Boundary Expansion Feasibility Assessment

Prepared for the Peace Airshed Zone Association (PASZA)
By Amarok Consulting and Focus Corporation

December 2006

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Contents

1. Introduction

In November 2005, in response to a request from Alberta Environment, the Peace Airshed Zone Association (PASZA) agreed to undertake a feasibility assessment to expand its boundaries to include areas formerly under consideration for a North Central Airshed Zone (See Figure 1). The assessment would also consider other areas to the south, east and north of PASZA's present boundaries.

This report summarizes the feasibility assessment conducted for the Peace Airshed Zone Association by Amarok Consulting in Partnership with the Focus Corporation. It will provide the PASZA board of directors the information they need to make a decision to expand the Peace Airshed's boundaries.

The feasibility assessment also includes a separate scenario for the originally proposed North Central Airshed. This scenario will ensure that the stakeholders in this area are provided with the information needed to make a decision on a path forward after the feasibility assessment is complete, regardless of whether or not PASZA decides to expand.

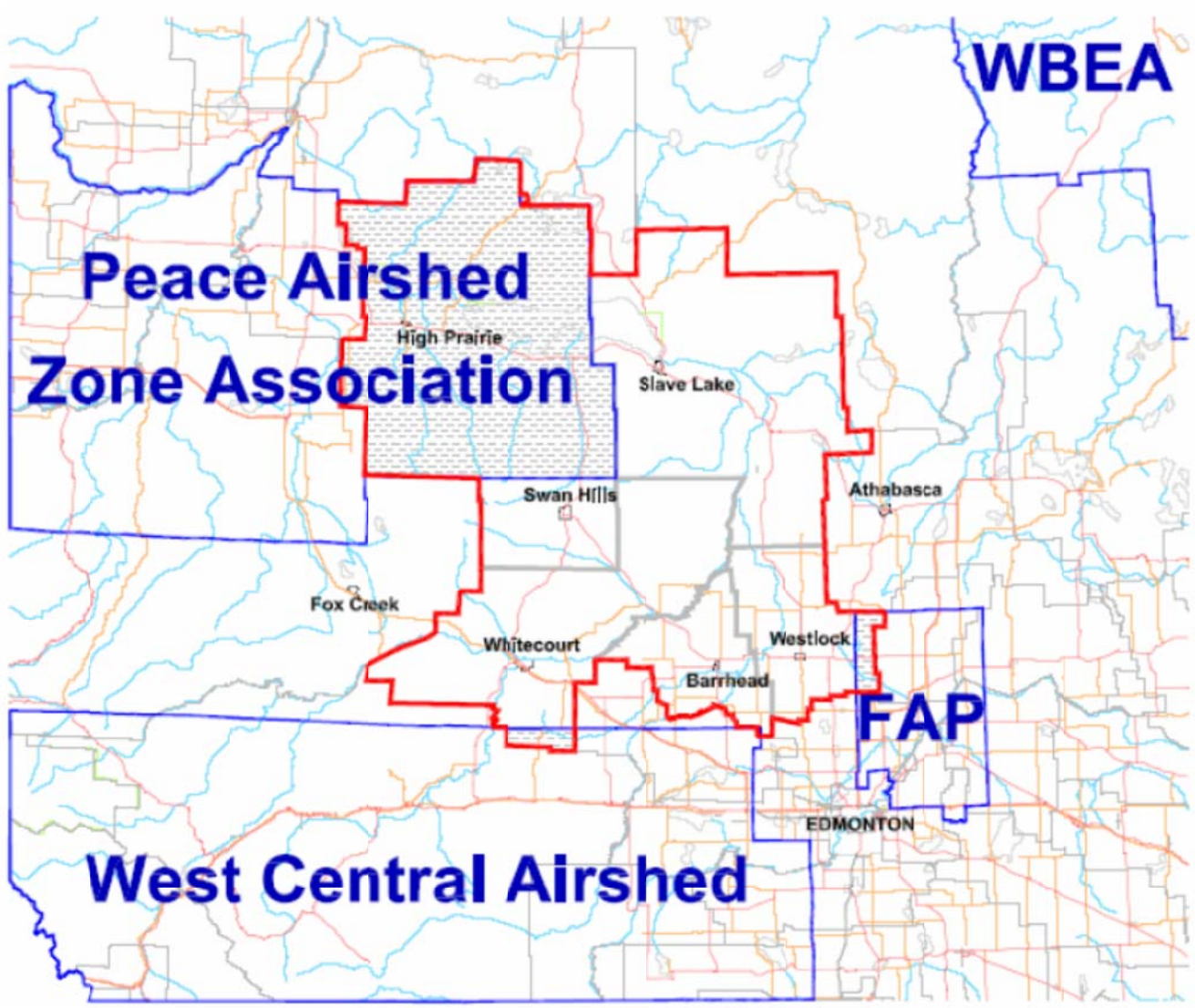


Figure 1: Proposed North Central Airshed Zone Boundaries (Red)

2. Background & History

2.1 Peace Airshed Zone Association

The Peace Airshed Zone Association (PASZA) is a multi-stakeholder non-profit organization consisting of industry, local government, environmental organizations, Alberta Environment, Alberta Energy & Utilities Board, the local health authority, and members of the public. PASZA was formed in March 1999 in response to concerns over air quality in the Grande Prairie Region. PASZA was the fifth airshed management zone formed in the province. The PASZA Mission Statement is:

> *The Peace Air Shed Zone Association will create and implement a process that provides relevant, scientifically credible information to stakeholders who will use the information to ensure continuous improvement of regional air quality, protect environmental health, and influence policy.*

Incorporated under the Societies Act, PASZA operates under guidelines put forth in the Clean Air Strategic Alliance's (CASA) Zone Air Quality Management Guidelines, including management by consensus, representation from affected stakeholders and public accessibility to data and information from its monitoring activities. Air Quality Management Zones are a key component in CASA's strategy for the management of air quality within Alberta.

This Peace Airshed Zone covers a 38,500 square kilometer area of northwestern Alberta, stretching from the Peace River south to the top of Township 64 and includes the area's two major population centres, Grande Prairie and High Prairie (see Figure 2). Approximately 85,000 people live and work in this area. The zone's major industries are oil and gas processing, forestry, agriculture and tourism.

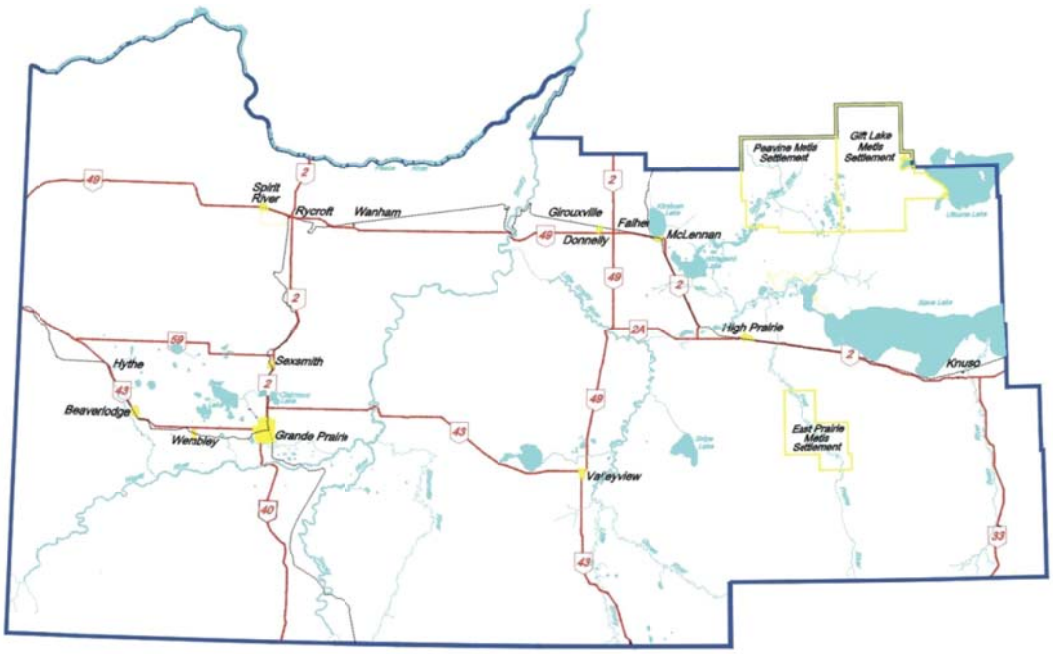


Figure 2: Peace Airshed Zone Boundaries

2.1.1 Regional Air Quality Monitoring Program

The primary purpose of the PASZA Regional Air Quality Monitoring Program is to provide stakeholders with a better understanding of the air quality within the zone, a first step in the process of developing, implementing, and evaluating strategies to "ensure continuous improvement of regional air quality, protect environmental health, and influence policy". It has been operating since July 2002 when the establishment of a 49 Station Passive Air Monitoring Network whose stations are distributed relatively homogenously throughout the airshed.

In June 2004, after a review of data collected by the network from August 2002-April 2003 indicated that results at six stations were redundant with those collected at nearby stations, the network was reduced from 49 to 43 stations. The locations of the 43 stations are indicated in Figure 3.

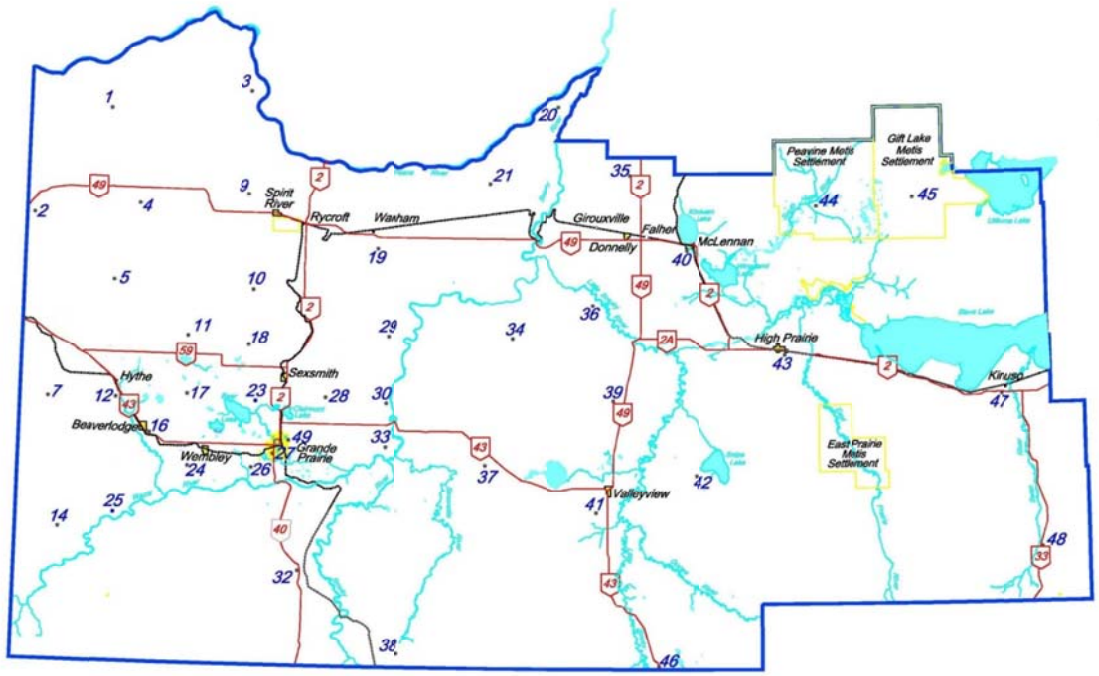


Figure 3: PASZA Passive Monitoring Network

In January 2004, the Alberta Environment-issued operating approvals of sixteen oil and gas member facilities were amended to reflect their funding and support for the regional monitoring program. The requirements to conduct facility-specific static ambient air quality monitoring for these facilities were removed.

In February 2004, the operation of the continuous monitoring component of the program began with the start-up of the Henry Pirker Continuous Monitoring Station located in Grande Prairie's Muskoseepi Park (see Figure 4). The continuous program was enhanced further with the startup of two more stations in early 2005: the Evergreen Park station located on the southeast boundary of Grande Prairie and the Smoky Heights station located approximately 40 km. northeast of Grande Prairie. It was also at this time that the operating approvals for seven of eight member oil and gas facilities who had participated in a joint application submitted to Alberta Environment in July 2004 received amendments to their operating approvals that

recognized their participation in the continuous monitoring portion of the PASZA Regional AQM Program.

In April 2005, PASZA took over the operations of the Beaverlodge station. This is an existing AQM Station located near the community of Beaverlodge at the Agriculture Canada Research Farm and had previously been operated by Alberta Environment continuously for over two decades providing usable data both from a historical and a provincial monitoring perspective.

In 2006 two more continuous monitoring stations were added to the program. The Valleyview station is located approximately 14 km southeast of Valleyview where, similar to the Smoky Heights Station, passive monitoring has indicated that annual average ground-level concentrations of Sulphur Dioxide are among the highest observed in the zone. Significant ground-level concentrations of Nitrogen Dioxide are also present in this area due primarily to the vehicle emissions associated with Highway 43. The station utilizes an existing industry-operated station already located at the site.

The Rover Station is a portable trailer that will eventually be equipped to monitor a broad range of air quality parameters and is designated as the zone's second human health "superstation". It will be moved to various locations in the zone where the passive monitoring program has indicated high levels of sulphur dioxide, nitrogen dioxide or ozone. The first designated site is located in the vicinity of Falher where operations began in late August. This site was selected based on significant levels of ground-level ozone concentrations as indicated by the passive monitoring network.

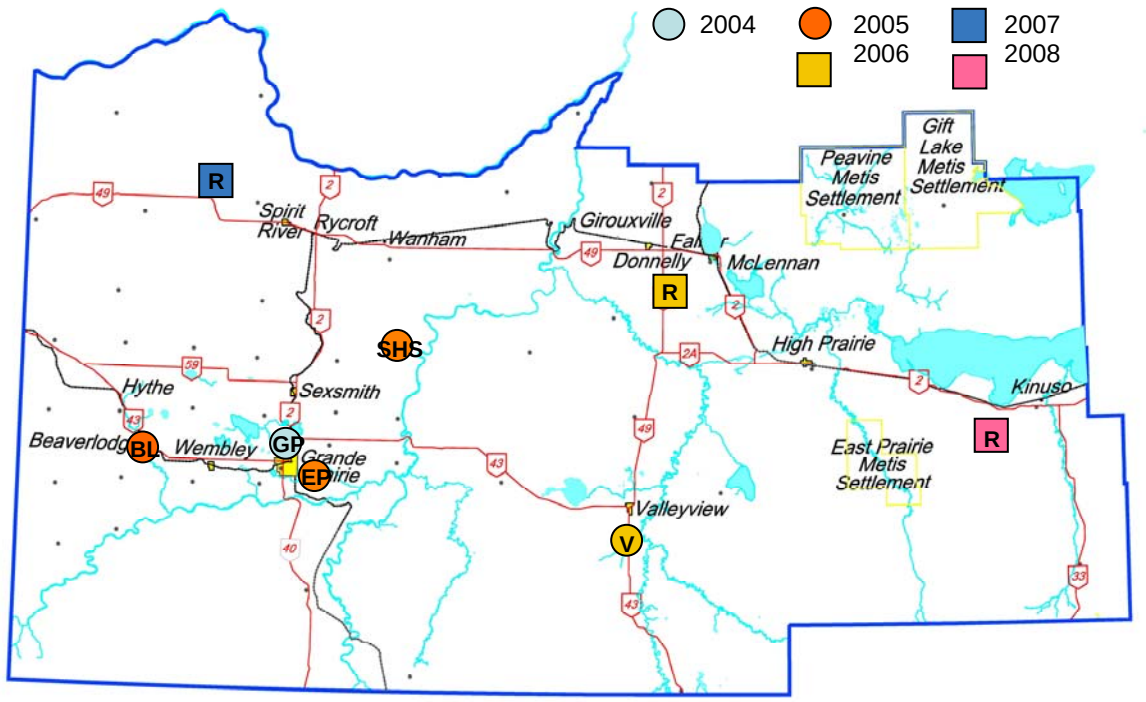


Figure 4: Peace Airshed Zone Association Continuous Monitoring Locations

2.1.2 Boundary Expansion

Boundaries for an airshed in the Grande Prairie area were first proposed in December 1998 in a report by Jacques Whitford (JW) commissioned by the Alberta Energy Company West (AEC West). The boundaries used in the report can roughly be defined as 54.2° and 56.8° latitude 118° and 120° longitude.

PASZA's present boundaries were finalized in early 2002 after approximately two years of discussions with regional industrial, public and administrative stakeholders. The discussions used the JW Report as a starting point but ending with a much greater east-west orientation.

In March 2004, PASZA received a request from one of its municipal members, the M.D. of Big Lakes, to consider expanding its boundaries to include all of the M.D. The M.D. was concerned that an airshed being proposed for the Whitecourt-Swan Hills-Westlock region (discussed later) would require it to provide resources for two airsheds instead of just one.

In reviewing the request, PASZA decided that a feasibility study was needed to study the implications and requirements of the requested boundary expansion plus additional expansion

scenarios. After receiving the technical committee's proposal and budget for the study in June 2004, the PASZA Board of Directors decided that PASZA would not pursue any further expansion of its boundaries at the time. The board indicated that the completion of the establishment of the Regional Air Quality Monitoring Program was to remain the focus of the organization although it was acknowledged that the boundaries were not static and could be reviewed in the future once the program was firmly established.

In September 2005, Alberta Environment approached PASZA's Board of Directors with a request that PASZA consider expanding the zone's southern boundaries to include areas that were previously under consideration for an airshed that AENV was trying to facilitate in the Whitecourt-Swan Hills-Westlock area. A small committee of PASZA stakeholders and support staff was formed to develop a proposal to conduct a feasibility assessment for this expansion with other scenarios that included other areas north, south and east of PASZA's current boundaries. The resulting proposal was put forward to Alberta Environment in November 2005 and after discussions in January 2006 finalized the scope of the feasibility assessment, the work began.

2.2 North Central Airshed Zone

In June 2003, The Town of Swan Hills, Woodlands County and the Swan Hills Special Waste Liaison Committee requested that Alberta Environment review a proposal by the Focus Corporation for the development of an airshed in North Central Alberta. A grant of $70,000 was requested from Alberta Environment to fund this. Alberta Environment declined the request but offered to contribute some funding to the project as well as in-kind support inventorying approved source facilities and ambient monitoring in the region.

The inventory was completed and a grant for $10,000 was provided and is being held in trust by Woodlands County. A steering committee was formed by regional stakeholders with representation for oil and gas and forestry companies, local municipalities, Alberta Environment and non-government organizations. From this committee, a technical subcommittee and a communications subcommittee were formed.

In the summer and fall of 2004, the technical committee developed a request for proposals to complete a feasibility assessment for the development of a North Central Airshed Zone (See Figure 1). This request was released in November 2004 and proposals were received in December.

In November 2004, a general open house aimed at securing and involving public members was held with no public showing up. Other attempts to engage the public made through May 2005 were equally unsuccessful.

In June 2005, the North Central Airshed Zone Steering Committee saw the need to make a decision on whether or not to move forward and hire a consultant to formulate a development plan. A funding call was made, but was unsuccessful resulting in commitments totaling less than half the cost of the feasibility assessment.

Based on the shortfall and other considerations, Alberta Environment concluded that although there was some interest in the area to initiate the formation of an airshed, there may not have been enough resources to accommodate three separate airsheds, the West Central Airshed Society (WCAS), the Peace Airshed Zone Association (PASZA) and a North Central Airshed Zone (NOCAZ).

Money originally collected for NOCAZ feasibility assessment was sent back to the contributing organizations.

As there was still the desire for a regional air quality monitoring program in this area, alternative options were explored, including the possible expansion of the Peace Airshed Zone Association (PASZA) boundaries to include portions, or all of, the North Central region. As reported earlier, in November 2005, after discussions with Alberta Environment, PASZA agreed to undertake a feasibility study to determine the viability of the various options concerning an airshed zone for the North Central Region.

3. Issues Identification

The priority air quality issues previously identified by members of the Peace Airshed Zone Association are:

- Human Health
- Crop & Vegetation Effects
- Intensive Livestock Operations

The parameters monitored by the continuous and passive components of the air quality monitoring program can provide PASZA's stakeholders with data required to gain a better understanding of these issues and the effects of strategies that may be put into place by the association's stakeholders to address these issues.

In determining the boundaries for an airshed and designing a monitoring program its is important to become familiar with the air quality issues of concerns of the region's stakeholders. To this end, a series of public meetings and interviews with some of the key regional stakeholders were undertaken in early 2006.

3.1 Issues Identification Meetings

In March 2006, the Peace Airshed Zone Association hosted a series of public meetings located in the areas under consideration by the Boundary Expansion Feasibility Assessment. The meetings were held over a period of four evenings from March 13-16.

March 13	Slave Lake	Northern Lakes College
March 14	Peace River	Provincial Building
March 15	Swan Hills	Keyano Centre
March 16	Whitecourt	Woodlands County Office

The purpose of the meetings was to inform regional stakeholders, especially the public, about the Peace Airshed's Boundary Expansion Initiative and solicit their input identifying air quality concerns that could be addressed by a regional air quality monitoring program and other issues or concerns that should be accounted for in the development of an airshed in their region.

The agenda developed for the meetings consisted of a presentation about PASZA and its Boundary Expansion Initiative, followed by a round-table brainstorming session. During a break the meeting facilitators grouped the issues and concerns identified in the session into common themes. The attendees then participated in an exercise prioritizing the issues by allowing them to assigned weightings to the various themes of their choice.

The Slave Lake Meeting resulted in 10 attendees and a representative cross-section of all four main stakeholder groups: government, industry, non-government organizations and the public in attendance. The priority issues and concerns identified in descending order were:

- Particulate matter (natural & man-made sources) and effects on health
- Full support of all sectors
- Urbanization effects on air quality
- Emissions from Swan Hills hazardous waste treatment centre
- Emissions from mills in vicinity of town
- Dry & wet deposition on soils and water
- Effects of emissions on vegetation
- Provincial responsibility for monitoring environment
- Emissions and odours from intensive livestock operations
- Public access to monitoring data

There were no attendees for the Peace River meeting with the exception of a reporter from a local radio station. The reporter conducted an extensive interview with the PASZA Program Manager, and the following day excerpts of the interview were broadcast over the radio.

There were five attendees at the Swan Hills Meeting, consisted of three government representatives, one industry representative and a member of the media. The priority issues and concerns identified in descending order were:

- Concerns with location of Swan Hills hazardous waste treatment centre
- Credibility of monitoring data
- Health effects of emissions
- Need for health advisories
- Increase in oil and gas activities in and around the town and their emissions
- Logging activities and effects of associated deforestation
- Transport of pollution from other regions within province

There were six attendees at the Whitecourt Meeting, all from the industry and government sectors, with no representation from the non-government and public sectors. All of the

attendees were familiar with previous Airshed Initiative in the area and were given the presentation describing the PASZA Boundary Expansion Initiative. The attendees while disappointed at the lack of turnout from the non-government and public sectors indicated that they were not surprised based on previous efforts and results. There was no formal brainstorming session or prioritization of issues. Most of the discussion was focussed on the need for support from all sectors, the roles of government in facilitating airshed development, and questions specifically about the Peace Airshed and its Monitoring Program.

3.2 Stakeholder Meetings & Discussions

In early 2006, a number of meetings and discussions with some of the key industry stakeholders in the regions being considered for expansion were held. These were dedicated meetings and interviews or were part of the issues identification meetings as described above.

The majority of concerns and issues identified and discussed in these meetings were not specifically air quality issues, but rather issues associated with airsheds themselves. Some of the major issues identified during these discussions were questions and concerns about:

- Process for expansion or formation of an airshed
- Advantages gained by participation in an airshed
- Funding and sustainability of airsheds
- Rationalization of existing ambient monitoring into a regional monitoring program
- Need for participation by all sectors in an airshed (especially public)

The information gained from these discussions was valuable and was considered in the identification of boundaries, the design of monitoring programs and their associated implementation plans, and design of funding formulae.

4. Emissions Inventory and Modeling

The following emission inventory and modeling profile has been developed based on emissions released within the expanded zone boundary, which is completely bounded within the province of Alberta, Canada (refer to Figure 5). The zone covers an area from Township 88 in the north to Township 56 in the south. The western border is contained by the British Columbia border. The Eastern border is bounded by the MD of Big Lakes (Range 7, West of the 5th Meridian). These boundaries contain an area of land covering approximately 72,850 square kilometers.

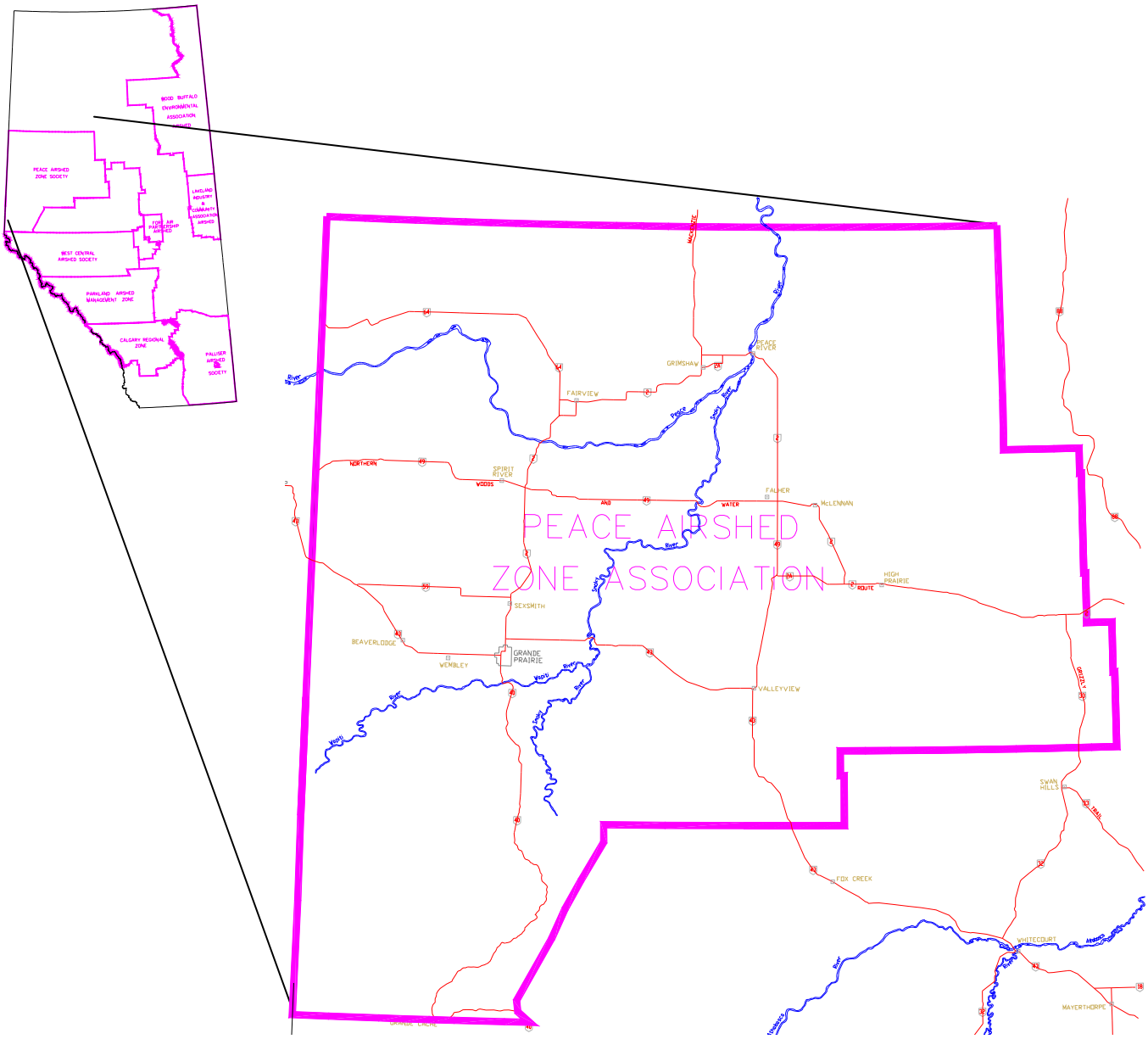


Figure 5: Emissions Inventory Boundary

4.1 Emission Sources

The emission profile developed for PASZA included point sources, area sources, and transportation sources. In addition only the primary emission sources of sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and total particulate matter (TSP) were included in the emission breakdown. The zone emissions were further broken into two main areas, the PASZA expansion zone area and the NOCAZ area. The following is a brief explanation of the source profiled used in the inventory:

- **Point sources** are industrial facilities that operate under AENV approval or EUB permits. Emissions from these point sources were used to model potential impacts within the two areas of study.

- **Area sources** was determined from municipal districts and counties, which are not required to obtain air permits from AENV. These emissions take into consideration emissions from homes within the zone. Emissions from most of these area sources individually are quite small compared to the point sources but can be significant when considered collectively. Area source emissions are normally predicted utilizing emission factors developed for the specific area source.

- **Transportation sources** only included emissions from on-road motor vehicles from the primary and secondary highways throughout the zone. In addition these emissions only take into consideration the passenger vehicles and trucks, whereas emissions from off-road vehicles, aircrafts, and railways, were not included in this summary.

4.1.1 Point Sources

Based on the approval holders from within the zone, there are a total of sixty-eight (68) Alberta Environment approvals within the PASZA boundaries (2004 data). In the NOCAZ area there are a total of fifty-three (53) Alberta Environment approval holders. In addition to the Alberta Environment approvals, the data collected from the Energy and Utilities Board (EUB) include Batteries, Gas Gathering systems and Gas Plants. For the purposes of this review, a total 1,623 EUB and AENV facilities were identified within the PASZA zone, and 584 facilities identified within the NOCAZ area (refer to Figure 6).

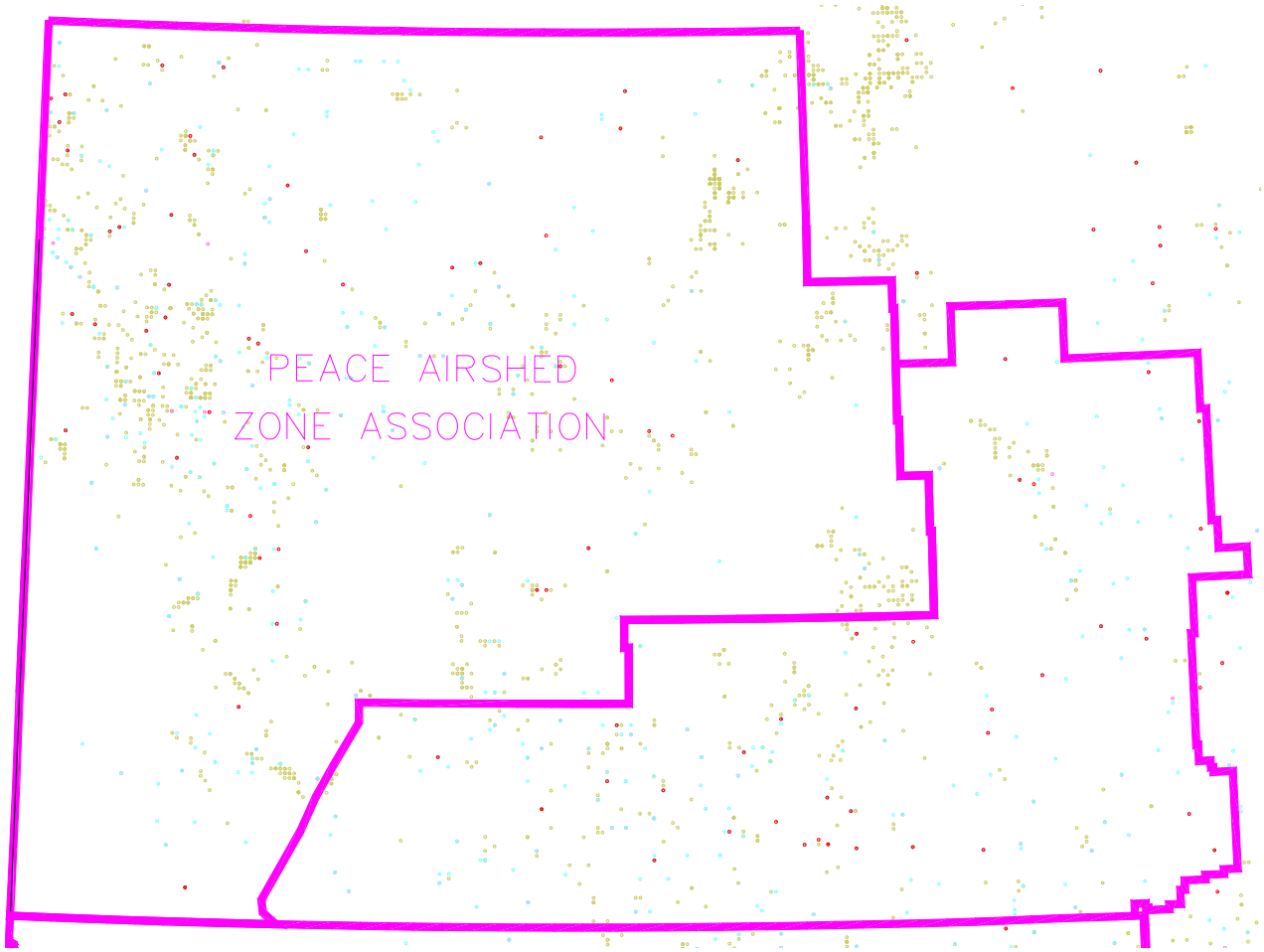


Figure 6: AENV approval holders and EUB facilities located in PASZA and NOCAZ (2004)

The following table is a summary of the total emissions calculated from within the zones The EUB provides data on oil and gas facilities from within the zone through the following production accounting forms:

- ST-60A – EUB – Crude Oil and Crude Bitumen Batteries Annual Flaring, Venting and Production Data
- No. S8 – EUB – Gas Gathering Statement
- No. S20 – EUB – Gas Processing Statement

In addition, AENV also reports data from the larger oil and gas facilities and additional facilities that require approvals. Data reported by EUB can potentially be duplicated through data reported to AENV (from Gas Processing). Therefore the larger facilities which report data to

AENV are used for emission accounting and are removed from the EUB data to avoid double accounting.

Table 1: EUB and AENV Emissions

	EUB ST60A Batteries	EUB S20 Gas Plants	EUB S8 Gas Gathering	AENV Approvals
Total facilities	**1,182**	**55**	**275**	**68**
SO_2 (tonnes/yr)	-	0.2	-	16,181
NOx (tonnes/yr)	814	13,514	11,801	11,783
TSP (tonnes/yr)	-	-	-	1,015

NOTES:

a) Emissions factors used in calculating NOx, and SO_2 are taken from the USEPA AP-42 and CAPP

b) Reference No S8 – EUB – Gas Gathering Statement; No S20 – EUB – Gas Processing Statement; No ST-60A – EUB – Crude Oil and Crude Bitumen Batteries Annual Flaring, Venting and Production Data; AENV – Approvals – provides reported NOX, SO2, and PM emissions

Isopleths of the emission data has been prepared and presented over the next several pages. All data prepared is from the 2004 emission year, in addition two plots for each emission is presented, the first with all data from both zones, then with the highest emitter(s)removed in order to better see the profile of emissions for the remaining sources.

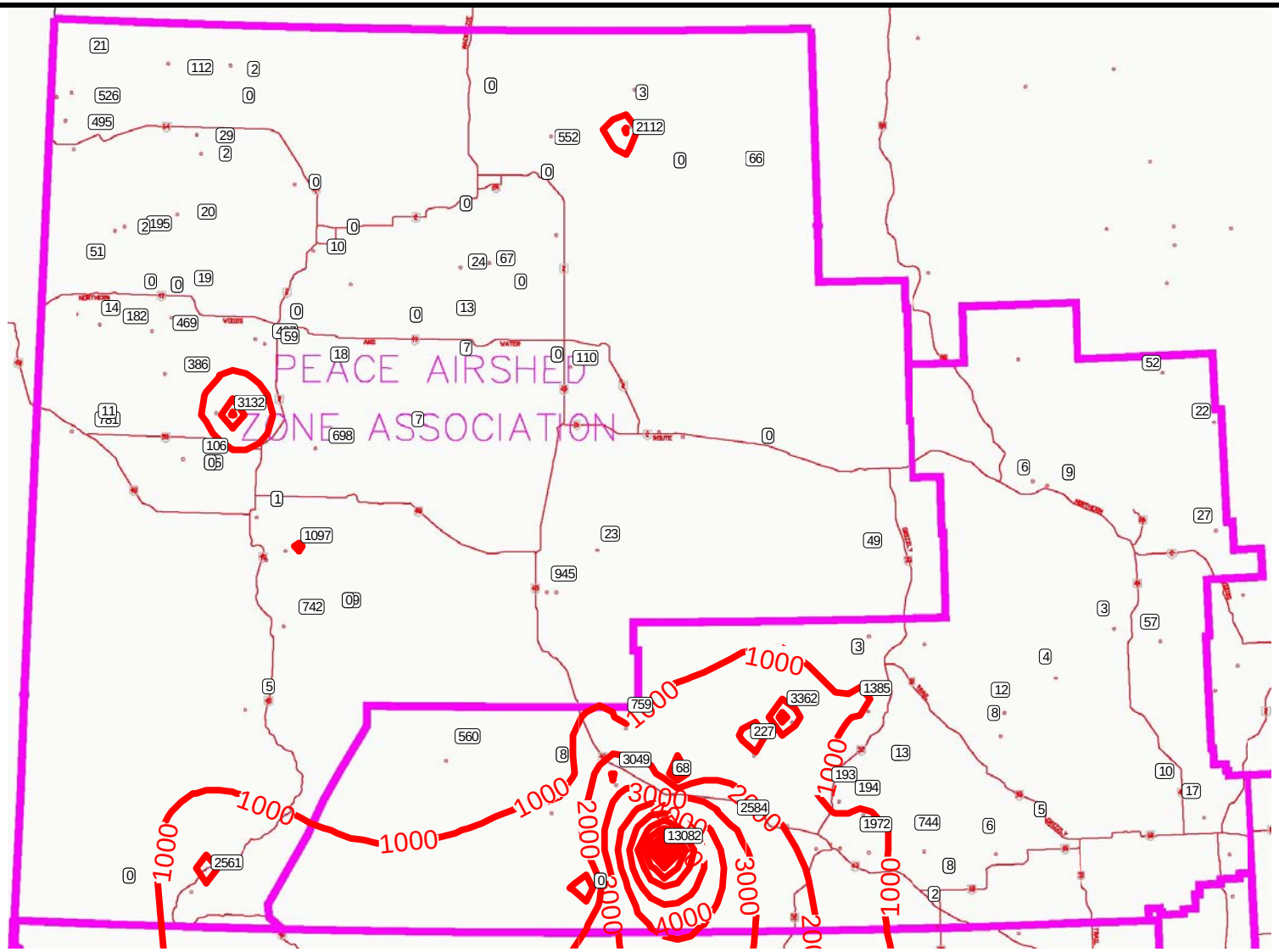
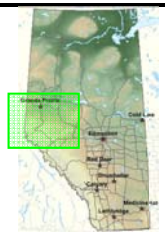


Figure 7: Map of SO_2 Emissions including 74 sources from PASZA and 46 sources from NOCAZ – Largest source Kaybob South #3 at 13,082 tonnes/yr



Prepared for: **PASZA SO_2 Emission Profile**

Prepared by: FOCUS

Date: **August 29, 2006**

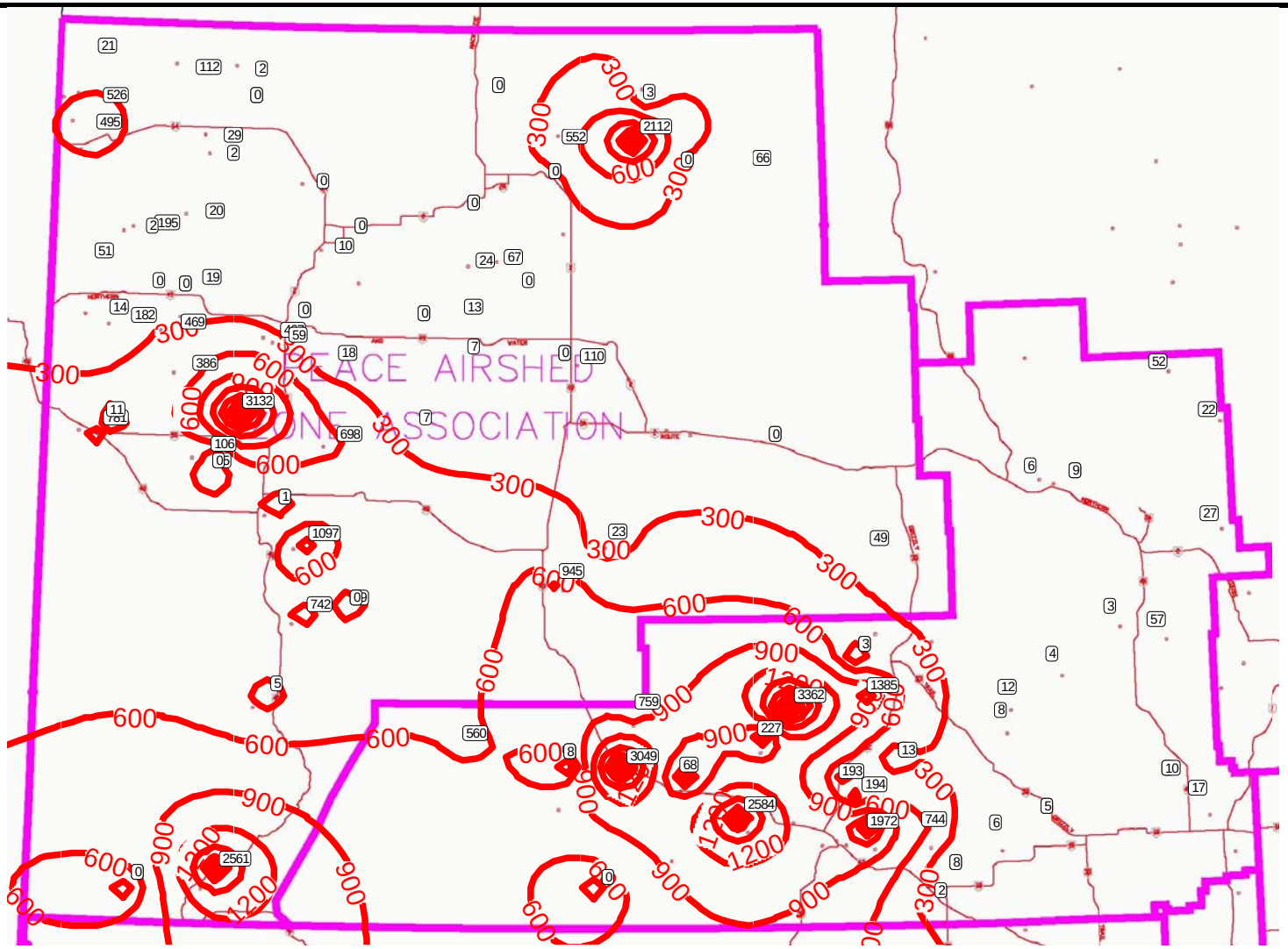
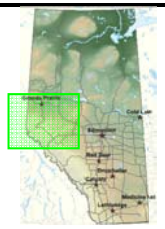


Figure 8: Map of SO_2 Emissions including 74 sources from PASZA and 45 sources from NOCAZ – Largest source Kaybob South #3 removed to highlight additional sources across the zone



Prepared for: **PASZA SO_2 Emission Profile**

Prepared by: FOCUS

Date: **August 29, 2006**

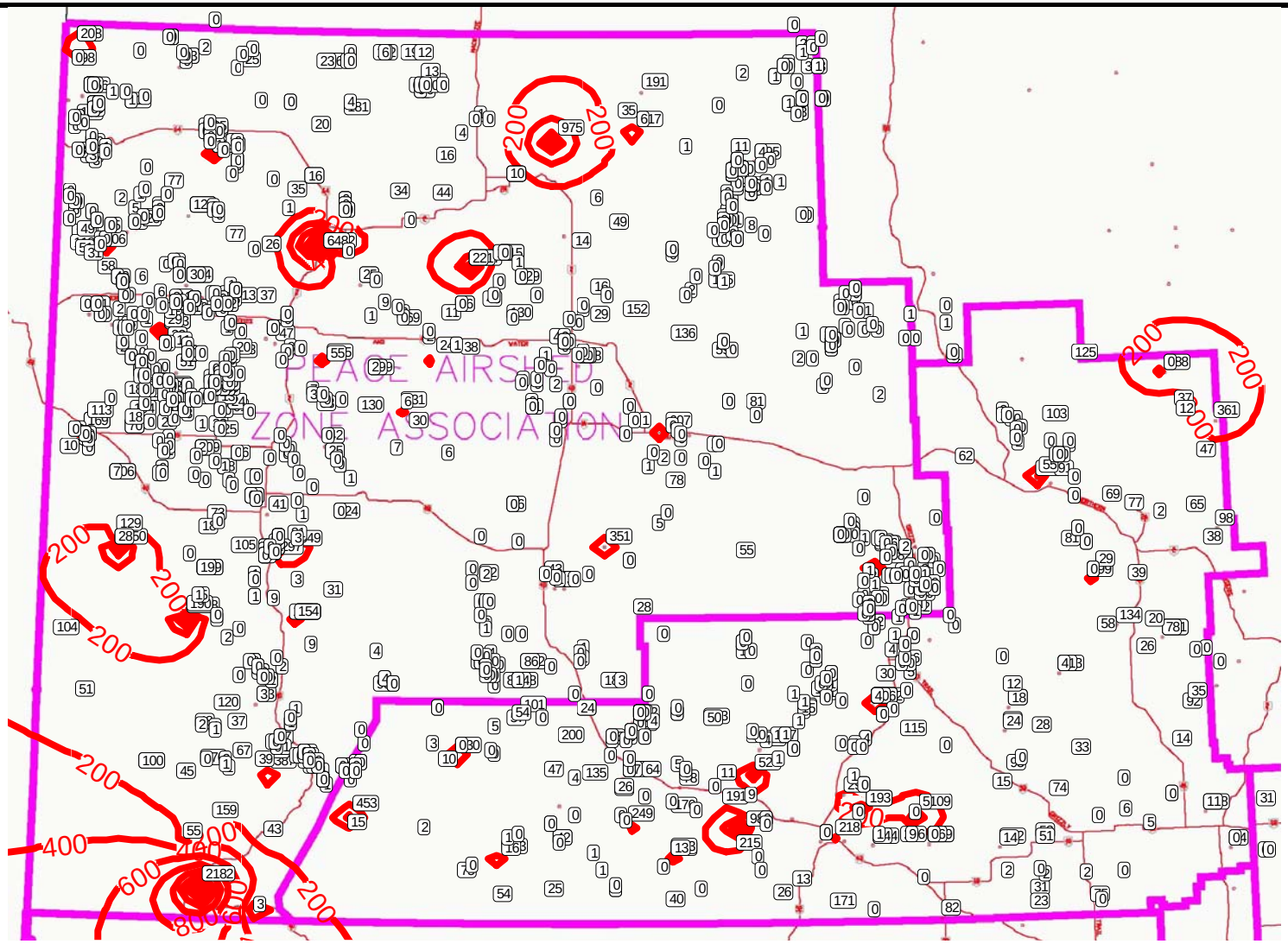


Figure 9: Map of NO_X Emissions including 1,168 sources from PASZA and 370 sources from NOCAZ – Largest source Milner Power Limited at 2,182 tonnes/yr

Prepared for: **PASZA NO_X Emission Profile**

Prepared by: FOCUS

Date: **August 29, 2006**

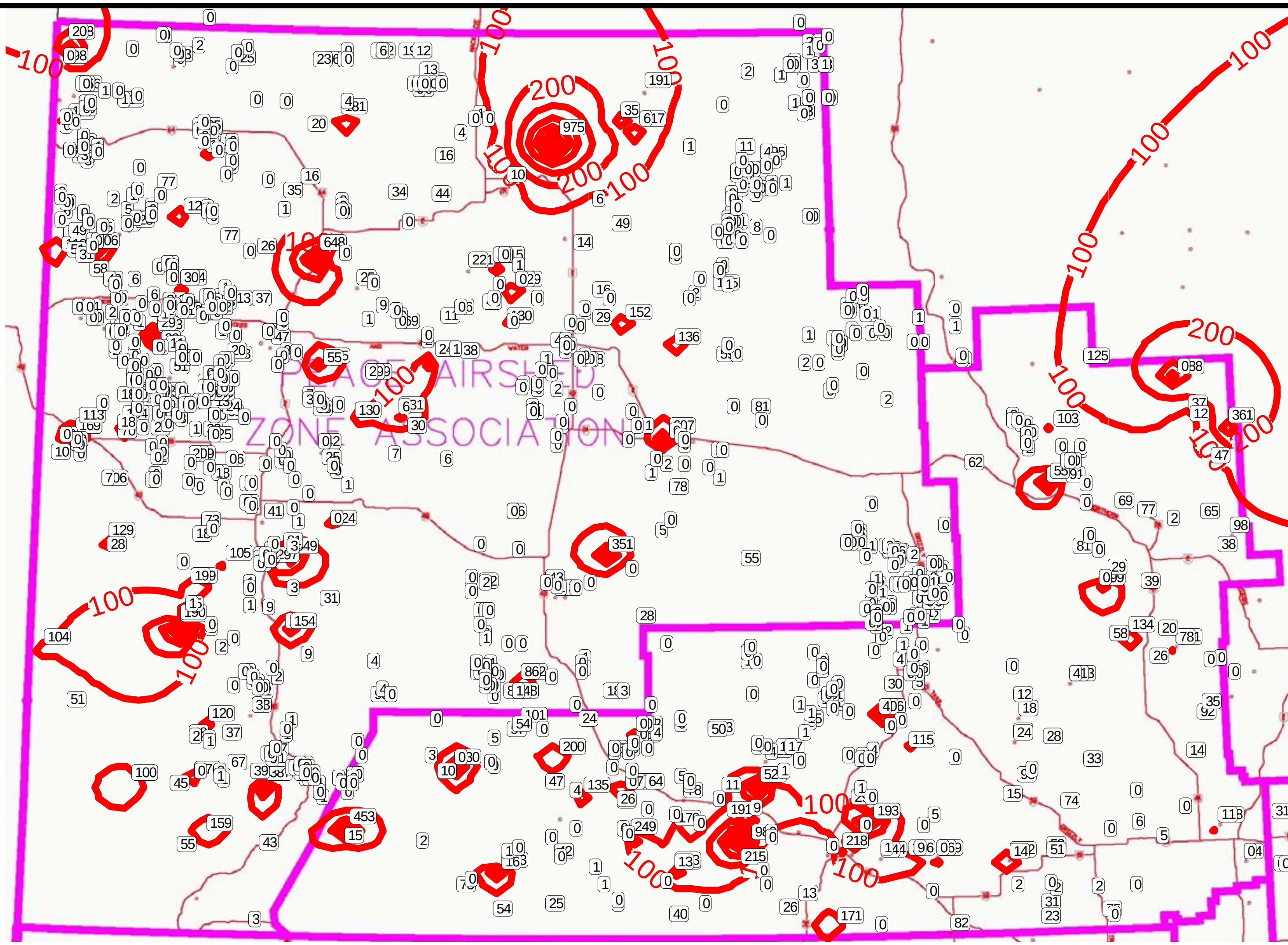


Figure 10: Map of NO_X Emissions with the top 10 facilities removed to ascertain lower contours

Prepared for: **PASZA NO_X Emission Profile**

Prepared by: FOCUS

Date: **August 29, 2006**

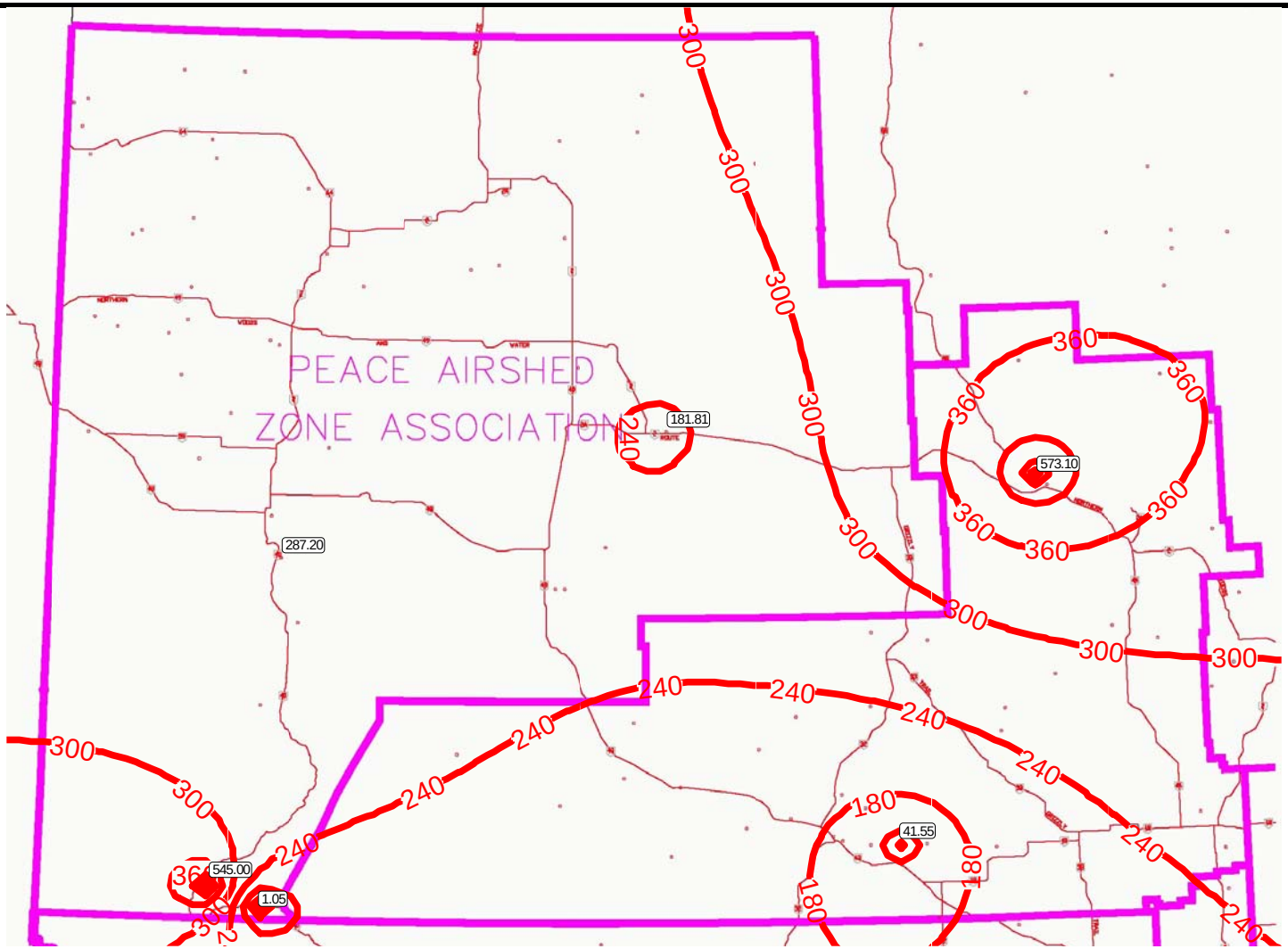
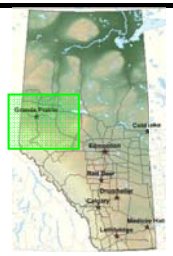


Figure 11: Map of TSP Emissions including four sources from PASZA and two sources from NOCAZ – Largest source Weyerhaeuser Canada at 573 tonnes/yrs



Prepared for: **PASZA TSP Emission Profile**

Prepared by: FOCUS

Date: **August 29, 2006**

4.1.2 Residential

Within PASZA there are thirteen counties (including municipal districts and improvement districts), one city, twelve towns and eight villages. The county areas within the zone are presented in the following figures. Based on the percentage of area within the zone and population / dwelling information supplied by Statistics Canada (2001 Census Data) PASZA has a population of approximately 110,016 people living in a total of 41,722 dwellings. Whereas in NOCAZ there is a population of approximately 52,763 people living in a total of 20,846 dwellings

The residential emissions do not take into account those emissions from municipal activities, such as; municipal buildings, recreation facilities, street lighting, turf maintenance, fleets (including buses, municipal vehicles, and emergency response vehicles), and processes (water treatment, wastewater treatment, landfills). Data required to predict emissions based upon acceptable factors is supplied through the latest Census Survey

(http://www12.statcan.ca/english/census01/home/index.cfm). Emission factors applied to the number of dwellings in order to calculate predicted emissions from residential buildings are referenced to USEPA AP-42.

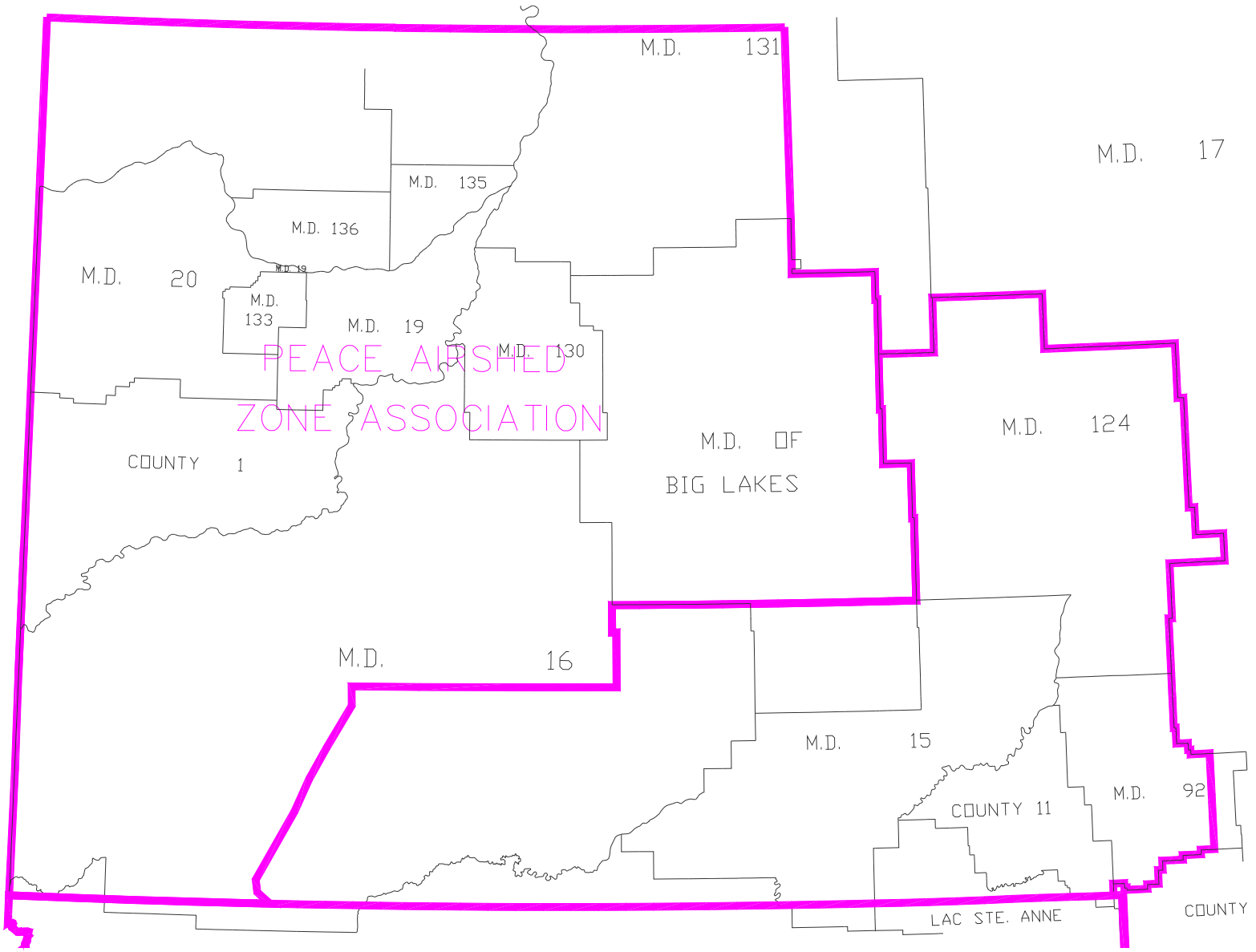


Figure 12: NOCAZ County Map

Table 2: Summary of Emissions from Residential Heating in PASZA

Counties	SO_2 (tonnes/yr)	NO_X (tonnes/yr)	Total PM (tonnes/yr)	THC (tonnes/yr)	CO (tonnes/yr)	CO_2 (tonnes/yr)	CH_4 (tonnes/yr)	N_2O (tonnes/yr)
Emission Factor Used[b]:	**0.00025 kg/GJ**	**0.040 kg/GJ**	**0.0032 kg/GJ**	**0.0023 kg/GJ**	**0.017 kg/GJ**	**50.9 kg/GJ**	**0.00098 kg/GJ**	**0.00093 kg/GJ**
Clear Hills (MD 21)	0.0	4.7	2.0	5989.9	0.1	0.1	0.3	0.1
Northern Lights (MD 22)	0.0	1.7	0.7	2188.2	0.0	0.0	0.1	0.0
Northern Sunrise (MD 131)	0.0	4.7	2.0	6010.1	0.1	0.1	0.3	0.1
Peace River	0.1	19.9	8.5	25442.0	0.5	0.5	1.2	0.4
Peace (MD 135)	0.1	14.1	6.0	18020.1	0.3	0.3	0.8	0.3
Smoky River (MD 130)	0.1	15.3	6.5	19472.2	0.4	0.4	0.9	0.3
County of Grande Prairie	0.4	62.3	26.5	79532.7	1.5	1.5	3.6	1.3
Grande Prairie	0.7	110.6	47.0	141146.1	2.7	2.6	6.5	2.2
Birch Hills County (MD 19)	0.0	5.0	2.1	6413.4	0.1	0.1	0.3	0.1
Spirit River (MD 133)	0.1	8.3	3.5	10648.7	0.2	0.2	0.5	0.2
Saddle Hills County (MD 20)	0.1	8.1	3.4	10336.1	0.2	0.2	0.5	0.2
Fairview (MD 136)	0.1	15.5	6.6	19744.5	0.4	0.4	0.9	0.3
Big Lakes (MD 125)	0.2	29.3	12.5	37401.6	0.7	0.7	1.7	0.6
Greenview (MD 16)	0.2	30.1	12.8	38379.8	0.7	0.7	1.8	0.6
Willmore Wilderness (ID 25)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS	**2**	**330**	**140**	**420,726**	**8**	**8**	**19**	**7**

NOTES:

a) The average gas usage per home for the year of 2004 was assumed to be 200 GJ.

b) The emission factors were taken from AP 42, Fifth Edition, Volume I, Chapter 1: External Combustion Sources, 1.4 Natural Gas Combustion

c) The number of dwellings and land area in the zone was calculated from Statistics Canada 2001 Census data.

Table 3: Summary of Emissions from Residential Heating in NOCAZ

Counties	SO_2 (tonnes/yr)	NO_X (tonnes/yr)	Total PM (tonnes/yr)	THC (tonnes/yr)	CO (tonnes/yr)	CO_2 (tonnes/yr)	CH_4 (tonnes/yr)	N_2O (tonnes/yr)
Emission Factor Used[b]:	**0.00025 kg/GJ**	**0.040 kg/GJ**	**0.0032 kg/GJ**	**0.0023 kg/GJ**	**0.017 kg/GJ**	**50.9 kg/GJ**	**0.00098 kg/GJ**	**0.00093 kg/GJ**
Big Lakes (MD 125)	0	7	3	9,066	0	0	0	0
Greenview (MD 16)	0	12	5	15,650	0	0	1	0
Lesser Slave River MD 124	0	18	8	23,284	0	0	1	0
Westlock County	0	37	16	47,697	1	1	2	1
County of Barrhead (No.11)	0	33	14	41,859	1	1	2	1
Woodlands County (MD15)	0	35	15	44,944	1	1	2	1
Yellowhead County	0	3	1	3,287	0	0	0	0
Lac Ste. Anne County	0	19	8	24,424	0	0	1	0
TOTALS	**1**	**165**	**70**	**210,212**	**4**	**4**	**10**	**3**

NOTES:

a) The average gas usage per home for the year of 2004 was assumed to be 200 GJ.

b) The emission factors were taken from AP 42, Fifth Edition, Volume I, Chapter 1: External Combustion Sources, 1.4 Natural Gas Combustion

c) The number of dwellings and land area in the zone was calculated from Statistics Canada 2001 Census data.

4.1.3 Transportation

In addition to the emissions generated from residential homes within the zone, there are substantial emissions that are generated from the transportation sector. The method used to determine emissions from vehicles, is by the volume of traffic per section of road, and demonstrates movement of vehicular emissions in counties per roadway. For this report, emissions predicted from the vehicular transportation within the zone will be based upon emission factors for the various classes of vehicles (Environment Canada) multiplied by the distance travelled within the zone (Alberta Transportation).

Transportation has been recognized as a contributor to air pollution within zones therefore it is important to include the transportation emissions as part of the overall emissions. The larger population hubs will generate more emissions from vehicular use; however pockets of higher vehicular contributions tend to happen in areas concentrated with oil & gas activity and smaller communities. By using the classification reported by Environment Canada which provides updates to the average number of vehicles owned in Canada per classification type (*Trends in Vehicle Populations in Canada* http://www.ec.gc.ca/pdb/ghg/inventory_report/2003_report/c2_e.cfm). This breakdown by Environment Canada categorizes vehicles into 7 classes: *Light Duty Gasoline Vehicles (LDGV), Light Duty Gasoline Trucks (LDGT), Heavy Duty Gasoline Vehicles (HDGV), Motorcycles (MC) Light Duty Diesel Vehicles (LDDV), Light Duty Diesel Trucks (LDDT) and Heavy Duty Diesel Vehicles (HDDV)*. In addition Emission factors have been developed for each of the vehicle class by Environment Canada and are based on distance travelled (per kilometre) and volume of traffic (vehicle count).

One of the initial steps used to determine the contribution of emissions from vehicles to the zones' air quality is to determine the number of vehicles traveling within the zone as well as their distance traveled. The highways that are included in the emissions inventory are those rated as being primary or secondary in terms of road quality. These highways were chosen not only because they have the majority of the highway travel occurring on them, but also because they have the most recent and accurate data available based on traffic counters on these highways. Traffic count data can be provided through Alberta Transportation and Utilities website (http://www.inftra.gov.ab.ca/). The data presented is broken down by the numbered highway and traffic volumes recorded at different locations along a stretch of road. For this inventory, the traffic counts provided for the sections of roadways within PASZA was totaled for each road and then averaged across the entire stretch included within the zone. The data has been summarized by counties and municipal districts. These traffic counts were further categorized by applying the average vehicular class to estimate the number and type of vehicles using the roadways. Utilizing emission factors developed for the different vehicle classes, an estimated inventory was completed based upon the traffic count and vehicular class. The vehicular contribution within PASZA

utilized 2005 annual average vehicular counts for the various identified highways in the zone and the 2003 breakdown of vehicular types to estimate the emissions derived from roadway transportation.

The summaries presents the emissions based on Carbon Monoxide (CO), Oxides of Nitrogen (NOx), Total Particulate Matter (PM), Oxides of Sulphur (SOx), and Volatile Organic Compounds (VOCs) which are estimated for each stretch of highway and as a total for the entire zone. Emission factors used for this inventory were based upon results of the Mobile 6.2C Model, which used inputs reflective of the present day technologies implemented into new Canadian vehicles. Additional information is available in the Excel Workbook (Roads 2004 Section) with respect to highways and vehicular traffic.

Table 4. Summary of Transportation Emissions from PASZA

Counties	Control Section km	Average Daily Traffic	CO	NOX	TSP	PM10	PM2.5	SOX	VOC	NH3	CO2	CH4	N2O
Clear Hills (MD 21)	234	3,919	635	68	1	1	1	2	56	2	12,682	1	3
Northern Lights (MD 22)	210	6,086	1,189	127	3	3	2	4	105	4	23,728	3	5
Northern Sunrise (MD 131)	195	7,274	1,264	135	3	3	2	4	112	4	25,236	3	5
Peace (MD 135)	152	14,885	1,466	156	3	3	2	5	130	5	29,267	3	6
Smoky River (MD 130)	281	10,676	1,523	162	3	3	2	5	135	5	30,394	4	6
County of Grande Prairie	524	68,149	7,608	810	17	17	12	25	675	26	151,844	18	30
Grande Prairie	11	23,053	1,413	151	3	3	2	5	125	5	28,197	3	6
Birch Hills County (MD 19)	147	3,072	402	43	1	1	1	1	36	1	8,030	1	2
Spirit River (MD 133)	73	8,145	762	81	2	2	1	3	68	3	15,217	2	3
Saddle Hills County (MD 20)	233	8,429	1,100	117	3	3	2	4	98	4	21,951	3	4
Fairview (MD 136)	149	8,846	1,263	135	3	3	2	4	112	4	25,205	3	5
Big Lakes (MD 125)	348	12,969	108	12	0	0	0	0	10	0	2,157	0	0
Greenview (MD 16)	571	32,976	5,703	608	13	13	9	19	506	20	113,838	13	23
TOTALS	**3,129**	**208,479**	**24,436**	**2,603**	**56**	**56**	**39**	**82**	**2,167**	**84**	**487,746**	**57**	**98**

Table 5. Summary of Transportation Emissions from NOCAZ

Counties	Control Section km	Average Daily Traffic	CO	NOX	TSP	PM10	PM2.5	SOX	VOC	NH3	CO2	CH4	N2O
Big Lakes (MD 125)	153	2,830	827	88	2	2	1	3	73	3	16,507	2	3
Greenview (MD 16)	101	11,684	2,524	269	6	6	4	8	224	9	50,371	6	10
Lesser Slave River MD 124	301	12,897	2,742	292	6	6	4	9	243	9	54,737	6	11
Westlock County	286	18,294	2,878	307	7	7	5	10	255	10	57,451	7	12
County of Barrhead (No.11)	291	15,615	1,632	174	4	4	3	5	145	6	32,570	4	7
Woodlands County (MD15)	301	21,189	3,913	417	9	9	6	13	347	13	78,095	9	16
Yellowhead County	18	1,380	137	15	0	0	0	0	12	0	2,728	0	1
Lac Ste. Anne County	171	17,956	2,382	254	5	5	4	8	211	8	47,549	6	10
TOTALS	**1,622**	**101,844**	**17,035**	**1,815**	**39**	**39**	**27**	**57**	**1,511**	**59**	**340,008**	**40**	**68**

4.2 Emission Modeling

ISC-AERMOD View, Version 5.3 (Lakes Environmental, 2006), is the dispersion modeling software used to complete the modeling of Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_X), and Particulate Matter (TSP). Emission data was obtained from stack surveys and data reported to AENV from facilities within the region. Meteorological inputs were obtained from the Peace River and from the Stony Plain Meteorological station. Information collected included: wind speed, wind direction, relative humidity and ambient temperature. The Stony Plain station supplied the cloud cover variable. This information was collected for the time period from July 1998 to July 2003. The model was set-up to run on a large domain covering 100 kilometers by 100 kilometers per run. A listing of the included sources can be found in Appendix A. For this project a total of 6000 receptor sites (in a grid format) located at equal distances within the modeling domain were used to identify the potential impacts of emissions from companies within the zone.

4.2.1 Modeling Methodology

Meteorological data was pre-processed to identify any erroneous data. The pre-processed data was then used in the meteorological pre-processor AERMET, to format the data in a form suitable for the AERMOD software. Inputs used in AERMOD included; source emission (point and area sources) data, receptor sites and meteorological data. Pollutants modeled in this project included SO_2, NO_x, and Particulate Matter. The dispersion resolution within the modeling domain was applied for worst case scenarios and set at 1-hour maximum predicted levels and 9^{th} highest levels generated for each model run.

4.2.2 Modeling Results

For this report a total of three parameters were modeled; Sulphur Dioxide (SO_2) for 1-hr and 24-hr results (Figure 13 and Figure 14), Oxides of Nitrogen (NO_X) for 1-hr and 24-hr results (Figure 15 and Figure 16), and Total Particulate Matter (TSP) for 1-hr and 24-hr results (Figure 17 and Figure 18)

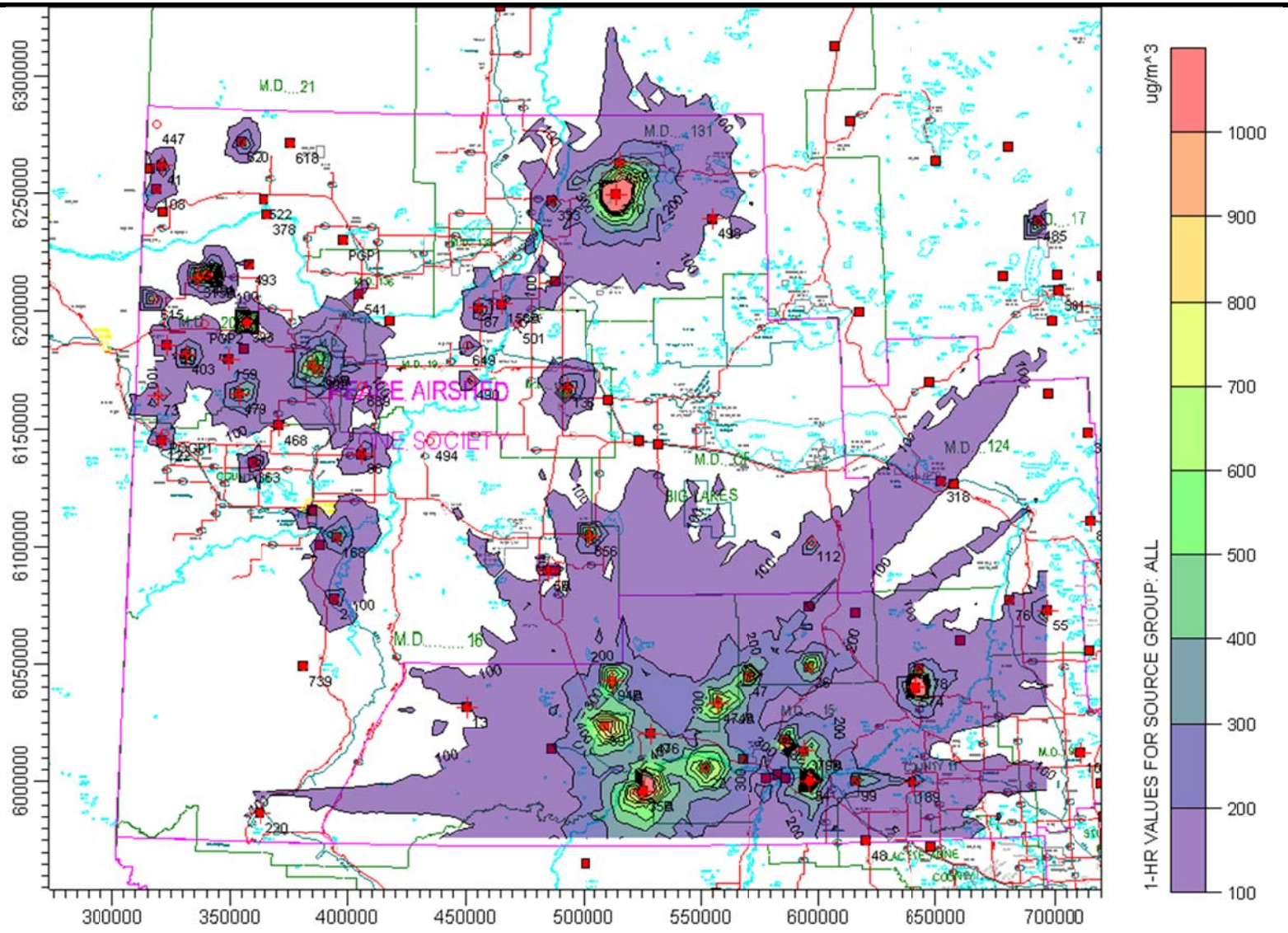


Figure 13: 1-hr SO_2 Model Results (in µg/m³).

Maximum ground level concentration was recorded at 3,800 µg/m³ (1.45 ppm) - 82 sources modeled

Prepared for: **PASZA Emission Profile**

Prepared by: **FOCUS**

Date: **August 29, 2006**

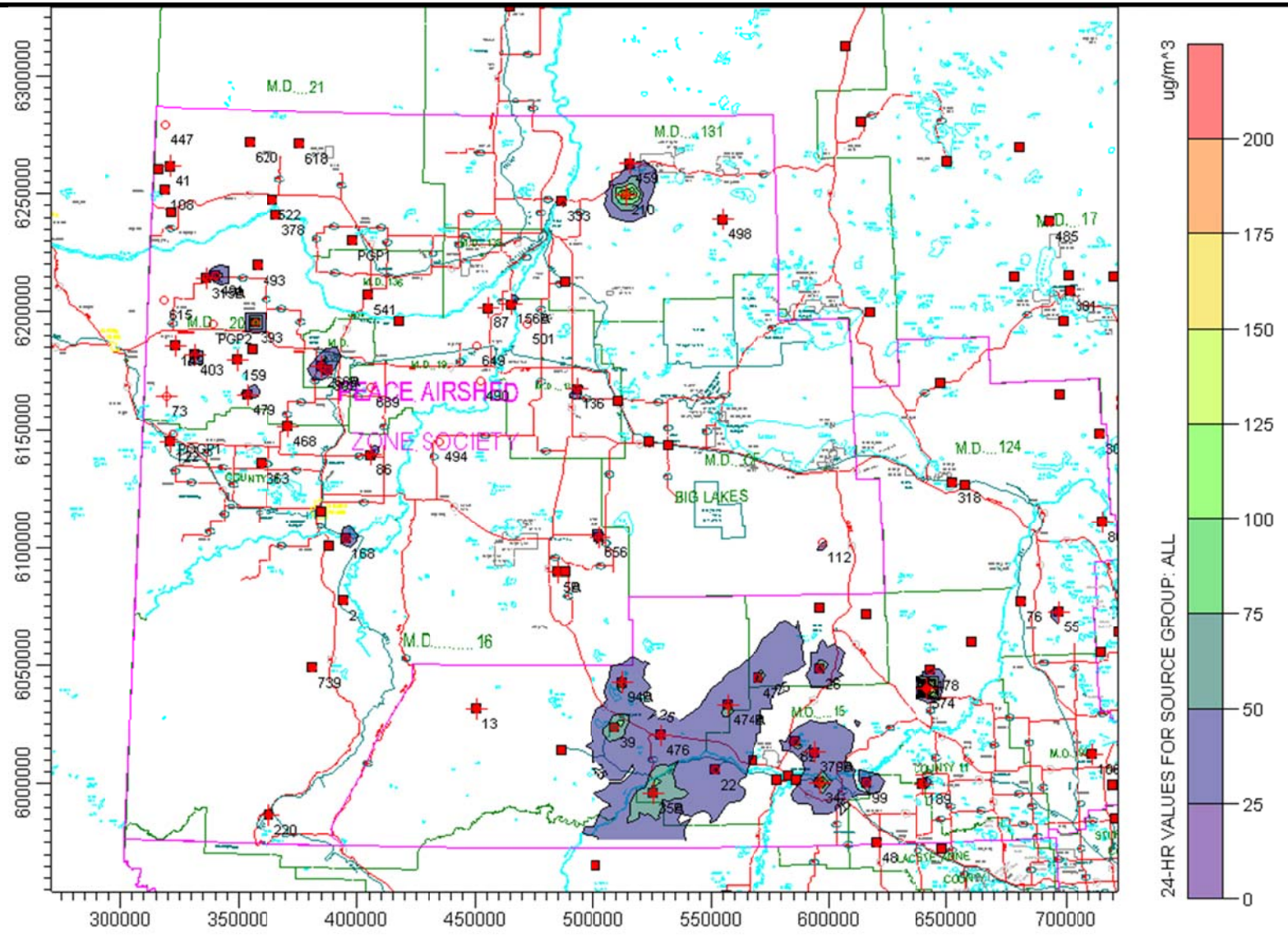


Figure 14: 24-hr SO_2 Model Results (in µg/m³).

Maximum ground level concentration was recorded at 386 µg/m³ (150 ppb) - 82 sources modeled

Prepared for: **PASZA Emission Profile**

Prepared by: FOCUS

Date: **August 29, 2006**

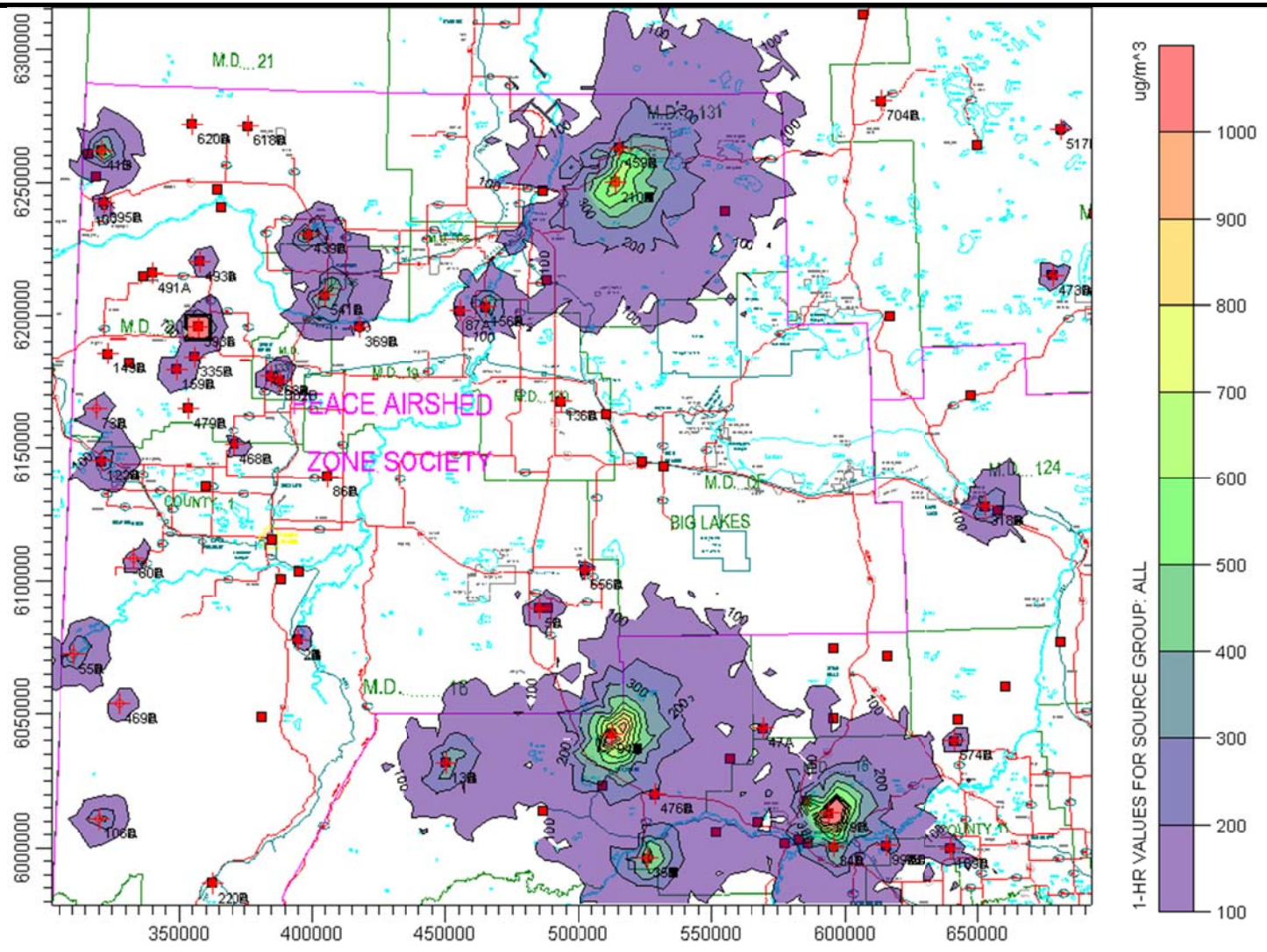


Figure 15: 1-hr NO_x Model Results (in µg/m³).

Maximum ground level concentration was recorded at 5,700 µg/m³ (3.03 ppm) - 252 sources modeled

Prepared for: **PASZA Emission Profile**

Prepared by: FOCUS

Date: **August 29, 2006**

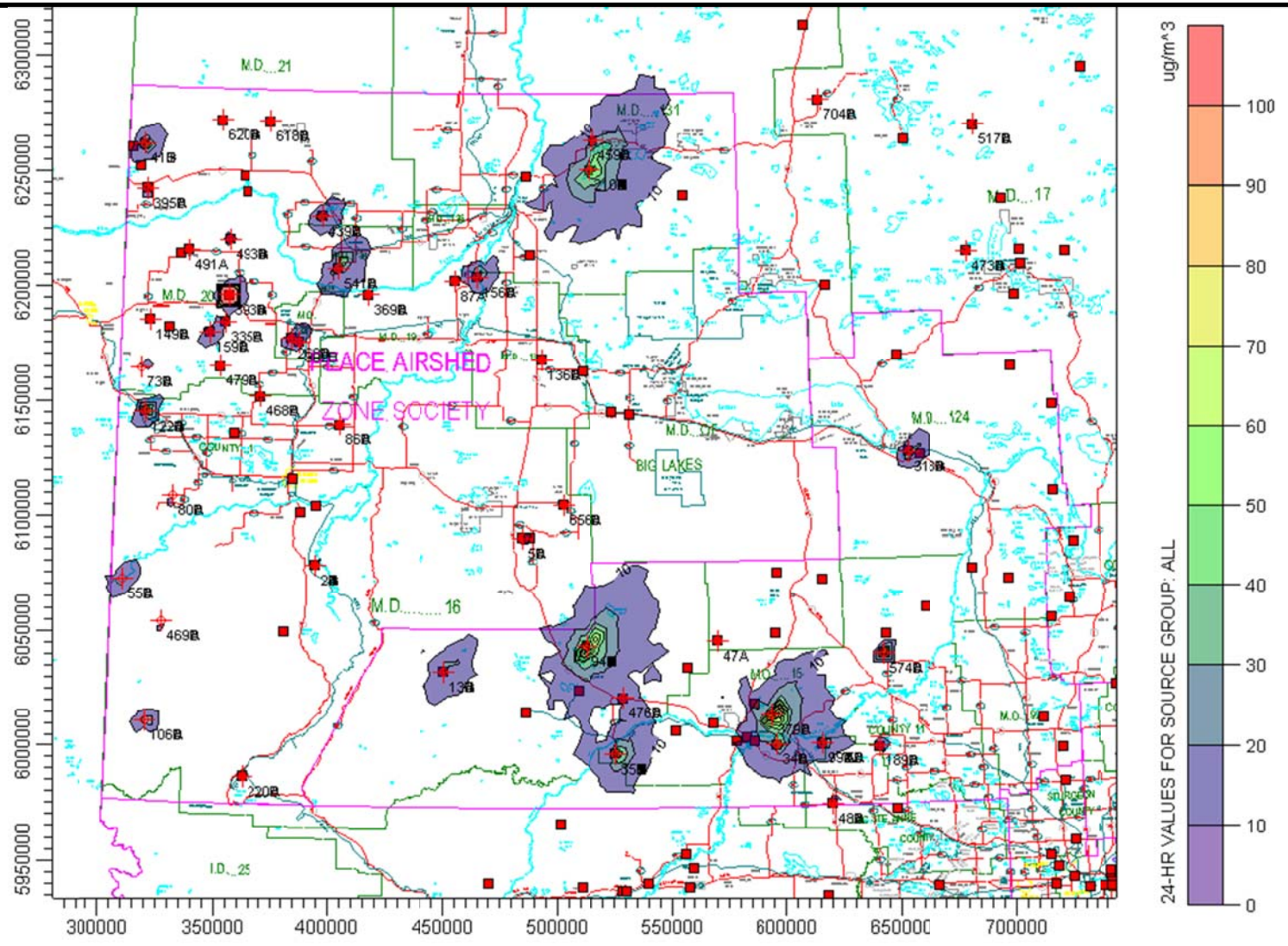


Figure 16: 24-hr NO_X Model Results (in µg/m³).

Maximum ground level concentration was recorded at 420 µg/m³ (223 ppb) - 252 sources modeled

Prepared for: **PASZA Emission Profile**

Prepared by: FOCUS

Date: **August 29, 2006**

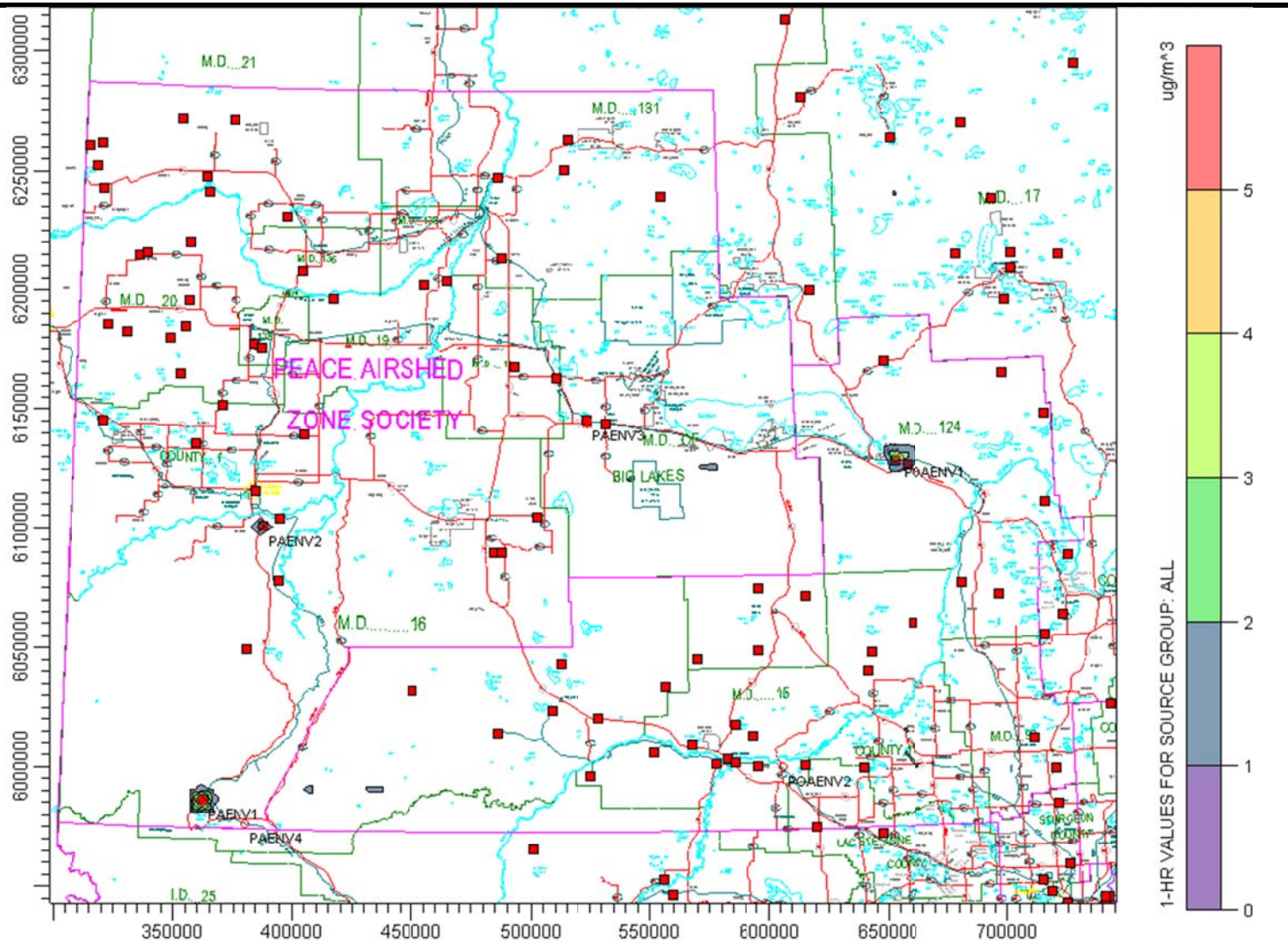


Figure 17: 1-hr TSP Model Results (in µg/m³).

Maximum ground level concentration was recorded at 10 µg/m³ - 6 sources modeled

Prepared for: **PASZA Emission Profile**

Prepared by: **FOCUS**

Date: **August 29, 2006**

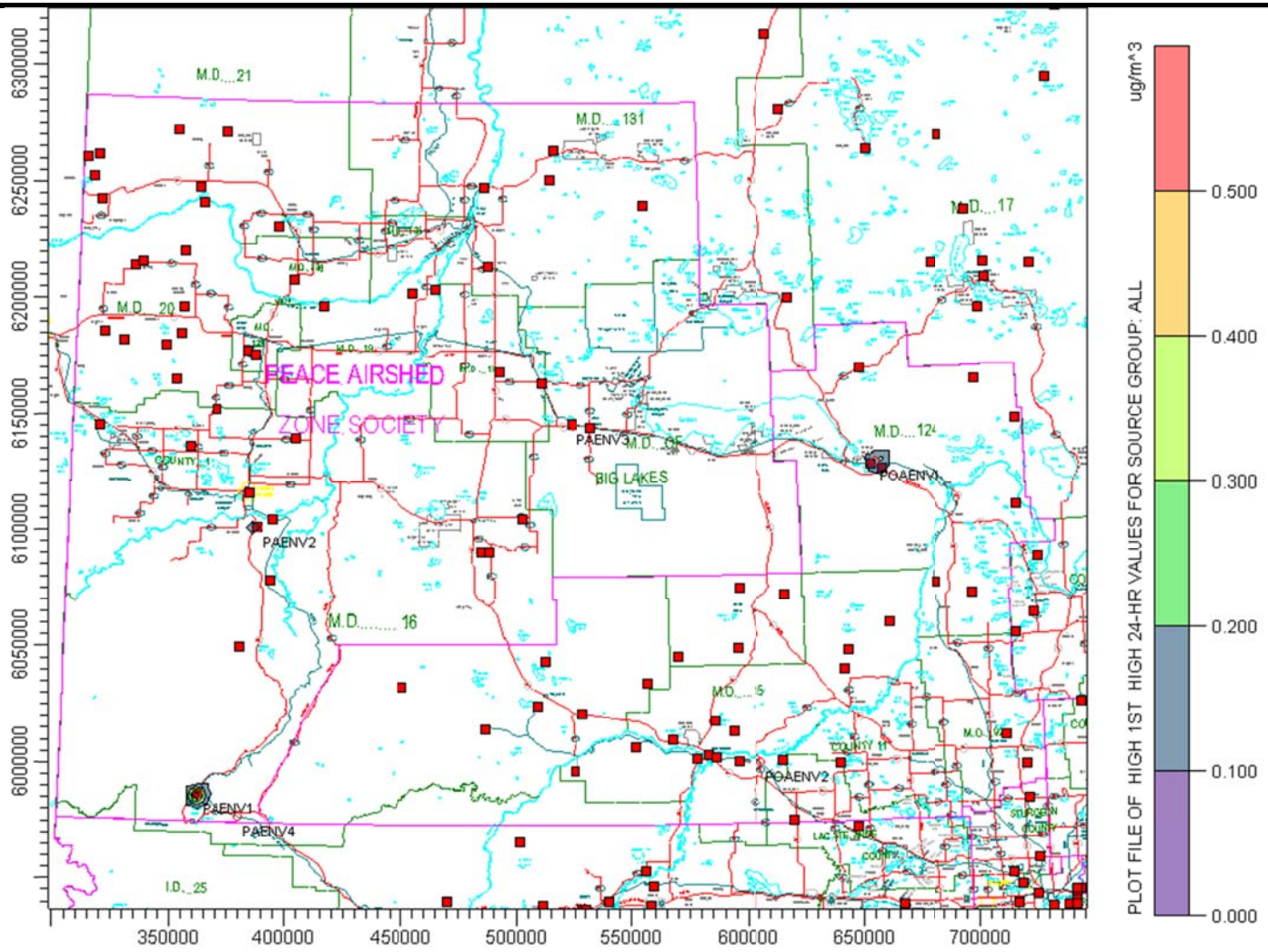


Figure 18: 24-hr TSP Model Results (in µg/m³).

Maximum ground level concentration was recorded at 1 µg/m³ - 6 sources modeled

Prepared for: **PASZA Emission Profile**

Prepared by: FOCUS

Date: **August 29, 2006**

5. Facility Operating Histories

5.1 Continuous Ambient Monitoring

An additional review was performed to identify those facilities which had 1 or 24-hr readings above AENV objective limits. The following charts depict a comparison between the two zones based on 1-hr and 24-hr reported exceedences for H_2S, SO_2, and TRS. The facility number is depicted in these charts, and the table following identifies these facilities.

PASZA		NOCAZ	
2	Canadian Natural Resources Ltd	22	Bp Canada Energy Co
5	Kereco Energy Ltd	26	Pengrowth Corporation
41	Penn West Petroleum Ltd	34	Shiningbank Energy Ltd
168	Weyerhaeuser Canada	35	Central Midstream (1) Company
210	Shell Canada Ltd.	39	Bp Canada Energy Co
468	Encana Oil & Gas	47	Apache Canada Limited

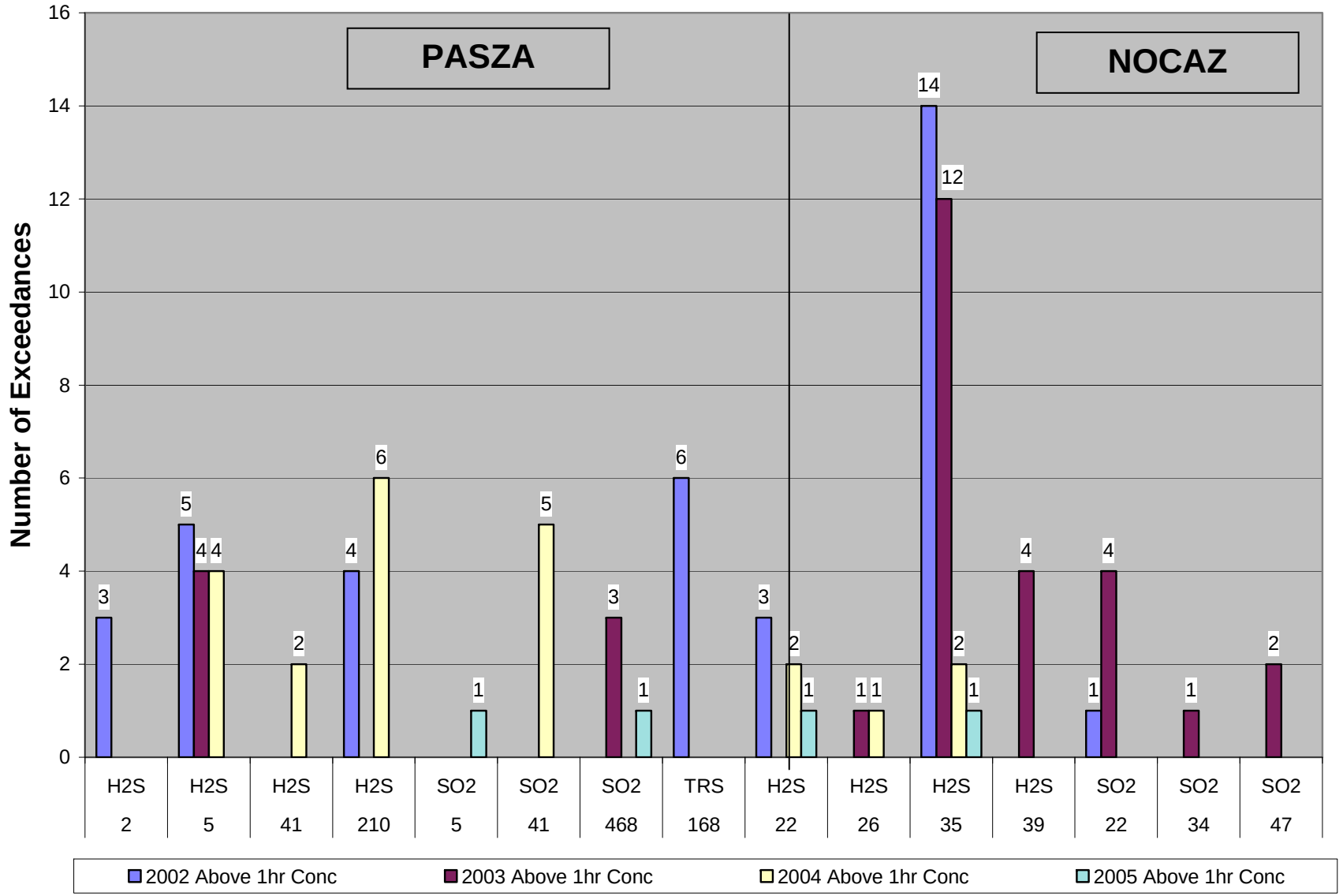


Figure 19: Ambient Hydrogen Sulphide Exceedence Summary

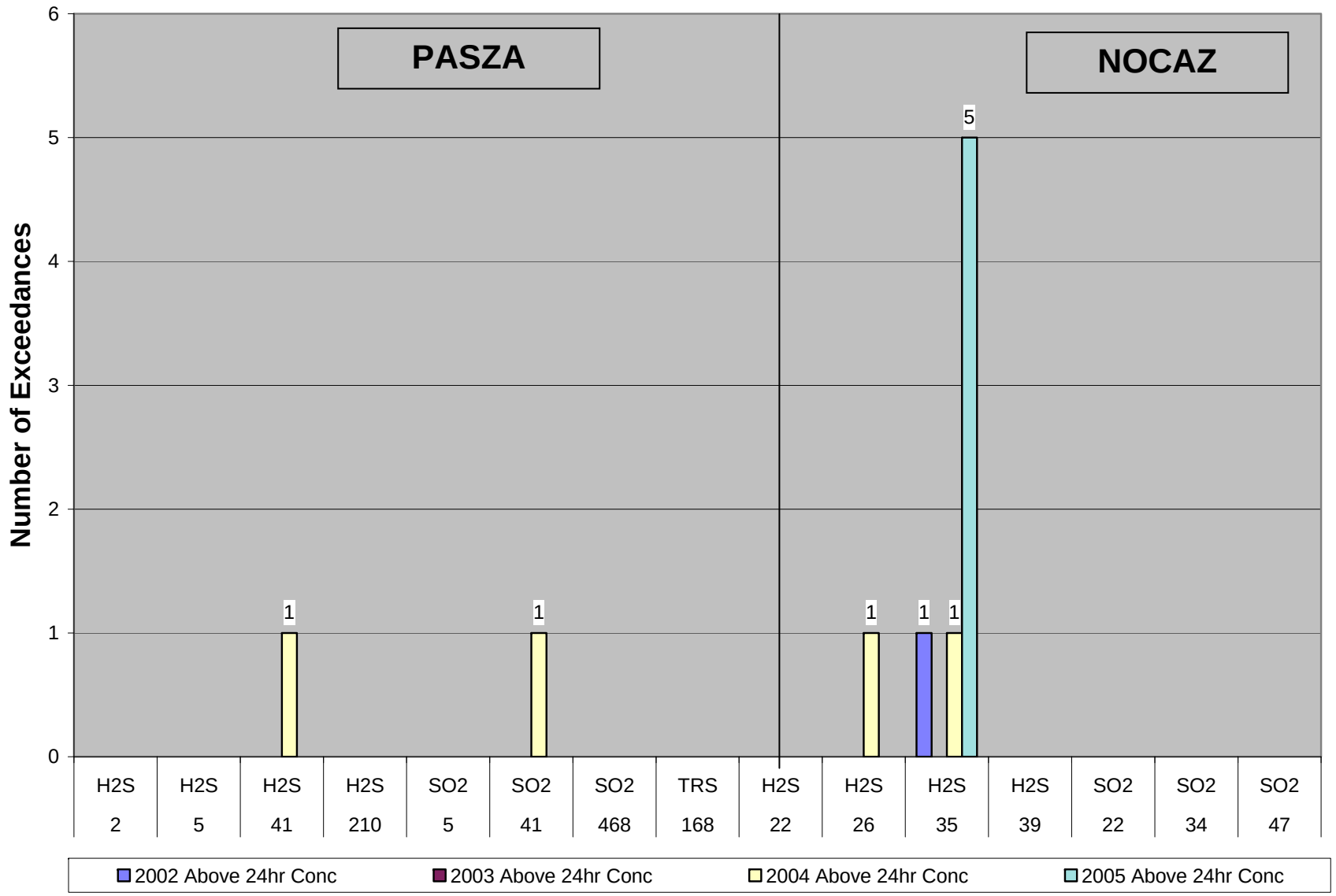


Figure 20: Ambient Sulphur Dioxide Exceedence Summary

5.2 Static Ambient Monitoring

For those facilities that are required to perform static sampling, the following table demonstrates the number of incidents that were required to be reported to AENV due to static exceedences between 2002 and 2005.

Table 7: Static Monitoring Exceedence Summary

Facility ID	Zone	Company Name	Number of Static Exceedences
136	PASZA	Galleon Energy Inc	3
167	PASZA	Can-For Products(Sawmills)	63
182	PASZA	Smoky River Coal Ltd.	8
210	PASZA	Shell Canada Ltd.	2
220	PASZA	Milner Power Limited Partnership	75
738	PASZA	Grande Cache Coal Corporation	56
39	NOCAZ	Bp Canada Energy Co	1
379	NOCAZ	Enermark Inc	1
401	NOCAZ	Slave Lake Pulp	30
465	NOCAZ	Millar Western Pulp	73

5.3 Continuous Emission Monitoring

In addition to the reported exceedences above, the following table identifies the companies within PASZA that had reported stack or ambient exceedences from their facilities between 2002 and 2005.

Table 6: Stack Top and Ambient Exceedence Summary

Facility ID	Zone	Company Name	Number of Stack Exceedences	Number of Ambient Exceedences
2	PASZA	Canadian Natural Resources Ltd.	40	3
5	PASZA	Kereco Energy Ltd	40	14
41	PASZA	Penn West Petroleum Ltd	0	9
86	PASZA	Talisman Energy Inc	3	0
122	PASZA	Encana Oil & Gas	122	0
159	PASZA	Anadarko Canada Corporation	73	0
168	PASZA	Weyerhaeuser Canada	0	6
210	PASZA	Shell Canada Ltd.	0	10
468	PASZA	Encana Oil & Gas	107	4
479	PASZA	Primewest Energy	144	144
13	NOCAZ	Suncor Inc	380	0
22	NOCAZ	Bp Canada Energy Co	5	11
26	NOCAZ	Pengrowth Corporation	0	3
34	NOCAZ	Shiningbank Energy Ltd.	0	1
35	NOCAZ	Central Midstream (1) Company	17	36
39	NOCAZ	BP Canada Energy Co	25	4
47	NOCAZ	Apache Canada Limited	0	2
398	NOCAZ	Eagle River Power Services Inc	51	0

For those facilities that are required to perform static sampling, the following table demonstrates the number of incidents that were required to be reported to AENV due to static exceedances between 2002 and 2005.

6. Expansion and Boundary Recommendations

In determining appropriate boundaries for the expansion of the Peace Airshed Zone Association and the establishment of the North Central Airshed Zone, the appropriate factors identified in the 2004 CASA document, *Airshed Zones Guidelines* were reviewed, selected and applied. For the North Central Airshed Zone, the initial boundaries identified by the NOCAZ steering committee were used as a starting point.

Additional areas taken into consideration were the areas north of the Peace Airshed Zone Association up to the top of Township 88 and the areas west of the proposed NOCAZ boundaries in between PASZA's southern boundary and West Central Airshed Society's northern boundary.

The factors that were given primary consideration in the identification of the proposed boundaries included:

Boundaries of existing and proposed airshed zones.

- Boundaries of existing Municipalities, First Nations and Aboriginal Communities
- Emission sources, volumes, types and dispersion patterns
- Geography including landforms, water bodies, and road locations
- Regional stakeholders' issues

It is important to note that the boundaries proposed in this report, once established, need not be permanent and can be adjusted as needed as the zone itself evolves and matures.

6.1 Peace Airshed Zone Association

It is recommended that the Peace Airshed Zone Association expand its northern boundary to the top of Township 88 and the eastern edge of Range 12 west of the 5th Meridian. The southern boundary should be expanded to the top of Township 56 (WCAS Northern Boundary) and the western edge of the Forest Trunk Road (Highway 734). The expansion will increase the total area of the airshed to approximately 72,850 sq. km with a population of approximately 110,000 (based on 2001 Canadian Census).

6.1.1 Northern Expansion

The makeup of the industries in the expanded northern area is very similar to that in the rest of the zone, primarily oil and gas, agriculture and forest products. Many of the oil and gas companies that operate facilities in the area are already members of PASZA with their regional offices are located in Grande Prairie or elsewhere within PASZA's present boundaries. The topography, natural ecosystems, and rural population distribution are similar to those regions located within the current PASZA boundaries.

The emission characteristics of the oil and gas facilities in the expanded northern area are also very similar to those within the current region. The majority are newer operations with relatively low levels of emissions as evidenced by the isopleth maps in Figures 7 through 11. Dispersion modelling of the emissions for these facilities, Figures 13 through 18, indicate that their effects are largely localized and that concentrations fall off rapidly as the distance from the facility is increased. These localized effects support the limiting of the northern boundary to the top of Township 88, where the geographic constraints of the Clear Hills have to this date, limited significant further development.

The similarity in the industry makeup and region's emissions characteristics indicate that the application of the current PASZA funding formula for this region is appropriate. The incremental costs of expanding the PASZA air quality monitoring program into this region would largely be borne by the emission sources located in the expansion area. Industries located within the region and currently operating ambient monitoring programs specific to their own facilities would be invited to join PASZA. They could either incorporate elements or all of their monitoring programs into the PASZA program or participate in a future application to replace that monitoring with participation in the PASZA Regional Monitoring program.

An additional five municipalities, four towns and three first nation reservations will fall within PASZA's boundaries through the northern expansion.

- M.D. of Peace (100%)
- M.D. of Fairview (100%)
- Municipal District (MD) of Clear Hills (43%)
- Northern Sunrise County (35%)
- M.D. of Northern Lights (13%)
- Peace River
- Fairview
- Grimshaw
- Hines Creek
- Clear Hills I.R. 152C
- Woodland Cree I.R. 226 and 228.

In the absence of any turnout at the issues identification meeting held in Peace River, it was assumed that the air quality issues of concern for this area most likely would be similar to those of the stakeholders within the current PASZA boundaries. The effects of air quality on human health would probably be the primary concern. Conversations with some of the industrial stakeholders in this region such as Daishowa-Marubeni and Shell Canada Ltd. indicate that the needs of stakeholders in the vicinity of Peace River and east need to be carefully taken into consideration in terms of representation in the

association and in the design of a monitoring program. It is recommended that PASZA consider holding at minimum of one of its approximately five meetings in Peace River each year.

6.1.2 Southern Expansion

Similar to the areas identified for the northern expansion, the makeup of the industries in the expanded southern area is very similar to that in the rest of the zone, primarily oil and gas-related. Again, many of these oil and gas companies are already PASZA members of PASZA run out of Grande Prairie. One notable exception is the H.R. Milner coal-fired power generating plant and an associated coal-mining operation located near Grande Cache. Because of the unique nature of this operation compared to other regional industries and its unique local topography it is recommended that this facility continue to operate its ownfacility-specific ambient monitoring program

A majority of the M.D. of Greenview (60%), the Improvement District of the Willmore Wilderness (4%) and the town of Grande Cache will all lie within PASZA's boundaries as a result of the southern expansion. It is felt that the cutting the eastern boundary of the southern expansion off at the forestry trunk road would allow the facilities in the areas further east to be included in a North Central Airshed Zone as conversations with the Executive Director of the West Central Airshed Society that any expansion into the areas north of their current boundary is not currently being pursued by the society.

6.2 North Central Airshed Zone

It is recommended that the North Central Airshed Zone use some of the initial boundaries proposed in 2004 by the NOCAZ Steering Committee expanded to include portions of the M.D. of Greenview and Lac St. Anne County. According to the 2001 Canadian Census the total population of this 38,220 sq. km area is approximately 56,000.

The municipalities, towns and first nation reservations that will be fall within the zone's boundaries will include:

- MD of Lesser Slave River
- County of Barrhead
- Woodlands County north of Township 56 (97%)
- Westlock County west of Range 24 east of the 4th Meridian (90%)
- Lac St. Anne County north of Township 56 (38%)
- The portion of the M.D. of Greenview not within the expanded PASZA (34%)
- The southwest portion of MD of Big Lakes not within PASZA (8%)
- The portion of Yellowhead County above Township 56 (8%)
- Slave Lake

- Swan Hills
- Fox Creek
- Westlock
- Barrhead
- Whitecourt
- Mayerthorpe
- Sawridge I. R. 150G and H
- Whitecourt I.R. 232

While the makeup of the industries in the region is similar to that with PASZA, there are significantly more emissions, especially sulphur dioxide, primarily resulting from the operations of the region's top five largest sour gas processing plants, In generally these are older plants with lower sulphur recovery efficiencies.

Expanding the PASZA boundaries to take in these plants using the current PASZA emissions-based funding formula would result in the allocation of a large portion of the current PASZA program costs to these older plants in addition to the costs associated with any new regional-based ambient monitoring in this area.

Expanding the western boundary of the proposed zone to the eastern boundary of the expanded PASZA zone (forestry trunk road) would add more oil and gas facilities into the total to make an emissions-based funding formula more workable.

The majority of the M.D. of Big Lakes (92%), currently within PASZA, identified by the NOCAZ steering committee for possible inclusion into the new zone will remain within PASZA for the time being. The size of the proposed zone keeps the travel distances and times for administrative and logistical purpose workable. As indicated previously, zone boundaries are not static, and as the North Central Airshed Zone evolves it may wish to negotiate with PASZA for the inclusion of this area into their airshed.

The southwestern portion of the M.D. of Big Lakes, outside PASZA, including the Town of Swan Hills, has been included in the north central zone rather than in the PASZA expansion. There is little influence of emissions from this region into PASZA as evidenced in Figures 13 through 18. The town has much stronger socio-economic ties to the north central region due in part to its proximity to the towns of Fox Creek and Whitecourt.

7. NOCAZ Air Monitoring Program Design & Implementation Plan

The design and implementation of the NOCAZ Ambient Air Quality Monitoring Network will focus on the types of monitoring, monitoring locations, and the operating procedures and processes required for collecting and reporting on regional air quality data that can be used by NOCAZ and others to understand air quality in the region.

In review, the ambient air monitoring network will have to be designed in such a way as to provide data that will assist NOCAZ in:

- understanding how their air quality compares to other airsheds and urban areas within the province;
- determining if the air quality is acceptable with no resulting adverse health impacts; and
- identifying and addressing areas of potential concern (*e.g.* odours).

The NOCAZ AQM Programs will be operated to provide a scientific understanding of air quality processes and trends by monitoring a broad range of contributing compounds, both naturally-occurring and anthropogenic. The programs will be focused on the accuracy of all values including the lowest ones and will therefore require a higher level of QA/QC than existing compliance monitoring. This higher level of quality provides data that are suitable for a broad range of uses (e.g. health effects, deposition calculations, etc.).

7.1 Primary Pollutants of Interest

7.1.1 Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless gas with a strong odour similar to that produced from a burning match. It can be detected by taste and odour at concentrations as low as 300 ppb. Sulphur dioxide in excessive amounts can have deleterious effects on plant and human life. Sulphur dioxide is formed by the combustion and processing of fossil fuels and other raw materials that contain sulphur, such as wood and coal. Emissions of SO_2 in the Alberta result primarily from activities surrounding the oil and gas, forest products and power generation industry. There are AAAQG for hourly, daily, and annual average SO_2 equal to 172, 57, and 11 ppb, respectively.

7.1.2 Total Reduced Sulphur including Hydrogen Sulphide

Hydrogen sulphide (H2S) is a colourless gas with a strong rotten-egg odour that is poisonous to animals and humans. H2S can be lethal to people and animals within minutes at concentrations between 450 to 700 parts per million (ppm). Ambient concentrations of H2S tend to be in the low ppb range. Most people can smell H2S at concentrations between 10 and 100 ppb. Emissions of H2S in the feasibility

study area result from natural and anthropogenic sources. Natural H2S emissions may occur from anaerobic marshlands and rotting manure (Warneck 1988). Anthropogenic H2S emissions may occur at sour gas processing plants, well site or pipeline facilities, incomplete combustion in flare stacks, intensive livestock operations or sewage treatment facilities. There are AAAQG for hourly and daily average H2S equal to 10 and 3 ppb, respectively.

Total reduced sulphur (TRS) compounds include hydrogen sulphide, mercaptans, carbonyl sulphide, and carbon disulphide. All of these compounds have characteristic odours that are detectable at very low concentrations. Sources of hydrogen sulphide are discussed above. Possible sources of other reduced sulphur compounds are incomplete combustion in sour gas flares, fugitive emissions from pipelines, decaying organic matter, and intensive livestock operations. There are no ambient air quality guidelines for TRS although TRS concentrations are usually compared to the H2S hourly and daily guidelines equal to 10 and 3 ppb, respectively.

7.1.3 Nitrogen Dioxide

Oxides of nitrogen (NO_x), result from combustion processes using air as a source of oxygen. NO_x includes the components nitric oxide and nitrogen dioxide. Nitric oxide (NO) is a colourless, odourless gas that is slightly soluble in water while nitrogen dioxide (NO_2) is an orange-brown gas with a characteristic pungent odour. Nitrogen dioxide is much more toxic and irritating than NO. Nitrogen dioxide reacts with water to form nitric acid (HNO_3). The main sources of NO_x are combustion processes in which the nitrogen and oxygen in combustion air produce NO_2 and NO. The major oxide in combustion emissions is NO. Nitric oxide is rapidly converted to NO_2 in the presence of ozone and other oxidants. NO_x is emitted through the operation of vehicles, furnaces, boilers, heaters, and combustion-engine-driven compressors. It is a suitable surrogate for emissions resulting from a wide variety of activities associated with industry, transportation, and personal lifestyles.

Nitrogen oxides and in particular NO_2 affect human health, suppress growth of vegetation, and cause corrosion of metals. Nitrogen dioxide, being a highly coloured gas, reduces atmospheric visibility and is responsible for a portion of the brownish discolouration of air masses over and near urban areas. Nitrogen oxides can be chemically transformed to nitrates, thus NO_x is also a source of secondary particulate matter, which further reduces visibility and leads to human respiratory problems. NO_x is also implicated in the formation of ground-level ozone. There are Alberta Ambient Air Quality Guidelines (AAAQG) for hourly, daily, and annual average NO_2 equal to 212, 106, and 32 parts per billion (ppb), respectively.

7.1.4 Particulate Matter

A variety of emission sources and meteorological conditions contribute to ambient particulate matter (PM). In Alberta, sources of inhalable particulates include biological material such as pollen, spores and bacteria, soil, road dust, dust resulting from other human activities (e.g., harvesting), smoke from forest fires, smoke from recreational sources (e.g., campfires and fireplaces), smoke from other various sources (e.g., stubble-burning), vehicle exhaust emissions, and industrial emission sources (e.g. power plants, cement manufacturing facilities, coal mining operations, and the forest products industry).

Atmospheric particulate matter (PM) is defined as all airborne solid and liquid particles, except pure water, that are microscopic in size. Current scientific evidence indicates that smaller particle fractions are primarily responsible for observed health and environmental effects. Particles equal to or less than 10 micrometres in diameter (PM10) and are suspended in the air for an indefinite period are known as inhalable particulates. PM10 is a mixture of various substances, which occur in the form of solid particles or liquid drops. Some particles are emitted directly into the atmosphere (primary PM). Other particles result from gases that are transformed into particles through physical and chemical processes in the atmosphere (secondary PM).

PM10 can be divided into two groups of particles based on size: fine particles and coarse particles. The fine particles are those particles equal to or less than 2.5 micrometres in diameter (roughly 1/20th the width of a human hair) and are known collectively as PM2.5. Coarse particles are those that are greater than 2.5 micrometers in diameter. Generally, the fine particles pose the greater health risk because they can be deposited deep in the lung and contain substances that may be harmful to human health. In addition to their health impacts, the fine particles are the main contributors to reduced visibility. These particles cause light scattering, which reduces visibility and causes the haze symptomatic of smog. Particulate pollution can cause eye, nose and throat irritation, and other health problems.

7.2 Monitoring Types

The NOCAZ air monitoring network will utilize two of the three basic monitoring technologies to accurately and comprehensively measure regional air quality. The three basic technologies are:

- passive monitoring;
- continuous monitoring;
- and intermittent/integrated monitoring (not needed for NOCAZ at this time)

7.2.1 Passive Monitoring

A passive monitoring network will form the backbone of the program and will provide data that will be useful for:

- assessing the spatial variation of the monitored parameters throughout the majority of the zone;
- identifying long-term air quality trends, a typical approach in making regional-scale air quality assessments;
- qualifying data in relation to Alberta's air quality guidelines where applicable; and
- assisting in determination of suitable locations for future continuous monitoring stations.

Passive samplers rely on the principles of permeation and diffusion to physically uptake the pollutant gas being sampled. This method is an alternative to active sampling or continuous monitoring, where an air sample is drawn or forced mechanically into or through a collection device or past a detector. Passive sampling technology is a significant improvement over static sampling technology primarily because the volume of air sampled is controlled by a diffusion barrier and estimated by calculations that account for site-specific meteorological conditions. Because the volume sampled can be accurately estimated, a concentration can be calculated. Recent comparative studies of concentrations observed at passive samplers with co-located continuous analyzers have indicated very good correlations (JWEL 2002).

The data collected from passive samplers is considered to be reliable data that can be used to make further assessments regarding air quality. The advantages of passive samplers are their:

- simple design;
- relatively low capital and operating costs;
- ease of operation; and
- suitability for remote use (because they require no electricity for operation).

The only major restriction in locating samplers is the ability to access the sampler and siting considerations (*e.g.* local obstacles).

The compounds that will be monitored by the passive monitoring network will include sulphur dioxide, nitrogen dioxide, hydrogen sulphide, and ozone. Sulphur dioxide is a suitable surrogate for emissions resulting from oil and gas activities, while nitrogen dioxide is a suitable surrogate for emissions resulting from a wide range of activities associated with various industries, transportation, and personal lifestyles. Ozone is of interest from both human health and ecological effects perspectives.

Samples will be collected on a monthly sampling frequency, consistent with the passive monitoring networks in place in other provincial airsheds. The analysis methods, sampling frequency, and resulting lower detectable limits (LDLs) are detailed in Table 8.

Table 8: Recommended passive monitoring specifications.

PARAMETER	METHOD	LDL (30 DAY EXPOSURE)
Sulphur Dioxide	EPA 300	0.1 ppb
Nitrogen Dioxide	APHA 4500	0.1 ppb
Ozone	EPA 300	0.1 ppb

As passive monitoring technology continues to evolve, there will be other compounds that can be accurately and effectively monitored that may be of interest in the NOCAZ region and could be considered for the network.

7.2.2 Continuous Monitoring

The priority air quality issue identified by NOCAZ is the possible adverse effect of air quality on human health. A network of three fixed continuous monitoring stations will collect data on ambient concentrations of compounds that are associated with known human health effects. Because continuous monitoring produces a near-instantaneous result, its data is the most versatile and has the greatest resolution. It is the preferred technology for collecting data for correlation and intercomparison purposes.

The compounds that will be monitored at the continuous stations were identified in *A Strategic Plan for Air Quality Monitoring in Alberta* developed in 1995 for the Clean Air Strategic Alliance (CASA) by BOVAR-CONCORD Environmental. The plan was developed through extensive consultation with a number of CASA committees including the Ambient Air Quality Monitoring Project Team, the Ecological Effects Monitoring Working Group, and several other CASA Stakeholder Groups.

The compounds identified in the plan as being relevant to human health include nitrogen dioxide, ozone, sulphur dioxide, hydrogen sulphide, volatile organic compounds, and both inhalable and fine particulate matter. A 2001 update to the strategic plan by the CASA Alberta Ambient Air Quality Monitoring System (AAAQMS) Operations Steering Committee added carbon monoxide, polycyclic aromatic hydrocarbons, and total hydrocarbons to the list of relevant compounds (to be monitored 4 times per year). A number

of airsheds are now monitoring total reduced sulphur rather than hydrogen sulphide as the members of this group of compounds all have noxious properties.

The broad range of continuous air quality parameters that have been selected for the NOCAZ program will allow for thorough assessment of the region's air quality and comparisons to the rest of the province because these parameters are consistent with those monitored throughout the AAAQMS, including other provincial airsheds.

The compounds that will be monitored by the continuous network will include:

- nitrogen dioxide;
- nitric oxide;
- oxides of nitrogen;
- ozone;
- sulphur dioxide;
- total reduced sulphurs (including hydrogen sulphide);
- total hydrocarbons;
- carbon monoxide; and
- fine particulate matter ($PM_{2.5}$).

Continuous monitoring of meteorological parameters that affect the transport and dispersion of emissions will include:

- wind speed;
- wind direction;
- ambient temperature; and
- relative humidity.

The recommended operating specifications for the continuous monitors to be used in the NOCAZ program are detailed in Table 9.

Table 9: Recommended continuous monitoring specifications.

COMPOUND	RANGE	LDL	ZERO NOISE	METHOD
NO_2-NO-NO_X	0-500 ppb	0.5 ppb	< ± 0.5 ppb	Chemiluminescence
O3	0-500 ppb	1 ppb	< ± 0.5 ppb	Ultraviolet Absorption
$PM_{2.5}$	0-500µg/m^3	1µg/m3	< ± 0.5 µg/m3	TEOM*
SO_2	0-500 ppb	0.5 ppb	< ± 0.5 ppb	Fluorescence
THC-CH_4-NMHC	0-20 ppm	0.1 ppm	< ± 0.01 ppm	Flame Photometry

TRS	0-100 ppb	0.5 ppb	< ± 0.5 ppb	Fluorescence
CO	0-50 ppm	0. 1 ppm	< ± 0.05 ppm	Gas Filter Correlation

* Tapered Element Oscillating Microbalance

Provisionshas been made for the addition of a fourth mobile continuous station during the third year of the air monitoring program's operation. This station can be used to gather data to better understand air quality issues of concern to regional stakeholders and to fill geographic and technical data gaps.

7.2.3 Integrated/Intermittent Monitoring

A number of the compounds identified in the 1995 CASA Strategic Plan and its 2001 update cannot be monitored by existing continuous monitoring technologies. Integrated/intermittent technologies are the only currently available technologies for accurately and effectively monitoring polycyclic aromatic hydrocarbons and volatile organic compounds. The NOCAZ program could include these compounds in the future if desired.

Integrated/intermittent monitoring samples a known volume of air that is physically drawn through a solution, adsorbent column, or filter, or otherwise collected in a container for subsequent analysis. The accuracy of the technology is highly dependent on sample flow measurement and control. The lower detectable limits are dependent upon the volume sampled. Sampling typically varies from 8 to 24 hours.

7.3 Monitoring Locations

7.3.1 Passive Network

The 24 passive monitoring stations will be located using a grid system. The use of a grid system reduces biases in site selection and provides a simple and cost effective method of locating the passive monitors. Consistent with the passive monitoring networks employed by other provincial airsheds, each station will be located roughly every 300 square miles or roughly every three townships by three townships except where limited by access.

Four stations will be co-located with continuous monitoring locations for data validation purposes. A complete a map of proposed network locations is presented in Figure 21. Exact locations of the sites will be determined during the ground-truthing phase of the network's establishment. For QA/QC purposes, duplicate samples will be maintained at 10% (3) of the stations in any one month and are rotated through the network so that each station has had one monthly duplicate sample after ten months of operation. All results are blank-corrected using the average of 10% (3) field blanks for each monitored parameter.

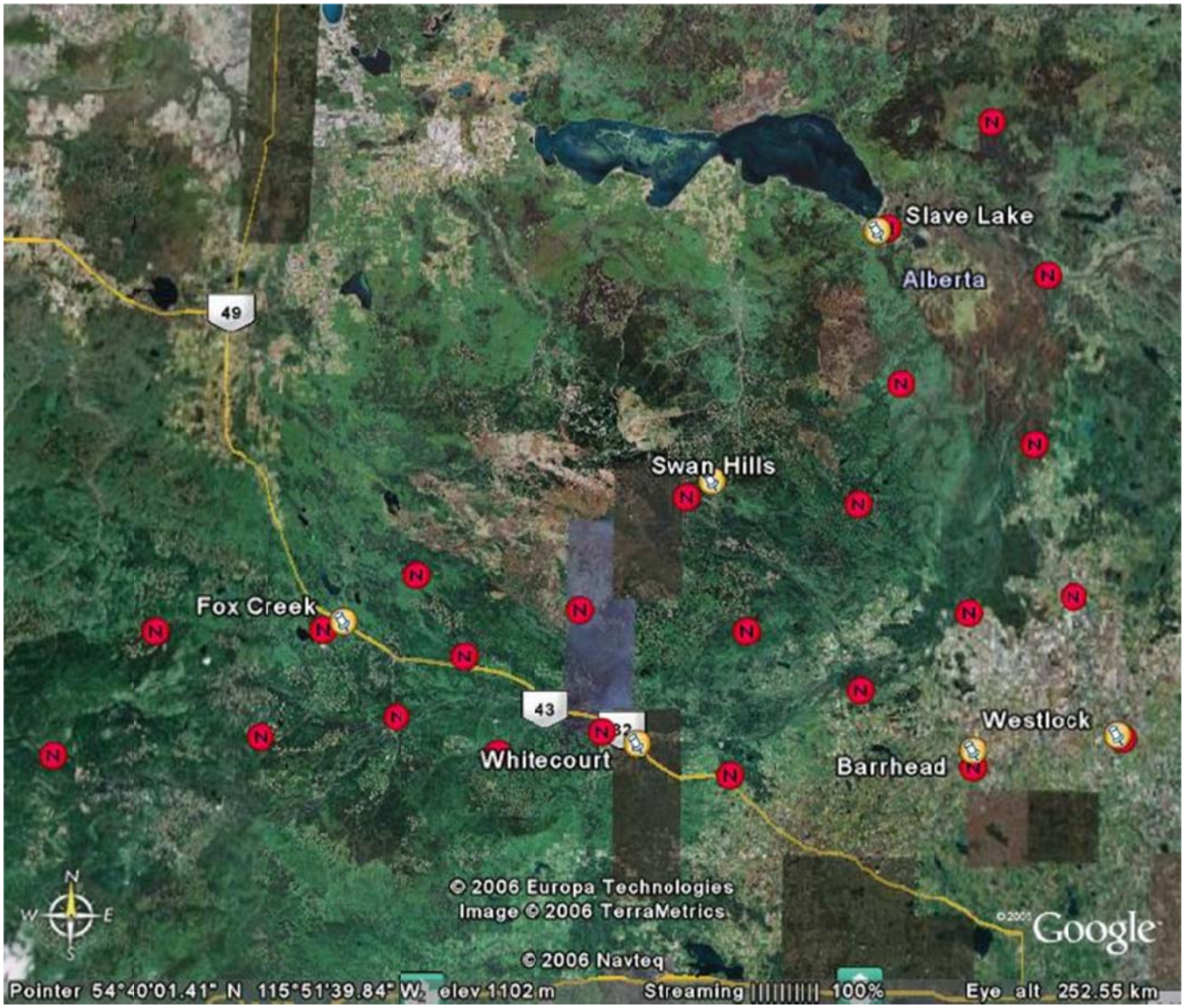


Figure 21: Proposed North Central Airshed Zone Passive Network

7.3.2 Continuous Sites

As reported earlier, modeling results of current NO_2, SO_2, and Particulate emissions were used to generate isopleth maps of the region predicting one-hour and 24-hour, and annual average ground-level concentrations. NO_2 and SO_2 are suitable surrogates for emissions from oil and gas, various industrial, transportation, and personal lifestyle activities in the region. The isopleth maps have been used to select appropriate locations to site the fixed continuous monitoring stations.

To date in Alberta, three basic options/approaches have been employed by the various airsheds to select sites for continuous monitoring stations. These options are as follows:

1. Locate stations at sites of expected highest and/or most frequent ground-level concentrations "Hot Spots" (*e.g.* Parkland and Peace airsheds);
2. Measure air quality representative of the entire airshed by locating stations in areas of low, moderate, and high industrial activity (*e.g.* West Central airshed); and
3. Measure facility compliance by locating stations downwind of licensed industrial facilities (*e.g.* Wood Buffalo and Fort Saskatchewan airsheds).

It should be noted that political, administrative, geographic, and socioeconomic considerations are factors that have all influenced, to various degrees, the siting of monitoring locations in the existing Alberta airsheds.

The option/approach utilized for the North Central Airshed Zone is the first option, to measure air quality at sites of expected highest and/or most frequent ground-level concentrations "Hot Spots".

The "Hot Spot" approach was selected for three main reasons:

- Locating stations at sites of known or predicted highest average ground-level concentrations results provided a good distribution of the continuous monitoring stations throughout a majority of the zone.
- The main air quality issue of the region is human health. In order to relate human health to air quality, monitoring needs to be conducted at locations where people live and where there are the highest emissions. The town of Whitecourt is in Woodland County, the most populated municipality in the zone. The isopleth maps indicate that this is an area of relatively high ground-level NO_2 and SO_2 concentrations. The station that will be located in Whitecourt will be designated as the network's human health "superstation" and will monitor the full suite of parameters identified earlier.
- One can make the general assumption that regional air quality in areas shown by modeling to have low average ground-level concentrations, where no continuous monitoring will be undertaken, will be better than that of regions associated with higher modeled results.

The locations of the five Continuous AQM Sites are indicated in the following figure. Specific siting rationale and other important particulars are detailed below.

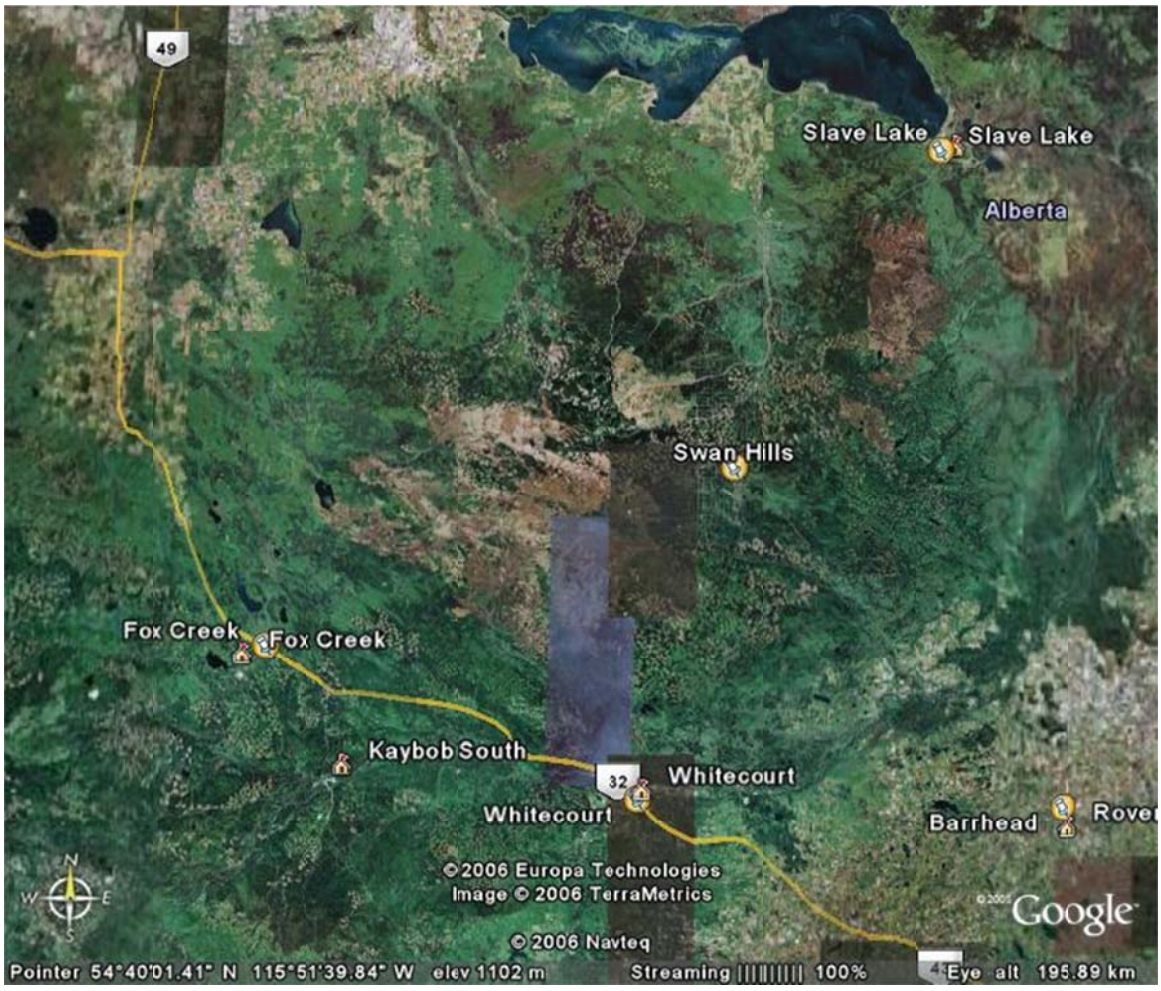


Figure 22: Proposed North Central Zone Airshed Continuous Monitoring Network

7.3.2.1 Fox Creek Station

This station will utilize an existing industry compliance monitoring station operated by the Central Midstream Company in the vicinity of its Kaybob #1 and #2 plants just west of Fox Creek. Both air quality modeling and ambient monitoring indicate that this location is within an area with higher ground-level concentrations relative to the rest of the zone. This station has been in operation since the 70s and will *provide a good historical record to which current and future air quality measurements can be applied.*

7.3.2.2 Kaybob South

This station will utilize an existing industry compliance monitoring station operated by SECAMS in the vicinity of its Kaybob #3 plant approximately 88 km west of Whitecourt. Air quality modelling and

ambient monitoring indicate that this location is within an area with higher ground-level concentrations relative to the rest of the zone. This station has also been in operation since the 70s and will provide a good historical record to which current and future air quality measurements can be applied.

7.3.2.3 Whitecourt

As indicated above this station will be the network's first human health "superstation" and will monitor all the parameters needed to calculate an Air Quality Index that will give area residents an indication of their air quality that is both simple and easy to understand. Addition of parameters will be done in stages to minimize capital requirements. The station will be located in a new shelter that will be situated to provide high visibility for the airshed and constructed so as to allow for the opportunity to educate students and the public about air quality.

7.3.2.4 Slave Lake

This station will be located in a new shelter that will be located on the eastern edge of Slave Lake so as to provide measurements of the emissions entering the town from the concentration of forest industry facilities located east of town. Initial measurements will focus on particulate matter, one of the primary concerns of the area's stakeholders with additional parameters being added later.

7.3.2.5 Rover

This station will be a portable trailer equipped to monitor a broad range of air quality parameters and will be designated as the zone's second human health "superstation". Addition of parameters will be done in stages to minimize capital requirements. It will be moved to various locations in the zone where modeling or the passive monitoring program has indicated high levels of ozone and/or other monitored parameters. It will remain at each site for an entire year to collect data under a wide variety of seasonal and meteorological conditions. The first two anticipated location will be in the Swan Hills Region.

The proposed configurations for all the continuous stations is detailed in Table 10 below.

Table 10: Configuration of New NOCAZ Continuous monitoring stations

PARAMETERS	STATION 1	STATION 2	STATION 3	STATION 4	STATION 5
	Whitecourt	Fox Creek	Kaybob	Slave Lake	Rover
SO_2	x	x	x	—	x
TRS	x	x	x	—	x
NO_2	x	—	—	x	x
THC	x	—	—	—	x
CH_4	x	—	—	—	x
NMHC	x	—	—	—	x
CO	x	—	—	—	—
O_3	x	—	—	x	—
PM_{10}	—	—	—	x	—
$PM_{2.5}$	x	—	—	x	—
Wind	x	x	x	x	x
Temperature	x	x	x	x	x
Relative Humidity	x	—	—	—	x

7.4 Program Management

An independent program manager will oversee the operation of the NOCAZ AQM Program. His duties and responsibilities include:

- Develop terms of reference and protocol for the hiring of contractors and participate in the selection process.
- Evaluate contractor's performance, report and make recommendations to NOCAZ.
- Review air quality monitoring data on a monthly basis.
- Assess/evaluate air quality monitoring data against air quality guidelines and against other provincial data.
- Track air quality monitoring program progress, effectiveness and efficiency and report to NOCAZ.
- Promptly advise NOCAZ and appropriate committee/or contractors of all situations or unusual circumstances that require immediate attention. Follow up on relative matters as appropriate.
- Make recommendations to NOCAZ on continuous improvement of the monitoring program.
- Work with contractor and NOCAZ in writing of Annual Report to NOCAZ Stakeholders.
- Represent NOCAZ at various meetings, conferences, & CASA Project Teams as needed.

7.5 Program Operation

An independent contractor is responsible for the operation of the NOCAZ AQM Program and reports to the Program Manager. The responsibilities of the contractor include:

- Operation and maintenance of all continuous monitoring analyzers, ensuring that they are operating within the manufacturer's performance specifications and maintenance schedules.
- Operation and maintenance of the meteorological sensors, ensuring that they are operating within the manufacturer's performance specifications.
- Providing, at a minimum weekly visits to all stations to affect the above.
- Unscheduled maintenance and repair of all instrumentation.
- Hourly polling and daily review of station data to detect analyzer problems and/or abnormal operating conditions.
- Maintaining sufficient parts inventory to ensure 90% uptime requirement can be met.
- Supply of all consumables, operating supplies, parts, support and calibration gases.
- Monthly multi-point calibrations of all continuous AQM analyzers.
- Operation of QA/QC program as detailed below and arranging external audits.
- Operation of the Passive Monitoring Network.

All operational procedures and calibrations will meet the Alberta Environment Air Monitoring Directive at a minimum.

7.6 Quality Assurance and Quality Control (QA/QC)

The quality assurance and quality control (QA/QC) of the air monitoring program will consist of a system of procedures designed to certify that data resulting from field, laboratory and data management activities are of the quality necessary to meet the objectives of the program. The main steps in the process of QA/QC, data validation, and data management include:

1) review and understanding of measurement system capabilities, performance, and status;
2) verification of air quality monitor calibration procedures and results;
3) summary and review of data values (tabular, statistical, and/or graphical);
4) identification and investigation of episodes of potentially invalid data;
5) flagging of invalid data;
6) systematic correction of data values, including calculation of ambient air pollutant concentrations by baseline correction of raw ambient data values;
7) summary and documentation of events discovered, investigations, and corrective actions taken;
8) operationally oriented feedback to technologists operating monitoring equipment;

9) archiving data;
10) formatting data into routine reports, and formatting data into files for dissemination; and
11) reporting to the technical staff and the program manager.

7.7 Station Polling and Data Retrieval

Routine and frequent station polling and data retrieval, will ensure that any problems or abnormalities in data are detected early to minimize downtime.

Hourly polling of the AQM Stations will be required for the calculation of an Air Quality Index and to make the stations "raw" data available to the public through the NOCAZ website similar to what is being done in other Alberta Airsheds.

The most affordable means of communication with the stations in the long term would be through modems over dial-up phone lines wherever possible. Cellular phones are an alternative to dial-up lines but cellular communication is not as reliable. An evaluation of the costs of the two options, including the costs to install landlines to the stations will be undertaken on a station-by-station basis.

7.8 Reporting to NOCAZ Members

Reporting of data collected by the monitoring program to NOCAZ members will be accomplished by the preparation of regular monthly data summary reports that will be available through the NOCAZ website www.NOCAZ.ca.. Monthly and annual data summaries will be submitted on behalf of the members directly to Alberta Environment as per the requirements that may be contained in any amended operating approvals.

7.9 CASA Data Warehouse

Once the data collected by the NOCAZ AQM Program has been processed by the QA/QC System, it can be converted into Continuous Data Electronic Format (CDEF) and transmitted electronically to a central repository for air quality data collected in Alberta. This repository is known as the Alberta Ambient Air Data Management System (AAADMS), or more commonly, the CASA Data Warehouse (www.casadata.org).

Data in the warehouse are freely accessible to the public and any interested party. The data can be viewed in graphical formats that make it easier to understand, establish relationships to air quality guidelines, and identify trends in air quality over time.

8. PASZA Expanded AQM Program

8.1 Passive Monitoring Network

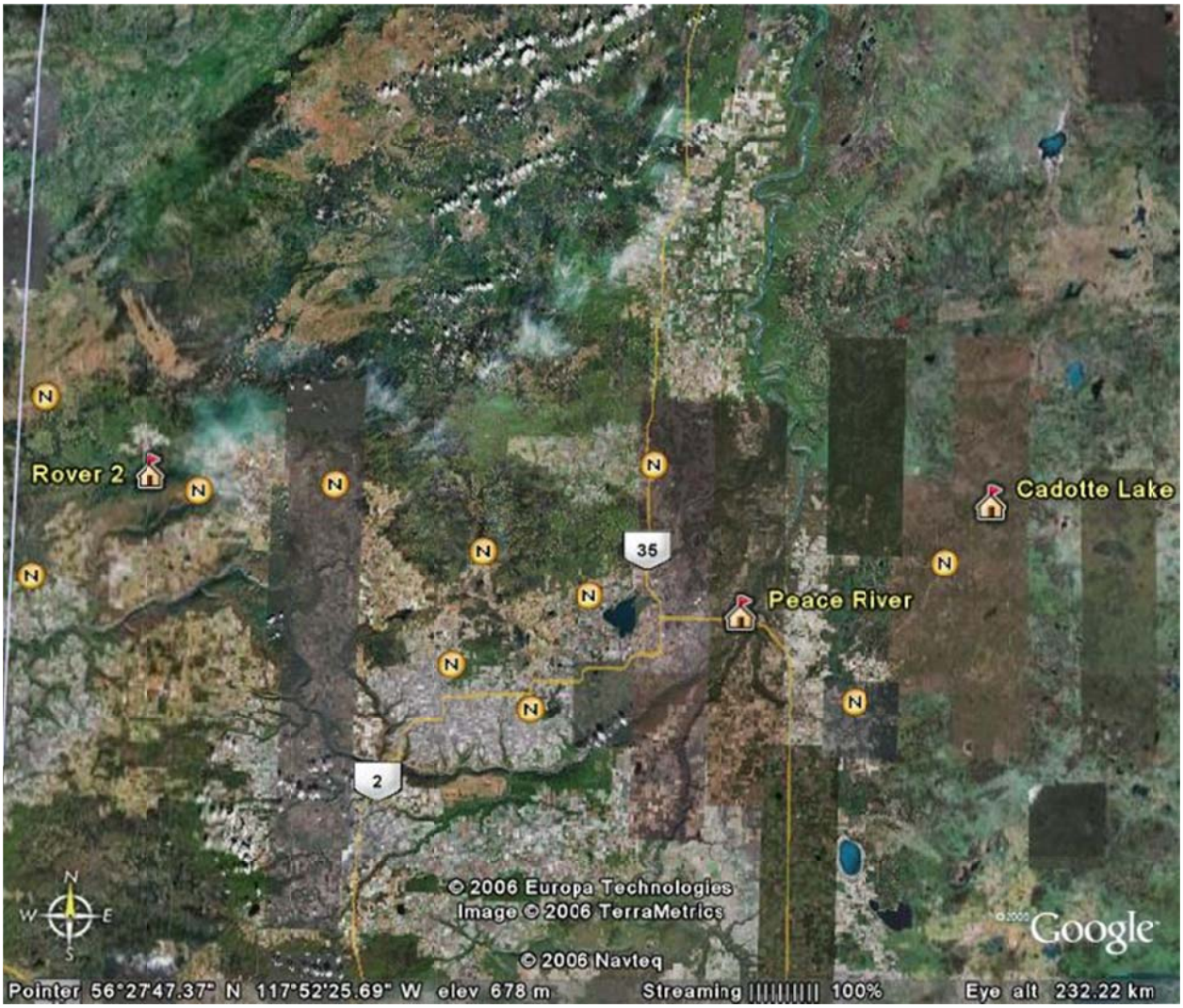


Figure 23: Proposed PASZA AQM Program Expansion North

A total of nineteen additional passive monitoring stations will be added to the existing PASZA Passive Monitoring Network. These stations will be located using a similar spacing grid (one station per 3 x 3 township grid). Fifteen of these stations will be located in the northern expansion area (see Figure 23) and five in the south (see figure 24). Two of the stations in the northern expansion area will be co-located with continuous monitoring station (Peace River and Cadotte lake) for data validation purposes. The passive results will be compared against the average values determined from the continuous program for the three parameters being monitored (Sulphur Dioxide, Nitrogen Dioxide and Ozone).

Figure 24: Proposed PASZA AQM Program Expansion South

8.2 Continuous Monitoring

Three additional continuous monitoring stations will be operated in the northern expansion area. The locations of the three Continuous AQM Sites are indicated in Figure 23 above. Their configuration is detailed in Table 11 below. Specific siting rationale and other important particulars are detailed below.

Table 11: Configuration of New PASZA Continuous monitoring stations (Northern Area)

PARAMETERS	STATION 7	STATION 8	STATION 9
	PR	CL	R
	Peace River	Cadotte Lake	Rover
SO_2	x	x	x
TRS	x	x	x
NO_2	x	x	x
THC	x	—	x
CH_4	x	—	x
NMHC	x	—	x
CO	x	—	—
O_3	x	—	x
$PM_{2.5}$	x	—	x
Wind	x	x	x
Temperature	x	x	x
Relative Humidity	x	—	x

8.2.1 Peace River

The station will be located in an existing industry-operated compliance monitoring station. This station will be the network's third human health "superstation" and will monitor all the parameters needed to calculate an Air Quality Index that will give area residents an indication of their air quality that is both simple and easy to understand.

8.2.2 Cadotte Lake

The station will utilize an existing industry-operated compliance monitoring station that will be relocated to the Cadotte Lake Area from Shell's Peace River Complex. Measurements at this station will provide some indication of air quality for air leaving the Peace River Airshed.

8.2.3 Rover 2

This station will be a portable trailer equipped to monitor a broad range of air quality parameters and will be designated as the zone's fourth human health "superstation". It will be moved to various locations in

the zone where the passive monitoring program has indicated high levels of ozone and/or other monitored parameters. It will remain at each site for an entire year to collect data under a wide variety of seasonal and meteorological conditions. For its first year of operation in 2009 it is anticipated that it will be located in the northwest corner of the zone.

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Appendix A

Stack Emission Data used for Modeling

Table A-1 SO2 Stack emission details – Data reported to AENV

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
2	AREA	394914	6077561	651	23.5230	10	1	1		SO2
5a	POINT	485259	6089504	641	47.2222	65.5	693	7.78	1.22	SO2
5b	POINT	485259	6089504	641	0.0000	45.7	1273	8.3	0.25	SO2
13	POINT	450858	6031490	884	47.4537	114.3	423	10.77	1.37	SO2
22	AREA	552091	6005403	813	81.9391	10	1	1		SO2
26	AREA	596086	6048202	952	43.9307	10	1	1		SO2
34	POINT	596260	5999850	716	173.6111	91.4	1273	7.71	0.102	SO2
35a	POINT	526048	5995685	1035	410.8796	70.1	763	12.5	3.86	SO2
35b	POINT	526048	5995685	1035	879.6296	140	1273	0.5	4.12	SO2
39	AREA	509649	6022905	837	96.6683	10	1	1		SO2
41	POINT	321392	6261554	758	21.9907	61	1273	0.5	0.0053	SO2
47	AREA	570069	6044499	1158	106.5925	73.3	1	1		SO2
48	AREA	620412	5974211	773	0.0568	10	1	1		SO2
55	POINT	697007	6072379	688	33.79608	45.7	1273	0.5	0.2	SO2
57	AREA	428195	6340759	738	0.0774	10	1	1		SO2
73	POINT	319683	6164361	815	20.1389	43.5	1273	0.011	0.914	SO2
76	AREA	681233	6076739	611	0.0837	5	1	1		SO2
80	POINT	715933	6110574	570	9.72216	27.4	1273	0.5	0.219	SO2
82	AREA	586128	6017235	870	7.1089	5	1	1		SO2
86	POINT	405776	6139059	669	46.296	50.3	811	4.4	0.914	SO2
87	POINT	455814	6201408	572	7.6389	23	1273	0.2	0.152	SO2
94a	POINT	513004	6042582	762	119.2130	79	1273	0.15	0.61	SO2
94b	POINT	513004	6042582	762	97.2222	114.3	743	9.7	1.52	SO2
99	AREA	615853	6000085	761	23.6809	10	1	1		SO2
106	POINT	711892	6011572	646	4.6296	23.2	1273	0.5	0.1	SO2
108	AREA	319351	6251706	714	15.6837	10	1	1		SO2
112	AREA	597357	6101655	788	1.5601	10	1	1		SO2
122	POINT	321470	6144690	815	115.74	91.4	811	13	1.219	SO2
136	POINT	493353	6167186	599	11.2269	24.38	1273	0.006	0.457	SO2
149	POINT	323750	6185098	739	2.6620	20	1273	0.1	0.168	SO2

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
156a	POINT	465606	6202954	557	11.8056	38.1	1273	17.22	0.053	SO2
156b	POINT	465606	6202954	557	12.0370	38.1	1273	284	0.102	SO2
159	POINT	349531	6179489	830	40.1620	45.7	673	23.6	0.406	SO2
168	AREA	395515	6103449	648	34.7816	10	1	1		SO2
189	POINT	640382	5999112	676	17.70822	35	1273	20	0.2	SO2
210	POINT	514279	6249503	618	162.0370	18.2	273	0.5	0.508	SO2
220	POINT	362975	5986066	1131	347.2222	91	435	22.3	4.57	SO2
268a	POINT	385193	6176757	677	60.1852	50	1273	0.056	0.71	SO2
268b	POINT	385193	6176757	675	0.081018	54.9	866	5.78	0.78	SO2
301	AREA	715340	6147892	649	0.6976	5	1	1		SO2
302	AREA	388397	6174850	659	1.8791	22.9	1	1		SO2
315a	POINT	336879	6213997	645	0.0810	11.9	1143	2.2	1.07	SO2
315b	POINT	336879	6213997	645	0.0116	3.1	453	1.7	0.33	SO2
318	AREA	652991	6127518	560	0.1943	10	1	1		SO2
352	AREA	486693	6246381	483	17.5196	10	1	1		SO2
363	AREA	360147	6135181	717	3.3549	16.9	1	1		SO2
378	AREA	366241	6240359	360	0.0745	10	1	1		SO2
379a	POINT	594357	6012765	777	21.4120	45	810	0.69	0.3048	SO2
379b	POINT	594357	6012765	777	21.4120	15.2	810	33.52	0.32	SO2
381	AREA	701850	6208837	618	0.743658042	10	1	1		SO2
393	AREA	357425	6195244	766	0.6088	10	1	1		SO2
403	POINT	331731	6181540	784	22.6852	41	1273	0.62	0.154	SO2
447	AREA	319433	6279253	824	0.662100457	10	1	1		SO2
459	POINT	515852	6262669	600	1.3889	10.67	894	8.94	0.48	SO2
468	POINT	371435	6151043	915	143.5185	76.81	733	17.18	2.29	SO2
474a	POINT	557170	6032977	862	18.5185	21.9	1273	11.8	0.114	SO2
474b	POINT	557170	6032977	862	25.7523	21.9	1273	40.2	0.273	SO2
476	POINT	529164	6019754	852	20.8333	27.4	1273	14.8	0.152	SO2
478	AREA	643349	6047821	746	0.370053272	10	1	1		SO2
479	POINT	353909	6164754	922	22.45356	34	1273	0.5	0.09	SO2
485	AREA	693472	6237651	558	3.864155251	10	1	1		SO2
490	AREA	452710	6170462	555	0.229261796	10	1	1		SO2

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
491	AREA	340181	6215287	644	6.1875	10	1	1		SO2
493	AREA	358216	6219508	708	0.6215	10	1	1		SO2
494	AREA	435098	6144791	645	0.22101725	10	1	1		SO2
498	POINT	555103	6238729	637	14.6991	12.5	811	15	0.95	SO2
501	AREA	472075	6194586	566	0.004122273	10	1	1		SO2
522	AREA	364813	6246878	360	0.9294	10	1	1		SO2
535	AREA	660861	6059766	687	0.1240	10	1	1		SO2
535	AREA	427385	6612729	600	5.1861	10	1	1		SO2
541	AREA	405037	6206897	586	0.3314	10	1	1		SO2
574	POINT	641969	6039907	792	21.4120	21.3	1273	0.240	0.203	SO2
615	AREA	318587	6204789	491	1.6235	10	1	1		SO2
618	AREA	376352	6270724	899	0.0589	10	1	1		SO2
620	AREA	355091	6271400	1003	3.5607	10	1	1		SO2
649	AREA	451257	6185049	531	0.4189	10	1	1		SO2
656	POINT	503166	6104042	914	9.6065	18.3	1273	0.521	0.152	SO2
689	AREA	406114	6167978	658	0.5733	10	1	1		SO2
739	AREA	381635	6048758	820	0.1455	10	1	1		SO2
PGP1	AREA	398663	6229951	645	0.00588814	10	1	1		SO2
PGP2	AREA	339408	6194457	778	0.00014948	10	1	1		SO2
POGP1	AREA	322809	6148032	699	0.346561809	10	1	1		SO2

Table A-2 NOx Stack emission details – Data reported to AENV

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
106a	POINT	320629	6010405	657.1	4.062474	10.1	841	35.64	0.3	NOX
106b	POINT	320629	6010405	657.1	2.731464	10.1	843	45.63	0.15	NOX
106c	POINT	320629	6010405	657.1	0.624996	7.9	613	2.54	0.05	NOX
106d	POINT	320629	6010405	657.1	0.002546	4.9	655	6.47	0.19	NOX
106e	POINT	320629	6010405	657.1	0.004977	7.15	358	1.31	0.15	NOX
122a	POINT	321476	6144904	810	5.682834	12	944	31.2	0.38	NOX
122b	POINT	321476	6144904	810	6.145794	12	944	31.2	0.38	NOX
122c	POINT	321476	6144904	810	0.416664	9.9	483	10.2	0.46	NOX
122d	POINT	321476	6144904	810	0.023148	7.6	483	1.8	0.41	NOX
122e	POINT	321476	6144904	810	0.497682	9.1	461	1.9	0.61	NOX
122f	POINT	321476	6144904	810	0.034722	4.6	498	0.6	0.32	NOX
122g	POINT	321476	6144904	810	0.05787	7.6	483	2.4	0.41	NOX
122h	POINT	321476	6144904	810	0.046296	6.1	398	0.8	0.32	NOX
136a	POINT	493353	6167186	599	1.86343	9.32	711	44.6	0.375	NOx
136b	POINT	493353	6167186	599	0.00579	4.61	597	3.4	0.254	NOx
136c	POINT	493353	6167186	599	0.01157	4.88	597	2.7	0.406	NOx
136d	POINT	493353	6167186	599	0.03125	24.38	1273	0.000016	0.457	NOx
13a	POINT	450858	6031490	884	1.52778	12.5	673	16.74	1.52	NOx
13b	POINT	450858	6031490	884	0.34028	9.75	723	42.03	0.61	NOx
13c	POINT	450858	6031490	884	14.98958	9.75	986	45.3	0.356	NOx
13d	POINT	450858	6031490	884	5.62963	9.75	986	41.5	0.254	NOx
13e	POINT	450858	6031490	884	1.01157	6.4	773	45.8	0.254	NOx
13f	POINT	450858	6031490	884	0.05787	9.75	473	3.74	0.406	NOx
13g	POINT	450858	6031490	884	0.21759	10.7	523	3	1.07	NOx
13h	POINT	450858	6031490	884	0.33912	10.7	673	24.1	0.457	NOx
149a	POINT	323756	6185311	739	0.00157	5.3	477	0.7	0.2	NOx
149b	POINT	323756	6185311	739	0.00378	6	477	1.6	0.22	NOx
149c	POINT	323756	6185311	739	0.00164	5.8	477	1.6	0.22	NOx
149d	POINT	323756	6185311	739	1.73611	7.35	813	40.4	0.152	NOx

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
156a	POINT	465606	6202954	557	3.76157	9.14	847	17.74	0.3	NOx
156b	POINT	465606	6202954	557	1.94444	7.62	796	33.31	0.2	NOx
156c	POINT	465606	6202954	557	1.22685	8.23	880	37.44	0.15	NOx
156d	POINT	465606	6202954	557	0.21991	6.1	752	54.44	0.15	NOx
156e	POINT	465606	6202954	557	0.40509	7.32	811	9.86	0.15	NOx
156f	POINT	465606	6202954	557	0.40509	4.39	811	37.96	0.08	NOx
159a	POINT	349531	6179489	830	2.92824	16.2	533	4.3	0.84	NOx
159b	POINT	349531	6179489	830	4.47917	7.6	533	13.2	0.71	NOx
159c	POINT	349531	6179489	830	0.61343	11	695	19.3	0.27	NOx
159d	POINT	349531	6179489	830	0.55556	12.5	695	14.8	0.36	NOx
159e	POINT	349531	6179489	830	0.46296	11	695	14.2	0.27	NOx
189a	POINT	640377	5999327	675.9	0.505784	8.8	633	39	0.15	NOX
189b	POINT	640377	5999327	675.9	2.439799	7.9	571	47.8	0.2	NOX
189c	POINT	640377	5999327	675.9	0.018518	4.9	573	4.4	0.25	NOX
189d	POINT	640377	5999327	675.9	0.023148	5.4	573	2.4	0.3	NOX
210a	POINT	514278	6249715	620	2.20023	45	503	38	1.524	NOx
210b	POINT	514278	6249715	620	6.50000	24.4	473	15.2	1.513	NOx
210c	POINT	514278	6249715	620	6.79977	24	443	12.9	1.513	NOx
210d	POINT	514278	6249715	620	6.79977	16.8	443	12.9	1.513	NOx
210e	POINT	514278	6249715	620	7.39583	7.7	673	29.8	0.61	NOx
210f	POINT	514278	6249715	620	7.39583	8.3	673	29.8	0.61	NOx
210g	POINT	514278	6249715	620	6.01273	8.4	673	35.5	0.51	NOx
210h	POINT	514278	6249715	620	6.93981	8.4	673	38.4	0.38	NOx
210i	POINT	514278	6249715	620	6.34838	16.4	673	7.8	1.4	NOx
210j	POINT	514278	6249715	620	8.88889	9.3	628	34.9	0.61	NOx
210k	POINT	514278	6249715	620	0.37037	15.5	523	5.1	1.58	NOx
210l	POINT	514278	6249715	620	2.50000	8.5	813	27	0.305	NOx
210m	POINT	514278	6249715	620	2.52315	10.8	513	39.2	0.44	NOx
210n	POINT	514278	6249715	620	0.21759	10.8	513	39.2	0.44	NOx
210o	POINT	514278	6249715	620	3.12616	8.3	673	27	0.305	NOx
210p	POINT	514278	6249715	620	0.36921	6.6	698	44.7	0.61	NOx
210q	POINT	514278	6249715	620	0.40278	6.9	733	44.7	0.61	NOx

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
210r	POINT	514278	6249715	620	0.47106	6.9	733	44.7	0.61	NOx
220a	POINT	362980	5986281	1131	33.33333	91	435	22.3	4.57	NOx
220b	POINT	362980	5986281	1131	208.33333	91	435	22.3	4.57	NOx
268a	POINT	385193	6176757	675	5.080986	12.5	860	40.21	17	NOX
268a	POINT	385193	6176757	677	2.21991	12.5	693	50	0.15	NOx
268b	POINT	385193	6176757	675	1.053234	5.7			0.6	NOX
268c	POINT	385193	6176757	675	0.05787	4.9			0.43	NOX
268d	POINT	385193	6176757	675	0.034722	6.5			0.31	NOX
2a	POINT	394918	6077775	651	0.34491	9.1	737	20.2	0.457	NOx
2b	POINT	394918	6077775	651	1.86343	9	866	8.75	0.35	NOx
2c	POINT	394918	6077775	651	0.68287	9.5	841	35.42	0.31	NOx
2d	POINT	394918	6077775	651	0.33912	14.2	531	3.8	0.91	NOx
2e	POINT	394918	6077775	651	0.38657	13.8	531	4.3	0.91	NOx
2f	POINT	394918	6077775	651	0.01898	5.8	760	3.7	0.31	NOx
2g	POINT	394918	6077775	651	0.07199	5.8	760	5.5	0.51	NOx
2i	POINT	394918	6077775	651	0.16435	10	531	31.6	0.31	NOx
2j	POINT	394918	6077775	651	0.01400	10	760	2.7	0.31	NOx
2k	POINT	394918	6077775	651	0.02199	10	760	4.2	0.31	NOx
302b	POINT	388401	6175063	644	4.55556	9.1	839	37	0.254	NOx
318a	POINT	652986	6127732	600	3.76852	18.3	813	49.2	0.203	NOx
318b	POINT	652986	6127732	600	2.74653	18.3	994	32.2	0.254	NOx
318c	POINT	652986	6127732	600	0.15278	5	589	5.2	0.203	NOx
318d	POINT	652986	6127732	600	2.49537	10.9	950	43.7	0.203	NOx
318e	POINT	652986	6127732	600	1.11111	12.2	994	32.1	0.254	NOx
318f	POINT	652986	6127732	600	2.74653	12.2	994	32.1	0.254	NOx
318g	POINT	652986	6127732	600	1.11111	12.2	994	38.9	0.254	NOx
335a	POINT	356178	6184114	754	0.10417	4.5	473	4.6	0.46	NOx
335b	POINT	356178	6184114	754	0.10417	5.7	603	7	0.61	NOx
34a	POINT	596260	5999850	716	7.39583	15.2	758	26.4	0.457	NOx
34b	POINT	596260	5999850	716	5.05787	15.2	944	39.5	0.305	NOx
34c	POINT	596260	5999850	716	2.71991	15.2	894	41	0.254	NOx
35j	POINT	526048	5995685	1035	9.78009	6.1	772	25.8	0.254	NOx

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
35k	POINT	526048	5995685	1035	3.42593	9.2	828	35.5	0.31	NOx
35l	POINT	526048	5995685	1035	1.59722	9.2	813	24.5	1.1	NOx
35m	POINT	526048	5995685	1035	2.29167	18	477	3.9	1.98	NOx
35n	POINT	526048	5995685	1035	0.57870	13.7	644	19.9	1.68	NOx
35o	POINT	526048	5995685	1035	0.24306	9.1	828	35.5	0.31	NOx
35p	POINT	526048	5995685	1035	1.59722	9.2	813	24.5	1.1	NOx
35q	POINT	526048	5995685	1035	1.25000	17.4	715	13.2	1.21	NOx
35r	POINT	526048	5995685	1035	0.23148	12.9	477	3.6	0.67	NOx
35s	POINT	526048	5995685	1035	0.57870	13.7	644	19.9	1.68	NOx
35t	POINT	526048	5995685	1035	3.42593	9.1	828	35.5	0.31	NOx
369a	POINT	417846	6195541	552.3	0.624996	10.34	677	35.43	0.38	NOX
369a	POINT	417846	6195541	552	0.62500	10.34	677	35.43	0.38	NOx
369b	POINT	417846	6195541	552.3	0.624996	7.26	677	43.51	0.343	NOX
369b	POINT	417846	6195541	552	0.62500	7.26	677	43.51	0.343	NOx
369c	POINT	417846	6195541	552.3	0.011574	4.39	623	7	0.254	NOX
369c	POINT	417846	6195541	552	0.01157	4.39	623	7	0.254	NOx
369d	POINT	417846	6195541	552.3	0.011574	2.44	623	7	0.152	NOX
369d	POINT	417846	6195541	552	0.01157	2.44	623	7	0.152	NOx
369e	POINT	417846	6195541	552.3	0.011574	4.39	623	7	0.219	NOX
369e	POINT	417846	6195541	552	0.01157	4.39	623	7	0.219	NOx
369f	POINT	417846	6195541	552.3	0.046296	5.41	623	7	0.406	NOX
369f	POINT	417846	6195541	552	0.04630	5.41	623	7	0.406	NOx
379a	POINT	594357	6012765	777	2.15278	4.57	792	27.6	0.314	NOx
379b	POINT	594357	6012765	777	0.05787	2.74	1028	2.75	0.08	NOx
379c	POINT	594357	6012765	777	29.28241	7.95	661	16.56	0.22	NOx
393a	POINT	357430	6195457	766	0.61111	7	1273	0.004201	0.308	NOx
393b	POINT	357430	6195457	766	0.59722	7.6	1273	0.001515	0.508	NOx
393c	POINT	357430	6195457	766	0.46181	9.1	1273	0.000592	0.714	NOx
393d	POINT	357430	6195457	766	1.02431	7.2	1273	0.006166	0.337	NOx
393e	POINT	357430	6195457	766	0.26968	7.5	1273	0.001852	0.308	NOx
393f	POINT	357430	6195457	766	0.41898	7.5	1273	0.002886	0.308	NOx
393g	POINT	357430	6195457	766	1.18866	7.5	1273	0.001974	0.508	NOx

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
395a	POINT	322204	6242071	728	0.61111	9	1273	0.103814	0.203	NOx
395b	POINT	322204	6242071	728	0.34028	6.5	1273	0.028106	0.152	NOx
395c	POINT	322204	6242071	728	0.20718	5	1273	0.019156	0.406	NOx
41f	POINT	321392	6261554	758	2.50000	6.25	963	20.53	0.305	NOx
41g	POINT	321392	6261554	758	1.47801	4.5	955	61.95	0.102	NOx
41h	POINT	321392	6261554	758	3.70949	5.41	856	110.37	0.127	NOx
41i	POINT	321392	6261554	758	1.47917	4.5	955	61.95	0.102	NOx
41j	POINT	321392	6261554	758	1.10648	6.25	894	44.39	0.102	NOx
439a	POINT	398663	6229951	644	7.40741	6.7	735	10.4	0.2	NOx
439b	POINT	398663	6229951	644	0.03472	7.3	493	2.5	0.41	NOx
439c	POINT	398663	6229951	644	0.00694	4.6	493	1.75	0.22	NOx
459a	POINT	515852	6262669	603	1.20370	8.4	750	37	0.31	NOx
459b	POINT	515852	6262669	603	0.00231	5.94	772	0.46	0.2	NOx
459c	POINT	515852	6262669	603	0.00579	7.1	772	0.84	0.25	NOx
459d	POINT	515852	6262669	603	0.05556	7.4	772	0.92	0.51	NOx
459e	POINT	515852	6262669	603	0.01620	4.5	772	0.66	0.46	NOx
459f	POINT	515852	6262669	603	1.27141	8.4	1271	34.2	0.15	NOx
468a	POINT	371440	6151256	915	1.73611	76.81	733	17.18	2.29	NOx
468b	POINT	371440	6151256	915	6.94444	15.24	422	13.12	0.591	NOx
469a	POINT	328147	6053729	719	0.858791	5.8	585	31	0.355	NOX
469b	POINT	328147	6053729	719	0.428238	6.6	585	31	0.305	NOX
469c	POINT	328147	6053729	719	3.434006	9.8	733	17	0.253	NOX
473a	POINT	678635	6214608	576	0.533561	9.14	880	68.5	0.255	NOX
473b	POINT	678635	6214608	576	1.939802	5.49	837	12.5	0.102	NOX
473c	POINT	678635	6214608	576	0.05324	6.1	626	2.2	0.489	NOX
473d	POINT	678635	6214608	576	0.018518	5	595	2.6	0.254	NOX
473e	POINT	678635	6214608	576	0.013889	5.49	572	2.9	0.203	NOX
473f	POINT	678635	6214608	576	0.05787	8.53	350	1.3	0.154	NOX
473g	POINT	678635	6214608	576	0.034722	3.05	542	1.6	0.154	NOX
476a	POINT	529163	6019969	852	0.32407	6.7	728	45.9	0.22	NOx
476b	POINT	529163	6019969	852	0.09144	8.4	1273	0.000423	0.38	NOx
476c	POINT	529163	6019969	852	0.00914	6.1	1273	4.23E-05	0.38	NOx

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
476d	POINT	529163	6019969	852	0.00613	6.1	1273	0.000102	0.2	NOx
479a	POINT	353909	6164754	922	2.986092	15.2	950	57.7	0.3	NOX
479b	POINT	353909	6164754	922	0.601848	10	873	45.8	0.3	NOX
479c	POINT	353909	6164754	922	0.682866	10	679	51.7	0.3	NOX
47a	POINT	570067	6044714	1158	0.00000	9.14	768	19.9	0.76	NOx
48a	POINT	620408	5974427	778	3.890021	18.3	593	18.4	0.508	NOX
48b	POINT	620408	5974427	778	1.939802	9.5	483	6	1.47	NOX
48c	POINT	620408	5974427	778	0.999994	11.6	657	15	0.254	NOX
491a	POINT	340187	6215500	648	1.73611	9.4	639	22.9	0.203	NOx
493a	POINT	358221	6219721	715	2.45949	7.54	651	35.5	0.254	NOx
493b	POINT	358221	6219721	715	0.45602	9.2	661	37	0.254	NOx
493c	POINT	358221	6219721	715	0.29398	8.62	683	36.4	0.203	NOx
493d	POINT	358221	6219721	715	0.68056	11.22	683	45.2	0.305	NOx
493e	POINT	358221	6219721	715	0.21759	5.5	1273	0.000171	0.914	NOx
493f	POINT	358221	6219721	715	0.14468	5.5	1273	0.000255	0.61	NOx
493g	POINT	358221	6219721	715	0.02083	8.9	1273	2.35E-05	0.762	NOx
517a	POINT	681071	6269762	755	2.08332	10.7	632	43.6	0.508	NOX
517b	POINT	681071	6269762	755	0.393516	6	724	46.7	0.2	NOX
517c	POINT	681071	6269762	755	0.219906	7.5			0.711	NOX
517d	POINT	681071	6269762	755	0.08449	6.7			0.61	NOX
517e	POINT	681071	6269762	755	0.023148	7.5			0.457	NOX
541a	POINT	405041	6207110	670	4.77662	8.2	753	42.4	0.61	NOx
541b	POINT	405041	6207110	670	4.99769	7.6	843	72	0.203	NOx
541c	POINT	405041	6207110	670	4.99769	7.6	843	31.9	0.305	NOx
541d	POINT	405041	6207110	670	4.00000	10.3	843	24.8	0.305	NOx
541e	POINT	405041	6207110	670	0.25463	9.8	843	40	0.356	NOx
55a	POINT	310978	6072252	678	4.583304	8	768	54.9	0.305	NOX
55b	POINT	310978	6072252	678	3.333312	8	1000	44	0.254	NOX
55c	POINT	310978	6072252	678	0.40046	10.1	755	46.8	0.28	NOX
55d	POINT	310978	6072252	678	3.685162	7.7	854	56	0.203	NOX
574a	POINT	641969	6039907	792	0.91435	5.46	837	58	0.14	NOx
574b	POINT	641969	6039907	792	0.46296	9.28	750	58	0.25	NOx

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
574c	POINT	641969	6039907	792	0.06944	7.2	1273	8.59E-05	0.71	NOx
574d	POINT	641969	6039907	792	0.01157	7.2	1273	0.000178	0.169	NOx
574e	POINT	641969	6039907	792	0.03472	7.2	1273	7.64E-05	0.5	NOx
574f	POINT	641969	6039907	792	1.01852	4	970	81.2	0.1	NOx
5a	POINT	485259	6089504	641	3.00926	6.6	684	44.7	0.31	NOx
5b	POINT	485259	6089504	641	3.00926	6.6	684	50.72	0.31	NOx
5c	POINT	485259	6089504	641	0.34722	8.8	513	10.93	0.76	NOx
5d	POINT	485259	6089504	641	0.00000	6.7	586	5.24	0.25	NOx
5e	POINT	485259	6089504	641	0.11574	65.5	693	7.78	1.22	NOx
618a	POINT	376357	6270936	899	0.83333	6	1273	1	8	NOx
618b	POINT	376357	6270936	899	0.90278	7.5	1273	1	8	NOx
618c	POINT	376357	6270936	899	1.52778	6	1273	1	10	NOx
618d	POINT	376357	6270936	899	4.44444	6	1273	1	6	NOx
618e	POINT	376357	6270936	899	0.06250	6	1273	1	18	NOx
618f	POINT	376357	6270936	899	0.10417	6	1273	1	24	NOx
620a	POINT	355097	6271611	730	0.21412	7	723	4.16	0.38	NOx
620b	POINT	355097	6271611	730	0.00579	4.27	723	1.71	0.1	NOx
620c	POINT	355097	6271611	730	0.01852	3.96	723	2.23	0.15	NOx
620d	POINT	355097	6271611	730	0.12153	7.52	723	2.09	0.41	NOx
620e	POINT	355097	6271611	730	0.12153	3.66	723	14.9	0.15	NOx
620f	POINT	355097	6271611	730	0.13542	6.45	720	40	0.1	NOx
620g	POINT	355097	6271611	730	0.45023	8.2	754	29.5	0.255	NOx
656a	POINT	503166	6104042	914.4	2.17014	7.5	800	25.05	0.203	NOx
656b	POINT	503166	6104042	914.4	0.45023	7.5	800	59.98	0.203	NOx
656c	POINT	503166	6104042	914.4	0.00810	6.1	750	2	0.255	NOx
656d	POINT	503166	6104042	914.4	0.02431	6.1	750	2	0.439	NOx
704a	POINT	613715	6280368	582	0.729162	9.6	723	44	0.45	NOX
704b	POINT	613715	6280368	582	0.185184	12	477	16.6	0.59	NOX
704c	POINT	613715	6280368	582	0.011574	4.5	477	6	0.22	NOX
73a	POINT	319683	6164361	815	1.79051	8.5	862	28.1	0.337	NOx
73b	POINT	319683	6164361	815	1.59838	8.5	766	37.4	0.305	NOx
73c	POINT	319683	6164361	815	0.68403	9.3	705	45.7	0.31	NOx

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
73d	POINT	319683	6164361	815	1.24653	5.5	813	29.1	0.152	NOx
80a	POINT	333101	6108680	600	1.866886	15.5	950	53.6	0.203	NOX
80b	POINT	333101	6108680	600	2.749982	6.7	886	34.5	0.254	NOX
80c	POINT	333101	6108680	600	0.633098	8.5	726	23.4	0.305	NOX
86a	POINT	405776	6139059	669	2.66202	11.4	773	46	0.203	NOX
86b	POINT	405776	6139059	669	0.243054	5.5	513	8.3	0.61	NOX
86c	POINT	405776	6139059	669	0.046296	4.5	478	0.1	0.61	NOX
87a	POINT	455814	6201408	572	3.04630	7.6	799	26.1	0.254	NOx
94a	POINT	513004	6042582	762	9.97685	7.8	663	36.4	0.406	NOx
94b	POINT	513004	6042582	762	5.10417	7	673	43.1	0.305	NOx
94c	POINT	513004	6042582	762	5.10417	5.6	673	43.1	0.305	NOx
94d	POINT	513004	6042582	762	4.64120	5.6	673	39.1	0.305	NOx
94e	POINT	513004	6042582	762	9.97685	10.3	650	30.7	0.406	NOx
94f	POINT	513004	6042582	762	0.26620	6.7	715	30.9	0.254	NOx
94g	POINT	513004	6042582	762	0.26620	6.6	715	30.9	0.254	NOx
94h	POINT	513004	6042582	762	0.23148	4.5	850	33.1	0.254	NOx
94i	POINT	513004	6042582	762	5.10417	6.7	673	62.1	0.254	NOx
94j	POINT	513004	6042582	762	1.87500	4.8	706	20.7	0.203	NOx
94k	POINT	513004	6042582	762	0.94907	5.5	704	19.9	0.152	NOx
94l	POINT	513004	6042582	762	0.94907	5.4	704	19.9	0.152	NOx
94m	POINT	513004	6042582	762	0.26620	7.1	850	37.8	0.254	NOx
94n	POINT	513004	6042582	762	0.26620	7.1	850	37.8	0.254	NOx
94o	POINT	513004	6042582	762	0.26620	8.9	850	37.8	0.254	NOx
94p	POINT	513004	6042582	762	0.26620	8.9	850	37.8	0.254	NOx
94q	POINT	513004	6042582	762	1.51620	12.1	673	16.7	1.52	NOx
94q	POINT	513004	6042582	762	1.00694	8	986	58.6	0.273	NOx
94r	POINT	513004	6042582	762	0.33565	9.75	723	42	0.61	NOx
94r	POINT	513004	6042582	762	0.82176	10.7	773	58.5	0.305	NOx
94s	POINT	513004	6042582	762	5.09259	9.1	986	45.3	0.356	NOx
94s	POINT	513004	6042582	762	0.05787	8.1	473	8.7	0.406	NOx
94t	POINT	513004	6042582	762	2.89352	6.4	986	41.5	0.254	NOx
94t	POINT	513004	6042582	762	0.21991	10.7	523	3	1.07	NOx

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s)	Stk. Ht. (m)	Temp (K)	Vel. (m/s)	Stk. Dia. (m)	Parameter
94u	POINT	513004	6042582	762	0.42824	10.7	673	24.1	0.46	NOx
94v	POINT	513004	6042582	762	0.01157	4.9	673	1.5	0.22	NOx
99aa	POINT	615849	6000300	761	0.01157	4.9	541	0.11	0.203	NOx
99ab	POINT	615849	6000300	761	0.15046	7.9	654	1.17	0.693	NOx
99ac	POINT	615849	6000300	761	0.57870	8.2	611	0.41	0.387	NOx
99ad	POINT	615849	6000300	761	0.09259	7.3	640	0.72	0.61	NOx
99w	POINT	615849	6000300	761	9.17824	25	677	32.68	0.457	NOx
99x	POINT	615849	6000300	761	0.03472	8.5	535	1.39	0.438	NOx
99y	POINT	615849	6000300	761	0.13889	7.3	624	2.04	0.591	NOx
99z	POINT	615849	6000300	761	0.57870	4.9	654	1.72	0.591	NOx

Table A-3 TSP Stack emission details – Data reported to AENV

Facility ID	Type	X Coord	Y Coord	Elev.	Emis (g/s-m2)	ReleaseHt (m)	Radius (m)	Vertices
PAENV1	AREA	362975	5986066	1131	0.017281837	5	1	5
PAENV2	AREA	388945	6100373	620	0.009107052	5	1	5
PAENV3	AREA	524226	6144435	604	0.005765126	5	1	5
PAENV4	AREA	380609	5975869	1324	3.32953E-05	5	1	5
POAENV1	AREA	654564	6129184	560	0.018172882	5	1	5
POAENV2	AREA	606057	5999851	786	0.00131751	5	1	5

Appendix B

Monitoring Program Implementation Timelines and Budgets

PASZA Expanded Monitoring Program Timeline
(Northern Expansion only)

	2007				2008				2009				2010				2011			
PASZA	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
43 Passives																				
Henry Pirker																				
Evergreen																				
Smoky Heights																				
Beaverlodge																				
Rover 1																				
Valleyview																				
	2007				2008				2009				2010				2011			
Expansion	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Peace River																				
12 Passives																				
Cadotte Lake																				
Rover 2																				

Peace River 2007	SO2	TRS	NO2	O3	THC	PM2.5	CO	Assume AENV will provide 2-3 Analyzers
20 Passives 2007	SO2	NO2	O3					(16 + 2 Blank + 2 Duplicate)
Cadotte Lake 2008	SO2	TRS	NO2					
Rover 2 2009	SO2	TRS	NO2					
Rover 2 2010	O3	THC						
Rover 2 2011	PM2.5							

PASZA Expanded Monitoring Program Budget
(Northern Expansion only)

PASZA EXPANDED ZONE BUDGET

	2007	2008	2009	2010	2011
Passive Monitoring Program	148440	152151	155955	159854	163850
Existing Continuous Program	240920	246943	253117	259444	265931
Continuous Program Additions	28876	99696	123088	148795	153957
Passive Program Additions	29450	60373	61882	63429	65015
Program Support	78874	94318	109607	108331	109193
Total Operations	**526560**	**653480**	**703648**	**739854**	**757945**
Capital Cost	80181	36000	119000	29142	30000
Capital Fund	1518	1625	3263	3345	3428
Capital	**81699**	**37625**	**122263**	**32487**	**33428**
Total Admin	**132510**	**135823**	**139218**	**142699**	**146266**
TOTAL Program	740770	826928	965130	915039	937640
AENV GRANT	-100000	-100000	-100000	-100000	-100000
	640770	**726928**	**865130**	**815039**	**837640**
5 YEAR PLAN (2005)	**625062**	**628778**	**614185**	**592681**	

NOCAZ Monitoring Program Timeline

	2007				2008				2009				2010				2011			
NOCAZ	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
30 Passives																				
Fox Creek																				
Kaybob South																				
Whitecourt																				
Slave Lake																				
Rover																				

30 Passives 2007	SO2	NO2	O3					(24 + 3 Blank + 3 Duplicate)
Fox Creek 2008	SO2	TRS						
Kaybob South 2008	SO2	TRS						
Whitecourt 2008	SO2	TRS	NO2	O3	THC	PM2.5	CO	Assume AENV will provide 2-3 Analyzers and 50 K annual operating funds
Slave Lake 2008	PM2.5	PM10						
Slave Lake 2009	NO2	O3						
Rover 2009	SO2	NO2						
Rover 2010	TRS	O3						
Rover 2011	THC	PM2.5						

NOCAZ Monitoring Program Budget

NOCAZ AQM PROGRAM

	2007	2008	2009	2010	2011
Program					
Passive Program	43500	89175	91404	93689	96032
Continuous Program	0	93498	180909	222141	240689
Program Support	4275	44072	61863	65457	66501
Total Operations	**47775**	**226745**	**334177**	**381287**	**403221**
Total Capital Cost	3,920	167,948	126,194	15,194	41,948
Capital Leasing	1485	69458	90947	62254	54564
Capital Fund	74	3473	4547	3113	2728
Capital Purchase	3994	171421	130741	18307	44676
Capital Lease	1559	72931	95494	65367	57292
Total Admin	**118650**	**121616**	**124657**	**127773**	**130967**
TOTAL Program lease	167984	421293	554328	574427	591481
TOTAL Program capital	170419	519783	589575	527367	578865
AENV		-50000	-50000	-50000	-50000
Total Leasing	**167984**	**371293**	**504328**	**524427**	**541481**
Total Purchasing	**170419**	**469783**	**539575**	**477367**	**528865**