NORTH DAKOTA DEPARTMENT OF HEALTH
Environmental Health Section

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June 26, 2000

FILE

Mr. Ron Heavner
U.S. EPA - Region VIII
One Denver Place
999 18th Street, Suite 500
Denver, CO 80202-2466

Re: FY '00-'01 PPA, Air Quality
Media Workplan, Monitoring,
Item C (Network Review)

Dear Mr. Heavner:

Enclosed are two copies of the referenced review. Please note that our plans for the network modification are either vague or not addressed. Because we do not have a clear understanding of the impact of the court rulings and the impact of the regional haze rule, it is not practical for us to consider any serious network changes beyond what has been agreed to in the $PM_{2.5}$ monitoring plan and what is required to accommodate the speciation National Trend Network site in Fargo.

One of the three continuous $PM_{2.5}$ analyzers (TEOM) has been installed at the Fargo site. The other two analyzers have been ordered and will be installed and operational by October 1, 2000. The current plan is to install the second analyzer at Beulah. The third analyzer will be installed at either Hannover or Short Creek - SPM. At this point the most likely location is Short Creek - SPM.

If you have any questions about the attached Network Review, please call me at 701-328-5188 or by e-mail at dharman@state.nd.us.

Sincerely,

Daniel E. Harman
Manager
Air Quality Monitoring
Div. of Air Quality

DEH:saj
Enc:

NORTH DAKOTA DEPARTMENT OF HEALTH
DIVISION OF AIR QUALITY

AMBIENT AIR QUALITY MONITORING
ANNUAL NETWORK REVIEW
1999

June 2000

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1.0 INTRODUCTION

The North Dakota Department of Health, Division of Environmental Engineering, 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 of Environmental Engineering 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 (AAQS) and the Prevention of Significant Deterioration of Air Quality (PSD) Rules. To carry out this responsibility, the Division of Environmental Engineering operates and maintains a network of ambient air quality monitors and requires five major industrial pollution sources to conduct source specific ambient air quality monitoring.

To evaluate the effectiveness of the State's air quality monitoring effort, the U.S. Environmental Protection Agency (EPA) requires the Division of Environmental Engineering to conduct an annual review of the State's ambient air quality monitoring (AAQM) network. EPA's requirements, as set forth in 40 CFR 58.20, are to (1) determine if the system meets the monitoring objectives defined in 40 CFR 58, Appendix D, and (2) identify network modifications such as termination or relocation of unnecessary sites or establishment of new sites which are necessary. 40 CFR 58.25 requires the State to annually develop and implement a schedule to modify the AAQM network to eliminate any unnecessary sites or correct any inadequacies indicated as a result of the annual review required by 40 CFR 58.20(d). This document and subsequent revisions satisfy these annual requirements.

1.1 Network Review Process

The locations of sites in a monitoring program are established to meet certain objectives. The May 10, 1979, Federal Register (40 CFR 58), "Air Quality Monitoring, Data Reporting, and Surveillance Provisions," as amended, has specified a minimum of four basic monitoring objectives. These objectives are as follows:

1. To determine the highest <u>pollutant concentrations</u> expected to occur in an area covered by the network.

2. To determine representative concentrations in areas of high <u>population density</u>.

3. To determine the impact on ambient pollution levels by a <u>significant source</u> or class of sources.

4. To determine the general/background concentration levels.

The link between basic monitoring objectives and the physical location of a particular monitoring site involves the concept of spatial scale of representativeness. This spatial scale is determined by the physical dimensions of the air parcel nearest a monitoring site throughout which actual pollutant concentrations are reasonably similar. The goal in locating sites is to match the spatial scale represented by the sample of monitored air with a spatial scale most appropriate for the monitoring objective. Spatial scales of representativeness, as specified by EPA, are described as follows:

Microscale - 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 4.0 to 50.0 km. (Usually requires more than one site for definition.)

Regional Scale - rural areas of reasonably homogeneous geography covering from 50 km to hundreds of km.

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

Monitoring Objective	Appropriate Siting Scales
Highest Concentration	Micro, middle, neighborhood
Population Exposure	Neighborhood, urban
Source Impact	Micro, middle, neighborhood
General/Background	Urban, regional

Recommended scales of representativeness appropriate to the criteria pollutants monitored in North Dakota are shown below:

Criteria Pollutant	Spatial Scales
Inhalable Particulate (PM_{10})	micro, middle, neighborhood, urban, regional
Sulfur Dioxide (SO_2)	middle, neighborhood, urban, regional
Ozone (O_3)	middle, neighborhood, urban, regional
Nitrogen Dioxide (NO_2)	middle, neighborhood, urban
Carbon Monoxide (CO)	micro, middle, neighborhood

Using this physical basis 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 an examination of existing sites to evaluate their monitoring objectives and spatial scale with sites deleted, added, or modified accordingly. Further details on network design can be found in 40 CFR 58, Appendix D.

1.2 General Monitoring Needs

As can be gathered from the prior discussion, each air pollutant has certain characteristics which must be considered when establishing a monitoring site. These characteristics may result from 1) variations in the number and types of sources and emissions in question; 2) reactivity of a particular pollutant with other constituents in the air; 3) local site influences such as terrain and land use; and 4) climatology. The State AAQM network is designed to monitor air quality data for three basic conditions: 1) background monitoring; 2) population exposure; and 3) highest concentration. The industrial AAQM network sites are designed to monitor air quality data for source specific highest concentration impacts on a neighborhood scale.

The primary function of the department operated continuous sites is to collect background data to determine if and when there is any change in background concentrations. Beulah, Fargo NW, Short Creek - SPM, and Lignite - SPM are exceptions to this primary function. Beulah is population exposure because of the major sources in the vicinity. Fargo NW is also population orientated because Fargo is a major population center with PSD sources in the Fargo-Moorhead area. The data from these sites will be used as input to dispersion models to evaluate permits-to-construct and permits-to-operate for projects located in or near population centers in the eastern part of the state. Short Creek - SPM and Lignite - SPM are sites that will be transferred to the SK-ND Trans-Boundary Monitoring Network as soon as the three Saskatchewan sites are operational. These sites in the SK-ND Trans-Boundary Monitoring Network will be addressed in their own quarterly and annual reports. The PM_{10} site at Fargo NW is maintained to provided data for comparison to the State PM_{10} standard. The $PM_{2.5}$ sites are population exposure except for Sharon, which is a background site.

Background sites are chosen to determine concentrations of air contaminants in areas remote from urban sources and generally are sited using the regional spatial scale. This is true for NO_2 despite the fact that the regional spatial scale is not normally used for NO_2 monitoring. Once general locations are established, all monitoring sites are established in accordance with the specific probe siting criteria specified in 40 CFR 58, Appendix E.

Since all industrial AAQM network sites are source specific, all the pollutants at industry sites are source oriented on a neighborhood scale. Industrial sites are selected using dispersion modeling results and meteorological data. These sites are the most likely locations to have elevated ambient concentrations. The data collected at the industry-operated sites is included in the data summaries for comparison but not included in any discussion of the State ambient monitoring network needs or analysis. Each industry network is an entity unto itself and does not influence the placement of State operated sites.

The Fort Berthold Indian Reservation operates an ambient air quality monitoring network. Since the department has influence on neither the operation nor maintenance of the network, the data collected are included only to indicate the presence of the sites and reflects the data sent to the department. The validity of the data is not certified by inclusion.

1.3 Monitoring Objectives

The monitoring objectives of the Department are to track those pollutants that are judged to have the potential for violating either State or Federal Ambient Air Quality Standards and to ensure that those pollutants do not cause significant deterioration of our existing air quality. To accomplish these objectives, the Department operated 15 AAQM sites around the State. Eleven were SLAMS/NAMS sites, and four were special purpose monitoring (SPM) sites. There were three industries reporting ambient air quality data to this Department. Table 1 lists each site's type and the parameters monitored. Figure 1 shows the approximate site locations. For the industry networks, each network is represented by a single circle whether there is a single site or multiple sites.

The numbers in the Site Name/Company column in Table 1 and in the '#' column in Tables 2, 5, 7, 9, and 12 correspond to the numbers on the figures. The numbers in the circles correspond to the monitoring site monitoring that pollutant and the squares correspond to the major sources for that particular pollutant.

TABLE 1

AAQM Network Description

Site Name AQS Site #	Type Station	Parameter Monitored[1]	Operating Schedule	Monitoring Objective[2]	Spatial Scale[2]	Date Site Began
1 Beulah North 380570004	SLAMS	$PM_{2.5}$ SO_2, NO_2, O_3, MET	6th Day cont.	Population Exposure Population Exposure	Neighborhood Neighborhood	12/98 04/80
2 Bismarck Residential 380150003	SLAMS	$PM_{2.5}$	3rd Day	Population Exposure	Urban	12/98
3 Dickinson Residential 380890002	SLAMS	PM_{10}	6th Day	Population Exposure	Urban	07/89
4 Dunn Center 380250003	SLAMS	SO_2, NO_2, O_3, MET	cont.	General Background	Regional	10/79
5 Fargo NW 380171004	SLAMS	PM_{10} PM_{10} $PM_{2.5}$ $PM_{2.5}$ SO_2, NO_2, O_3, MET	6th Day 6th Day 3rd day 3rd Day cont.	Population Exposure Collocated SSI Population Exposure Collocated Population Exposure	Urban N/A Urban N/A Urban	05/98 12/98 05/98
6 Grand Forks North 380350004	SLAMS	$PM_{2.5}$	3rd Day	Population Exposure	Urban	12/98
7 Hannover 380650002	SLAMS	SO_2, NO_2, O_3, MET	cont.	General Background	Regional	10/84
8 Lignite - SPM 380130003	SPM	$PM_{2.5}$ $PM_{2.5}$	6th Day 6th Day	Population Exposure Collocated	Regional N/A	10/99
9 Mandan Refinery - SPM 380590002	SPM	SO_2, MET	cont.	Source Impact	Neighborhood	12/95
10 Mandan Refinery NW - SPM 380590003	SPM	SO_2, MET	cont.	Source Impact	Neighborhood	09/98
11 Sharon 380910001	SLAMS	SO_2, NO_2 O_3, MET $PM_{2.5}$	cont. 6th Day	General Background	Regional	07/94 12/98
12 Short Creek - SPM 380130002	SPM	SO_2, NO_2, MET PM_{10} $PM_{2.5}$	Cont. 6th Day 6th Day	Source Impact	Regional	02/99 09/98 04/99
13 TRNP - SU 380070002	SPM	SO_2, O_3 MET	cont.	General Background	Regional	07/95
Company	**Site Name AQS Site #**					
14 Amerada Hess Corporation	TIOGA #1 381050103 TIOGA #2 381050104 TIOGA #3 381050105	SO_2 H_2S, MET SO_2	cont. cont. cont.	Source Impact Source Impact Source Impact	Urban Urban Urban	07/87 07/87 11/87
15 Dakota Gasification Company	DGC #12 380570102 DGC #14 380570118 DGC #16 380570123 DGC #17 380570124	SO_2, NO_2, MET SO_2 SO_2 SO_2, NO_2	cont. cont. cont. cont.	Source Impact Source Impact Source Impact Source Impact	Urban Urban Urban Urban	01/80 01/89 10/95 10/95
16 Bear Paw Energy, Inc.	MGP #3 380530104 MGP #5 380530111	SO_2, MET SO_2, MET	cont. cont.	Source Impact Source Impact	Urban Urban	11/94 05/94

1. MET refers to meteorological and indicates wind speed and wind direction monitoring equipment.
2. Not applicable to MET.

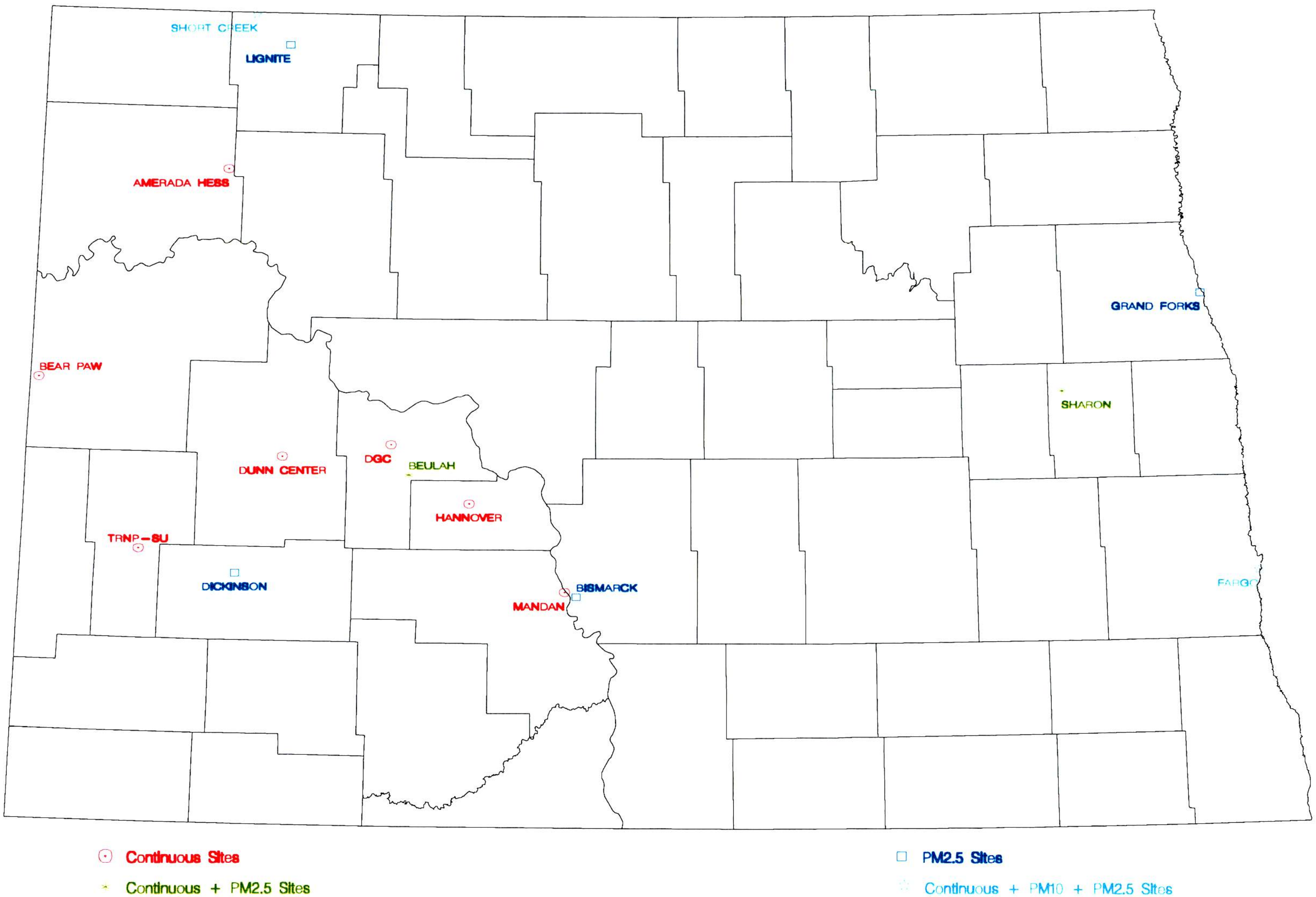

Figure 1 North Dakota Ambient Air Quality Monitoring Sites

2.0 AMBIENT AIR MONITORING NETWORK COVERAGE

The State of North Dakota is attainment for all criteria pollutants. As such, there are no "problem areas" in the general sense of the term. However, there are areas of concern where the Department has established monitoring sites to track the emissions of specific pollutants from point sources. Also, three major sources maintained monitoring networks in the vicinity of their plants (see Table 1 and Figure 1). Due to problems with EPA-AIRS access, 1998 emissions data are used for this report.

2.1 Sulfur Dioxide

Energy development in the west and west-central portions of North Dakota has produced a number of sources of sulfur dioxide (SO_2). These sources include coal-fired steam-powered electrical generating facilities, a coal gasification plant, natural gas processing plants, an oil refinery, and flaring at oil/gas well sites. As a result, SO_2 is one of the Department's major concerns in regard to ambient air quality monitoring.

2.1.1 Point Sources

The major SO_2 point sources (>100 TPY) are listed in Table 2 along with their emissions from the emissions inventories reported to the department. Figure 2 shows the approximate locations of these facilities (the numbers correspond to the respective positions in the site and source tables).

2.1.2 Other Sources

The western part of the State has a number of potential SO_2 sources associated with the development of oil and gas. These sources include individual oil/gas wells, oil storage facilities, and compressor stations. Emissions from such sources can create two problems. First, these sources may directly emit significant amounts of hydrogen sulfide (H_2S) to the ambient air (see Section 2.7). Second, flaring the H_2S from these sources can create significant concentrations of SO_2 in the ambient air. The primary counties for these sources in western North Dakota are outlined in green on Figure 2.

TABLE 2

Major SO_2 Sources
(>100 TPY)

1998

#	FACILITY NAME	COUNTY	CITY	POLLUTANT EMISSIONS	PERCENT OF TOTAL EMISSIONS	FACILITY ID
1	Basin Electric: Leland Olds Station	Mercer	Stanton	52,272	24.33	380570001
2	Great River Energy: Coal Creek	Mc Lean	Underwood	47,055	21.90	380550017
3	Minnkota Power Coop: M R Young #2	Oliver	Center	20,246	9.42	380650020
3	Minnkota Power Coop: M R Young #1	Oliver	Center	20,039	9.33	380650001
4	Otter Tail Power Company: Coyote	Mercer	Beulah	18,364	8.55	380570012
5	Dakota Gasification Company	Mercer	Beulah	17,354	8.08	380570013
6	Basin Electric: Avs 1&2	Mercer	Beulah	16,020	7.46	380570011
7	Great River Energy: Stanton 1	Mercer	Stanton	7,522	3.50	380570004
8	Amoco Oil Co: Mandan Refinery	Morton	Mandan	6,394	2.98	380590003
9	Montana Dakota Utilities: Heskett 1 & 2	Morton	Mandan	2,554	1.19	380590001
7	Great River Energy: Stanton 10	Mercer	Stanton	1,269	0.59	380570007
10	Bear Paw Energy, Inc.: Grasslands Plant	Mc Kenzie	–	1,189	0.55	380530023
11	Amerada Hess Corp: Tioga Gas Plant	Williams	Tioga	1,150	0.54	381050004
12	American Crystal Sugar: Drayton Plant	Pembina	Drayton	738	0.34	380670003
13	Univ. Of North Dakota Heating Plant	Grand Forks	Grand Forks	625	0.29	380350003
14	Bear Paw Energy - Lignite Gas Plant	Burke	Lignite	561	0.26	380130071
15	American Crystal Sugar: Hillsboro Plant	Traill	Hillsboro	433	0.20	380970019
16	Petro-Hunt, Llc	Billings	Killdeer	409	0.19	380070002
17	Minn-Dak Farmers Cooperative	Richland	Wahpeton	265	0.12	380770026
18	Cargill Corn Milling - Wahpeton Facility	Richland	Wahpeton	205	0.10	380770110
19	North Dakota State University	Cass	Fargo	195	0.09	380170005

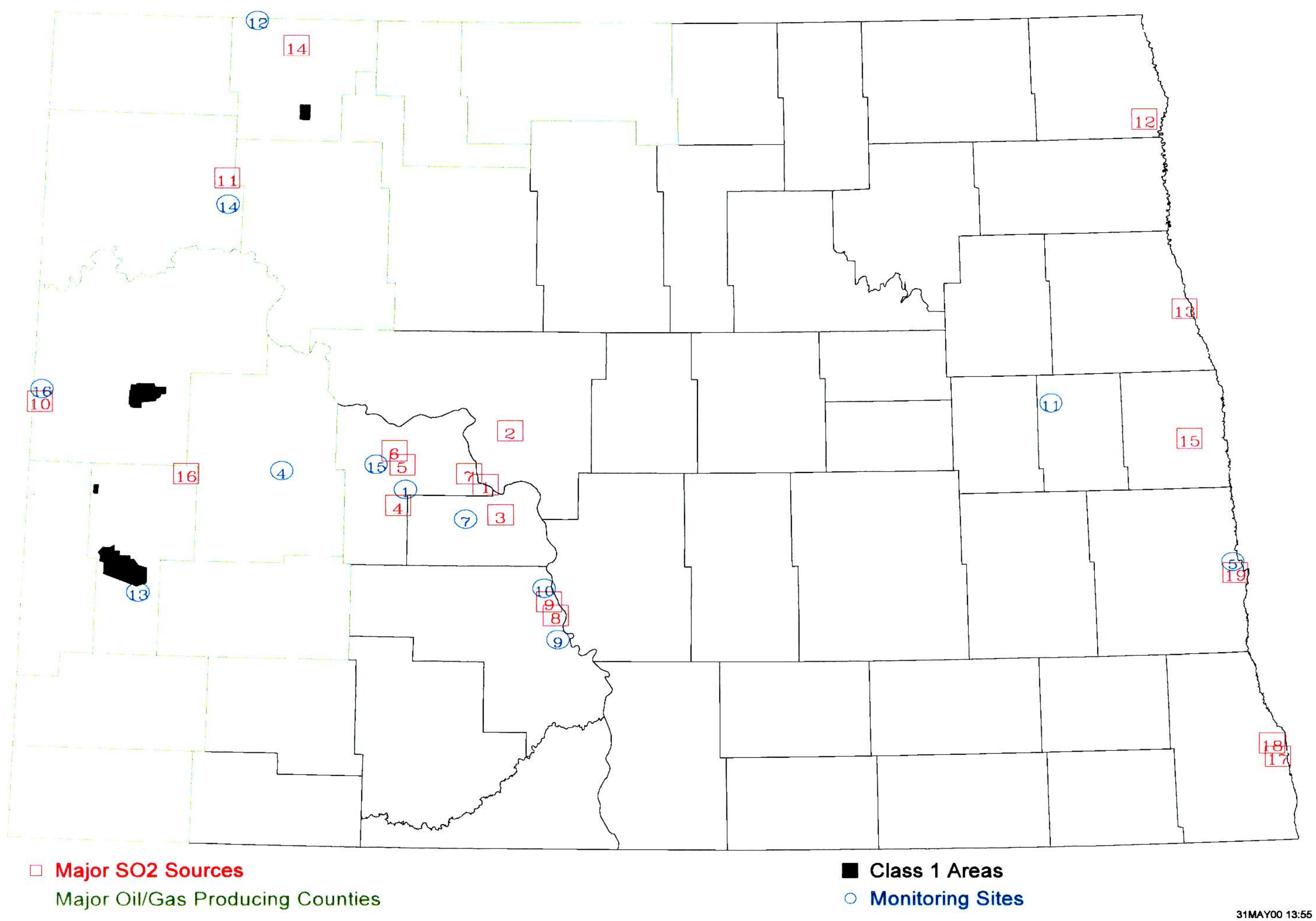

Figure 2 Major Sulfur Dioxide Sources

2.1.3 Monitoring Network

The SO_2 monitoring sites are shown on Figure 2. As can be seen, these monitoring 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 central part of the State. Table 3 shows the 1999 annual SO_2 data summaries; Table 4 shows the 5-minute data summary. There were no exceedances of either State or Federal SO_2 standards.

2.1.4 Network Analysis

The nine largest SO_2 sources in the state are within 45 miles of both the Beulah and Hannover sites. This makes these two sites very important in tracking the impact of these nine sources on the ambient air . In Beulah, many homes and businesses use coal as a heat source during the heating season. This local influence could be as much an influence on the data as the major sources in the vicinity. On January 14, the site in Beulah was moved to a new location North of town along Highway 200. This move to the new site is expected to reduce the local influence from homes and businesses. One would expect that as the large sources 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 nine sources combined. Figures 3, 4, 5, and 6, present a 20-year view of the percentage of data greater than the minimum detectable value (MDV), 1-hour maximums, 3-hour maximums, and 24-hour maximums, for the state operated sites. Because the industry sites are sited specifically for maximum expected concentrations (primarily as predicted by dispersion models and secondarily in a downwind direction), the industry sites are not reviewed for particular long term trends.

The best long term indicator of any change in the amount of SO_2 in the ambient air is seen by reviewing the percentages of data points greater than the MDV. Figure 3 presents this data for the active state sites from 1980 through 1999. To calculate valid annual statistics, at least 75% of the data must be greater than the MDV. Therefore, the annual mean is not a valid indicator and, consequently, not addressed.

TABLE 3

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Sulfur Dioxide (PPB)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MAXIMA 1 - HOUR 1ST MM/DD/HH	1 - HOUR 2ND MM/DD/HH	3 - HOUR 1ST MM/DD/HH	3 - HOUR 2ND MM/DD/HH	24 - HOUR 1ST MM/DD	24 - HOUR 2ND MM/DD	ARITH MEAN	1HR #>273	24HR #>99	% >MDV
Amerada Hess - Tioga #1	1999	JAN-DEC	8676	48 02/07/14	42 01/18/18	37 01/14/23	36 01/18/20	7 01/14	7 02/07	1.5			13.5
Amerada Hess - Tioga #3	1999	JAN-DEC	8673	401 05/05/21	375 05/05/22	346 05/05/23	265 05/06/02	72 05/06	64 05/05	3.3	3		21.3
Bear Paw - MGP #3	1999	JAN-DEC	8666	66 08/31/15	64 01/01/16	43 08/31/17	26 05/22/11	9 08/31	5 01/01	1.2			7.7
Bear Paw - MGP #5	1999	JAN-DEC	8118	134 10/06/06	85 08/31/01	57 08/31/02	54 09/01/11	13 09/01	10 08/31	1.4			10.6
Beulah	1999	JAN-JAN	326	18 01/09/07	16 01/08/01	14 01/09/08	12 01/14/02	8 01/07	7 01/11	5.1			98.2
Beulah - North	1999	JAN-DEC	8286	66 06/29/17	64 03/17/05	36 06/29/17	30 03/17/08	16 03/17	8 01/18	2.1			24.8
DGC #12	1999	JAN-DEC	8704	136 09/27/09	131 03/15/11	68 09/27/11	56 09/09/14	17 09/09	12 09/30	2.2			27.4
DGC #14	1999	JAN-DEC	8681	87 06/28/10	66 06/28/11	55 06/28/11	33 09/21/11	9 06/28	8 05/08	2.1			29.9
DGC #16	1999	JAN-DEC	8490	73 06/25/08	58 05/08/12	38 05/08/08	36 06/25/08	16 05/08	12 01/18	2.7			41.0
DGC #17	1999	JAN-DEC	8575	114 06/25/06	86 07/24/06	57 07/24/08	46 06/25/08	20 07/24	16 06/25	2.9			43.3
Dunn Center	1999	JAN-DEC	8689	34 09/10/08	34 09/10/09	19 12/16/02	16 09/10/11	5 08/28	5 12/16	1.3			13.1
Fargo NW	1999	JAN-DEC	8698	9 01/03/18	9 01/03/19	7 01/03/20	6 01/19/08	3 01/01	3 01/19	1.1			8.4
Hannover	1999	JAN-DEC	8683	139 11/15/12	135 09/16/11	75 09/16/11	74 11/15/14	16 03/31	14 09/16	2.4			26.3
Mandan - SPM	1999	JAN-DEC	8689	171 05/06/03	166 05/05/20	161 05/06/05	155 05/06/08	97 05/06	71 05/05	6.3			37.8
Mandan NW - SPM	1999	JAN-DEC	8708	123 05/21/20	118 01/01/10	67 01/01/11	63 02/19/20	34 02/22	26 05/13	4.0			41.2
Sharon	1999	JAN-DEC	8696	10 01/07/20	9 01/06/02	8 01/06/02	8 01/07/20	4 01/07	4 01/09	1.1			3.2
Short Creek - SPM	1999	FEB-DEC	7354	52 10/25/10	47 12/27/22	40 09/14/11	29 12/27/23	10 05/17	10 09/14	1.9			17.5
TRNP - SU (Painted Canyon)	1999	JAN-DEC	8121	12 01/11/22	11 01/11/23	9 01/01/02	9 01/20/05	4 01/01	4 01/26	1.2			7.8
White Shield	1999	JAN-DEC	8710	61 12/16/03	52 01/18/15	40 01/18/17	23 12/16/05	10 12/16	9 01/18	1.6			13.5

The maximum 1-hour concentration is 401 ppb at Amerada Hess - Tioga #3 on 05/05/21
The maximum 3-hour concentration is 346 ppb at Amerada Hess - Tioga #3 on 05/05/23
The maximum 24-hour concentration is 97 ppb at Mandan - SPM on 05/06

* The air quality standards are:

STATE Standards -
1) 273 ppb maximum 1-hour average concentration.
2) 99 ppb maximum 24-hour average concentration.
3) 23 ppb maximum annual arithmetic mean concentration.

FEDERAL Standards -
1) 500 ppb maximum 3-hour concentration not to be exceeded more than once per year.
2) 140 ppb maximum 24-hour concentration not to be exceeded more than once per year.
3) 30 ppb annual arithmetic mean.

TABLE 4

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : SO_2 5-Minute Averages (ppb)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	1ST	DATE MM/DD/HH	2ND	DATE MM/DD/HH	3RD	DATE MM/DD/HH	# HOURS >600	% >MDV
Bear Paw - MGP #3	1999	JAN-DEC	8668	387	05/22/10	281	01/22/16	233	08/31/15	0	14.6
Bear Paw - MGP #5	1999	JAN-DEC	8119	422	10/06/06	216	08/06/16	163	08/31/02	0	20.9
Beulah	1999	JAN-JAN	326	36	01/06/23	33	01/06/10	29	01/11/19	0	98.2
Beulah - North	1999	JAN-DEC	8286	260	06/29/17	162	03/29/15	157	06/29/16	0	34.3
Dunn Center	1999	JAN-DEC	8689	59	09/10/08	54	01/10/22	51	09/10/09	0	21.1
Fargo NW	1999	JAN-DEC	8698	9	01/03/18	9	01/03/19	7	01/11/06	0	8.4
Hannover	1999	JAN-DEC	8683	207	10/05/07	197	09/05/10	196	11/15/12	0	36.6
Mandan - SPM	1999	JAN-DEC	8689	248	02/27/19	228	05/27/20	217	02/11/00	0	49.3
Mandan NW - SPM	1999	JAN-DEC	8708	378	11/15/12	232	11/15/13	174	01/31/18	0	52.3
Sharon	1999	JAN-DEC	8696	10	01/07/20	9	01/07/02	8	01/07/18	0	3.2
Short Creek - SPM	1999	FEB-DEC	7354	172	03/01/13	135	03/01/13	130	03/01/12	0	26.2
TRNP - SU (Painted Canyon)	1999	JAN-DEC	8121	12	01/11/22	11	01/11/23	11	01/20/04	0	7.8

The maximum 5-minute concentration is 422 ppb at Bear Paw - MGP #5 on 10/06/06

* No Standard is currently in effect.

Beginning in 1980, major events are easily traceable. In 1980, the oil industry was expanding. In 1981, MDU's Coyote Power Station began operation. In 1982 the oil industry in western North Dakota hit its peak activity. 1983, 1984, and 1985 were startup years for Basin Electric's Antelope Valley Unit #1, the synthetic natural gas plant (aka, Dakota Gasification Company), and Antelope Valley Unit #2, respectively. From 1987 through 1993, for the Beulah and Hannover sites, there has been a steady increasing trend in the percentage of data greater than the MDV. However, Hannover showed a decrease for four years while Beulah continued to increase until 1997. In 1997, Hannover again begin to increase. In contrast, the Dunn Center site has remained consistently between 5% and 10% until 1999.

The same patterns seen in Figure 3 are discernable in the 1-hour, 3-hour, and 24-hour maximum concentration graphs (see Figures 4, 5, and 6, respectively). As can be seen from the graphs, the Mandan Refinery - SPM site exceeded the state and nearly the Federal 24-hour standard (see Figure 6): The 24-hour average was 143 ppb.

Because the newer sites (Fargo NW, Mandan Refinery - SPM, Mandan Refinery NW - SPM, Sharon, Short Creek - SPM and TRNP - SU) have a limited amount of data, no attempt is made to evaluate the results.

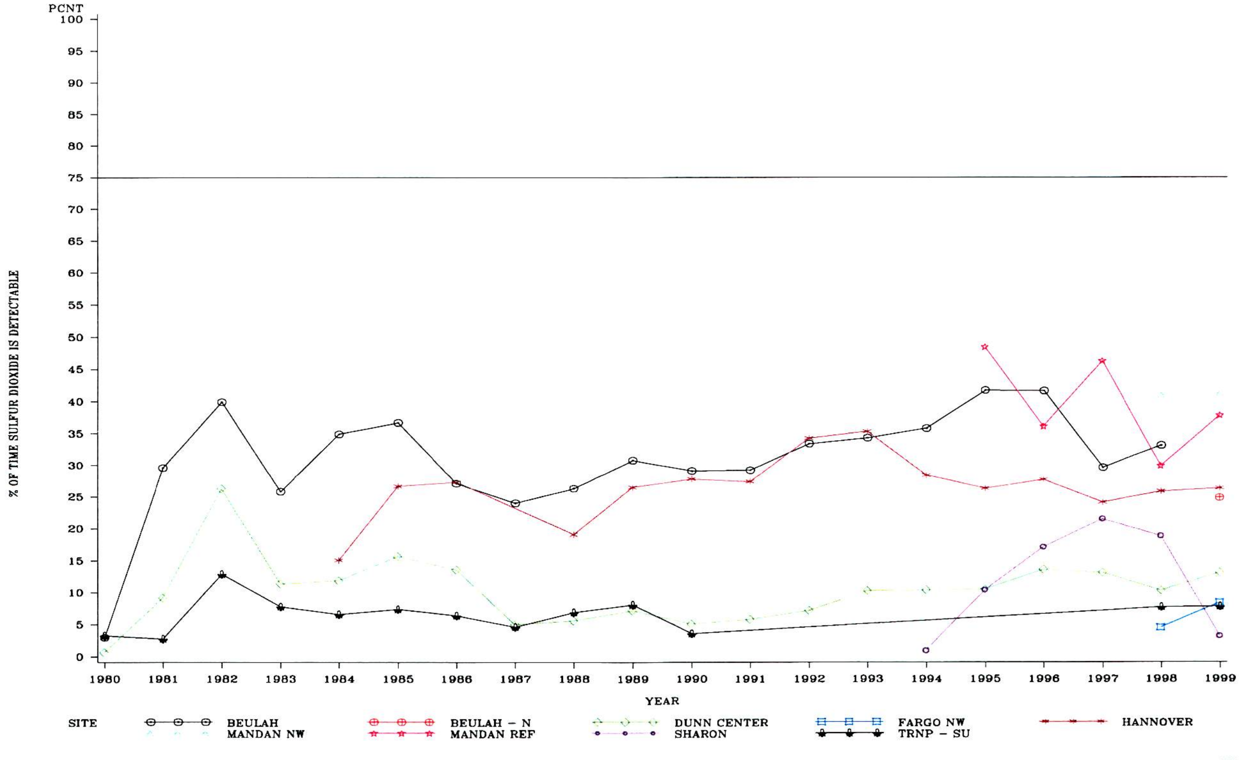

Figure 3 Percentage of Time SO_2 Detectable

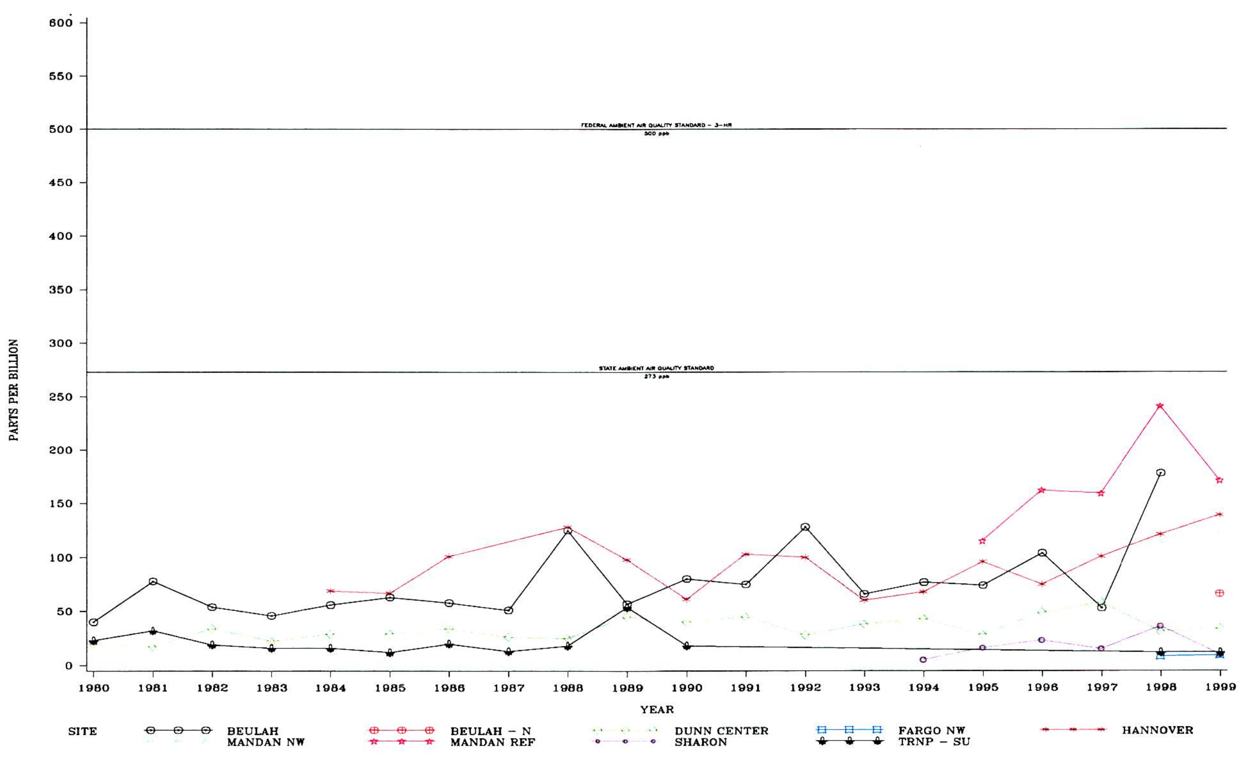

Figure 4 SO_2 Maximum 1-Hour Concentrations

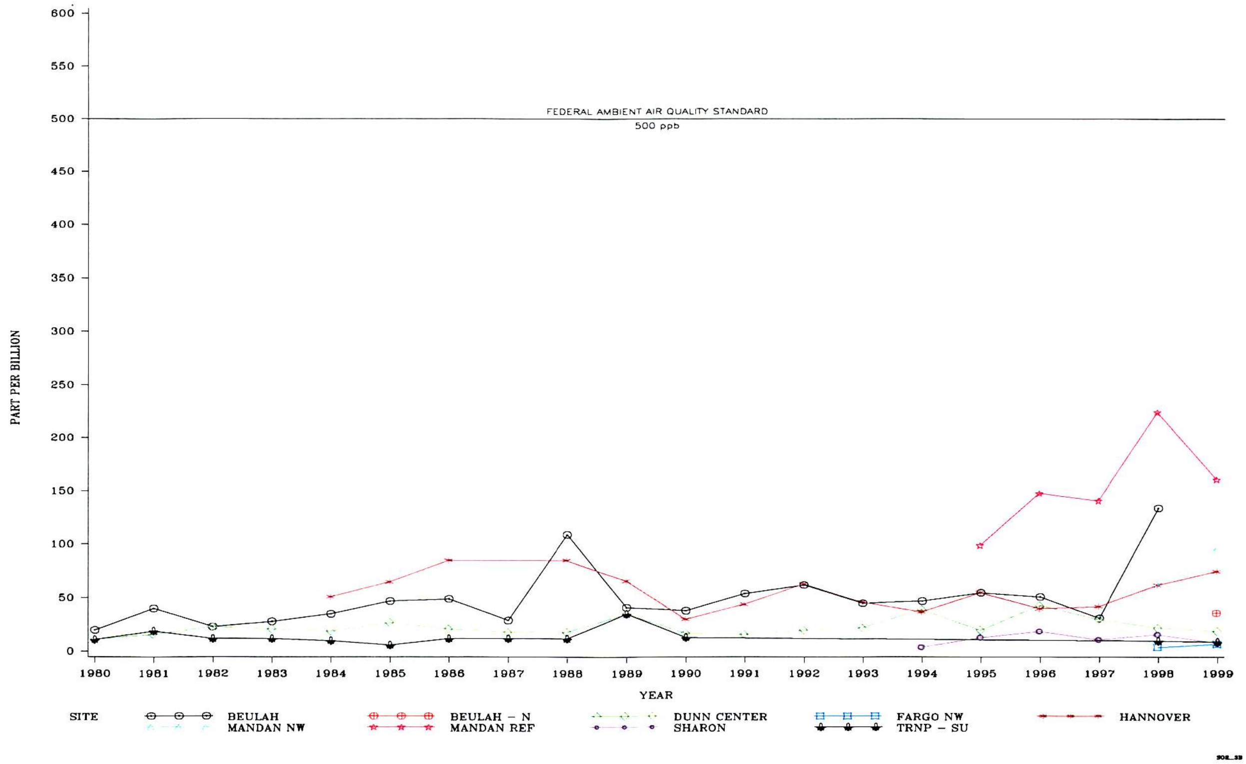

Figure 5 SO_2 Maximum 3-Hour Concentrations

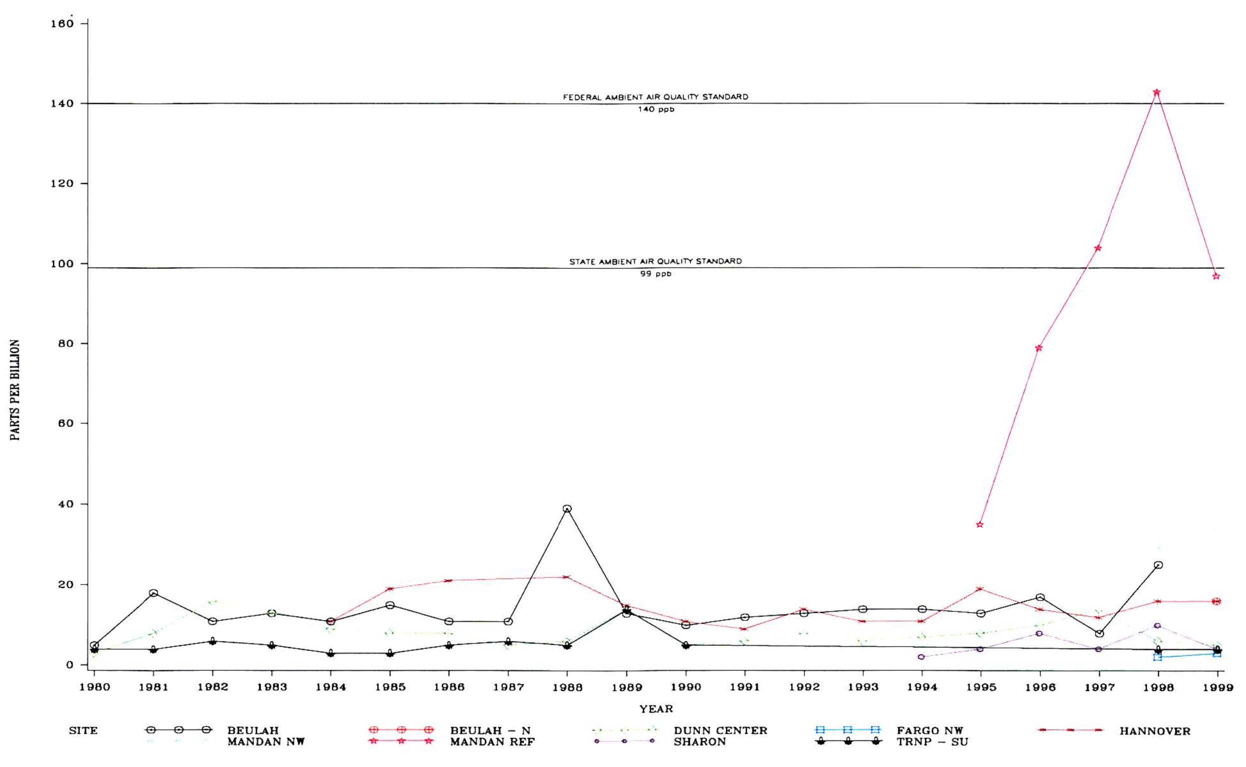

Figure 6 SO_2 Maximum 24-Hour Concentrations

2.2 Oxides of Nitrogen

Oxides of Nitrogen (NO_x) is the term used to represent both nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is formed when NO is oxidized in the ambient air. There are no ambient air quality standards for NO.

2.2.1 Point Sources

The major NO_x stationary point sources (>100 TPY) are listed in Table 5 along with their emissions as calculated from the most recent emission inventories reported to the department. Figure 7 shows the approximate locations of these facilities (the numbers correspond to the respective positions in 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.

2.2.2 Area Sources

Another source of NO_X is automobile emissions. North Dakota has no significant urbanized areas with regard to oxides of nitrogen; the entire population of the State is less than the 1,000,000 population figure that EPA specifies in the NO_2 requirement for NAMS monitoring.

2.2.3 Monitoring Network

The Department currently operates six $NO/NO_2/NO_x$ analyzers. These are located at Beulah, Dunn Center, Fargo, Hannover, Sharon, and Short Creek - SPM. The Dakota Gasification Company (DGC) network also operated analyzers at sites DGC #12 and DGC #17. Table 6 shows the 1999 NO_2 data summaries. The measured NO_2 values are quite low, particularly the annual means. From Figure 7 it can be seen that $NO/NO_2/NO_x$ analyzers, except for Dunn Center and Sharon, are well placed with respect to the major NO_x sources: Dunn Center and Sharon are defined as background sites. The Short Creek - SPM site is part of the SK-ND Trans-Boundary Monitoring Network and will be addressed in those network reports.

TABLE 5

Major NO_x Sources
(> 100 TPY)

1998

#	FACILITY NAME	COUNTY	CITY	POLLUTANT EMISSIONS	PERCENT OF TOTAL EMISSIONS	FACILITY ID
1	Great River Energy: Coal Creek	Mc Lean	Underwood	21,303	20.88	380550017
2	Minnkota Power Coop: My Young #2	Oliver	Center	15,438	15.13	380650020
3	Basin Electric: Avs 1&2	Mercer	Beulah	14,193	13.91	380570011
4	Basin Electric: Leland Olds Station	Mercer	Stanton	13,859	13.58	380570001
5	Otter Tail Power Company: Coyote	Mercer	Beulah	12,947	12.69	380570012
2	Minnkota Power Coop: Mr Young #1	Oliver	Center	8,641	8.47	380650001
6	Dakota Gasification Company	Mercer	Beulah	3,450	3.38	380570013
7	Great River Energy: Stanton 1	Mercer	Stanton	3,338	3.27	380570004
8	Amerada Hess Corp: Tioga Gas Plant	Williams	Tioga	2,153	2.11	381050004
9	Amoco Oil Co: Mandan Refinery	Morton	Mandan	1,243	1.22	380590003
10	Montana Dakota Utilities: Heskett 1 & 2	Morton	Mandan	1,031	1.01	380590001
7	Great River Energy: Stanton 10	Mercer	Stanton	757	0.74	380570007
11	Minn-Dak Farmers Cooperative	Richland	Wahpeton	639	0.63	380770026
12	American Crystal Sugar: Drayton Plant	Pembina	Drayton	556	0.54	380670003
13	American Crystal Sugar: Hillsboro Plant	Traill	Hillsboro	465	0.46	380970019
14	Cavalier Air Station	Pembina	Cavalier	322	0.32	380670005
15	Univ. Of North Dakota Heating Plant	Grand Forks	Grand Forks	234	0.23	380350003
16	Bear Paw Energy - Lignite Gas Plant	Burke	Lignite	196	0.19	380130071
17	Amerada Hess: Antelope #2	Mc Kenzie	–	168	0.16	380530045
18	Bear Paw Energy, Inc.: Alexander	Mc Kenzie	Alexander	166	0.16	380530024
19	Bear Paw Energy, Inc.: Boxcar Butte	Mc Kenzie	–	155	0.15	380530018
20	Northern Border Pipeline: Cs #4	Mc Kenzie	Arnegard	140	0.14	380530014
21	Bear Paw Energy, Inc.: Tree Top	Billings	Fairfield	136	0.13	380070019
22	Continental Resources Inc	Bowman	–	105	0.10	380110010
23	Amerada Hess: Cherry Creek	Mc Kenzie	–	105	0.10	380530005

#	FACILITY NAME	COUNTY	CITY	POLLUTANT EMISSIONS	PERCENT OF TOTAL EMISSIONS	FACILITY ID
24	Bear Paw Energy, Inc.: Demicks Lake	Mc Kenzie	–	104	0.10	380530040
25	North Dakota State University	Cass	Fargo	102	0.10	380170005
26	Amerada Hess: Antelope #1	Mc Kenzie	–	101	0.10	380530044

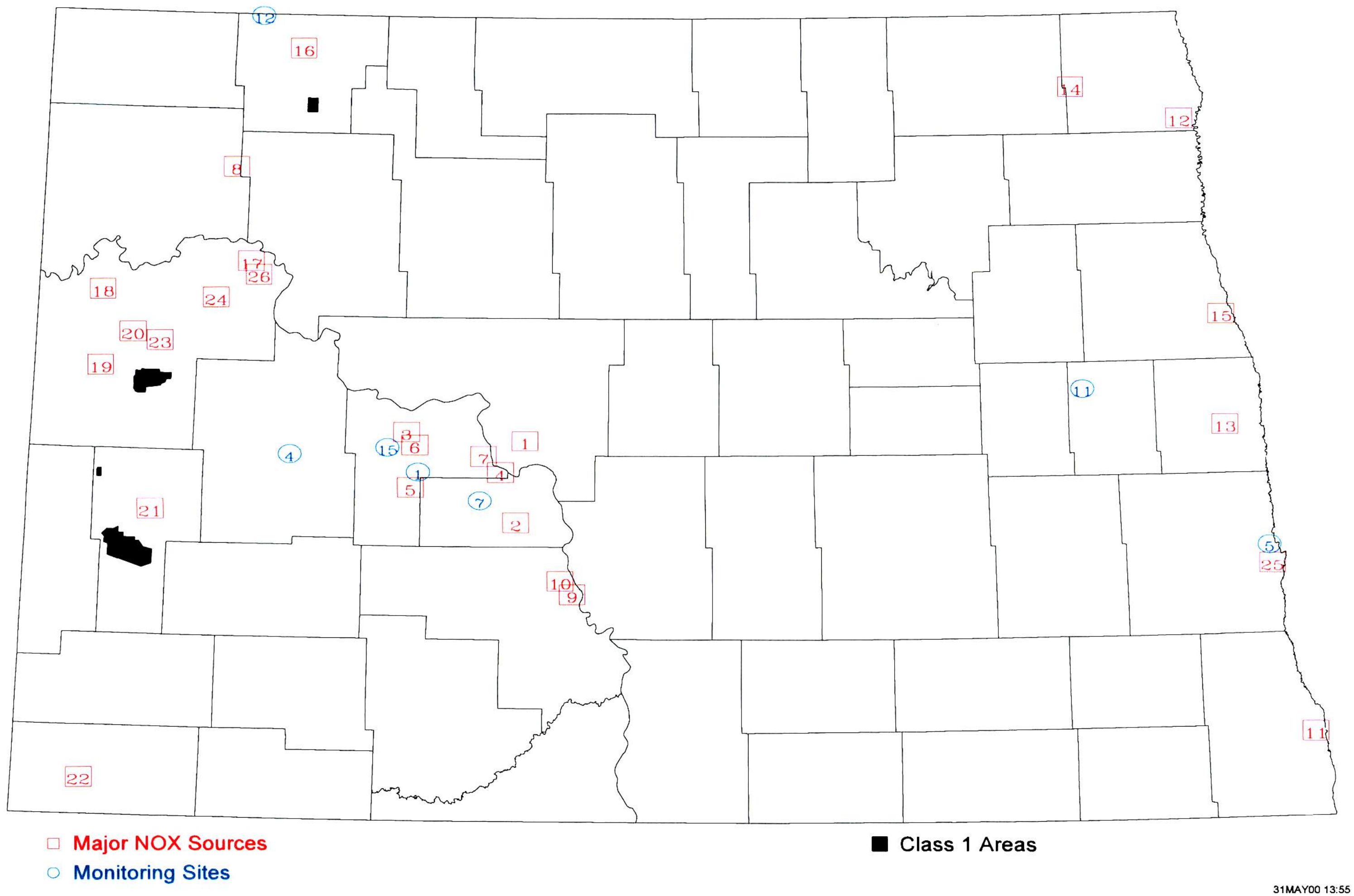

Figure 7 Major Nitrogen Dioxide Sources

TABLE 6

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Nitrogen Dioxide (PPB)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MAXIMA 1 - HOUR 1ST MM/DD/HH	MAXIMA 1 - HOUR 2ND MM/DD/HH	ARITH MEAN	% >MDV
Beulah	1999	JAN-JAN	327 ***	27 01/07/07	26 01/08/06	4.6	87.8
Beulah - North	1999	JAN-DEC	7201	27 10/31/22	24 02/16/01	3.2	72.2
DGC #12	1999	JAN-DEC	8594	108 11/01/02	89 03/05/09	4.5	96.9
DGC #17	1999	JAN-DEC	8450	49 03/29/22	41 07/24/06	3.9	95.1
Dunn Center	1999	JAN-DEC	8675	25 12/16/00	22 03/24/04	1.7	37.5
Fargo NW	1999	JAN-DEC	8683	55 12/10/10	53 03/11/19	6.4	79.3
Hannover	1999	JAN-DEC	8659	31 04/09/19	30 09/16/11	2.6	65.8
Sharon	1999	JAN-DEC	7973	14 11/29/06	13 01/20/01	1.7	37.4
Short Creek - SPM	1999	FEB-DEC	7336	24 12/27/22	22 04/14/03	2.6	71.3

The maximum 1-hour concentration is 108 ppb at DGC #12 on 11/01/02

* The air quality standards are:
STATE - 53 ppb maximum annual arithmetic mean.

FEDERAL - 53 ppb annual arithmetic mean.

2.2.4 Network Analysis

Ten of the eleven largest NO_2 sources in the state are within 45 miles of the Beulah and Hannover monitoring sites. Figures 8 and 9 show the trends for the state operated sites for the last 20 years. Since the industry operated sites are placed for maximum concentrations, trends are not considered.

With the exception of Beulah in 1981, the percentage of data greater than the MDV, shown in Figure 8, was reasonably stable until 1993. The significant increase in the percentage of detectable concentrations is contrary to the quantity of NO_2 emitted. In 1992 these nine sources emitted 119,213 tons; in 1993, 103,673 tons; in 1994, 97,583 tons; in 1995, 96,098 tons; in 1997, 108,676 tons; and , in 1998, 102,047 tons. A possible explanation for Hannover is the analyzer was changed in March 1992 from a Meloy 8101C to a TECO 42. However, the analyzer change did not produce a discreet jump: the increase was seen at both the Beulah and Hannover sites. A possible conclusion is the increase in detectable NO_2 concentrations is real and not the result of equipment changes. Another possibility, and more likely, is a change in the wind flow patterns. As Hannover began a decline in 1995, Sharon began to increase. In 1998, Beulah and Fargo Res/Fargo NW are the only State sites with more than 75% of the possible values greater then the MDV. In 1999, only Fargo NW had more than 75% of the possible values greater then the MDV.

If the 1-hour maximum concentrations had followed a pattern similar to the one shown in Figure 8, the equipment change could have accounted for the increase in the percentage of data greater than the MDV. However, the 1-hour maximums, shown in Figure 9, have shown an overall decrease. Since Dunn Center, Beulah - N, Fargo NW, Short Creek - SPM and Sharon are relatively new sites, no valid trending is possible.

The DGC sites consistently have more than 75% of the possible values greater then the MDV. A factor that may contribute to this is that DGC does not adjust data for zero drift.

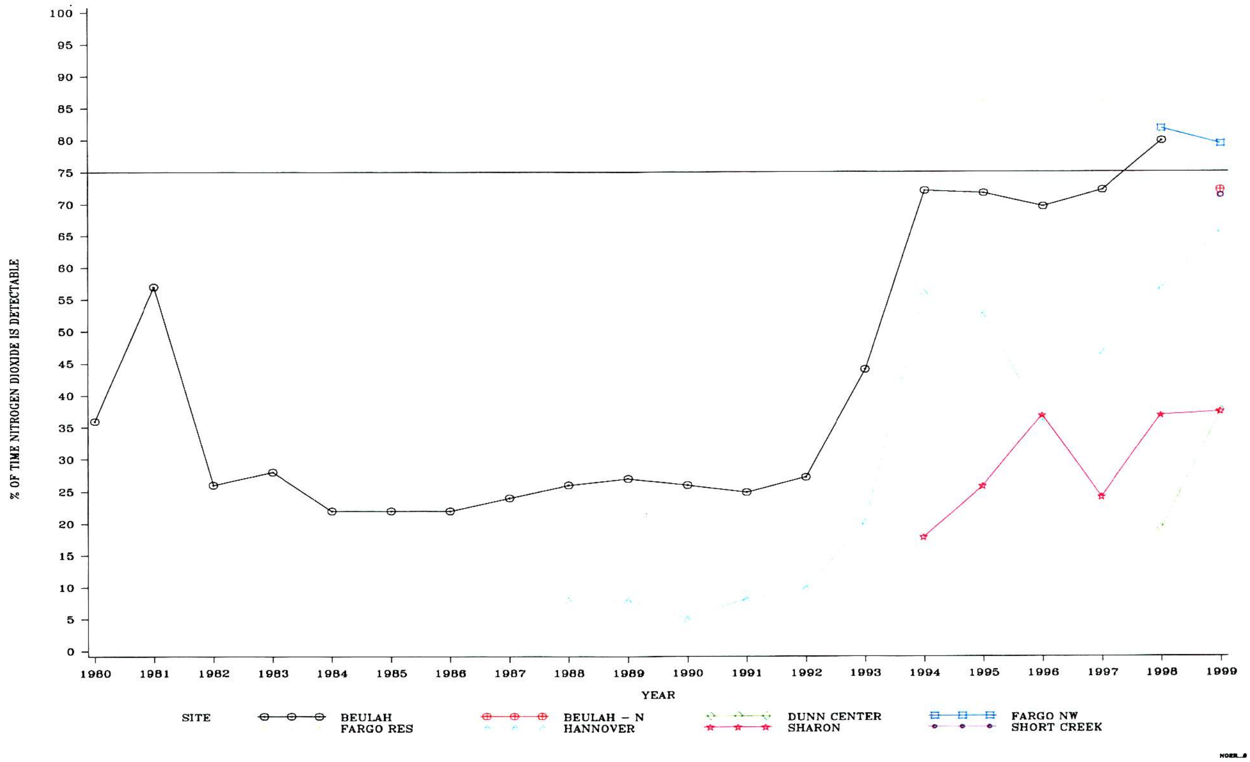

Figure 8 Percentage of Time NO_2 Detectable

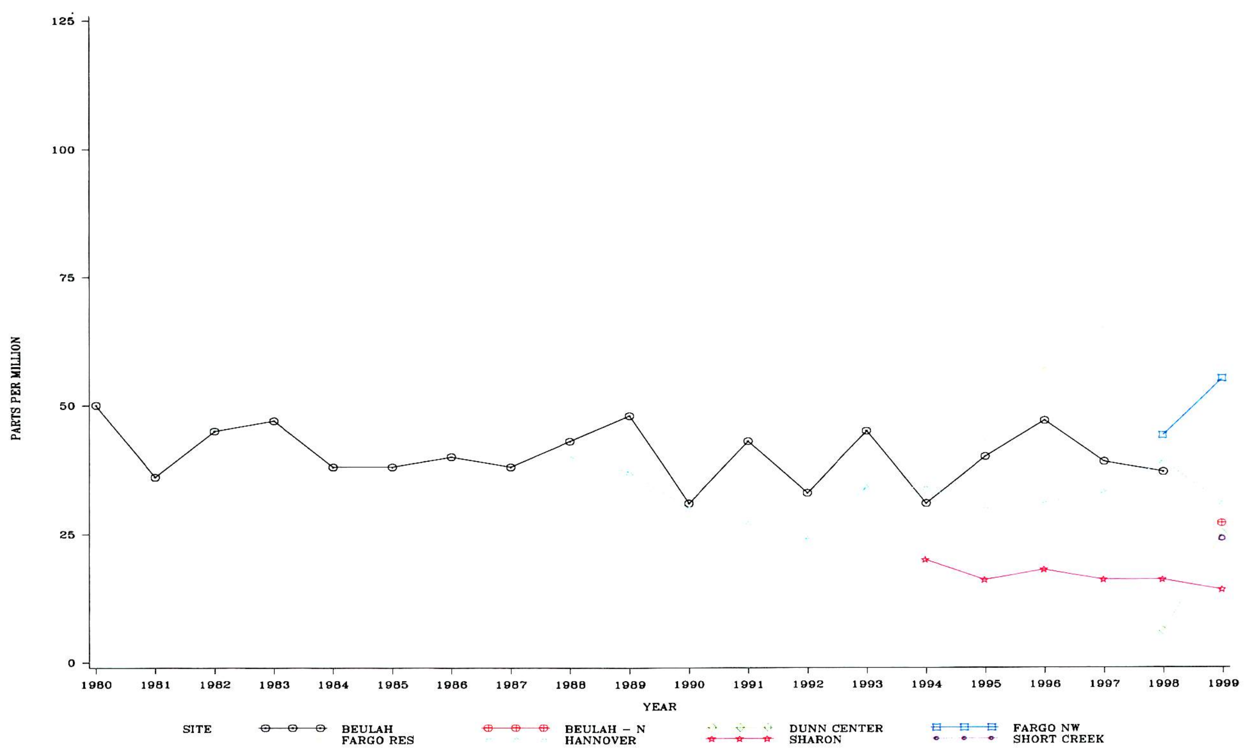

Figure 9 NO_2 Maximum 1-Hour Concentrations

2.3 Ozone

Unlike most other pollutants, ozone (O_3) is not emitted directly into the atmosphere but results from a complex photochemical reaction between volatile organic compounds (VOC), oxides of nitrogen (NO_x), and solar radiation. Both VOC and NO_x are emitted directly into the atmosphere from sources within the State. Since solar radiation is a major factor in O_3 production, O_3 concentrations are known to peak in summer months. 40 CFR 58 defines the O_3 monitoring season for North Dakota as May 1 through September 30. However, O_3 analyzers at all sites collect data year round for use in dispersion modeling.

2.3.1 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 7. Figure 10 shows the approximate locations of these facilities.

2.3.2 Area Sources

Point sources contribute only part of the total VOC and NO_x emissions. The remaining emissions are attributed to mobile sources in urban areas. The EPA has specified a design criteria for selecting NAMS locations for O_3 as any urbanized area having a population of more than 200,000. North Dakota has no urbanized areas large enough to warrant monitoring for ozone.

2.3.3 Monitoring Network

The state currently has six continuous ozone analyzers in operation. These are at Beulah, Dunn Center, Fargo NW, Hannover, Sharon, and Theodore Roosevelt National Park. Table 8 presents 1999 1-hour and 8-hour data summaries. This data indicates the O_3 concentrations are reasonably uniform across the State for both the 1-hour and 8-hour averages. Also, this indicates the ozone is unrelated to the major sources. Figure 11 shows the maximum 1-hour average by month for 1999.

TABLE 7

Major VOC Sources
(> 100 TPY)

1998

#	FACILITY NAME	COUNTY	CITY	POLLUTANT EMISSIONS	PERCENT OF TOTAL EMISSIONS	FACILITY ID
1	Otter Tail Power Company: Coyote	Mercer	Beulah	1,299	39.28	380570012
2	Dakota Gasification Company	Mercer	Beulah	407	12.31	380570013
3	Basin Electric: Avs 1&2	Mercer	Beulah	306	9.25	380570011
4	Kaneb Pipe Line Operating Partnership,Lp	Stutsman	Jameston	305	9.22	380930037
5	Cargill, Inc.	Cass	West Fargo	282	8.53	380170066
6	Basin Electric: Leland Olds Station	Mercer	Stanton	170	5.14	380570001
7	Great River Energy: Coal Creek	Mc Lean	Underwood	143	4.32	380550017
8	Amoco Oil Co: Mandan Refinery	Morton	Mandan	143	4.32	380590003
9	Minnkota Power Coop: My Young #2	Oliver	Center	140	4.23	380650020
10	Hood Flexible Packaging	Grand Forks	Grand Forks	112	3.39	380350052

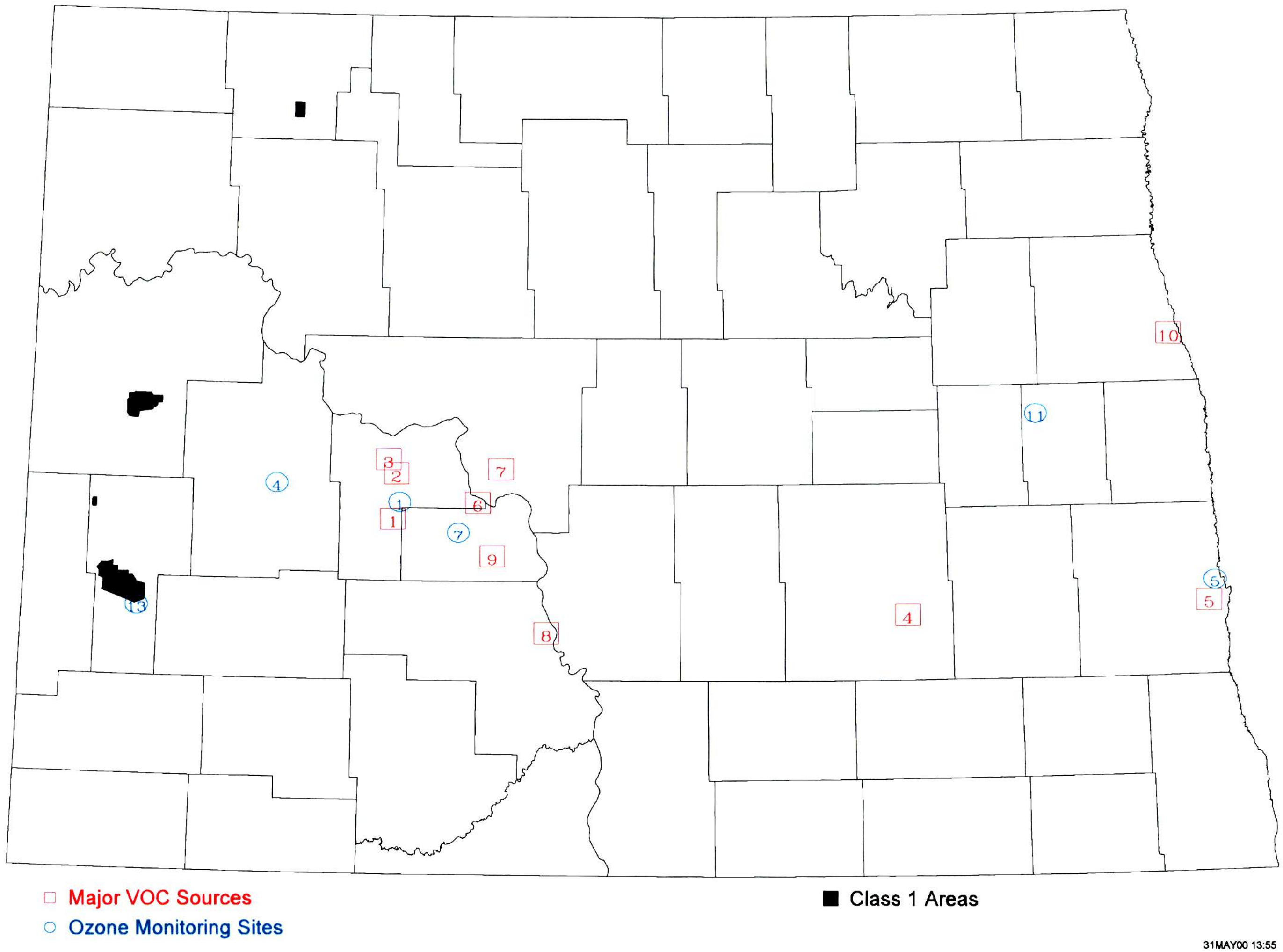

Figure 10 Major VOC Sources

TABLE 8

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Ozone (PPB)

				M A X I M A							
				1 - HOUR		8 - HOUR					
LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	1ST MM/DD/HH	2ND MM/DD/HH	1ST MM/DD/HH	2ND MM/DD/HH	3RD MM/DD/HH	4TH MM/DD/HH	1HR #>120	8HR #>80
Beulah	1999	JAN-JAN	6	2 01/14/10	2 01/14/11	2 01/14/07	1 99/99/92	1 99/99/92	1 99/99/92		
Beulah - North	1999	JAN-DEC	7458	73 04/30/15	71 04/30/14	68 04/30/09	64 04/30/08	64 04/30/10	64 04/30/11		
Dunn Center	1999	JAN-DEC	8707	71 06/06/13	68 06/06/12	60 05/01/10	60 05/01/09	60 05/01/08	60 05/01/07		
Fargo NW	1999	JAN-DEC	8698	75 08/31/15	75 08/31/16	71 05/02/09	70 08/31/09	67 05/02/08	67 05/01/10		
Hannover	1999	JAN-DEC	8700	84 07/22/11	75 06/06/16	69 04/30/09	67 04/30/08	67 04/30/10	67 06/06/09		
Sharon	1999	JAN-DEC	8694	70 05/02/13	70 06/07/11	68 06/07/09	68 06/07/08	68 06/07/07	68 05/01/09		
TRNP - SU (Painted Canyon)	1999	JAN-DEC	8556	70 08/05/17	70 08/05/18	63 08/05/11	60 08/05/12	60 08/05/10	60 08/05/13		

The maximum 1-hour concentration is 84 ppb at Hannover on 07/22/11
The 4th highest 8-hour concentration is 68 ppb at Sharon on 05/01/09

* The air quality standards for ozone are:
STATE - 120 ppb not to be exceeded more than once per year.

FEDERAL Standards -
1) 120 ppb maximum 1-hour concentration with no more than one expected exceedance per year.
2) Fourth highest daily maximum 8-hour averages for a 3-year period not to exceed 80 ppb.

The two sites, Beulah and Hannover, in the vicinity of the major VOC sources are not significantly different from the TRNP-SU site which is in a Class 1 area. However, the VOCs from the oil fields may have some effect on the O_3 levels at this site.

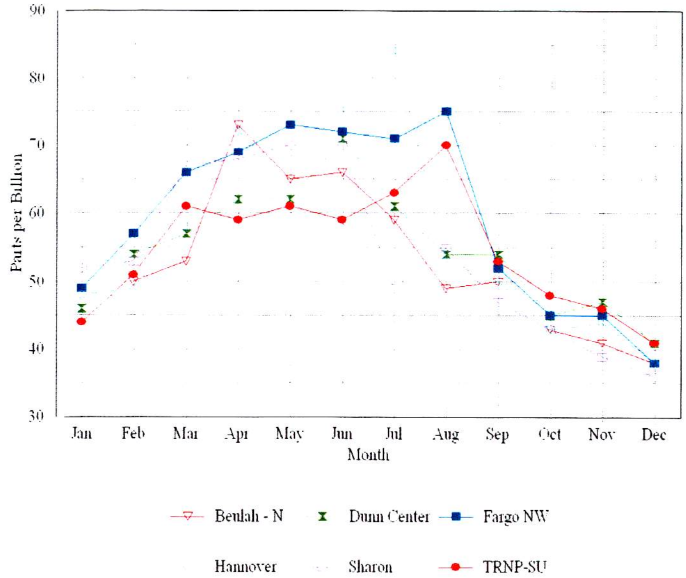

Figure 11 Monthly Maximum Ozone Concentrations

2.3.4 Network Analysis

Only one of the six state ozone monitoring sites is in an area not significantly influenced by VOC sources (see Figure 10). Beulah and Hannover are within 45 miles of eight of the ten major VOC sources in the state. TRNP-SU is located in a Class I area surrounded by oil fields. Fargo NW is located in Fargo and influenced by city traffic. Dunn Center and Sharon are located in a rural area surrounded by crop land. With this diversity of site locations and influences, it would be expected to see a diversity of ozone concentrations. On the contrary, Figure 12 shows a significant similarity among the maximum 1-hour concentrations. Since 1980, there have been only three hours of data collect higher than 80 ppb and none of these exceeded 100 ppb.

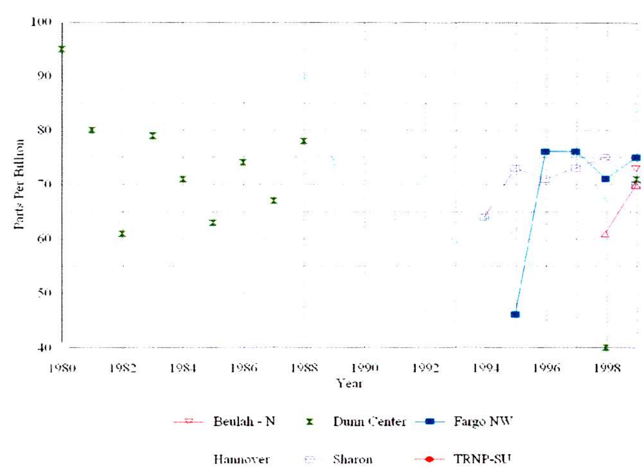

Figure 12. Annual Maximum Ozone Concentrations

2.4 Inhalable Particulates

The inhalable particulate standards are designed to protect against those particulates that can be inhaled deep into the lungs and cause respiratory problems. The major designation for inhalable particulates is PM. Within this designation are two subgroups: PM_{10} and $PM_{2.5}$. The PM_{10} particulates have an aerodynamic diameter less than or equal to a nominal 10 microns and are designated as PM_{10}. The $PM_{2.5}$ particulates have an aerodynamic diameter less than or equal to a nominal 2.5 microns and are designated as $PM_{2.5}$.

2.4.1 Sources

The major PM_{10} point sources (>100 TPY) are listed in Table 9 along with their emissions as calculated from the most recent emissions inventories reported to AIRS-AFS. Figure 13 shows the approximate locations of these facilities (the numbers correspond to the respective positions in the site and source tables). Most of these sources are large coal-fired facilities, and the PM_{10} 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

2.4.2 Monitoring Network

The State operates two PM_{10} samplers and nine FRM $PM_{2.5}$ samplers at seven sites. Since PM_{10} and smaller particles are of concern mainly because of their effects on people, monitoring efforts are concentrated in a population center and a high emissions area. Table 10 shows the inhalable PM_{10} particulate data summary, Table 11 shows the FRM $PM_{2.5}$ particulate data summary.

R&P single-day samplers were installed at Beulah, Lignite, Short Creek, and Sharon. And, R&P sequential samplers were installed at Bismarck, Fargo, and Grand Forks. Duplicate samplers were co-located at Beulah and Fargo. However, the only samplers that ran without a problem were the single-day samplers. It appears the sequential samplers were not adequately tested for cold weather.

TABLE 9

Major PM_{10} Sources
(> 100 TPY)

1998

#	FACILITY NAME	COUNTY	CITY	POLLUTANT EMISSIONS	PERCENT OF TOTAL EMISSIONS	FACILITY ID
1	Dakota Gasification Company	Mercer	Beulah	1,366	23.42	380570013
2	Great River Energy: Coal Creek	Mc Lean	Underwood	1,360	23.32	380550017
3	Basin Electric: Avs 1&2	Mercer	Beulah	694	11.90	380570011
4	Basin Electric: Leland Olds Station	Mercer	Stanton	617	10.58	380570001
5	Otter Tail Power Company: Coyote	Mercer	Beulah	569	9.75	380570012
6	Amoco Oil Co: Mandan Refinery	Morton	Mandan	416	7.13	380590003
7	American Crystal Sugar: Drayton Plant	Pembina	Drayton	200	3.43	380670003
8	American Crystal Sugar: Hillsboro Plant	Traill	Hillsboro	194	3.33	380970019
9	Minn-Dak Farmers Cooperative	Richland	Wahpeton	180	3.09	380770026
10	Montana Dakota Utilities: Heskett 1 & 2	Morton	Mandan	119	2.04	380590001
11	Minnkota Power Coop: M R Young #1	Oliver	Center	118	2.02	380650001

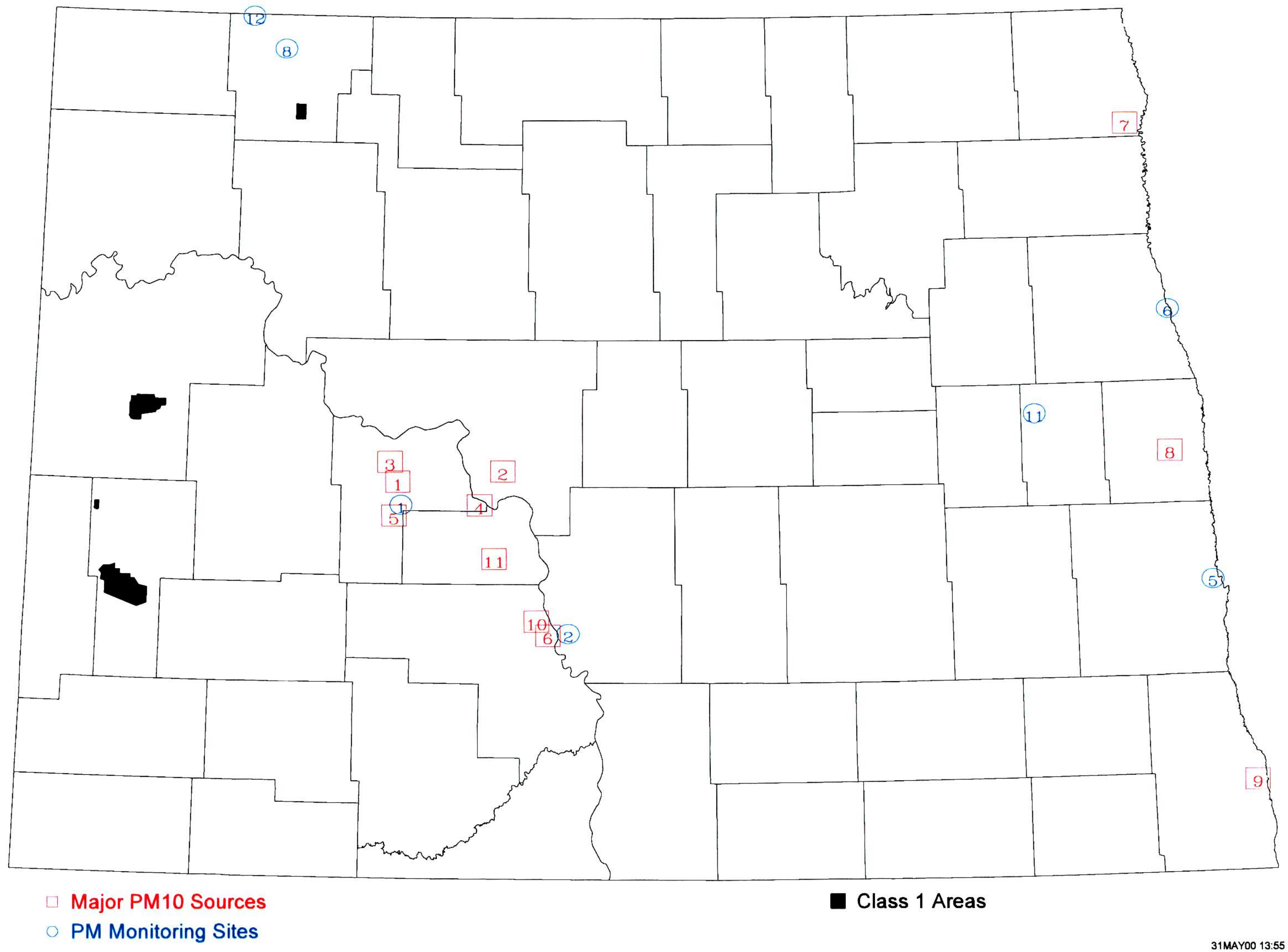

Figure 13 Major PM_{10} Sources

TABLE 10

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Inhalable PM_{10} Particulates (µg/m³)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 24 - HOUR 1ST MM/DD	2ND MM/DD	3RD MM/DD	ARITH MEAN	#>150	AM>50	% >MDV
Dragswolf	1999	JAN-DEC	44	0.0	16.6 03/13	14.8 03/07	12.8 04/18	5.9			68.1
Fargo NW	1999	JAN-DEC	60	4.3	70.8 11/02	64.9 11/08	52.0 07/29	20.7			100.0
Short Creek - SPM	1999	JAN-DEC	56	5.2	52.1 08/04	44.6 07/29	42.2 10/21	17.0			100.0
White Shield	1999	JAN-DEC	60	0.0	18.7 08/28	17.4 03/07	15.3 03/13	6.9			78.3

The maximum 24-hour concentration is 70.8 µg/m3 at Fargo NW on 11/02

* The STATE and FEDERAL air quality standards are:
1) 150 µg/m³ maximum averaged over a 24-hour period with no more than one expected exceedance per year.
2) 50 µg/m³ expected annual arithmetic mean.

TABLE 11

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : FRM $PM_{2.5}$ Particulates (µg/m³)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 1ST MM/DD	2ND MM/DD	3RD MM/DD	ARITH MEAN	#>65	AM>15	% >MDV
Beulah - North	1999	JAN-DEC	56	2.0	21.2 03/07	20.9 03/13	15.5 02/11	7.0			100.0
Bismarck Residential	1999	JAN-DEC	93	0.4	24.4 03/16	23.0 02/20	22.5 03/19	7.0			95.7
Fargo NW	1999	JAN-DEC	108	1.9	30.7 01/30	27.4 11/11	26.7 02/26	9.2			99.0
Grand Forks - North	1999	JAN-DEC	93	1.0	30.0 03/13	26.3 02/26	23.1 08/31	9.6			95.7
Lignite - SPM	1999	SEP-DEC	16	1.8	8.1 11/08	7.6 09/09	6.5 11/14	4.6			93.7
Sharon	1999	JAN-DEC	56	1.9	27.4 03/13	21.3 01/30	16.2 10/27	7.6			98.2
Short Creek - SPM	1999	APR-DEC	35	2.1	21.8 10/27	10.5 08/04	9.7 05/01	6.2			100.0

The maximum 24-hour concentration is 30.7 µg/m3 at Fargo NW on 01/30

* The ambient air quality standards are:
FEDERAL Standards -
1) 24-hour: 3-year average of 98th percentiles not to exceed 65 µg/m³.
2) Annual: 3-year average not to exceed 15µg/m³.

2.4.3 $PM_{2.5}$ Network

The basic monitoring plan for the $PM_{2.5}$ network was submitted in letter form on July 10, 1998. A total of 12 sites were planned be established in 1998 and 1999 to satisfy the new PM monitoring requirement: eight sites in 1998 and four in 1999. The following is the detailed description of the sites and equipment to be added in 1999 for the 2000 calendar year.

Of the eight sites planned for startup for 1998, five were actually started: Beulah, Bismarck, Fargo, Sharon, and Short Creek. One more site, Lignite, with two samplers was added in 1999. Due to major problems with the filter change mechanism in the sequential samplers at Bismarck and Grand Forks, most of first quarter was lost.

The sites planned for startup and placed on hold were TRNP-SU and Dickinson. The IMPROVE sampler scheduled for TRNP-SU was delayed until 1999, therefore the FRM sampler was not installed. When the NPS installs the IMPROVE sampler, the FRM will be started.

The site at Dickinson will begin operation effective January 1, 2000, and TRNP-SU will begin as soon as an operator can be found. An additional site may be installed on the Fort Berthold Indian Reservation if an agreeable site can be located. This site will be treated as a part of the state network even though it is on Tribal land.

2.4.5 Speciation Network

The Department currently has plans for three speciation sites: Fargo, Bismarck, and Bottineau. However, the Department has concluded that the current speciation samplers are not ready for field use. Therefore, the only speciation sampling site that will be set up is Fargo until after the samplers are field tested and the Department has the opportunity to review the operation characteristics of each sampler make available. Also, the actual location of the other sites is subject to further review after the sulfate and nitrate modeling results are available. The results may indicate better locations than those currently selected.

2.5 Carbon Monoxide

Many large urban areas in the United States have problems attaining the NAAQS for carbon monoxide (CO) where the primary source of CO is automobiles. North Dakota does not have sufficient population 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 TPY of CO.

2.5.1 Sources

The major stationary CO sources (>100 TPY) are listed in Table 12 along with their emissions as calculated from the most recent emissions inventories reported to the department. Figure 14 shows the approximate locations of these facilities (the numbers correspond to the respective positions in the site and source tables). Most of these sources are the same sources that are the major emitters of SO_2 and NO_x. However, the corresponding levels of CO from these sources are considerably lower.

2.5.2 Monitoring Network

Carbon monoxide monitoring in North Dakota was terminated March 31, 1994, after 5 years of operation. The conclusion drawn from the data was that North Dakota did not have a CO problem. 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 their traffic planning program.

TABLE 12

Major CO Sources
(> 100 TPY)

1998

#	FACILITY NAME	COUNTY	CITY	POLLUTANT EMISSIONS	PERCENT OF TOTAL EMISSIONS	FACILITY ID
1	Dakota Gasification Company	Mercer	Beulah	2,189	19.82	380570013
2	Great River Energy: Coal Creek	Mc Lean	Underwood	1,777	16.09	380550017
3	Basin Electric: Avs 1&2	Mercer	Beulah	1,436	13.00	380570011
4	Minn-Dak Farmers Cooperative	Richland	Wahpeton	1,054	9.54	380770026
5	Basin Electric: Leland Olds Station	Mercer	Stanton	902	8.17	380570001
6	Minnkota Power Coop: My Young #2	Oliver	Center	639	5.79	380650020
7	Otter Tail Power Company: Coyote	Mercer	Beulah	587	5.32	380570012
6	Minnkota Power Coop: Mr Young #1	Oliver	Center	399	3.61	380650001
8	American Crystal Sugar: Drayton Plant	Pembina	Drayton	378	3.42	380670003
9	Amoco Oil Co: Mandan Refinery	Morton	Mandan	321	2.91	380590003
10	American Crystal Sugar: Hillsboro Plant	Traill	Hillsboro	308	2.79	380970019
11	Amerada Hess Corp: Tioga Gas Plant	Williams	Tioga	285	2.58	381050004
12	Montana Dakota Utilities: Heskett 1 & 2	Morton	Mandan	172	1.56	380590001
13	Univ. Of North Dakota Heating Plant	Grand Forks	Grand Forks	134	1.21	380350003
14	Cavalier Air Station	Pembina	Cavalier	129	1.17	380670005
15	Bear Paw Energy, Inc.: Alexander	Mc Kenzie	Alexander	123	1.11	380530024
16	Bear Paw Energy, Inc.: Tree Top	Billings	Fairfield	108	0.98	380070019
17	Continental Resources Inc	Bowman	–	103	0.93	380110010

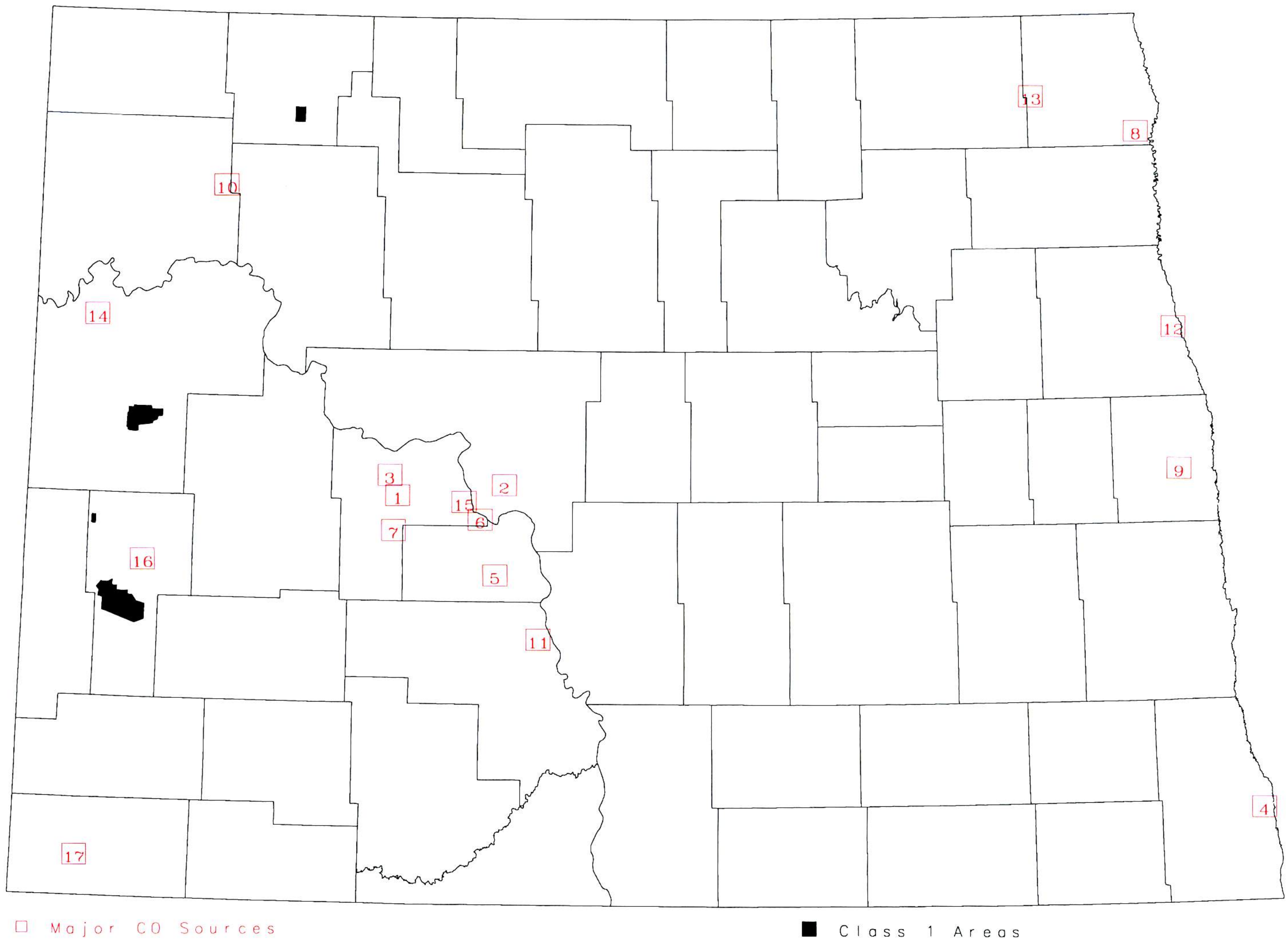

Figure 14 Major CO Sources

2.6 Lead

Through prior sampling efforts, the Department has determined that the State has low lead concentrations (38.6% of the standard) and no significant lead sources. This determination, coupled with the Federal requirement for a NAMS network only in urbanized areas with populations greater than 500,000, resulted in terminating the lead monitoring program effective December 31, 1983. Along with the low monitored concentrations, lead has been completely removed from gasoline since lead monitoring began in 1979.

2.7 Hydrogen Sulfide

Although no Federal Ambient Air Quality Standard exists for hydrogen sulfide (H_2S), the State of North Dakota has developed H_2S standards.

2.7.1 Sources

H_2S emissions of concern stems almost totally from the oil and gas operations in the western part of the State; principally from the green outlined area on Figure 2. Flares and treater stacks associated with oil/gas wells, oil storage tanks, compressor stations, pipeline risers, and natural gas processing plants are potential sources of H_2S emissions.

2.7.2 Monitoring Network

The are not state-operated sites. There is only one industry-operated site remaining, which is in the Amerada Hess -Tioga network and was terminated on December 31, 1999. Table 13 shows the 1998 H_2S data summaries.

TABLE 13

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Hydrogen Sulfide (PPB)

				M A X I M A									
				1 - HOUR		24 - HOUR		3 - MONTH					
LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	1ST MM/DD/HH	2ND MM/DD/HH	1ST MM/DD	2ND MM/DD	1ST MM	2ND MM	ARITH MEAN	1HR #>200	24HR #>100	% MDV
Amerada Hess - Tioga #2	1999	JAN-DEC	8664	101 12/02/20	94 04/12/21	19 04/12	9 09/20	2 04	2 12	1.9			19.2

The maximum 1-hour concentration is 101 ppb at Amerada Hess - Tioga #2 on 12/02/20
the maximum 24-hour concentration is 19 ppb at Amerada Hess - Tioga #2 on 04/12
The maximum 3-month concentration is 2 ppb at Amerada Hess - Tioga #2 on 04

* The State air quality standards are:
1) 10 ppm maximum instantaneous (ceiling) concentration not to be exceeded.
2) 200 ppb maximum 1-hour average concentration not to be exceeded more than once per month.
3) 100 ppb maximum 24-hour average concentration not to be exceeded more than once per year.
4) 20 ppb maximum arithmetic mean concentration averaged over three consecutive months.

2.8 Inhalable Particulate Sulfates

Sulfates are any of a group of compounds that contain the sulfate ($SO_4^=$) ion. Sulfates are generally found as a fine particulate with an aerometric diameter of 2.5 microns or less ($PM_{2.5}$). Due to changes to the network, Fargo will be the only site with a PM_{10} sampler , therefore, this analysis will not be included in future network reviews.

2.8.1 Sources

Most sulfates are a secondary particulate, not directly emitted from a source, but created by oxidation of SO_2. Sulfur dioxide can be transformed to $SO_4^=$ by several atmospheric chemical reactions. These various reactions involve water vapor, ozone, hydrocarbons, peroxides or free radicals. Sulfates can be directly emitted from application of fertilizers and some industrial sources. Atmospheric sulfates usually exist as sulfuric acid or ammonium sulfate.

2.8.2 Monitoring Network

The State operates two PM_{10} samplers at two sites. Since sulfates have health effects such as decreased lung function in exercising adolescent asthmatics, efforts are concentrated in the state's population center. Also, fine particulate sulfate is efficient at scattering light: thus a factor in visibility degradation. Even at concentrations as low as 3 $\mu g/m^3$, sulfate will affect visibility. Table 14 shows the inhalable particulate sulfate data summaries with Table 15 showing the ratios of sulfates to total mass for each sample.

2.8.3 Network Analysis

There are only two PM_{10} sites remaining in the network: Fargo NW and Short Creek - SPM. Fargo is located in the largest city and Short Creek - SPM is located down wind from a major power plant near Estevan, SK.

Ratios were calculated for data pairs only when both samples were greater than the minimum detectable for the analysis method. The ratios for the 24-hour PM_{10} sulfates to PM_{10} total mass range from 0.7% to 33.1%. The averages for all samples collected range from to 7.9% to 10.4%. The highest 24-hour and annual averages were at Short Creek - SPM.

Table 14

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : PM_{10} Sulfate (µg/m^3)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 1ST MM/DD	MAXIMA 2ND MM/DD	MAXIMA 3RD MM/DD	ARITH MEAN	#>15.	AM>5.	% >MDV
Fargo NW	1999	JAN-DEC	60	0.2	3.7 08/22	2.7 03/13	2.5 03/01	1.1			88.3
Short Creek - SPM	1999	JAN-DEC	56	0.3	5.7 04/30	5.5 03/13	5.2 03/07	1.3			92.8

The maximum 24-hour concentration is 5.7 µg/m3 at Short Creek - SPM on 04/30

* No standard is currently in effect.

Table 15

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : PM_{10} Sulfate/PM_{10} Total Mass Ratio (PERCENTAGE)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 1ST MM/DD	MAXIMA 2ND MM/DD	MAXIMA 3RD MM/DD	ARITH MEAN
Fargo NW	1999	JAN-DEC	53	0.7	26.9 03/01	20.0 01/18	18.6 01/24	7.9
Short Creek - SPM	1999	JAN-DEC	52	2.0	33.1 03/13	28.8 01/12	27.8 04/30	10.4

The maximum 24-hour ratio is 33.1 percent at Short Creek - SPM on 03/13

* No standard is currently in effect.

3.0 SUMMARY AND CONCLUSIONS

The North Dakota Ambient Air Quality Monitoring Network is designed to monitor those air pollutants which 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.

3.1 Sulfur Dioxide (SO_2)

The State 1-hour standard was exceeded three times. Federal standards were not exceeded at any monitoring site. The maximum concentrations and the maximum concentrations expressed as a percentage of the applicable standard are as follows: 1-hour - 401 ppb (146.9%); 3-hour - 346 ppb (69.2%); 24-hour - 97 ppb (98%); annual - 6.3 ppb (27.4%).

There is no SO_2 5-minute standard currently in effect. The maximum 5-minute average was 422 ppb.

3.2 Nitrogen Dioxide (NO_2)

Neither the State nor Federal standards were exceeded at any of the monitoring sites. The maximum concentrations and the maximum concentrations expressed as a percentage of the applicable standard are as follows: annual (full year) - 6.4 ppb (12.1%).

3.3 Ozone (O_3)

Neither the State nor Federal standard was exceeded during the year. The maximum concentrations and the maximum concentrations expressed as a percentage of the applicable standard are as follows: 1-hour - 84 ppb (70.0%); 8-hour - 68 ppb (85.0%).

3.4 Inhalable Particulates

Neither the State nor Federal PM_{10} standards were exceeded during the year. The maximum concentrations and the maximum concentrations expressed as a percentage of the applicable PM_{10} standard are as follows: 24-hour - 70.8 $\mu g/m^3$ (47.2%); annual - 20.7 $\mu g/m^3$ (41.4%).

Neither the State nor Federal $PM_{2.5}$ standards were exceeded during the year. The maximum concentrations and maximum concentrations expressed as a percentage of the standard are as follows: 24-hour FRM - 30.7 $\mu g/m^3$ (47.2%); annual FRM - 9.2 $\mu g/m^3$ (64.0%).

3.5 Carbon Monoxide (CO)

No monitoring was conducted.

3.6 Lead

No monitoring was conducted.

3.7 Hydrogen Sulfide

There were no exceedances of any of the standards. The maximum concentrations and the maximum concentrations expressed as a percentage of the applicable standard are as follows: 1-hour - 101 ppb (50.5%); 24-hour - 19 ppb (19%); 3-month - 2 ppb (10.0%).

3.8 Inhalable Particulate Sulfates

There are no inhalable particulate sulfate standards. The maximum PM_{10} 24-hour and annual concentrations are 5.7 $\mu g/m^3$ and 1.3 $\mu g/m^3$, respectively.