NORTH DAKOTA
DEPARTMENT *of* HEALTH

ENVIRONMENTAL HEALTH SECTION
Gold Seal Center, 918 E. Divide Ave.
Bismarck, ND 58501-1947
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August 2, 2016

Monica Morales, Acting Director
Air Program, Mail Code 8P-AR
U.S. EPA, Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Re: 2016 North Dakota Ambient Air Monitoring Network Plan and Monitoring for the 1-Hour SO_2 Data Requirements Rule

Dear Ms. Morales:

On June 28, 2016 the North Dakota Department of Health (Department) submitted to EPA a draft copy of the 2016 ambient air monitoring network plan for the State of North Dakota. The network plan is written to meet the requirements of 40 CFR Part 58.

Additionally, in accordance with the Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS) final rule (40 CFR Part 51), the network plan included information on selecting ambient air quality monitoring to characterize air quality in the vicinity of the Hess Tioga Gas Plant in Williams County, ND.

A public comment period was held from July 1, 2016 to August 1, 2016. During this time, no comments were received.

Please find attached the final copy of the 2016 ambient air monitoring network plan for the State of North Dakota. If you have any questions, please contact Charles Hyatt of my staff at (701)328-5188.

Sincerely,

Terry O'Clair

Terry L. O'Clair, P.E.
Director
Division of Air Quality

TLO/CRH:csc

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ENVIRONMENTAL HEALTH SECTION
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June 28, 2016

Monica Morales, Acting Director
Air Program, Mail Code 8P-AR
U.S. EPA, Region 8
1595 Wynkoop Street
Denver, CO 80305

Re: 2016 North Dakota Ambient Air Monitoring Network Plan and Monitoring for the 1-Hour SO_2 Data Requirements Rule

Dear Ms. Morales:

The Code of Federal Regulations Title 40 Part 58 states that "(Agencies) shall adopt and submit to the Regional Administrator an annual monitoring network plan". This plan identifies monitoring stations and monitors that make up an air quality surveillance network under authority of the State. Additionally, the plan outlines any proposed changes or modifications to the network.

The Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS) final rule (40 CFR Part 51) states that "...by July 1, 2016, the air agency must ... include information in the Annual Monitoring Network Plan that specifies the monitoring to be conducted to address the requirements of this rule."

Please find attached the 2016 ambient air monitoring network plan for the State of North Dakota. The plan provides information on the selection of monitoring to characterize air quality in the vicinity of the Hess Tioga Gas Plant in accordance with the Data Requirements Rule.

A thirty day public comment period is required on the network plan. In order to meet the submittal deadline specified in the Data Requirements Rule, the comment period will be held concurrently with the initial period of EPA review. It will begin on July 1, 2016 and conclude on August 1, 2016. Any comments received will be addressed in a future addendum to this plan.

If you have any questions concerning the materials provided or require additional information or clarification, please contact Charles Hyatt of my staff at (701)328-5188.

Sincerely,

Terry O'Clair

Terry L. O'Clair, P.E.
Director
Division of Air Quality

TLO/CRH:csc
Enc:

Annual Report

North Dakota
Ambient Air Quality Monitoring Program

Network Plan
with
Data Summary

2016

NORTH DAKOTA
DEPARTMENT *of* HEALTH

Annual Report

North Dakota
Ambient Monitoring
Network Plan
With Data Summary
2016

Jack Dalrymple
Governor

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ACRONYMS AND ABBREVIATIONS

- AQM – Ambient Air Quality Monitoring
- AQS – Air Quality System
- BAM – Beta Attenuation Particulate Monitor
- BART – Best Available Retrofit Technology
- CFR – Code of Federal Regulations
- CO – Carbon Monoxide
- CSN – Chemical Speciation Network
- DRR – Data Requirements Rule
- EPA – United States Environmental Protection Agency
- FEM – Federal Equivalent Method
- FRM – Federal Reference Method
- GIS – Geographic Information System
- H_2S – Hydrogen sulfide
- H_2SO_3 – Sulfurous acid
- H_2SO_4 – Sulfuric acid
- HAP – Hazardous Air Pollutant
- IMPROVE – Interagency Monitoring of Protected Visual Environments
- MSA – Metropolitan Statistical Area
- NAAMS – National Ambient Air Monitoring Strategy
- NAAQS – National (also North Dakota) Ambient Air Quality Standards
- NCore – National Core Monitoring Network
- NH_3 – Ammonia
- NO – Nitric oxide
- NO_2 – Nitrogen dioxide
- NO_x – Oxides of Nitrogen
- NO_y – Total Reactive Nitrogen
- NPS – National Park Service
- NTN – National Trends Network
- NWR – National Wildlife Refuge
- O_3 – Ozone
- PM – Particulate Matter
- PM_{10} – Particulate Matter less than 10 microns in diameter
- $PM_{2.5}$ – Particulate Matter less than 2.5 microns in diameter (fine particulate matter)
- $PM_{10\text{-}2.5}$ - Particulate Matter between 2.5 and 10 microns in diameter (coarse particulate matter)
- ppb – parts per billion
- PSD – Prevention of Significant Deterioration
- SLAMS – State and Local Air Monitoring Stations
- SO_2 – Sulfur dioxide
- SPM – Special Purpose Monitoring
- STN – Speciation Trends Network
- TAD – Technical Assistance Document
- TEOM – Tapered Element Oscillating Microbalance
- TRNP – Theodore Roosevelt National Park (NU – North Unit; SU – South Unit at Painted Canyon)
- TPY – Tons Per Year
- UV - Ultraviolet
- VOC – Volatile Organic Compound

1.0 INTRODUCTION

The North Dakota Department of Health (Department), Division of Air Quality (Division)[1], has the primary responsibility of protecting the health and welfare of North Dakotans from the detrimental effects of air pollution. Toward that end, the Division ensures that the ambient air quality in North Dakota is maintained in accordance with the levels established by the state and federal Ambient Air Quality Standards (NAAQS)[2] and the Prevention of Significant Deterioration of Air Quality (PSD) Rules.

To carry out this responsibility, the Division operates and maintains a network of ambient air quality monitoring (AQM) sites throughout the state[3].

The Division conducts an annual review of the network to determine if all federal monitoring requirements as set forth in 40 CFR 58[4] are being met. This document is an account of the review and demonstrates that siting and operation of each monitor in the network meets the requirements of appendices A, B, C, D, and E of the part, where applicable. The annual review also serves to identify any network modifications that are necessary to meet federal requirements. Modifications could include the establishment of new sites, relocation of sites to more appropriate areas, or the removal of sites where the original justification for the site no longer exists. Modifications described in this report are proposed for a period within 18 months of report publication.

Additionally, every five years the Division completes a longer range assessment to assure that the network has and will continue to meet all its monitoring obligations. The five year assessment allows for the evaluation of future possible expansions or retractions of the network and the possible incorporation of new technologies.

Each year, the Division completes a data summary report for the previous 12-month data collection season. In the past, this report was issued as a separate document from the network review. Upon inspection, it was found that much of the information included in the data summary report duplicates what was included in the network review. To avoid a doubling-up of effort, beginning in 2015, the data summary for state run AQM sites was combined with the network review resulting in one single comprehensive annual report document[5].

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[1] See Appendix A of this document for an organizational chart for the Division.

[2] See Appendix B of this document for a summary table of all applicable federal and state ambient air quality standards.

[3] See Appendix C of this document for a full description for each site, site photographs, and a site map.

[4] The Code of Federal Regulations - 40 CFR 58 was promulgated by the Environmental Protection Agency (EPA) on October 17, 2006 and updated effective April 27, 2016.

[5] This document is subject to 30 days of public comment before finalization. See Appendix E of this document for applicable public comments received.

1.1 Site Selection

1.1.1 Monitoring Objectives

The AQM network consists of a number of individual sites located throughout North Dakota which host the equipment needed to measure pollution concentrations in the air. The process of selecting a monitoring site begins by identifying a monitoring objective. Appendix D of 40 CFR 58 defines the six basic monitoring objectives used to choose the locations of sites in a monitoring program:

- To determine the highest pollutant concentrations expected to occur in an area covered by the network.
- To determine representative concentrations in areas of high population density.
- To determine the impact on ambient pollution levels by a significant source or source categories[6].
- To determine the general/background concentration levels.
- To determine the impact on air quality by regional transport.
- To determine welfare-related impacts (such as impacts on visibility and vegetation).

1.1.2 Spatial Scale

Once an objective for a site has been identified, a spatial scale is chosen. EPA has defined a set of spatial scales based on physical dimensions that, given a particular objective, would be likely to have similar pollutant concentrations throughout. These are:

- **Micro-scale**
  – Dimensions ranging from several meters up to about 100 meters.
- **Middle Scale**
  – Areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 km.
- **Neighborhood Scale**
  – City areas of relatively uniform land use with dimensions of 0.5 to 4.0 km.
- **Urban Scale**
  – Overall, city-wide dimensions on the order of 4 to 50 km (Usually requires

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[6] Sources of interest could be point sources (a major industrial facility), area sources (a number of smaller emissions sources that collectively impact ambient air quality), or mobile sources (automobiles on a busy roadway or non-road sources including aircraft, construction vehicles, farm equipment, etc.)

more than one site for definition).

- **Regional Scale**
  – Rural areas of reasonably homogeneous geography covering from 50 km to hundreds of km.
- **National or Global Scale**
  – The entire nation or greater.

The relationships between monitoring objectives and spatial scales, as specified by EPA, are as follows:

Monitoring Objective	**Appropriate Siting Scales**
Highest Concentration	Micro, middle, neighborhood, (sometimes urban or regional for secondarily formed pollutants)
Population Oriented	Neighborhood, urban
Source Impact	Micro, middle, neighborhood
General/Background	Urban, regional
Regional Transport	Urban, regional
Welfare-related Impacts	Urban, regional

Spatial scales appropriate to the criteria pollutants monitored in North Dakota are shown below[7]:

Criteria Pollutant	**Spatial Scales**
Inhalable Particulate	micro, middle, neighborhood, urban, regional
Sulfur Dioxide	middle, neighborhood, urban, regional
Ozone	middle, neighborhood, urban, regional

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[7] Carbon monoxide (CO) is also monitored at the North Dakota National Core (NCore) site in order to meet federal requirements. Appendix D to 40 CFR 58 does not identify an urban spatial scale (4 to 50 kilometers) for Carbon monoxide because this pollutant is primarily associated with automobile traffic on a neighborhood or smaller scale. However, because the CO monitor is present to satisfy NCore specific requirements, it has historically been considered by the Department to be an urban scale monitor in alignment with the other monitors at the site.

Nitrogen Dioxide	middle, neighborhood, urban

A good understanding of the appropriate monitoring objective and spatial scale permits a site location to be chosen. Using these criteria to locate sites allows for an objective approach, ensures compatibility among sites, and provides a common basis for data interpretation and application. The annual review process involves assessing each site and associated monitors to confirm that all still meet their intended purpose. Sites and/or monitors that no longer satisfy the intended purpose are either discontinued or modified accordingly.

1.2 General Monitoring Needs

Each air pollutant has certain characteristics that must be considered when establishing a monitoring site. These characteristics may result from:

(A) Variations in the number and types of sources and emissions in question;
(B) Reactivity of a particular pollutant with other constituents in the air;
(C) Local site influences such as terrain and land use; and
(D) Climatology.

The Department's AQM network is designed to monitor air quality data for five basic objectives:

(1) Monitoring of criteria pollutant background concentrations;
(2) Quantifying population exposure to pollutants;
(3) Monitoring significant sources of pollutants or class category;
(4) Long-range transport of pollutants; and
(5) Regional haze.

The 2008 National Ambient Air Monitoring Strategy (NAAMS[8]) establishes a monitoring site classification system for the national AQM network. State and Local Monitoring Stations (SLAMS) make up the primary component for determining criteria pollutant NAAQS compliance. The Department operates eight ambient air quality monitoring sites in North Dakota (Figure 1). Additionally a ninth site, the Theodore Roosevelt National Park – South Unit site at Painted Canyon (TRNP – SU), is operated by the Department in partnership with the National Park Service (NPS). All of the state operated sites and the partnership site at Painted Canyon have been designated SLAMS sites[9].

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[8] U.S. EPA (2008). Ambient Air Monitoring Strategy for State, Local, and Tribal Air Agencies. Available via link at: www.epa.gov/ttn/amtic/monstratdoc.html.

[9] See Appendix C of this report for specific information on the location of each monitoring site.

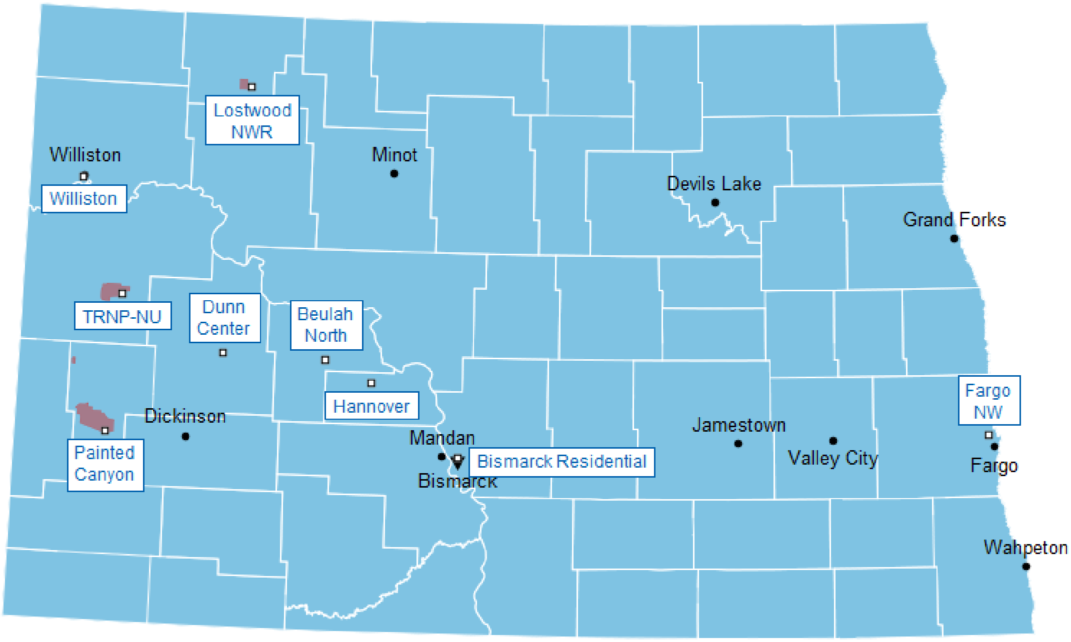

Figure 1. North Dakota Ambient Air Quality Monitoring Sites (Indicated with White Labels)

A National Core (NCore) site is a one in a network of approximately 80 multi-pollutant monitoring sites throughout the United States designed to support specific EPA core monitoring objectives in public reporting, emissions trends tracking, and NAAQS compliance evaluation. Each state is required to have one or more NCore designated sites. In addition to being a SLAMS site, on April 18, 2016, EPA approved the Department's request to designate the Bismarck Residential site as the required NCore site in North Dakota[10].

The Bismarck site is also a part of EPA's Chemical Speciation Network (CSN) as a trends site. The Speciation Trends Network (STN; a subset of the CSN) was established to monitor long term trends in concentration of selected particulate matter constituents. The NAAMS document provides additional information regarding these national networks.

1.3 Monitoring Objectives

The monitoring sites in the state fall into two categories: 40 CFR 58 required (3 sites) and supplemental (6 sites). The primary function of the Department's three required sites is to satisfy five monitoring objectives (Table 1).

The **Beulah** monitoring site, which lies between the city of Beulah and two major air

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[10] Previously the Fargo NW site was the North Dakota designated NCore site. See the NCore Relocation addendum to the 2014-2015 Annual Report for more information on the relocation request. Available online at: http://www.ndhealth.gov/AQ/ambient/Annual%20Reports/ARNP_14-15_Addendum.pdf

pollutant emissions sources (and in the vicinity to a third), has been designated a significant source and population-oriented site.

The **Fargo NW** site has been designated a population orientated site because the city of Fargo is a major population center in North Dakota with five major emissions sources located in the area. The data from the Fargo site are used in dispersion modeling to evaluate construction and operating permit applications for projects located in the eastern part of the state.

The **Theodore Roosevelt National Park North Unit (TRNP-NU)** site is used to evaluate background concentrations, long-range transport, and welfare-related impacts of pollutants.

Table 1. Ambient Air Quality Network Description

	Site Name AQS* Site Number	Parameter Monitored											Monitoring Objective
		SO_2	NO_2	O_3	CO	Continuous $PM_{2.5}$	Continuous PM_{10}	Manual $PM_{2.5}$	PM_{fine} Speciation	NH_3	NO_y	Wind Speed & Direction	
1	Beulah North 380570004	★	★	★		★	★	★		★		★	Population Exposure & Significant Source
2	Bismarck Residential** 380150003	★	★	★	★	★	★	★	★		★	★	Population Exposure
3	Dunn Center 380250003	★	★	★		★	★					★	General Background
4	Fargo NW** 380171004	★	★	★		★	★	★				★	Population Exposure
5	Hannover 380650002	★	★	★		★	★					★	Source Impact
6	Lostwood NWR 380130004	★	★	★		★	★		★	★		★	General Background & Significant Source
7	Painted Canyon 380070002	★		★		★		★				★	General Background
8	TRNP – NU 380530002	★	★	★		★	★					★	General Background, Long-range Transport, & Welfare-related
9	Williston 381050003			★		★	★					★	Population Exposure

* Air Quality System – EPA's computer database and information system of ambient air quality data.
** Parameters shown represent the monitoring coverage after the completion of the Fargo to Bismarck NCore relocation.

The remaining six sites are used to support air dispersion model calibration and/or validation and to supplement data collected at the required sites.

Background, welfare-related and long-range transport sites are chosen to determine concentrations of air contaminants in areas remote from urban sources. These are generally sited using the regional spatial scale. Once a specific location is selected for a site, the site is established in accordance with the specific sitting criteria specified in 40 CFR 58, Appendices A, C, D and E.

The Department evaluates any monitoring requirements and site changes needed to support the visibility regulations in 40 CFR 51.300, 40 CFR 51.308 (regional haze rules) and 40 CFR 51, Appendix Y (Best Available Retrofit Technology, BART).

2.0 AMBIENT AIR MONITORING NETWORK COVERAGE

The nine ambient air quality monitoring sites in the state are positioned to satisfy the five monitoring objectives (described in Section 1.3 of this report), to collect data to support dispersion modeling activities relating to visibility/regional haze and source permit evaluation, and to compare to the State and Federal ambient air quality standards.

The NAAQS[11] are established by EPA in order to meet the requirements of the Clean Air Act and address concentrations of six criteria pollutants in the ambient air. The following sections describe the pollutants and outline state monitoring efforts with respect to each pollutant. Monitoring results in relation to the NAAQS are presented in each section. Additionally, Appendix D of this document includes wind and pollution roses for each monitoring site.

2.1 Carbon Monoxide

Carbon monoxide (CO) is an odorless, colorless, and toxic gas. Worn or poorly adjusted and maintained combustion devices (e.g. boilers and furnaces), or those with improperly sized, blocked, disconnected, or leaking flues, can be significant sources of CO. Auto, truck, or bus exhaust can also be a source of CO. Many large urban areas in the United States have problems attaining the NAAQS for CO where the primary source of CO is automobiles. To date, North Dakota does not have large population centers with the corresponding traffic congestion and geographical/meteorological conditions to create significant CO emission problems. However, there are several stationary sources in the state that emit more than 100 tons per year (TPY) of CO.

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[11] Appendix B.

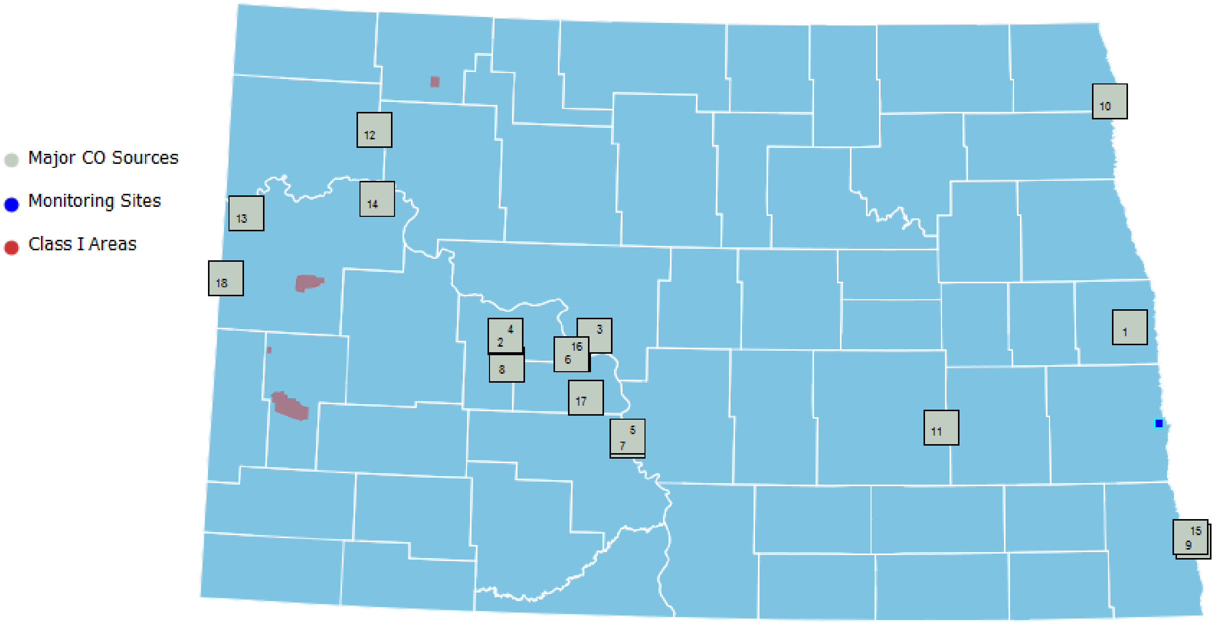

Figure 2. Major CO Sources in 2015

Table 2. Major CO Sources (≥ 100 TPY) in 2015

#	COMPANY	SOURCE	EIS Facility ID
1	American Crystal Sugar Company	Hillsboro Plant	7939011
2	Dakota Gasification Company	Great Plains Synfuels Facility	8086711
3	Great River Energy	Coal Creek Station	8011011
4	Basin Electric Power Cooperative	Antelope Valley Station	8086511
5	Montana Dakota Utilities Company	RM Heskett Station	8087011
6	Basin Electric Power Cooperative	Leland Olds Station	8086311
7	Tesoro Refining and Marketing Company	Mandan Refinery	7923611
8	Otter Tail Power Company	Coyote Station	8086611
9	Minn-Dak Farmers Cooperative	Wahpeton Plant	7924011
10	American Crystal Sugar Company	Drayton Plant	7923811
11	Great River Energy	Spiritwood Station	16937511
12	Hess Corporation	Tioga Gas Plant	8013911
13	ONEOK Rockies Midstream, L.L.C.	Fort Buford Compressor Station	10612511
14	Hess North Dakota Pipelines LLC	Hawkeye Compressor Station	10613211
15	Cargill Corn Milling	Wahpeton Facility	10612711
16	Great River Energy	Stanton Station	8086411
17	Minnkota Power Cooperative, Inc.	Milton R. Young Station	8087911
18	ONEOK Rockies Midstream, LLC	Grasslands Gas Plant	8085511

The effects of CO exposure can vary greatly from person to person depending on age, overall health and the concentration and length of exposure. At lower levels of exposure, CO causes mild effects that are often mistaken for a cold or the flu virus. These symptoms include headaches, dizziness, disorientation, nausea, and fatigue. In individuals with heart disease, chest pain may be a symptom. At moderate concentrations, angina, impaired vision, and reduced brain function may result. At very high concentrations, CO exposure can be fatal. Acute effects are due to the formation of carboxyhemoglobin in the blood, which inhibits oxygen intake.

2.1.1 Point Sources

The major stationary CO sources (>100 TPY) are listed in Table 2. Figure 2 shows the approximate locations of these facilities (the numbers correspond to the site and source tables). Most of these sources are the same sources that are the major emitters of sulfur dioxide and oxides of nitrogen. However, the corresponding CO levels from these sources are considerably lower.

2.1.2 Monitoring Network

Carbon monoxide monitoring in North Dakota ended in 1994, after operating five years. The conclusion drawn from the data was that CO concentrations in North Dakota were well below the NAAQS and exceedances were unlikely. A summary report of the data collected at the West Acres Shopping Mall was drafted for the Fargo-Moorhead Council of Governments for use in its traffic planning program. Since 2009, the Department has operated a Trace Level CO analyzer at the Fargo NW site in order to comply with the NCore requirements. Figure 3 shows CO concentrations at Fargo in comparison to the 1- and 8-hour NAAQS.

2.1.3 Network Changes

There were no significant changes made to the CO network in 2015. Concentrations measured by the trace level CO monitor at Fargo have consistently been lower than the NAAQS. No changes to the CO emissions inventory that would result in significant changes in ambient concentrations of this pollutant are foreseen.

With the relocation of the NCore site the trace level CO monitor will be moved from Fargo to Bismarck. This change will be reflected in next year’s annual report.

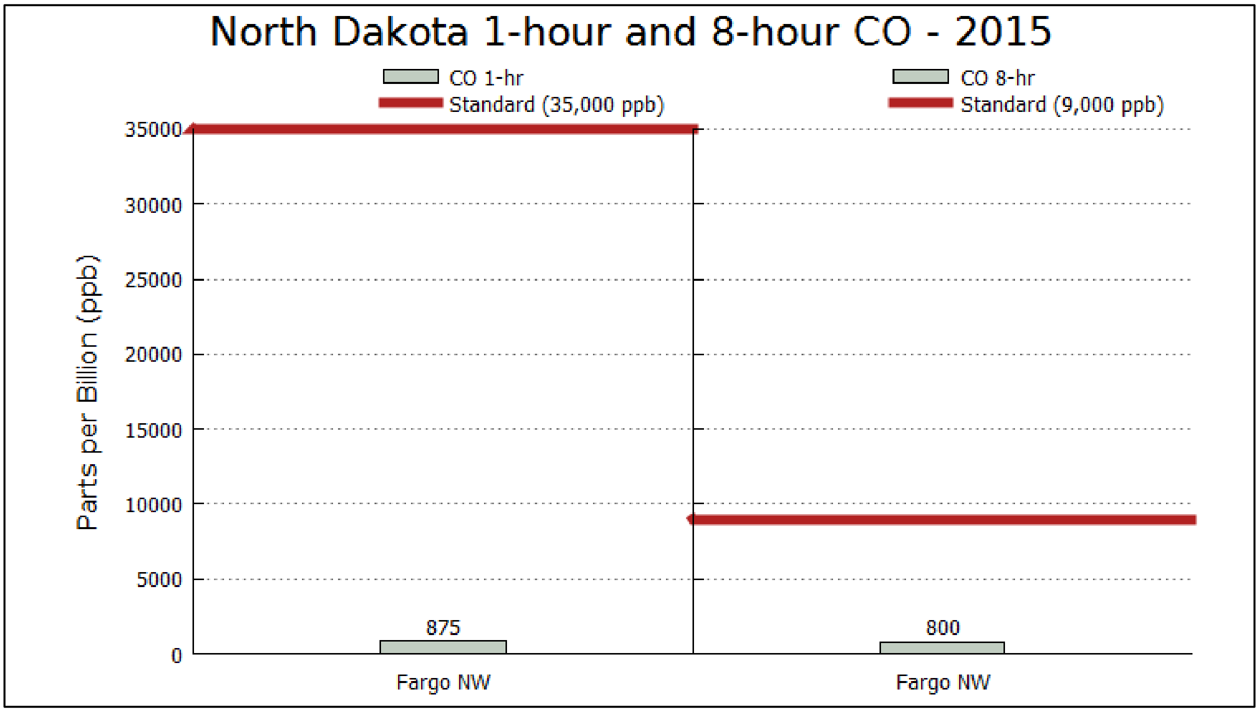

Figure 3. CO Concentrations Compared to the 1-hour and 8-hour Standards

2.2 Lead

Lead is a heavy metal that can be emitted through some heavy industrial manufacturing processes, including metals processing. Lead is also used as a fuel additive to increase engine performance and reduce valve wear. Although phased out of general use in the United States for on-road automobile and truck fuel in the 1970s, lead additive is still used in some aviation fuels.

High lead levels in the body can affect the nervous system, kidneys, and the immune system. Reproductive and cardiovascular health can also be impacted.

Through prior sampling efforts, the Department has determined that the state has low lead concentrations and no significant lead sources. This determination, coupled with the federal lead monitoring requirements, resulted in the state lead monitoring program ending effective Dec. 31, 1983.

2.2.1 Network Changes

There were no significant changes made to the lead monitoring network in 2015. There are no changes planned for 2016.

2.3 Oxides of Nitrogen

Oxides of Nitrogen (NO_x) is the term used to represent nitric oxide (NO) plus nitrogen dioxide (NO_2). NO and NO_2 are formed when the nitrogen and oxygen in the air are combined in high-temperature combustion. Major NO_x sources in North Dakota are coal conversion processes, natural gas processing plants, and natural gas compressor stations.

In its pure state, NO_2 is a reddish-orangish-brown gas with a characteristic pungent odor. As a pollutant in ambient air, however, NO_2 is virtually odorless – although it may be an irritant to the eyes and throat. NO_2 is corrosive and a strong oxidizing agent. The dark orangish-brown colored plume that can sometimes be seen downwind from a major combustion emissions source is most likely the result of NO_2 or the conversion of NO to NO_2.

There is no ambient air quality standard for NO, a colorless gas. NO released into ambient air combines with excess oxygen to form NO_2. The speed with which this conversion occurs is dependent on several factors, including the relative concentrations of NO and ozone, the amount of ultraviolet light available, and meteorological conditions.

NO_x exposure can result in respiratory distress, including airway inflammation and aggravation of asthmatic symptoms. Ozone, with its own health concerns, is a byproduct of the chemical reaction of NO_x and volatile organic compounds with heat and sunlight. In the form of the corrosive species nitrous and nitric acid, NO_x can result in impacts on vegetation and materials. In combination with ammonia and water vapor, NO_x can form small particulates, impairing visibility and impacting health.

NO_y, or "total reactive nitrogen", consists of oxidized compounds of nitrogen (i.e. NO_x + nitric acid and organic nitrates). A NO_y monitor works by converting all reactive species to NO. Non-NO_x species concentrations can be determined by subtracting monitored ambient NO and NO_2 concentrations from the resultant total concentration of converted NO. There is no ambient air quality standard for NO_y.

2.3.1 Point Sources

The major NO_x stationary point sources (>100 TPY) are listed in Table 3, along with their emissions as calculated from the most recent emission inventories reported to the Department.

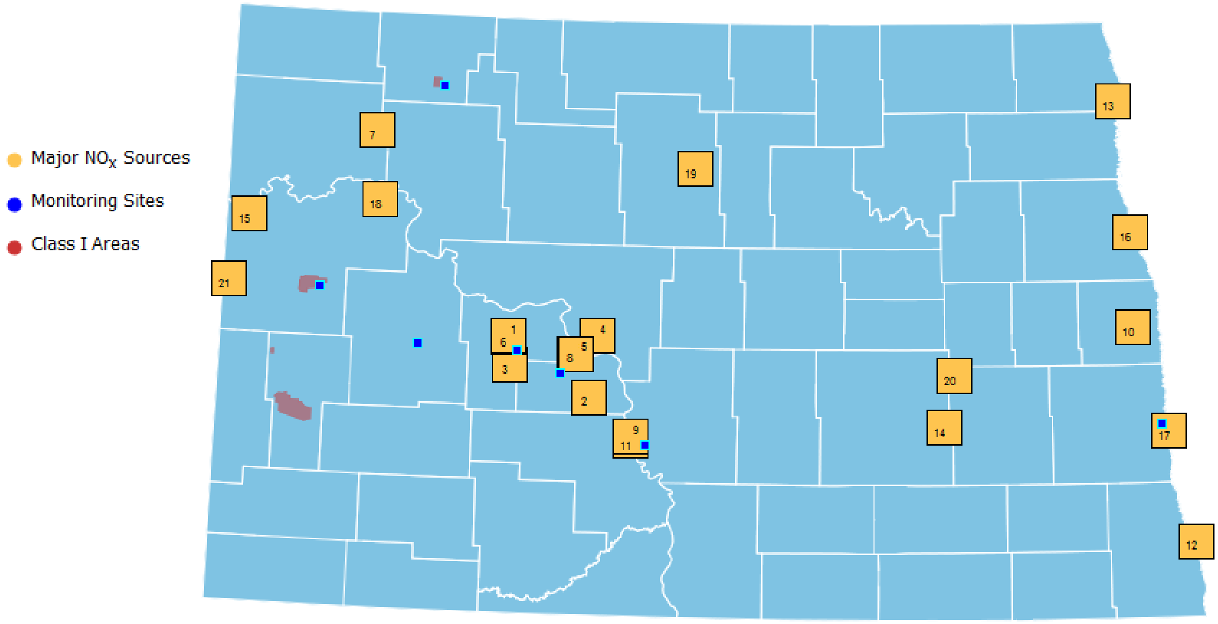

Figure 4. Major Oxides of Nitrogen Sources in 2015

Table 3. Major NO_x Sources (≥ 100 TPY) in 2015

#	Company	Source	EIS Facility ID
1	Basin Electric Power Cooperative	Antelope Valley Station	8086511
2	Minnkota Power Cooperative, Inc.	Milton R. Young Station	8087911
3	Otter Tail Power Company	Coyote Station	8086611
4	Great River Energy	Coal Creek Station	8011011
5	Basin Electric Power Cooperative	Leland Olds Station	8086311
6	Dakota Gasification Company	Great Plains Synfuels Facility	8086711
7	Hess Corporation	Tioga Gas Plant	8013911
8	Great River Energy	Stanton Station	8086411
9	Montana Dakota Utilities Company	RM Heskett Station	8087011
10	American Crystal Sugar Company	Hillsboro Plant	7939011
11	Tesoro Refining and Marketing Company	Mandan Refinery	7923611
12	Minn-Dak Farmers Cooperative	Wahpeton Plant	7924011
13	American Crystal Sugar Company	Drayton Plant	7923811
14	Great River Energy	Spiritwood Station	16937511
15	ONEOK Rockies Midstream, LLC	Fort Buford Compressor Station	10612511
16	University of North Dakota	UND Heating Plant	7292911
17	North Dakota State University	NDSU Heating Plant	8448211
18	Hess North Dakota Pipelines LLC	Hawkeye Compressor Station	10613211

19	Alliance Pipeline, LP	Towner Compressor Station	10612311
20	Alliance Pipeline, LP	Wimbledon Compressor Station	10612411
21	ONEOK Rockies Midstream, LLC	Grasslands Gas Plant	8085511

Figure 4 shows the approximate locations of these facilities (the numbers correspond to the site and source tables). The larger NO_x point sources in North Dakota are associated with coal-fired steam-powered electrical generating plants in the west-central portion of the state and large internal combustion compressor engines in the natural gas fields in the western part of the state. Figure 5 shows the contribution of point sources to the total NO_x emissions. The “Point Sources” category consists of utility boilers (power plant boilers) and oil and gas wells.

2.3.2 Area Sources

Another source of NO_x is automobile emissions. North Dakota has no significant urbanized areas with respect to oxides of nitrogen; the entire population of the state is less than 1,000,000 people and the largest Metropolitan Statistical Area (MSA; includes Fargo) has a population of 233,836 (2015 estimate[12]). Figure 5 shows the contribution of “Other Point Sources” and “Utility Boilers.” The “Other Point Sources” category consists of coal gasification, oil refineries, natural gas processing plants and agricultural processing plants.

2.3.3 Monitoring Network

The Department currently operates seven $NO/NO_2/NO_x$ analyzers. From Figure 4 it can be seen that $NO/NO_2/NO_x$ analyzers are well placed with respect to the major NO_x sources. Additionally, as part of the NCore network site at Fargo, the Department operates a NO_y monitor.

2.3.4 Network Analysis

Figures 6 and 7 show the 2015 NO_2 monitoring results in comparison to the 1-hour and annual NO_2 NAAQS, respectively. Numbers above the bars indicate monitored concentrations.

Nine of the ten largest NO_x sources in the state are within 45 miles of the Beulah and Hannover monitoring sites. Figures 8 and 9 show the 1-hour and annual average concentrations for the Department-operated sites for 1980 – 2015, respectively.

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[12] US Census Bureau. Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2015 – United States – Metropolitan and Micropolitan Statistical Area; and for Puerto Rico 2015 Population Estimates. https://www.census.gov/popest/data/metro/totals/2015/. Retrieved 5/26/2016

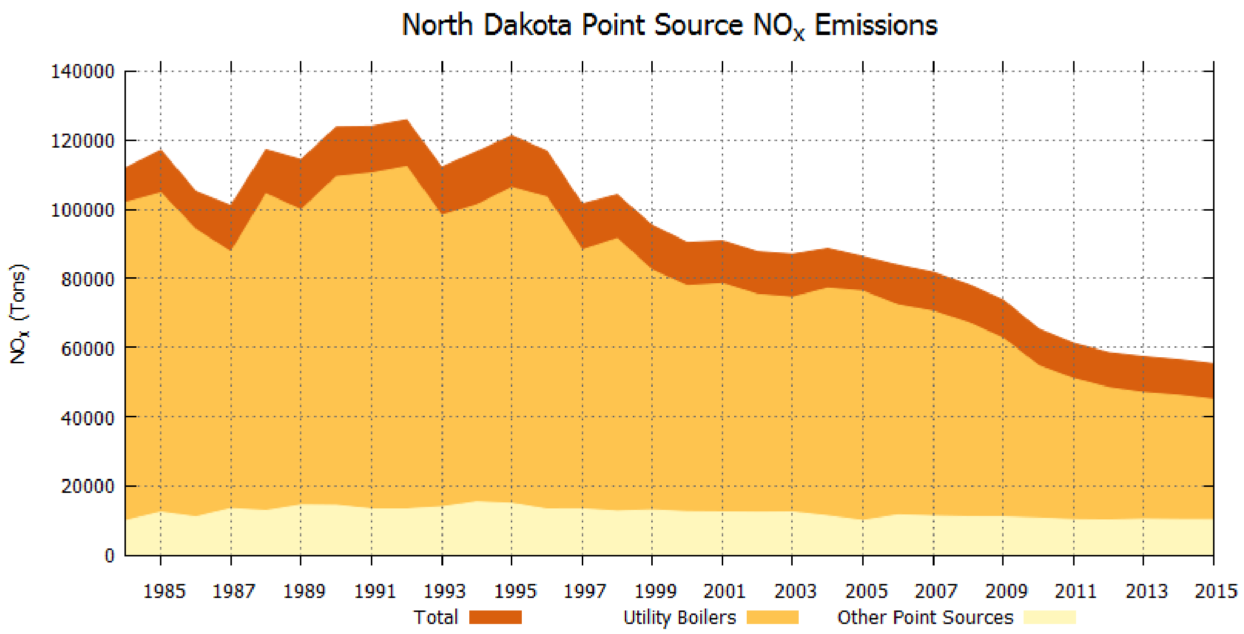

Figure 5. Annual Oxides of Nitrogen Emissions

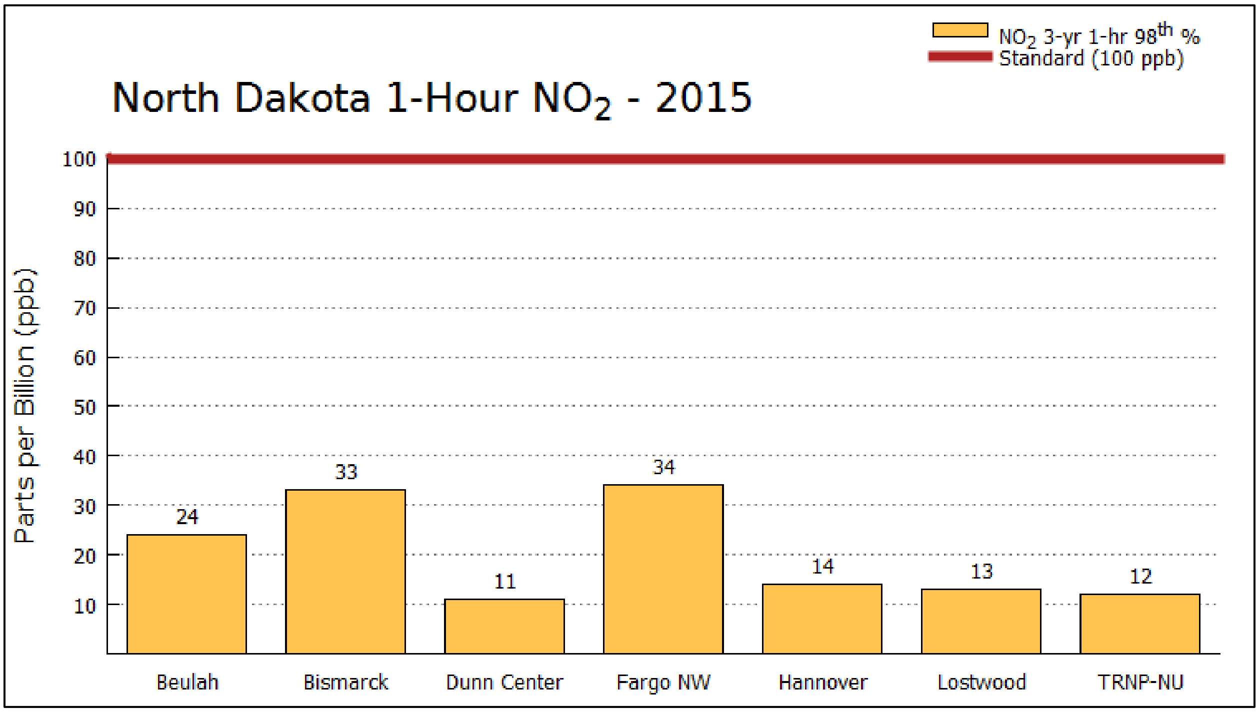

Figure 6. NO_2 Concentrations Compared to the 1-hour Standard

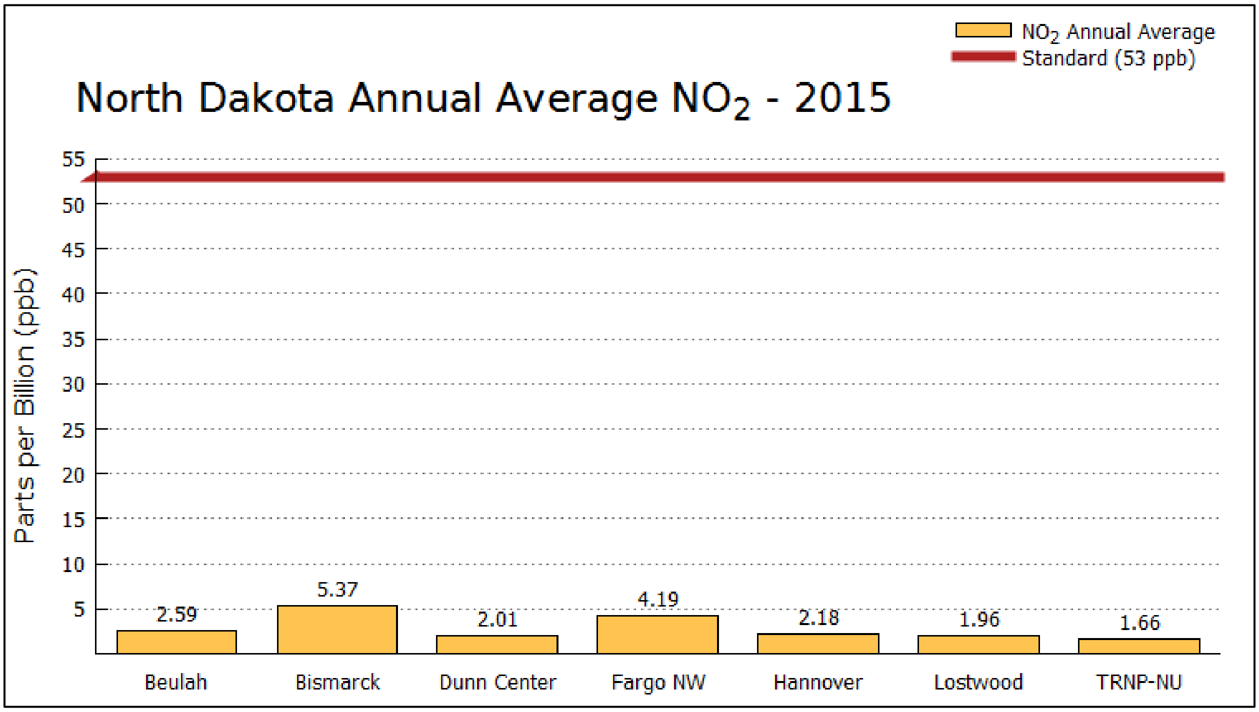

Figure 7. NO_2 Concentrations Compared to the Annual Standard

2.3.5 Network Changes

There were no significant changes made to the NO_2 network in 2015.

With the relocation of the NCore site, the NO_y monitor will move from Fargo to Bismarck. Trace level monitoring for NO_2 will end in Fargo and begin in Bismarck. Standard NO_2 monitoring will begin in Fargo.

See section 3.0 – Network Site Changes for discussion of the addition of a new ambient monitoring station to the network.

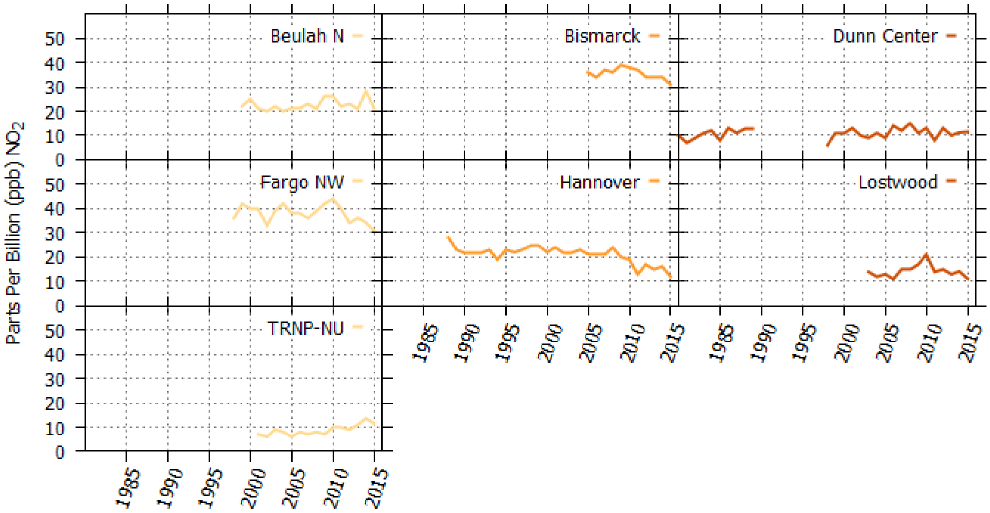

Figure 8. NO_2 98th Percentile 1-Hour Concentrations

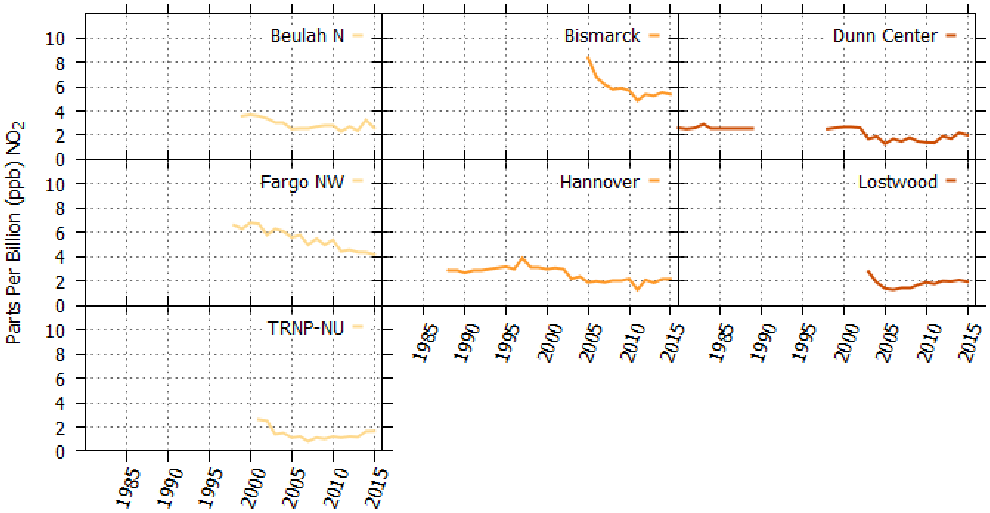

Figure 9. NO_2 Annual Average Concentrations

2.4 Ozone

Ozone (O_3) is a highly reactive form of oxygen. At very high concentrations, it is a blue, unstable gas with a characteristic pungent odor. It can often be detected around an arcing electric motor, lightning storms, or other electrical discharges. However, at ambient concentrations, O_3 is colorless and odorless.

Unlike most other pollutants, O_3 is not emitted directly into the atmosphere, but results from a complex photochemical reaction between volatile organic compounds (VOC), NO_x, and solar radiation. Both VOC and NO_x are emitted directly into the atmosphere. Sources of VOC include automobile exhaust, gasoline and oil storage and transfer, industrial paint solvents, degreasing agents, cleaning fluids, and ink solvents. Some vegetation can also emit VOC (e.g. terpene from pine trees).

Production of O_3 is a year-round phenomenon. However, the highest O_3 levels generally occur during the summer months when sunlight is stronger and stagnant meteorological conditions can cause reactive pollutants to remain in an area for several days. Ozone produced under these conditions can be transported many miles. 40 CFR 58 defines the O_3 monitoring season for North Dakota as March 1 through September 30[13].

At ground level where it can be breathed, O_3 is a pollutant. However, ground-level O_3 should not be confused with the stratospheric O_3 located between 12 and 20 miles above the earth's surface. The stratospheric O_3 layer shields the earth from intense cancer-causing ultraviolet radiation. Concentrations of O_3 in this layer are approximately 10,000 to 12,000 ppb, or 100 times the state's ambient air quality standard. Occasionally, meteorological conditions can result in stratospheric O_3 being brought to ground level. This can increase ambient air concentrations by 50 to 100 ppb.

Short-term exposure to O_3 in the range of 150 to 250 ppb may impair mechanical functions of the lungs and may induce respiratory difficulties and related symptoms in sensitive individuals (those who have asthma, emphysema, or reduced lung function). Symptoms and effects of O_3 exposure are more readily induced in people who are exercising.

O_3 is the major component of photochemical "smog", although the haziness and odors of the smog are caused by other components. The deterioration and degradation of material, especially the splitting and cracking of rubber tires and windshield wiper blades, is associated with O_3. Many plants, such as soybeans and alfalfa, are sensitive to O_3 and can be damaged by extended exposure to low levels.

2.4.1 Point Sources

The major stationary point sources (> 100 TPY) of VOC as calculated from the most recent emission inventories reported to the Department are listed in Table 4. Figure 10 shows the approximate locations of these facilities.

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[13] The required O_3 monitoring season for NCore stations is January through December. The Department typically collects O_3 monitoring data year-round at all ozone monitoring sites.

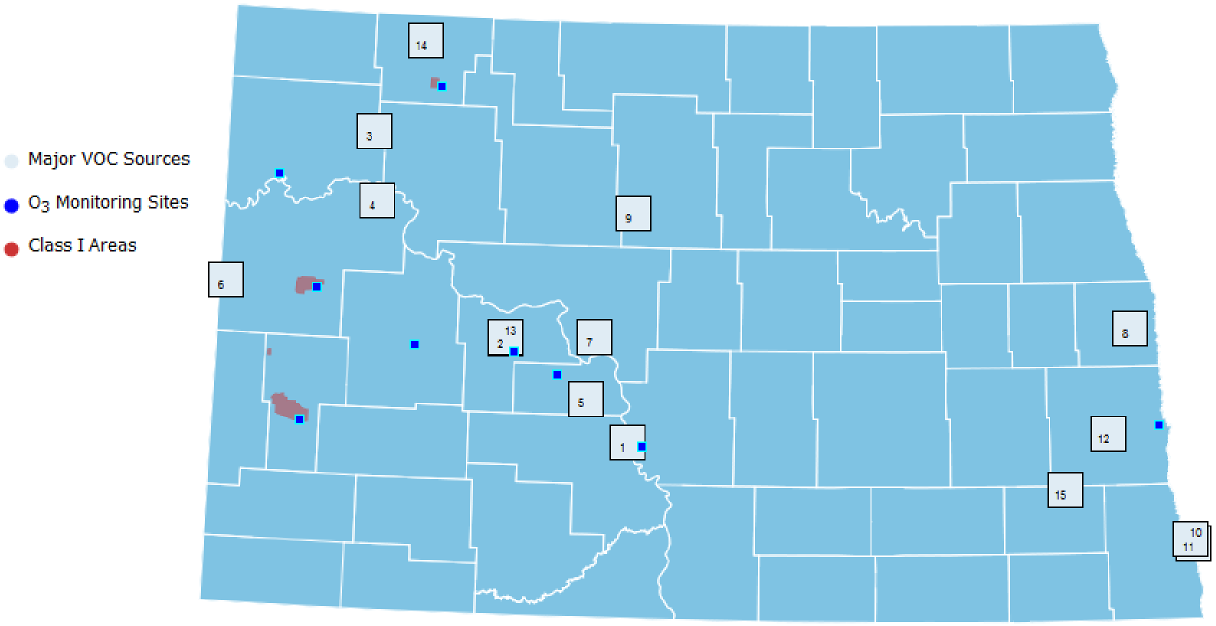

Figure 10. Major VOC Sources in 2015

Table 4. Major VOC Sources (≥ 100 TPY) in 2015

#	Company	Source	EIS Facility ID
1	Tesoro Refining and Marketing Company	Mandan Refinery	7923611
2	Dakota Gasification Company	Great Plains Synfuels Facility	8086711
3	Hess Corporation	Tioga Gas Plant	8013911
4	Hess North Dakota Pipelines LLC	Hawkeye Compressor Station	10613211
5	Minnkota Power Cooperative, Inc.	Milton R. Young Station	8087911
6	ONEOK Rockies Midstream, LLC	Grasslands Gas Plant	8085511
7	Great River Energy	Coal Creek Station	8011011
8	American Crystal Sugar Company	Hillsboro Plant	7939011
9	ADM Processing	Velva Facility	8085211
10	Cargill Corn Milling	Wahpeton Facility	10612711
11	Minn-Dak Farmers Cooperative	Wahpeton Plant	7924011
12	Tharaldson Ethanol Plant I, LLC	Tharaldson Ethanol Plant I, LLC	12682411
13	Basin Electric Power Cooperative	Antelope Valley Station	8086511
14	ONEOK Rockies Midstream, LLC	Lignite Gas Plant	8024311
15	Northern Sun (Division of ADM)	Enderlin Facility	7923911

2.4.2 Area Sources

Point sources contribute only part of the total VOC and NO_x emissions. The remaining emissions can be attributed to oilfield-related activities and mobile sources in urban areas. The EPA has specified design criteria for selecting locations for population-oriented O_3 monitoring as any urbanized area having a population of 50,000 to less than 350,000. North Dakota has three urbanized areas (Bismarck; Fargo, ND-Moorhead, MN; and Grand Forks) that meet these criteria. However, to require monitoring, the 4th highest 8-hour average concentration must be at least 68 parts per billion. As can be seen from Figure 11 (numbers above the bars indicate concentration), none of the O_3 monitors at SLAMS sites reach this threshold.

2.4.3 Monitoring Network

The Department currently has nine continuous ultraviolet (UV) photometric ozone analyzers in operation (Figure 10), two of which are co-located with chemiluminescence ozone analyzers (Lostwood and Beulah). Figure 11 presents the 2015 8-hour data summaries. Co-location was implemented in order to determine the cause(s) of elevated readings occurring at select UV photometric analyzers. The readings are suspected to be the result of UV photometric method-specific interference as they do not appear to register in the chemiluminescence based machine. For the time being, the Department will continue to operate collocated UV and chemiluminescence based analyzers to observe and resolve any differences in method results.

2.4.4 Network Analysis

Only three of the nine monitoring sites are in an area not significantly influenced by VOC sources (see Figure 10). Beulah and Hannover are within 45 miles of five of the 12 major VOC sources in the state. Lostwood National Wildlife Refuge (NWR) and TRNP - NU are located in Class I areas[14] surrounded by oil fields. Bismarck Residential and Fargo NW are located in population centers and influenced by city traffic. Williston is also in a population center located in the heart of oil country. Dunn Center is located in a rural area surrounded by crop land. With this diversity of site locations and influences, one would expect to see a diversity of ozone concentrations. On the contrary, Figure 11 shows a striking similarity among the 4th maximum 8-hour annual concentrations. Since 1980, only four 8-hour averages have been higher than 70 ppb. Another, even stronger, indication of a uniform ozone distribution is the 8-hour concentrations: for all sites, the difference among the 4th highest average is 4 ppb (see Figure 11). Figure 12 shows the annual average concentrations for the Department-operated sites for 1980 - 2015.

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[14] A Class I area is one of 156 parks and wilderness areas given special protection under the Clean Air Act for the purpose of visibility protection.

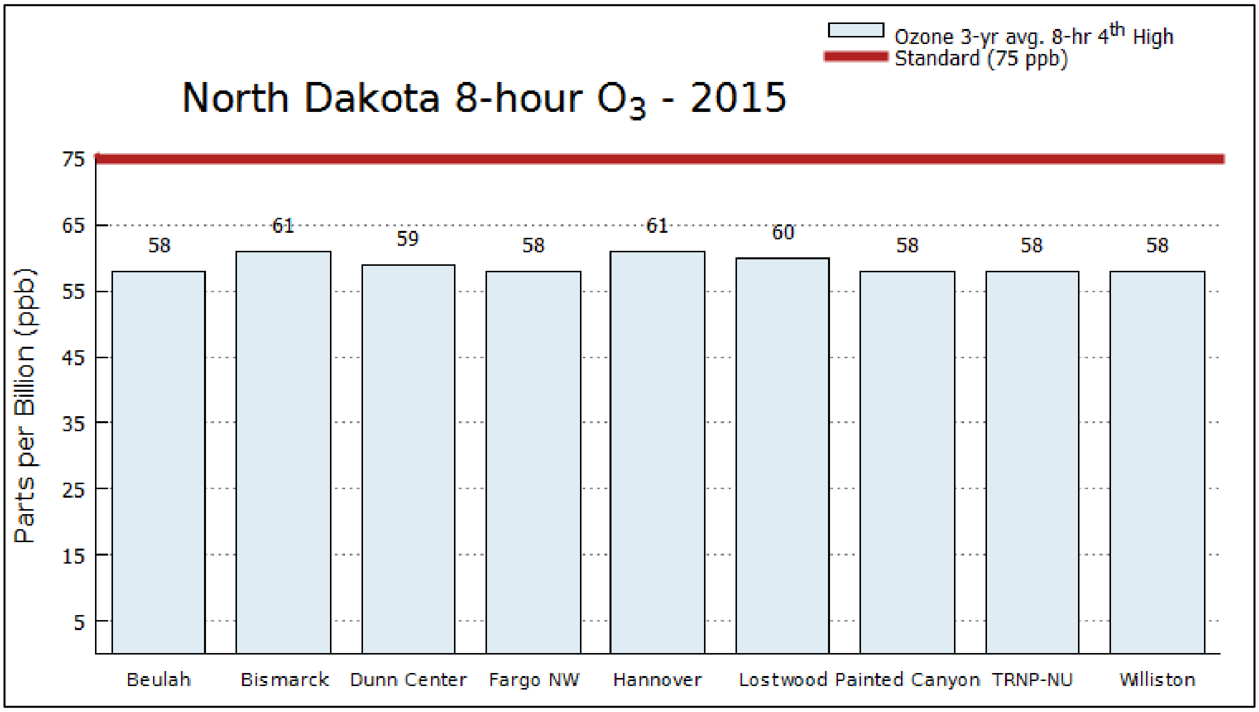

Figure 11. Ozone Concentrations Compared to the 8-hour Standard

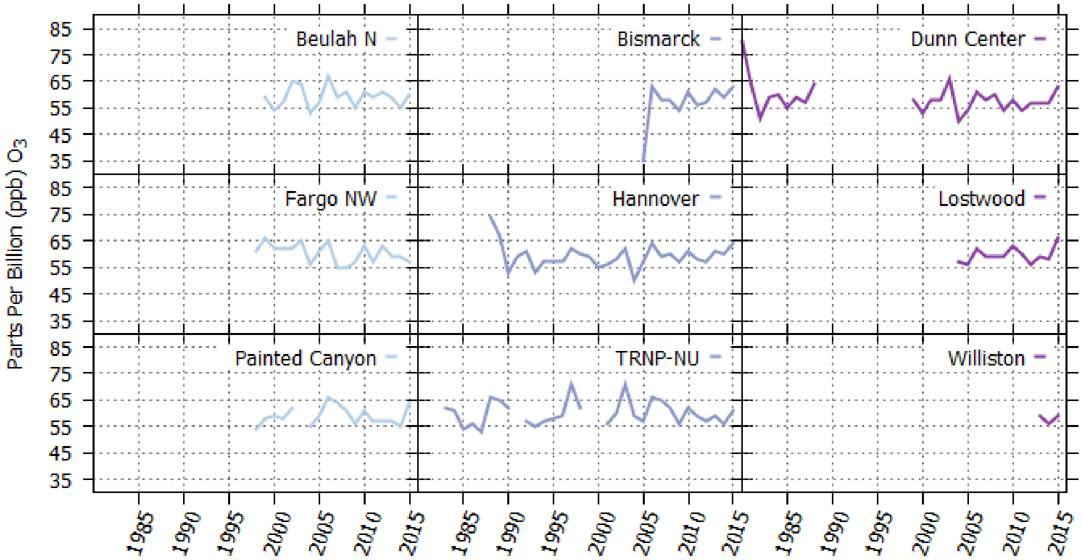

Figure 12. Annual 4th Highest 8-HR Ozone Concentrations

(As of December 28, 2015 the ozone standard changed from 75 ppb to 70 ppb)

2.4.5 Network Changes

There were no significant changes made to the O_3 network in 2015. The Department will continue to evaluate the utility of collocating ozone monitors to evaluate functional differences. Changes will be made to the collocations as necessary.

See section 3.0 – Network Site Changes for discussion of the addition of a new ambient monitoring station to the network.

2.5 Particle Pollution

Particulate matter (PM) is the term given to the tiny particles of solid or semi-solid material found in the atmosphere. The inhalable PM standards are designed to protect against those particulates that can be inhaled deep into the lungs and cause respiratory problems.

Particles larger than 10 micrometers are usually due to “fugitive dust” (windblown sand and dirt from roadways, fields, and constructions sites) and contain large amounts of silica (sand-like) materials. The majority of anthropogenic (man-made) PM is in the 0.1 to 10 micrometer particle diameter range. Within the NAAQS, there are two subgroups of PM identified: PM_{10} and $PM_{2.5}$. The PM_{10} particles have an aerodynamic diameter less than or equal to a nominal 10 microns, while the $PM_{2.5}$ particles have an aerodynamic diameter less than or equal to a nominal 2.5 microns.

PM_{10} is generally created during a burning process and includes fly ash (from power plants), carbon black (from automobiles and diesel engines), and soot (from fireplaces and wood-burning stoves); or industrial processes including grinding, crushing, or agricultural processing. PM_{10} from these sources contain a large percentage of elemental and organic carbon, which play a role in both visual haze and health issues. $PM_{2.5}$ can also form directly through combustion processes, but can also be the result of indirect formation through chemical reactions between various other compounds and meteorological factors in the atmosphere. The EPA has also defined PM subgroup of particles called “coarse fraction,” designated $PM_{10-2.5}$, with an aerodynamic diameter between 10 and 2.5 microns.

The health risk from an inhaled dose of PM depends on the size and concentration of the particulate. Size determines how deeply the inhaled particulate with penetrate into the respiratory tract, where it can persist and do damage. Particles less than 10 micrometers in diameter are easily inhaled deeply into the lungs. $PM_{2.5}$ (also called fine particulate pollution) affects the health of certain subgroups, which can be identified as potentially at risk of adverse health effects from airborne pollutants. There is very strong evidence that asthmatics are much more sensitive (i.e., respond with symptoms at relatively low concentrations) to the effects of particulates than is the general healthy population.

The effects of PM exposure may be the most widespread of all pollutants. Because of the potential for extremely long-range transport of $PM_{2.5}$ particles and because of the chemical reactions that occur, no place on earth has been spared from the particulate generated by urban and rural sources. The effects of PM range from visibility degradation to climate changes to vegetation damage. General soiling can have long-term effects on paint and other materials. Acid deposition can be detected in the most remote areas in the world.

2.5.1 Point Sources

The major PM point sources (>100 TPY of PM_{10}-Filterable + PM-Condensable) are listed in Table 5. Figure 13 shows the approximate locations of these facilities (the numbers correspond to the site and source tables). Most of these sources are large coal-fired facilities, and the particles are part of the boiler stack emissions; however, some of the emissions are the result of processing operations. Not included in this table are sources of fugitive dust such as coal mines, gravel pits, agricultural fields and unpaved roads. Figure 14 shows the contribution of point sources to the total PM emissions. The "Utility Boilers" category consists of power plant boilers. The "Other Point Sources" category consists of coal gasification, oil refineries, natural gas processing plants and agricultural processing plants.

2.5.2 Monitoring Network

The Department operated eight continuous PM_{10} analyzer sites, four Federal Reference Method (FRM) manual $PM_{2.5}$ sites, nine Federal Equivalent Method (FEM) continuous $PM_{2.5}$ analyzer sites, and one speciation sampler site.

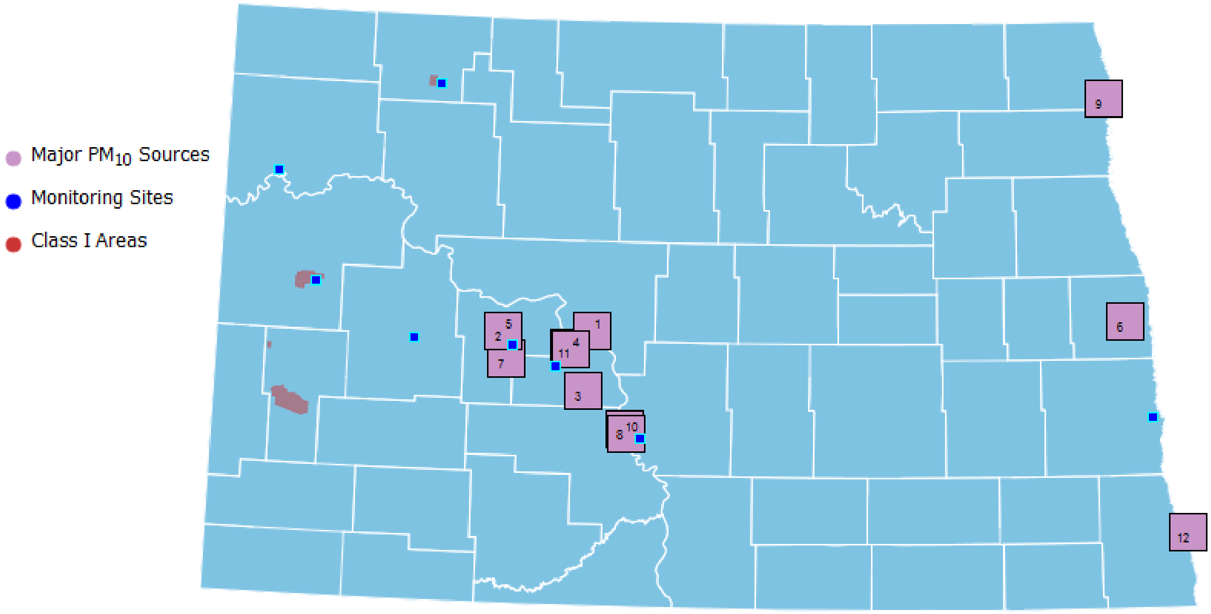

Figure 13. Major PM Sources in 2015

Table 5. Major PM Sources (≥ 100 TPY)* in 2015

#	COMPANY	SOURCE	EIS Facility ID
1	Great River Energy	Coal Creek Station	8011011
2	Dakota Gasification Company	Great Plains Synfuels Facility	8086711
3	Minnkota Power Cooperative, Inc.	Milton R. Young Station	8087911
4	Basin Electric Power Cooperative	Leland Olds Station	8086311
5	Basin Electric Power Cooperative	Antelope Valley Station	8086511
6	American Crystal Sugar Company	Hillsboro Plant	7939011
7	Otter Tail Power Company	Coyote Station	8086611
8	Montana Dakota Utilities Company	RM Heskett Station	8087011
9	American Crystal Sugar Company	Drayton Plant	7923811
10	Tesoro Refining and Marketing Company	Mandan Refinery	7923611
11	Great River Energy	Stanton Station	8086411
12	Minn-Dak Farmers Cooperative	Wahpeton Plant	7924011

* Total PM_{10}-Filterable + PM-Condensable as reported.

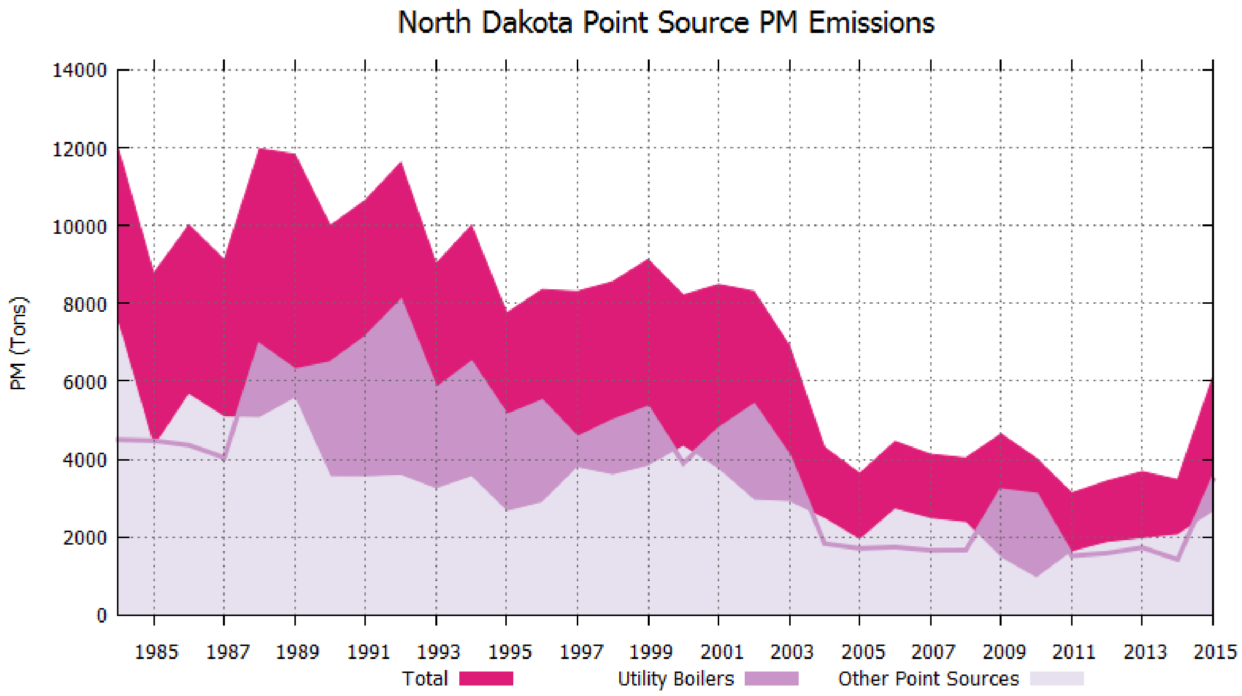

Figure 14. Annual PM Emissions[15]

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[15] From 2015, values represent PM_{10}-Filterable + PM-Condensable.

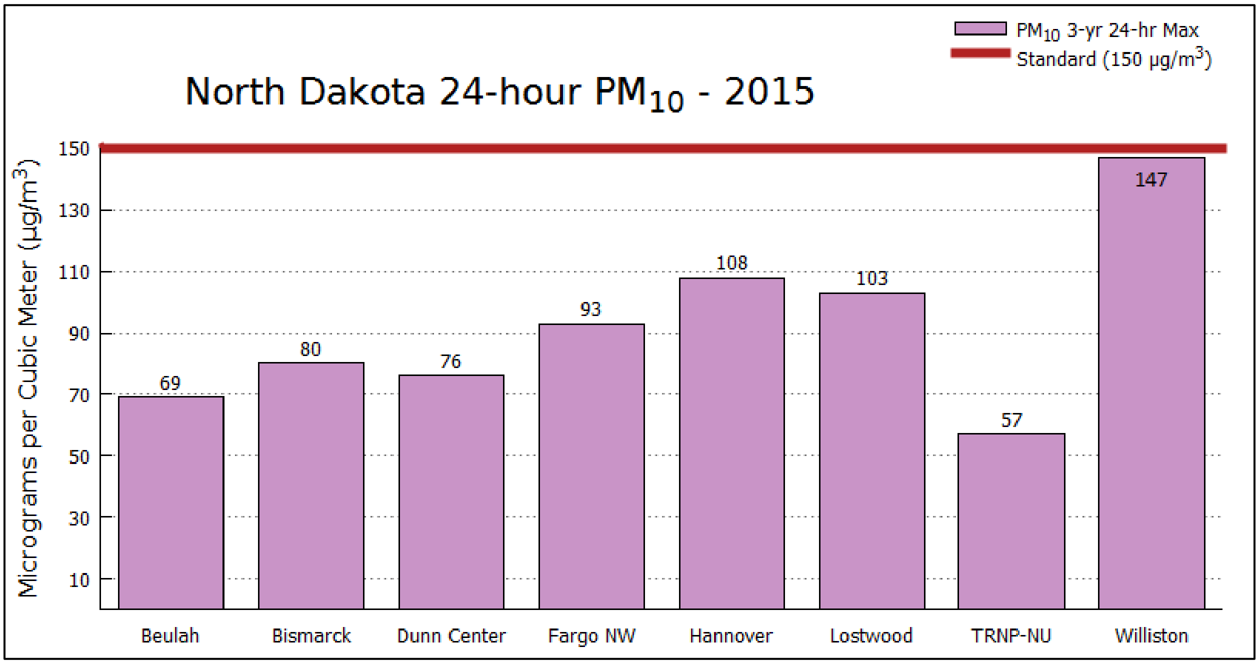

Figure 15. PM$_{10}$ Concentrations Compared to the 24-hour Standard[16]

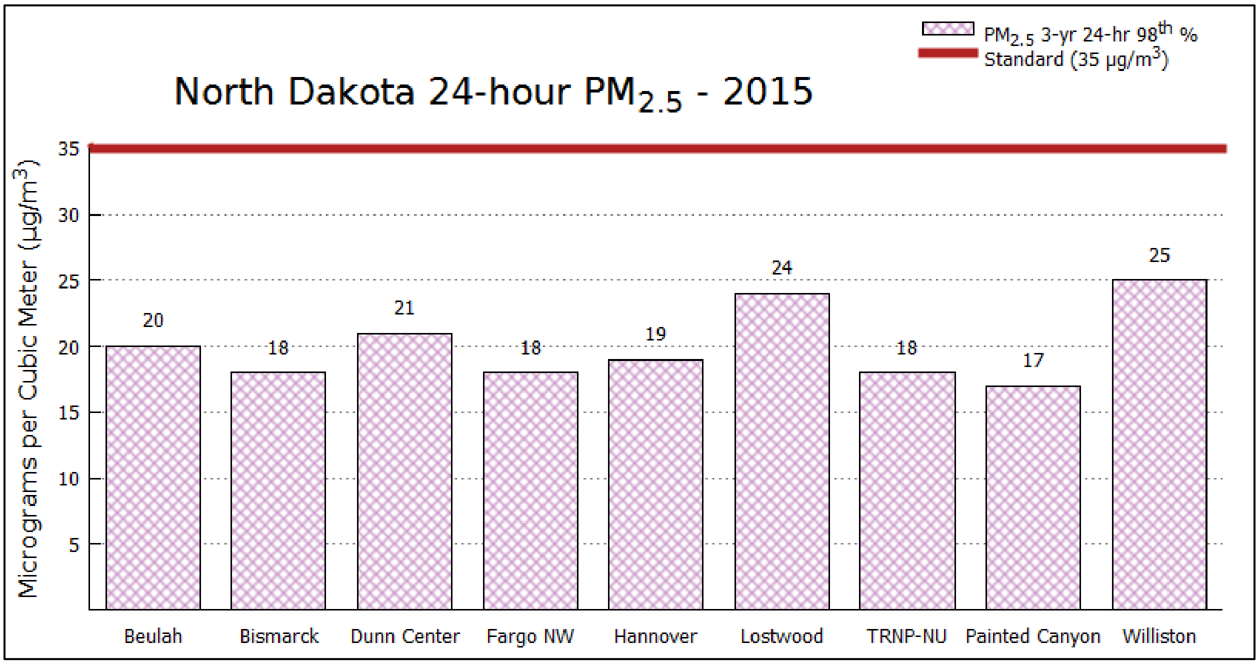

Figure 16. PM$_{2.5}$ Concentrations Compared to the 24-hour Standard

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[16] Values shown represent the high value over three years.

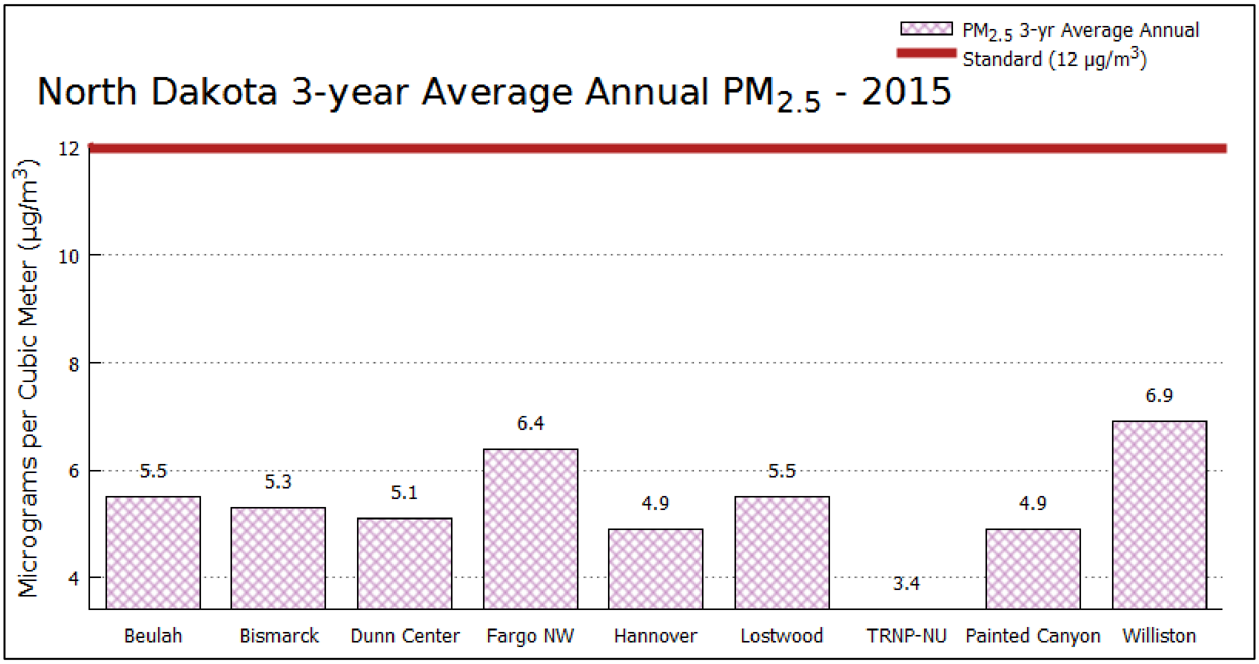

Figure 17. $PM_{2.5}$ Concentrations Compared to the Annual Standard

2.5.3 PM_{10} Network Analysis

PM_{10} and smaller particles are of concern mainly because of their health effects. Continuous PM_{10} analyzers are used with the continuous $PM_{2.5}$ analyzers to determine the $PM_{10-2.5}$ fraction. The data also are compared to both the state and federal ambient air quality standards. Figure 15 shows the 2015 PM_{10} particulate monitoring results in comparison to the 24-hour NAAQS. Numbers above the bars indicate monitored concentrations.

2.5.4 $PM_{2.5}$ Network Analysis

The manual $PM_{2.5}$ network currently has four sites: Bismarck, Beulah, Fargo and Painted Canyon. Bismarck and Fargo operate on a 1-in-3 day schedule, while Beulah and Painted Canyon operate on a 1-in-6 day schedule. FEM continuous $PM_{2.5}$ analyzers have been installed at all sites in the network. Figures 16 and 17 show the 2015 $PM_{2.5}$ particulate monitoring results in comparison to the 24-hour and annual standards. Numbers above the bars indicate monitored concentrations.

2.5.5 Speciation Network

One speciation sampler is installed as a National Trends Network sampler in Fargo. The data collected by this sampler are added to the Air Quality System (AQS) database by an EPA contractor[17].

2.5.6 Network Changes

The Department has evaluated co-location requirements for $PM_{2.5}$ particulate matter samplers and determined that a number of FRM manual samplers present in the network are redundant. Because the Department operates FEM continuous analyzers as primary monitors at all nine of the current monitoring sites, the Beulah and Painted Canyon manual FRM monitors will be removed. Additionally, with the NCore relocation from Fargo to Bismarck, manual sampling for $PM_{2.5}$ at Fargo will also end.

The Bismarck FRM will continue to operate on a 1-in-3 day schedule with a second FRM also on a 1-in-3 day schedule. The $PM_{2.5}$ speciation samplers will be located at Bismarck as well.

See section 3.0 – Network Site Changes for discussion of the addition of a new ambient monitoring station to the network.

2.6 Sulfur Dioxide

Sulfur dioxide (SO_2) is a colorless gas with a pungent odor detectable by the human nose at concentrations of 500 to 800 ppb. It is highly soluble in water where it forms sulfurous acid (H_2SO_3). In the atmosphere, sulfurous acid is easily converted to sulfuric acid (H_2SO_4), the major acidic component of “acid rain”, which then may convert again to form particulate sulfate compounds. On a worldwide basis, sulfur dioxide is considered to be a major pollutant. It is emitted mainly from stationary sources that burn coal and oil. Energy development in the west and west-central portions of North Dakota has produced a number of sources of SO_2. These sources include coal-fired steam-powered electrical generating facilities, a coal gasification plant, natural gas processing plants, oil refineries, and flaring at oil/gas well sites.

Sulfuric acid aerosols and particulate sulfate compounds, the result of conversions of SO_2 in the atmosphere, are corrosive and potentially carcinogenic (cancer-causing). The major health effects of SO_2 appear when it is associated with high levels of other pollutants, such as particulate. SO_2 also may play an important role in the aggravation of chronic illnesses, such as asthma. The incidence and intensity of asthma attacks have increased when asthmatics are exposed to higher levels of sulfur dioxide and particulate matter sulfates[18].

Particulate matter sulfates resulting from SO_2 emissions can also affect visibility. In combination with high humidity, sulfates can develop to sizes that are effective at scattering sunlight, thus resulting in reduced visibility through haze formation. SO_2 is one of the Department's primary

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[17] RTI International

[18] U.S. EPA (2008). Integrated Science Assessment (ISA) for Sulfur Oxides – Health Criteria (Final Report). Available at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=198843.

interests with respect to visibility: first, to aid in establishing the visibility baseline, then to track visibility improvement over time.

2.6.1 Point Sources

The major SO_2 point sources (>100 TPY) based on 2015 emissions are listed in Table 6. Figure 18 shows the approximate locations of these facilities. Figure 19 shows the total annual SO_2 emissions from point sources and three sub-categories for 1984 through 2015.

2.6.2 Other Sources

The western part of the state has a number of potential SO_2 sources including oil wells, oil storage facilities, and natural gas compressor stations. These sources may directly emit amounts of hydrogen sulfide to the ambient air (see Section 2.7 for further discussion on hydrogen sulfide) or they may flare the hydrogen sulfide creating SO_2 and contributing to concentrations of this pollutant.

2.6.3 Monitoring Network

There are eight SO_2 monitoring sites in the state. As can be seen in Figure 18, the majority of the sites are concentrated in the vicinity of the oil and gas development in the west and the coal-fired steam electrical generating plants in the west-central part of the state.

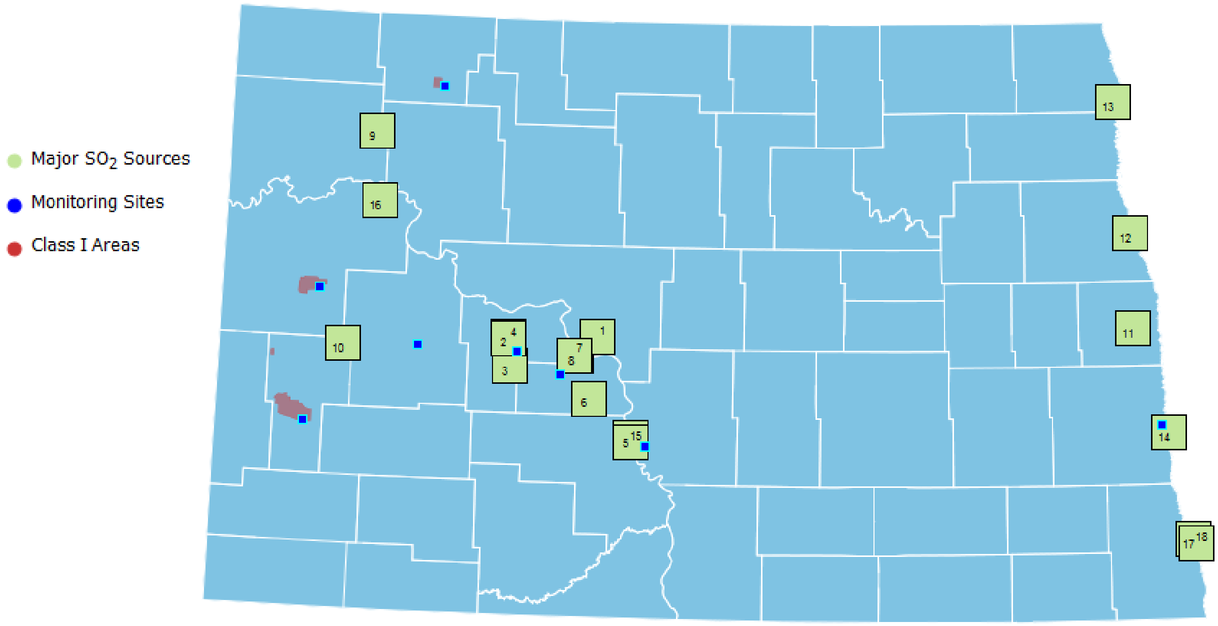

Figure 18. Major Sulfur Dioxide Sources in 2015

Table 6. Major SO_2 Sources (≥100 TPY) in 2015

#	Company Name	Source	EIS Facility ID
1	Great River Energy	Coal Creek Station	8011011
2	Basin Electric Power Cooperative	Antelope Valley Station	8086511
3	Otter Tail Power Company	Coyote Station	8086611
4	Dakota Gasification Company	Great Plains Synfuels Facility	8086711
5	Montana Dakota Utilities Company	RM Heskett Station	8087011
6	Minnkota Power Cooperative, Inc.	Milton R. Young Station	8087911
7	Great River Energy	Stanton Station	8086411
8	Basin Electric Power Cooperative	Leland Olds Station	8086311
9	Hess Corporation	Tioga Gas Plant	8013911
10	Petro-Hunt, LLC	Little Knife Gas Plant	8023811
11	American Crystal Sugar Company	Hillsboro Plant	7939011
12	University of North Dakota	UND Heating Plant	7292911
13	American Crystal Sugar Company	Drayton Plant	7923811
14	North Dakota State University	NDSU Heating Plant	8448211
15	Tesoro Refining and Marketing Company	Mandan Refinery	7923611
16	Hess North Dakota Pipelines LLC	Hawkeye Compressor Station	10613211
17	Cargill Corn Milling	Wahpeton Facility	10612711
18	Minn-Dak Farmers' Cooperative	Wahpeton Plant	7924011

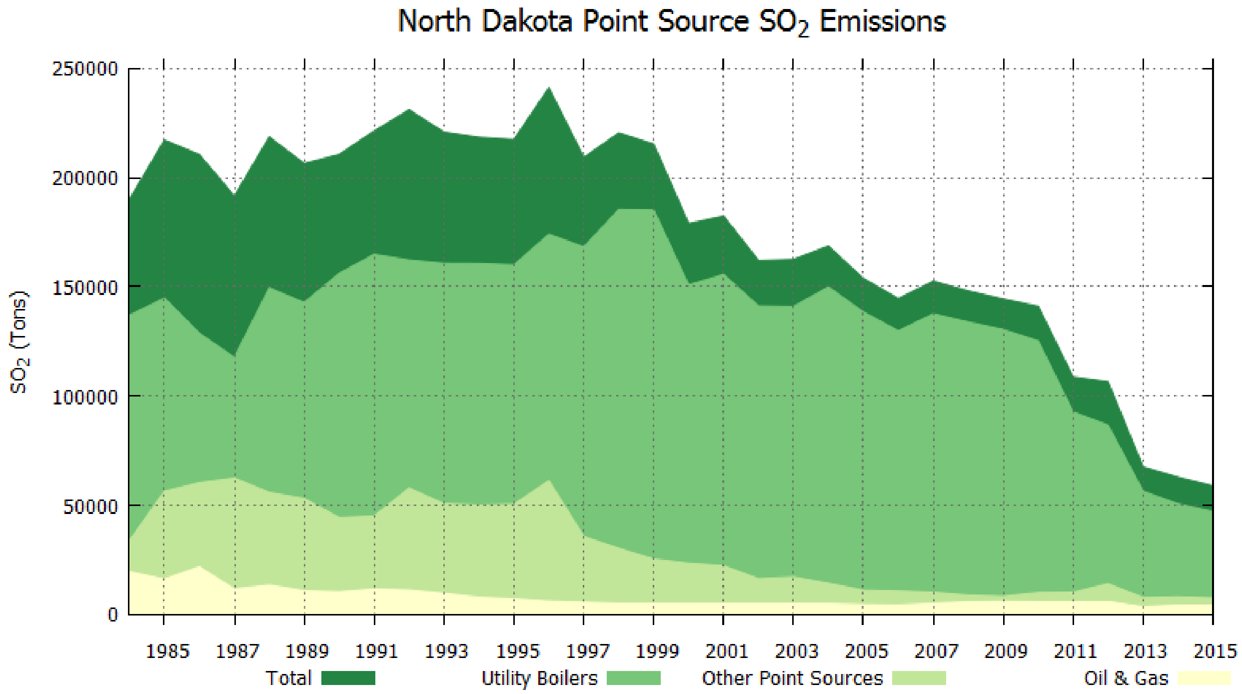

Figure 19. Annual Sulfur Dioxide Emissions

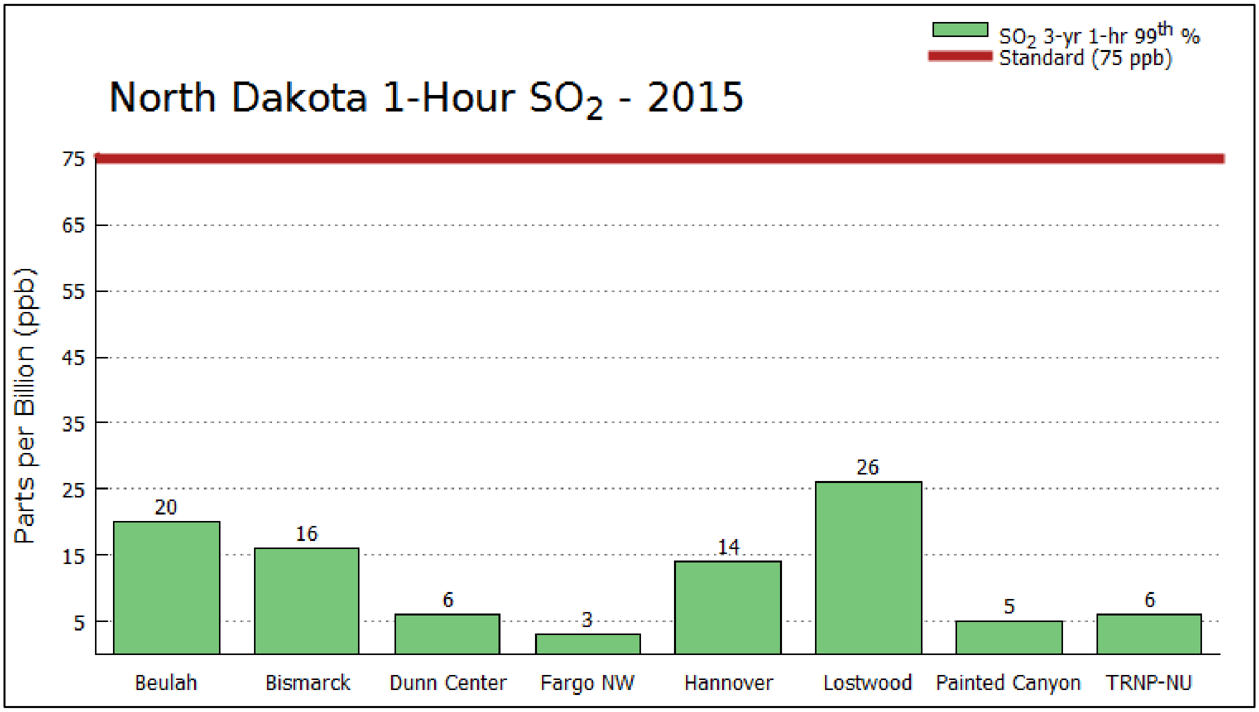

Figure 20. SO_2 Concentrations Compared to the 1-hour Standard

2.6.4 Network Analysis

Figure 20 shows the 2015 SO_2 monitoring results in comparison to the 1-hour SO_2 NAAQS. Numbers above the bars indicate monitored concentrations.

Ten major SO_2 sources are within 45 miles of both the Beulah and Hannover sites. This makes these two sites very important in tracking the impact of these sources on the ambient air. Also, Lostwood NWR is within 45 miles of four major sources: two natural gas processing plants and two power plants. The two power plants are located near Estevan, Saskatchewan, approximately 40 miles to the northwest.

One would expect that as the large sources in Oliver and Mercer counties came on line beginning in 1980, a noticeable change would be seen on the ambient air quality. This has not been the case. There have been possible short-term influences, but no significant long-term impact by these sources combined has been demonstrated in the data. Figure 21 presents 1-hour maximums for the Department-operated sites.

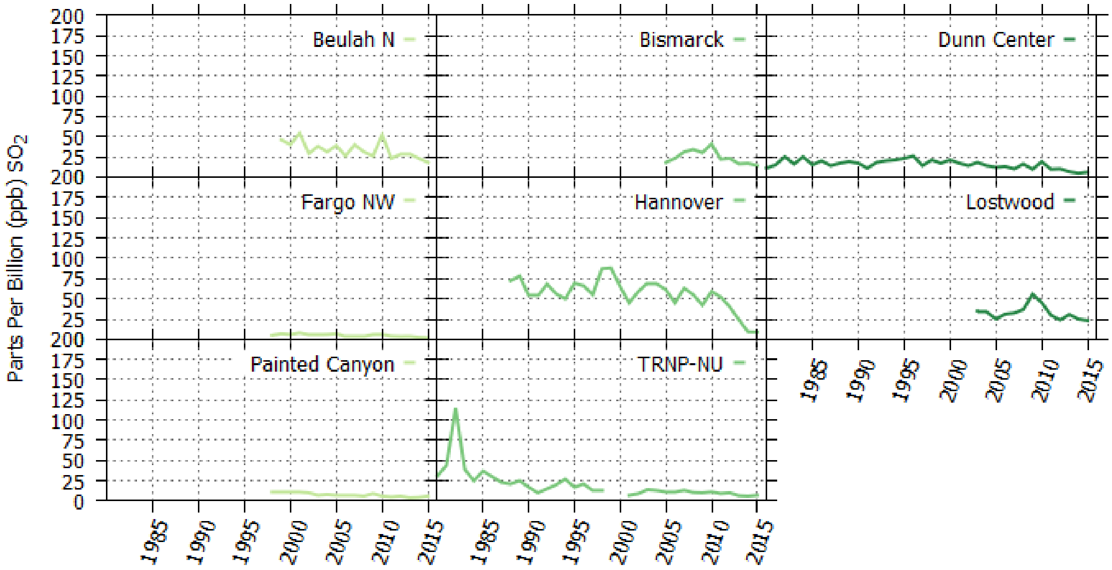

Figure 21 SO_2 99th Percentile 1-Hour Concentrations

Beginning in 1980, major events are traceable. In 1980, the oil industry was expanding and in 1982 the oil industry in western North Dakota hit a peak in activity prior to the most recent increase. Dunn Center and TRNP – NU show the influence from the oil field activity as the oil fields expanded and flared the gas. As pipelines were built and wells were tied into the pipelines, the amount of hydrogen sulfide gas flared decreased, reducing the amount of sulfur dioxide emitted. Once the wells were tied into pipelines, the predominant influence at these two sites has been long-range transport from major point sources.

Dunn Center and TRNP – NU are indicators of the “oil patch” activity and tracked the activity very well. Since TRNP – NU is more centrally located in the “oil patch,” it is the stronger indicator. Dunn Center, which is on the eastern edge of the oil development area, demonstrates influences from both the “oil patch” and the coal conversion facilities to the east.

2.6.5 Network Changes

There were no significant changes made to the SO_2 monitoring network in 2015.

With the relocation of the NCore site, trace level monitoring for SO_2 will end in Fargo and begin in Bismarck. Standard SO_2 monitoring will begin in Fargo. Additionally, the Department has determined that because of continued low design values and fairly consistent data results for SO_2 at the TRNP-NU, Lostwood, and Dunn Center sites, trace level SO_2 monitoring will be suspended and standard SO_2 monitoring will be initiated at these sites as well.

See section 3.0 – Network Site Changes for the discussion on the addition of a new SLAMS ambient monitoring station to the network as well as ambient monitor site selection in response to the requirement of 40 CFR 51.1203 (b) concerning characterization of 1-hour SO_2 concentrations for the Tioga area.

2.7 Hydrogen Sulfide

Hydrogen sulfide (H_2S) is a colorless gas with a rotten egg odor. It is incompatible with strong oxidizers and reacts violently with metal oxides. It will attack many metals, forming sulfides.

A 5-minute exposure to 800 ppm H_2S has resulted in death. Inhalation of 1,000 to 2,000 ppm may cause a coma after a single breath. Exposure to lower concentrations may cause headache, dizziness and upset stomach. Low concentrations (20 to 150 ppm) can cause eye irritation which may be delayed in onset. Although the odor is detectable at very low concentrations, it rapidly causes olfactory fatigue at higher levels, and, therefore, is not considered to have adequate warning.

Although no Federal Ambient Air Quality Standard exists for H_2S, the state of North Dakota has developed H_2S standards in response to historically high petroleum sulfur content (during the 1980s in particular) and associated high H_2S. The major source of H_2S is oil wells. Other sources are natural gas processing plants, lagoons, and sloughs. Emissions have been reduced significantly over time as production from these older sites has declined. The Bakken formation, the focus of the most recent oil and gas activity in the state, has been found to result in very low H_2S emissions when compared to legacy (non-Bakken) operations.

2.7.1 Point Sources

H_2S emissions of concern stems almost totally from the oil and gas operations in the western part of the state. Flares and treater stacks associated with oil/gas wells, oil storage tanks, compressor stations, pipeline risers, and natural gas processing plants are potential H_2S emission sources.

2.7.2 Monitoring Network

Currently there are no state H_2S monitoring sites.

2.7.3 Network Changes

There were no significant changes made to the H_2S network in 2015. There are no changes planned for 2016.

2.8 Ammonia

Ammonia (NH_3) is a corrosive, colorless gas with a strong irritating odor. It is used in making fertilizer, plastics, dyes, textiles, detergents, and pesticides. It reacts with acids and oxidizing materials (fluorine, chlorine, etc.). It is corrosive to copper, zinc, and many metal surfaces and reacts with hypochlorite and halogens to form explosive compounds that are pressure and temperature sensitive. In combination with oxides of nitrogen and sulfur, NH_3 can form small particulates with potential impact to health and visibility.

In mild concentrations (< 25,000 ppb), NH_3 will cause conjunctivitis and dermatitis. At higher concentrations, it will cause swelling of tissue, painful burns, lesions, and possible loss of vision. On contact with the skin, it will cause caustic-like burns and inflammation. Toxic level skin exposure (± 300,000 ppb) may cause skin lesions resulting in early necrosis and scarring. Inhalation of NH_3 is corrosive and irritating to the upper respiratory system and mucus membranes. Depending on the concentration inhaled, NH_3 may cause burning sensations, coughing, wheezing, shortness of breath, headache and nausea, with eventual collapse and death.

There is no ambient air quality standard for NH_3. However, because NH_3 concentrations are an important factor in the secondary formation of fine particulate matter through reactions with NO_x and SO_2, the Department maintains a select number of NH_3 monitors throughout North Dakota.

2.8.1 Point Sources

The major sources of NH_3 are listed in Table 7 and Figure 22 shows the approximate locations of these facilities (the numbers correspond to the source table).

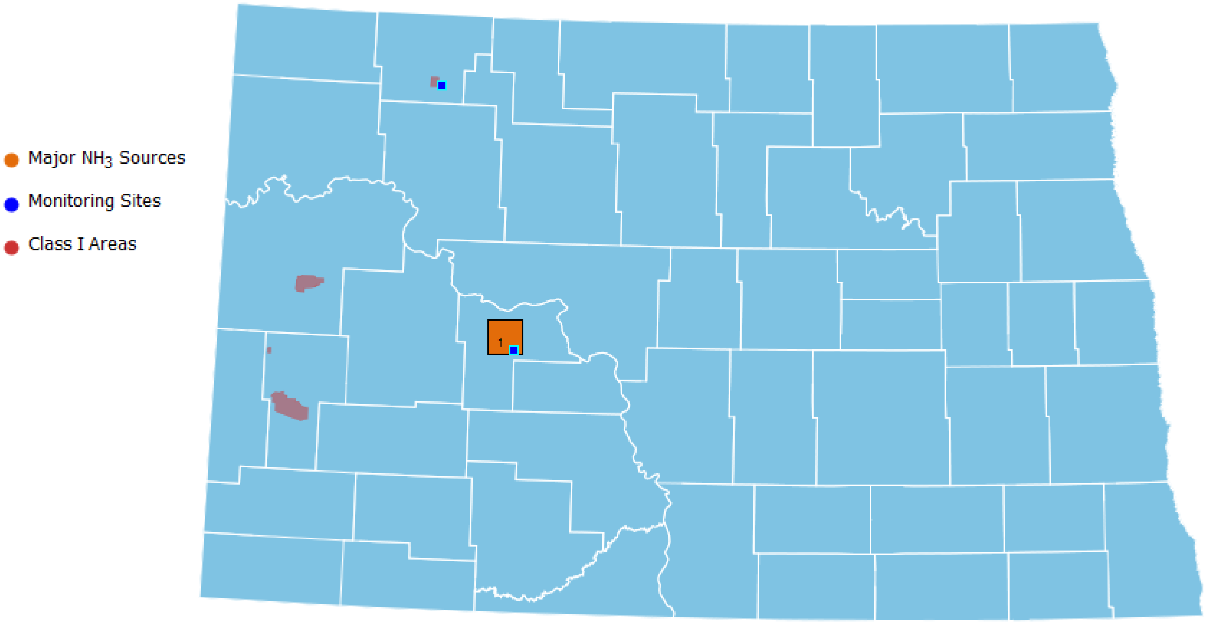

Figure 22. Major Ammonia Sources in 2015

Table 7. Major Ammonia Sources (≥ 100 TPY) in 2015

#	COMPANY	SOURCE	EIS Facility ID
1	Dakota Gasification Company	Great Plains Synfuels Facility	8086711

2.8.2 Monitoring Network

Currently there are two NH_3 monitoring sites in the state.

2.8.3 Network Analysis

Figure 23 shows maximum monitored NH_3 concentrations at the two monitoring sites in comparison with the arithmetic mean yearly concentration. As there is currently no NAAQS for NH_3, none is shown on the chart.

2.8.4 Network Changes

There were no significant changes made to the NH_3 network in 2015. There are no changes planned for 2016.

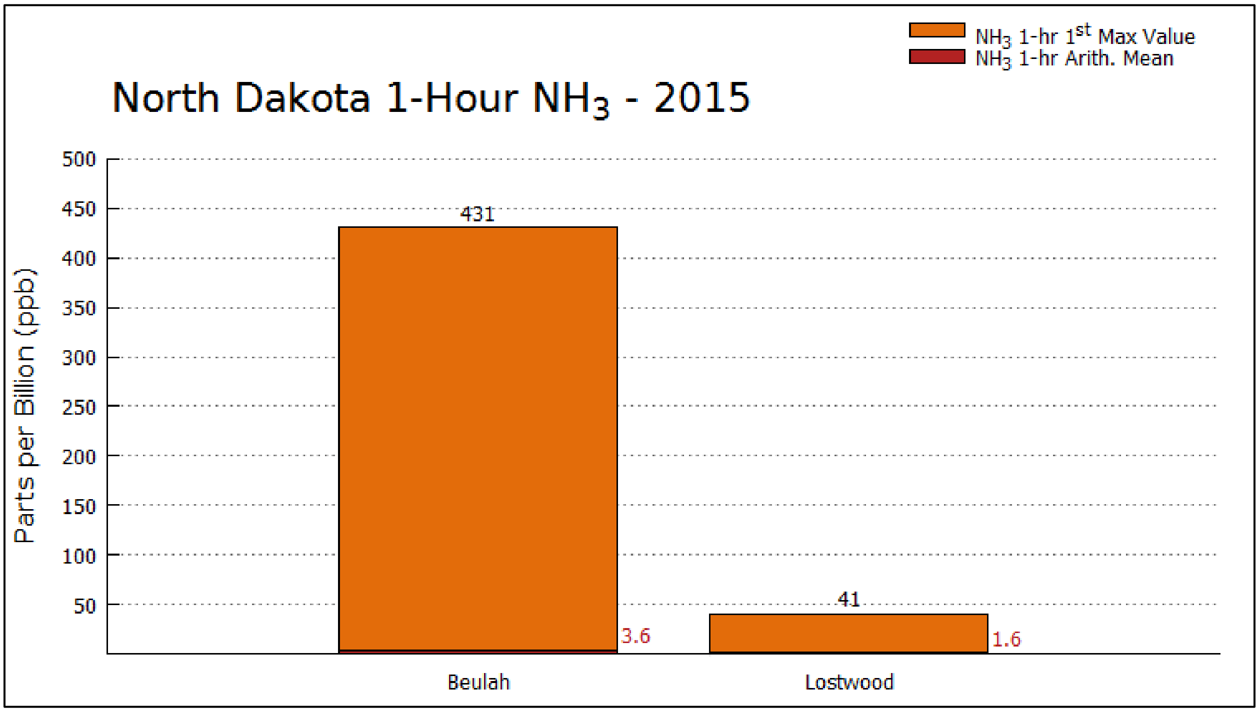

Figure 23. NH_3 Concentrations: Maximum Value and Arithmetic Mean

2.9 Air Toxics

The term 'air toxics' refers to Hazardous Air Pollutants (HAP) - air contaminants, other than those listed above, that at certain concentrations could be "injurious to human health or well-being or unreasonably interfere with the enjoyment of property or that would injure plant or animal life."[19] Currently there are no state or federal air toxics monitoring sites in North Dakota.

2.9.1 Point Sources

The major air toxics sources are listed in Table 8 and Figure 24 shows the approximate locations of these facilities (the numbers correspond to the source table).

2.9.2 Monitoring Network

Currently there are no state air toxics monitoring sites. The historic raw data and associated summaries are available in EPA's AQS.

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[19] NDDoH (2010). Policy for the Control of Hazardous Air Pollutant Emissions in North Dakota (Air Toxics Policy). Available via link at http://www.ndhealth.gov/AQ/HAPs.aspx

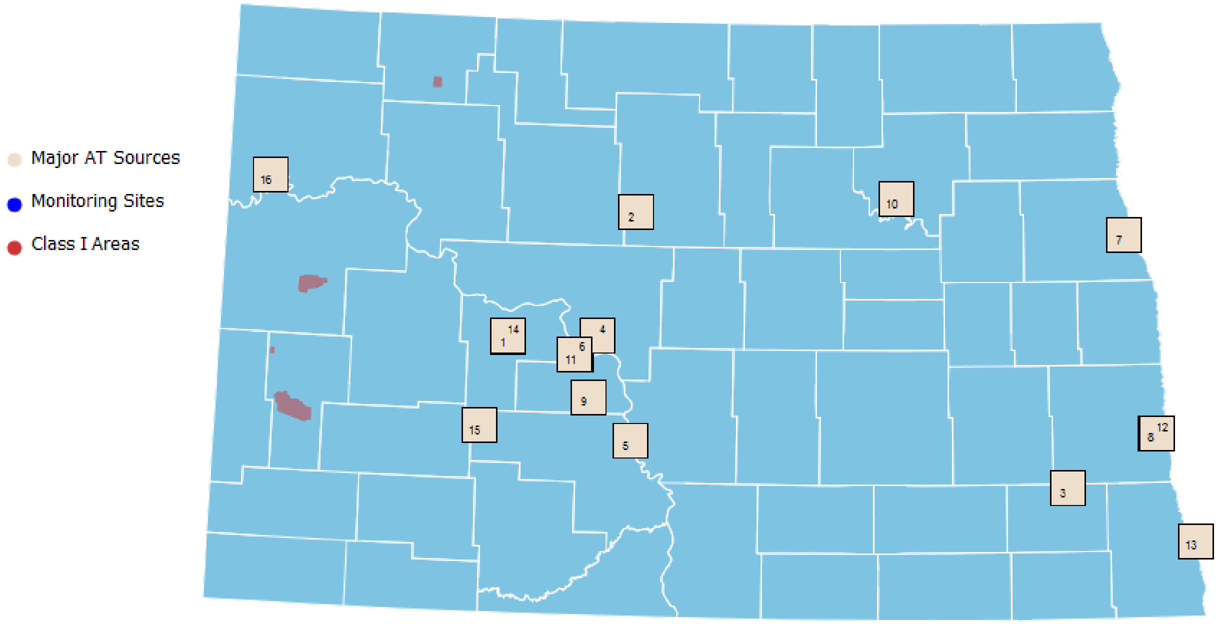

Figure 24. Major Air Toxics Sources in 2015

Table 8. Major Air Toxics Sources (≥ 10 TPY of a single HAP or ≥ 25 TPY aggregate HAPS) in 2015

#	COMPANY	SOURCE	EIS Facility ID
1	Dakota Gasification Company	Great Plains Synfuels Facility	8086711
2	ADM Processing	Velva Facility	8085211
3	Northern Sun (Division of ADM)	Enderlin Facility	7923911
4	Great River Energy	Coal Creek Station	8011011
5	Tesoro Refining and Marketing Company	Mandan Refinery	7923611
6	Great River Energy	Stanton Station	8086411
7	LM Wind Power Blades	Grand Forks Facility	7293311
8	Cargill, Inc.	Cargill Oilseeds Processing	9271111
9	Minnkota Power Cooperative, Inc.	Milton R. Young Station	8087911
10	Nordic Fiberglass, Inc.	Devils Lake Plant	8203411
11	Basin Electric Power Cooperative	Leland Olds Station	8086311
12	Trinity Containers, LLC	Trinity Containers, LLC – Plant #1593	10612911
13	Minn-Dak Farmers Cooperative	Wahpeton Plant	7924011
14	Basin Electric Power Cooperative	Antelope Valley Station	8086511
15	Hebron Brick Company	Hebron Brick Plant	8087211
16	Mor-Tech-Fab, Inc.	Williston Plant	8014311

2.9.3 Network Changes

There were no significant changes made to the Air Toxics network in 2015. There are no changes planned for 2016.

3.0 NETWORK SITE CHANGES

3.1 NCore (Bismarck/Fargo)

On April 18, 2016, EPA approved the Bismarck Residential site (AQS# 38-015-0003) to be the required NCore site for North Dakota[20]. The Fargo NW station (AQS# 38-017-1004) was the previously designated NCore site in the state. Because of the new designation, monitors associated exclusively with the NCore site will move from Fargo to Bismarck – these include NOy, CO, trace level SO_2 and NO_2 (although standard SO_2 and NO_2 monitoring will continue in Fargo), $PM_{10-2.5}$, and $PM_{2.5}$ speciation. Bismarck will host two $PM_{2.5}$ FRM manual samplers operating on 1-in-3 day schedules. The move is tentatively scheduled to be completed in June of 2016.

3.2 Dunn Center/Lake Ilo

A monitoring station in the Dunn Center area (AQS# 38-025-0003) has been providing air quality data for approximately 40 years. The current site is located on leased private land and future accessibility has been called into question. The Department has entered into an agreement with the U.S. Fish and Wildlife Service to allow a new air monitoring site to be located at the Lake Ilo National Wildlife Refuge. The Lake Ilo site is about 1 mile west of the city of Dunn Center and about 6 miles WNW of the current Dunn Center monitoring site location. Initially, the Lake Ilo site will be operated concurrently with the Dunn Center station. This will allow for comparison of monitoring results as the same pollutants will be monitored at both sites. The Department plans a minimum of one quarter of valid data collection to show concurrence between the two stations. If, based on a review of the collected data, concurrence is satisfactorily demonstrated, monitoring at the current Dunn Center site will end and the Lake Ilo site will be re-designated a SLAMS site. Monitoring is projected to begin at Lake Ilo in the third quarter of 2016.

Lake Ilo site specifics will be provided prior to the start of monitoring at the site; in either a future addendum to this annual report document or the next annual report.

3.3 Ryder (Minot)

To continue its mission to gain an accurate picture of the air quality in North Dakota, the Department has been charged with deploying a new, 10th, ambient monitoring station. The purpose of this station is to gain a fuller understanding of the impacts on air quality due to oil and

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[20] See the NCore Relocation addendum to the 2014-2015 Annual Report for more information on the relocation request. Available online at: http://www.ndhealth.gov/AQ/ambient/Annual%20Reports/ARNP_14-15_Addendum.pdf

gas development in the state.

The siting process has identified a location on state owned land in Ryder, ND, approximately 20 miles southwest of Minot. This location is on the eastern edge of the oil patch in Ward County.

The new site is will consist of a suite of pollutant monitoring instruments selected to best provide an accurate assessment of air quality conditions. Monitors at the station will include ones designed to measure NO_2, SO_2, O_3, and $PM_{2.5}$. Additionally, the site will host a complement of meteorological instrumentation (e.g. wind speed and wind direction).

The Ryder site is anticipated to begin operations upon the conclusion of the Dunn Center/Lake Ilo concurrent monitoring period described in Section 3.2.

Ryder site specifics will be provided prior to the start of monitoring at the site; in either a future addendum to this annual report document or the next annual report.

3.4 Peak 1-Hour SO_2 Characterization for the Tioga Area

Effective September 21, 2015, EPA promulgated the Data Requirements Rule (DRR) for the 2010 1-hour SO_2 standard which requires state air agencies to characterize air quality in areas with large sources of SO_2 emissions. The Hess Corporation's Tioga Gas Plant in Williams County is subject to this rule as an applicable source due to non-regulatory monitors in the area suggesting excessive ambient concentrations of SO_2. This applicability is outlined in the March 18, 2016 DRR Response letter from EPA[21]. One of the pathways for a state agency to characterize air quality is to use ambient air quality monitoring by use of SLAMS or SLAMS-like[22] monitors. The decision to use monitoring for air quality characterization must be communicated to EPA by July 1, 2016. It is the intent of the Department to use SLAMS-like monitors to meet this requirement.

In support of the ambient monitoring decision, the Department reviewed the two current industry operated ambient monitoring sites associated with the Tioga Gas Plant. These are located 0.8 miles north and 0.5 miles southeast, respectively, of the facility. Preliminary screening air dispersion modeling conducted by the Department suggested that a monitor location along the facility fenceline to the northwest of the facility may show higher concentrations than either of the two existing monitoring sites.

Based on these preliminary findings, the Department requested that the Hess Corporation prepare a comprehensive air dispersion modeling analysis for the Tioga Gas Plant to aid in monitor siting. Hess conducted the analysis in accordance with applicable sections of 40 CFR 51, Appendix W and recommendations of the SO_2 NAAQS Designations Source-oriented Monitoring Technical

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[21] Available at https://www3.epa.gov/airquality/sulfurdioxide/drr/nd-response.pdf

[22] Monitors operated in a manner equivalent to SLAMS as to meet all applicable requirements of 40 CFR 58, appendices A, C, and E, and subject to the data certification and reporting requirements of 40 CFR 58.15 and 58.16.

Assistance Document (TAD[23]). The results of this analysis are provided in Appendix E and suggest that the current high reading monitor (the site located to the SE of the facility and the one that triggered the action under the DRR) should be retained and supplemented by a second monitor located approximately five miles NNE of the facility. This second location was shown through the modeling analysis as the point of maximum concentration and frequency. After a thorough review, The Department concurs with the conclusions reported in the analysis and has determined that SO_2 monitors should be located in the locations as proposed. These two monitors will be sufficient to characterize the air quality in the ambient air impacted by the Tioga Gas Plant.

4.0 SUMMARY AND CONCLUSIONS

The North Dakota Ambient Air Quality Monitoring Network is designed to monitor those air pollutants that demonstrate the greatest potential for deteriorating the air quality of North Dakota. Due to a greater number of pollution-producing sources in the western part of the state (primarily associated with the energy producing industries) the greatest percentage of the network is located in the western part of the State.

4.1 Carbon Monoxide (CO)

Neither the state nor federal CO standards of 35,000 ppb (1-hour) or 9,000 ppb (8-hour) were exceeded at the monitoring site. The maximum concentrations are as follows: 1-hour – 875 ppb; 8-hour – 800 ppb.

The Department will move the trace-level CO monitor from Fargo to Bismarck as part of the larger NCore site relocation.

4.2 Lead

No lead monitoring was conducted. No changes to the network were identified.

4.3 Nitrogen Dioxide (NO_2)

Neither the state nor federal NO_2 standards of 100 ppb (1-hour) or 53 ppb (annual) were exceeded at any of the monitoring sites. The maximum concentrations were as follows: Three year average of the 98th percentile 1-hour average concentrations – 34 ppb; annual – 5.37 ppb.

The Department will move the NO_y monitor from Fargo to Bismarck as part of the larger NCore

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[23] In Draft. Updated February, 2016 and available online at https://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2MonitoringTAD.pdf

site relocation. NO_2 monitors will be installed at the new ambient monitoring stations at Lake Ilo and Ryder and contingent on concurrence being demonstrated between Lake Ilo and Dunn Center, NO_2 monitoring will end at Dunn Center.

4.4 • Ozone (O_3)

Neither the state nor federal O_3 standard of 75 ppb was exceeded during the year. The maximum fourth-highest 8-hour concentration was 61 ppb.

O_3 monitors will be installed at the new ambient monitoring stations at Lake Ilo and Ryder and contingent on concurrence being demonstrated between Lake Ilo and Dunn Center, O_3 monitoring will end at Dunn Center.

4.5 • Particulate Matter (PM_{10}, $PM_{2.5}$)

The federal PM_{10} 24-hour standard states that the concentration of PM_{10} in the ambient air should not go over 150 $\mu g/m^3$ more than once per year on average over a three year period. Neither the state nor federal PM_{10} standard was exceeded during the year. The highest applicable concentration recorded in the state was 147.0 $\mu g/m^3$.

Neither the state nor federal $PM_{2.5}$ standards of 35 $\mu g/m^3$ (24-hour) and 12 $\mu g/m^3$ (annual) were exceeded during the year. The maximum concentrations are as follows: 24-hour – 24 $\mu g/m^3$; annual – 6.9 $\mu g/m^3$.

The Department will move the $PM_{10-2.5}$ and $PM_{2.5}$ speciation samplers from Fargo to Bismarck as part of the larger NCore site relocation. Manual FRM $PM_{2.5}$ sampling will end at Beulah, Painted Canyon, and Fargo. Bismarck will operate two manual FRM $PM_{2.5}$ samplers on a 1-in-3 day schedule. Continuous FEM $PM_{2.5}$ monitors will be installed at the new ambient monitoring stations at Lake Ilo and Ryder and contingent on concurrence being demonstrated between Lake Ilo and Dunn Center, $PM_{2.5}$ monitoring will end at Dunn Center.

4.6 • Sulfur Dioxide (SO_2)

Neither the state nor federal SO_2 standard of 75 ppb (1-hour) was exceeded at any state operated monitoring site. The maximum concentrations were as follows: 3-year average 1-hour 99th percentile – 26 ppb.

The Department will move the trace level SO_2 monitor from Fargo to Bismarck as part of the larger NCore site relocation. Standard SO_2 monitoring will commence in Fargo. Additionally, trace level monitoring for SO_2 will end and standard SO_2 monitoring will begin at the TRNP-NU and Lostwood sites. SO_2 monitors will be installed at the new ambient monitoring stations at Lake Ilo and Ryder and contingent on concurrence being demonstrated between Lake Ilo and Dunn Center, SO_2 monitoring will end at Dunn Center.

In order to fulfill the obligations of the DDR, two SO_2 monitoring sites will be operated as SLAMS-like monitors in the vicinity of the Hess Corporation Tioga Gas Plant in Williams County. These will be located 0.5 miles to the SE and 5 miles to the NNE of the facility, respectively. Specific location information will be provided in a network plan addendum.

4.7 ● Hydrogen Sulfide (H_2S)

No H_2S monitoring was conducted. No changes to the network were identified.

4.8 ● Ammonia (NH_3)

There is no ambient air quality standard for ammonia. The maximum 1-hour concentration measured was 431 ppb with a maximum yearly average (arithmetic mean) of 3.6 ppb. No changes to the network were identified.

4.9 ● Air Toxics (HAP)

No Air Toxics monitoring was conducted. No changes to the network were identified.

Appendix A Air Quality Personnel Organizational Chart

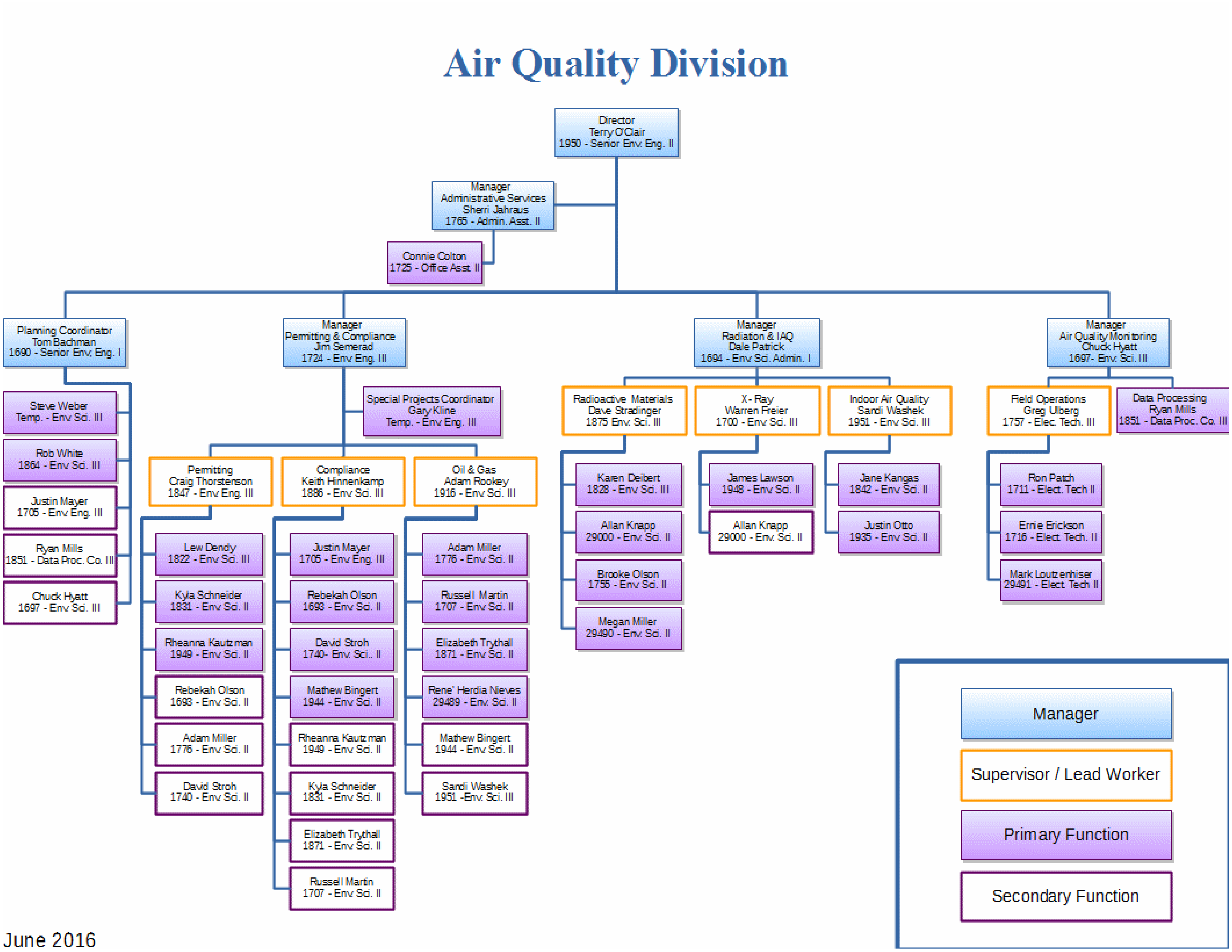


Figure 25. Organizational Chart

Appendix B Ambient Air Quality Standards

Table 9. National and North Dakota Ambient Air Quality Standards

Ambient Air Quality Standards

Pollutant		Averaging Period	North Dakota		Federal	
			µg/m^3	ppb	µg/m^3	ppb
Carbon Monoxide (CO)		1-hour [a]	40,000	35,000	40,000	35,000
		8-hour [a]	10,000	9,000	10,000	9,000
Lead		3-month [b]	0.15	--	0.15	--
Nitrogen Dioxide (NO_2)		Annual [c]	100	53	100	53
		1-hour [d]	188	100	188	100
Ozone (O_3)		8-hour [e]	147	75	147	75 **
Particulate Matter	PM_{10}	24-hour [f]	150	--	150	--
	$PM_{2.5}$	24-hour [g]	35	--	35	--
		Annual [h]	12	--	12	--
Sulfur Dioxide (SO_2)		1-hour [i]	196	75	196	75
		3-hour [a]	1309	500	1309	500
		24-hour [a]*	--	--	365	140
		Annual [c]*	--	--	80	30
Hydrogen Sulfide (H_2S)		Instantaneous	14,000	10,000	--	--
		1-hour [j]	280	200	--	--
		24-hour [a]	140	100	--	--
		Quarter	28	20	--	--

[a] Not to be exceeded more than once per calendar year.
[b] Not to be exceeded by a rolling three month arithmetic mean.
[c] Annual arithmetic mean.
[d] Three year average of 98th percentile of 1-hour daily maximum concentrations.
[e] Three year average of the annual fourth-highest daily maximum 8-hour concentrations.
[f] Not to be exceeded more than once per year on average over a 3 year period.
[g] Three year average of the annual 98th percentile values.
[h] Three year average of annual concentrations.
[i] Three year average of 99th percentile of 1-hour daily maximum concentrations.
[j] Not to be exceeded more than once per month.

* The 24-hour and Annual SO^2 standards were revoked per the 2010 rulemaking. However, these standards will remain in effect until one year after attainment status designations for the 2010 1-hour SO^2 standard are complete for a given area.

** On October 26, 2015 EPA revised the primary ozone standard level to from 75 to 70 ppb with an effective date of December 28, 2015. Charts and graphs in this report reflect the 75 ppb level that was in effect for the majority of the 2015 monitoring season.

Appendix C AAQM Site Descriptions

This appendix includes site descriptions and information relating to State operated analyzers and samplers onsite. Please note that all sites meet the siting criteria specified in 40 CFR 58, Appendices A, C, D, and E. When selecting a site, five factors are considered: modeling results, landowner permission, power availability, year-round access to the site, and prevailing wind direction.

The sites addressed in this report are only the current active sites. A complete list of sites and all monitoring that has been conducted at each site can be found in the AQS system at www.epa.gov/air/data/aqsdb.html. Also available at this site are air quality summary data and emissions data.

Map images in this appendix are from the North Dakota Geographic Information Systems (GIS) Hub site at http://www.nd.gov/gis.

Site Name: Beulah – North

Station Type: SLAMS (required)
AQS#: 38-057-0004 **MSA:** 0000
Address: 6024 Highway 200
Beulah, ND
Latitude: +47.298611 **Longitude:** -101.766944

Site Description: This is one of three key sites in the Department's ambient monitoring network to meet the six required monitoring objectives. When this site was established, it was decided to enhance the site to include ammonia, solar radiation and delta temperature to support air quality dispersion modeling. This site is one of the required $PM_{2.5}$ monitoring sites for North Dakota

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Population Exposure	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	Urban
Ozone	Instrumental Ultraviolet	Continuous	Population Exposure	Urban
Ozone	Instrumental Chemiluminescence	Continuous	Population Exposure	Urban
Ammonia	Instrumental Chemiluminescence	Continuous	General Background	Regional
$PM_{2.5}$	24-hour Gravimetric	1/6	Population Exposure	Urban
$PM_{2.5}$	FEM $PM_{2.5}$ BAM	Continuous	Population Exposure	Urban
PM_{10}	PM_{10} TEOM Gravimetric 50° Celsius	Continuous	Population Exposure	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Delta Temperature	Elec. or Mach Avg.	Continuous	10 - 2 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Solar Radiation	Pyranometer	Continuous	2 meters	Urban

There are no plans to move or remove this site.

Site Pictures: **Beulah North**

North

South

East

West

Looking Northeast

Looking Northwest

Beulah - North

North Dakota state agencies and the ND GIS Hub

Site Name: Bismarck Residential

Station Type: SLAMS
AQS#: 38-015-0003 **MSA:** 1010
Address: 1810 N 16th Street
Bismarck, ND
Latitude: +46.825425 **Longitude:** -100.768210

Site Description: This site is located in the second largest metropolitan area in the state. When two special purpose sites in Mandan were closed, this site was expanded from a particulates-only site to be a full site for gases, continuous particulates (inc. ambient pressure) and the basic meteorological parameters (wind speed, wind direction and temperature). Another key role this site plays is to field test new types of equipment and procedures isolated from the equipment used to report data to AQS.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Population Exposure	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	Urban
Ozone	Instrumental Ultraviolet	Continuous	Population Exposure	Urban
$PM_{2.5}$	24-hour Gravimetric	1/3	Population Exposure	Urban
$PM_{2.5}$	FEM $PM_{2.5}$ BAM	Continuous	Population Exposure	Urban
PM_{10}	PM_{10} BAM	Continuous	Population Exposure	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban

There are no plans to move or remove this site. This site will be designated the new NCore site upon completion of the relocation from Fargo.

Site Pictures: **Bismarck Residential**


North


East


West


Looking Northwest


South


Looking Southeast

Bismarck Residential

North Dakota state agencies and the ND GIS Hub

Site Name: Dunn Center

Station Type: SLAMS
AQS#: 38-025-0003 **MSA:** 0000
Address: 9610 Seventh Street SW
Dunn Center, ND
Latitude: +47.313200 **Longitude:** -102.527300

Site Description: This site is located about midway between the oil development all along the North Dakota – Montana border and the seven coal conversion facilities to the east. The importance lies in the ability to monitor the transport of sulfur dioxide, nitrogen dioxide, and $PM_{2.5}$ between these two areas. Also, this is a key site used in dispersion model calibration and validation.

Gas/Particulate parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	General/Background	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	General/Background	Urban
Ozone	Instrumental Ultraviolet	Continuous	General/Background	Urban
$PM_{2.5}$	FEM $PM_{2.5}$ BAM	Continuous	General/Background	Urban
PM_{10}	PM_{10} TEOM Gravimetric 50° Celsius	Continuous	General/Background	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Delta Temperature	Elec. or Mach Avg.	Continuous	10 - 2 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Solar Radiation	Pyranometer	Continuous	2 meters	Urban

Changing site conditions have prompted the Department to evaluate the possibility of relocating this site. It is the Department's aim to continue to have the site meet appropriate siting criteria (including continued staff accessibility). Any relocation would maintain instrumental consistency. A new site location has been identified at Lake Ilo NWR. See section 3.2 of this annual report for discussion on the new site.

Site Pictures: **Dunn Center**

North

West

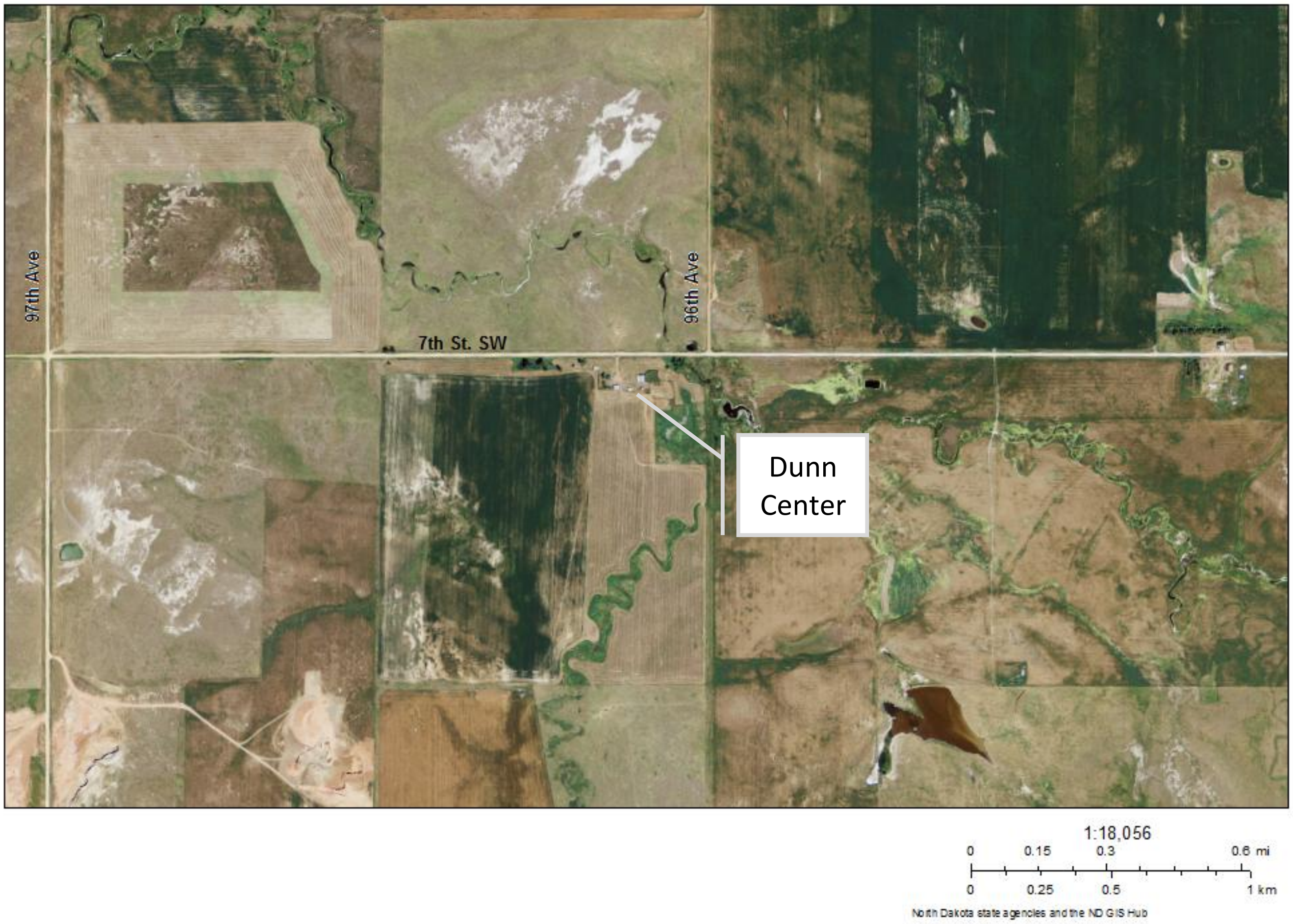
East

South

Looking Northwest

Looking Northeast

Dunn Center



North Dakota state agencies and the ND GIS Hub

Site Name: Fargo NW

Station Type: SLAMS (required)
AQS#: 38-017-1004 **MSA:** 2520
Address: 4266 40th Avenue North
Fargo, ND
Latitude: +46.933754 **Longitude:** -96.855350

Site Description: This site is located in the largest metropolitan area in North Dakota. Through 2015 it operated as one of EPA's 54 Speciation Trends Network sites and the state's required NCORE site. The data collected at this site are used in dispersion modeling for input, calibration and validation.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Population Exposure	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	Urban
Carbon Monoxide	Instrumental Gas Filter Correlation	Continuous	Population Exposure	Urban
NO_y	Instrumental Chemiluminescence	Continuous	Population Exposure	Urban
Ozone	Instrumental Ultraviolet	Continuous	Population Exposure	Urban
$PM_{2.5}$	24-hour Gravimetric	1/3	Population Exposure	Urban
$PM_{2.5}$	FEM $PM_{2.5}$ BAM	Continuous	Population Exposure	Urban
PM_{10}	PM_{10} BAM	Continuous	Population Exposure	Urban
$PM_{10\text{-}2.5}$ Speciation	METOne SASS 24-hour Gravimetric	1/3	Population Exposure	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Delta Temperature	Elec. or Mach Avg.	Continuous	10 - 2 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Relative Humidity	Hygroscopic Plastic Film	Continuous	10 meters	Urban
Solar Radiation	Pyranometer	Continuous	2 meters	Urban

There are no plans to move or remove this site. Although the NCore designation for this site will end with the relocation to Bismarck, this site will remain a SLAMS site.

Site Pictures: **Fargo NW**

North

West

East

South

Looking Northeast

Looking West

Fargo NW

North Dakota state agencies and the ND GIS Hub

Site Name: Hannover

Station Type: SLAMS

AQS#: 38-065-0002 **MSA:** 0000

Address:
1575 Highway 31
Stanton, ND

Latitude: +47.185833 **Longitude:** -101.428056

Site Description: This site is centrally located to the power plants in the Oliver-Mercer-McLean county area. The data collected here are used to supplement ambient data collected at Beulah – North and TRNP – NU.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Source Oriented	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Source Oriented	Urban
Ozone	Instrumental Ultraviolet	Continuous	Source Oriented	Urban
$PM_{2.5}$	FEM $PM_{2.5}$ BAM	Continuous	Source Oriented	Urban
PM_{10}	PM_{10} TEOM Gravimetric 50° Celsius	Continuous	Source Oriented	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban

There are no plans to move or remove this site.

Site Pictures: **Hannover**


North


East


South


West


Looking Southwest


Looking Northeast

Hannover

North Dakota state agencies and the ND GIS Hub

Site Name: Lostwood NWR

Station Type: SLAMS
AQS#: 38-013-0004 **MSA:** 0000
Address: 8315 Highway 8
Kenmare, ND
Latitude: +48.641930 **Longitude:** -102.401800

Site Description: This site is located in a PSD Class I area. This site is downwind of two power plants near Estevan, SK, and located in the Souris River Airshed.

The site has an IMPROVE sampler operated by the US Fish and Wildlife Service. These data will be used with the other ambient data collected here to evaluate long-range transport of aerosols affecting regional haze/visibility.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Regional Transport	Regional
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Regional Transport	Regional
Ozone	Instrumental Ultraviolet	Continuous	Regional Transport	Regional
Ozone	Instrumental Chemiluminescence	Continuous	Regional Transport	Regional
$PM_{2.5}$	FEM $PM_{2.5}$ BAM	Continuous	Regional Transport	Regional
PM_{10}	PM_{10} TEOM Gravimetric 50° Celsius	Continuous	Regional Transport	Regional

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Delta Temperature	Elec. or Mach Avg.	Continuous	10 - 2 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Solar Radiation	Pyranometer	Continuous	2 meters	Urban
Relative Humidity	Hygroscopic Plastic Film	Continuous	10 meters	Urban

There are no plans to move or remove this site.

Site Pictures: **Lostwood NWR**

North

South

East

West

Looking Northwest

Looking North

Lostwood NWR

North Dakota state agencies and the ND GIS Hub

Site Name: Painted Canyon (TRNP – SU)

Station Type: SLAMS
AQS#: 38-007-0002 **MSA:** 0000
Address: Theodore Roosevelt National Park – South Unit
13881 I94 East
Latitude: +46.894300 **Longitude:** -103.378530

Site Description: Located in the South Unit of Theodore Roosevelt National Park, this Class I area site is operated in partnership with the National Park Service. As it is positioned south of the majority of oil and gas activity in the state, this station plays a key role in monitoring general background conditions and providing data for dispersion modeling input, calibration and validation.

The site has an IMPROVE sampler operated by the National Park Service. These data will be used with the other ambient data collected here to evaluate long-range transport of aerosols affecting regional haze/visibility.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	General/Background	Urban
Ozone	Instrumental Ultraviolet	Continuous	General/Background	Urban
$PM_{2.5}$	FEM $PM_{2.5}$ BAM	Continuous	General/Background	Urban
$PM_{2.5}$	24-hour Gravimetric	1/6	General/Background	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
*	*	*	*	*

* All meteorological parameters are monitored as part of the NPS network.

There are no plans to move or remove this site.

Site Pictures: **Painted Canyon**


North

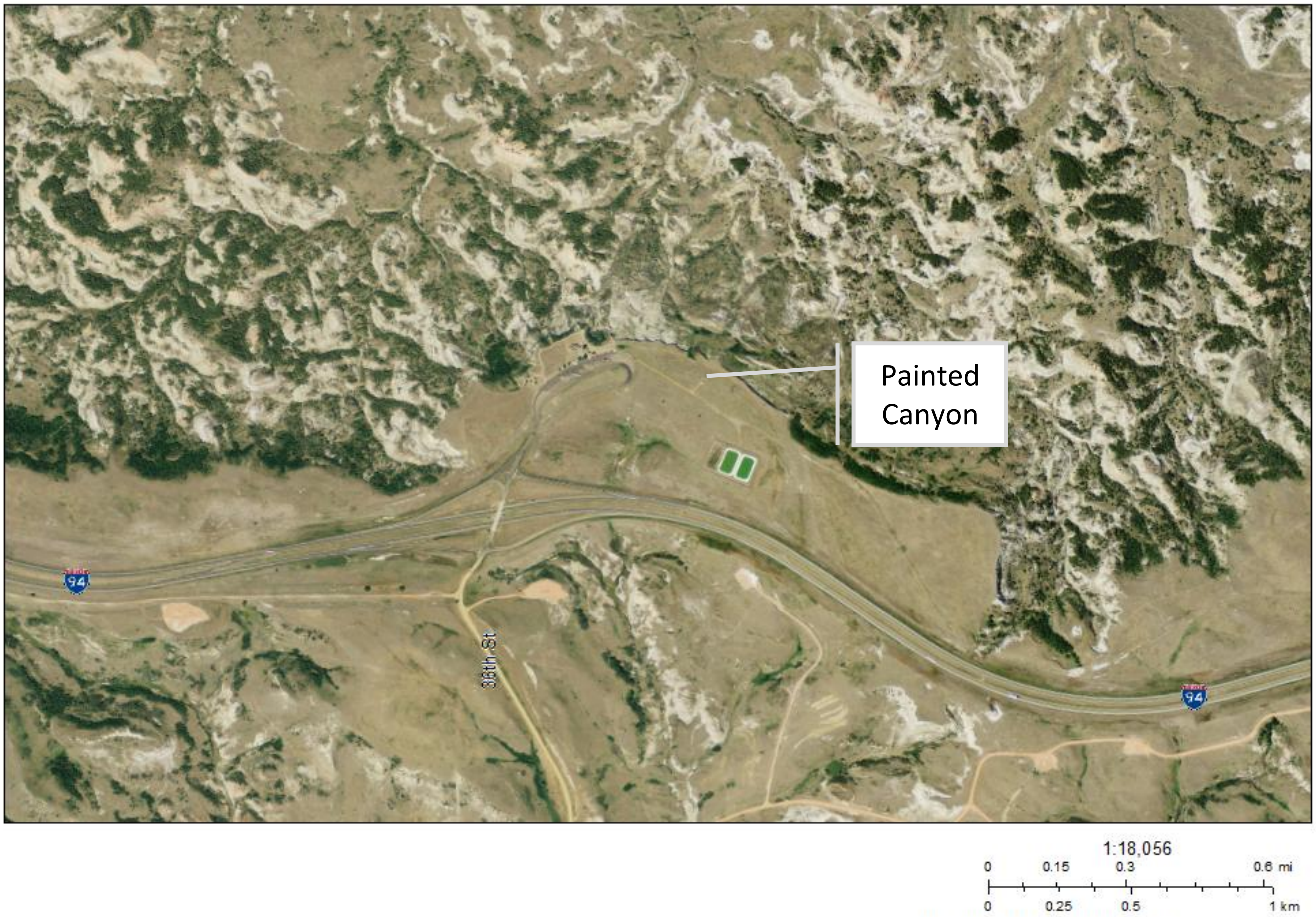

East


South


West


Looking Southwest

Painted Canyon



North Dakota state agencies and the ND GIS Hub

Site Name: TRNP-NU

Station Type: SLAMS (required)
AQS#: 38-053-0002 **MSA:** 0000
Address: 229 Service Road
Watford City, ND
Latitude: +47.581200 **Longitude:** -103.299500

Site Description: This site is located in Theodore Roosevelt National Park – North Unit and is one of three key sites in the Department's ambient monitoring network to meet the six required monitoring objectives. The data collected are used for model calibration/validation.

Gas/Particulate parameters:

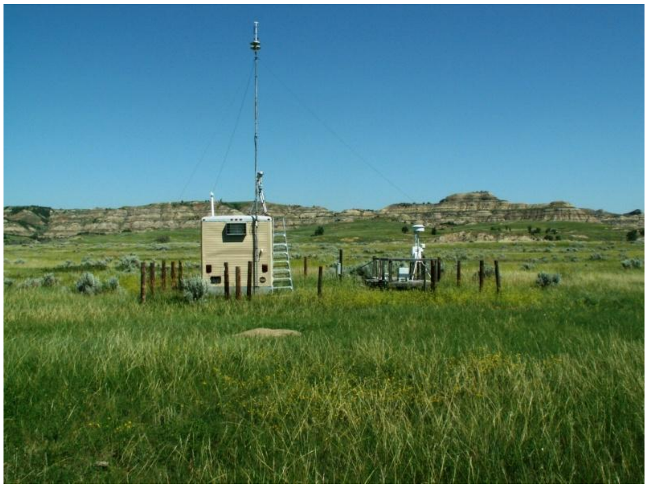
Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	General/Background	Regional
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	General/Background	Regional
Ozone	Instrumental Ultraviolet	Continuous	General/Background	Regional
$PM_{2.5}$	FEM $PM_{2.5}$ BAM	Continuous	General/Background Regional Transport	Regional
PM_{10}	PM_{10} TEOM Gravimetric 50° Celsius	Continuous	General/Background Regional Transport	Regional

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Relative Humidity	Hygroscopic Plastic Film	Continuous	10 meters	Urban

There are no plans to move or remove this site.

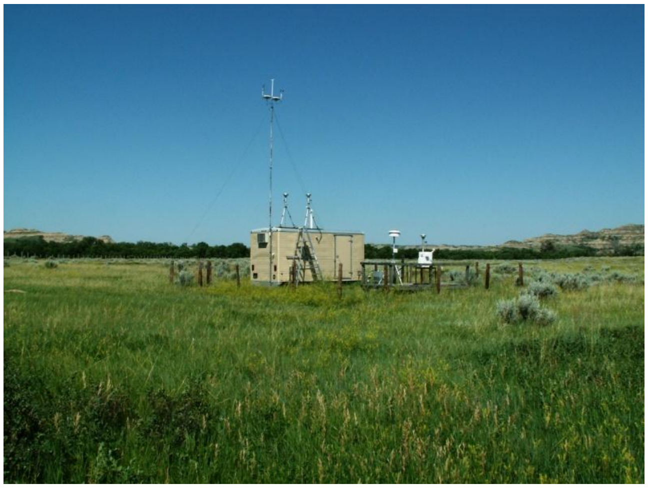
Site Pictures: **TRNP-NU**



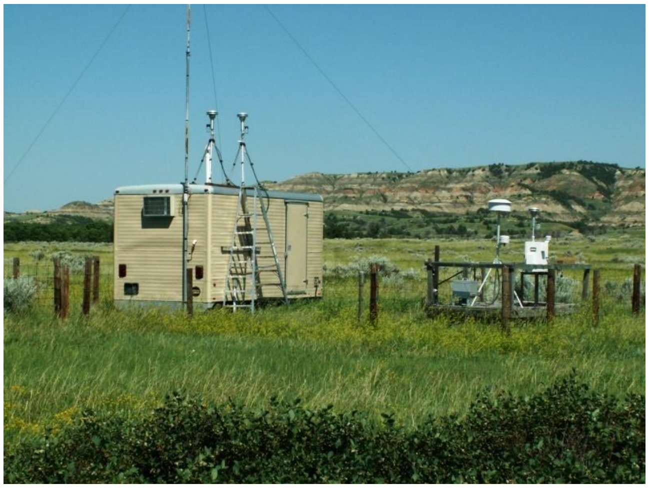
North

South

East



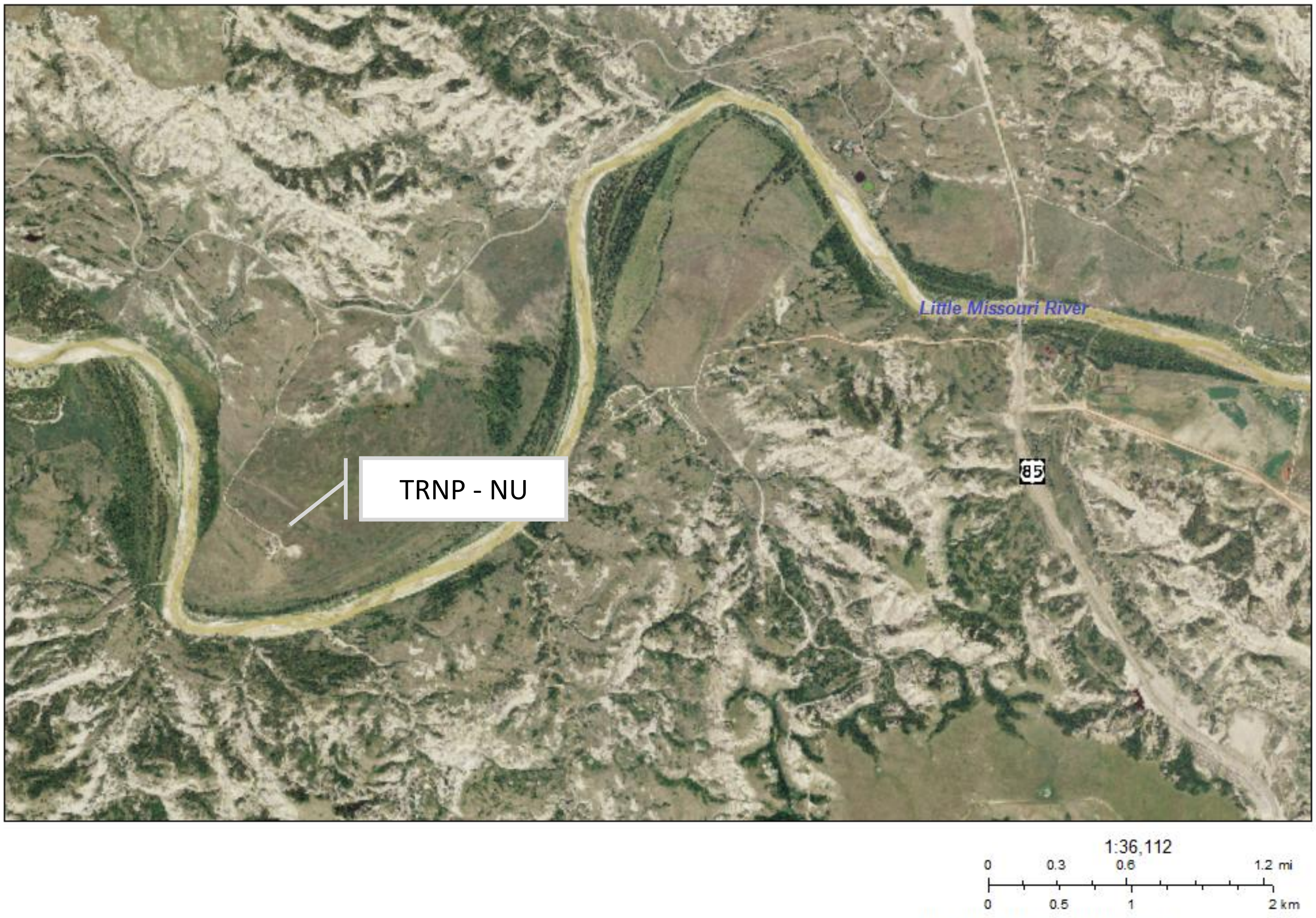
West



Looking Northwest

Looking Northeast

Theodore Roosevelt National Park - North Unit



North Dakota state agencies and the ND GIS Hub

Site Name: Williston

Station Type: SLAMS
AQS#: 38-105-0003 **MSA:** 0000
Address: 10th Street West
Williston, ND
Latitude: +48.152780 **Longitude:** -103.639510

Site Description: This site is located in the Williston Riverview Cemetery in downtown Williston. It is in the heart of the oil and gas development activity area and serves to meet the objective of monitoring population exposure to particulate matter and ozone.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ozone	Instrumental Ultraviolet	Continuous	Population Exposure	Urban
$PM_{2.5}$	FEM $PM_{2.5}$ BAM	Continuous	Population Exposure	Urban
PM_{10}	PM_{10} TEOM Gravimetric 50° Celsius	Continuous	Population Exposure	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban

There are no plans to move or remove this site.

Site Pictures: **Williston**


North


South


East


West

Williston


11th St. W
Williston
Cemetery
2
2nd Ave. W
Main St.
2nd St. W
1:18,056
0
0.15
0.3
0.6 mi
0
0.25
0.5
1 km
North Dakota state agencies and the ND GIS Hub

Appendix D Wind and Pollution Roses

The figures in this appendix are organized with the site's wind rose presented at top, criteria pollutant roses follow in alphabetical order, and conclude with non-criteria (e.g. NH_3) monitored pollutant roses.

The pollution roses show the percentage of time a pollutant is detected when the wind is <u>from</u> a given direction and provide a total summary of detected concentrations in the legend.

Site Name: Beulah – North

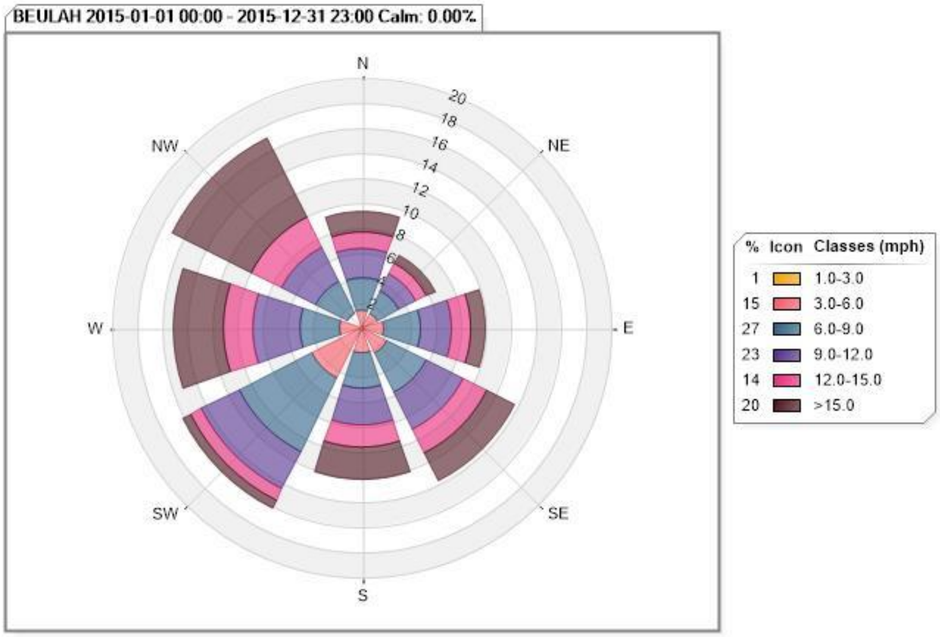


Figure 26. Beulah Wind Rose for 2015

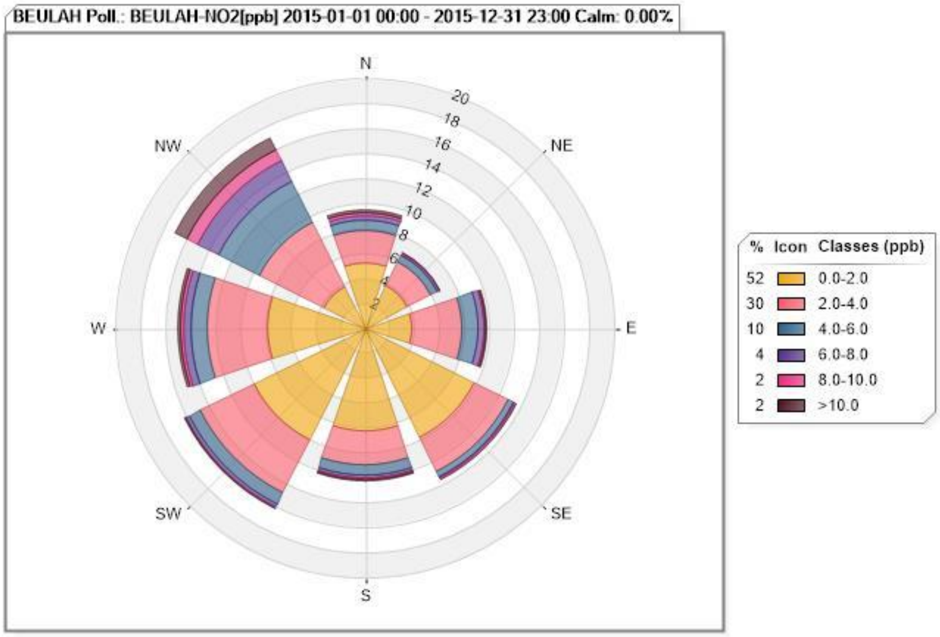


Figure 27. Beulah NO_2 Pollution Rose for 2015

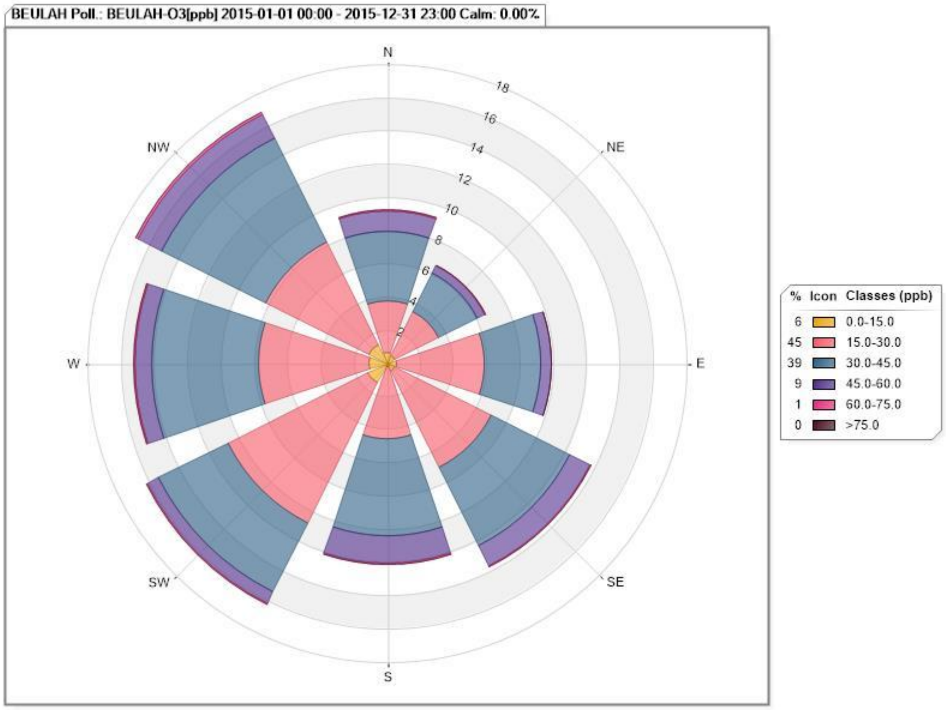


Figure 28. Beulah O_3 Pollution Rose for 2015

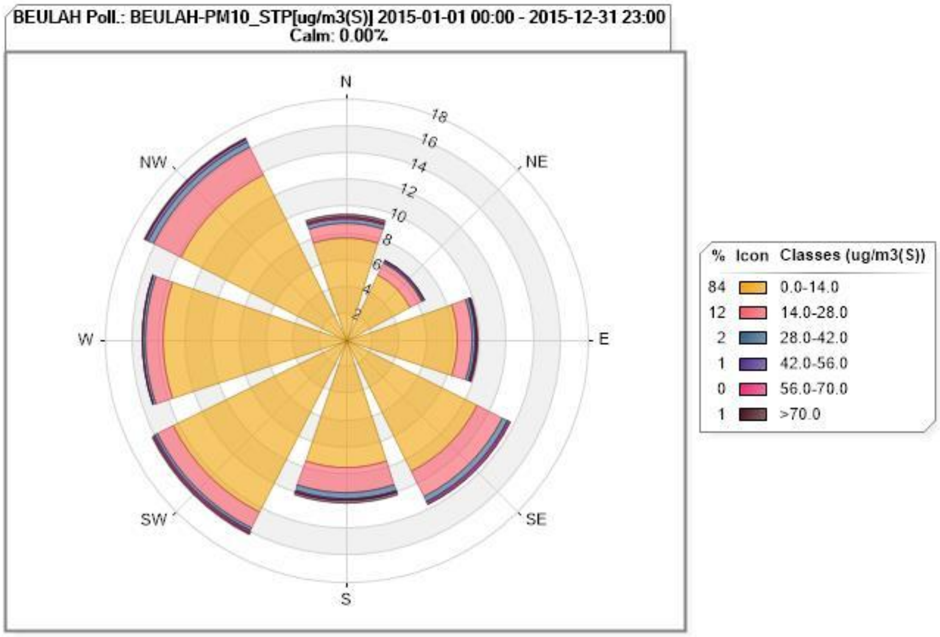


Figure 29. Beulah PM_{10} Pollution Rose for 2015

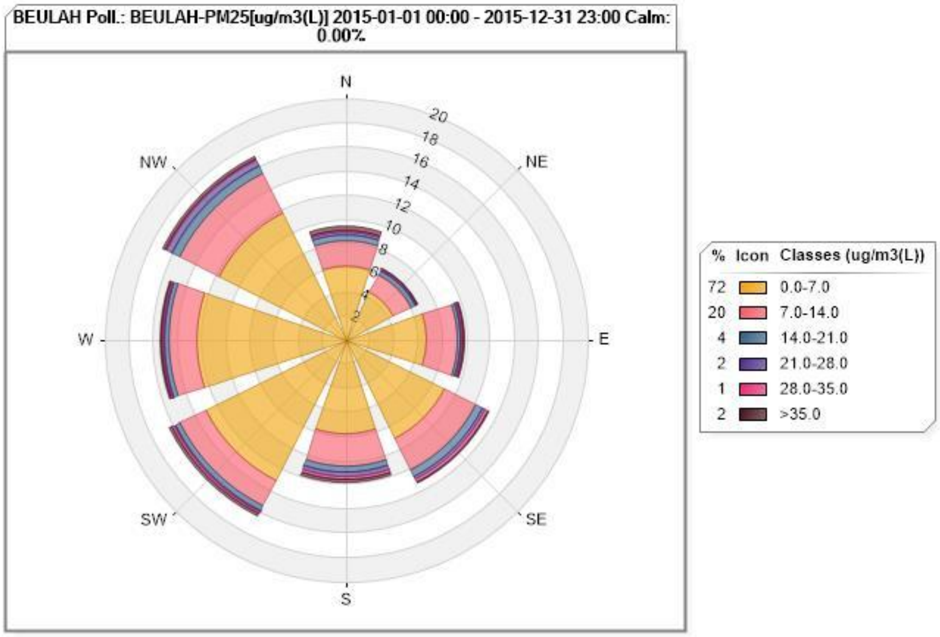


Figure 30. Beulah $PM_{2.5}$ Pollution Rose for 2015

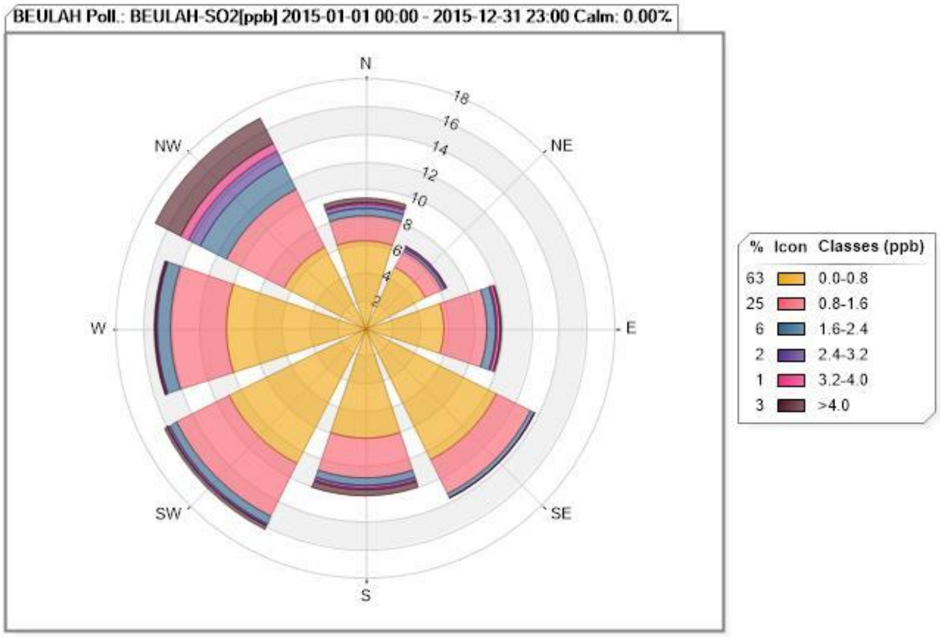


Figure 31. Beulah SO_2 Pollution Rose for 2015

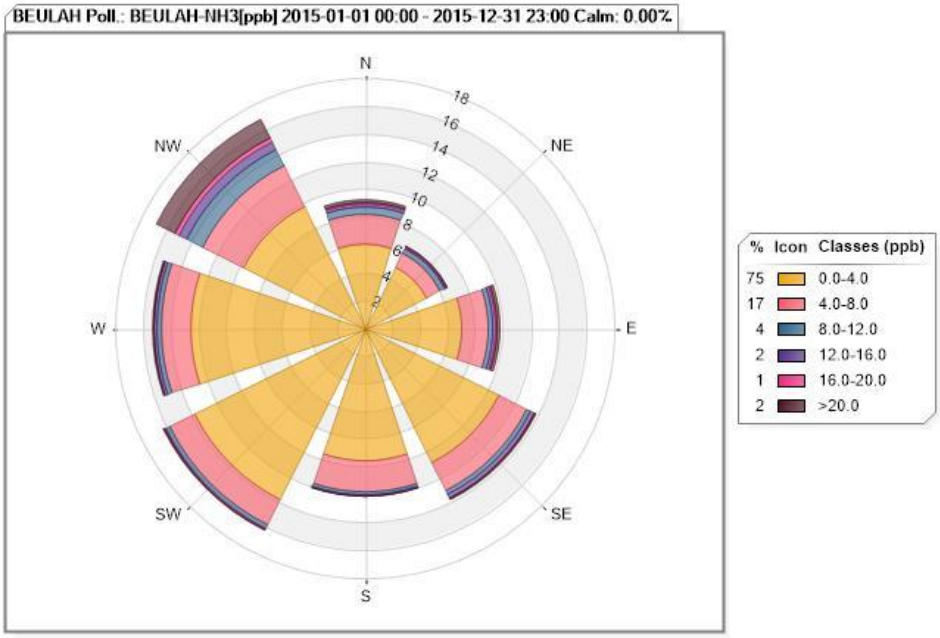


Figure 32. Beulah NH_3 Pollution Rose for 2015

Site Name: Bismarck Residential

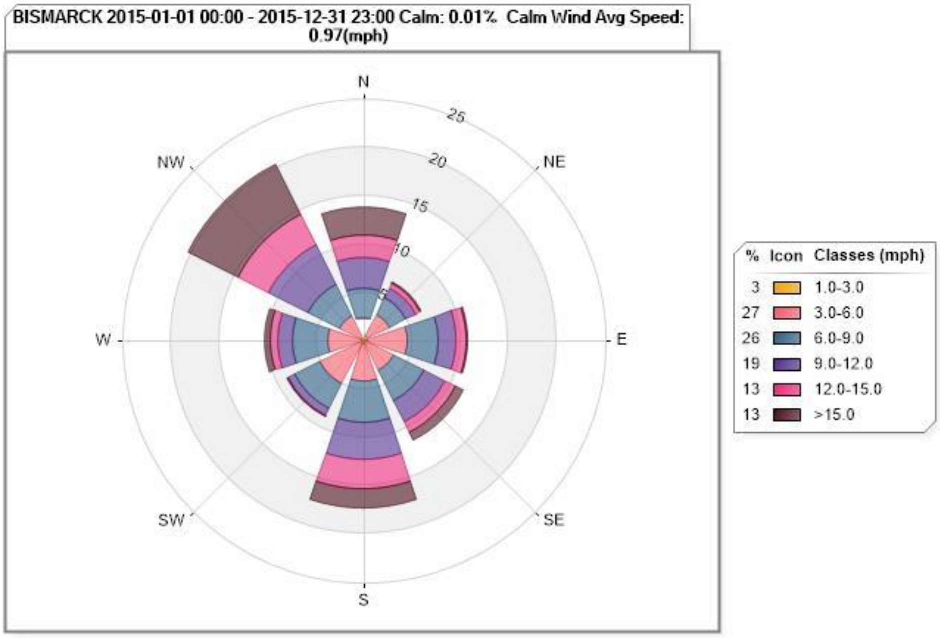


Figure 33. Bismarck Wind Rose for 2015

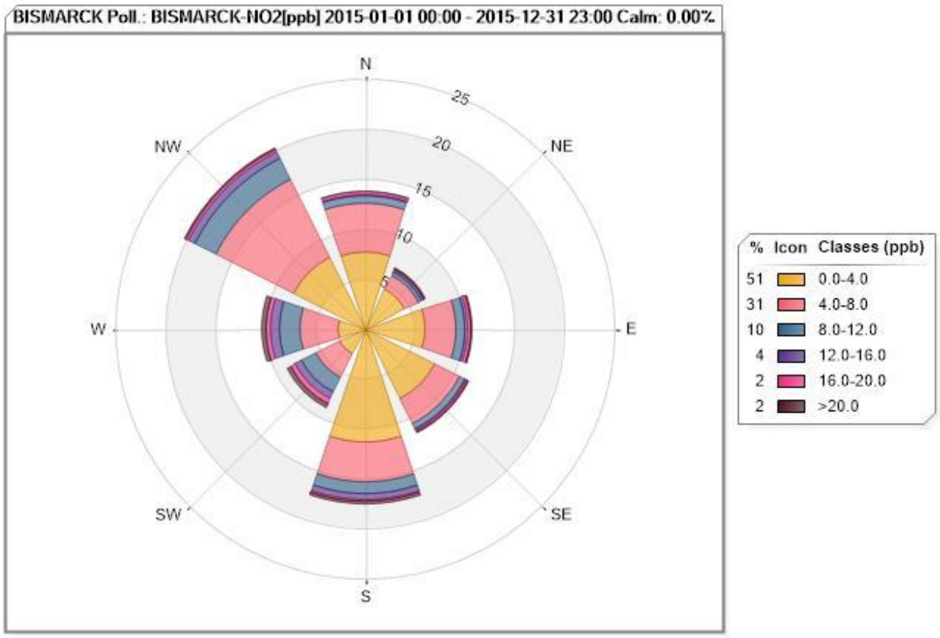


Figure 34. Bismarck NO_2 Pollution Rose for 2015

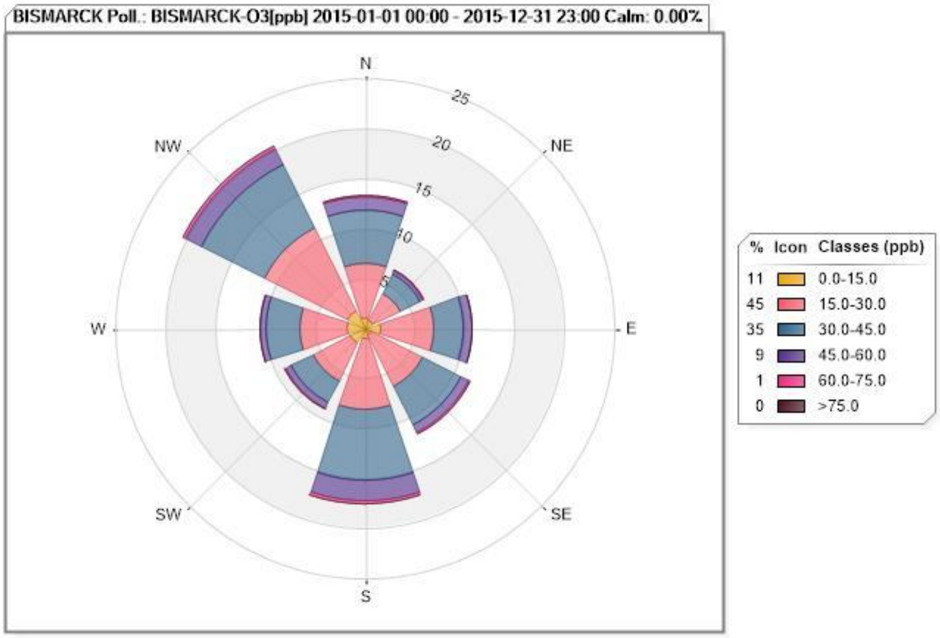


Figure 35. Bismarck O_3 Pollution Rose for 2015

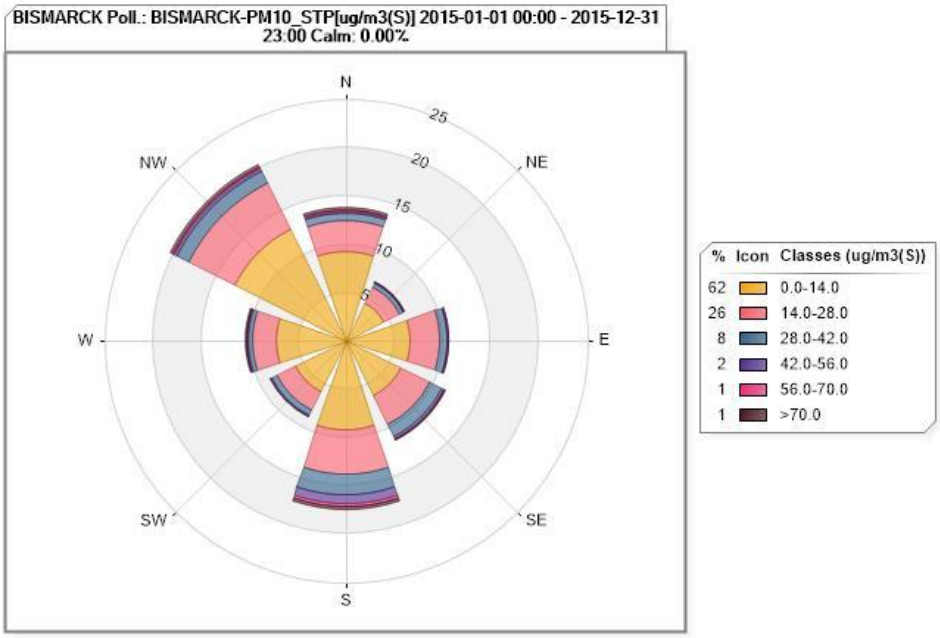


Figure 36. Bismarck PM_{10} Pollution Rose for 2015

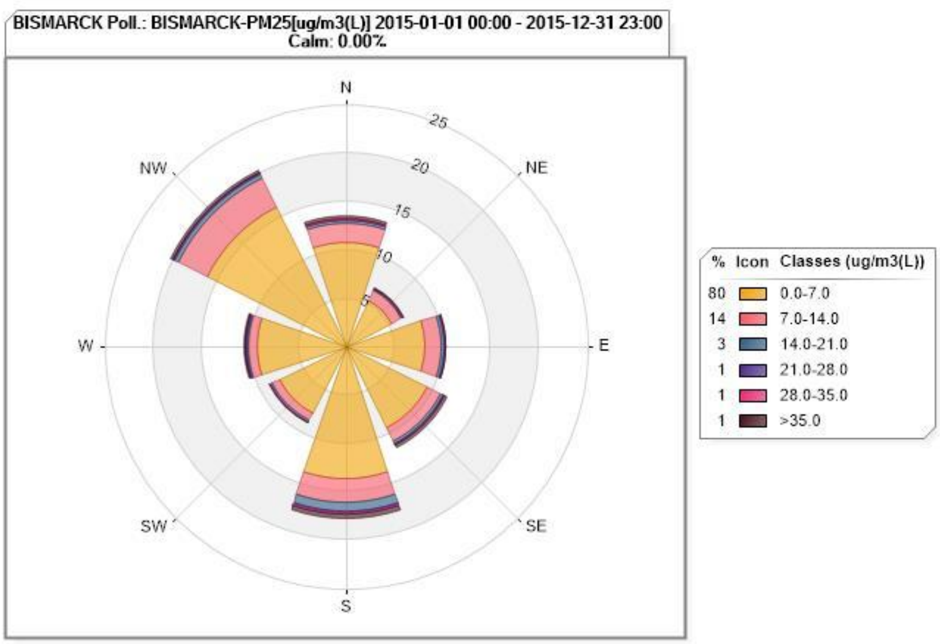


Figure 37. Bismarck $PM_{2.5}$ Pollution Rose for 2015

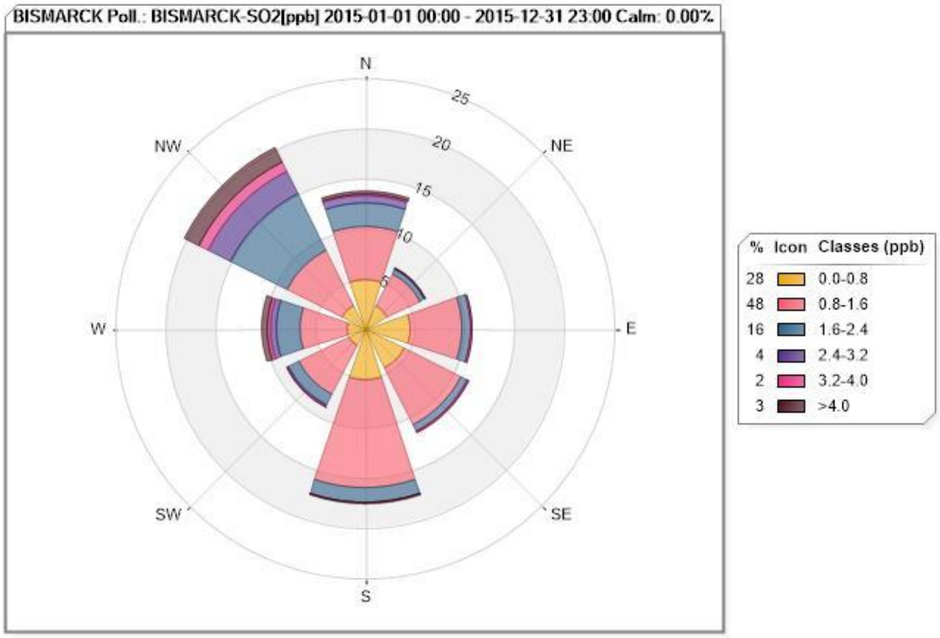


Figure 38. Bismarck SO_2 Pollution Rose for 2015

Site Name: Dunn Center

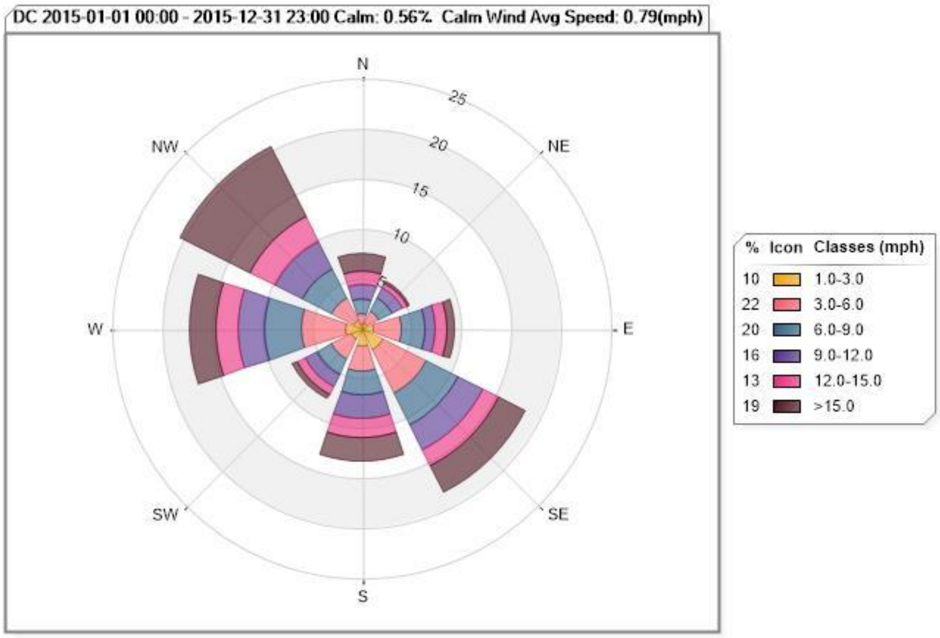


Figure 39. Dunn Center Wind Rose for 2015

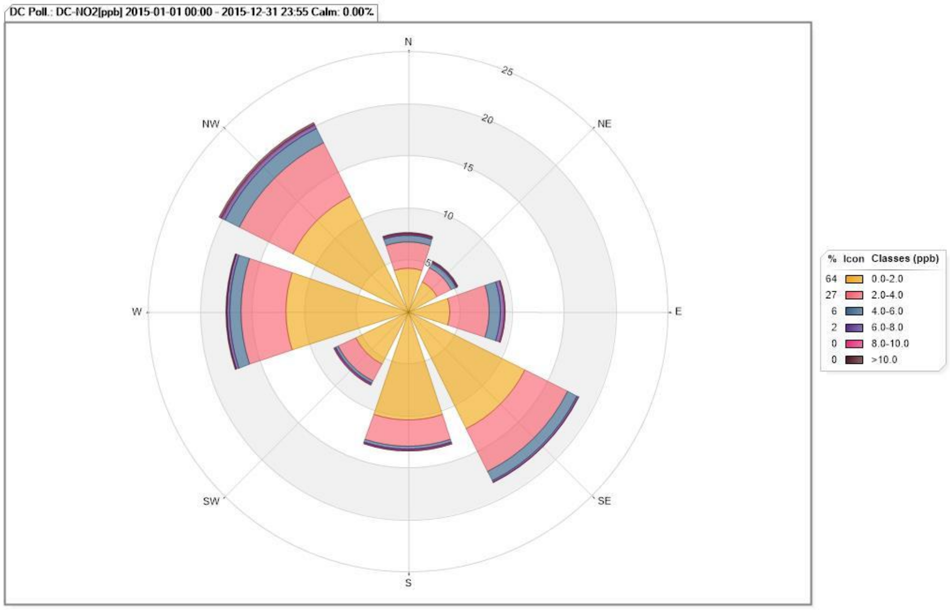


Figure 40. Dunn Center NO_2 Pollution Rose for 2015

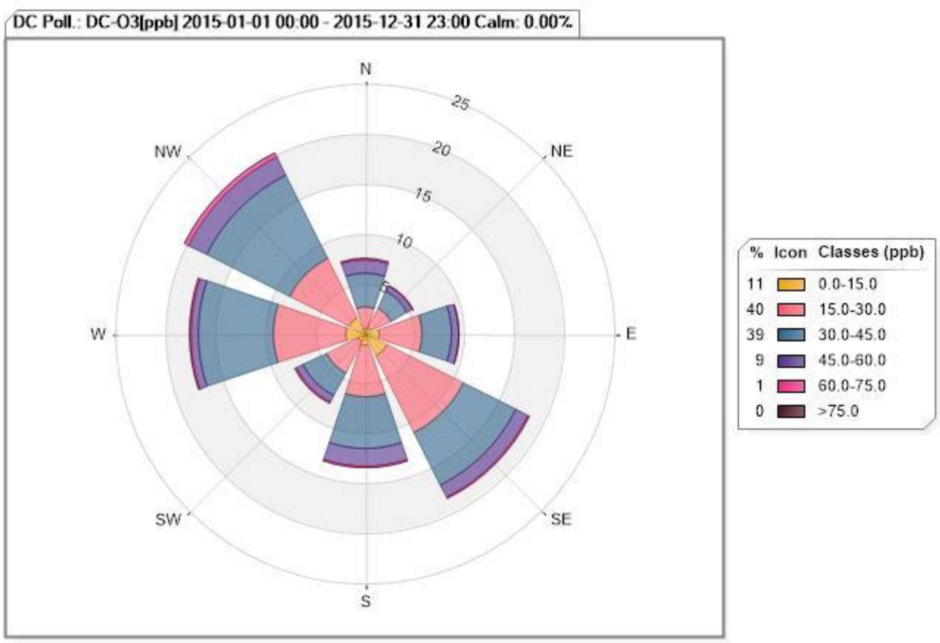


Figure 41. Dunn Center O_3 Pollution Rose for 2015

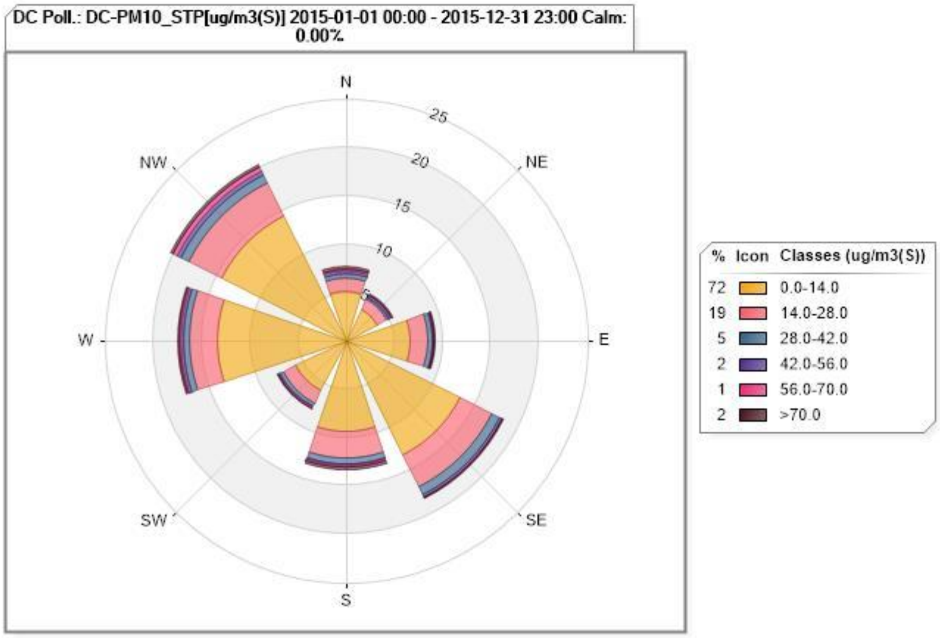


Figure 42. Dunn Center PM_{10} Pollution Rose for 2015

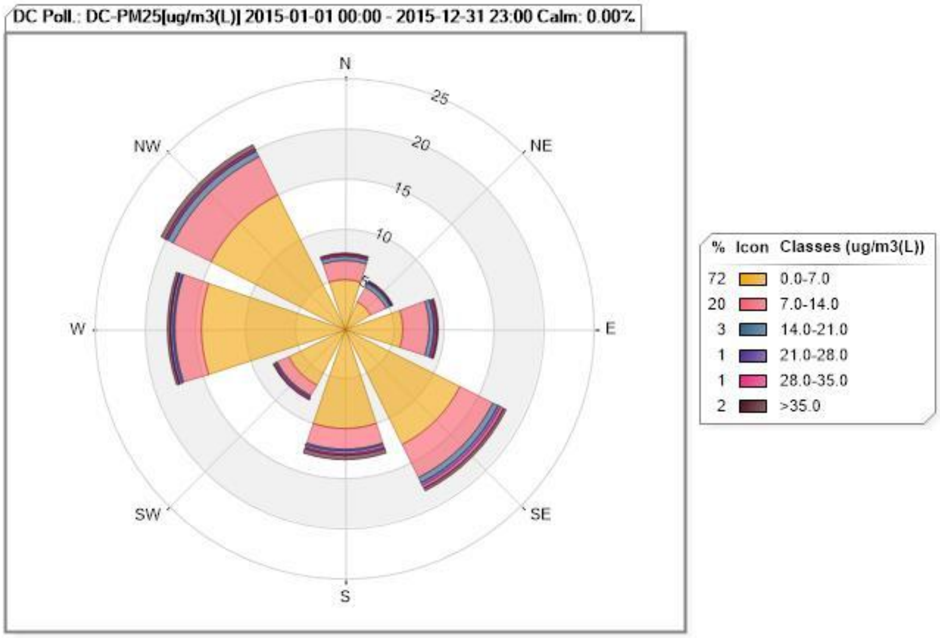


Figure 43. Dunn Center $PM_{2.5}$ Pollution Rose for 2015

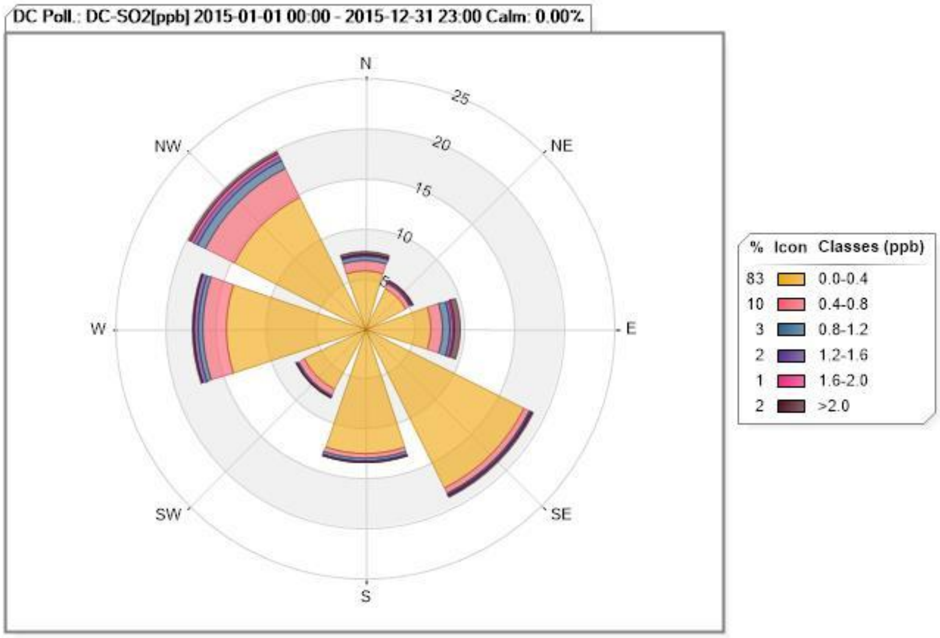


Figure 44. Dunn Center SO_2 Pollution Rose for 2015

Site Name: Fargo NW

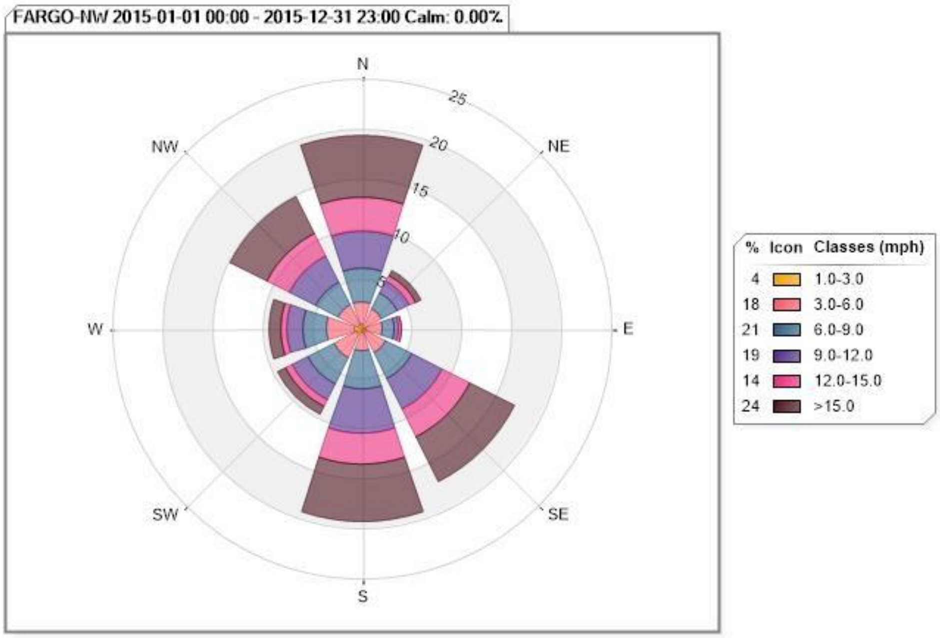


Figure 45. Fargo Wind Rose for 2015

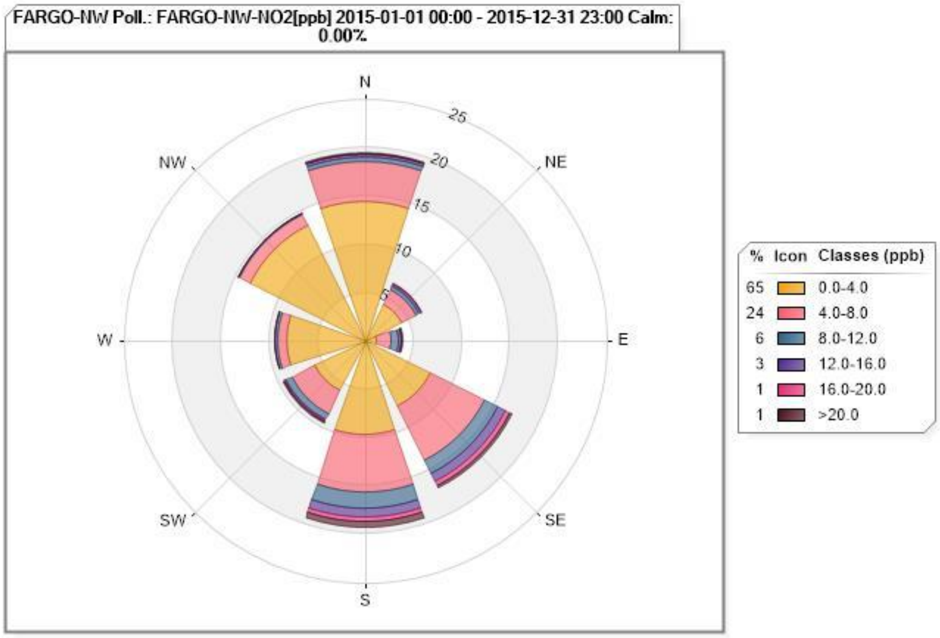


Figure 46. Fargo NO_2 Pollution Rose for 2015

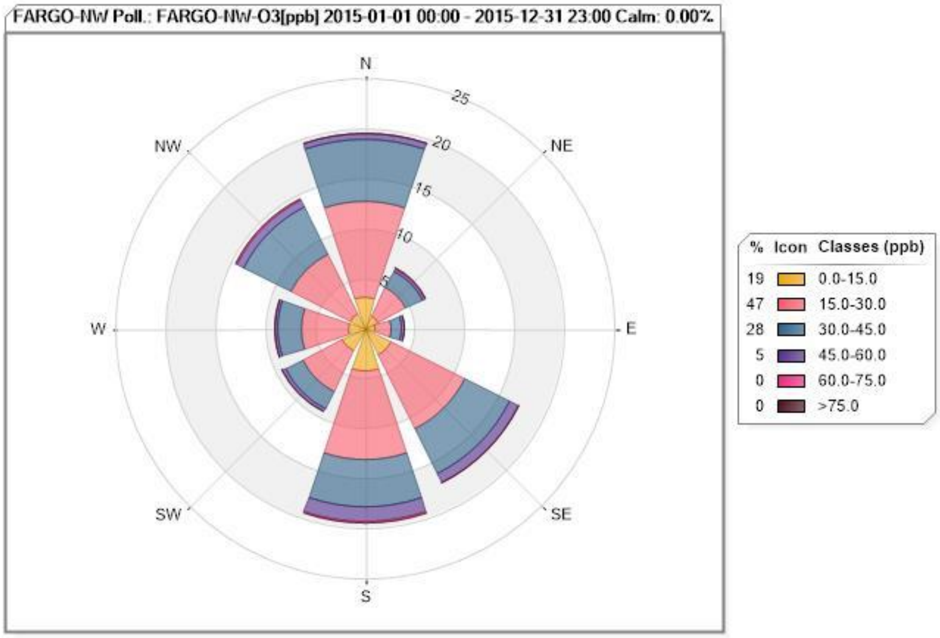


Figure 47. Fargo O_3 Pollution Rose for 2015

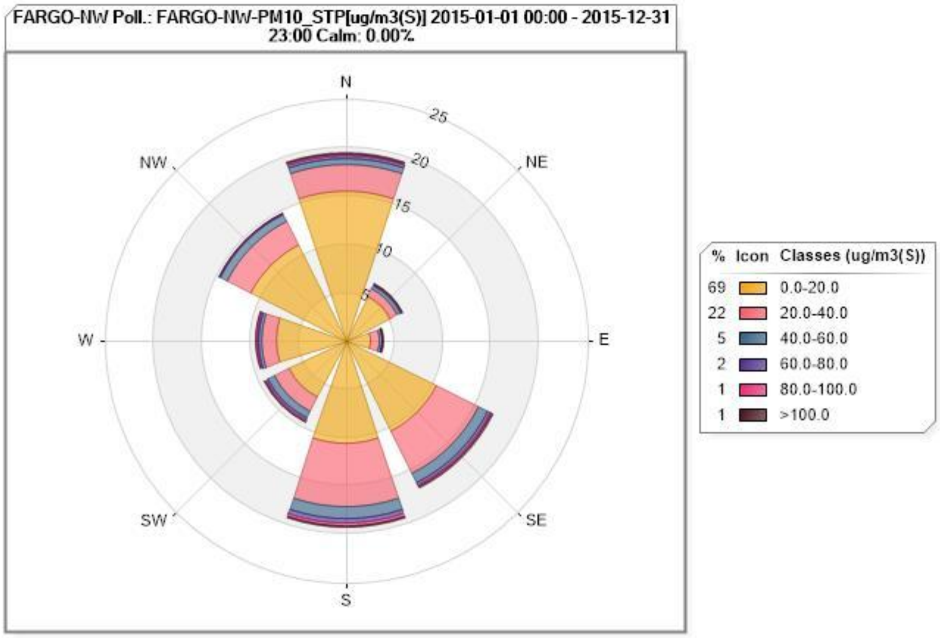


Figure 48. Fargo PM_{10} Pollution Rose for 2015

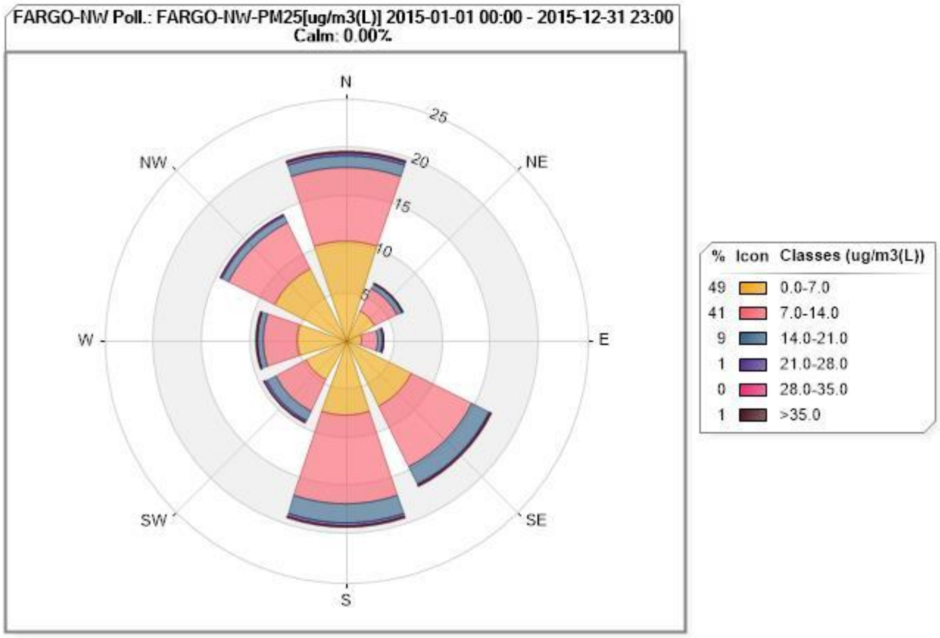


Figure 49. Fargo $PM_{2.5}$ Pollution Rose for 2015

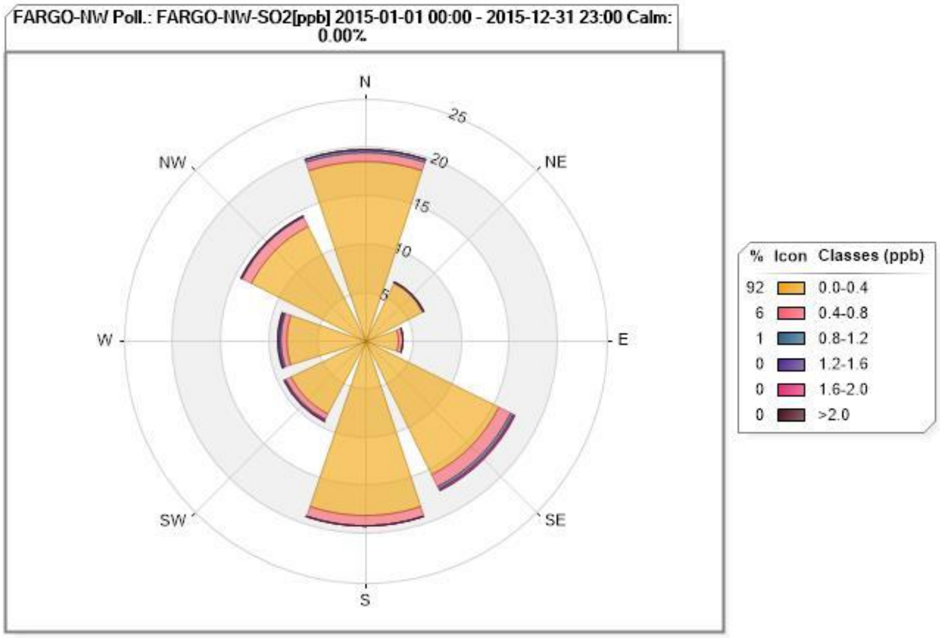


Figure 50. Fargo SO_2 Pollution Rose for 2015

Site Name: Hannover

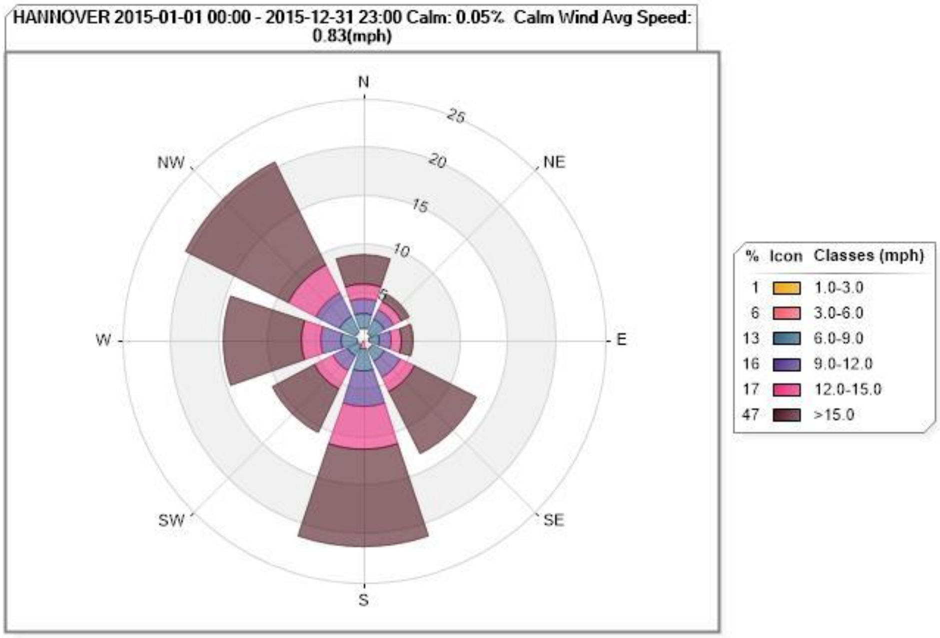


Figure 51. Hannover Wind Rose for 2015

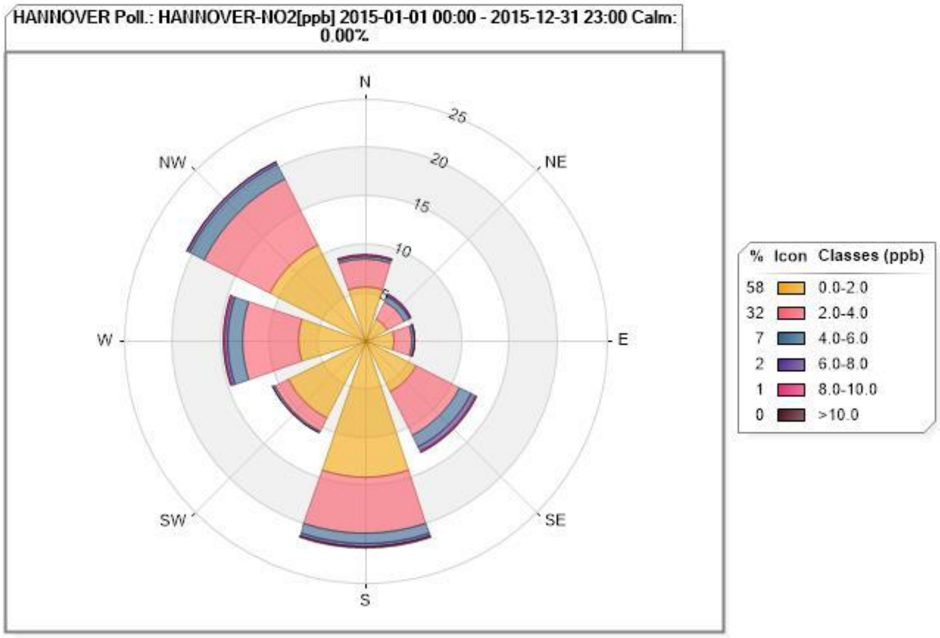


Figure 52. Hannover NO_2 Pollution Rose for 2015

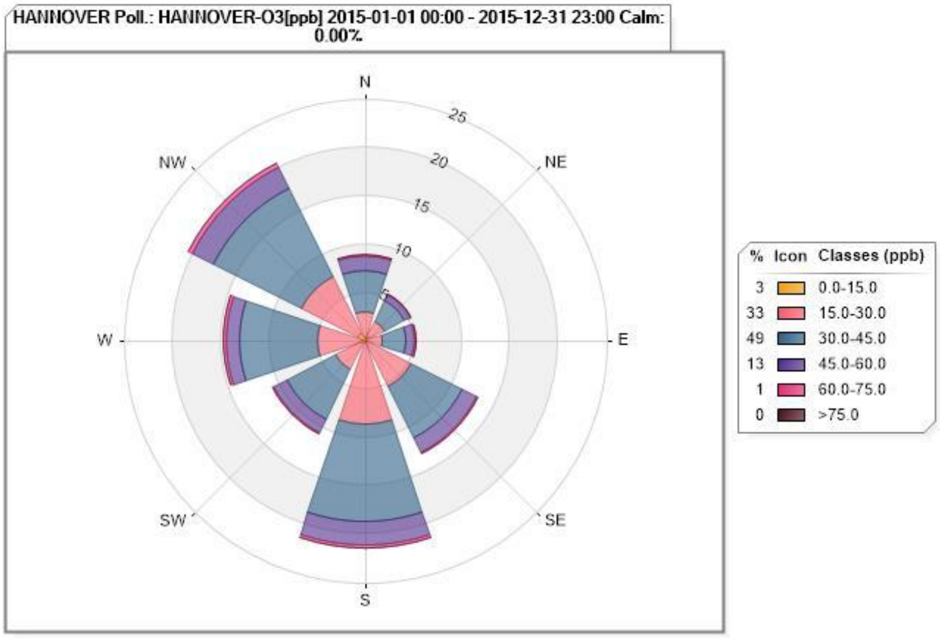


Figure 53. Hannover O_3 Pollution Rose for 2015

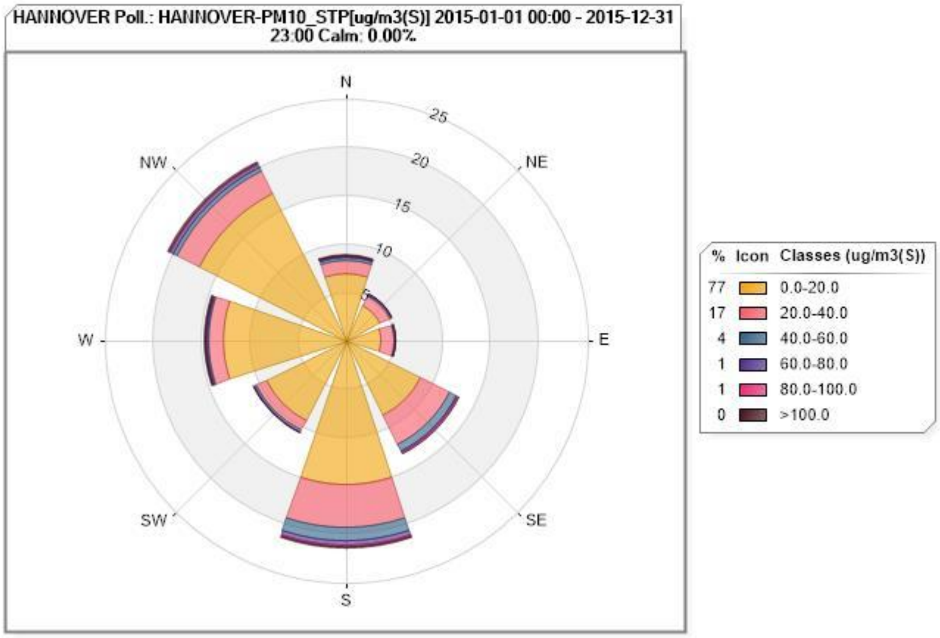


Figure 54. Hannover PM_{10} Pollution Rose for 2015

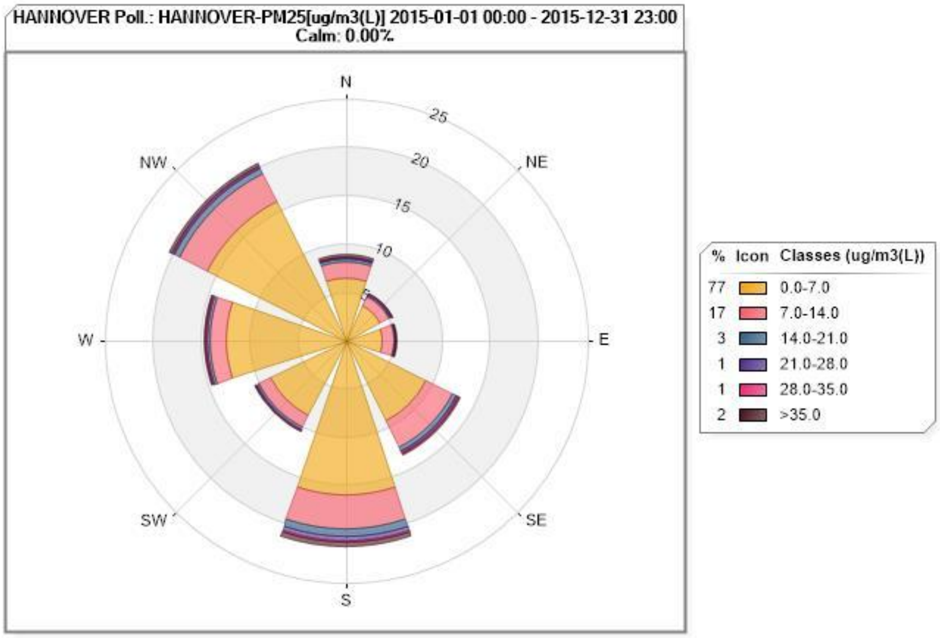


Figure 55. Hannover $PM_{2.5}$ Pollution Rose for 2015

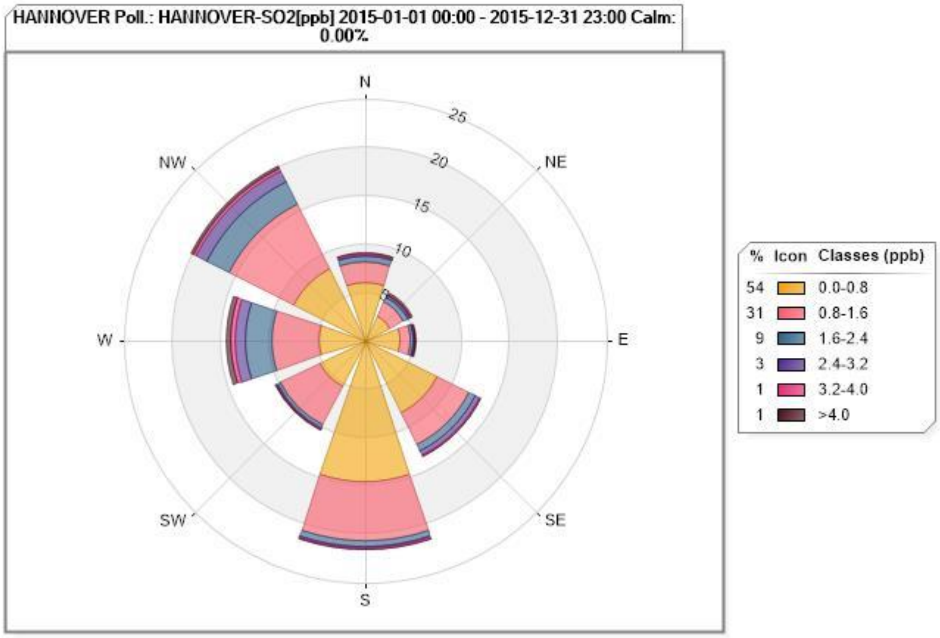


Figure 56. Hannover SO_2 Pollution Rose for 2015

Site Name: Lostwood NWR

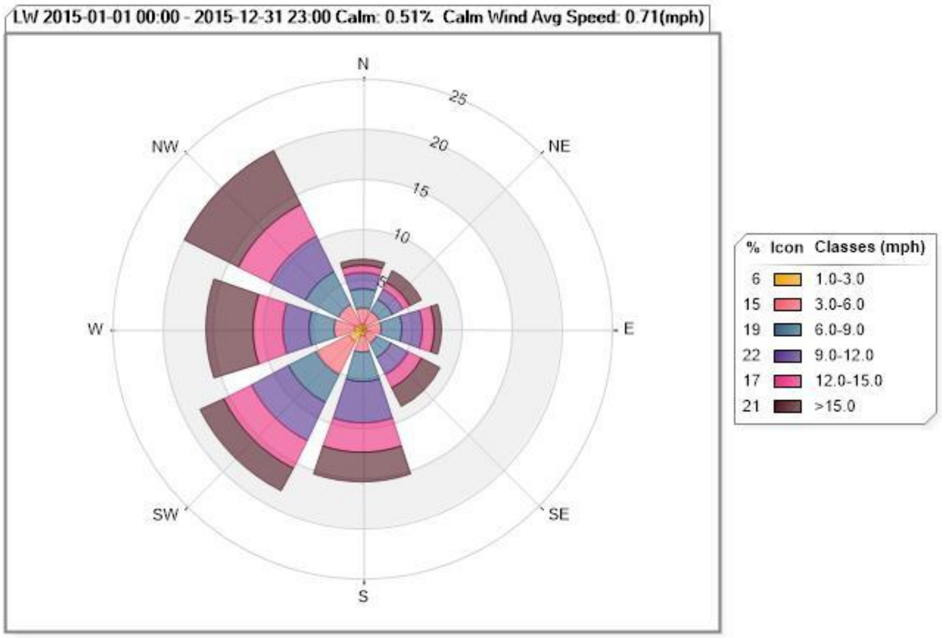


Figure 57. Lostwood Wind Rose for 2015

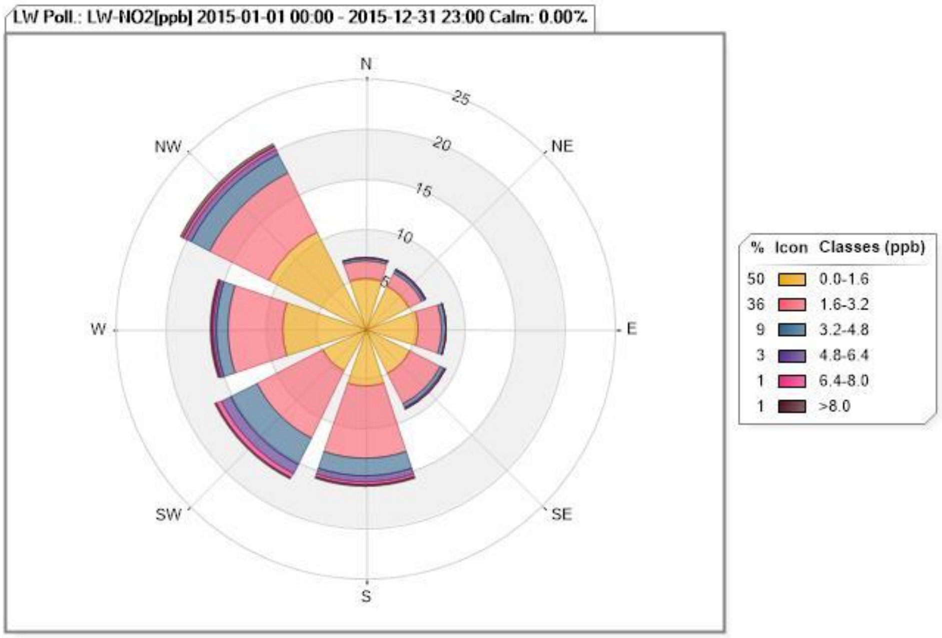


Figure 58. Lostwood NO_2 Pollution Rose for 2015

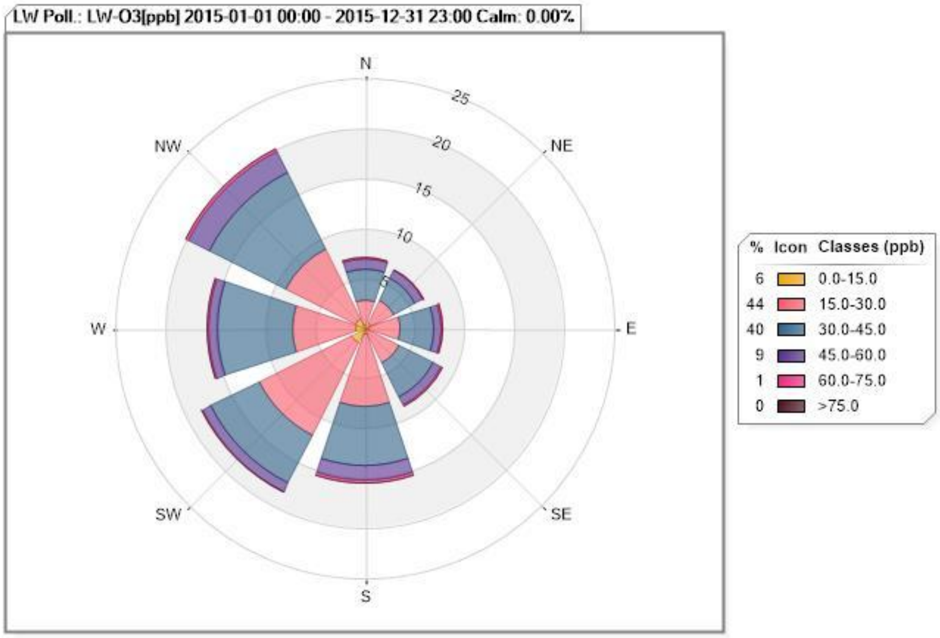


Figure 59. Lostwood O_3 Pollution Rose for 2015

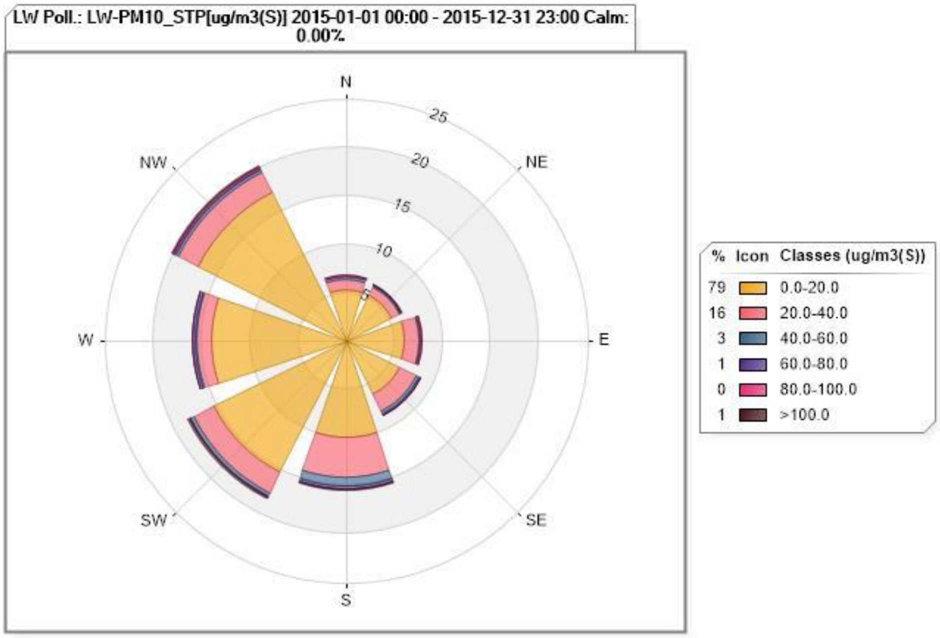


Figure 60. Lostwood PM_{10} Pollution Rose for 2015

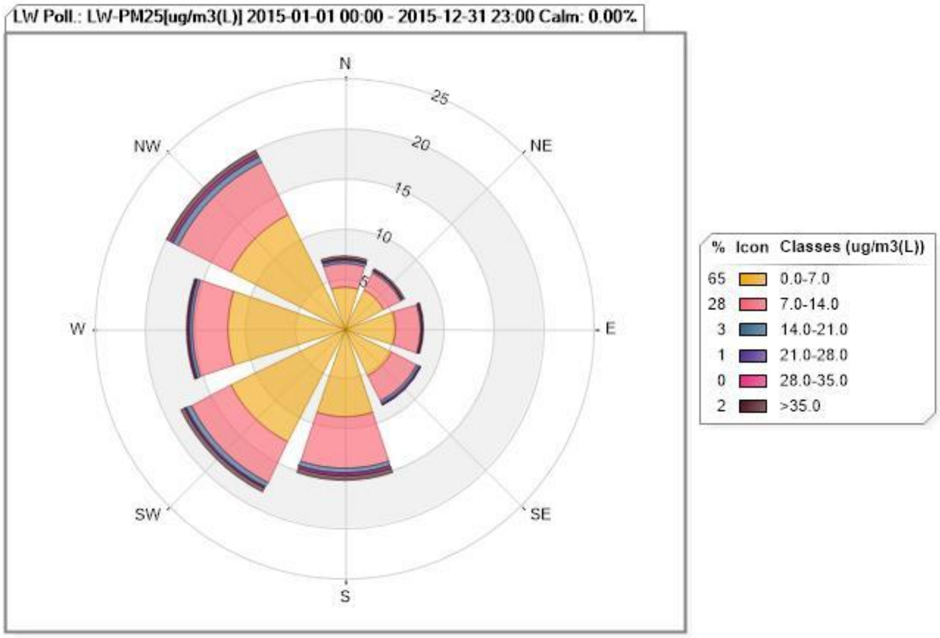


Figure 61. Lostwood $PM_{2.5}$ Pollution Rose for 2015

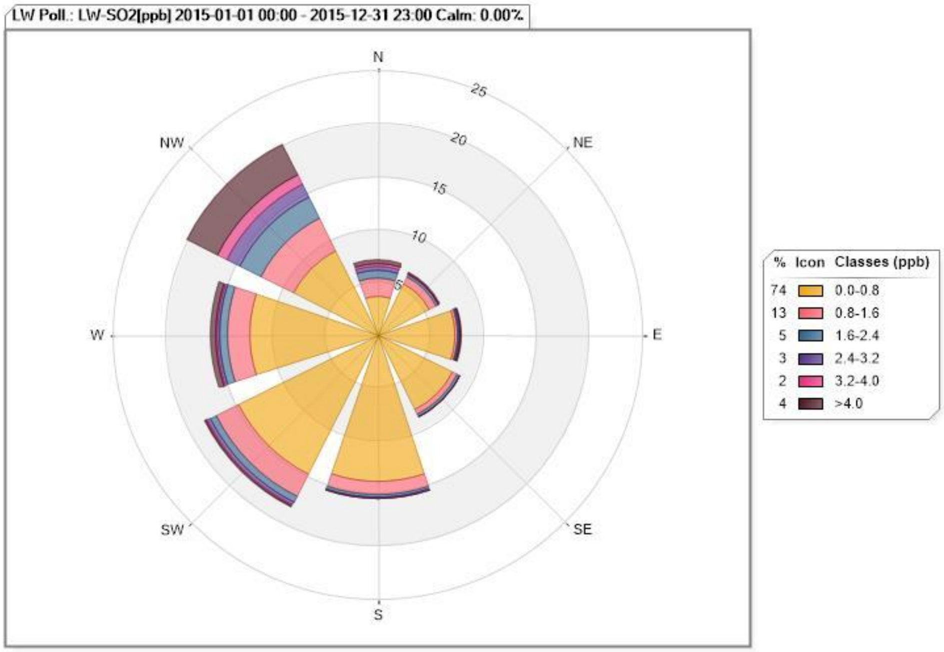


Figure 62. Lostwood SO_2 Pollution Rose for 2015

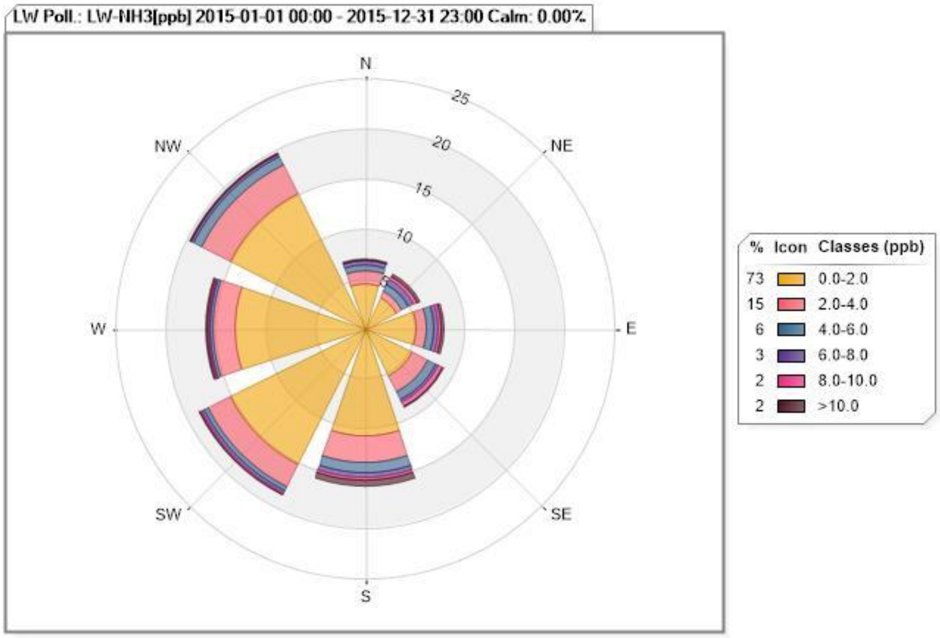
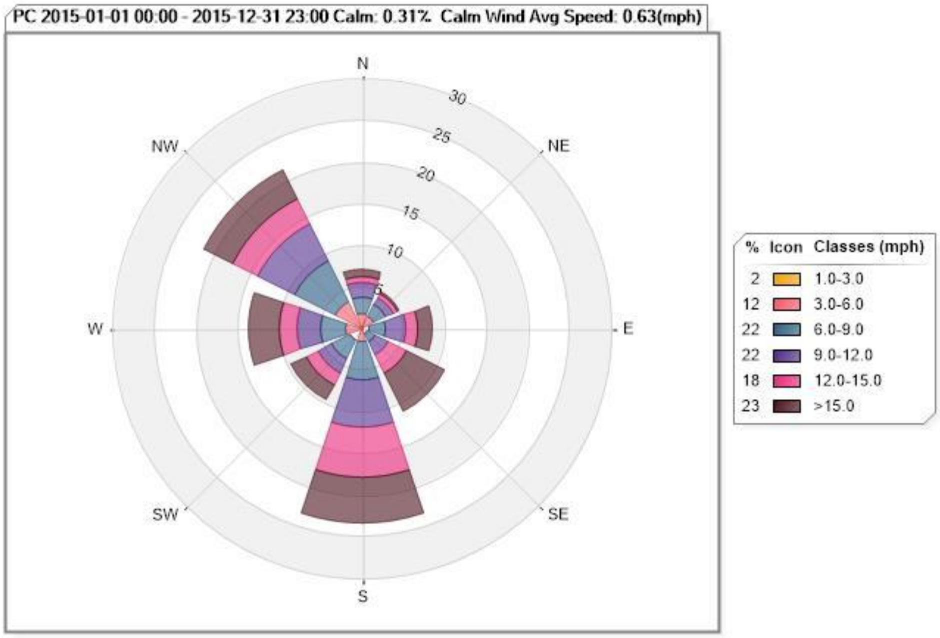
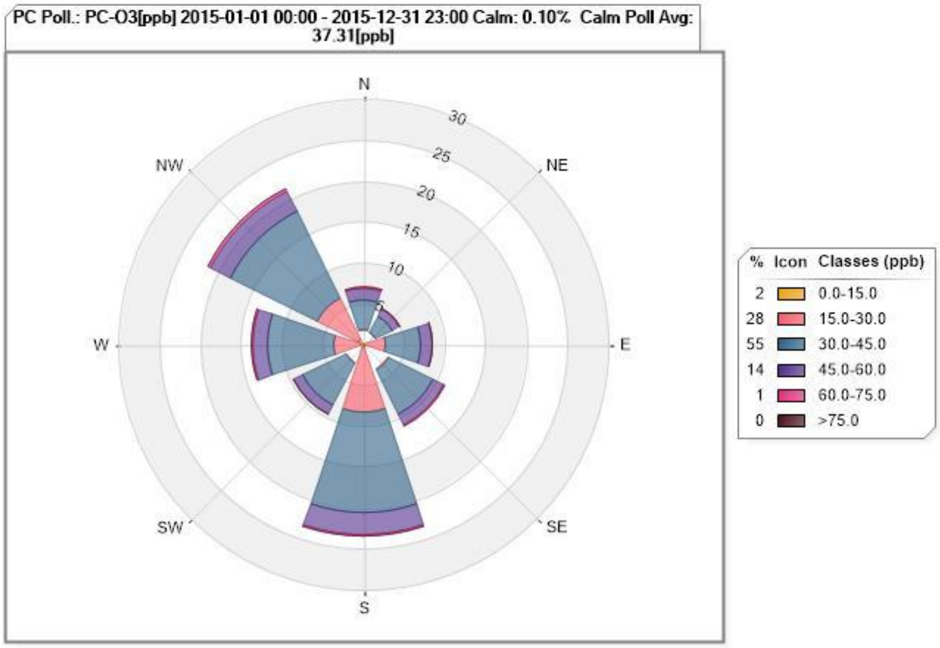
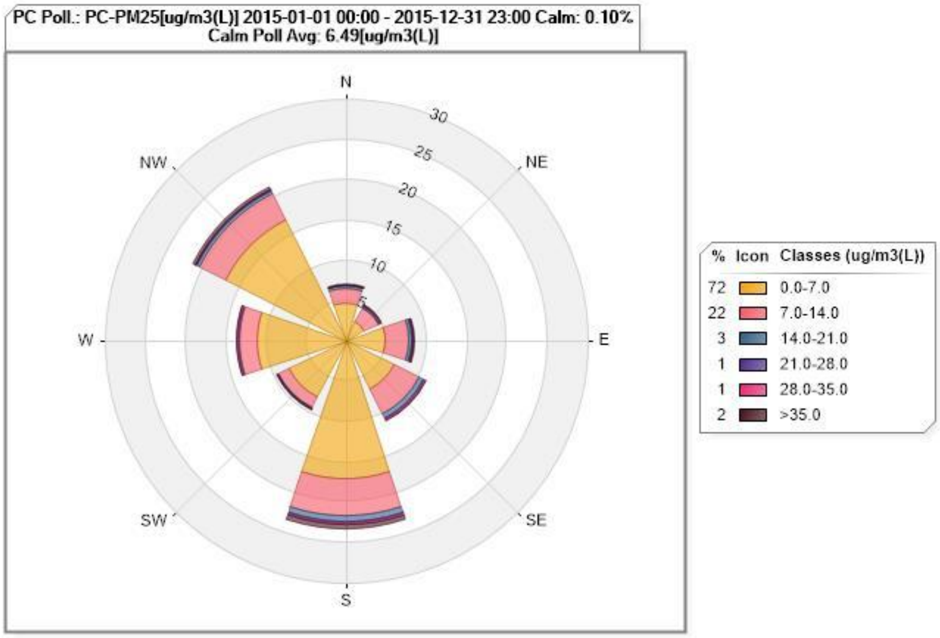


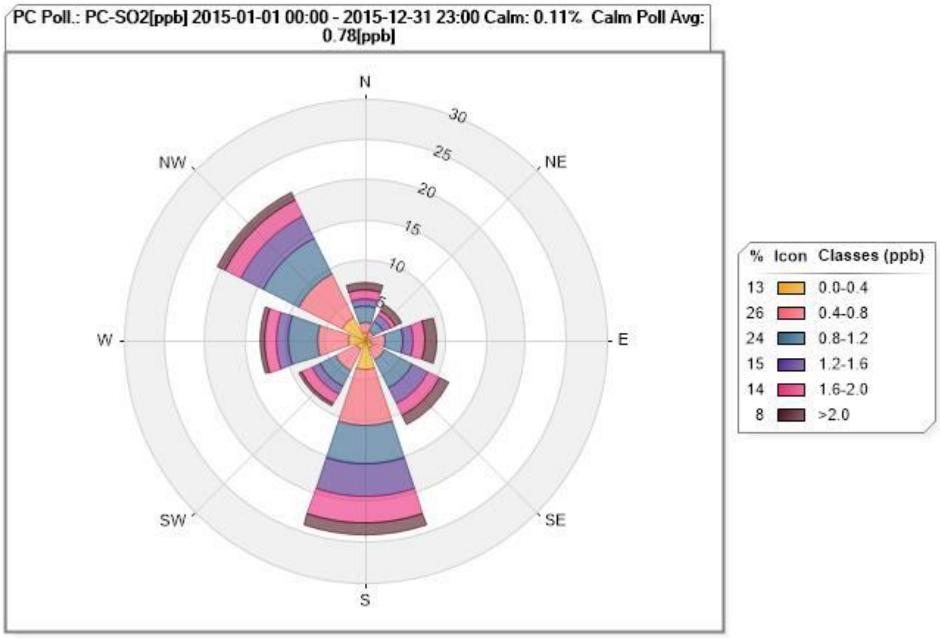
Figure 63. Lostwood NH_3 Pollution Rose for 2015

Site Name: Painted Canyon (TRNP - SU)

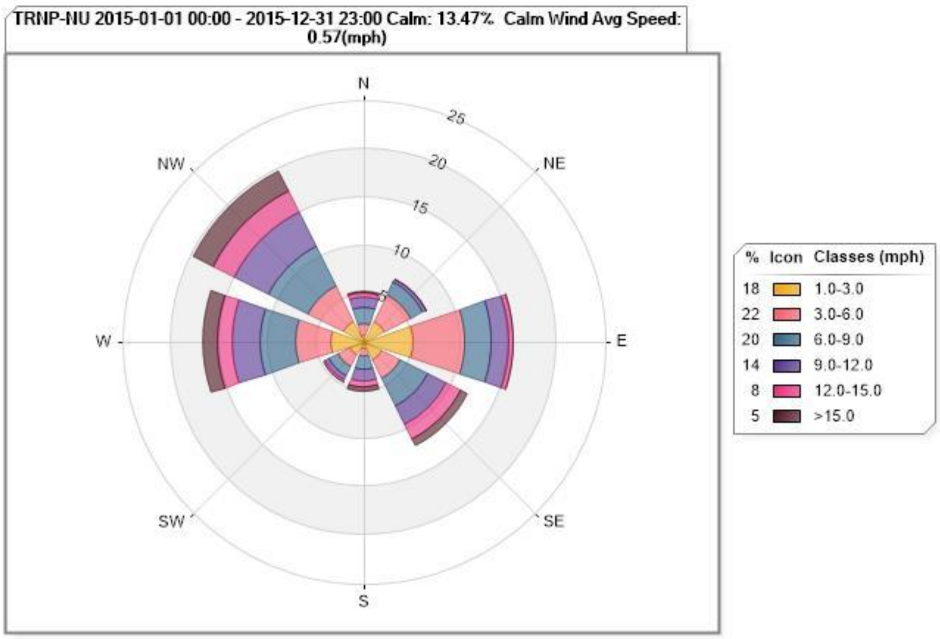

PC 2015-01-01 00:00 - 2015-12-31 23:00 Calm: 0.31% Calm Wind Avg Speed: 0.63(mph)

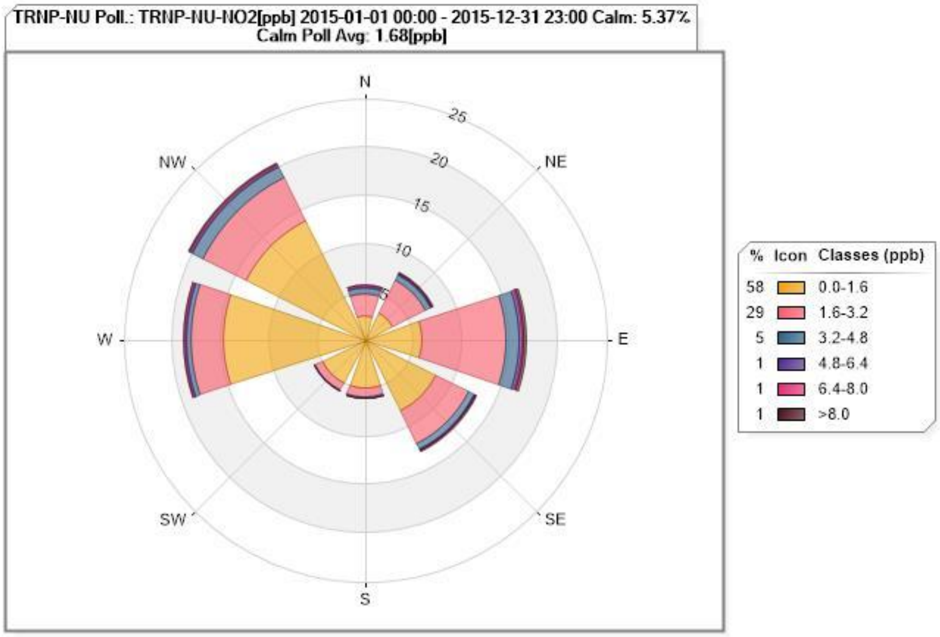

PC Poll.: PC-O3[ppb] 2015-01-01 00:00 - 2015-12-31 23:00 Calm: 0.10% Calm Poll Avg: 37.31[ppb]

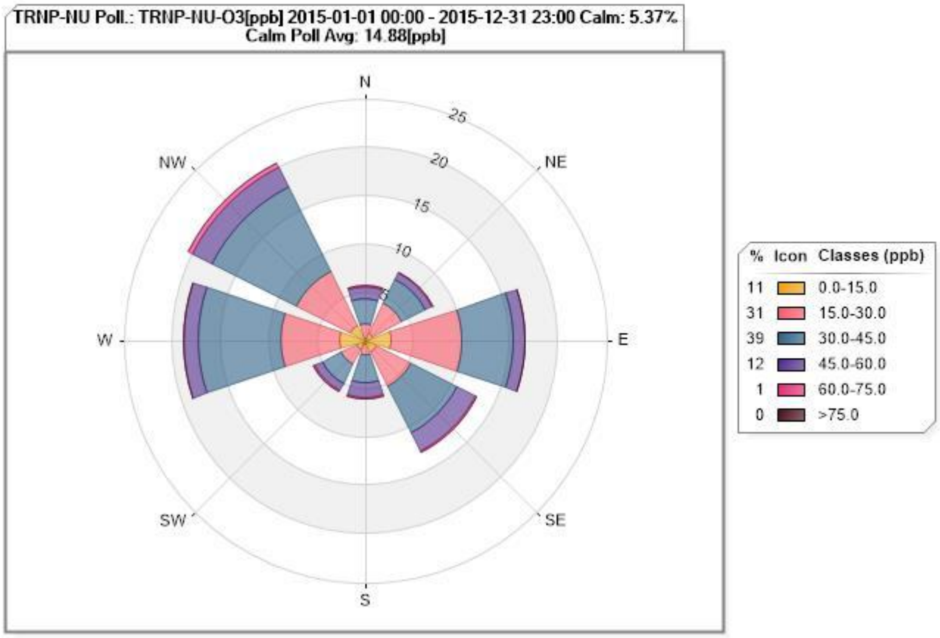

PC Poll.: PC-PM25[ug/m3(L)] 2015-01-01 00:00 - 2015-12-31 23:00 Calm: 0.10%
Calm Poll Avg: 6.49[ug/m3(L)]
N
NE
E
SE
S
SW
W
NW
5
10
15
20
25
30
% Icon Classes (ug/m3(L))
72 0.0-7.0
22 7.0-14.0
3 14.0-21.0
1 21.0-28.0
1 28.0-35.0
2 >35.0

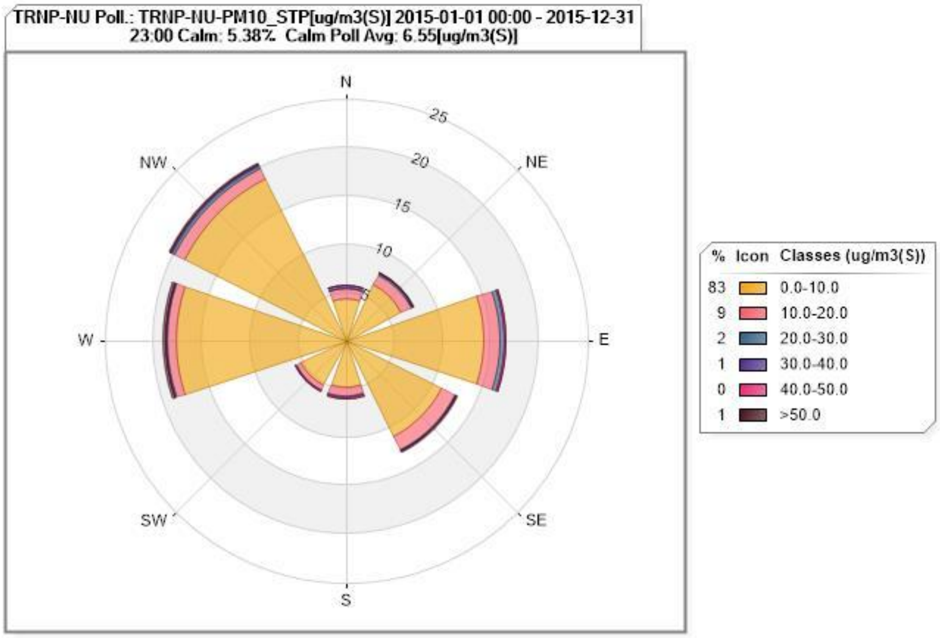

PC Poll.: PC-SO2[ppb] 2015-01-01 00:00 - 2015-12-31 23:00 Calm: 0.11% Calm Poll Avg:
0.78[ppb]
N
NE
E
SE
S
SW
W
NW
5
10
15
20
25
30
% Icon Classes (ppb)
13 0.0-0.4
26 0.4-0.8
24 0.8-1.2
15 1.2-1.6
14 1.6-2.0
8 >2.0

Site Name: TRNP-NU

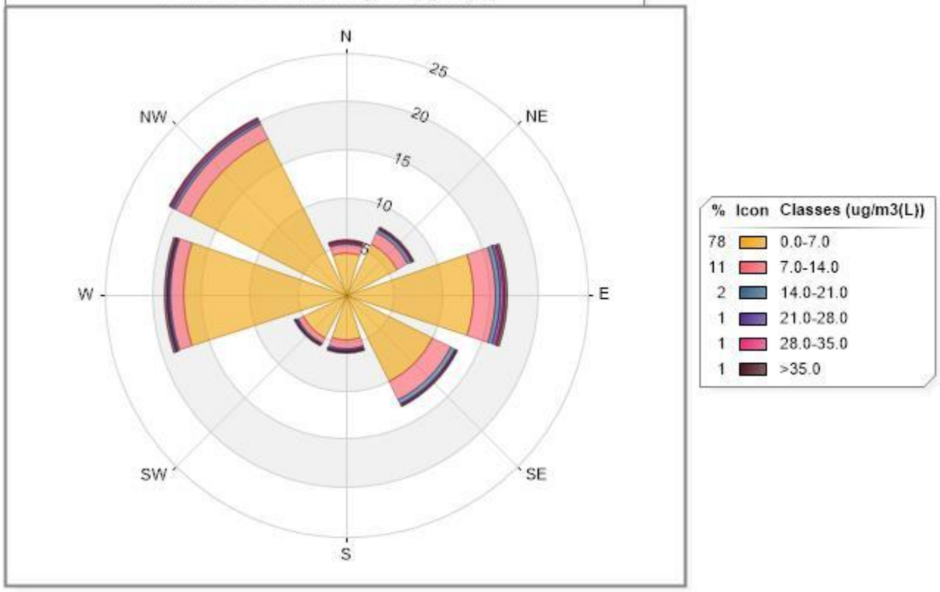




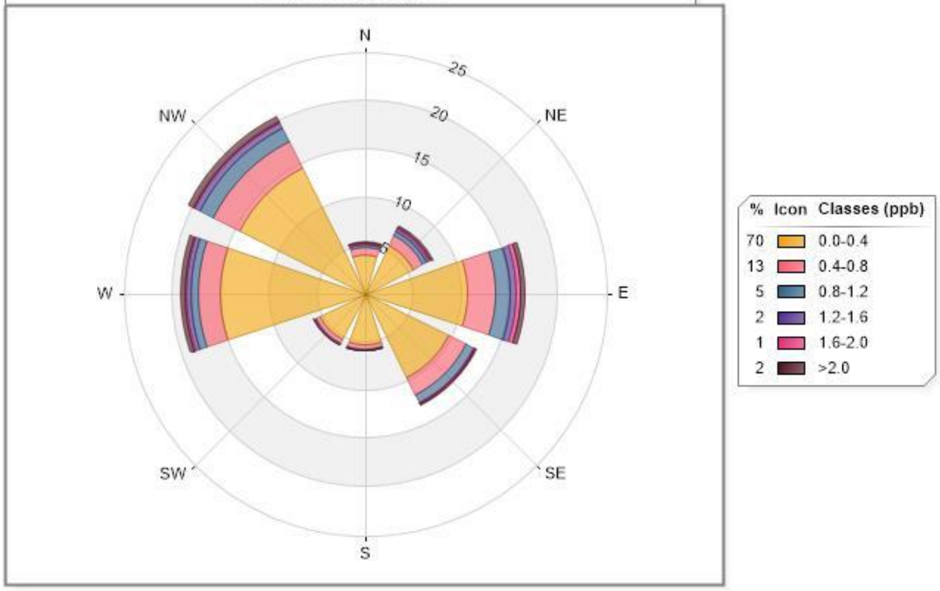

TRNP-NU Poll.: TRNP-NU-O3[ppb] 2015-01-01 00:00 - 2015-12-31 23:00 Calm: 5.37%
Calm Poll Avg: 14.88[ppb]
N
NE
E
SE
S
SW
W
NW
5
10
15
20
25
% Icon Classes (ppb)
11 0.0-15.0
31 15.0-30.0
39 30.0-45.0
12 45.0-60.0
1 60.0-75.0
0 >75.0


TRNP-NU Poll.: TRNP-NU-PM10_STP[ug/m3(S)] 2015-01-01 00:00 - 2015-12-31
23:00 Calm: 5.38% Calm Poll Avg: 6.55[ug/m3(S)]
N
NE
E
SE
S
SW
W
NW
5
10
15
20
25
% Icon Classes (ug/m3(S))
83 0.0-10.0
9 10.0-20.0
2 20.0-30.0
1 30.0-40.0
0 40.0-50.0
1 >50.0

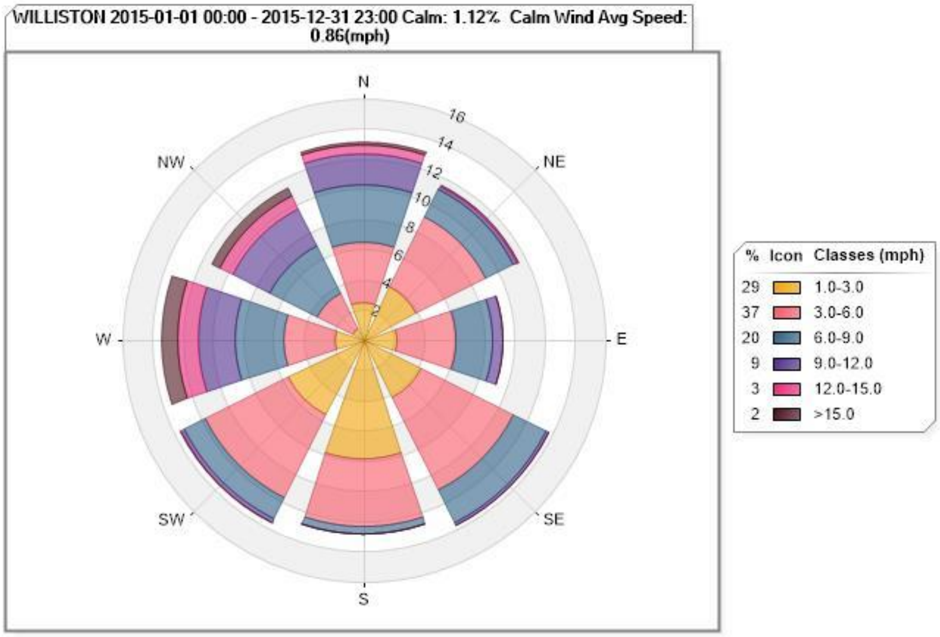
TRNP-NU Poll.: TRNP-NU-PM25[ug/m3(L)] 2015-01-01 00:00 - 2015-12-31 23:00
Calm: 5.38% Calm Poll Avg: 2.53[ug/m3(L)]

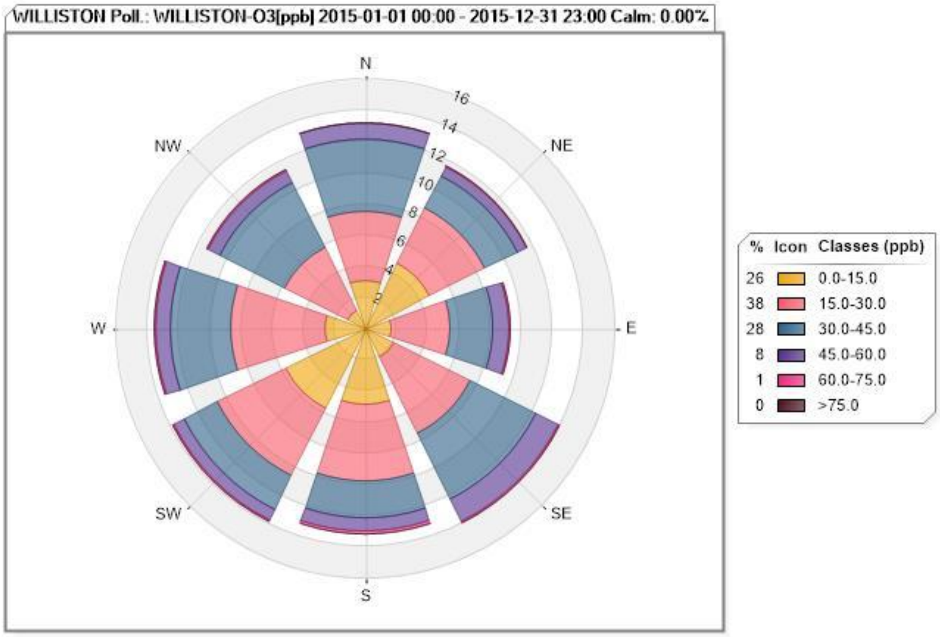


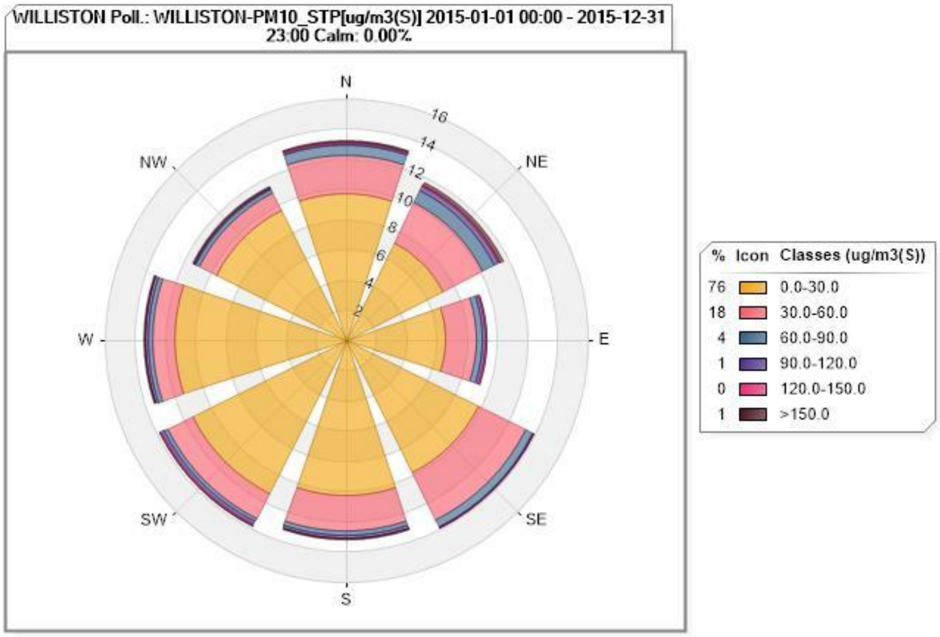
TRNP-NU Poll.: TRNP-NU-SO2[ppb] 2015-01-01 00:00 - 2015-12-31 23:00 Calm: 5.36%
Calm Poll Avg: 0.19[ppb]



Site Name: Williston

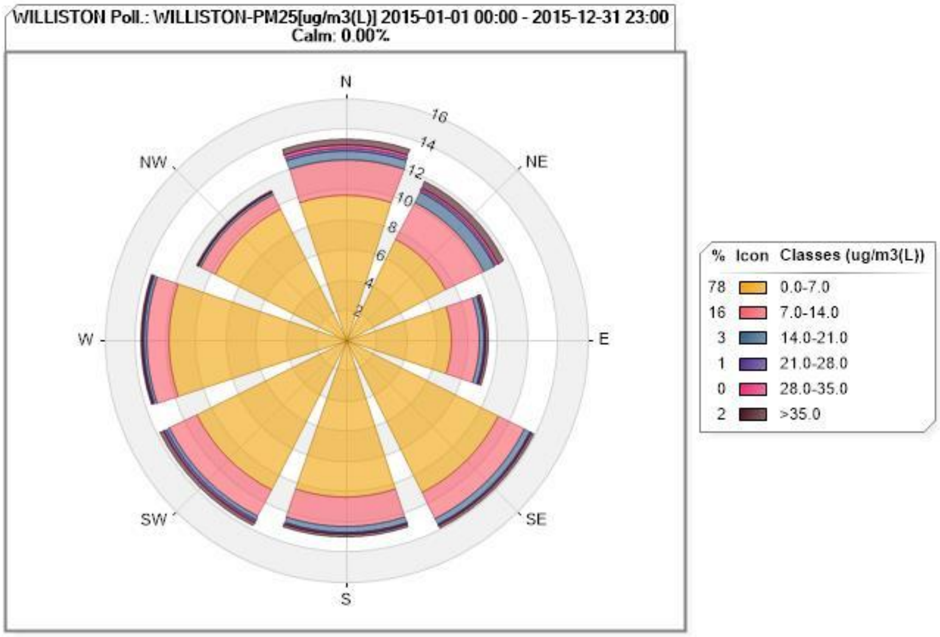






WILLISTON Poll.: WILLISTON-PM10_STP[ug/m3(S)] 2015-01-01 00:00 - 2015-12-31 23:00 Calm: 0.00%

%	Icon	Classes (ug/m3(S))
76	🟧	0.0-30.0
18	🟥	30.0-60.0
4	🟦	60.0-90.0
1	🟪	90.0-120.0
0	🟥	120.0-150.0
1	⬛	>150.0



WILLISTON Poll.: WILLISTON-PM25[ug/m3(L)] 2015-01-01 00:00 - 2015-12-31 23:00 Calm: 0.00%

%	Icon	Classes (ug/m3(L))
78	🟧	0.0-7.0
16	🟥	7.0-14.0
3	🟦	14.0-21.0
1	🟪	21.0-28.0
0	🟥	28.0-35.0
2	⬛	>35.0

Appendix E SO$_2$ Monitor Site Selection for Data Requirements Rule

Introduction:

The Department requested that the Hess Corporation (Hess) prepare a comprehensive air dispersion modeling analysis for the Tioga Gas Plant. This analysis was submitted on May 20, 2016 and is titled: *SO_2 Ambient Monitor Site Selection Implementation of Data Requirements Rule (40 CFR 51.1200* et seq.*)*[24]. This analysis was conducted to inform siting of SO_2 ambient air quality monitors which will allow for the characterization of the ambient air quality with respect to applicable state and federal ambient air quality standards.

This memorandum serves as a summary of the Department's findings based on a thorough review of this analysis.

Background:

Hess operates a natural gas processing facility in Williams County North Dakota. The facility, called the Tioga Gas Plant, consists of gas sweetening operations, gas separation and dehydration, sulfur recover, and tail gas incineration. The facility currently operates under Title V Permit to Operate No. T5-O82002 and is designated a major source for Title V because it emits more than 100 tons per year of the criteria pollutants: Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), and Sulfur Dioxide (SO_2).

Hess currently operates two industrial ambient SO_2 monitoring stations near the Tioga Gas Plant called Site #1 (AQS# 38-105-0103 - located ~0.8 miles north of the facility) and Site #3 (AQS# 38-105-0150 - located ~0.5 miles to the southeast of the facility). These two stations are not considered regulatory; however, Site #3 has suggested excessive ambient concentrations of SO_2.

Effective September 21, 2015, EPA promulgated the Data Requirements Rule (DRR) for the 2010 1-hour SO_2 standard which requires state air agencies to characterize air quality in areas with large sources of SO_2 emissions. The Hess Tioga Gas Plant is subject to this rule as an applicable source due to concerns expressed by EPA over the concentrations seen at the two Hess monitoring sites. This applicability is outlined in the March 18, 2016 DRR Response letter from EPA[25].

One of the pathways for a state agency to characterize air quality is to use ambient air quality monitoring by use of SLAMS or SLAMS-like[26] monitors. The decision to use monitoring for air quality characterization must be communicated to EPA by July 1, 2016. It is the intent of the Department to use air quality monitors for this purpose.

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[24] A copy of the analysis is attached at the end of this memorandum.

[25] Available at https://www3.epa.gov/airquality/sulfurdioxide/drr/nd-response.pdf

[26] Monitors operated in a manner equivalent to SLAMS as to meet all applicable requirements of 40 CFR 58, appendices A, C, and E, and subject to the data certification and reporting requirements of 40 CFR 58.15 and 58.16.

The Department conducted preliminary screening air dispersion computer modeling to identify locations of maximum impact due to SO_2 emissions from the Hess facility. The results of this exercise suggested that the existing monitor sites may not represent areas of maximum concentration. Based on these preliminary findings, the Department requested that Hess prepare a comprehensive air dispersion modeling analysis for the Tioga Gas Plant to aid in monitor siting.

Hess conducted the analysis in accordance with applicable sections of the *Guideline on Air Quality Models* (40 CFR 51, Appendix W; Guideline) and recommendations of the *SO_2 NAAQS Designations Source-oriented Monitoring Technical Assistance Document* (TAD[27]).

Method:

Model:

The U.S. Environmental Protection Agency (EPA) has created a Guideline on air quality models wherein they list preferred models, as well as guidance on selecting appropriate model inputs, for permitting review. Additionally, EPA has published a draft technical document, or TAD, with recommendations for characterizing air quality with respect to SO_2 by use of ambient monitoring. That document references the *SO_2 NAAQS Designations Modeling Technical Assistance Document*[28] for those agencies that use modeling to inform monitor placement. For the type of analysis required for the Hess Tioga facility monitor siting, these documents suggest that the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) should be used unless an alternative model can be justified. AERMOD was used for this analysis

In addition to the AERMOD (core) dispersion model which is used to estimate ambient concentrations of a given pollutant, the AERMOD system contains the following pre- and post-processors: AERMET, a meteorological data preprocessor; AERMAP, a terrain data preprocessor which generates elevation inputs for receptors; AERSURFACE, a surface land cover characteristics preprocessor; and BPIP-PRIME, a building profile input and downwash calculation pre-processor. For their analysis, Hess utilized the following versions:

AERMOD	-	15181
AERMET	-	15181
AERMAP	-	11103
AERSURFACE	-	13016
BPIP-PRIME	-	04274

The versions noted are the current versions of each processor. In addition, AERSURFACE

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[27] In Draft. Updated February, 2016 and available online at https://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2MonitoringTAD.pdf

[28] In Draft. Updated February, 2016 and available online at https://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf

parameters were applied using files from the 1992 National Land Cover Database (NLCD1992). The Department finds that AERMOD and the associated pre-processors as noted are appropriate for the analysis of the project as described.

Meteorological Data:

Surface and upper-air data are pre-processed by AERMET to generate the boundary layer parameters required by AERMOD to calculate plume dispersion. Per 8.3.1.2 of the Guideline, a minimum of one year of site-specific data, or five years of representative National Weather Service (NWS) data should be used to ensure a sufficiently conservative result which addresses the worst-case atmospheric conditions. The TAD amends this requirement by suggesting that the use of three complete years of meteorological data is appropriate for monitor siting.

If site specific data is not available, the Department provides representative National Weather Service (NWS) data from various stations throughout the state. For use in this analysis, the Department processed three years of data (2011-2013) from the Williston, ND, NWS station.

1. *Surface:*

   Surface roughness length, albedo, and Bowen ratio are required values used by AERMET to pre-process meteorological data for AERMOD. AERSURFACE allows the user to develop these values using inputs based on set seasonal variability in the vegetative landscape (land cover). Hess utilized seasonally and directionally varying data in the form of land cover data files from NLCD1992 for the AERSURFACE pre-processor inputs.

   AERMET uses hourly surface observations of wind speed and direction, ambient temperature, sky cover (opacity), and (optionally) local air pressure, in addition to the AERSURFACE output, to compile the appropriate surface meteorological inputs for AERMOD. Hess used the files for the Williston, ND station (NWS Station 94014) provided by the Department for the hourly surface observations. The Williston station is the nearest suitable NWS station to the facility and is located approximately 35 miles from the site.

2. *Upper-Air:*

   Mixing heights used by AERMOD to determine plume dispersion are calculated based on upper-air data collected by Radiosonde at a NWS upper-air observation station. Hess used the Glasgow, MT upper-air station (NWS Station 94008) as the source for the upper-air data used in their analysis. The Glasgow station is located approximately 170 miles from the site and was determined to be an acceptable choice for the analysis.

Emission Source Data:

In air dispersion modeling, pollutant emission releases can be configured as point, volume, or area sources. Point sources are typically used to represent conventional stacks, flares, and cooling towers. Area sources are often used to represent vents and other emission surfaces which can be defined as two-dimensional sources of emissions (often fugitive). Volume sources are used to simulate fugitive emissions from haul roads, piles, and other potential three-dimensional sources.

Source data required by AERMOD includes the type and location for each emission point, the base elevation of a given stack, emission height and rate, and gas exit velocity and temperature. The units at the Hess Tioga Gas Plant that are associated with SO_2 emissions are the Sulfur Recovery Unit (SRU) and flare. The SRU is designed to handle up to 220 long tons of sulfur per day. The flare is designed to operate during upset conditions that may occur and is fed from the SRU or the acid gas system. The Hess analysis shows that over the past 10 years, the flare has contributed approximately 6%, on average, of total SO_2 emissions at the facility. Additionally, flare emissions were approximately zero for 98% of all hours, suggesting that emissions from the flare are concentrated over a small number of hours. This is consistent with an upset relief system.

The Department conducted preliminary screening modeling using conservative assumptions whereby the flare and SRU operate concurrently all modeled hours. It was found that at a resolution meaningful to monitoring, emissions from the flare are not likely to significantly impact the location of the modeled maximum concentrations when compared to modeling the SRU alone. Because of this, the flare was not considered in the modeling analysis.

Hess has outlined specific emission point parameters and rates used in their analysis (reproduced as Table 1 below). Stack exit velocity and temperature have been determined from Continuous Emissions Monitoring System (CEMS) data. The TAD suggests using normalized actual emission rates for a modeling analysis. Because of changes to the operations at the facility and non-representativeness of actual emissions during the 2011-2013 modeled time period, Hess proposed to use a more conservative single emission value of 1 pound per hour for all 8,760 hours for each of the three modeled years. This unitary emission rate was justified in the analysis by stating that emissions are from a single source and modeling results are not intended for use as a compliance tool. Rather, the modeling analysis is used solely to locate an ambient monitoring site. The Department agrees with this approach.

Table 10. Values utilized in air dispersion modeling input files: Hess Tioga Gas Plant Parameters

Stack ID	Description		Stack Parameters			
		Emissions Rate[29]	Diameter	Height	Temperature	Velocity
		lb/hr	m	m	°C (K)	m/s
SRU	Sulfur Recovery Unit	1.00	0.89	50.3	305 (578)	22.8

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[29] Because this analysis was designed to inform monitoring site placement and not to quantify maximum impact or serve as a compliance tool, a unitary emissions rate was used.

Ambient Air Boundary:

Ambient air refers to the air to which the general public can reasonably be expected to have access. Typically this refers to air located outside a boundary (fence, wall, etc.) which restricts access to a facility or source. Because this analysis was conducted in order to locate an ambient air quality monitor, only locations outside the ambient air boundary were evaluated.

The Hess analysis indicates that the existing facility fence line will constitute the ambient air boundary.

Receptor Grid:

Receptors are the locations where a dispersion model calculates ground-level pollutant concentrations. Receptor spacing was set as follows:

- 100-meter (m) spacing for receptor placement along the property ambient air boundary.
- 100-m spacing out to 1 km
- 250-m spacing from 1 km to 2 km
- 500-m spacing from 2 km to 7 km
- 1000-m spacing from 7 km to 20 km
- “Hot spot” receptors were placed at 100-m spacing around the highest design value receptors.

A total of 8,010 receptors were defined.

The Department has determined that this spacing is acceptable based on the topographical profile for the project area guaranteeing a reasonable probability that the location of the highest pollutant impact has been represented. Receptor elevations were based on 1/3 arc-second GeoTIFF files.

Off-Site Impacts, Nearby Sources, and Background Concentrations:

Within the 50 km domain of the model, the Tioga Gas Plant is the significant contributor of SO^2 emissions. Other nearby sources are minor and the Department, based on historical modeling and permitting actions, has determined that they are not likely to either cause a significant concentration gradient of SO_2 in the vicinity of the subject source, or emit SO_2 at a significant level.

Because modeling for monitor siting is based on unitary emission rates and is not designed to identify a specific modeled maximum concentration *value*, but rather the *location* of maximum concentration, the addition of a uniform background concentration to all locations is superfluous and was not done for this analysis.

Building Downwash:

Downwash is the result of the interference of buildings or other nearby structures with plume dispersion. Downwash is assumed to occur when stack heights are below Good Engineering

Practice (GEP) heights[30]. Hess has indicated that stacks at the facility may be below GEP heights. Downwash was simulated for nearby buildings by use of the Building Profile Input Program with the PRIME downwash algorithm (BPIP-PRIME).

Output:

The model was executed with the standard pollutant ID parameter of “SO2” to allow for an output comparable to the ambient standard (i.e. in the form of the design value – not a concentration comparison). The MAXDAILY option was applied which outputs the maximum 2-hour value for each receptor. This allows for a frequency analysis of peak values as recommended in the TAD.

Results and Discussion:

Maximum Concentration Location:

The AERMOD model was executed using the source, receptor, and meteorological data, as described above, in order to obtain “design value” form SO_2 maximums[31]. In their analysis, Hess identified the top 20 receptors with maximum modeled concentrations based on the unitary emission rate (Table 11). Figure 64 plots the location of the high value receptors as isopleths (greater than 0.7 µg/m^3) and shows the highest concentration (primary isopleth) located approximately 7 km NNE of the Tioga Gas Plant facility. Hess also identified two secondary locations of high concentration within 5 km of the primary isopleth, but noted their small geographical extent. For monitor siting, the analysis suggested that the probability of collecting maximum concentration monitoring data is increased with an increased geographical area of high modeled concentration. The larger primary isopleth (which includes the maximum receptor design values) provides for more flexibility in land acquisition, securing utility access, etc. for a future monitoring station while still remaining within the maximum concentration area. The Department concurs with this assessment.

Table 11. Receptor Rank Order - Maximum Modeled Value (Data taken from Table 9 of Hess analysis report)

Rank Order	UTM Easting (meters)	UTM Northing (meters)	Receptor Design Value (µg/m^3)
1	656,200	5,369,900	0.91
2	655,800	5,370,300	0.88
3	656,100	5,370,000	0.87
4	655,500	5,370,200	0.87
5	656,200	5,370,000	0.86
6	655,300	5,370,500	0.86
7	655,400	5,370,300	0.86
8	655,800	5,370,400	0.86

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[30] GEP = H + 1.5L where H is the height of nearby structure(s) and L is the lesser dimension, height or projected width, of nearby structure(s); from EPA’s *Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document For the Stack Height Regulations)(Revised)(June 1985)*

[31] Three year average of the 99th percentile of the daily hourly maximum (40 CFR 50).

9	655,800	5,370,200	0.86
10	655,300	5,370,400	0.85
11	655,400	5,370,400	0.85
12	655,800	5,370,100	0.85
13	655,300	5,370,300	0.84
14	655,400	5,370,200	0.84
15	655,700	5,370,200	0.84
16	655,500	5,370,500	0.83
17	653,000	5,368,300	0.83
18	655,600	5,370,300	0.83
19	656,100	5,370,100	0.82
20	655,600	5,370,700	0.82

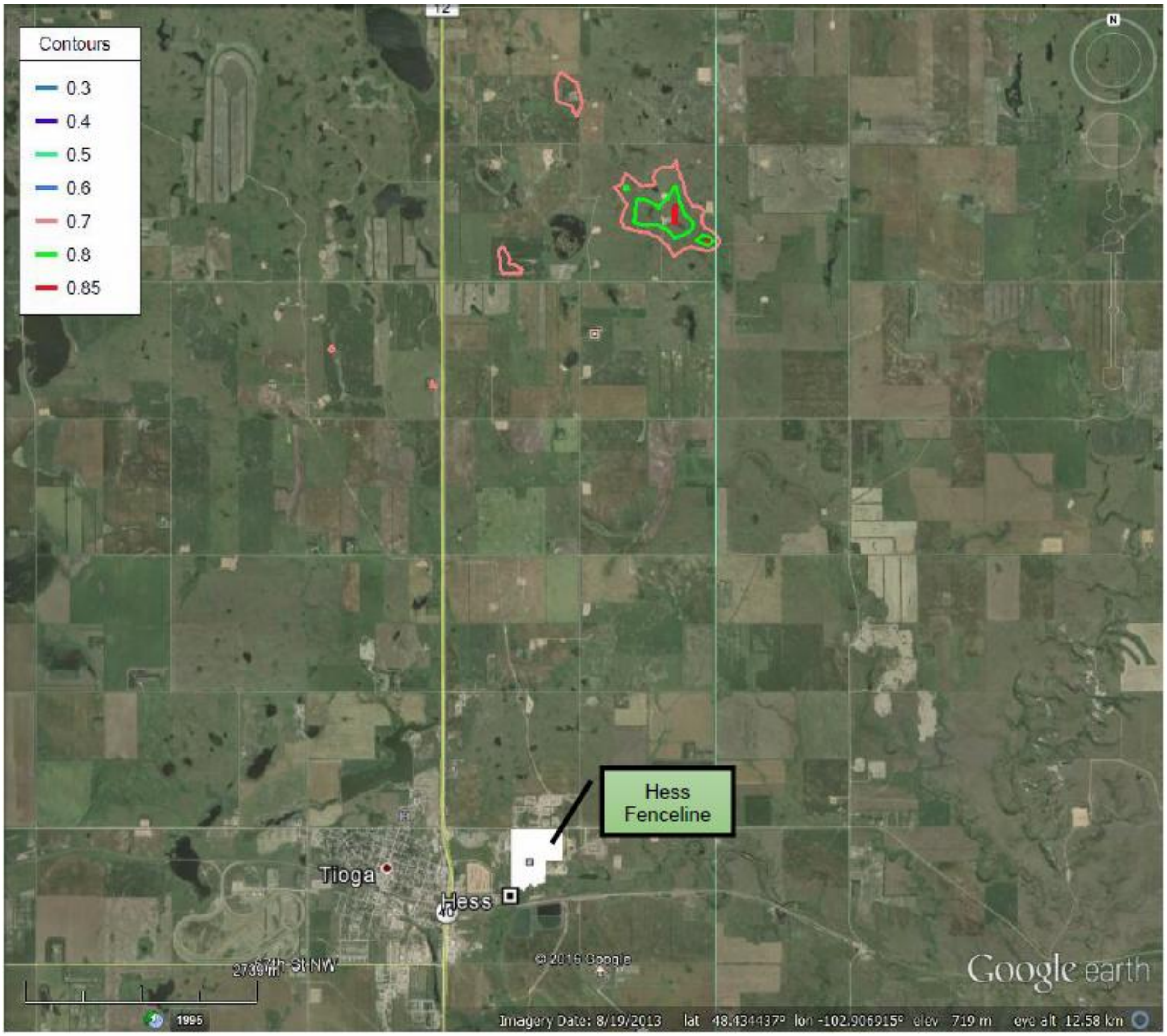

Figure 64. Design Value Isopleths (Reproduced from Figure 15 of the Hess analysis report).

Frequency of High Concentrations:

Hess also evaluated the frequency of high concentrations in accordance with the recommendations of the TAD (p. A-6). The MAXDAILY option was used to output the maximum 1-hour concentration for each receptor for each day. Hess limited the dataset by eliminating those values with a maximum concentration less than ½ of the single highest value.

The receptors were then ordered by the number of days each receptor had the highest 1-hour concentration for the day over the 3 modeled years. Table 12 shows the top 25 ranked receptors. The analysis shows that there are some minor differences in frequency of occurrences among the top ranked receptors. However, the majority of the receptors are clustered within the area identified by the primary isopleth (Figure 65). The Department determined that 56% of the daily

Table 12. Receptor Rank Order – Daily Max Frequency (Data taken from Table 10 of Hess analysis report)

Rank Order	Rank	Receptor #	Count (# of Daily Max)	UTM Easting (meters)	UTM Northing (meters)
1	1	201	25	653,000	5,368,300
2	2	990	18	653,900	5,369,600
3	2	1,193	18	656,200	5,369,900
4	2	1,602	18	655,100	5,370,600
5	3	1,309	11	655,800	5,370,100
6	4	991	9	654,000	5,369,600
7	4	1,252	9	656,100	5,370,000
8	4	1,368	9	655,700	5,370,200
9	4	1,603	9	655,200	5,370,600
10	5	140	8	652,900	5,368,200
11	5	1,311	8	656,000	5,370,100
12	6	368	7	651,800	5,368,600
13	6	2,315	7	654,400	5,371,800
14	7	369	6	651,800	5,368,600
15	7	1,425	6	655,400	5,370,300
16	7	1,485	6	655,400	5,370,400
17	8	202	5	653,100	5,368,300
18	8	429	5	651,800	5,368,700
19	8	430	5	651,900	5,368,700
20	8	1,109	5	653,800	5,369,800
21	8	1,192	5	656,100	5,369,900
22	8	1,195	5	656,400	5,369,900
23	8	1,365	5	655,400	5,370,200
24	8	1,427	5	655,600	5,370,300
25	9	61	4	651,000	5,368,100

Table 13. Percentage of Total Daily Maximums per Isopleth

Isopleths (Identified by Top 25 Receptor Rank)	Count (Sum)	Percentage of Total
All	218	100%
Primary Isopleth*	121	56%
1, 10, & 17	38	17%
2, 6, & 20	32	15%
12, 14, 18 & 19	23	11%
13	7	3%
25**	4	2%

* 3, 4, 5, 7, 8, 9, 11, 15, 16, 21, 22, 23, & 24

** Does not represent an isopleth illustrated in Figure 64.

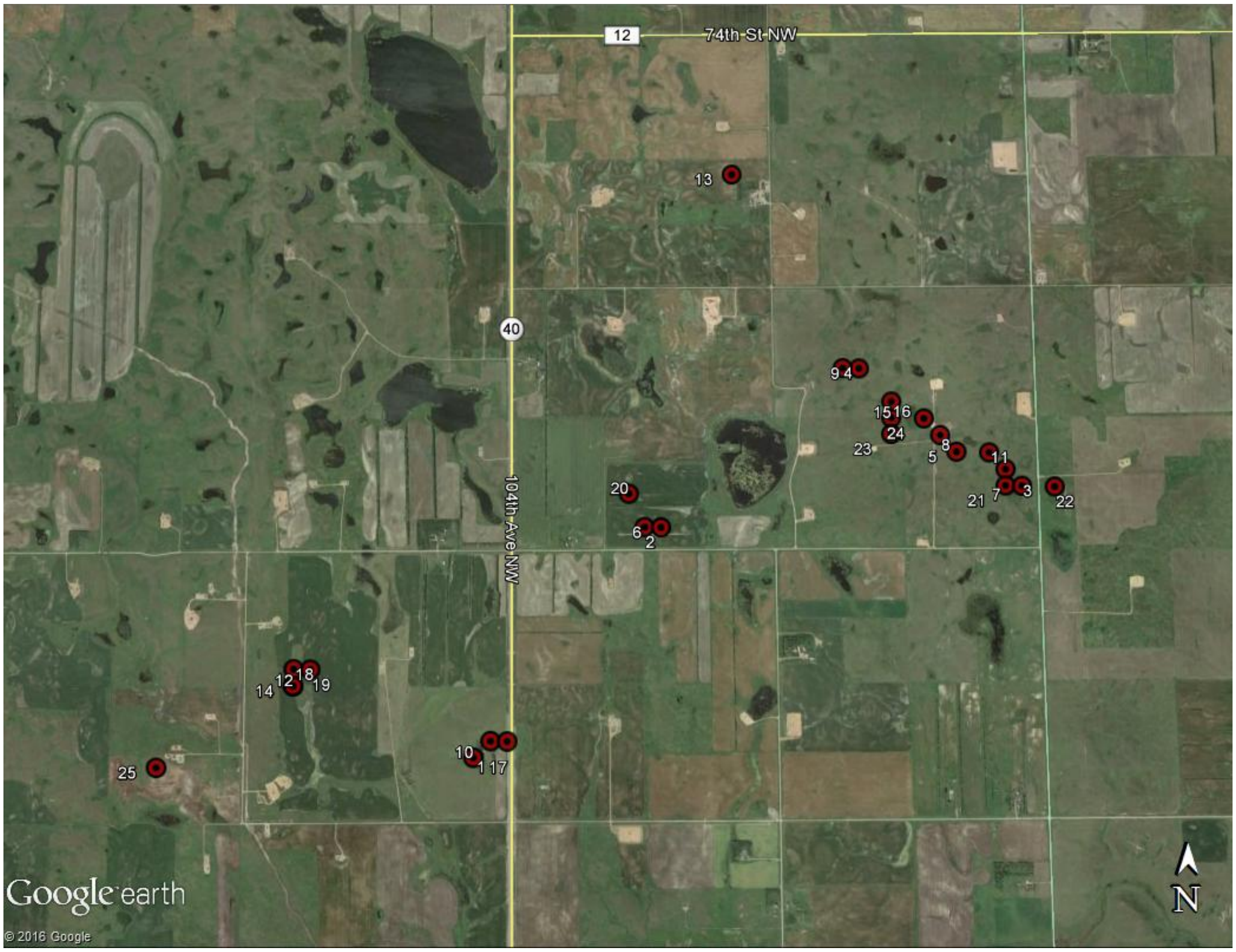

Figure 65. Plot of Top 25 Receptors Ranked by Daily Maximum Frequency (Rank Order ID)

maximums recorded for the top 25 receptors were accounted for by the primary isopleth, whereas the next most frequent isopleth only accounted for 17% of the daily maximums (Table 13).

***Model Score*:**

Hess continued the analysis with additional receptor scoring by determining the sum of the design value rank for each receptor and the frequency count rank. Hess identified the three top scored receptors, all which were located in the primary isopleth. The Department re-ran this analysis using different ranking scores for the frequency count rank whereby those receptors with equal counts were ranked equally. The results of the Department's analysis are presented in Table 14. Those receptors located in within the general vicinity of the primary isopleth again scored highest, including the top three ranked receptors, indicating that a monitor located in that area would provide data adequate to characterize the ambient air quality by resolving maximum impact.

***Site Selection*:**

Based on the above described modeling analysis, a location approximately five miles NNE of the

SRU stack is proposed, within the area identified as the primary isopleth. This location has been identified by both a maximum design value analysis and a frequency analysis as one most likely to allow for the characterization of air quality due to maximum SO_2 impact from the Hass Tioga Gas Plant facility. Specific siting location information will be provided in a future supplement to this report.

Table 14. Receptor Score Rank

Receptor #	UTM Easting (meters)	UTM Northing (meters)	Design Value Rank (Table 11)	Frequency Day Count (Table 12)	Frequency Rank[32]	Score (sum of Rank)	Score Rank
1193	656,100	5,369,900	1	18	2	3	1
1602	655,500	5,370,200	4	18	2	6	2
1252	655,800	5,370,100	3	9	4	7	3
1429	655,500	5,370,200	2	3	10	12	4
1366	656,200	5,370,000	4	3	10	14	5
1425	656,100	5,370,100	7	6	7	14	6
1253	655,700	5,370,000	5	1	12	17	7
201	653,000	5,368,300	17	25	1	18	8
1485	655,700	5,370,200	11	6	7	18	9
1368	655,800	5,370,100	15	9	4	19	10
1484	655,500	5,370,200	10	1	12	22	11
1365	656,100	5,370,000	14	5	8	22	12
1424	656,000	5,370,100	13	2	11	24	13
1427	656,200	5,370,100	18	5	8	26	14
1603	655,600	5,370,300	28	9	4	32	15
1192	565,100	5,369,900	24	5	8	32	16
1367	655,700	5,370,100	21	1	12	33	17
1428	655,400	5,370,200	31	1	12	43	18
1488	655,900	5,370,200	39	1	12	51	19
990	654,200	5,368,700	74	18	2	76	20

As is noted in the introduction to this report, there are two historical ambient air quality monitoring site locations in the vicinity of the facility as well. Data collected at one of these (Site #3 - Southeast) was the primary impetus for including the Tioga Gas Plant in the list of facilities subject to the DRR, as it included values above the 75 ppb (Table 15). Site #3 has been in operation for more than 25 years.

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[32] The Department chose to use a different frequency rank method from Hess whereby rank is listed sequentially for the top 25 receptors and those receptors with equal counts were ranked equally. This did not change the overall conclusions based on the score rank.

Table 15. Ambient Monitoring Data Summary: 2010 – 2015 (Data from Table 4 of Hess analysis report)

Year	99th Percentile (ppb)		Annual Average (ppb)	
	Site #1 (N)	Site #3 (SE)	Site #1 (N)	Site #3 (SE)
2010	27	77	0.5	2.2
2011	75	68	1.1	1.6
2012*	35	161	0.6	3.1
2013	44	264	0.5	3.2
2014	16	180	0.3	1.6
2015	17	74	0.4	1.4

* The 75 ppb standard became effective in August 2012

Because of existing ambient monitoring data suggesting that this site is the location of significant impacts due to a SO_2 plume originating from the facility, the Department proposes to continue monitoring at this site. This will allow for data continuity and evaluation of trends with respect to SO_2 impacts in this area.

In their analysis, Hess suggests further justification for continued monitoring at Site #3:

- **Wind Direction** – Site #3 is at a 320° direction measured to the SRU unit, inside the most frequent wind direction quadrant measured over the past three years. Figure 66 shows that wind predominantly blows from the SRU to the SE over the combined three year period of 2013-2015. Individual years show the same trend. Hess also calculated a resultant wind vector based on a unit wind speed for each hour of the year. When combined with observed wind direction, the resultant wind vector shows the values in Table 16.

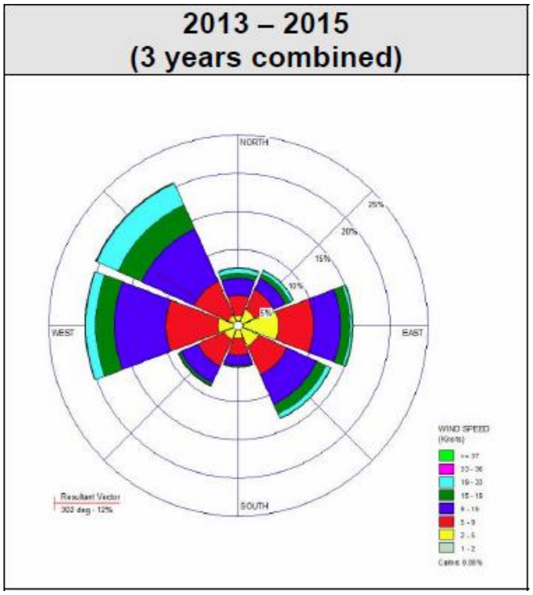

Figure 66. Tioga Gas Plant Wind Rose – Three Year Summary
(reproduced from Figure 14 of Hess analysis report)

Table 16. Resultant Wind Vectors at Hess Tioga Gas Plant

Year	Resultant Vector
2013	322
2014	300
2015	290
2013-2015	302

They suggest that the current Site #3 location is well within the demonstrated range of wind vectors and represents an appropriate location.

- **Wind Speed** – Hess evaluated wind speed with the aim of determining plume travel. The expectation was that lower wind speeds would allow a buoyant plume (identified by the average stack exit temperature of 520° F) to rise to a greater height and cause impacts farther from the facility than high wind speeds which would limit plume rise. To resolve the most favorable wind speed for current monitor site detection, Hess examined historical wind speeds when compared to SO_2 concentration. The results are reproduced in Figure 67. The analysis shows that high concentrations (>75 ppb) have occurred at a wide range of wind speeds including those considered “low”, “medium”, and “high”. Therefore the existing location is at a distance from the facility suitable to resolve high concentration impacts at a variety of representative wind speeds.

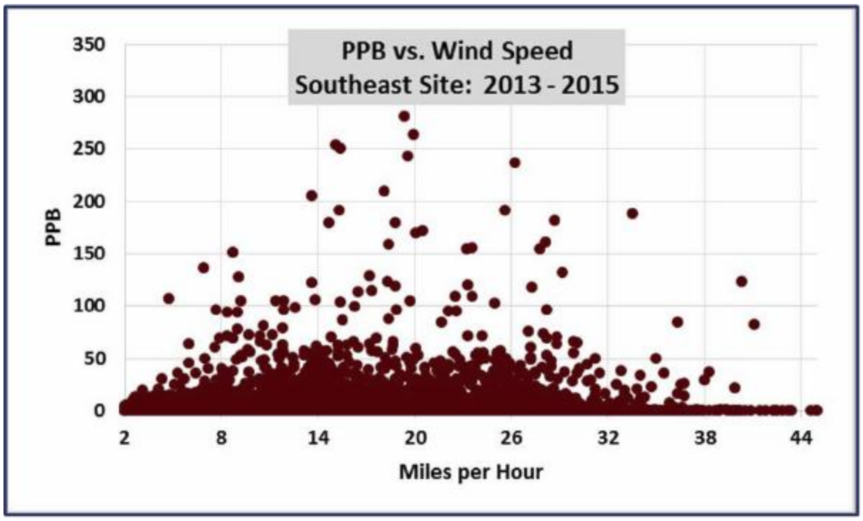

Figure 67. Concentration (ppb) as Compared to Wind Speed at Tioga Gas Plant Monitoring Site #3 (SE) – (reproduced from Figure 18 of Hess analysis report)

The Department concurs that both the wind speed and wind direction analyses provide additional compelling arguments for continued monitoring at Site #3.

Conclusions:

The Department has completed review of the modeling analysis submitted by Hess. Based on this review, the following is concluded:

1. Based on the March 18, 2016 DRR Response letter from EPA, the Hess Tioga Gas Plant is subject to the DRR. This determination was triggered, in part, due to high SO_2 readings at a non-regulatory monitor located in the area around the Tioga Gas Plant.

2. The DRR requires the characterization of the ambient air quality in areas with significant SO_2 emissions sources. One method of achieving this is through ambient air quality monitoring. In response to a request by the Department, Hess conducted an air dispersion modeling analysis to inform potential monitor placement. This analysis has been completed in accordance with applicable sections of the EPA modeling Guideline document and the TAD.

3. Hess has adequately demonstrated via modeling an appropriate general location for a monitor in order to identify peak SO_2 concentrations that occur in the area around the Tioga Gas Plant.

4. Historical data review suggests that continued monitoring at the existing high reading monitor site (Site #3) will provide additional confidence in the ability to correctly characterize the air quality in the vicinity of the Tioga Gas Plant.

The Department therefore proposes that source-oriented SO_2 monitoring be used to create data for comparison to the SO_2 National Ambient Air Quality Standard. Two monitors will be used to characterize ambient air quality around the Hess Tioga Gas Plant: one in the general area identified via the modeling analysis discussed in this report as the location of peak SO_2 concentration, and one at the current location of the non-regulatory monitor that collected data that resulted in the facility being subject to the DRR (Site #3). These monitors will operate in a “SLAMS-like” manner. Specifics on the location and site characteristics will be addressed in a future addendum to this report.

Appendix F Public Comments[33]

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[33] The language in this section was updated in the final document to reflect the completed public comment period. Additionally, the original web address for the Calendar & Events page was in error. This has been corrected.

A 30-day public comment period for a draft of this document was held from July 1, 2016 through August 1, 2016. No Comments were received.

Notice for the comment period and a link to an electronic version of the document was placed on the North Dakota Department of Health Air Quality Monitoring web page at: http://www.ndhealth.gov/AQ/Ambient.aspx, on the Division of Air Quality Public Comments & Notices web page at: http://www.ndhealth.gov/AQ/PublicCom.aspx, and the Calendar & Events page at: http://www.ndhealth.gov/AQ/Calendar.aspx; as well as on the ND Department of Health Public Notices/Public Comment system which includes the webpage at http://www.ndhealth.gov/DoH/PublicNotices.aspx, an e-mail notification, and an RSS feed.

In order to meet the July 1, 2016 date[34] for submitting to the EPA Regional Administrator the Department's selection of ambient monitoring to characterize SO_2 concentrations in the area around the subject Hess Tioga Gas Plant, a pre-public comment version of this report was provided to EPA Region 8. Additionally, an applicable addendum addressing specifics of monitor siting (also subject to public comment) is anticipated and will be submitted to the Regional Administrator upon completion.

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[34] "For each source on the list, the air agency will be required to indicate by July 1, 2016, whether it will characterize air quality through ambient monitoring or through air quality modeling… If the air agency chooses the first option, ambient monitoring for a source, the air agency must include information about the planned new monitor(s) in the annual monitoring plan that the air agency must submit to the EPA by July 1, 2016…" *Data Requirements Rule for the 2010 1-hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS).* Available at: www.gpo.gov/fdsys/pkg/FR-2015-08-21/pdf/2015-20367.pdf