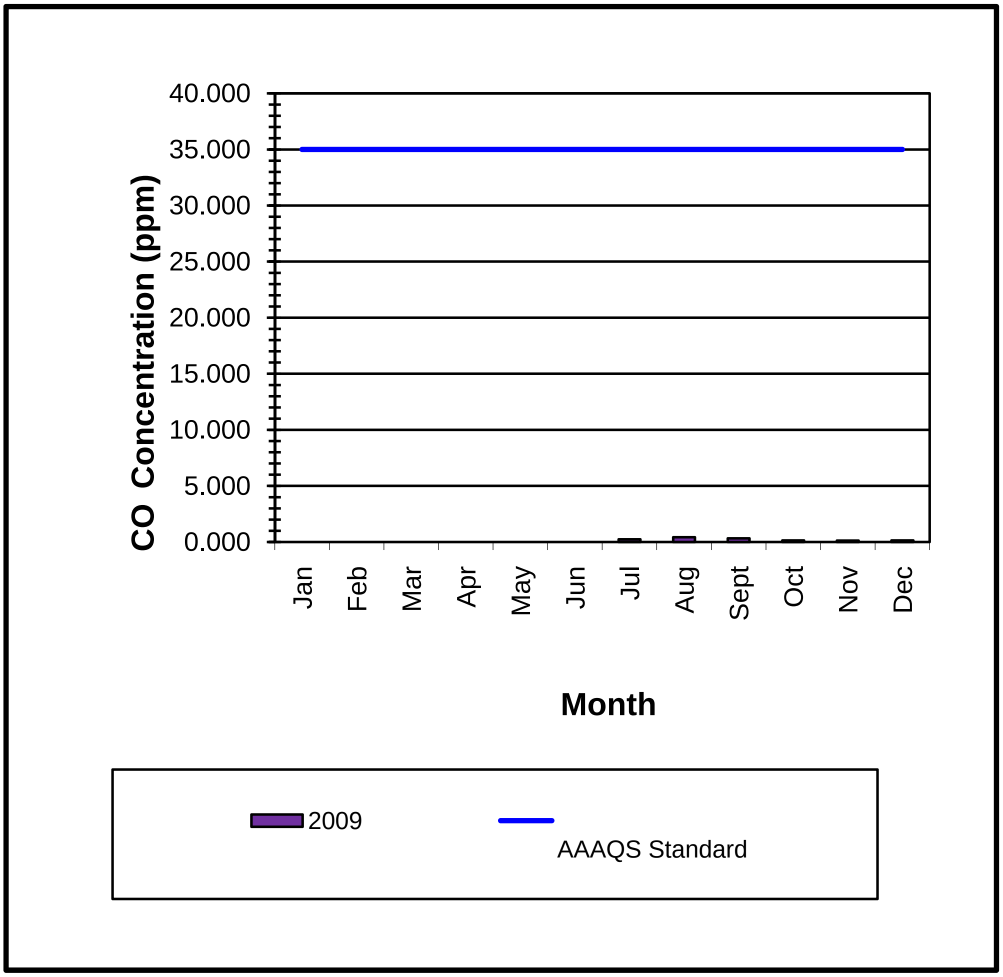
Figure 3-5 shows the average hourly CO concentration by wind direction for the third and fourth quarters.

Figure 3-6 compares the monthly average hourly of CO concentrations measured at the Nuiqsut Station to the AAAQS standard for CO.



[1] Data were only collected during third and fourth quarters

Figure 3-5 Average CO Concentration Wind Direction, 2009 Annual Data



[1] Data were only collected during the third and fourth quarters

Figure 3-6 Average CO Concentration by Summary by Month, 2009 Annual Data Summary

3.1.6 Respirable Particulate Matter ($PM_{2.5}$)

Respirable particulate matter less than 2.5 micrometer (µm) in diameter ($PM_{2.5}$) measured at USEPA standard temperature and pressure, has a 24-hour and annual AAAQS of 35µg/m^3 and 15µg/m^3, respectively. As listed in **Table 3-6**, the maximum 24-hour $PM_{2.5}$ concentration measured from July to the end of the year was 83 µg/m^3. The six month average concentration of $PM_{2.5}$ was 3µg/m^3. This is well below the annual AAAQS of 15µg/m^3 standard.

The $PM_{2.5}$ exceedance was associated with large regional scale forest fires. A persistent weather pattern with high pressure over central and eastern Alaska prevented deep mixing and dispersion of smoke from these large wild fires for several days as shown on **Figure 3-7**, the 850 mb analyses for August 4, 2009, 1200 UTC. This map also shows low pressure off the western shore of AK that resulted in southerly winds in the lower levels of the atmosphere. These southerly winds carried the dense smoke northward and covered much of the North Slope including the Colville River valley and surrounding areas for an extended period of time during the first week of August.

Table 3-6 Measured $PM_{2.5}$ 2009 Annual Data Summary

Monitoring Period	Year	24-hour (µg/m³)[3]		Period Mean (µg/m³)[2]	Number of Exceedances
		1st high	2nd high		
1st Quarter	2009	N/A[1]	N/A[1]	N/A[1]	N/A[1]
2nd Quarter	2009	N/A[1]	N/A[1]	N/A[1]	N/A[1]
3rd Quarter	2009	83	32	4	None
4th Quarter	2009	8	6	2	None
Annual	2009	83	32	3	None

[1]$PM_{2.5}$ data collection started during the 3rd quarter 2009

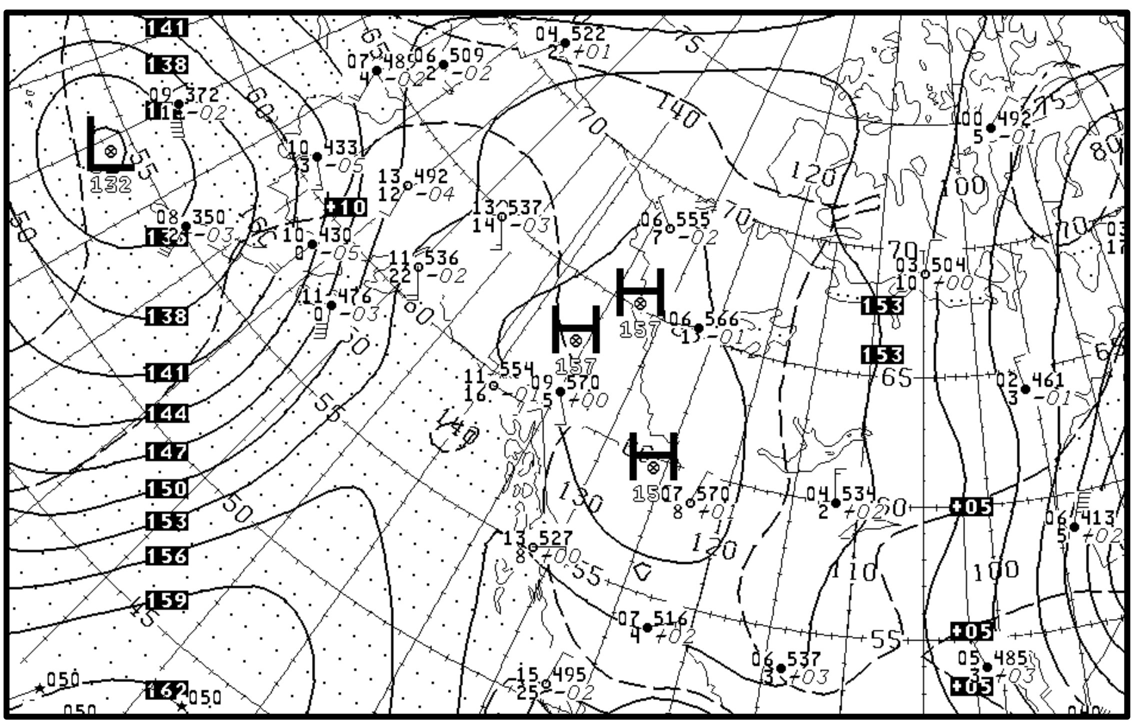
[2]Annual average.

[3]Midnight-to-midnight 24-hour average.

NAAQS/AAAQS:

24-hour – 35 µg/m³ – Not to be exceeded more than once per year measured from midnight to midnight at USEPA Standard Conditions.

Annual – 15 µg/m³ – Compared to the 3-year average of the weighted annual arithmetic mean concentration measured at USEPA Standard Conditions.

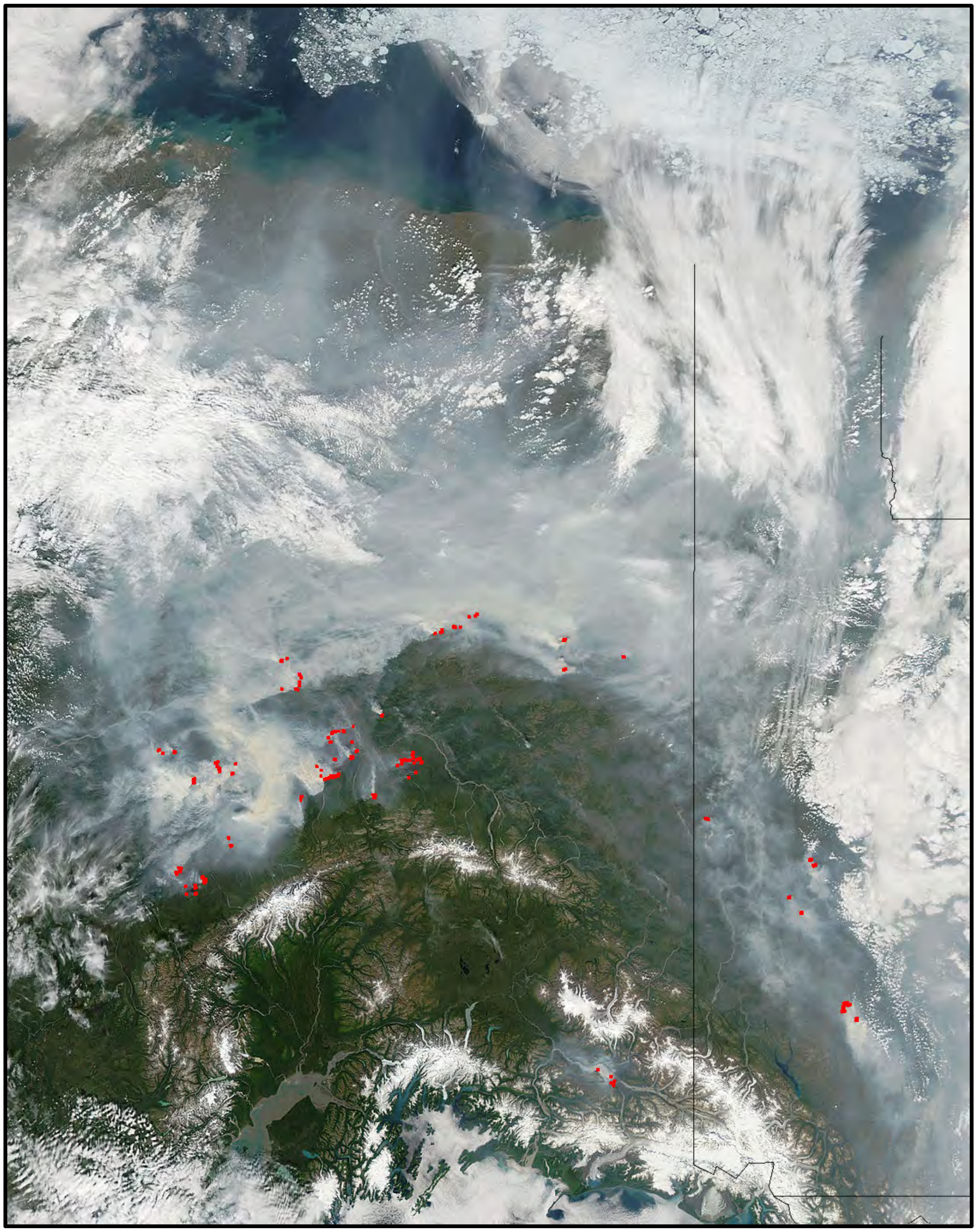


Source: NOAA

Figure 3-7 850 mb analysis for 1200Z August 4, 2009

The forest fire plume was captured in satellite imagery on August 3, 2009 as shown in **Figure 3-8**. The Beaufort Sea and North Slope region in the vicinity of Nuiqsut and Prudhoe Bay area can be easily seen near the top of the picture. The plume was characteristic of an aged combustion source with elevated CO, O_3, and a high $PM_{2.5}/PM_{10}$ ratio. There was no correlated increase in SO_2 or NO_x ruling out a nearby industrial source.

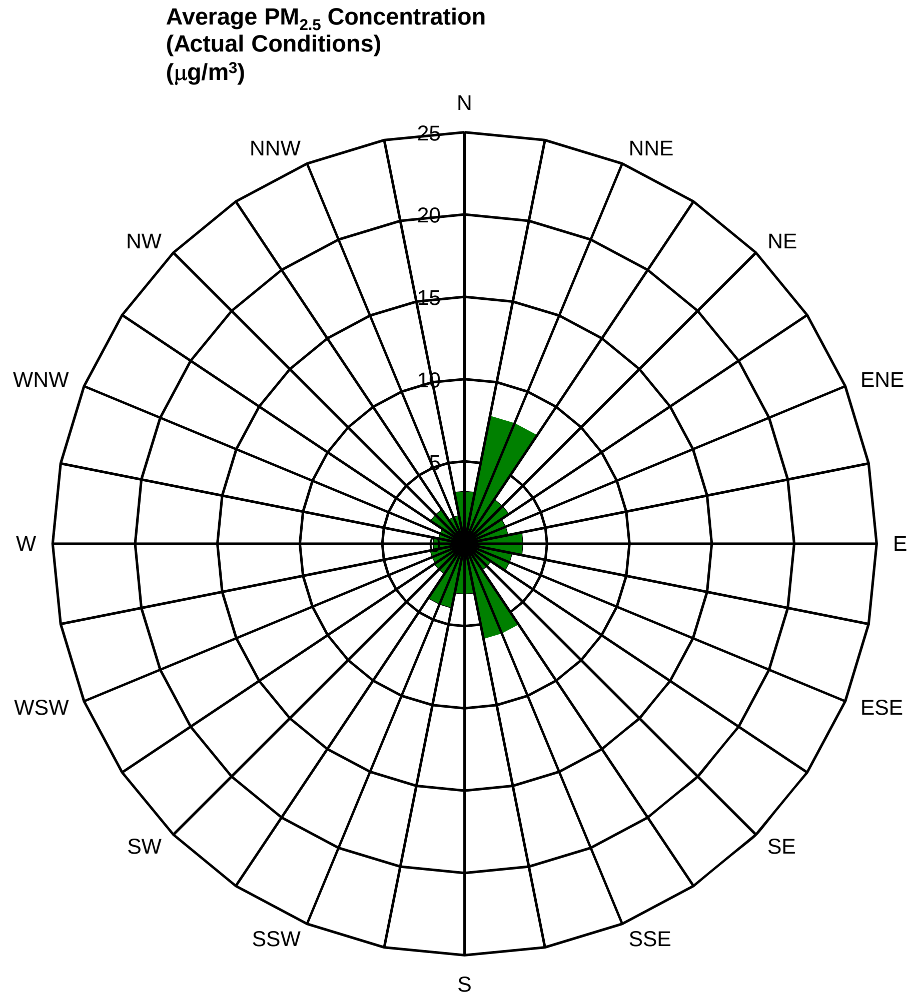
When particulate from local fugitive dust and smoke is not present (i.e., during winter), hourly concentrations decrease to near the PSD de minimus levels.



(Source: http://rapidfire.sci.gsfc.nasa.gov/gallery/?2009215-0803/Alaska.A2009215.2230.1km.jpg)

Figure 3-8 Satellite Imagery August 3, 2009, at 14:30 ADT

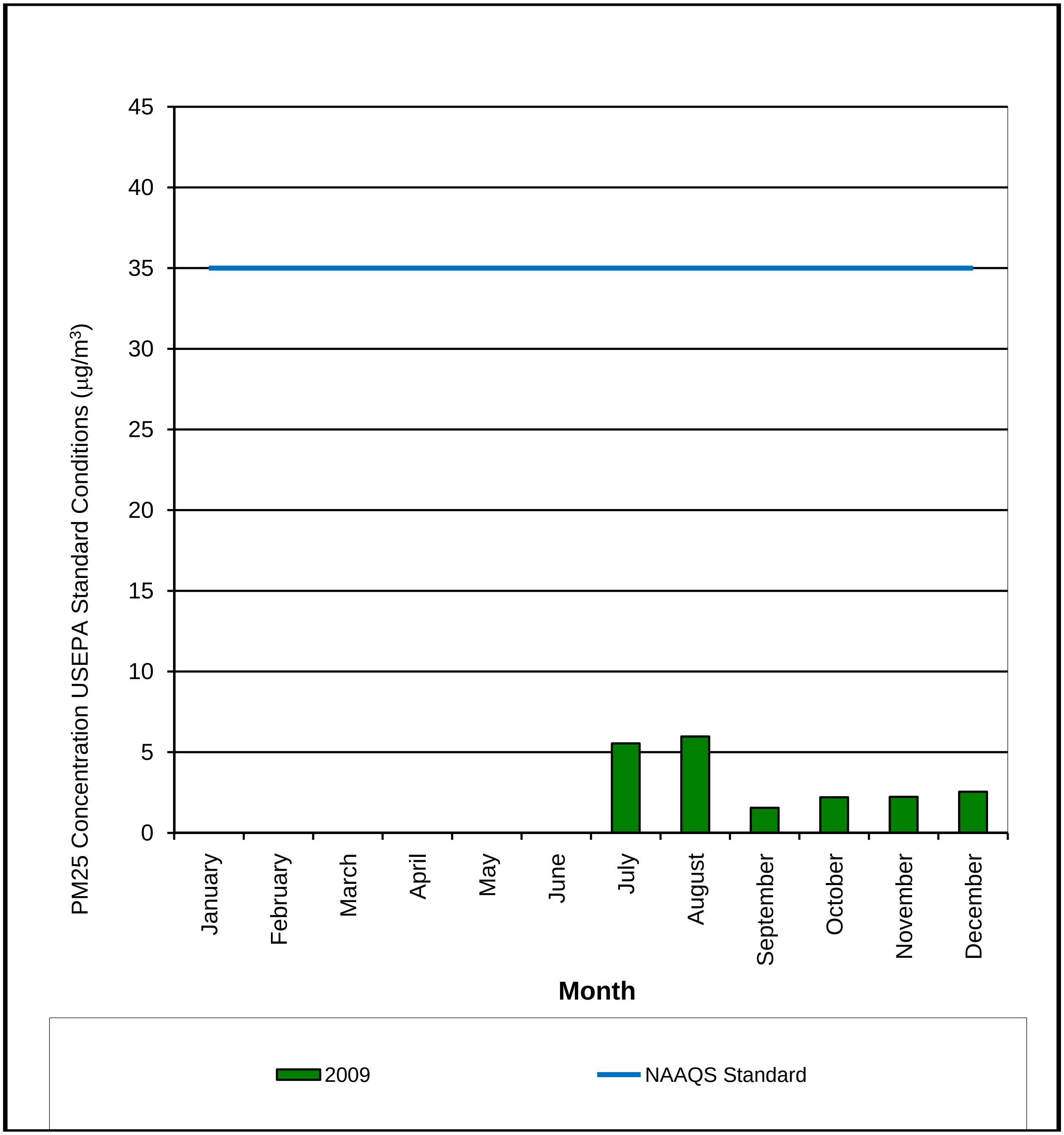
Figure 3-9 shows annual average hourly $PM_{2.5}$ concentrations by wind direction measured this year. Except for concentrations associated with northeasterly through easterly wind directions, concentrations for all wind directions were consistent. Directional dependence is related to influence of local fugitive dust sources discussed previously. Anomalously high averages associated with northeasterly through easterly wind directions appear to be related to the dust events previously discussed. Smoke from remote wild fires also contributed to high $PM_{2.5}$ concentrations during the first week of August.



[1] Data were only collected during the third and fourth quarters.

Figure 3-9 Average $PM_{2.5}$ Concentration by Wind Direction, 2009 Annual Data Summary

Figure 3-10 compares the monthly average hourly $PM_{2.5}$ concentrations measured at the Nuiqsut Station to the AAAQS standard for $PM_{2.5}$.



[1] Data were only collected during the third and fourth quarters.

Figure 3-10 Average $PM_{2.5}$ Concentration by Month, 2009 Annual Data Summary

3.2 Meteorological Data Summary

Temperature, wind speed, and wind direction data collected at the Nuiqsut Station during the monitoring year are summarized in the following subsections. Vertical wind speed and solar radiation data are also collected at the Nuiqsut Station, but are not specifically discussed in this section.

3.2.1 Wind Speed and Direction Climatology

The annual Nuiqsut bivariate wind frequency distribution (wind rose) is presented in **Figure 3-11**. Data presented in this figure is consistent with the established North Slope wind climatology and typical of the Nuiqsut bimodal wind direction distribution demonstrated every year since monitoring began. This figure shows winds during the monitoring year were dominated by northeast through easterly (NE-E) and to a lesser degree south-southwest through westerly (SSW-W). Winds from these 2 sectors occurred nearly 80 percent of the total hours this year and are caused by persistent regional weather patterns. Without respect to direction, the mean 10 m wind speed for the monitoring year was 4.3 m/s and the maximum was 19.6 m/s.

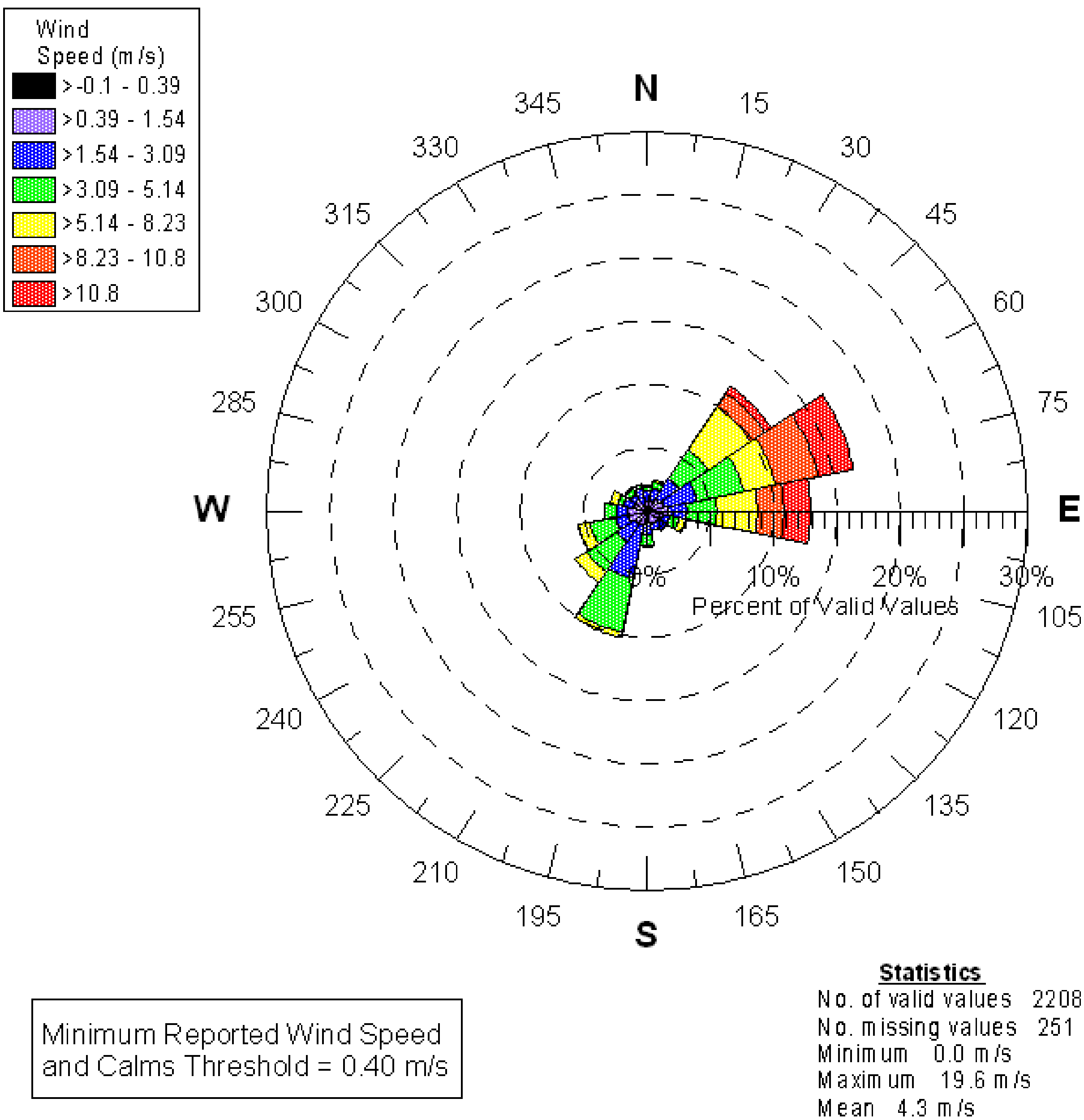


Figure 3-11 2009 Annual Nuiqsut Wind Rose

The persistence of weather patterns season to season can be inferred from **Figures 3-12** through **3-15**, which present wind roses by quarter. Typical of the Nuiqsut Station wind climatology, the quarterly wind roses collected this year indicate there is a general persistence of NE-E all year long. SSW-W winds are present all year long, but only become a significant part of the climatology during the winter months. Mean and maximum wind speeds remain fairly constant over all quarters. The quarterly wind rose depictions are augmented by **Tables 3-7** through **3-10**, which present quarterly wind rose data as a percent of valid hours.

3.2.2 Temperature Climatology

During the monitoring year, the hourly averaged 2-m ambient temperature reached a maximum of 28.6°C (83.5 degrees Fahrenheit [°F]) on July15, 2009 and a minimum of -44.3°C (-47.7°F) on February 9, 2009. **Table 3-11** shows the monthly hourly minimum and the hourly maximum.

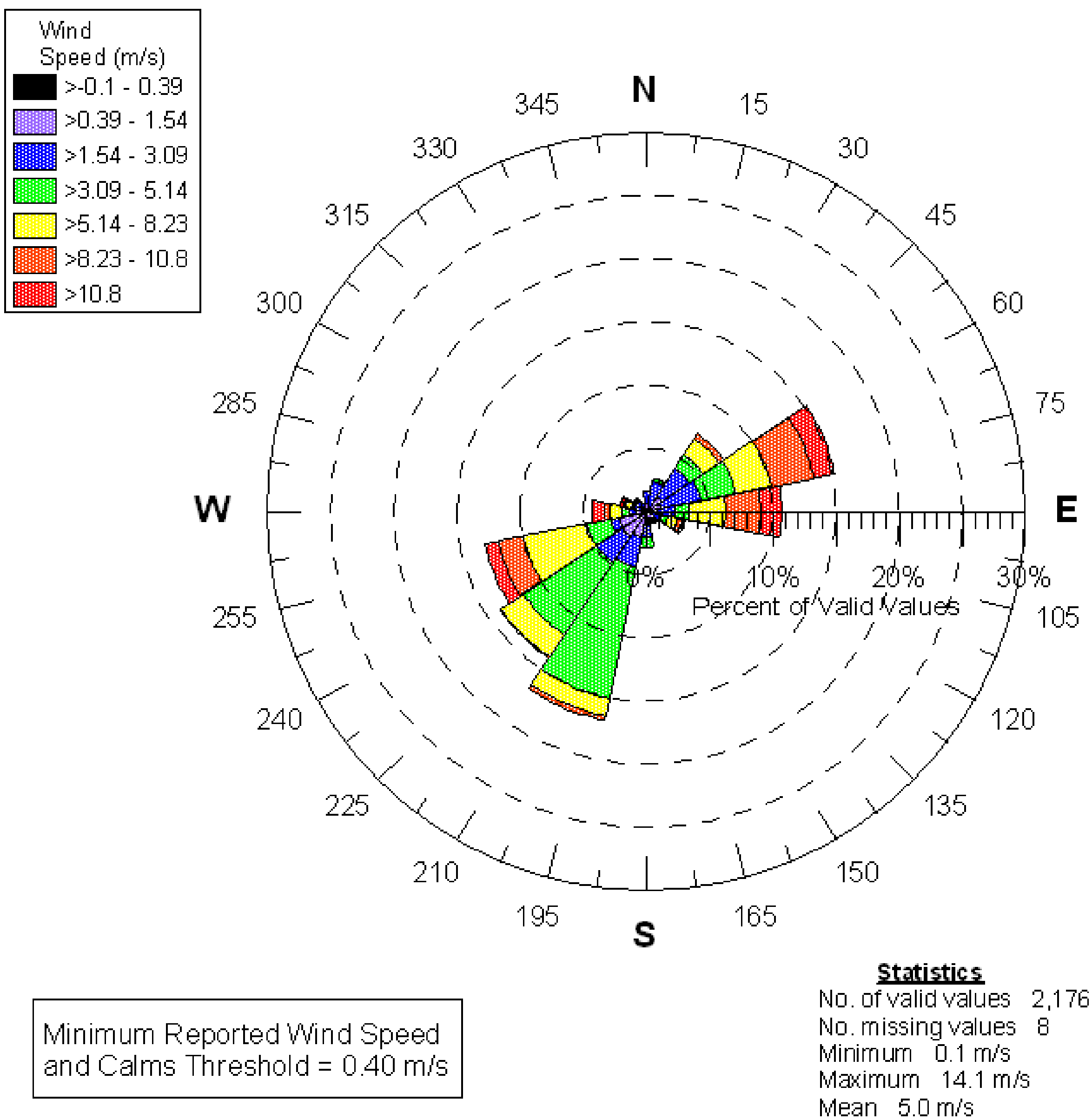


Figure 3-12 First Quarter 2009 Nuiqsut Wind Rose

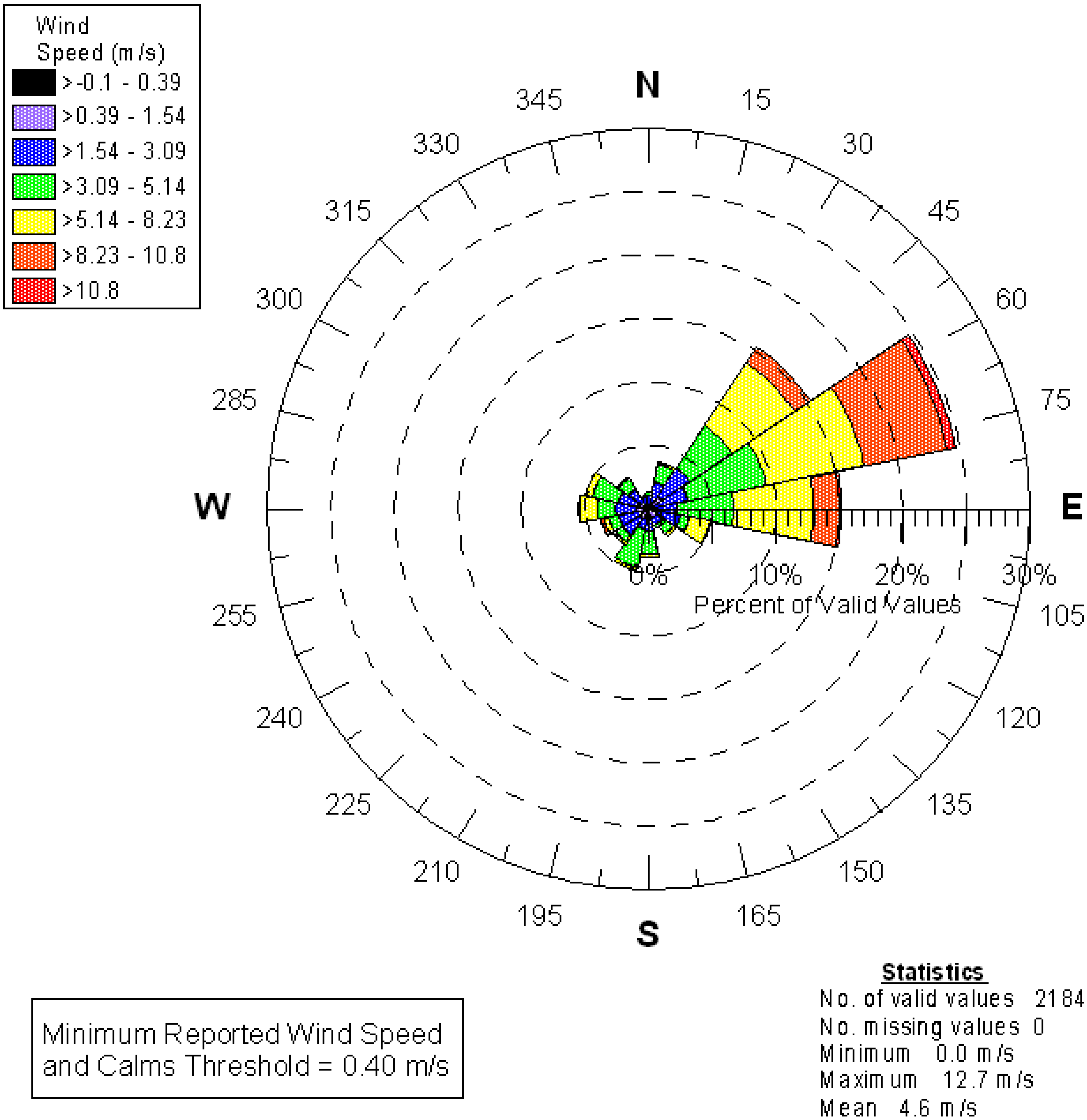


Figure 3-13 Second Quarter 2009 Nuiqsut Wind Rose

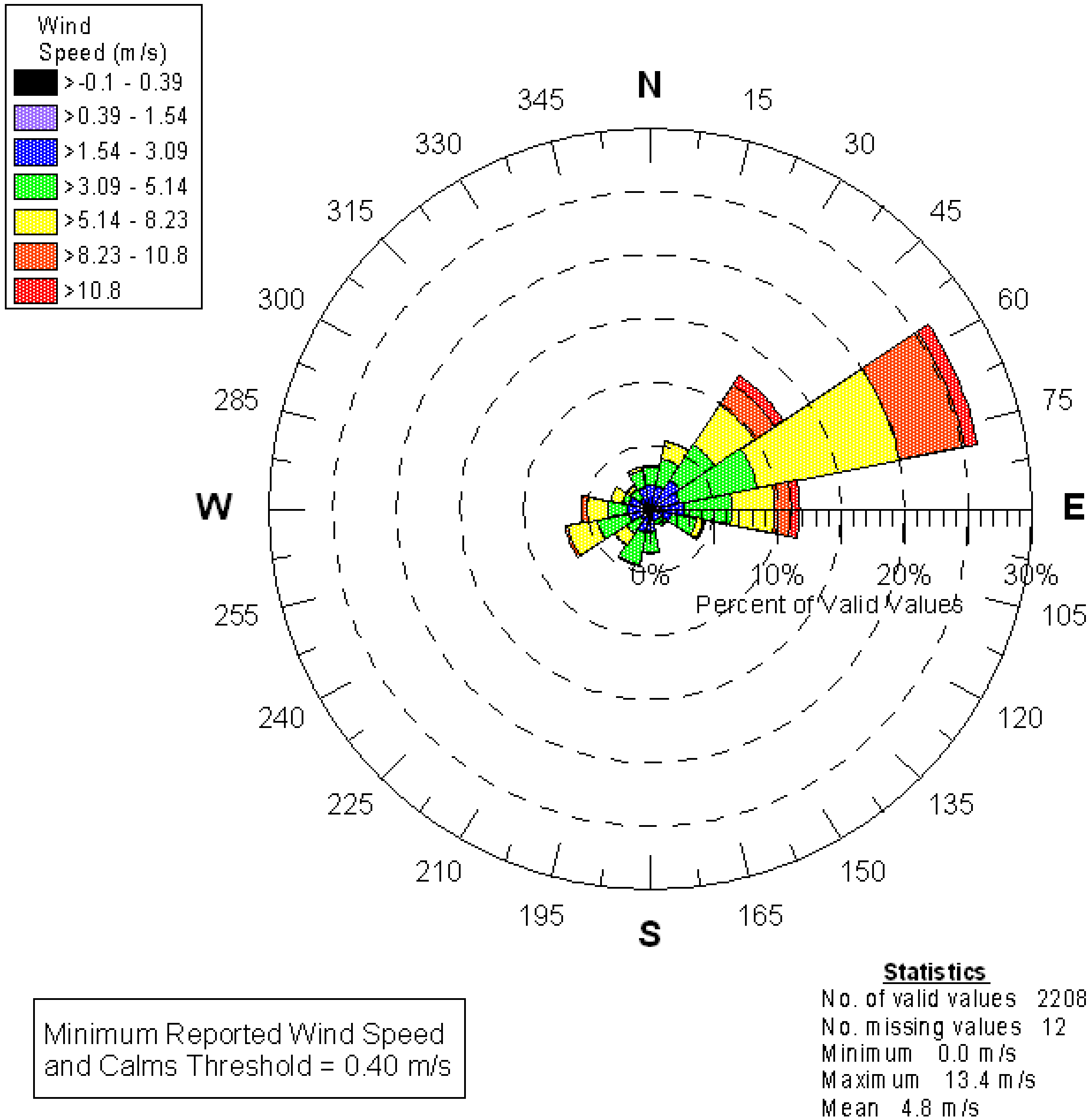


Figure 3-14 Third Quarter 2009 Nuiqsut Wind Rose

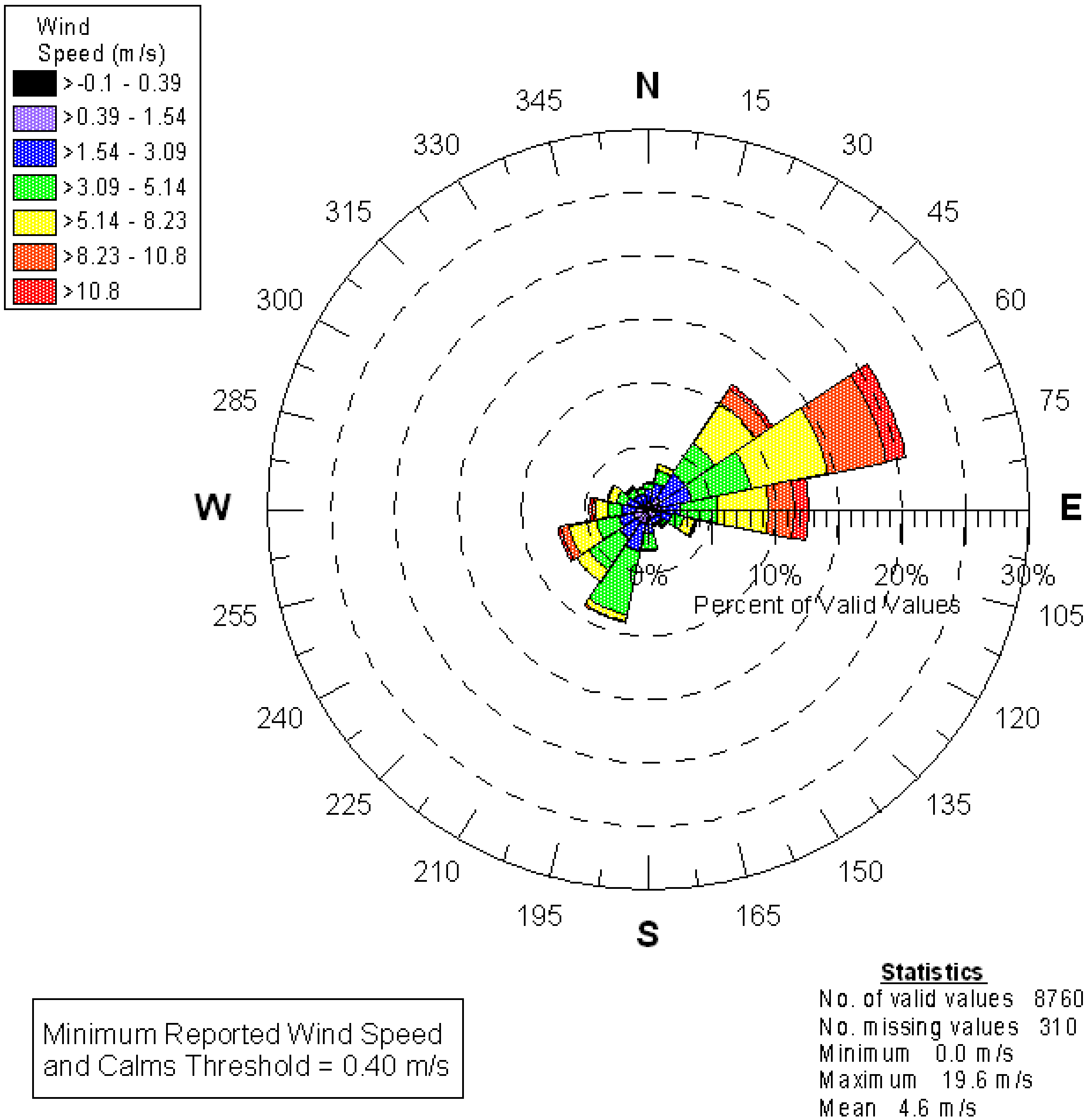


Figure 3-15 Fourth Quarter 2009 Nuiqsut Wind Rose

Table 3-7 First Quarter 2009 Wind Direction/Speed Frequency Analysis

Wind Rose Analysis – Percent of Valid Hourly Values (All Valid Hours)									
Wind Direction	**Wind Speed – m/s**								**Average Speed**
	≤ 0.39	**≤ 1.54**	**≤ 3.09**	**≤ 5.14**	**≤ 8.23**	**≤ 10.8**	**> 10.8**	**Total**	
N		1.02	1.85	0.05	0.00	0.00	0.00	3.08	1.84
NE		2.22	6.02	2.82	2.87	1.94	0.69	16.74	4.35
E		1.44	2.96	2.96	5.09	5.09	2.82	20.53	6.49
SE		0.83	0.51	0.51	0.37	0.00	0.00	2.38	2.84
S		1.85	2.13	3.52	0.51	0.09	0.00	8.26	3.10
SW		4.68	4.35	15.79	5.42	0.83	0.37	31.60	4.03
W		2.04	1.06	1.71	4.21	2.08	1.99	13.26	6.10
NW		0.56	0.74	0.14	0.09	0.05	0.23	1.97	3.36
CALM	1.30								
TOTAL	1.30	14.63	19.63	27.50	18.56	10.09	6.11	98	

Table 3-8 Second Quarter 2009 Wind Direction/Speed Frequency Analysis

Wind Rose Analysis – Percent of Valid Hourly Values (All Valid Hours)									
Wind Direction	**Wind Speed – m/s**								**Average Speed**
	≤ 0.39	**≤ 1.54**	**≤ 3.09**	**≤ 5.14**	**≤ 8.23**	**≤ 10.8**	**> 10.8**	**Total**	
N		0.82	1.51	0.32	0.00	0.00	0.00	2.71	2.09
NE		1.37	5.08	8.33	8.84	3.53	0.37	27.57	5.20
E		0.64	4.40	8.38	12.59	6.78	0.50	33.34	5.96
SE		0.92	2.61	1.28	0.73	0.00	0.00	5.59	3.06
S		1.42	1.65	3.94	0.37	0.00	0.00	7.42	3.21
SW		1.37	2.93	2.01	0.64	0.18	0.00	7.19	3.11
W		1.79	3.16	2.98	1.97	0.09	0.09	10.12	3.58
NW		1.10	2.66	2.01	0.23	0.00	0.00	6.05	2.81
CALM	0.41								
TOTAL	0.41	9.43	23.99	29.26	25.37	10.58	0.96	100	

Table 3-9 Third Quarter 2009 Wind Direction/Speed Frequency Analysis

Wind Rose Analysis – Percent of Valid Hourly Values (0 Valid Hours Used)									
Wind Direction	Wind Speed – m/s								Average Speed
	≤ 0.39	≤ 1.54	≤ 3.09	≤ 5.14	≤ 8.23	≤ 10.8	> 10.8	Total	
N		0.72	2.99	3.35	0.36	0.05	0.00	7.47	3.23
NE		0.82	3.99	7.61	9.47	3.67	1.54	27.08	5.74
E		1.45	3.03	8.06	10.69	4.85	1.09	29.17	5.84
SE		0.68	1.99	1.31	0.14	0.00	0.00	4.12	2.79
S		1.00	2.26	3.80	0.05	0.00	0.00	7.11	3.10
SW		0.91	1.72	3.26	2.08	0.18	0.00	8.15	4.14
W		1.22	2.31	2.99	3.40	0.54	0.05	10.51	4.47
NW		0.86	2.04	1.77	1.13	0.05	0.00	5.84	3.54
CALM	0.00								
TOTAL	0.00	7.65	20.34	32.16	27.31	9.33	2.67	99	

Table 3-10 Fourth Quarter 2009 Wind Direction/Speed Frequency Analysis

Wind Rose Analysis – Percent of Valid Hourly Values (2,145 Valid Hours Used)									
Wind Direction	Wind Speed – m/s								Average Speed
	≤ 0.39	≤ 1.54	≤ 3.09	≤ 5.14	≤ 8.23	≤ 10.8	> 10.8	Total	
N		1.22	2.17	0.59	0.27	0.00	0.00	4.46	2.40
NE		1.72	3.99	4.39	5.71	3.85	1.81	21.67	5.69
E		3.26	2.99	5.30	4.76	3.03	3.80	23.34	5.72
SE		1.86	1.36	0.27	0.09	0.00	0.00	3.78	1.83
S		1.63	2.94	3.03	0.09	0.00	0.00	7.90	2.75
SW		2.31	4.76	5.89	1.77	0.00	0.00	14.92	3.31
W		2.58	1.77	2.26	0.82	0.05	0.00	7.67	2.86
NW		1.99	1.31	0.86	0.54	0.00	0.00	4.91	2.52
CALM	1.59								
TOTAL	1.59	16.58	21.29	22.60	14.04	6.93	5.62	89	

Table 3-11 Nuiqsut Temperature Climate Summary, 2009 Annual Data Summary

2-Meter Temperature (°C)									
Month	Mean			Extreme					
	Maximum Daily (Monthly Average)	Minimum Daily (Monthly Average)	Monthly	Record Highest (Hourly Average)	Year	Day	Record Lowest (Hourly Average)	Year	Day
January 2009	-0.4	-39.2	-28.4	0.6	2005	8	-43.1	2002	23
February 2009	-2.9	-44.3	-27.7	1.8	2006	16	-45.9	2004	19
March 2009	-12.4	-43.7	-31.4	-3.1	2004	21	-43.7	2009	17
April 2009	6.1	-32.7	-15.7	2.5	2002	26	-35.8	2004	2, 3
May 2009	4.9	-8.6	-2.6	18.5	2002	24	-28.7	2001	1
June 2009	15.1	-1.8	4.8	27.3	2003	29	-5.0	2000	5
July 2009	28.6	0.8	9.7	28.6	2009	13	-1.6	2002	26
August 2009	22.0	-1.4	7.0	27.8	1999	5	-3.3	2000	27
September 2009	15.0	-12.4	1.2	18.8	2002	5	-13.6	1999	30
October 2009	2.3	-18.3	-5.0	7.4	2003	2	-27.2	1999/ 2004	31/31
November 2009	-8.1	-34.8	-20.7	0.7	2003	6	-35.5	1999	5
December 2009	-3.1	-40.6	-20.9	-2.5	2001/ 2006	28/2	-42.1	1999	18
1st Quarter 2009	-11.7	-40.1	-29.2	-	-	-	-	-	-
2nd Quarter 2009	3.0	-16.5	-4.5	-	-	-	-	-	-
3rd Quarter 2009	15.7	-0.4	6.0	-	-	-	-	-	-
4th Quarter 2009	-5.6	-20.2	-15.5	-	-	-	-	-	-
Monitoring Year	0.4	-21.0	-10.7	28.0	2001	16	-45.9	2004	19

Figure 3-16 compares average hourly temperatures by month measured at Nuiqsut during the current monitoring year to historical data collected at Barrow and the Nuiqsut Station. Comparisons are made to Barrow data because that data, collected over a 49-year period, is less likely influenced by interannual variability.

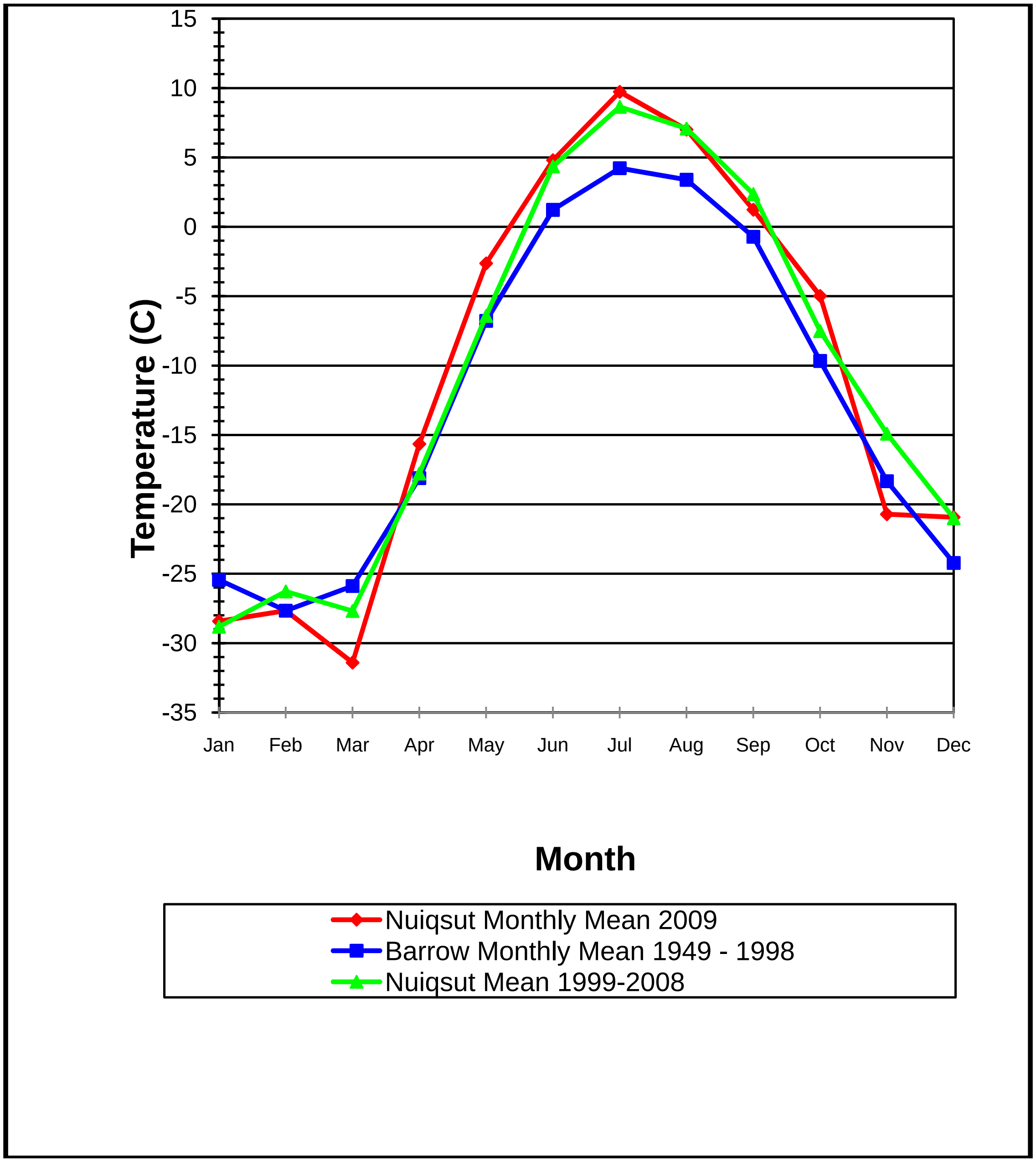


Figure 3-16 Nuiqsut Station Temperature Climatology, 2009 Annual Data Summary

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