UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
999 18TH STREET - SUITE 500
DENVER, CO 80202-2466

DEC 29 1998

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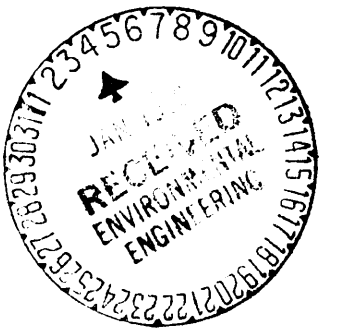

Daniel Harman, Manager
North Dakota Department of Health
Division of Environmental Engineering
P.O. Box 5520
Bismarck, ND 58506-5520

Dear Mr. Harman:

This letter is in reply to your 1997 Ambient Air Quality Monitoring Annual Network Review which was submitted by e-mail to Bernadette Gonzalez on July 31,1998. North Dakota's Division of Environmental Engineering conducted the Network Review. EPA Region VIII has assessed the report and found that it met the requirements of the Performance Partnership Agreement. Our comments are presented below.

Section 2.4.3 says that all of the monitoring stations for particulate matter except for the Sharon station are population-oriented, urban scale stations. The Aerometric Information Retrieval System, Air Quality Subsystem (AIRS-AQS) shows the following sites as neighborhood scale rather than urban scale:

Site Name	AIRS-AQS Identification Number
Bismarck Residential	380150003
Dickinson Residential	380890002
Williston Residential	381050002

Table18, Monitor Site Evaluation, lists the need for a new site other than Fargo Residential. North Dakota's State/Industry Network Air Quality Report for the 2nd Quarter 1998 shows that the SO_2, O_3, and NO_2 monitoring equipment was transferred from the Fargo Residential site to the Fargo NW site at the NDSU Weed Research Facility on May 12 and 13, 1998.

Section 3.2 has one typographical error. The annual (full year) NO_2 maximum concentration expressed as a percentage of the applicable standard is written as 8.1.0%. I believe it should be 8.1%. You may want to change this on your master document, especially if it is available for public review.

Done

Thank you for submitting this report. If you have any questions or further comments on the network review, please call Bernadette Gonzalez (303) 312-6072.

Sincerely,

Joseph C. Pehrcke
for

Callie Videtich
Unit Leader
Air Program Technical Unit

NORTH DAKOTA DEPARTMENT OF HEALTH
Environmental Health Section

Location:
1200 Missouri Avenue
Bismarck, ND 58504-5264

Fax #:
701-328-5200

Mailing Address:
P.O. Box 5520
Bismarck, ND 58506-5520

July 31, 1998

FILE

Ms. Bernadette Gonzalez
U.S. EPA - Region VIII
One Denver Place
999 18th Street, Suite 500
Denver, CO 80202-2466

Re: '98-'99 PPA, Air Quality Workplan,
Monitoring, C (Network Review)

Dear Ms. Gonzalez:

Attached is the referenced required report. The report typically is based on a calendar year to correspond with the annual data summary report. However, this review, for 1997, includes network changes related to adding $PM_{2.5}$ monitoring during 1998. This information is normally included in the network modification plan developed during the first quarter of each year, for that year. Because we do not have an approved $PM_{2.5}$ monitoring plan, the $PM_{2.5}$ sites scheduled for installation in 1999 will be included in the network modification plan for 1999.

If you have any questions about this report, please call me at (701)328-5188.

Sincerely,

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

DEH:saj
Enc:

NORTH DAKOTA DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL ENGINEERING

AMBIENT AIR QUALITY MONITORING
ANNUAL NETWORK REVIEW
1997

July 1998

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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 pollutant concentrations expected to occur in an area covered by the network.

2. To determine representative concentrations in areas of high population density.

3. To determine the impact on ambient pollution levels by a significant source 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 and Fargo Residential are exceptions to this primary function. Beulah is population exposure because of the major sources in the vicinity. Fargo Residential is also population orientated because Fargo is a major population center with PSD sources in the Fargo-Moorhead area. The data from this site 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. PM_{10} sites, except for Sharon, are population exposure sites: Sharon collects background data for the eastern part of the state.

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.

Two sites are scheduled to be terminated during 1998. Fargo Residential will be moved to a new location northwest of town, to the NDSU Weed Research Facility. The land owned by the city, where the site is currently located, was sold to a private party. As soon as the

new site can be prepared, the monitoring trailer and PM platforms will be moved. TRNP - NU will be terminated with the SO_2 and O_3 analyzers moved to the old Painted Canyon Rest Area site in the South Unit. The monitoring trailer and will be available to be a new monitoring site: Possibly north of the AMOCO Refinery at Mandan.

One site, Whiskey Joe - SPM was terminated on November 30. The problems at the oil well were resolved and no SO_2 PSD exceedances were detected.

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 network and data collected are not included in this review.

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. Thirteen were SLAMS/NAMS sites, and two were special purpose monitoring (SPM) sites. There were five industries that reported 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 Residential 380570001	SLAMS	PM_{10} SO_2, NO_2, O_3, MET	6th Day cont.	Population Exposure Population Exposure	Urban Urban	12/95 04/80
2 Bismarck Residential 380150003	SLAMS	PM_{10}, $PM_{2.5}$	6th Day	Population Exposure	Urban	07/95
3 Dickinson Residential 380890002	SLAMS	PM_{10}	6th Day	Population Exposure	Urban	07/89
4 Dunn Center 380250003	SLAMS	SO_2, MET	cont.	General Background	Regional	10/79
5 Fargo Residential 380171003	SLAMS	PM_{10} PM_{10} SO_2, NO_2, O_3, MET	6th Day 6th Day cont.	Population Exposure Collocated SSI Population Exposure	Urban N/A Regional	08/95 08/95
6 Grand Forks Residential 380350002	SLAMS	PM_{10}	6th Day	Population Exposure	Urban	07/89
7 Hannover 380650002	SLAMS	SO_2, NO_2, O_3, MET	cont.	General Background	Regional	10/84
8 Mandan Refinery - SPM 380590002	SPM	SO2, MET	cont.	Source Impact	Neighborhood	12/95
9 Sharon 380910001	SLAMS	SO_2, NO_X O_3, MET PM_{10}	cont. 6th Day	General Background	Regional	07/94
10 TRNP - NU 380530003	SLAMS	SO_2, O_3, H_2S, MET	cont.	General Background	Regional	02/80
11 Whiskey Joe - SPM 380070003	SPM	SO2, H2S, MET	cont.	Source Impact	Neighborhood	07/95
12 Williston Residential 381050002	SLAMS	PM_{10}	6th Day	Population Exposure	Urban	08/95

Company	Site Name AQS Site #					
13 Amerada Hess Corporation	TIOGA #1 381050103 TIOGA #2 381050104 TIOGA #3 381050105	SO_2 H_2S, MET SO_2	cont. cont. cont.	Source Source Source	Neighborhood Neighborhood Neighborhood	07/87 07/87 11/87
14 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 Source Source Source	Neighborhood Neighborhood Neighborhood Neighborhood	01/80 01/89 10/95 10/95
15 Koch Hydrocarbon Company	KOCH #3 380530103 KOCH #4 380530110	SO_2, MET H_2S, MET	cont. cont.	Source Source	Neighborhood Neighborhood	11/94 05/94
16 W. H. Hunt Estate	HUNT #5 380070111	SO_2, H_2S, MET	cont.	Source	Neighborhood	11/92

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

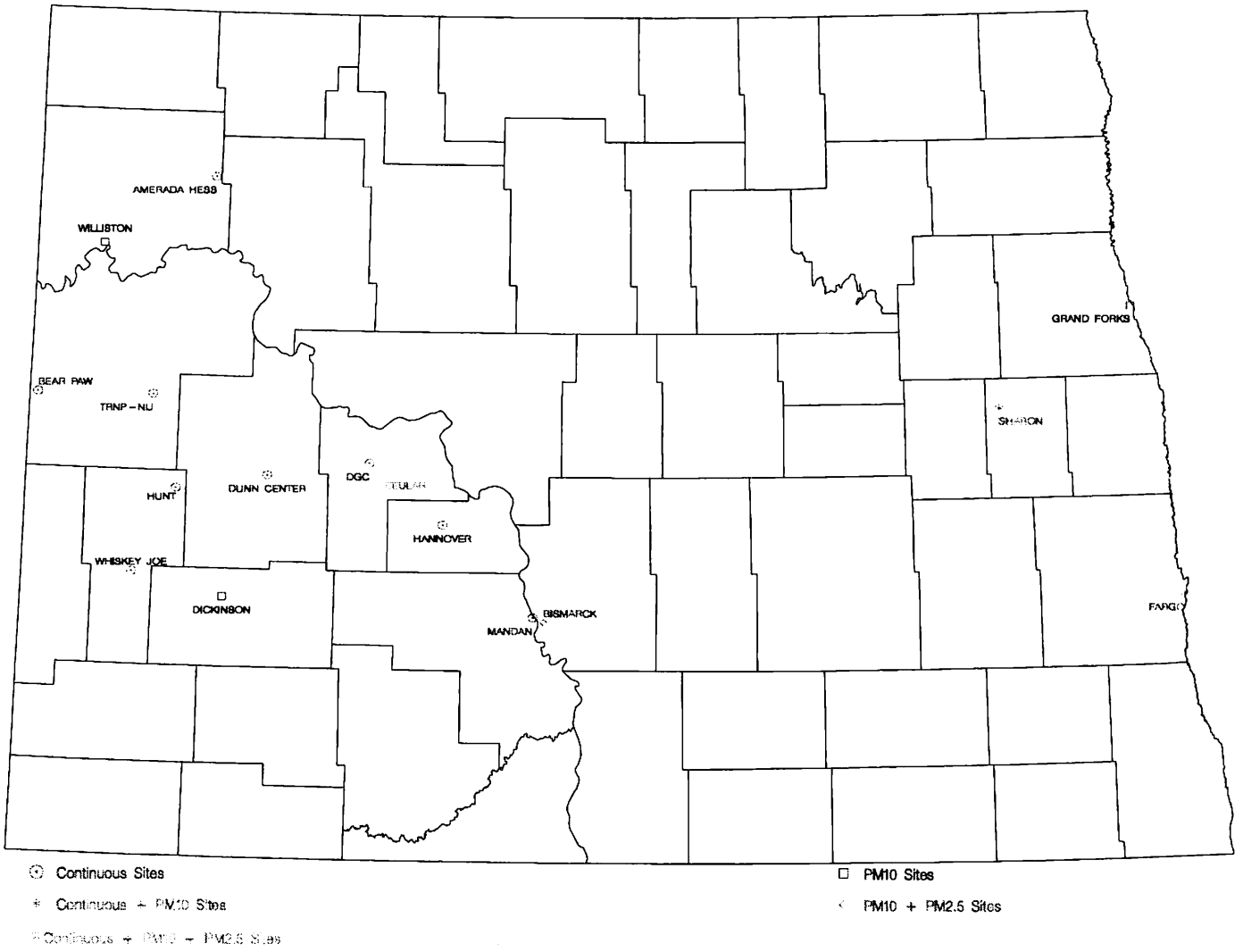

Figure 1 North Dakota Ambient Air Quality Monitoring Sites

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 area sources. Also, four major sources maintained monitoring networks in the vicinity of their plants (see Table 1 and Figure 1).

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)

1997

#	Name of Company	Type of Source	Location	County	SO_2 Emissions Ton/Yr
1	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	Mc Lean	45,415
2	Basin Electric Power Cooperative (Leland Olds)	Steam Electric Gen. Facility	Stanton	Mercer	44,515
3	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	40,087
4	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	15,345
5	Montana Dakota Utilities (Coyote Station)	Steam Electric Gen. Facility	Beulah	Mercer	13,579
6	United Power Association	Steam Electric Gen. Facility	Stanton	Mercer	8,709
7	Dakota Gasification Co.	Synthetic Fuel Plant	Beulah	Mercer	7,782
8	Amoco Oil Company	Oil Refinery	Mandan	Morton	6,103
9	Bear Paw Energy - Grasslands Plant	Natural Gas Processing Plant	---	McKenzie	2,270
10	Montana Dakota Utilities (Heskett)	Steam Electric Gen. Facility	Mandan	Morton	2,187
11	Amerada-Hess Corporation (Tioga Gas Plant)	Natural Gas Processing Plant	Tioga	Williams	1,552
12	American Crystal Sugar	Sugar Beet Processing Plant	Drayton	Pembina	763
13	Bear Paw Energy	Natural Gas Processing Plant	Lignite	Burke	705
14	W. H. Hunt Trust Estate	Natural Gas Processing Plant	---	Billings	631
15	Univ. of North Dakota	Steam Heat	Grand Forks	Grand Forks	603

TABLE 2 (cont.)

Major SO_2 Sources
(>100 TPY)

1997

#	Name of Company	Type of Source	Location	County	SO_2 Emissions Ton/Yr
16	American Crystal Sugar	Sugar Beet Processing Plant	Hillsboro	Traill	449
17	North Dakota State	Steam Heat	Fargo	Cass	256
18	Archer-Daniels-Midland	Corn Processing	Walhalla	Pembina	201
19	Minn-Dak Farmers Cooperative	Sugar Beet Processing Plant	Wahpeton	Richland	125

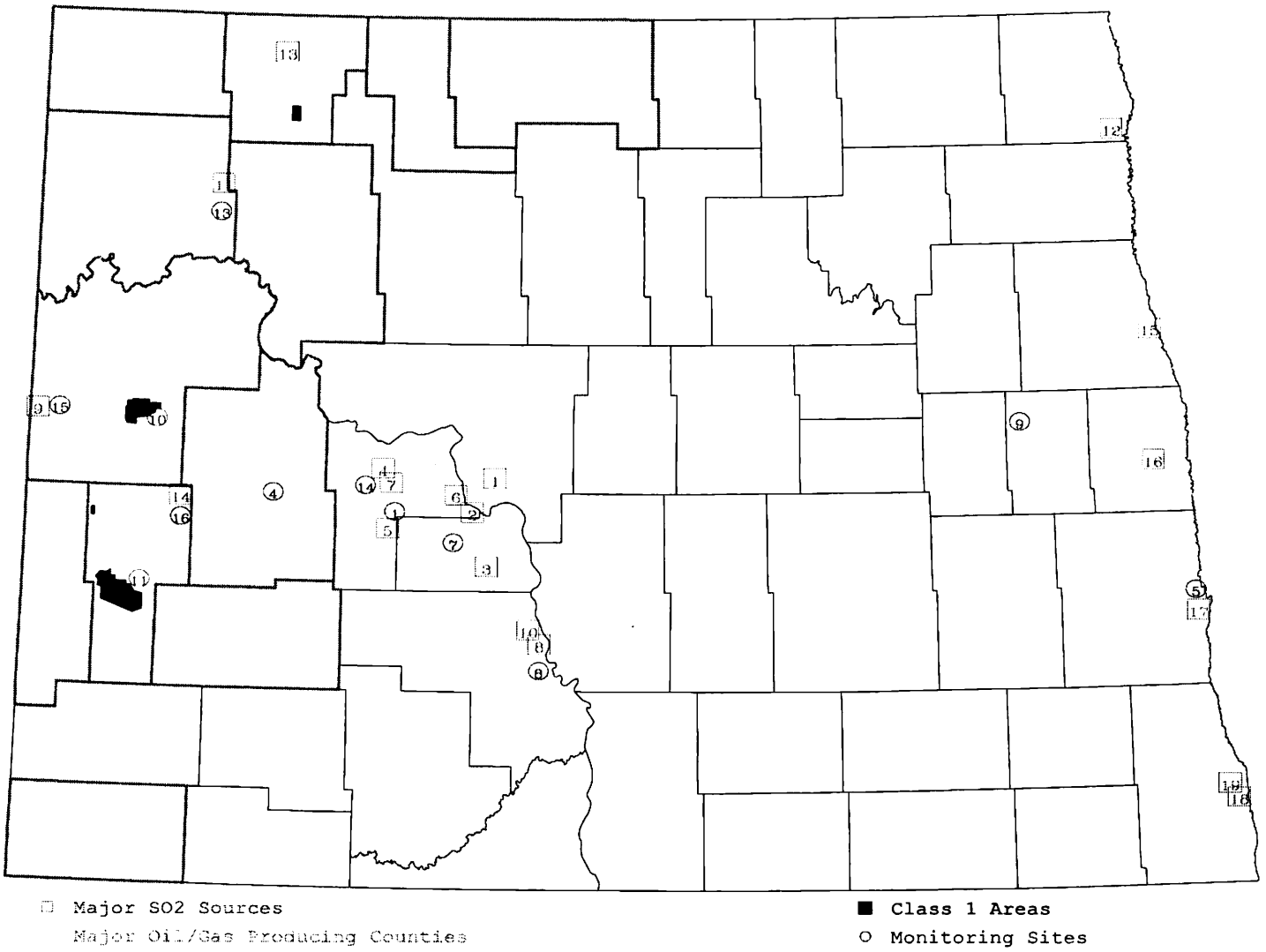

Figure 2 Major Sulfur Dioxide Sources

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 1997 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. One would expect that as these 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 18 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 the change in the amount of SO_2 in the ambient air is seen by reviewing the percentages of data less than the MDV. Figure 3 presents this data for the active state sites from 1980 through 1997. To calculate valid annual statistics, at least 75% of the data must be grater 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	1997	JAN-DEC	8662	54 07/31/08	36 05/04/09	23 07/31/08	23 12/20/05	8 01/26	8 12/20	1.6			15.4
AMERADA HESS - TIOGA #3	1997	JAN-DEC	8658	192 11/02/15	130 01/09/09	94 11/02/17	63 06/17/11	28 01/09	22 11/02	2.8			21.0
BEAR PAW - MGP #3	1997	JAN-DEC	6558 ***	170 09/27/02	131 05/10/17	101 09/27/02	91 05/10/17	23 05/10	22 05/07	1.7			9.6
BEULAH	1997	JAN-DEC	8713	53 04/18/11	53 06/02/12	31 11/19/14	27 06/02/11	8 03/12	8 11/19	2.1			29.6
DGC #12	1997	JAN-DEC	8669	612 09/08/22	233 09/08/23	288 09/08/23	140 09/08/20	55 09/08	9 06/01	2.5	1		35.7
DGC #14	1997	JAN-DEC	8479	144 11/16/13	99 01/30/17	75 11/16/14	46 01/30/17	16 01/30	13 11/16	2.6			40.3
DGC #16	1997	JAN-DEC	8304	140 03/31/10	122 07/23/13	79 02/02/17	72 03/31/11	28 09/03	20 09/02	3.6			62.4
DGC #17	1997	JAN-DEC	8327	164 06/06/08	143 06/06/06	137 06/06/08	70 04/20/11	30 06/06	27 04/20	3.7			67.7
DUNN CENTER	1997	JAN-DEC	8500	58 03/12/02	26 03/12/01	30 03/12/02	18 03/12/17	14 03/12	5 03/17	1.3			13.1
FARGO RESIDENTIAL	1997	JAN-DEC	8716	43 02/09/06	31 02/08/12	24 02/09/08	23 02/11/11	11 11/19	8 02/08	1.6			20.7
HANNOVER	1997	JAN-DEC	8509	101 06/03/08	73 10/06/08	42 06/03/11	40 08/23/11	12 06/03	10 04/09	2.2			24.1
LITTLE KNIFE #5	1997	JAN-DEC	8704	61 10/10/10	40 10/09/12	31 10/10/11	21 10/09/14	7 03/12	5 10/10	1.3			13.9
MANDAN REFINERY - SPM	1997	JAN-DEC	8700	159 12/27/20	158 01/09/04	141 11/02/05	138 01/09/05	104 01/09	60 11/02	7.5		1	46.3
SHARON	1997	JAN-DEC	8044	15 01/13/15	14 01/27/21	11 01/27/23	8 01/05/17	4 01/07	4 11/16	1.3			21.5
TRNP - NU	1997	JAN-DEC	8233	18 04/10/07	16 01/22/22	10 01/22/23	10 06/06/02	4 01/28	4 06/05	1.2			11.3
WHISKEY JOE - SPM	1997	JAN-SEP	6331	27 05/08/20	22 06/25/21	14 05/08/20	11 06/03/20	5 06/03	4 09/23	1.5			23.2

The maximum 1-hour concentration is 612 ppb at DGC #12 on 09/08/22
The maximum 3-hour concentration is 288 ppb at DGC #12 on 09/08/23
The maximum 24-hour concentration is 104 ppb at MANDAN REFINERY - SPM on 01/09

* 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.

*** Less than 80% of the possible samples (data) were collected.

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	5 - M I N U T E M A X I M A 1ST	DATE MM/DD/HH	2ND	DATE MM/DD/HH	3RD	DATE MM/DD/HH	# HOURS >600	% >MDV
BEULAH	1997	APR-DEC	6568	99	11/19/11	79	04/19/11	79	06/02/12	0	31.1
DUNN CENTER	1997	APR-DEC	5857	48	06/10/10	21	05/10/07	21	05/26/09	0	20.0
FARGO RESIDENTIAL	1997	APR-DEC	6566	26	11/19/09	25	05/19/20	23	11/19/04	0	8.2
HANNOVER	1997	APR-DEC	6380	164	06/03/08	122	04/03/08	122	08/19/10	0	30.0
MANDAN REFINERY - SPM	1997	JAN-DEC	8434	348	11/13/00	343	11/13/01	285	03/19/14	0	58.6
SHARON	1997	APR-DEC	5897	7	11/16/15	6	11/16/00	6	11/16/02	0	15.2
TRNP - NU	1997	APR-DEC	6560	26	04/10/07	24	06/10/17	23	06/06/01	0	14.6
WHISKEY JOE - SPM	1997	APR-SEP	4317	97	05/08/20	68	05/08/22	57	06/21/20	0	32.4

The maximum 5-minute concentration is 348 ppb at MANDAN REFINERY - SPM on 11/13/00

* 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 has shown a decrease the last four years while Beulah continued to increase until 1997. In contrast, the Dunn Center and TRNP - NU sites have remained consistently between 5% and 10% since 1988.

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 24-hour standard (see Figure 6).

Because the newer sites (Fargo Residential, Mandan Refinery - SPM, Sharon, and Whiskey Joe - SPM) have limited amount of data, no attempt is made to evaluate the results.

The purpose of the Whiskey Joe - SPM site was satisfied and the SO_2 monitoring was terminated in September.

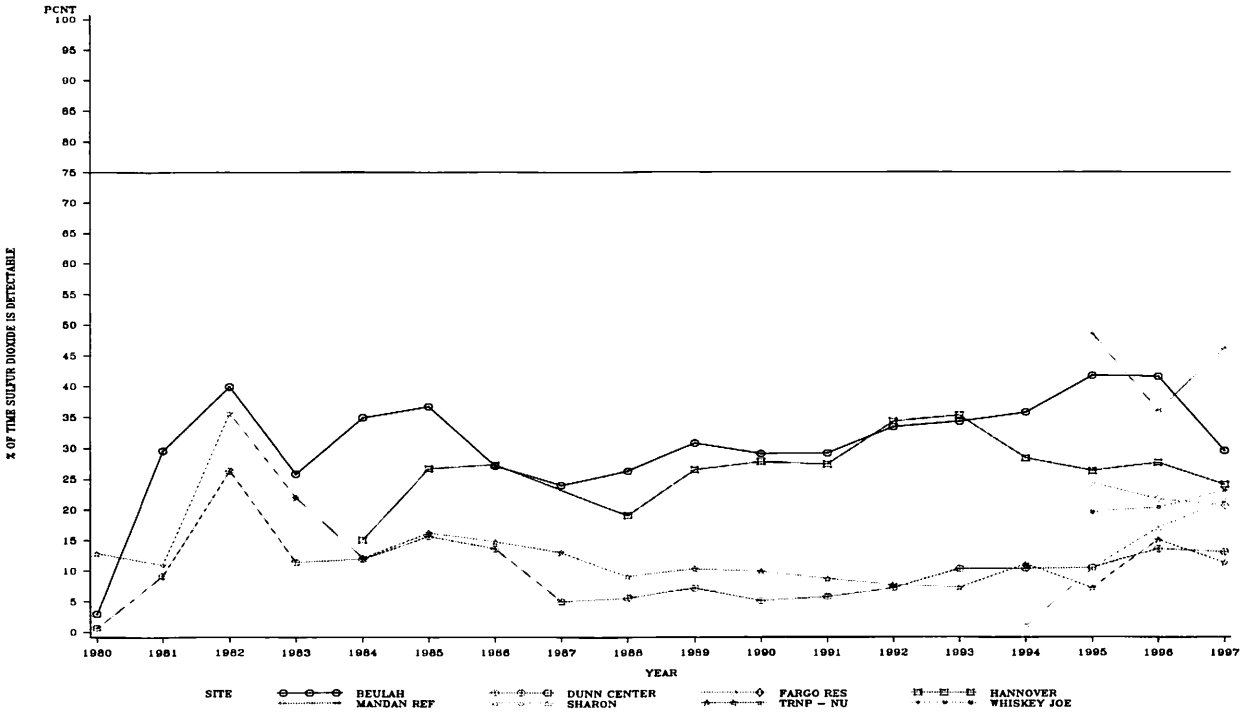

Figure 3 Percentage of Time SO_2 Detectable

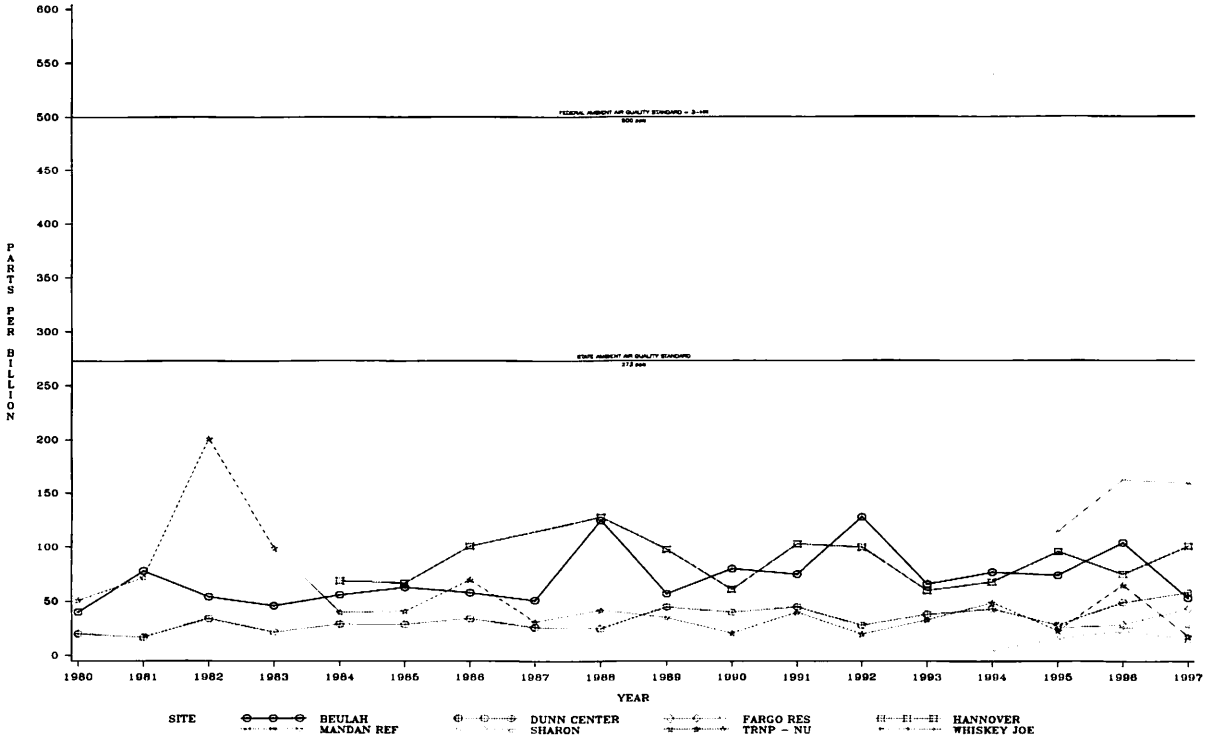

Figure 4 SO_2 Maximum 1-Hour Concentrations

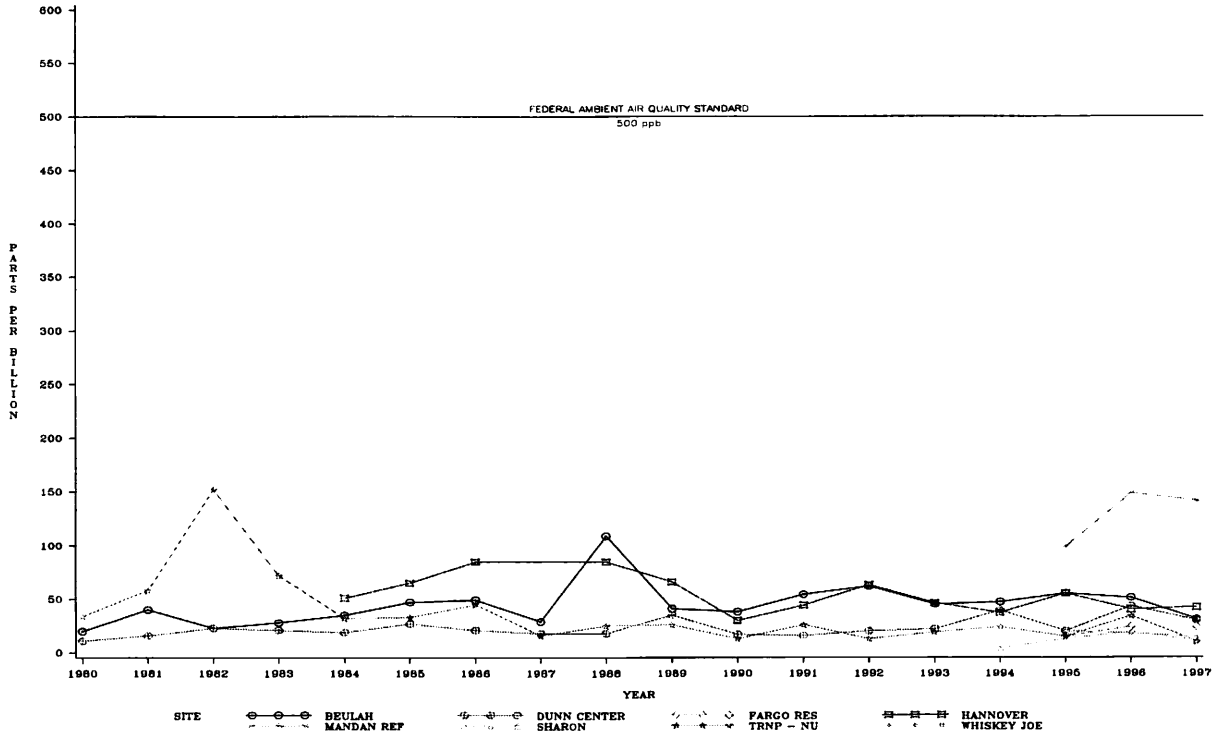

Figure 5 SO_2 Maximum 3-Hour Concentrations

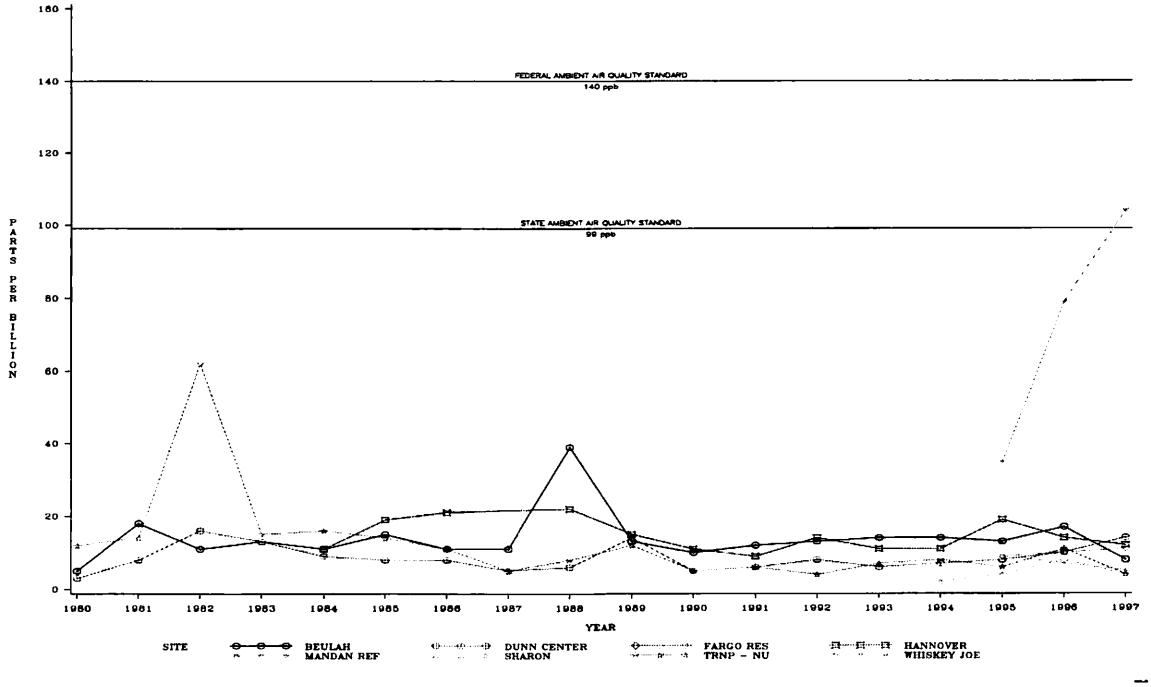

Figure 6 SO_2 Maximum 24-Hour Concentrations

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 four $NO/NO_2/NO_x$ analyzers. These are located at Beulah, Fargo, Hannover, and Sharon. The Dakota Gasification Company (DGC) network also operated analyzers at sites DGC #12 and DGC #17. Table 6 shows the 1997 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 Sharon, are well placed with respect to the major NO_x sources: Sharon is a background site.

TABLE 5

Major NO_x Sources
(> 100 TPY)

1997

#	Name of Company	Type of Source	Location	County	NO_x Emissions Ton/Yr
1	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	29,476
2	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	McLean	23,894
3	Basin Electric Power Cooperative (Leland Olds)	Steam Electric Gen. Facility	Stanton	Mercer	14,050
4	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	10,763
5	Montana Dakota Utilities (Coyote Station)	Steam Electric Gen. Facility	Beulah	Mercer	9,879
6	United Power Association	Steam Electric Gen. Facility	Stanton	Mercer	4,866
7	Dakota Gasification Co.	Synthetic Fuel Plant	Beulah	Mercer	2,770
8	Amoco Oil Company	Oil Refinery	Mandan	Morton	1,839
9	Amerada Hess Corporation (Tioga Gas Plant)	Natural Gas Processing Plant	Tioga	Williams	1,645
10	MDU - Heskett	Steam Electric Gen. Facility	Mandan	Morton	790
11	American Crystal - Drayton	Sugar Beet Processing	Drayton	Pembina	779
12	MINN-DAK Farmers	Sugar Beet Processing	Wahpeton	Richland	519
13	American Crystal - Hillsboro	Sugar Beet Processing	Hillsboro	Traill	452
14	University of North Dakota	Heating Plant	Grand Forks	Grand Forks	345

TABLE 5 (cont.)

Major NO_x Sources
(> 100 TPY)

1997

#	Name of Company	Type of Source	Location	County	NO_x Emissions Ton/Yr
15	Amerada Hess - Hawkeye	Compressor Station	---	McKenzie	206
16	Northern Border Pipeline - CS #8	Compressor Station	---	McIntosh	201
17	Amerada Hess - Antelope #2	Compressor Station	—	McKenzie	188
18	Northern Border Pipeline - CS #6	Compressor Station	Glen Ullin	Morton	181
19	Cavalier Air Station	Power Plant	Concrete	Pembina	177
20	Northern Border Pipeline - CS #4	Compressor Station	---	McKenzie	175
21	Bear Paw Energy - Alexander	Compressor Station	---	McKenzie	173
22	Williston Basin IPC	Compressor Station	Dickinson	Stark	170
23	Amerada Hess - Antelope #1	Compressor Station	---	McKenzie	166
24	Bear Paw Energy	Natural Gas Processing	Lignite	Burke	166
25	Bear Paw Energy-Tree Top	Compressor Station	---	Billings	137
26	ND State University	Heating Plant	Fargo	Cass	127
27	Bear Paw Energy - Boxcar Butte	Compressor Station	—	McKenzie	125
28	Bear Paw Energy - Cow Creek	Compressor Station	---	Williams	122
29	Bear Paw Energy - Demicks Lake	Compressor Station	—	McKenzie	115
30	Amerada Hess-Cherry Creek	Compressor Station	---	McKenzie	108
31	Continental Resources - Medicine Pole Hills	Compressor Station	—	Bowman	105
32	Northern Sun	Sunflower Processing	Enderlin	Ransom	100

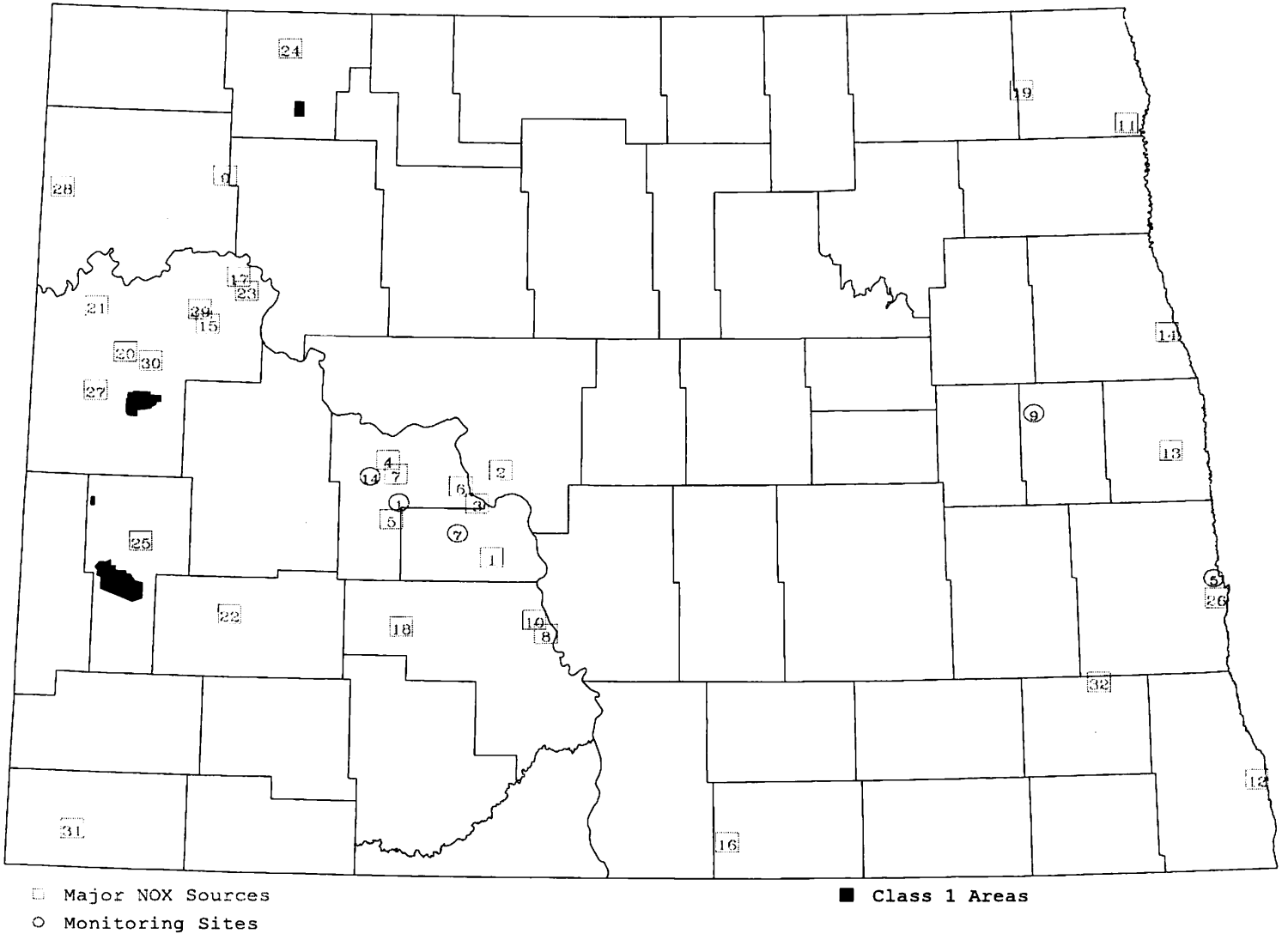

Figure 7 Major Nitrogen Dioxide Sources

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	1997	JAN-DEC	8700	39 01/02/16	39 03/07/06	3.9	72.2
DGC #12	1997	JAN-DEC	8634	45 04/11/21	45 10/13/18	4.3	99.1
DGC #17	1997	JAN-DEC	8094	207 11/29/13	108 08/22/04	3.9	86.6
FARGO RESIDENTIAL	1997	JAN-DEC	6574 ***	65 03/05/07	64 02/12/08	7.9	86.1
HANNOVER	1997	JAN-DEC	8684	33 01/20/21	27 01/02/21	2.2	46.7
SHARON	1997	JAN-DEC	8261	16 01/14/13	13 08/26/20	1.4	24.1

The maximum 1-hour concentration is 207 ppb at DGC #17 on 11/29/13

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

FEDERAL - 53 ppb annual arithmetic mean.

*** Less than 80% of the possible samples (data) were collected.

2.2.4 Network Analysis

Nine 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 18 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; and, in 1997, 108,676 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. An other possibility, and more likely, is a change in the wind flow patterns. As Hannover began a decline in 1995, Sharon began to increase. Fargo Res is the only State site with more then 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 Fargo Res and Sharon are relatively new sites, no valid trending is possible.

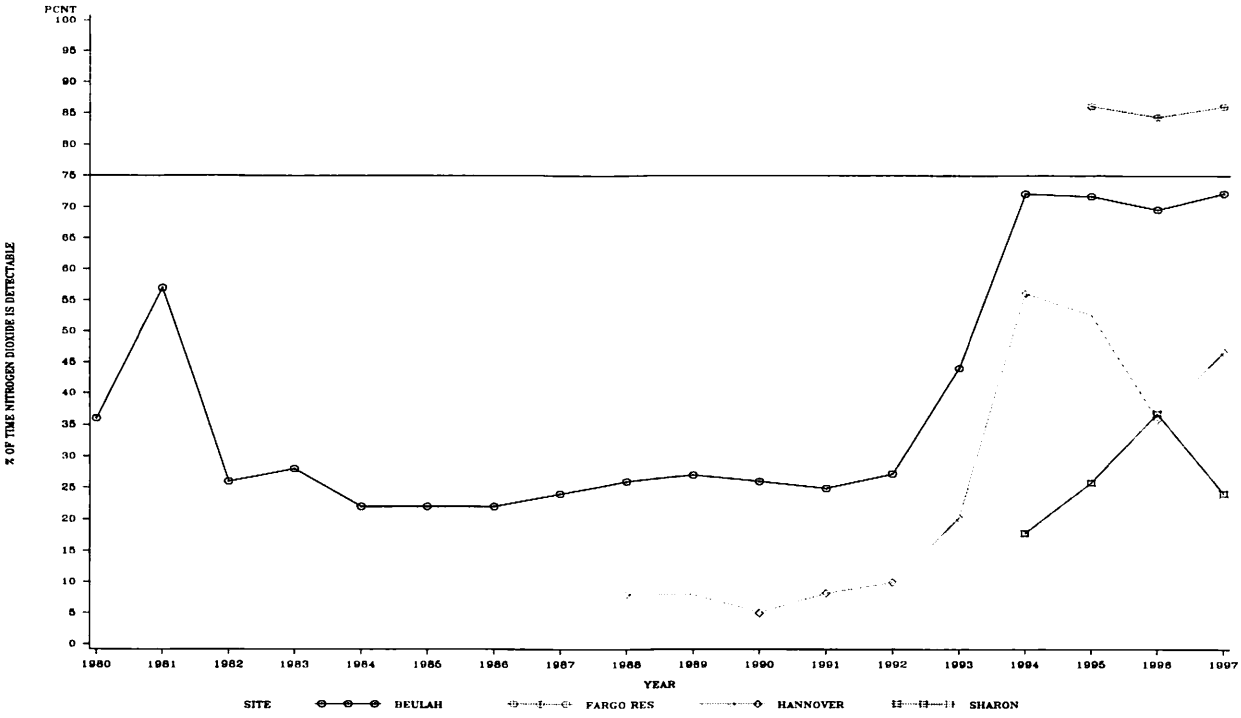

Figure 8 Percentage of Time NO_2 Detectable

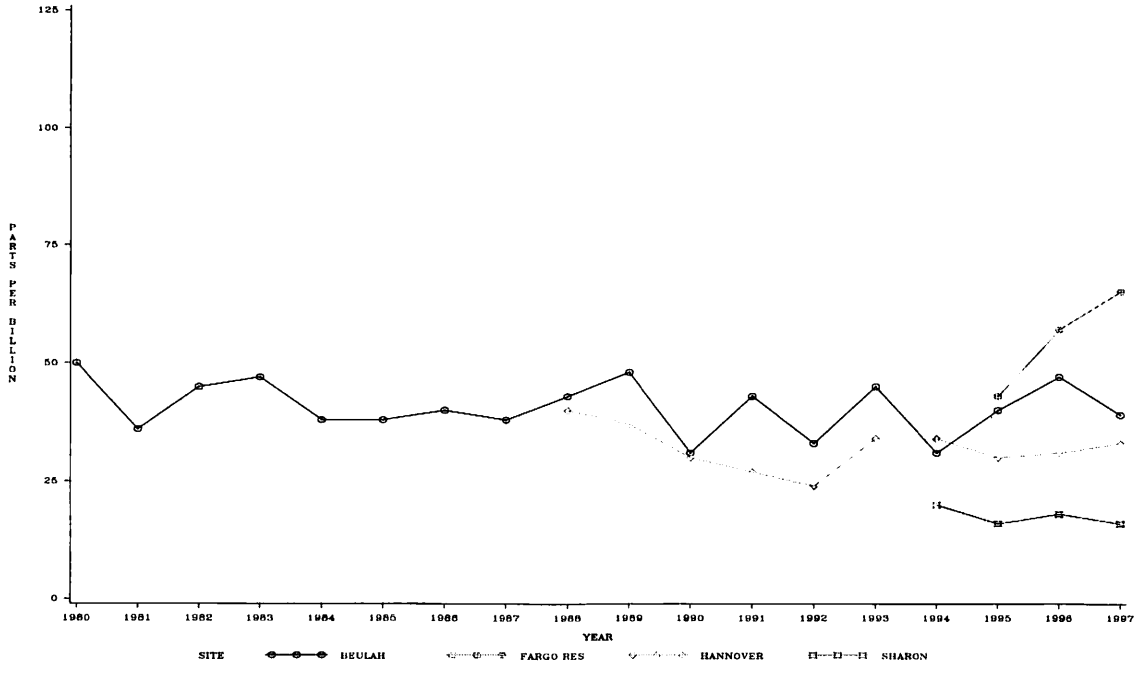

Figure 9 NO_2 Maximum 1-Hour Concentrations

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, at Beulah and TRNP - NU the O_3 analyzers are operated from April 1 through September 30 to collect two full quarters of data. The O_3 analyzers at Fargo, Hannover and Sharon 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 five continuous ozone analyzers in operation. These are at Beulah, Fargo, Hannover, Sharon, and Theodore Roosevelt National Park - North Unit. Table 8 presents 1997 1-hour and 8-hour data summaries. The most interesting aspect of the data is the similarity between the 1-hour and 8-hour averages. The greatest difference between any two pairs is eight parts per billion. This 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 1997.

TABLE 7

Major VOC Sources
(> 100 TPY)

1997

#	Name of Company	Type of Source	Location	County	VOC Emissions Ton/Year
1	Dakota Gasification Co.	Synthetic Fuel Plant	Beulah	Mercer	286
2	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	220
3	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	Mc Lean	206
4	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	161
5	Basin Electric Power Cooperative (Leland Olds)	Steam Electric Gen. Facility	Stanton	Mercer	153
6	Northern Sun	Sunflower Seed Processing	Enderlin	Ransom	106
7	Amoco Oil Company	Oil Refinery	Mandan	Morton	105

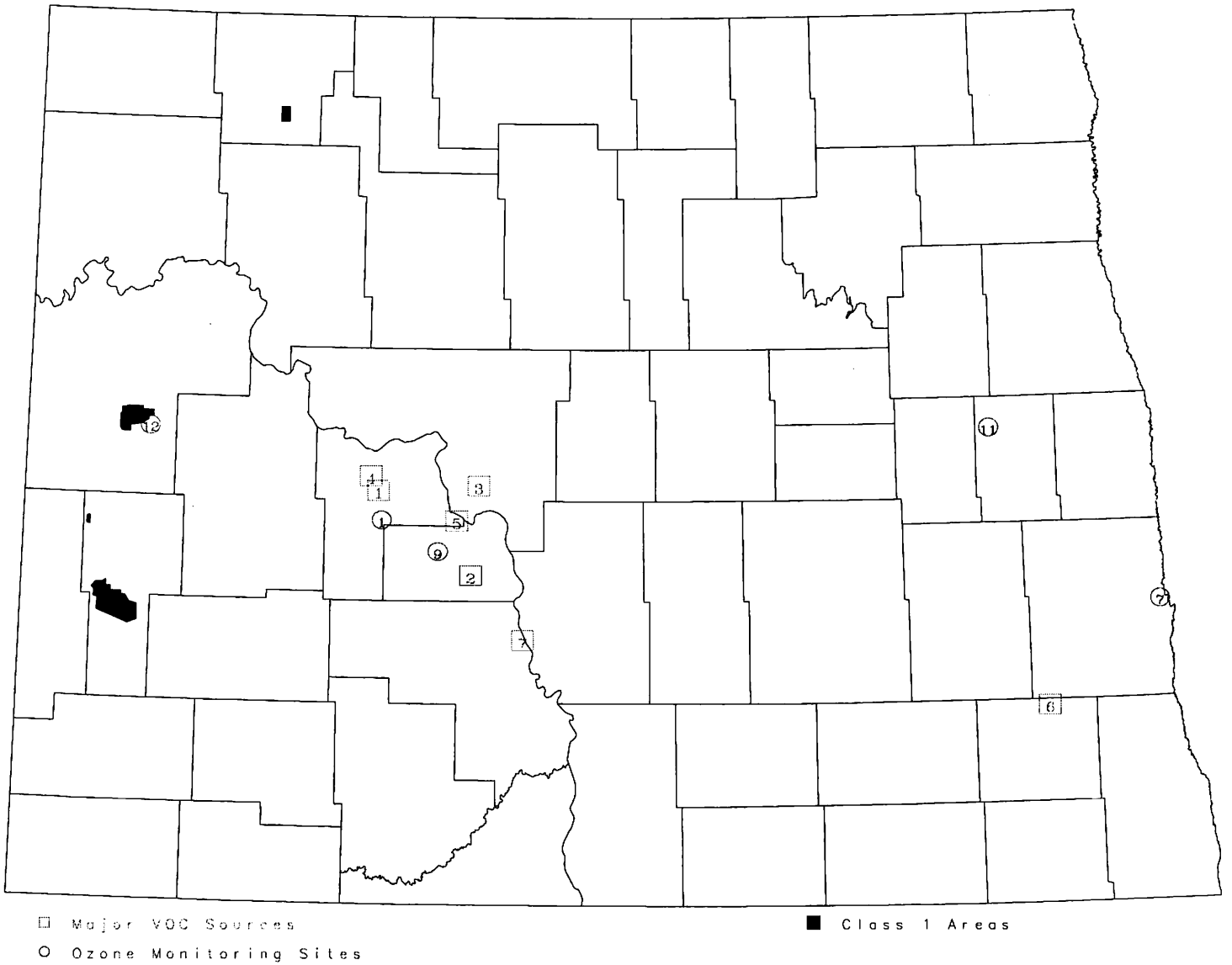

Figure 10 Major VOC Sources

TABLE 8

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

POLLUTANT : Ozone (PPB)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MAXIMUM 1-HOUR 1ST MM/DD/HH	2ND MM/DD/HH	3RD MM/DD/HH	MAXIMUM 8-HOUR 1ST MM/DD/HH	2ND MM/DD/HH	3RD MM/DD/HH	1HR #>120	8HR #>80
BEULAH	1997	APR-SEP	4373	74 06/12/10	73 06/12/11	71 06/11/10	71 06/12/08	65 06/12/09	65 06/12/07		
FARGO RESIDENTIAL	1997	JAN-DEC	8716	76 06/12/11	76 06/12/12	74 06/11/13	72 06/11/10	68 06/11/09	68 06/11/11		
HANNOVER	1997	JAN-DEC	8703	75 06/12/12	74 06/12/10	74 06/12/11	71 06/12/09	69 06/12/10	69 05/30/09		
SHARON	1997	JAN-DEC	8270	73 06/11/11	73 06/11/13	72 06/11/12	72 06/11/09	65 06/11/10	65 06/11/08		
TRNP - NU	1997	APR-SEP	4368	82 06/12/12	80 06/12/10	80 06/12/11	80 06/12/11	72 06/12/10	72 06/12/09		

The maximum 1-hour concentration is 82 ppb at TRNP - NU on 06/12/12
The maximum 8-hour concentration is 80 ppb at TRNP - NU on 06/12/11

* 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 average 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-NU 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 the TRNP - NU site.

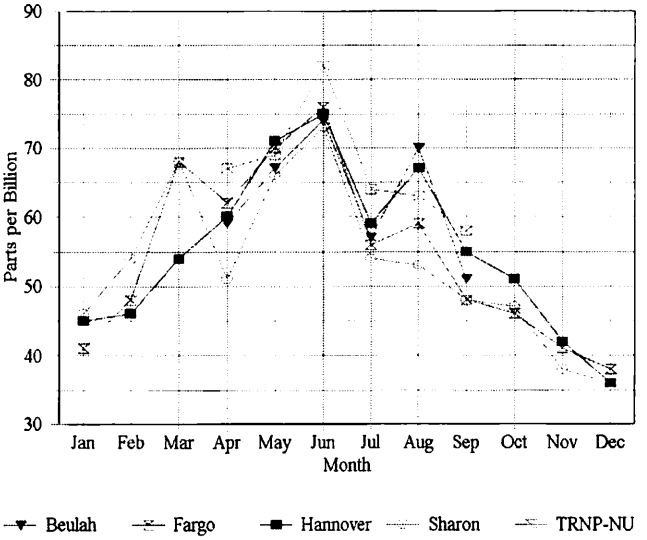

Figure 11 Maximum Ozone Concentrations

2.3.4 Network Analysis

Only one of the five 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 all seven of the major VOC sources in the state. TRNP- NU is located in a Class I area surrounded by oil fields. Fargo Residential is located in Fargo and influenced by city traffic. Sharon is located in a rural community 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 two hours of data collect higher than 80 ppb and neither of these exceeded 100 ppb.

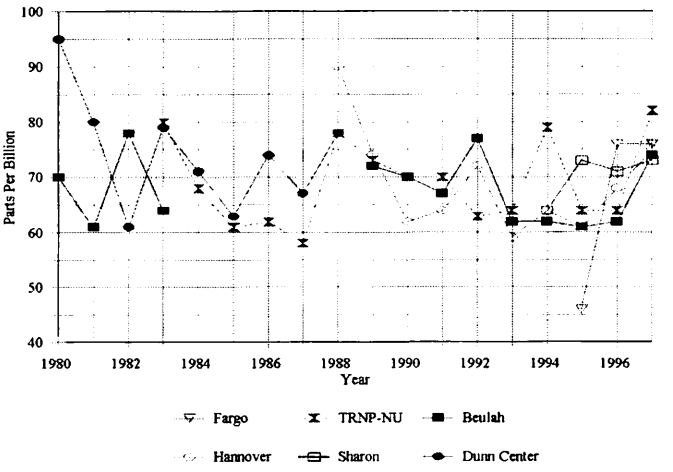

Figure 12. Maximum Ozone Concentrations

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 the department. 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 seven PM_{10} samplers at six sites and two $PM_{2.5}$ samplers; the Fargo site has collocated PM_{10} samplers. Since PM_{10} and smaller particles are of concern mainly because of their effects on people, monitoring efforts are concentrated in the state's population centers. Table 10 shows the inhalable PM_{10} particulate data summary and Table 11 shows the $PM_{2.5}$ particulate data summary.

Graseby Andersen Model 231-F $PM_{2.5}$ impactors are used on a PM_{10} sampler at the Bismarck and Beulah sites to collect $PM_{2.5}$ data. The first FRM $PM_{2.5}$ sampler will be colocated with the existing $PM_{2.5}$ sampler in Bismarck. This side-by-side comparison will help validate the existing $PM_{2.5}$ data.

TABLE 9

Major PM_{10} Sources
(> 100 TPY)

1997

#	Name of Company	Type of Source	Location	County	PM_{10} Emissions Ton/Year
1	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	Mc Lean	1,213
2	Dakota Gasification Co.	Synthetic Fuel Plant	Beulah	Mercer	1,129
3	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	953
4	Basin Electric Power Cooperative (Leland Olds)	Steam Electric Gen. Facility	Stanton	Mercer	559
5	Montana Dakota Utilities (Coyote Station)	Steam Electric Gen. Facility	Beulah	Mercer	433
6	Amoco Oil Company	Oil Refinery	Mandan	Morton	353
7	Minn-Dak Farmers Coop.	Sugar Beet Processing Plant	Wahpeton	Richland	336
8	American Crystal Sugar Co.	Sugar Beet Processing Plant	Hillboro	Traill	186
9	American Crystal Sugar Co.	Sugar Beet Processing Plant	Drayton	Pembina	164
10	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	115

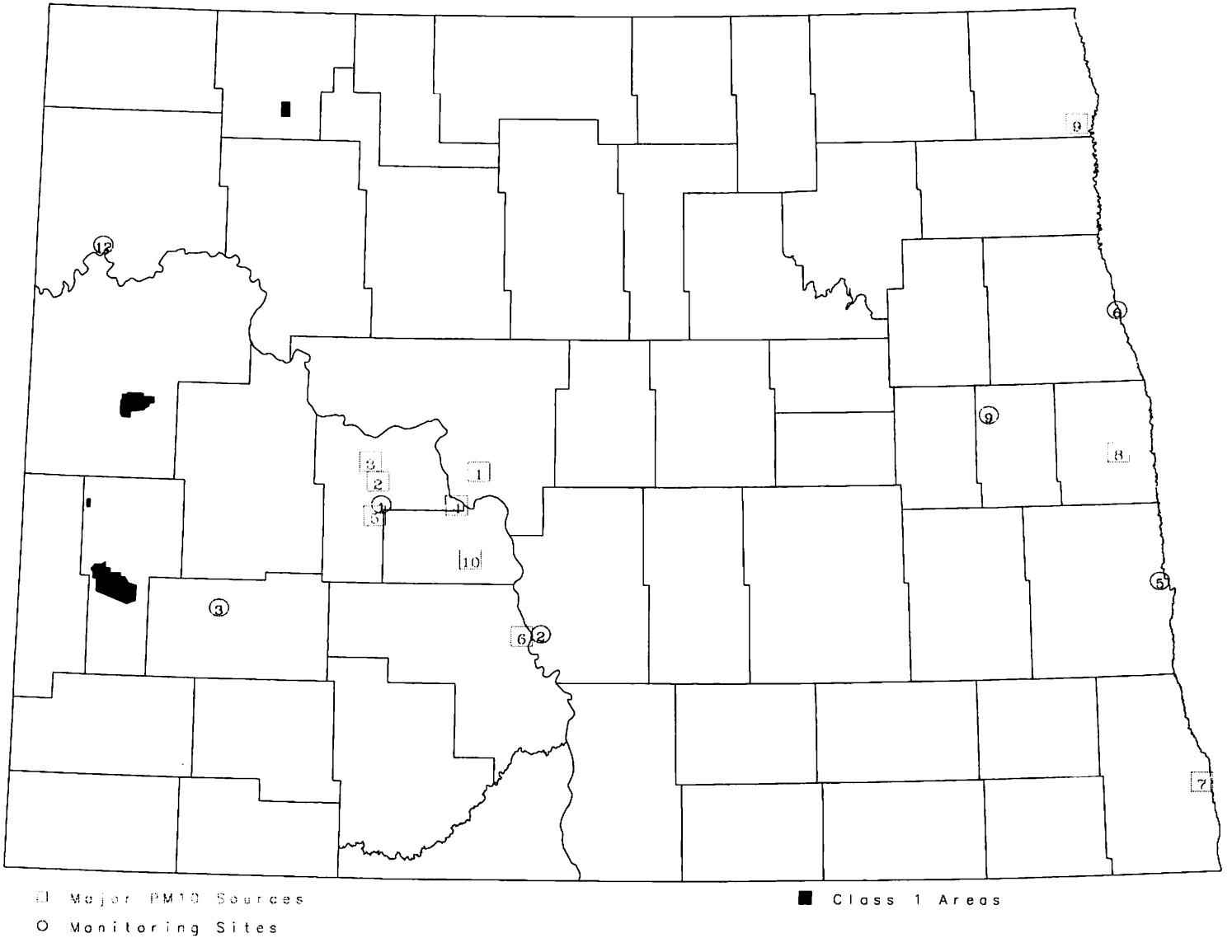

Figure 13 Major PM_{10} Sources

TABLE 10

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

POLLUTANT : Inhalable PM_{10} Particulates ($\mu g/m^3$)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAX 24-HOUR 1ST MM/DD	MAX 24-HOUR 2ND MM/DD	MAX 24-HOUR 3RD MM/DD	ARITH MEAN	#>150	AM>50	% >MDV
BEULAH	1997	JAN-DEC	55	4.0	31.8 10/01	30.3 05/16	28.2 08/02	13.2			100.0
BISMARCK RESIDENTIAL	1997	JAN-DEC	58	5.0	27.0 05/16	26.0 08/08	25.7 11/18	13.2			100.0
DICKINSON RESIDENTIAL	1997	JAN-DEC	49	1.1	28.7 05/16	23.7 09/25	23.3 10/01	11.0			81.6
FARGO RESIDENTIAL	1997	JAN-DEC	57	0.7	67.0 08/08	63.2 06/09	50.4 06/27	18.3			96.4
GRAND FORKS - NORTH	1997	JAN-DEC	54	5.5	81.7 06/09	64.4 08/08	59.8 05/04	22.8			100.0
SHARON	1997	JAN-DEC	61	1.2	47.6 10/01	37.0 06/09	33.1 05/28	13.1			90.1
WILLISTON RESIDENTIAL	1997	JAN-DEC	54	2.2	35.9 09/26	34.3 05/16	31.9 06/11	13.6			92.5

The maximum 24-hour concentration is 81.7 µg/m3 at GRAND FORKS - NORTH on 06/09

* 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.

*** Less than 80% of the possible samples (data) were collected.

TABLE 11

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

POLLUTANT : Inhalable $PM_{2.5}$ Particulates ($\mu g/m^3$)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAX 24-HOUR 1ST MM/DD	MAX 24-HOUR 2ND MM/DD	MAX 24-HOUR 3RD MM/DD	ARITH MEAN	% >MDV
BEULAH	1997	JAN-DEC	61	3.6	20.3 11/18	17.0 05/16	14.6 05/22	8.1	91.8
BISMARCK RESIDENTIAL	1997	JAN-DEC	58	5.0	19.0 11/18	18.5 05/16	17.2 05/10	10.2	100.0

The maximum 24-hour concentration is 20.3 µg/m3 at BEULAH on 11/18

* 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 Network Analysis

All sites, with the exception of Sharon, are population oriented urban scale sites: Sharon is a background regional scale site. Each site is located within the city limits of the respective cities. The population of the cities range from 119 (Sharon) to over 100,00 in the Fargo, ND-Moorhead, MN area. With this population range, it would be expected to see a wide range in both 24-hour and annual averages as well as a stratification following city population. Figures 14 and 15 show this is not the case. Figure 14 shows that Fargo maximums are about midrange while Bismarck, the third largest city, ranges from the highest ('87, '92, '93) to the lowest maximum ('97).

The annual means do demonstrate some stratification. Dickinson, Sharon and Williston are lower than Bismarck, Grand Forks, and Fargo. This stratification could be for two reasons. First, Dickinson, Sharon, and Williston are in predominantly farmland areas. Second, the reason for the higher average concentrations in Bismarck, Grand Forks, and Fargo is primarily due to anthropogenic activities like furnaces, gasoline engines, and fine dust particles from roadway surfaces. To help resolve this question, a PM_{10} sampler was added to the Beulah site which is a small city (pop. 3363) with three major sources within 10 miles. Also, many of the houses in town use coal for either primary or supplemental heat. If elevated concentrations are found in Beulah, it would be a good indication that combustion sources are the dominant source for fine particulates. Based on two years of data, combustion sources do not appear to be the major source of fine particulates. However, North Dakota has had three exceptional events since 1987, and all three have been associated with higher than normal winds. Since the PM_{10} heads are not efficient at rejecting particulates larger than 10 microns in aerodynamic diameter, these events were most likely caused by loading the filters with oversized particles.

Figures 16 through 19 present the Beulah and Bismark PM_{10}, $PM_{2.5}$, and $PM_{10}/PM_{2.5}$ ratios. In Figure 16, the 79.8 $\mu g/m^3$ on June 8 may be an anomaly, but after the filters are cut for sulfate analysis, there is no way to recheck the weights. In Figures 17 and 19, ratios greater than 100% were set to 100%. Most of these occurrences are when the concentrations are less than 10 $\mu g/m^3$. The dark line in these graphs represent the average percentage difference. It is interesting the ratio averages are within 10% of each other.

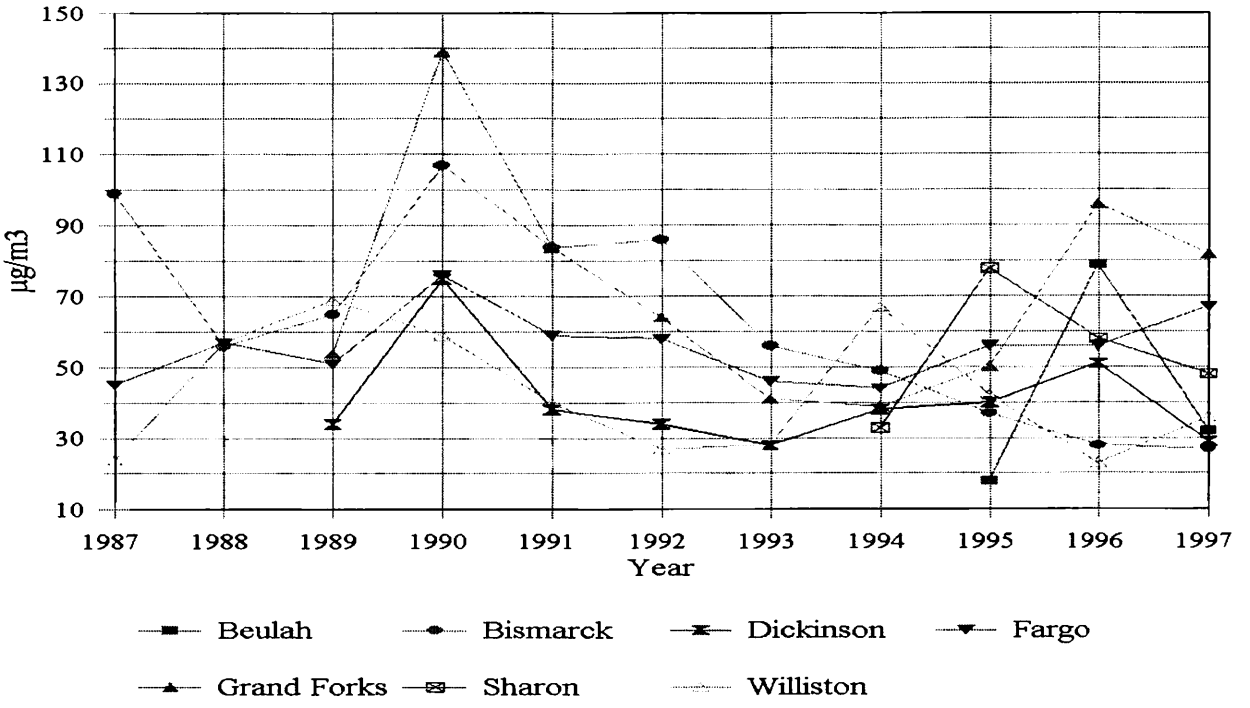

Figure 14 PM_{10} Maximum Concentrations

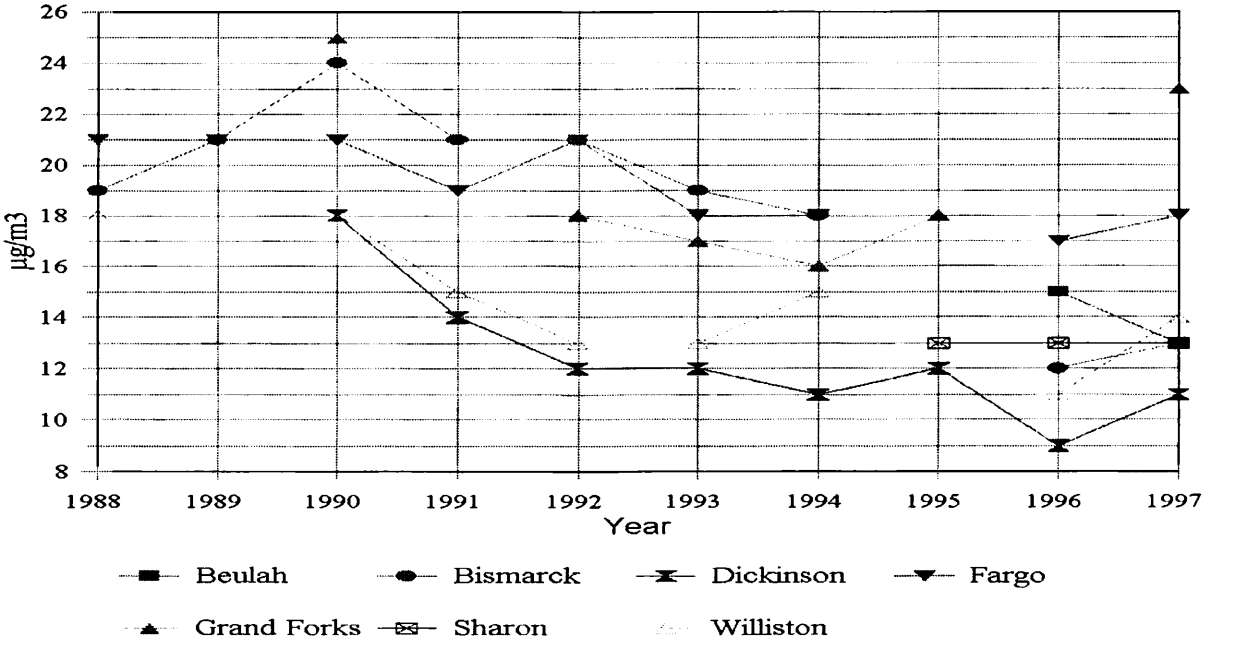

Figure 15 PM_{10} Annual Means

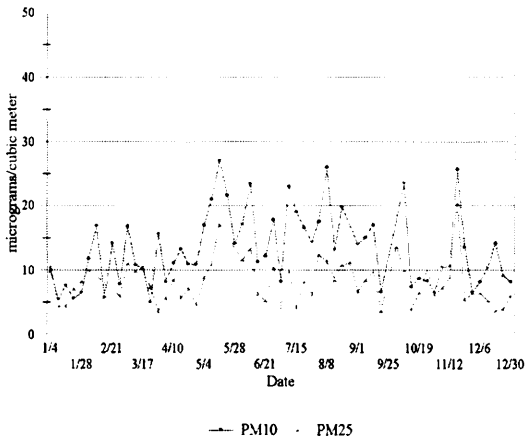

Figure 16 Beulah PM_{10} and $PM_{2.5}$ Data

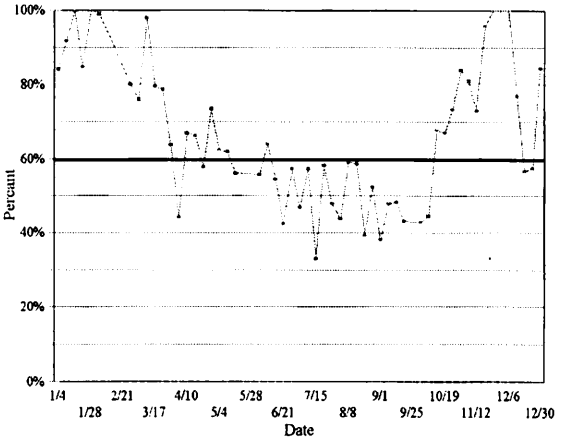

Figure 17 Beulah PM Ratio

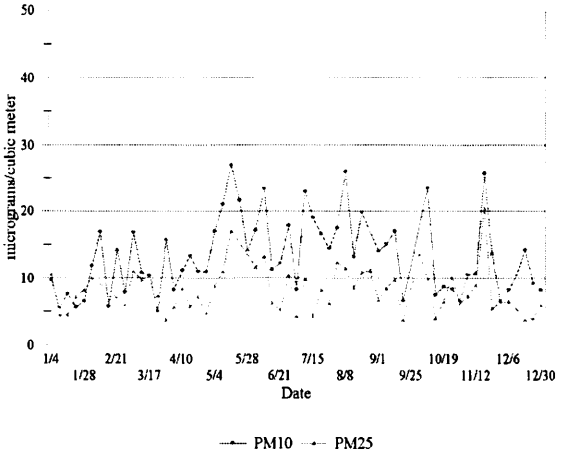

Figure 18 Bismarck PM_{10} and $PM_{2.5}$ Data

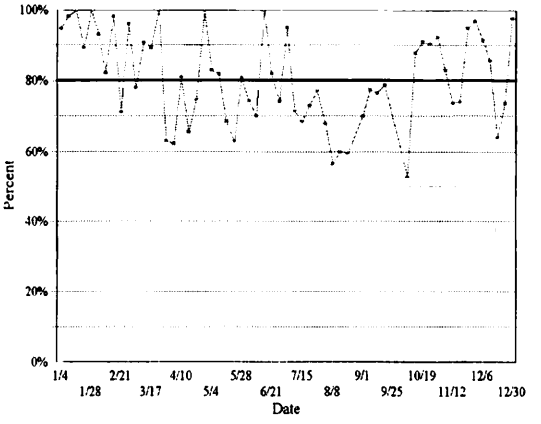

Figure 19 Bismarck PM Data

2.4.4 $PM_{2.5}$ 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 will 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 1998 for the 1999 calendar year.

In 1998 the eight PM2.5 sites will be established: three non-core required (Grand Forks, Fargo, Bismarck), two background/long range transport (Theodore National Park - South Unit, Sharon), one discretionary (Dickinson) and two high-emissions (Beulah, Short Creek - SPM). The non-core required sites will have R&P sequential samplers and collect data on the 1/3 day schedule. These three sites will be compared to both the 24-hour and annual NAAQS. The background/long range transport sites, the discretionary, and one high-emission site will have single day samplers and collect data on the 1/6 schedule. These sites will be compared to only the annual standard. The high-emission SPM site will have an R&P sequential sampler. The schedule has not yet been determined: It will start on a 1/6 schedule. After some data is collected and reviewed, the schedule may be changed to the 1/3 schedule.

Since the department as been collecting PM2.5 data with the G/A SA-231F impactor, The data at Bismarck has averaged 80 percent of the PM_{10} values. On March 24, 1998, an FRM R&P sampler began operation in Bismarck. On the limited data available, The FRM sampler is averaging 62 percent of the G/A impactor data. During the two years of G/A impactor data collected at Bismarck and Beulah, no sample was more than 39% of the 24-hour standard and the annual averages are less than 66 percent of the annual standard. Therefore, we do not expect to see any data approaching either the 24-hour or annual standard. We believe this justifies running the single-day samplers on the 1/6 schedule.

2.4.5 $PM_{2.5}$ 1998 Site Justification

Grand Forks: Required by the EPA as a non-CORE site. A sequential FEM $PM_{2.5}$ will be used at this site. The data collected will be compared to both the 24-hour and annual standards.

Fargo: Required by the EPA as a non-CORE site. A sequential FEM $PM_{2.5}$ will be used at this site. The data collected will be compared to both the 24-hour and annual standards.

Bismarck: Required by the EPA as a non-CORE site. A sequential FEM $PM_{2.5}$ will be used at this site. A duplicate FEM sampler will be at this site for the FEM

Network. The data collected will be compared to both the 24-hour and annual standards.

TRNP - SU: Designated as a background/long range transport site on the West end of the state. This site will identify the PM and its constituents entering the state from Montana. This site could be used as the long range transport site for astern Montana. The equipment at this site will include both an IMPROVE and an FRM $PM_{2.5}$ sampler. The data will be compared to only the annual standard.

Sharon: Designated as a background/long range transport site on the East end of the state. This site will identify the $PM_{2.5}$ add by activities in North Dakota and could serve as a background/long range transport site for Minnesota. An FRM $PM_{2.5}$ sampler will be used. The data will be compared to only the annual standard.

Dickinson: This site was selected as a discretionary site. It will have an FRM $PM_{2.5}$ sampler. The data will be compared to only the annual standard.

Beulah: Designated as a high emissions site because of the three major coal conversion facilities within seven miles. This site will have the duplicate FRM PM2.5 sampler for the single-day FRM network. The data will be compared to only the annual standard.

Short Creek: This site is a high emissions special purpose monitoring site to monitor the PM emissions from the Boundary Dam Power Plant in Canada. An FEM PM2.5 is planned for this site. Also, nylon filters will be used so sulfates and nitrates can be monitored. Because this a special purpose site, neither standard will be applied.

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 20 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)

1997

#	Name of Company	Type of Source	Location	County	CO Emissions Ton/Year
1	Dakota Gasification Co.	Synthetic Fuel Gen. Plant	Beulah	Mercer	2187
2	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	Mc Lean	1724
3	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	1349
4	MINN-DAK Farmers	Sugar Beet Processing Plant	Wahpeton	Richland	1164
5	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	1004
6	Basin Electric Power Coop. (Leland Olds)	Steam Electric Gen. Plant	Stanton	Mercer	820
7	Montana Dakota Utilities (Coyote Station)	Steam Electric Gen. Plant	Beulah	Mercer	446
8	American Crystal Sugar Co.	Sugar Beet Processing Plant	Drayton	Pembina	337
9	American Crystal Sugar Co.	Sugar Beet Processing Plant	Hillsboro	Pembina	312
10	Amerada Hess	Natural Gas Processing	Tioga	Williams	303
11	Northern Sun	Oil Seed Processing	Enderlin	Ransom	248
12	Amerada Hess - Hawkeye Station	Compressor station	---	McKenzie	156
13	Amoco Oil Co.	Oil refinery	Mandan	Morton	141

TABLE 12 (Cont.)

Major CO Sources
(> 100 TPY)

1997

#	Name of Company	Type of Source	Location	County	CO Emissions Ton/Year
14	University of North Dakota	Steam Heat	Grand Forks	Grand Forks	125
15	United Power Association	Steam Electric Gen. Facility	Stanton	Mercer	120
16	Bear Paw Energy - Alexander	Compressor Station	---	Billings	119
17	Montana Dakota Utilities (Heskett Plant)	Steam Electric Gen. Plant	Mandan	Morton	118
18	Bear Paw Energy - Demicks Lake	Compressor Station	---	McKenzie	115
19	Continental Resources - Medicine Pole Hills	Compressor Station	---	Bowman	109

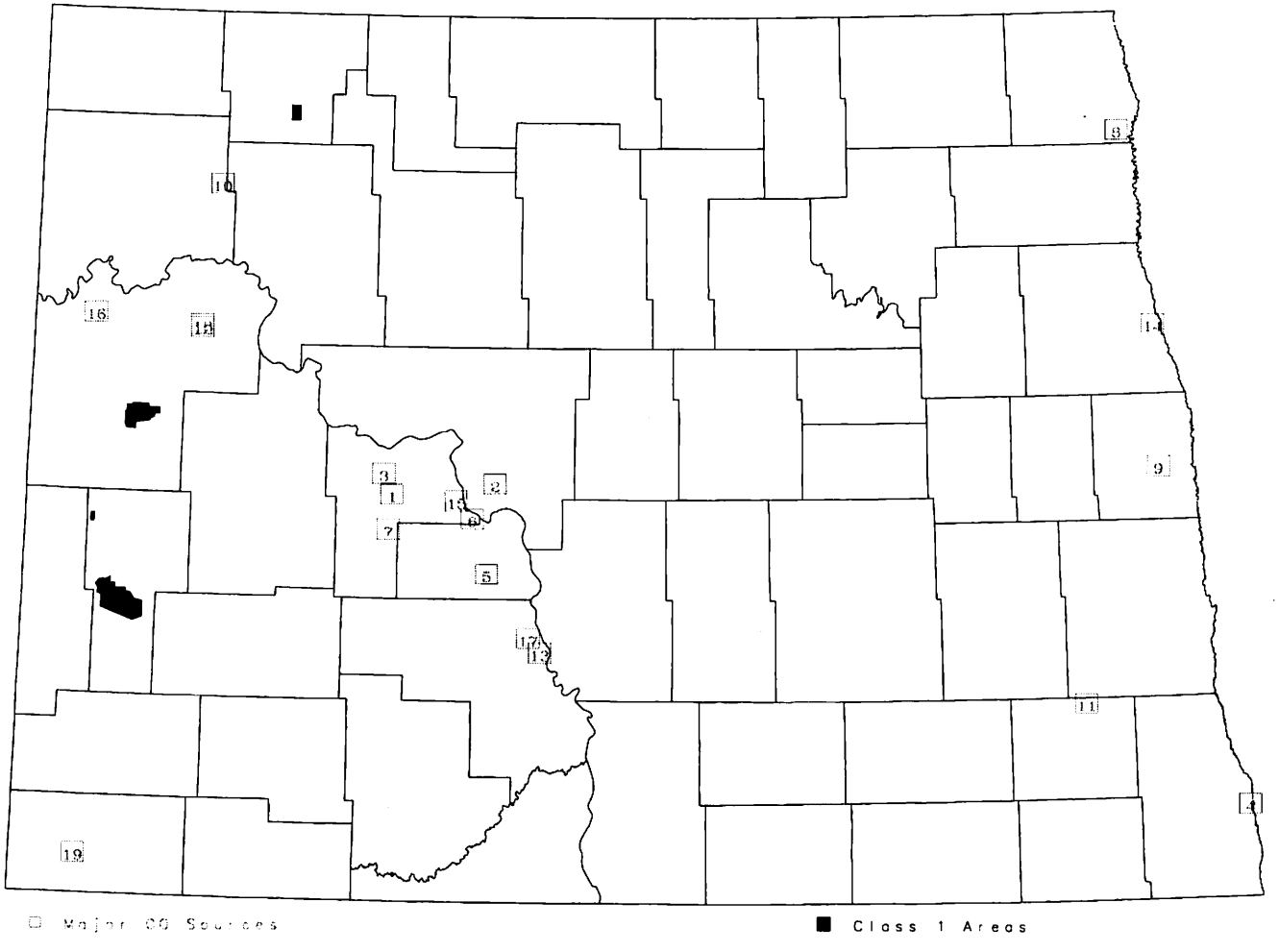

Figure 20 Major CO Sources

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

Currently two State-operated sites, TRNP-NU and Whiskey Joe - SPM, are monitoring for H_2S emissions. There are three industry-operated H_2S monitoring sites. Table 13 shows the 1997 H_2S data summaries.

TABLE 13

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

POLLUTANT : Hydrogen Sulfide (PPB)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MAXIMUM 1 - HOUR 1ST MM/DD/HH	MAXIMUM 1 - HOUR 2ND MM/DD/HH	MAXIMUM 24 - HOUR 1ST MM/DD	MAXIMUM 24 - HOUR 2ND MM/DD	MAXIMUM 3 - MONTH 1ST MM	MAXIMUM 3 - MONTH 2ND MM	ARITH MEAN	1HR #>200	24HR % #>100 MDV
AMERADA HESS - TIOGA #2	1997	JAN-DEC	8634	72 04/13/00	66 05/09/00	13 09/10	12 05/04	3 05	3 06	2.1		21.1
BEAR PAW - MGP #4	1997	JAN-DEC	7157	161 09/18/10	156 09/18/09	58 09/18	31 09/19	4 09	4 11	2.4		25.7
LITTLE KNIFE #5	1997	JAN-DEC	8407	144 05/12/04	118 07/21/20	21 07/20	20 07/21	4 07	3 12	3.1		45.8
TRNP - NU	1997	JAN-DEC	8231	29 02/18/21	25 02/18/20	4 02/18	3 02/19	1 03	1 12	1.1		5.1
WHISKEY JOE - SPM	1997	JAN-NOV	7923	400 04/03/19	355 11/09/18	65 04/11	56 10/19	15 11	13 04	10.6	38	38.1

The maximum 1-hour concentration is 400 ppb at WHISKEY JOE - SPM on 04/03/19
the maximum 24-hour concentration is 65 ppb at WHISKEY JOE - SPM on 04/11
The maximum 3-month concentration is 15 ppb at WHISKEY JOE - SPM on 11

* 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.

Since there are four oil fields with relatively sour gas (1 - 8 % H_2S) just north of the park with some sour gas flaring, and considering some of the problems the department has encountered in these four oil fields, it was decided that a monitoring site was justified along the north boundary of the park. This H_2S data will aid in identifying sources emitting elevated H_2S concentrations. The Notice of Violation filed for the Federal 1-7 well owned by Slawson Exploration, Inc., was satisfied and the Whisky Joe - SPM site was terminated in November.

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 ($PM_{2.5}$).

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 seven PM_{10} and two $PM_{2.5}$ samplers at six sites; the Fargo site has collocated samplers. Since sulfates have health effects such as decreased lung function in exercising adolescent asthmatics, efforts are concentrated in the state's population centers. 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. Tables 14 and 15 show the inhalable particulate sulfate data summaries with Tables 16 and 17 showing the ratios of sulfates to total mass for each sample.

2.8.3 Network Analysis

All sites, with the exception of Sharon, are population oriented urban scale sites: Sharon is a background regional scale site. Each site is located within the city limits of the respective cities. The population of the cities range from 119 (Sharon) to over 100,000 in the Fargo-Moorhead, MN area. The pattern seen in both averaging periods for the four highest concentrations for the PM_{10} and $PM_{2.5}$ samples closely follows the proximity of major sources/high-sulfur fuel usage sources. For the PM_{10} sulfates, only three of the sites met the 75% data recovery criteria for calculating unbiased statistics and all three of these sites are in the top four sites for both 24-hour and annual averages. For the $PM_{2.5}$ sulfates, both sites met the 75% data recovery for calculating statistics. The samplers at Beulah are within eight miles of three major point sources and within 32 miles of eight major point sources. Also, many homes in Beulah use coal as either primary or supplemental heat during the heating season.

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 2.8% to 81.0%. The averages for all samples collected range from to 12.7% to 20.4%. The highest 24-hour and annual average ratio for sites collecting at least 75% of possible samples is at Beulah. The $PM_{2.5}$ sulfates to $PM_{2.5}$ total mass appears to reflect the proximity to major sources. The Bismarck site is within seven miles, East-southeast of two major SO_2 point sources. A factor that is not considered is the effect of the combinations of chemical reactions that may occur in the sulfate formation process. Because the necessary information to quantify the speed of transformation from SO_2 to $SO_4^=$, this process is not addressed.

With the limited amount of data available, the most surprising information is the average sulfate concentrations for the Beulah and Bismarck PM_{10} and $PM_{2.5}$ samplers are similar. With that similarity, one would expect the ratios for the $PM_{2.5}$ samplers to be much higher. The Bismarck site appears to exhibit this trait, however, less than 75% of the possible data is available, making a valid comparison impossible.

Table 14

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

POLLUTANT : PM_{10} Sulfate (µg/m3)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAX 1ST MM/DD	MAX 2ND MM/DD	MAX 3RD MM/DD	ARITH MEAN
BEULAH	1997	JAN-DEC	57	0.5	7.2 11/18	6.2 01/04	5.5 05/22	2.2
BISMARCK RESIDENTIAL	1997	JAN-DEC	58	0.3	7.8 11/18	5.6 02/09	4.9 12/06	2.0
DICKINSON RESIDENTIAL	1997	JAN-DEC	49	0.4	4.7 06/09	3.8 05/22	3.0 03/17	1.6
FARGO RESIDENTIAL	1997	JAN-DEC	57	0.1	6.6 03/05	5.2 06/09	4.6 02/09	2.1
GRAND FORKS - NORTH	1997	JAN-DEC	54	0.1	6.3 02/03	5.1 06/09	4.9 03/23	2.0
SHARON	1997	JAN-DEC	61	0.4	5.0 02/09	4.8 06/09	3.8 02/03	1.7
WILLISTON RESIDENTIAL	1997	JAN-DEC	54	0.4	6.5 01/04	6.4 06/11	6.2 11/18	1.8

The maximum 24-hour concentration is 7.8 µg/m3 at BISMARCK RESIDENTIAL on 11/18

* No standard is currently in effect.

Table 15

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

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

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAX 1ST MM/DD	MAX 2ND MM/DD	MAX 3RD MM/DD	ARITH MEAN
BEULAH	1997	JAN-DEC	61	0.5	6.6 01/04	6.6 11/18	5.5 05/22	2.2
BISMARCK RESIDENTIAL	1997	JAN-DEC	58	0.3	7.5 11/18	6.0 01/04	5.1 02/09	2.2

The maximum 24-hour concentration is 7.5 µg/m3 at BISMARCK RESIDENTIAL on 11/18

* No standard is currently in effect.

Table 16

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	MAX 1ST MM/DD	MAX 2ND MM/DD	MAX 3RD MM/DD	ARITH MEAN
BEULAH	1997	JAN-DEC	55	4.0	81.0 12/06	49.6 01/04	45.0 01/16	20.4
BISMARCK RESIDENTIAL	1997	JAN-DEC	57	3.7	59.8 12/06	47.4 01/16	41.7 01/04	17.9
DICKINSON RESIDENTIAL	1997	JAN-NOV	39 ***	3.4	41.1 01/28	36.4 04/04	36.2 03/11	15.5
FARGO RESIDENTIAL	1997	JAN-DEC	54	2.3	57.1 12/06	38.0 01/10	36.4 01/04	17.1
GRAND FORKS - NORTH	1997	JAN-DEC	53	2.5	52.2 12/18	30.3 10/25	28.9 02/09	12.7
SHARON	1997	JAN-DEC	53	2.8	63.0 03/11	50.7 02/03	46.6 11/30	18.2
WILLISTON RESIDENTIAL	1997	JAN-DEC	49	2.8	49.6 01/04	46.2 11/08	39.1 03/11	15.5

The maximum 24-hour ratio is 81.0 percent at BEULAH on 12/06

* No standard is currently in effect.

*** Less than 80% of the possible samples (data) were collected.

Table 17

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

POLLUTANT : $PM_{2.5}$ Sulfate/PM_{25} Total Mass Ratio (PERCENTAGE)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAX 1ST MM/DD	MAX 2ND MM/DD	MAX 3RD MM/DD	ARITH MEAN	#>15..	% >MDV
BEULAH	1996	JAN-DEC	46	4.5	65.8 12/17	56.6 11/05	38.7 04/09	21.8		0.0
BISMARCK RESIDENTIAL	1996	JAN-DEC	43 ***	3.9	72.5 11/29	57.4 12/05	55.4 12/29	20.2		0.0

The maximum 24-hour ratio is 72.5 percent at BISMARCK RESIDENTIAL on 11/29

* No standard is currently in effect.

*** Less than 80% of the possible samples (data) were available.

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)

Neither the State nor 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 - 612 ppb (224%); 3-hour - 288 ppb (57.6%); 24-hour - 104 ppb (105%); annual (partial year) - 1.7 ppb (7.4%); annual (full year) - 7.5 ppb (32.6%).

There is no SO_2 5-minute standard currently in effect. The maximum 5-minute average was 348 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 (partial year) - 7.9 ppb (14.9%); annual (full year) - 4.3 ppb (8.1.0%).

3.3 Ozone (O_3)

Neither the State nor Federal standard was exceeded during the year. The maximum concentration and the maximum concentration expressed as a percentage of the applicable standard is 82 ppb (68.3%).

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 - 81.7 $\mu g/m^3$ (54.5%); annual - 22.8 $\mu g/m^3$ (45.0%).

There is no $PM_{2.5}$ standard currently in effect. The maximum 24-hour average $PM_{2.5}$ concentration was 20.3 $\mu g/m^3$.

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 - 400 ppb (200%); 24-hour - 65 ppb (65%); 3-month - 15 ppb (75%).

3.8 Inhalable Particulate Sulfates

There are no inhalable particulate sulfate standards. The maximum PM_{10} 24-hour and annual concentrations are 7.8 $\mu g/m^3$ and 2.2 $\mu g/m^3$, respectively The maximum $PM_{2.5}$ 24-hour and annual concentrations are 7.5 $\mu g/m^3$ and 2.2 $\mu g/m^3$, respectively.

Table 18 summarizes the evaluations for each of the sites in the State network. The justification for each site is contained in the AIRS-AQS data subsystem on the site level records. Justification for each parameter at each site is contained in the monitor level records.

TABLE 18
Monitoring Site Evaluation

Site	Parameter*	Meets Needs	Modification Needed	New Site Needed	Parameter Not Needed	Date Deleted
Beulah Residential	SO_2	X				
	NO_2	X				
	O_3	X				
	$PM_{2.5}$	X				
	PM_{10}	X				
	MET	X				
Bismarck Residential	PM_{25}	X				
	PM_{10}	X				
Dickinson Residential	PM_{10}	X				
Dunn Center Rural	SO_2	X				
	MET	X				
Fargo Residential	PM_{10}			X		
	SO_2			X		
	NO_2			X		
	O_3			X		
	MET			X		
Sharon	SO_2	X				
	NO_2	X				
	O_3	X				
	MET	X				
	PM_{10}	X				
Hannover Rural	SO_2	X				
	NO_2	X				
	O_3	X				
	MET	X				
Mandan Refinery (SPM)	SO_2	X				
	SO_2 (5-min)	X				
	MET	X				
TRNP-NU	SO_2	X				
	O_3	X				
	H_2S	X				
	MET	X				
TRNP-SU	SO_2				X	Sept 30
(Whiskey Joe - SPM)	H_2S				X	Nov 30
	MET				X	Nov 30
Williston Residential	PM_{10}	X				

*** MET refers to meteorology and indicates wind speed, wind direction, and temperature data are available from those sites.**