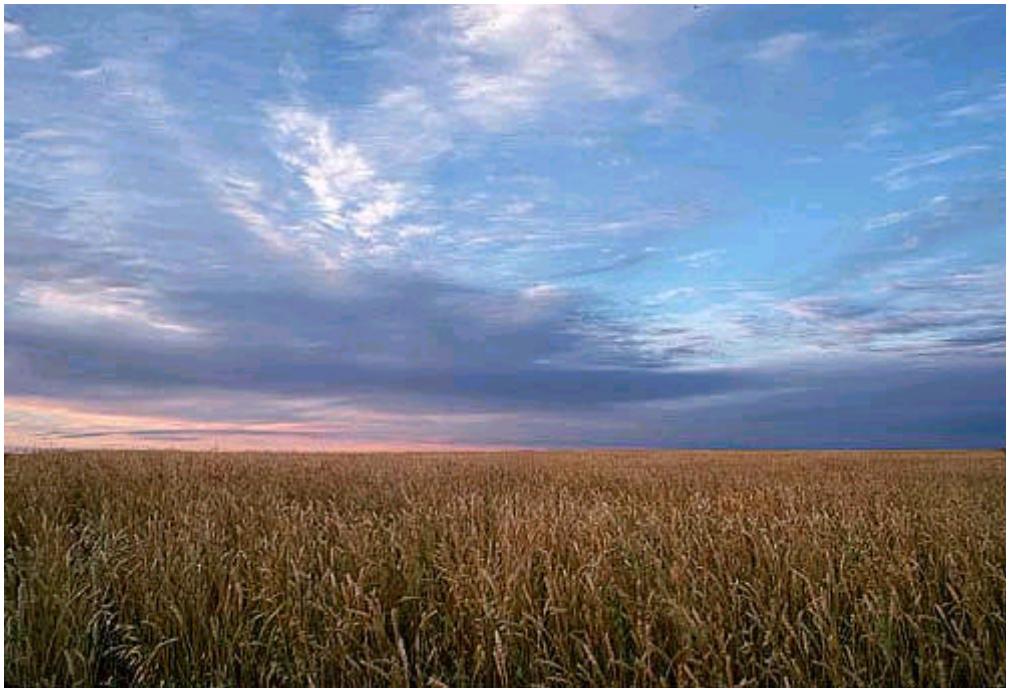

PARKLAND AIRSHED MANAGEMENT ZONE

2001 Annual Report

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Cover Photograph “Field” Image Credit: Roger Schmidt lklouise@yahoo.com

1. Executive Summary

The year 2001 was another significant and challenging year in the history of the Parkland Airshed Management Zone Association (PAMZ). Through the commitment and perseverance of its members and contractors, key goals the association had set for itself were achieved while significant progress was made on others. PAMZ is proud to present its accomplishments and progress in this, its fifth annual report.

2001 marked the first full year of operation of both the passive and continuous components of the PAMZ Air Quality Monitoring (AQM) Program. The Portable AQM station, a unique feature of the program, conducted monitoring at seven different locations during the year. The portable and the other three fixed stations that comprise the continuous AQM program collected the data needed by the association to better understand air quality issues that had been identified by its stakeholders and to build a geographic data base on air quality within the zone. For the year 2001, most of the air quality parameters monitored by the program were significantly below the Alberta Ambient Air Quality Guidelines, although there was one exceedence each of the hourly average hydrogen sulphide and ozone guidelines.

Four new passive monitoring stations were added to the AQM Network in January bringing the total number of permanent passive stations to thirty-two. In 2001, the passive monitoring network indicated that for the zone as a whole, sulphur dioxide levels were 33% lower than the previous year while nitrogen dioxide and ozone levels increased slightly. PAMZ stakeholders and others continue to be impressed with the results obtained from the passive AQM network. At the time of its establishment in 1999, the 45,000 km² PAMZ network was the largest scale application of this technology. The results achieved by PAMZ have demonstrated the accuracy and reliability of the technology when compared to other more established and expensive technologies. The PAMZ Program has influenced the decision of other airsheds (Peace Air Shed Zone Association) and organizations (Western Interprovincial Scientific Studies Association) to also employ this technology on a large scale.

In 2001, the various PAMZ committees organized public meetings, workshops and surveys to ensure that the air quality issues of the zone's residents could be recognized, understood and addressed. The results of the human health issues survey conducted at the end of the previous year were assessed and used in the planning of a series of public workshops being held in 2002. The public meeting held at Tees in May 2001 provided valuable input into the planning of the schedule and the locations for the Portable AQM Station. A survey of associa-

Bottrel Passive Monitoring Station

tion members in September re-prioritized existing and new air quality issues that had been identified at public meetings and from stakeholder input. Based on the survey results, workshops were planned for 2002 to explore air quality issues relevant to intensive livestock operations (ILOs) and to develop strategies for pollution prevention.

PAMZ and its members continued their involvement in several key Clean Air Strategic Alliance (CASA) Project Teams that are developing workplans and strategies to address those air quality issues common to all Albertans such as flaring, venting, and animal health. PAMZ was also actively involved in promoting the airshed management zone concept to several groups in the province that are considering zones to address their local air quality concerns.

Membership in the association grew to fifty-five companies from a broad range of sectors operating in the zone and to seven municipalities, making 2001 the most successful year yet both in terms of fund-raising and in improving regional participation in the association and its activities.

2. Introduction

PAMZ is a multi-stakeholder, non-profit society that was established in 1997 because of concerns regarding air quality issues within the zone as well as the emergence of a zonal air quality monitoring and management strategy under CASA.

PAMZ has the following Mission Statement: *The Parkland Airshed Management Zone (PAMZ) will implement a zonal approach to monitoring and managing air quality in the zone.*

Many of Alberta's air quality issues are local or regional, both in their causes and in the solutions required to deal with them. Establishing air quality management zones allows local stakeholders to design appropriate solutions for their problems. Zones are defined on the basis of emission sources and volumes, dispersion characteristics, impacts, and administrative characteristics such as land jurisdiction.

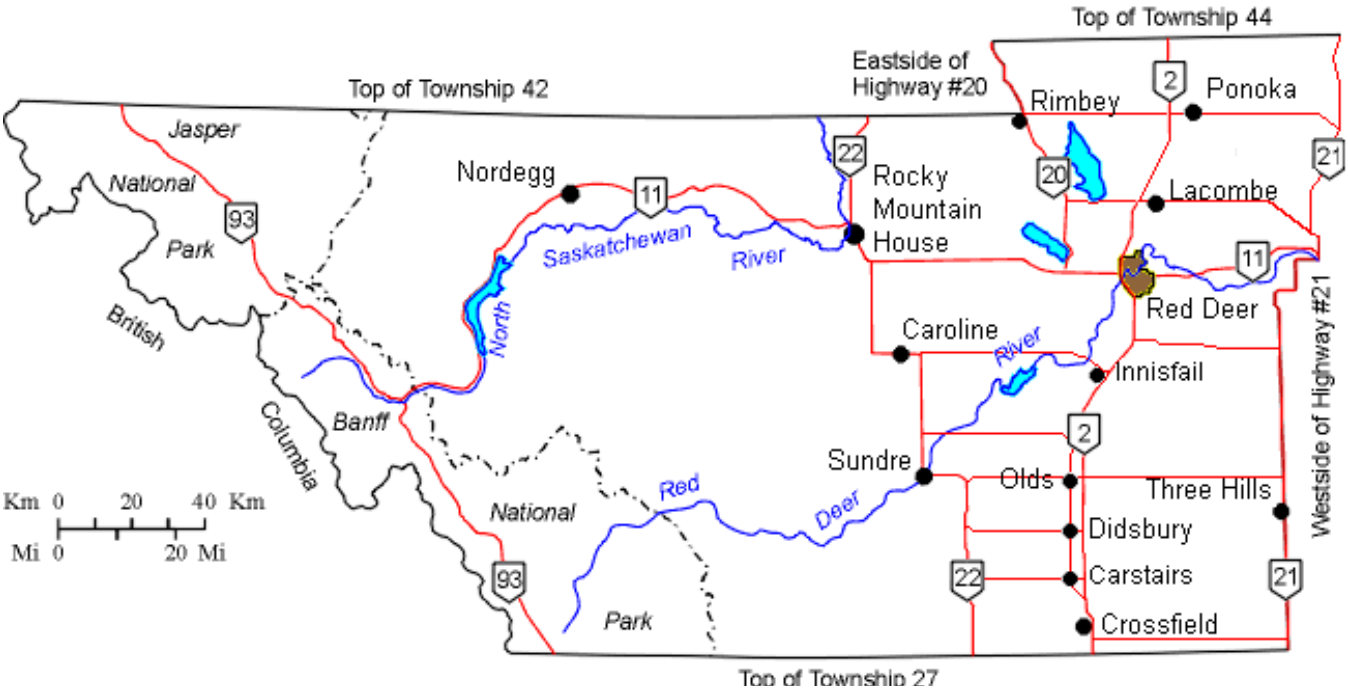
The air quality concerns that have been historically and more recently identified as being high priority issues for the zone are:

- **Human Health Effects**
- **Animal Health Effects**
- **Flaring**
- **Intensive Livestock Operations**
- **Pollution Prevention**

PAMZ recognizes that these are very broad issues and that an AQM Program can not address these issues alone. One of the first steps in the process of developing, implementing and evaluating strategies to address these issues is the collection of data by a comprehensive AQM Program operated within the zone's boundaries (see below) in order to understand the air quality within the region better.

PAMZ utilizes a public-based consensus decision-making process to identify and prioritize zonal air quality issues and to develop strategies and action plans to address these issues. The process has resulted in the establishment of various PAMZ committees to address some of these air quality issues. PAMZ is also actively involved in several important CASA Project Teams that have either developed or are developing strategies to address those issues common to all Albertans.

Funding of PAMZ is proportioned amongst its members at levels consistent with their contribution to emissions within the Zone, as determined by annual emission inventories. In 2001, PAMZ members' financial and in-kind contributions totaled approximately $449,000 and over 2500 hours, respectively.



Parkland Airshed Management Zone

3. Report From the Chair

The year 2001 as Chairman of the PAMZ Board of Directors has again been a rewarding one. It has been a pleasure working with such a dedicated group of people and I am thankful for the work of all the committees and the help I have received from other PAMZ members.

This has been a year of transitions. Until 2000 we had been striving to get our air monitoring programs up and running. We have now completed our first full year of operation of the continuous air monitoring program and the second full year of our passive network. We believe the current monitoring program is meeting our goals however we are now in a position to consider the future direction for PAMZ including changes to the air monitoring program in response to new air quality issues.

The existence of PAMZ is only possible through the financial and in-kind support of companies, municipalities and other stakeholders and I wish to acknowledge their contribution. Support continues to grow as various PAMZ initiatives are implemented. One of the goals of PAMZ was to make better use of funds spent on air monitoring and with the PAMZ Air Quality Monitoring Program I believe this goal is being achieved.

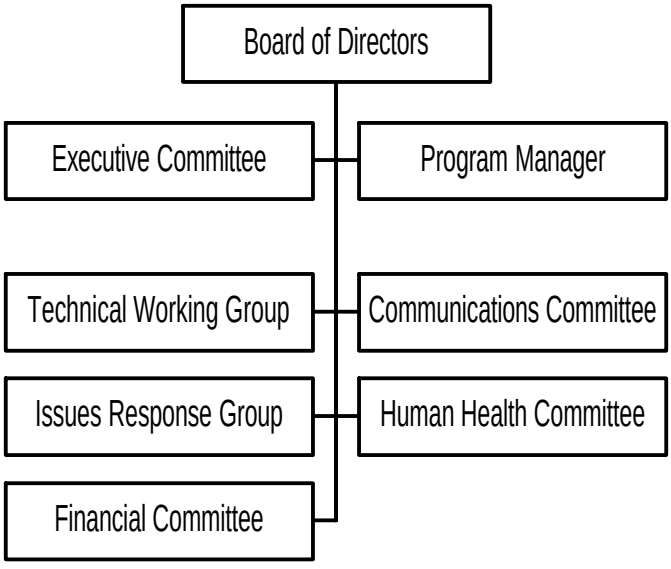
As this is my final year as the Chairman of PAMZ I wish to thank all the membership for their contributions and support over the past two years. It has taken a great deal of work from a great number of people but we are now seeing the results of those efforts. I look forward to what the future will bring and am confident that PAMZ will be successful in meeting all new challenges.

Brian Goliss
Chairman

4. Organization

The Parkland Airshed Management Zone Association is a non-profit organization whose membership is drawn from four stakeholder groups all united in a common purpose, to improve air quality. This goal is consistent with the objectives of CASA, PAMZ's parent organization. The Parkland Airshed Management Zone Association was incorporated under the Societies Act in April 1997, and operates under guidelines put forth by CASA.

Parkland Airshed Management Zone



The four stakeholder groups represented in the association are the public, industry, government, and non-government organizations (NGOs). The association's activities are managed by a Board of Directors. Each of the four sectors nominates directors and alternates to serve on the board. Individuals from local municipalities, provincial government departments, regional health authorities, the farming and ranching community, environmental organizations, industry and the general public represent their various sectors on the board, which has twelve directors at present. The current makeup of the board is:

- **Three public members**
- **Three industry members**
- **Four government members**
- **Two NGO members**

Committees for promoting the objectives or functions of the association are appointed and dissolved by the PAMZ Board. Each committee has a chairperson and reports to the board through that person. Currently there are five PAMZ committees:

- Technical Working Group (TWG)
- Human Health Committee (HHC)
- Issues Response Group (IRG)
- Communications Committee
- Financial Committee

The board may establish project teams to investigate, evaluate, and provide resolutions to specifically defined issues. The teams report to the board directly or through a manager and are composed of persons appointed by the board. Currently there are no project teams in operation.

A program manager, Kevin Warren, of Amarok Consulting, has been contracted to manage the PAMZ air quality monitoring program, oversee the implementation and evaluation of zonal air quality management strategies, and perform other tasks as identified in the position's terms of reference. The program manager reports to the board and sits on all of the association's committees and acts as an ambassador for the association.

Operation of the monitoring program has been contracted to a Calgary-based AQM services company, RSLS Environet Inc., that reports to the Program Manager. The analysis of the passive samplers is subcontracted to an Edmonton-based laboratory, Maxxam Analytics Inc.

PAMZ Executive & Members (L to R) Greg Calpas (Treasurer), Martha Kostuch (Secretary), Wayne Boyd (Board Member), Kevin Warren (Program Manager), Brian Goliss (Chairman), Reg Watson (2nd Vice-Chair), Donald Wainwright (TWG Member) Missing: David Lloyd (1st Vice-Chair)

5. Committee Reports

5.1 Technical Working Group

The Technical Working Group's (TWG) primary tasks are the operation of the zonal AQM Program, assessing the data collected by the program and recommending management strategies based on that data to the PAMZ Board. The group meets regularly and works closely with the program manager in overseeing the operation of the program to insure that the program is credible, affordable and provides the data required by the association's stakeholders to help them gain an understanding of the region's air quality.

In September, 2001 the TWG held a one-day planning session to assess the air quality program, the value that the zone's stakeholders are getting from the program and to draft a plan for the next five years of the program's operation.

The general view of the TWG was that the program has provided good value. The TWG agreed that communicating results and ensuring data are accessible and easy to understand are important and must be a focus of PAMZ. The plan and accompanying budget that was drafted for 2002-2006 considered the following possible areas where the program could be enhanced:

- More Continuous Ozone (O_3) Monitoring in the foothills region of the zone to establish the maximum levels and investigate the implications that these levels may have on achievement of the Canada Wide Standard (CWS) for O_3 and associated management strategies. Continuous O_3 monitoring will be conducted at a higher altitude station located northeast of Nordegg (Harlech) for six months in 2002.
- A fifth AQM station for the program that could be fixed or portable, and configured for monitoring specific pollutants or a broad range similar to the existing stations. This possibility is currently being reviewed by the TWG; some equipment that could later be used in a 5th station may be purchased in 2002.
- Monitoring of Ammonia at background sites and sites associated with Intensive Livestock Operations (ILOs). An existing analyzer was retrofitted to monitor ammonia and put into service in December.
- Monitoring of Volatile Organic Compounds (VOCs). Monitoring of VOCs using passive sampling on a weekly schedule also began in December.

- **Bio-Monitoring. The TWG will continue to monitor the programs underway in other zones and may implement similar strategies in the future.**

It was also agreed that an independent assessment of the AQM Program would be undertaken in 2002-2003.

5.2 Human Health Committee

The PAMZ Human Health Committee (HHC) acts as a forum to explore and address issues affecting human health that may be associated with air pollution. To this end, the HHC is comprised of representatives from a wide variety of interests including health, environment, academics, industry, agriculture and the general public.

In 2001 work continued on assessing the feasibility of implementing a human health–air quality monitoring system in a manner similar to that recommended by the CASA's Human Health Project Team in 1999. The initiative would be a long-range strategy, requiring the goodwill and teamwork of many sectors. The creation of an ongoing monitoring function of this nature would act as a tool to help understand the impact of air quality on human health.

In 2001 the HHC evaluated the results of a telephone survey of zone residents' air quality concerns that was conducted for PAMZ by the David Thompson Health Region and Olds College in December 2000. Public workshops are planned for the second quarter of 2002. The results of the survey will be used as a starting point for the workshops. The recommendations arising from the workshops will be utilized by the HHC in their development of a strategic work plan.

5.3 Issues Response Group

Throughout the year, work continued on four of the priority issues identified by PAMZ: human health, animal health, flaring, and intensive livestock operations. PAMZ members served on the various PAMZ committees and CASA project teams established to specifically address these issues.

In May 2001, a public meeting was held at the Tees Community Center to solicit input from the public and generate recommendations for the PAMZ Issues Response Group (IRG) on issues and possible locations for the Portable AQM Trailer. Approximately 40 attendees participated in the meeting, with representation from all four of PAMZ's stakeholder groups; public, NGOs, government (AENV & EUB), and industry.

The meeting resulted in the recommendation of four possible sites for the portable station from October 2001 through December 2002. These recommendations were adjusted and finalized by the Issues Response Group in July and adopted by the Technical Working Group and ratified by the PAMZ Board of Directors in September.

5.4 Communications Committee

In 2001 the PAMZ communications committee focused on increasing membership in the association. Membership drives aimed both at municipalities and industries operating within the zone were successful in increasing the association's membership from that of the previous year. Membership now includes 55 companies from a broad range of sectors that are operating within the zone's boundaries.

Presentations about the organization and its AQM were given to twelve municipalities located fully or partially within the zone's boundaries. Seven municipalities have become members of the association. Various presentations about the association were also given to students, companies, professional organizations, industrial associations, other airshed management zones and to the CASA's Board of Directors.

Besides securing members, these presentations sought to create an awareness of the work of PAMZ, its member companies and organizations. The presentations also sought to raise awareness of some of the principles of environmental protection, personal environmental responsibility and pollution prevention.

In the summer of 2001, the committee began publishing a quarterly newsletter, "The Zone", that provides information about PAMZ and related organizations and events, its Regional AQM Program, and air quality issues of concern to PAMZ stakeholders.

6.0 Emissions Inventory

The PAMZ Annual Emissions Inventory is a key component of the PAMZ AQM Program. The primary purpose of the inventory is to obtain a comprehensive assessment of all emission sources in the zone that are, or may be, affecting the zone's air quality. The emissions inventory provides assistance and guidance to the TWG in the operation and assessment of the air quality-monitoring program and also assists in the acquisition of additional participants within the zone.

The inventory is also used to generate the association's funding formulas that are reviewed on an annual basis and adjusted as necessary. The formulas ensure that funding of the program is proportioned amongst its members at levels consistent with their contribution to emissions within the zone.

For 2001 the results of the Emissions Inventory remained relatively consistent with those of the previous emissions inventory conducted in 2000 using emissions data for 1999. Emissions from six sectors are currently calculated and/or estimated using formulas consistent with those employed by the United States Environmental Protection Agency, Alberta Environment and the other airsheds in the province. These six sectors are:

- **Oil and Gas**
- **Agriculture**
- **Transportation**
- **Chemical**
- **Municipalities**
- **Natural Emissions**

Currently emissions from seven forestry facilities operating within the zone are not included in the emissions inventory. While some of the facilities record emissions concentrations, they do not record volumes and so no emissions data have been calculated. PAMZ is currently working on other means to obtain calculated or estimated emissions for the forestry sector.

The 2001 emissions inventory was conducted over a period of three months from September through November by a Husky Co-op Student from the University of Regina, David Kliman. Several substantial improvements were made to the Emissions Inventory with the goal of improving the inventory's overall accuracy, clarity, ease of use and reproducibility.

For the first time vented gas from oil and gas batteries and emissions associated with gas gathering systems were included in the oil and gas sector's inventory. Emissions for the transportation sector included both railways operating within the zone.

Detailed emissions data for livestock was extracted from an Alberta Agriculture June 1, 2001 Report entitled "Literature Review and Intensive Livestock Emission Inventory for Alberta" and was utilized in the 2001 emissions inventory.

In future years, the PAMZ Emissions Inventory will continue to be updated, reviewed and improved to ensure it can provide the data needed for funding and the assessment of air quality trends.

2000 PAMZ Emissions Inventory

	Sulphur Dioxide	Oxides of Nitrogen	Carbon Dioxide	Carbon Monoxide	Methane	Non-Methane Hydrocarbons	Volatile Organic Compounds	Total Organic Compounds	Primary Particulate Matter
	SO_2	NO_x	CO_2	CO	CH_4	NMHC	VOC	TOC	PM
Oil & Gas	54890	33552	1291344*	5241	6426	-	-	13069	-
Agriculture	-	120	-	-	61800	-	-	-	326222**
Transportation	255	7194	64105	17201	-	1408	736	-	33
Chemical	14	3480	2640027	1313	215	638	539	-	-
Municipalities	4	5904	737969	255	-	-	-	68	69
Natural	-	12	918	318	-	612	-	-	269
TOTALS	55163	50262	4734363	24328	68441	2658	1275	13137	326593

All Values Expressed in Tonnes

** Excludes Produced CO_2*

*** PM_{10} Only from " Literature Review and Intensive Livestock Emissions Inventory for Alberta", Alberta Agriculture June 2001*

7.0 Air Quality Monitoring Program

The year 2001 was the second full year of operation of the PAMZ Regional AQM Program which started in December 1999 with the establishment of the Program's Passive Monitoring Component.

The program's major components are:

- **A thirty-three station passive monitoring network for sampling NO_2, O_3 and SO_2 that began operation in December 1999.**
- **One continuous fixed monitoring station owned and operated by PAMZ.**
- **One continuous fixed monitoring station owned and operated by Alberta Environment.**
- **One continuous fixed monitoring station owned and operated by the West Central Airshed Society (WCAS).**
- **One continuous portable monitoring station owned and operated by PAMZ.**

The stations are configured for monitoring a number of parameters from a wide range of natural, industrial, non-industrial and mobile emission sources. The parameters that were chosen to be monitored are consistent with those being monitored in other air quality zones within Alberta and the Alberta Ambient Air Quality Monitoring System (AAAQMS) network .

The locations of all the continuous sites located within the PAMZ Boundaries (excluding the WCAS Station at Hightower Ridge) are identified on the map on page 20.

The program's design has four major attributes:

- **It will provide data to address the current and future air quality concerns/issues of the zone's various stakeholders.**
- **The data will contribute to the body of information required by the scientific community and other users to provide a better understanding of certain pollutants including their sources, behaviors and effects.**
- **It will be dynamic and evolutionary in nature and therefore, capable of responding to changing or emerging concerns, issues, technologies, and developments in other management zones/programs.**
- **It can be effectively funded by the zone's stakeholders while allowing PAMZ to research, develop and implement other programs and activities.**

The primary intent of the PAMZ Regional AQM Program is to provide high quality data required for the development and evaluation of strategies to address priority zonal air quality issues. As stated earlier, PAMZ recognizes that the issues are very broad and that an AQM program alone can not address them. One step in the process of developing, implementing and evaluating strategies to address the issues is the collection of data by a comprehensive AQM Program in order to understand the air quality within the region better. Informed decision-making concerning air quality issues requires information that has been derived from data that are complete, comprehensive and scientifically credible. The processes utilized to collect the data must be timely and efficient.

Partisol Particulate Sampler

Comprehensive and rigorous quality assurance and quality control (QA/QC) is an integral component of the PAMZ AQM program. It includes daily checks of calibration and instrument performance, regular multi-point calibrations and government audits. Data are examined for long-term systematic errors and all raw and quality controlled data are archived. Data collected by PAMZ is part of the province-wide, integrated data management system developed through CASA. The data can be accessed freely through both the PAMZ website (www.pamz.org) and the CASA Data Warehouse (www.casadata.org).

7.1 Continuous Monitoring

Continuous monitoring involves drawing air through a commercial analyzer calibrated to produce an output that is proportional to the ambient concentration of the compound being monitored. This methodology provides the greatest resolution but is also the most costly. Compounds typically measured in this way include sulphur dioxide (SO_2), hydrogen sulphide (H_2S), oxides of nitrogen (NO_X), ozone (O_3), particulates, and others.

The PAMZ continuous monitoring program monitors more parameters from a wider range of sources than those historically monitored in the zone. These include: NO_2, O_3, SO_2, H_2S, total reduced sulphur compounds (TRS), carbon monoxide (CO), methane, non-methane and total hydrocarbons (CH_4, NMHC, THC), and ammonia (NH_3). Inhalable particulate matter 10 microns in diameter and smaller (PM_{10}) and respirable particulate matter 2.5 microns in diameter and smaller ($PM_{2.5}$) are monitored intermittently.

The continuous monitoring program utilizes data collected at four continuous monitoring stations. The analyzers used in the program are capable of detecting low level concentrations of compounds that may be associated with chronic human and livestock health disorders as well as the higher levels associated with the health concerns resulting from acute exposures. The intensive QA/QC program associated with the monitoring and the data management make it possible to detect subtle changes and trends in data to allow for the assessment of the impacts of various emission-producing operations within the zone. Various meteorological parameters are also monitored continuously to gain a better understanding of possible sources and behaviors of the different pollutants.

The first station is a permanently fixed station located approximately 16 kms. south-southeast of the town of Caroline. It is situated at a location determined to have a relatively high SO_2 deposition level for the region through past modeling efforts.

The second station is located in the City of Red Deer and is currently owned by Alberta Environment and operated by Alberta Environment and the City of Red Deer as an AAAQMS Human Health Station.

The third station is located at Hightower Ridge, a remote area near the border of the Willmore Wilderness Park, northwest of Hinton. The station is owned and operated by WCAS. Because of its remote location and long distance from industrial emission sources, data collected by the station is used by WCAS and PAMZ as a regional background monitoring station.

Portable Continuous Monitoring Station at the Sundre Site

The fourth station is housed in a portable trailer that is located northeast of Crossfield for one month of every quarter and at other locations throughout the zone as recommended by the PAMZ Issues Response Group based on input received at public meetings and stakeholder input. Currently the primary uses of this station are to gather data to address regional air quality issues and to fill data gaps for specific geographic locations within the zone. The current monitoring schedule has the station on site at a location for a period of approximately 30 days, after which it is relocated to a new site. The portable trailer returns to the first site after an interval of six months so that data are collected during different seasons.

For the purposes of this report, data collected from the continuous stations in the PAMZ Program during 2001 have been compared to data collected at stations with similar characteristics (sources, population, etc.) located in other zones or cities.

In 2001, the locations and approximate months where monitoring with the portable station was conducted were:

Alix	April
Crossfield-Carstairs	February, May, August, & October
Leslieville	March & September
Rimbey	June
Stauffer	November
Sundre	January & July
Tees	December

The Alix Site was chosen because the passive data collected at a nearby site have frequently indicated that the SO_2 levels there were greater than the monthly network averages. There was a question as to whether these higher results were representative of the area or were associated with specific local sources. The monitoring conducted with the portable established that these higher levels were associated with two local sources located in the proximity of the site and were not indicative of the surrounding region as a whole. The high PM_{10} levels that were observed in April coincided with large grassfires burning in the Lacombe and Ponoka counties, upwind of the site.

The Leslieville Site was selected to fill in a geographic data gap for this area of the zone where no air quality monitoring had been previously undertaken. The monitoring indicated that air quality parameters for the area are generally at or near the detectable levels of the analyzers with the exception of O_3 and THC levels, which were comparable to the normal levels observed elsewhere in the zone. The high PM_{10} levels that were observed in September coincided with large forest fires burning in southeastern BC and in the Dogrib Creek area southwest from the site.

The Rimbey Site was chosen based on input received from the Rimbey and District Clean Air People (RADCAP) and the Town of Rimbey to measure the air quality in this area of the zone. The monitoring indicated that air quality parameters for this area are generally at or near the detectable levels of the analyzers with the exception of NO_2, O_3 and THC and CH_4 levels. The O_3 levels were comparable to the normal levels observed elsewhere in the zone. Based on these data and a request from PAMZ, Alberta Environment conducted a survey of possible sources for the elevated NO_2 and THC levels using their Mobile Air Monitoring laboratory (MAML) for a half-day in September. However, the monitoring by PAMZ and Alberta Environment was not able to establish the source(s) definitively. Similar levels of NO_2 and THC were also observed at the Tees Site in December. It is worth noting that both sites are located in valleys where there may be emission trapping due to the topography.

Monitoring in Stauffer was conducted based on a review of the historical complaint records maintained by Alberta Environment and the Alberta Energy and Utilities Board. The records indicated a cluster of complaints for the Stauffer area relating to a sour gas battery and a local recycling facility. Prior to the monitoring that was conducted in November, process upgrades and improvements had been made to the battery in the previous year, although there were still concerns relating to hydrocarbon odours from the recycling facility. The monitoring indicated that air quality parameters for the area are generally at or near the detectable levels of the analyzers with the exception of O_3 and THC levels. The O_3 levels were comparable to the normal levels observed elsewhere in the zone. Analysis of the THC observations is currently underway to determine if there is any correlation with winds from the direction of the recycling facility and another month of monitoring is scheduled for June 2002. The high PM_{10} levels that were observed in November coincided with a large forest fire that was still burning in the Dogrib Creek area.

Monitoring at the Sundre site was undertaken because of a history of concerns by a local rancher concerning the impacts of emissions from local oil and gas facilities on livestock health. To date, with the exception of one incident, the monitoring has indicated that air quality parameters for the site are generally at or near the detectable levels of the analyzers with the exception of O_3 and THC levels which were comparable to the normal levels observed elsewhere in the zone. On July 21, a 60 ppb hourly average of SO_2 (35% of Alberta Air Quality Guideline) was observed. An investigation into activities and operations in the area at the time of the observation was unable to ascertain a possible source(s). More monitoring at the site is being conducted in 2002 to provide data for all four seasons of the year.

The Tees Site was chosen based on input received from area residents concerning air quality and the possible impact of an Intensive Livestock Operation (ILO) that is scheduled to begin operations in 2002 at a location just southeast of the Town of Tees. The monitoring was conducted in December, before the ILO was operational, so that future data can be compared to information on background levels that predate the operation. To date, the monitoring has indicated that air quality parameters for the site are generally at or near the detectable levels of the analyzers with the exception of O_3 and THC and CH_4 levels. The O_3 levels were comparable to the normal levels observed elsewhere in the zone. Some elevated THC and CH_4 levels are probably related to emissions trapping by the topography of the valley in which the site is located. A $PM_{2.5}$ sample collected near the end of the December monitoring period that approached the CWS for $PM_{2.5}$ is currently being analyzed further to ascertain a possible source(s).

7.1.1 Sulphur Dioxide

Sulphur dioxide (SO_2) is a colorless gas with a strong, suffocating odor. It can be detected by taste and odour at concentrations as low as 300 parts per billion (ppb).

Sulphur dioxide is formed during the processing and combustion of fossil fuels that contain sulphur such as natural gas, coal and oil sands; only small quantities of sulphur dioxide come from gasoline fueled motor vehicle exhaust. Other sources of sulphur dioxide include gas plant flares, oil refineries, pulp and paper mills and fertilizer plants. Volcanic eruptions provide a natural source of sulphur dioxide in the atmosphere.

Sulphur dioxide is emitted directly into the atmosphere and can persist for days, allowing for wide distribution of the gas. In the atmosphere, sulfur dioxide is usually oxidized by ozone and hydrogen peroxide to form sulfur trioxide. Sulfur trioxide and sulfur dioxide are very soluble in water. If the sulfur oxides are present in the atmosphere when condensation occurs, tiny droplets of sulfuric acid (acid rain) are formed. Sulphur dioxide can combine with other atmospheric gases to produce fine particles.

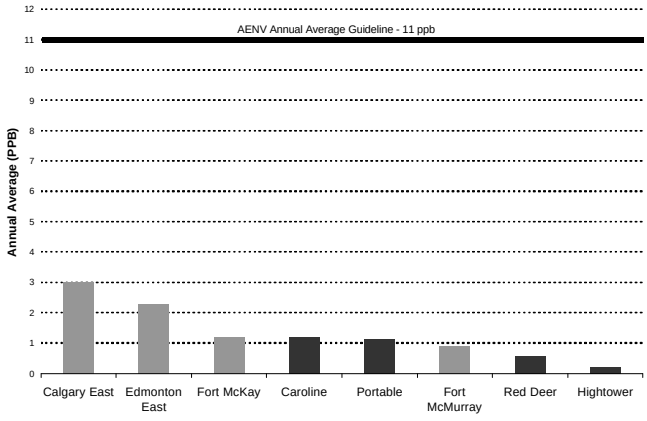
The 2001 inventory of SO_2 emissions within PAMZ was updated based on 2000 data. There was an 11% decrease in SO_2 emissions within PAMZ from the previous emissions inventory undertaken using 1999 data. It is estimated that sulphur dioxide emissions from sources located within PAMZ totaled 55,163 tonnes in 2000, primarily from the oil and gas sector. Improved operating efficiencies, process improvements, lower sulphur inlet levels and an overall reduction in flaring all contributed to the decrease.

The Alberta Ambient Air Quality Guidelines for sulphur dioxide are:

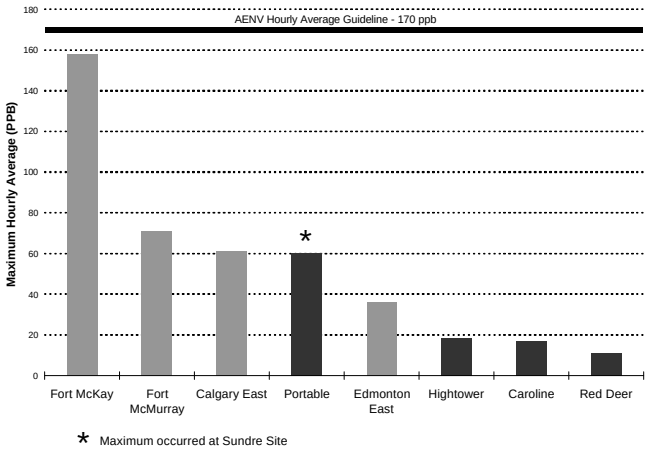
- **172 ppb averaged over a one-hour period**
- **57 ppb averaged for one day**
- **11 ppb averaged for one year**

Short-term (acute) exposures to high concentrations of sulphur dioxide can trigger constriction of the airways, causing particular difficulties for asthmatics. Children can experience increased respiratory tract infections and healthy people may experience sore throats, coughing, and breathing difficulties. Sensitive vegetation may be injured by exposure to high concentrations of sulphur dioxide. Long-term (chronic) exposure has been associated with increased risk of mortality from respiratory or cardiovascular disease.

The average sulphur dioxide concentration observed at the Caroline Station in 2001 was 1.2 ppb. The average sulphur dioxide concentrations observed at the Red Deer Station and Hightower Stations in 2001 were 0.6 ppb and 0.2 ppb respectively. These results are consistent with the location of the stations in relation to oil and gas producing operations. The Red Deer average was below the average observed in Fort McMurray (0.9 ppb), a similarly sized and populated city also located near oil and gas producing operations. The average sulphur dioxide concentration observed with the Portable Station in 2001 was 1.1 ppb, with the highest monthly average concentration of 2.1 ppb observed while the station was located at the Crossfield-Carstairs site. All of the above results are low and well within the Alberta Environment annual average guideline of 11 ppb.



SO_2 - 2001 Station Averages



SO_2 - 2001 Station Maximums

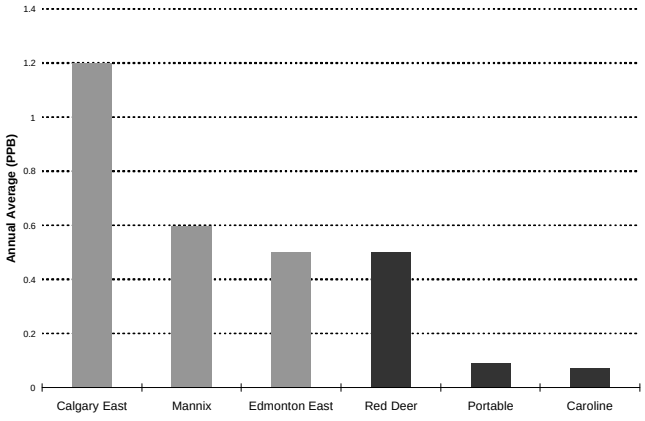
Sulphur dioxide concentrations during 2001 reached a maximum of 10% of the Alberta one-hour guideline at Caroline, 35% at the Sundre Site, 6% at Red Deer and 11% at Hightower.

The highest hourly average sulphur dioxide values at the Caroline, Hightower and Red Deer Stations occurred when the winds were from the north-northeast, northeast, and southern winds respectively. The highest average sulphur dioxide values at the Portable Station were recorded with north-northeast winds while the station was located at the Sundre Site. The north northeast directions for both the Caroline and Sundre sites are associated with local oil and gas production facilities. As discussed earlier, an investigation into the 60 ppb hourly average observed at the Sundre Site was unable to determine a possible source.

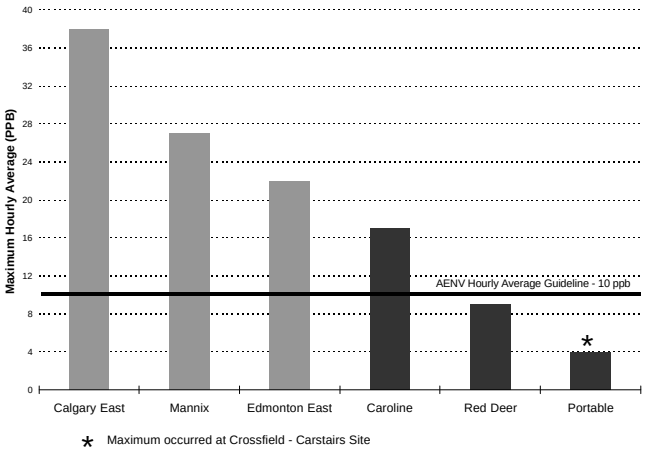
7.1.2 Hydrogen Sulphide

Hydrogen sulphide (H_2S) is a colourless gas with a rotten egg odour. While most people can detect hydrogen sulphide by odour at approximately 10 ppb, there are some individuals who can detect it at concentrations as low as 0.5 ppb. Hydrogen sulphide is heavier than air and is emitted at low temperatures, so it does not disperse rapidly in enclosed spaces and may collect in low-lying areas such as valleys.

The decomposition of organic matter by bacteria under anaerobic conditions (no oxygen) produces hydrogen sulphide. Natural sources of hydrogen sulphide include sulphur hot springs, sloughs, swamps, muskegs and lakes. Hydrogen sulphide can also be produced by chemical reactions within sedimentary rocks, particularly in the deeply buried sedimentary rocks such as those found in the foothills of the Canadian Rockies. "Sour" gas is natural gas containing hydrogen sulphide. Industrial sources of hydrogen sulphide include fugitive emissions from sour gas processing plants, sulphur pouring and remelting operations, exploratory wells, petroleum refineries, tank farms, oil sands plants, sewage treatment facilities, pulp and paper plants which use the kraft pulping process and animal feedlots.



H_2S - 2001 Station Averages



H_2S - 2001 Station Maximums

The Alberta Ambient Air Quality Guidelines for hydrogen sulphide are based on an odour threshold of 10 ppb. The guidelines for hydrogen sulphide are:

- **10 ppb averaged over a one-hour period**
- **3 ppb average for one day**

At concentrations of 1,000-5,000 ppb, H_2S causes a moderate to strong offensive odour and people may experience nausea, tearing of the eyes, headaches or loss of sleep following prolonged exposure. By 10,000 ppb, the symptoms may increase or persist with lung irritation and damage to eyes occurring at levels of 20,000 ppb.

The average hydrogen sulphide concentration observed at both the Caroline Station and the Portable Station in 2001 was 0.1 ppb. The highest monthly average concentration observed at the portable station was 0.2 ppb while the station was located at the Crossfield-Carstairs site. These values are slightly lower than that observed at a similarly located station named Mannix, a station located near two large oil sands processing facilities near Fort McMurray, with an annual average concentration of 0.6 ppb. The average hydrogen sulphide concentration

observed at the Red Deer Station in 2001 was 0.5 ppb, the same value for a station located in East Edmonton but lower than a similarly location station in East Calgary that had an annual average of 1.2 ppb.

Hydrogen sulphide concentrations observed at the Caroline station in 2001 exceeded the Alberta one-hour guideline of 10 ppb on one occasion in April. The cause of this exceedence of 17 ppb could not be ascertained. No exceedences of the Hydrogen Sulphide Guideline were observed at the Portable or Red Deer Stations during 2001. For comparison, the highest observed one hour concentrations at the Calgary East, Mannix and Edmonton East stations in 2001 were 37, 27 and 22 ppb respectively. During 2001 there were a total of 48, 12 and 4 exceedences of the one-hour average guideline observed at the Calgary East, Mannix and Edmonton East Stations respectively.

7.1.3 Total Reduced Sulphur Compounds

The term "total reduced sulphur compounds" (TRS) is used to collectively describe hydrogen sulphide, mercaptans and other reduced sulphur compounds such as carbonyl sulphide (COS) and carbon disulphide (CS_2). All of these compounds have characteristic odours that are readily detectable by people at very low concentrations.

The major component of the TRS observed by the PAMZ continuous monitors is hydrogen sulphide. The sources of hydrogen sulphide have been discussed previously. The sources of the other reduced sulphur compounds are treatment lagoons associated with kraft paper mills, incomplete combustion in sour gas flares and fugitive emissions from pipelines (mercaptans are used as an odorant in natural gas).

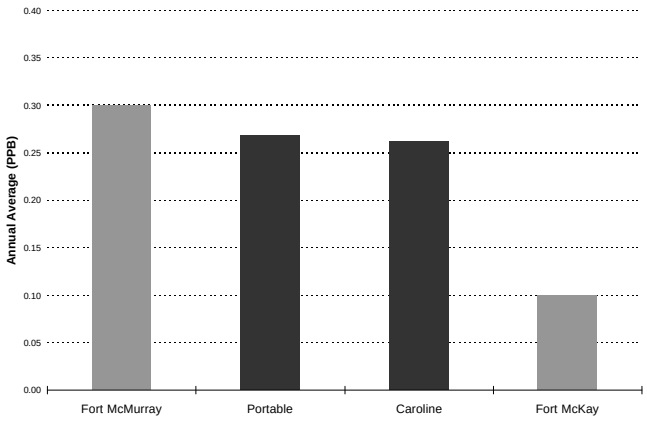
While there are no Alberta Environment Guidelines for TRS in general, there are guidelines for H_2S specifically as reported earlier.

TRS is monitored at the two PAMZ-operated stations but not at Red Deer or Hightower.

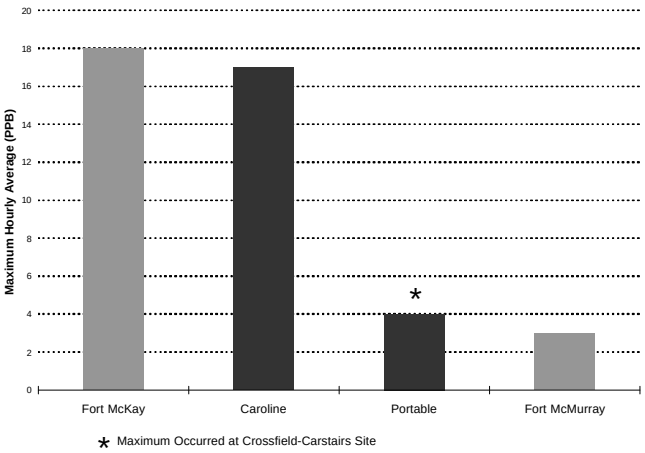
The average total reduced sulphur concentration observed at the Caroline and Portable Stations in was 0.3 ppb. The highest monthly average concentration of 0.5 ppb for the Portable Station was observed while the station was located at the Crossfield-Carstairs Site. These results are also consistent with the observations recorded by co-located H_2S analyzers. Again, it is important to note that the TRS results include H_2S concentrations and that within the Zone, H_2S is the primary component of the TRS observed.

The average values are also similar in magnitude to those observed at two similarly located stations, the first at Fort Mackay, a station located near two large oil sands processing facilities near Fort McMurray, with an average TRS concentration during the same time period of 0.1 ppb. The second station is located in Fort McMurray, a city also situated downwind from oil sands refining operations, that had an average TRS concentration during the same time period of 0.3 ppb.

The highest maximum one hour TRS measurement observed at the Caroline Station was 17 ppb. The maximum one hour average TRS concentration was recorded during the same episode when the maximum H_2S concentration (17 ppb) was recorded. The highest maximum one hour TRS measurement observed at the Portable Station was



TRS - 2001 Station Averages



TRS - 2001 Station Maximums

the 4 ppb value recorded in May with northwest winds while the station was located at the Crossfield-Carstairs Site. Again, these results are consistent with the observations recorded by co-located H_2S analyzers on the same dates.

During 2001 the maximum one hour TRS measurements observed at the Fort McMurray and Fort McKay stations located in the Wood Buffalo Environmental Association (WBEA) monitoring network (H_2S is not monitored specifically at these sites) were 3 and 18 ppb respectively.

7.1.4 Oxides of Nitrogen

Oxides of nitrogen (NO_X), mostly in the form of nitric oxide (NO) and nitrogen dioxide (NO_2), are products of all types of combustion, but are primarily produced by the high temperature combustion of fossil fuels. For the purposes of air quality monitoring, oxides of nitrogen are considered to be the sum of nitric oxide and nitrogen dioxide. Most oxides of nitrogen are emitted in the form of nitric oxide. Nitric oxide reacts rapidly in the atmosphere through various mechanisms to form nitrogen dioxide. Nitrogen dioxide is a reddish-brown gas with a pungent irritating odor.

Oxides of nitrogen emissions are produced by transportation (automobiles, trucks, trains), industrial sources (oil and gas industries) and power generation plants. Smaller sources of oxides of nitrogen include natural gas combustion (e.g. home heating), heating fuel combustion and forest fires. The largest urban source of oxides of nitrogen is emissions from motor vehicles.

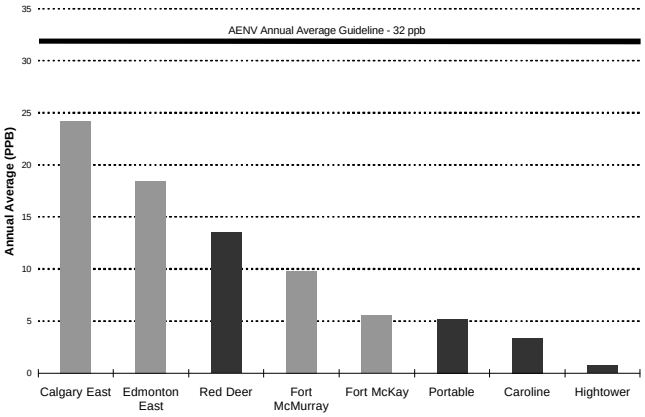
The 2001 inventory of NO_X emissions within PAMZ was updated based on 2000 data. There was a substantial increase (44%) in reported NO_X emissions within PAMZ from the previous emissions inventory undertaken in 2000 using 1999 data, primarily due to the inclusion of NO_2 emissions associated with oil and gas gathering systems (compressor facilities) in the inventory for the first time. It is estimated that oxides of nitrogen emissions from sources located within the Zone totaled 50,262 tonnes in 2000. The two major contributors were oil and gas and transportation sectors, accounting for 67% and 12%, respectively, of the total emissions.

The Alberta Ambient Air Quality Guidelines for nitrogen dioxide, the major component of nitrogen oxides in the ambient atmosphere, are:

- 212 ppb averaged over a one-hour period
- 106 ppb averaged for one day
- 32 ppb averaged for one year

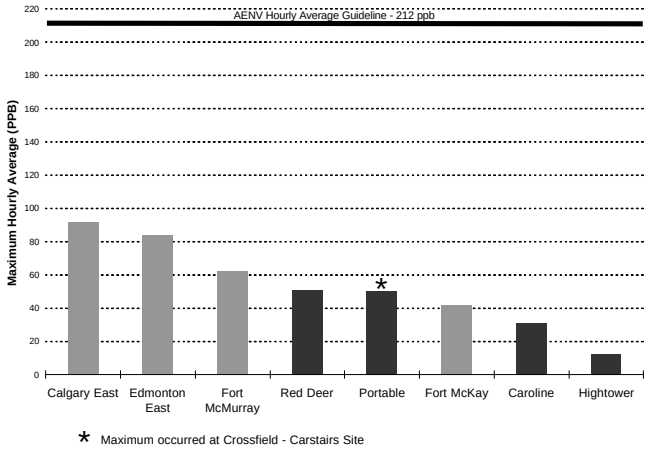
At higher concentrations, nitrogen dioxide is an irritating gas that may constrict the airways of asthmatics and increase the susceptibility to infection in the general population. It is a major component of atmospheric photochemical reactions that lead to smog formation, acid rain and ground level ozone formation and destruction. Exposure of vegetation to high concentrations of oxides of nitrogen results in observable effects such as leaf colouring and impairment of leaf function.

The average nitrogen dioxide concentration observed at the Caroline Stations in 2001 was 3.4 ppb. The average nitrogen dioxide concentration observed with the Portable Station in 2001 was 5.2 ppb, with the highest monthly average concentration of 12 ppb observed while the station was located at the Crossfield-Carstairs site. The average nitrogen dioxide concentrations observed at the Red Deer Station and Hightower Stations during the year were 13.5 and 0.7 ppb respectively. These results are all consistent with the location of the stations in relation to oil and gas facilities and transportation sources. The average concentration for Red Deer is slightly higher than the average of 9.8 ppb observed during 2001 for the station located in the similarly sized city of Fort McMurray.



NO_2 - 2001 Station Averages

The annual averages for all sites in the PAMZ monitoring program network are less than 31% of the Alberta Guideline of 32 ppb for an annual average nitrogen dioxide concentration in ambient air. These values are also all lower than the 2001 averages measured in the downtown areas of Alberta's two largest cities, Edmonton and Calgary, where emissions are primarily from motor vehicles.



NO_2 - 2001 Station Maximums

In 2001, nitrogen dioxide concentrations reached a maximum of 15% of the Alberta one-hour guideline at Caroline, 24% at the Crossfield-Carstairs location, 24% at Red Deer and 6% at Hightower, again consistent with the stations' proximity to oil and gas producing operations or transportation sources. The highest hourly average nitrogen dioxide values at the Caroline, Portable and Red Deer Stations occurred when the winds were from directions associated with motor vehicle traffic.

7.1.5 Ozone

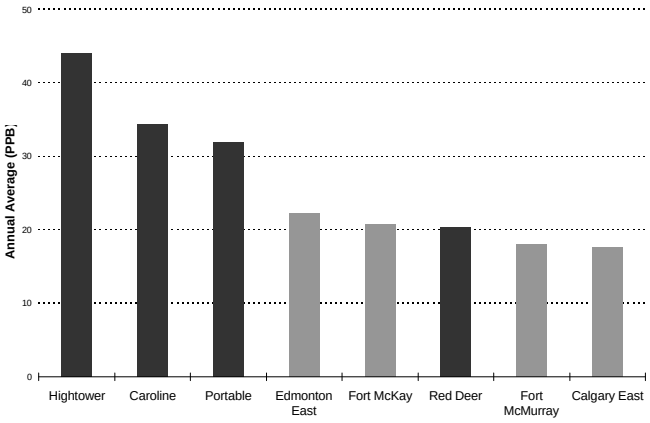
Ozone (O_3) is a colorless gas that at normal outdoor concentrations is odourless. However, ozone does have a distinctive sharp odour when found at higher concentrations, such as those associated with electrical discharges from lightning storms or photocopiers.

The ozone layer in the upper atmosphere (stratosphere) absorbs UV radiation and creates a warm layer of air in the stratosphere. The ozone layer is therefore responsible for the thermal structure of the stratosphere. Stratospheric ozone shields the Earth against harmful rays from the sun, particularly ultraviolet B radiation. Ozone that is present at ground level (troposphere) is a pollutant, as it is involved with NO_X in the photochemical production of many of the constituents of air pollution, and is also a primary constituent of smog.

Globally, ground-level ozone is mostly anthropogenic, the result of man's activities. However ozone is different from other pollutants in that it is not emitted directly into the air. It is a "secondary" pollutant because it is produced when two "primary" precursor pollutants, nitrogen oxides and volatile organic compounds (VOCs), react in the presence of heat and sunlight under stagnant meteorological conditions. VOCs are emitted from a variety of sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources. Ozone and the precursor pollutants that cause ozone can also be transported into an area from pollution sources, such as urban centers and industrial complexes, that are located hundreds of kilometers upwind. A major source of VOCs in rural areas is natural emissions from trees and vegetation.

In Alberta, ozone concentrations are generally lower at urban locations than at rural locations. This may be due to the destruction of ozone by nitric oxide that is emitted by motor vehicles. In Alberta, maximum ozone values are generally recorded during the late spring and summer when ozone production in the lower atmosphere is at a maximum due to a peak in incoming sunlight combined with stagnant weather conditions. At other times of the year, high daily average ozone values may be influenced by dynamic atmospheric processes such as tropopause folding and episodes of stratospheric ozone intrusion.

A Canada Wide Standard for ozone has been issued and the Province of Alberta has given the Clean Air Strategic Alliance a mandate to develop an implementation plan for Alberta. Several PAMZ members and PAMZ itself are represented on the project team that has been formed to



O_3 - 2001 Station Averages

formulate implementation plans for both particulate matter and ozone. The Alberta Ambient Air Quality Guideline for ozone is:

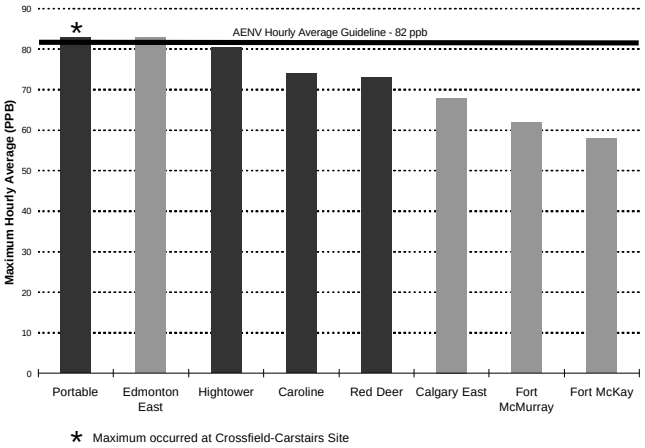
- 82 ppb averaged over a one-hour period

At higher concentrations, ozone's health effects can include reduced lung function; aggravated existing respiratory illness; and irritated eyes, nose, and throat as it is a strong oxidizer. High concentrations can reduce crop yields. Chronic exposure can cause permanent damage to the alveoli of the lungs.

In 2002, the CASA PM and O_3 Project Team will use data from the Caroline Station for one of three scenarios to develop methodologies for determining when sources of ozone are natural or anthropogenic or a combination of the two. The result will have implications for a management framework the team is developing for managing Ozone levels in Alberta. The Canada Wide Standard for Ozone will be 65 ppb based on an 8-hour averaging time with achievement to be based on the 4th highest measurement annually, averaged over 3 consecutive years.

During 2001 there was one exceedence (83 ppb) of Alberta Environment's hourly average guideline. It was recorded at the Crossfield-Carstairs site on August 18 with northeast winds. Over the two-day period in August, during which the 83 ppb exceedence was recorded, the 8-hour average of 65 ppb was also exceeded twice. The source(s) of these high readings has not been established.

The maximum ozone concentrations recorded at the Caroline and Red Deer stations in 2001 were 74 ppb



O_3 - 2001 Station Maximums

and 73 ppb respectively. The average annual ozone concentrations for the three stations located within the zone, the Caroline, Red Deer and Portable Stations were 34 ppb, 20 ppb and 32 ppb respectively. At the Hightower station, the background monitoring station, located in an area remote from industrial activity, the maximum one hour and average for the period were 81 ppb and 44 ppb respectively. These values are all consistent with and typical of the values observed at other urban, rural and remote locations where continuous monitoring is conducted in Alberta.

In 2002, ozone concentrations at the Harlech site located near Nordegg will be monitored with a continuous monitor for a six-month period. This program is discussed further in the section on ozone passive monitoring.

7.1.6 Hydrocarbons

Hydrocarbons are divided into two broad categories, "reactive" and "non-reactive" hydrocarbons. The term "total hydrocarbons" (THC) refers to a broad family of chemicals that contain carbon and hydrogen atoms and includes both reactive and non-reactive hydrocarbons.

Reactive hydrocarbons include many volatile organic compounds such as alkenes, alkynes, benzene, toluene, ethylbenzenes and xylenes and other aromatics. Reactive hydrocarbons are important because they can react with oxides of nitrogen in the presence of sunlight to form ozone and may be toxic to humans, animals or vegetation. Polycyclic aromatic hydrocarbons are of particular interest because they are less volatile than other reactive hydrocarbons and many are known carcinogens.

The major non-reactive hydrocarbon in the atmosphere is methane, which is a naturally occurring colorless, odorless gas that is recognized as a major contributor to the greenhouse effect.

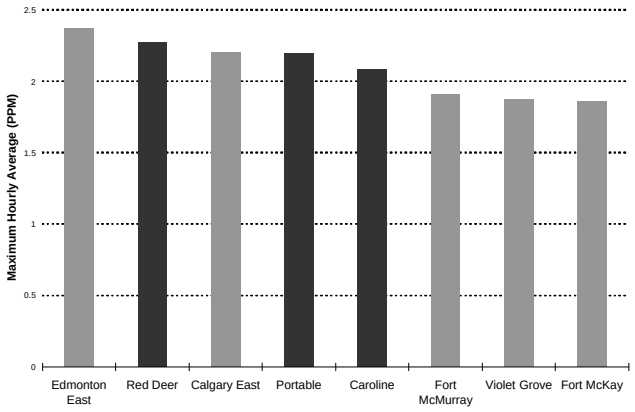
Large amounts of methane are produced naturally through the decay of vegetation but human activity is contributing to a worldwide increase in methane concentrations of about 1% per year. Trees and plants are major natural emitters of reactive hydrocarbons with other significant sources being vehicular emissions, gasoline marketing and storage tanks, petroleum and chemical industries, dry cleaning, fireplaces, natural gas combustion and aircraft traffic. Motor vehicles are the major source of hydrocarbons in urban areas.

Alberta does not have guidelines for ambient (outdoor) concentrations of total hydrocarbons. Natural background total hydrocarbon concentration ranges from 1.5 to 2.5 ppm.

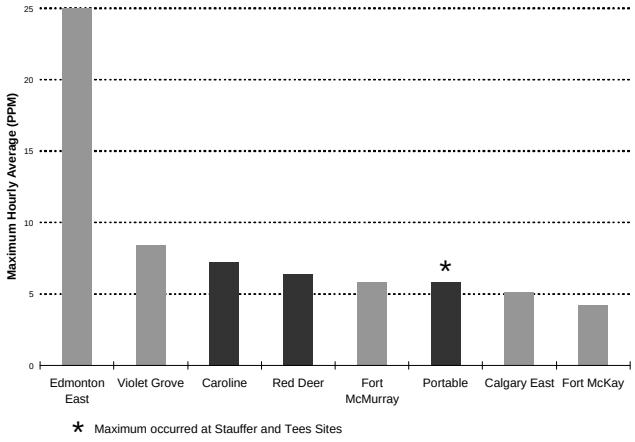
From January through May 2001, the PAMZ program monitored both Total Hydrocarbons and Methane concentrations at the Caroline Station and Total Hydrocarbons only at the Portable and Red Deer Stations. From June through December 2001, the PAMZ program monitored both Total Hydrocarbons and Methane concentrations at the Portable Station and Total Hydrocarbons only at the Caroline and Red Deer Stations. Total hydrocarbons are not monitored continuously at the Hightower Station.

The average total hydrocarbon concentration observed at the Caroline Station in 2001 was 2.1 ppm. This average is slightly higher than that observed during the same time period at the Violet Grove Station (1.9 ppm), located near Drayton Valley and consistent with both stations' locations with respect to oil and gas producing locations. The total hydrocarbon concentrations observed at the Red Deer Station during 2001 was 2.3 ppm, greater than those observed in Fort McMurray, a similar-sized city, but similar to those observed in the cities of Calgary and Edmonton. The average total hydrocarbon concentration observed with the Portable Station in 2001 was 2.2 ppm, with the highest average concentration of 2.9 ppm observed while the station was located at the Tees site. The average is higher than normal for a rural site and may be associated with vehicle traffic on a major highway (Highway 12) located south of the Tees Site in the same valley.

The highest maximum one hour THC measurement observed at the Caroline Station was the 7.2 ppm value observed when winds were from the west, a direction associated with a local pipeline compressor station. This maximum is slightly lower than the 8.4 maximum observed at the similarly-located Violet Grove Station. The highest maximum one hour THC measurements observed with the Portable Station were the two 5.8 ppm values observed in November and December when the station was located at the Stauffer and Tees Sites with east southeast winds and south winds respectively. These directions are associated with a local recycling facility and a major highway. The highest maximum THC concentration observed at the Red Deer Station was 6.4 ppm, which was similar to the maximums of 5.8 ppm and 5.1 ppm observed at the Fort McMurray and Calgary East Stations respectively and attributable to motor vehicle traffic.



THC - 2001 Station Averages



THC - 2001 Station Maximums

7.1.7 Inhalable Particulates

The term inhalable particulates, or PM_{10}, refers to particles that have a diameter of less than 10 microns and are suspended in the air for an indefinite period of time. PM_{10} is a mixture of various substances. These substances occur in the form of solid particles or as liquid drops. Some particles are emitted directly into the atmosphere. Other particles result from gases that are transformed into particles through physical and chemical processes in the atmosphere.

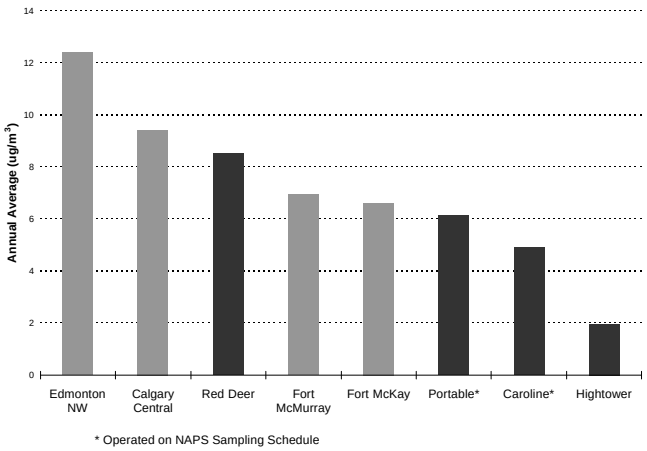
A variety of emission sources and meteorological conditions contribute to ambient PM_{10}. PM_{10} can be divided into two groups of particles based on size: fine particles and coarse particles. The fine particles are those particles that are less than about 2.5 microns in diameter and are known collectively as $PM_{2.5}$. In contrast, the coarse particles are those that are greater than about 2.5 microns in diameter.

A variety of emission sources and meteorological conditions contribute to ambient PM_{10}. In Alberta, sources of inhalable particulates include soil, road dust, dust result-

ing 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).

A variety of emission sources and meteorological conditions contribute to ambient PM_{10}. Generally, the fine particles pose the greater health risk because these particles can be deposited deep in the lung and contain substances that may be harmful to health. In addition to their health impacts, the fine particles are the main contributors to reduced visibility. The particles give smog its colour. Particulate pollution can cause eye, nose and throat irritation and other health problems. Numerous studies have linked inhalable particulate matter to aggravated heart and lung diseases such as asthma, bronchitis and emphysema.

The PAMZ Monitoring Program utilizes integrated particulate samplers to collect both PM_{10} and $PM_{2.5}$ samples at its Caroline and Portable Stations. PM_{10} and $PM_{2.5}$ concentrations were monitored continuously at the Hightower Station, while only $PM_{2.5}$ was monitored at the Red Deer Station during 2000. Integrated particulate sampling involves drawing a known volume of air through

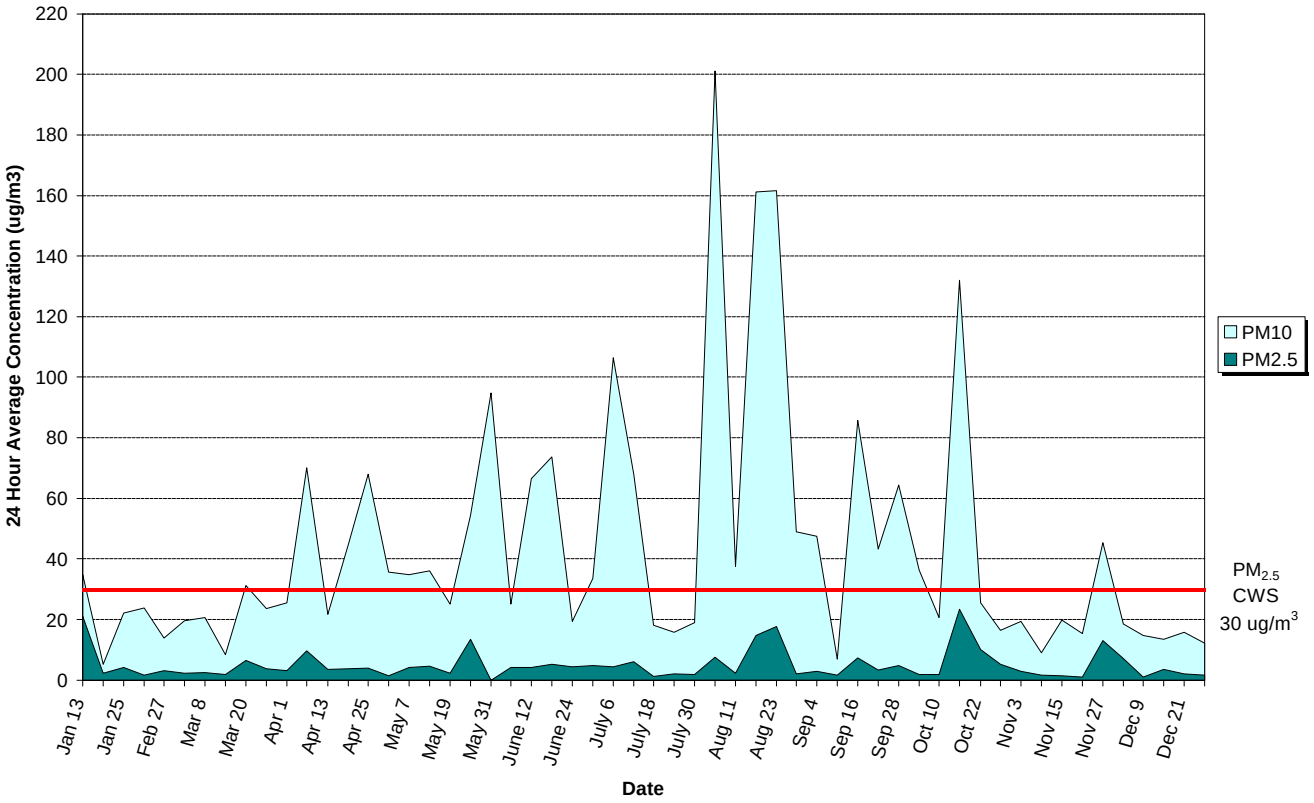


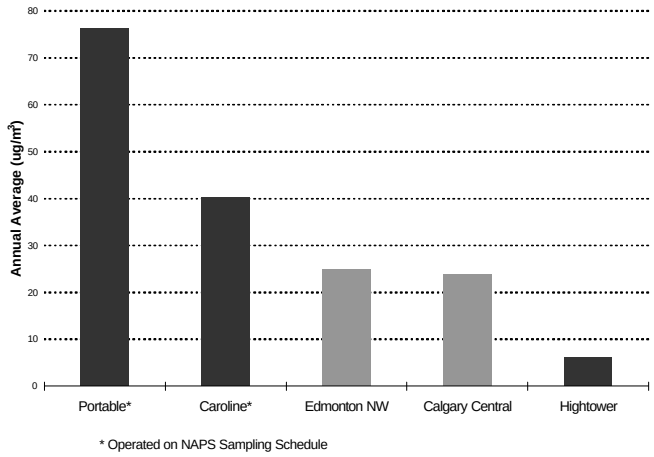
$PM_{2.5}$ - 2001 Station Averages

a filter to collect a specific pollutant. After a known period of exposure, the filter is analyzed gravimetrically (weighed) in a laboratory to determine the amount of particulate that was collected, from which an average ambient air concentration can be determined.

The PAMZ program collects particulate samples every six days for a twenty-four hour period, on the same schedule (NAPS Schedule) as many other AQM Networks located

Particulate Sampling Results - Caroline - 2001



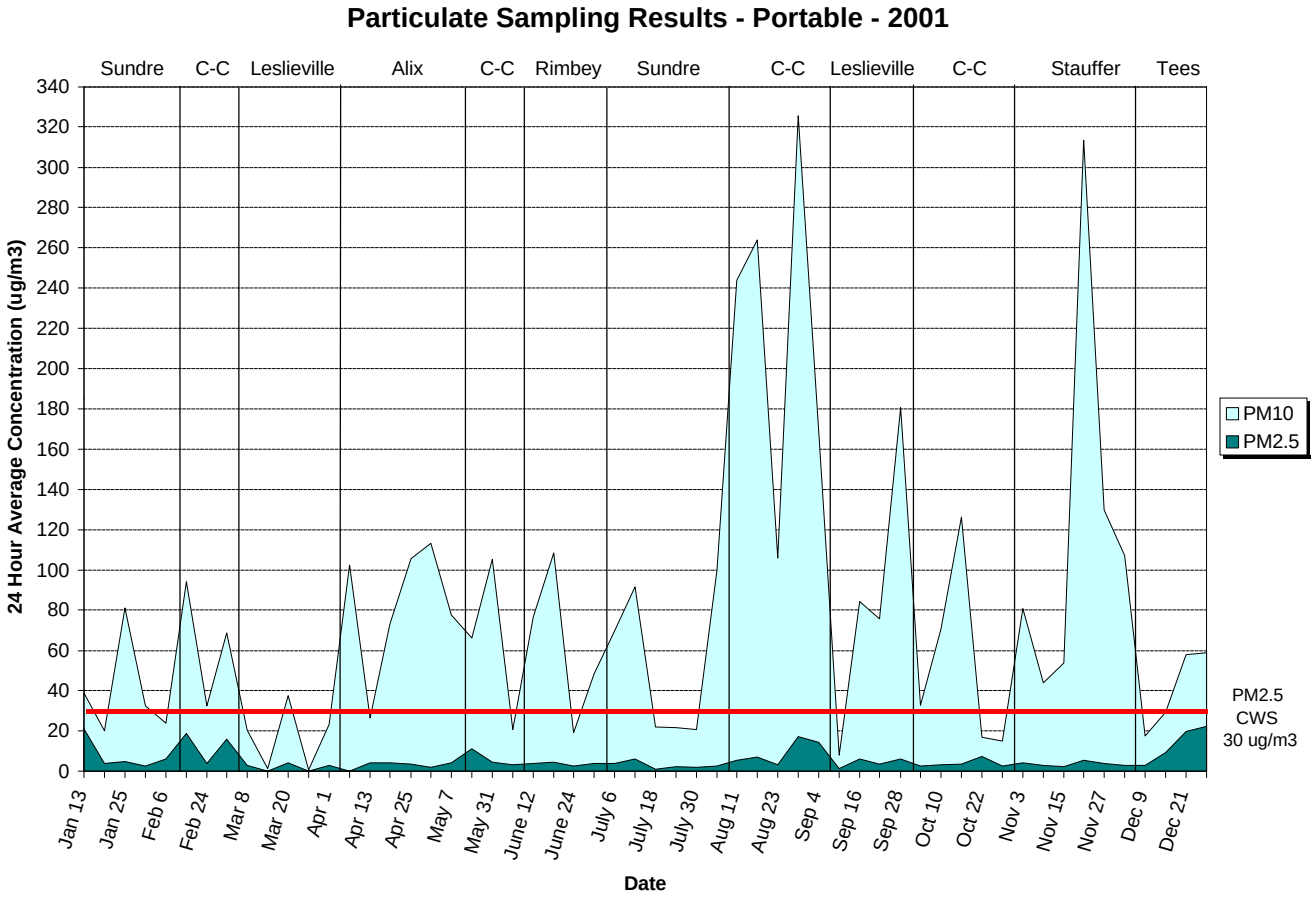


PM_{10} - 2001 Station Averages

throughout North America. While the PAMZ program is currently focused on quantitative analysis of the filters, these filters are retained and further analysis can be performed to determine the compounds that are present in the sample for the purposes of source apportionment or other reasons. There are currently no Alberta Guidelines for PM_{10} or $PM_{2.5}$. A Canada Wide Standard (CWS) for $PM_{2.5}$ has been issued. The CWS for $PM_{2.5}$ is a 24 hour average of 30 micrograms per cubic meter (ug/m³) based on the 98th percentile ambient measured annually, averaged over 3 consecutive years.

For 2001, the average $PM_{2.5}$ concentrations at the Hightower, Caroline and Portable stations were significantly lower than those observed at urban locations such as Edmonton, Calgary, Red Deer and Fort McMurray where a significant portion of the $PM_{2.5}$ monitored can be attributed directly to motor vehicle traffic. During 2001, there were no exceedences of the $PM_{2.5}$ CWS observed by the PAMZ AQM Program with at either the Caroline or Portable Stations with integrated sampling on the NAPS Schedule or at the Hightower and Red Deer Stations with continuous monitoring.

On several occasions, the integrated PM_{10} samples collected at both the Caroline and Portable Stations the PAMZ AQM program exceeded the Alberta Total Suspended Particulate Guideline (100 ug/m³). The probable sources of the episodes were grass fires, forest fires and agricultural activities such as stubble-burning and plowing. For 2001, the average PM_{10} concentrations at the Caroline and Portable stations were significantly higher than those observed at urban locations such as Edmonton and Calgary. While the fires and agricultural activities appear to have had a very significant impact on the PAMZ PM_{10} averages, their impact on the $PM_{2.5}$ averages appears to be minor.



7.1.8 Meteorology

Air quality depends on the rate that pollutants are emitted to the atmosphere and the rate at which these compounds are dispersed away from the sources. Air pollution transport and dispersion are influenced by wind speed and direction, the temperature structure of the atmosphere, the solar cycle, turbulence and changes in these elements induced by local topography.

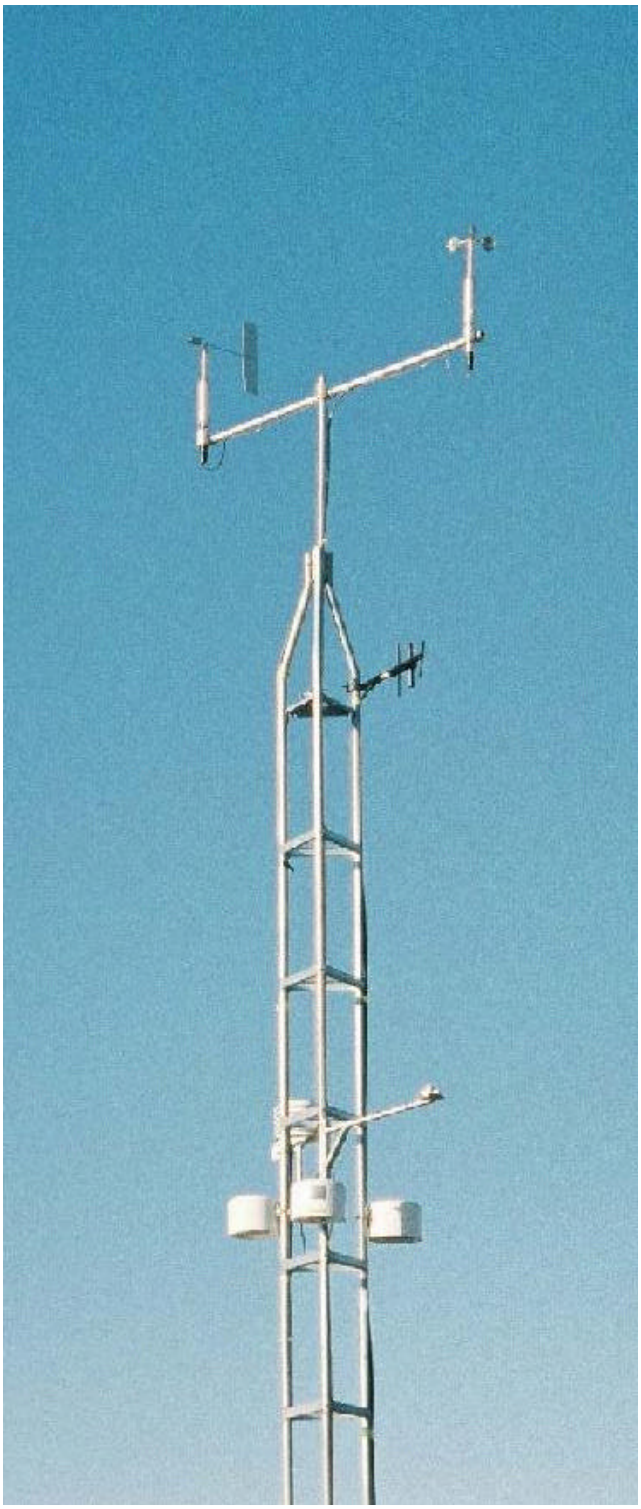
The interpretation of the continuous and passive data is supported by basic meteorological measurements of parameters that affect the transport and dispersion of emissions. Meteorological parameters measured in support of the Parkland Airshed Management Zone's Air Quality Monitoring program are:

- **wind speed and direction**
- **temperature**
- **solar radiation**
- **relative humidity**

For 2001, the average temperature for the Caroline Station was 4.4 degrees C, with a maximum of 32.0 degrees C and a minimum of –27.4 degrees C. The average temperature for the Portable Station was 4.4 degrees C, with a maximum of 33.6 degrees C and a minimum of –29.4 degrees C, both of which were observed at the Crossfield-Carstairs site. The 2001 average temperatures for the Red Deer and Hightower Ridge stations were 5.0 and 3.2 degrees C respectively.

Winds at the Caroline Station were predominantly from the west and northwest, with winds from the southeast also occurring frequently. At the Alix location winds were predominantly from the northwest, with a large component of southerly winds as well. At the Crossfield-Carstairs location the winds were predominantly from the southwest. At the Leslieville location the winds were predominantly from the southeast, with a large component of northwest winds as well. At the Rimbey location the winds were predominantly from the northwest and southeast due to the influence of the Blindman River Valley in which the station was located. At the Stauffer location, the winds were predominantly from the southeast, with a large component of northwest winds as well. At the Sundre location, the winds were predominantly from the southwest.

The winds at the Red Deer Station were primarily from the south due to the influence of the Red Deer River valley in which the station is located. Winds at Hightower Ridge were predominantly from the west.



Meteorological Tower and Sensors for the Portable Continuous Monitoring Station

7.2 Passive Monitoring

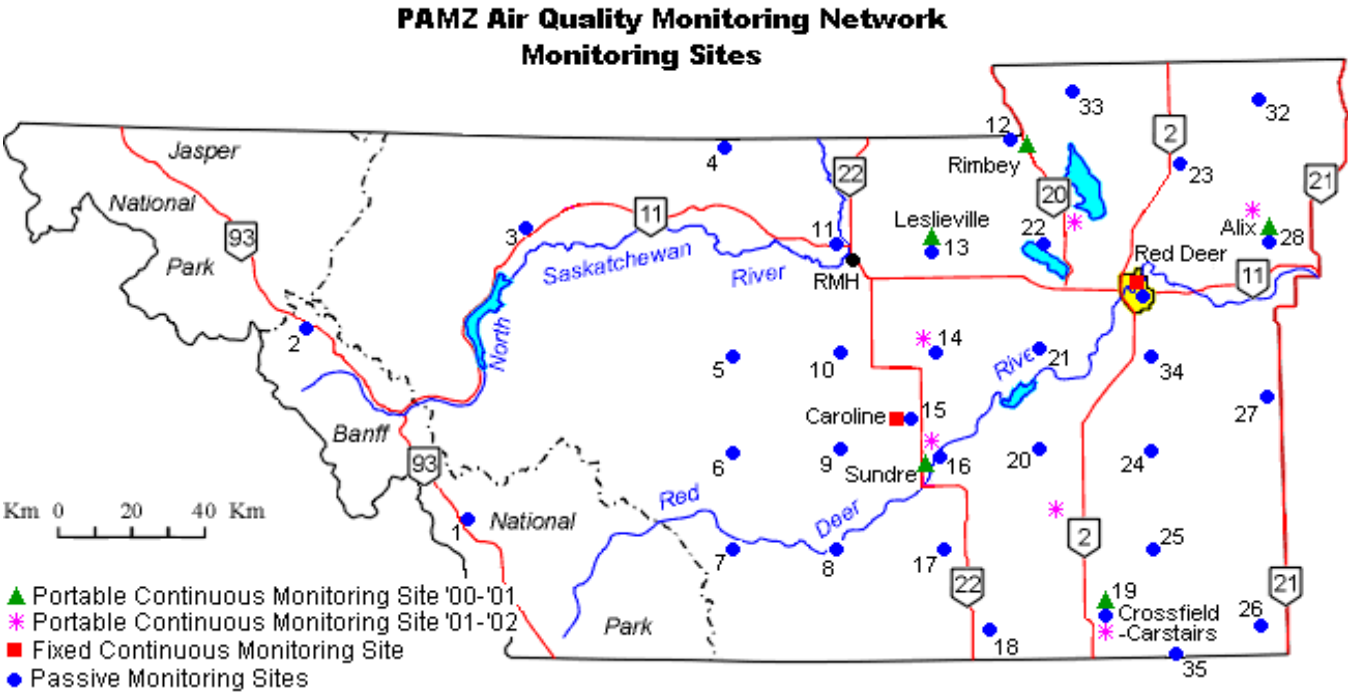
The PAMZ AQM Program uses passive monitors as a cost-effective method of collecting air quality data over a large region (45,000 sq. km.). The resulting database is suitable for the identification of long term air quality trends and assessing spatial variability, a typical approach in making regional-scale air quality assessments. The advantages of the passive samplers used by PAMZ are their simple design, low cost and ease of use. No power is required for operation, making them suitable for remote use; the only major restriction in locating samplers is the ability to access the sampler.

Passive samplers rely on the principles of permeation and diffusion to physically uptake the specific compound 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.

The PAMZ Passive Monitoring Network was expanded to thirty-two permanent stations in January 2001 with the addition of four new stations. Two of these sites (32 & 33) were located to provide air quality data in Ponoka County within the newest part of the zone added in March 2000. The other two locations (34 & 35) were established to monitor emissions downwind of large population centers (Red Deer and Calgary). For 2001, passive data collected at the Red Deer AQM Station, owned and operated by Alberta Environment, has also been included in the PAMZ Passive Monitoring Network. Currently the parameters included in the network are SO_2, NO_2 and O_3. The passive monitoring stations are located throughout the zone on a 3 X 3 township grid system, though there is a bias to the more developed eastern part of the zone, due in part to the limited accessibility of the zone's western regions. Passive monitoring is conducted on a monthly interval year-round.

In January 2002 a detailed review of the passive data collected at the Caroline and Portable Monitoring Stations in 2001 was undertaken. The review indicates that, similar to 2000, the monthly average data for all three passive parameters at the two reference stations correlated very closely to the monthly averages obtained from the co-located continuous monitors.

Average monthly concentrations are calculated for each site from an average of the samples collected and analyzed. After review and acceptance by the PAMZ program manager, the passive data are archived in the CASA Data Warehouse. Post maps are used to summarize the results. The diameter of each circle in the post map is proportional to the monthly average concentration of the compound at each station. Some of the zone's major population centers are also indicated on the map. Monthly average post maps can be viewed on the association's website www.pamz.org. Hard copy and digital formats of the data and post maps of the results are available upon request, from the PAMZ program manager.

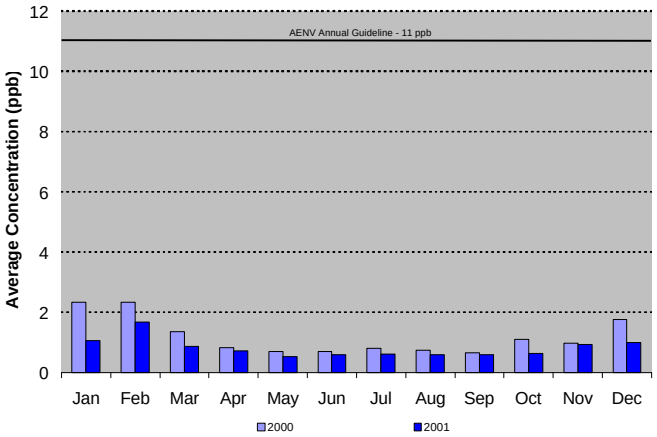


7.2.1 Sulphur Dioxide

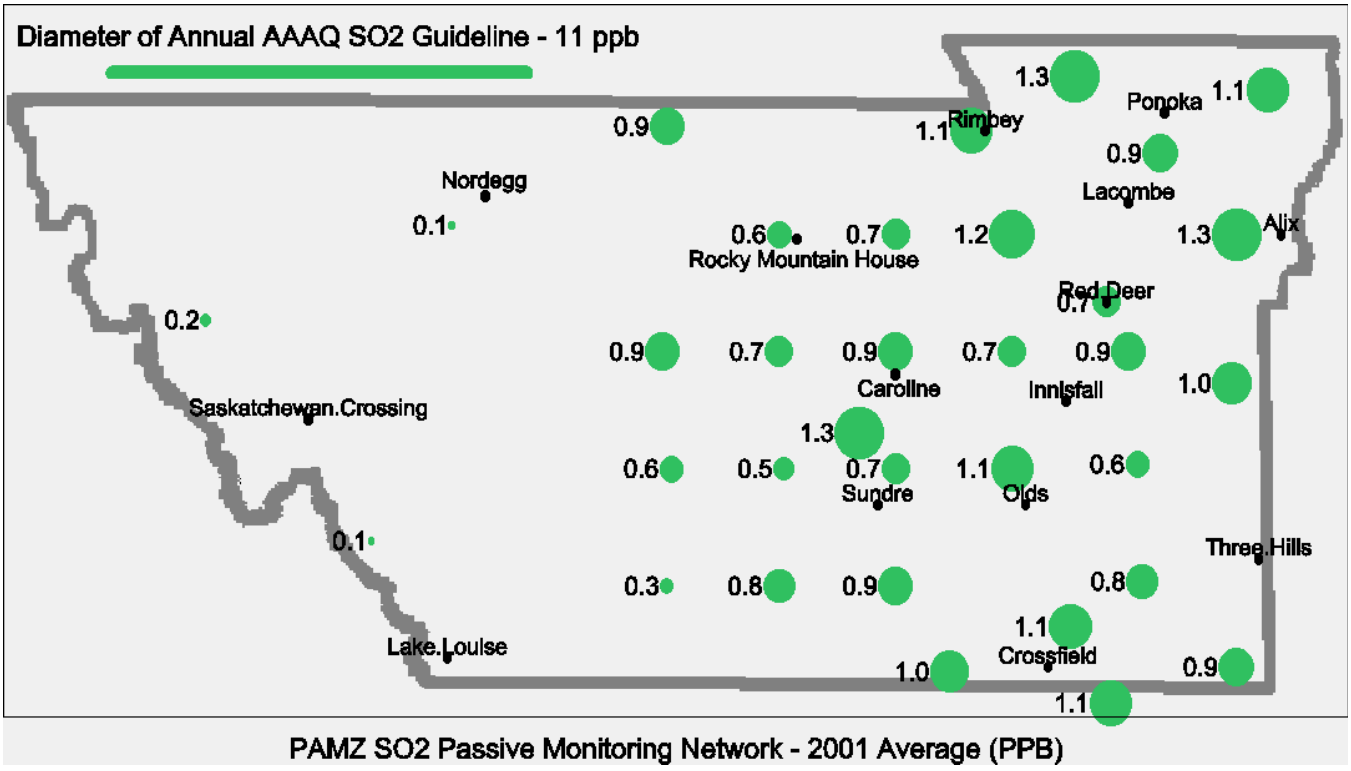
The production levels of the large sour gas processing facilities in the Zone, the major source of SO_2 emissions in the Zone, remained relatively consistent throughout the year. Ambient SO_2 concentrations observed throughout the zone, however, displayed predictable seasonal variations. The highest monthly averages for the passive sulphur dioxide network were observed during the coldest months of the year, when the amount of thermally-induced mixing of the atmosphere was at a minimum. The lowest monthly averages were observed in late spring and summer when there was much higher dispersion of sulphur dioxide due to the greater amount of thermal mixing brought about by higher solar radiation levels.

The 2001 annual average SO_2 concentration for the entire network was 0.8 ppb, which was 33% lower than the 2000 average of 1.2 ppb and significantly below the Alberta Environment annual guideline of 11 ppb. With only two years of data, it is difficult to ascertain if this data represents a decreasing trend given that SO_2 emissions from sources within the zone had also decreased from the previous year by 11% or if the lower average is the result of differing climatic conditions or a combination of both.

For 2001, the two sites with the greatest annual average concentrations, consistent with the observations for the year 2000, were Sites 15 (Caroline), 28 (Alix), and 33 (Ferrybank) all measuring 1.3 ppb. These sites are located in the vicinity of sour gas processing facilities. The sites with the lowest annual average SO_2 concentration were Site 1 (Bow Summit) and 3 (Bighorn) both measuring 0.1 ppb. These sites are located in the western region of the zone, far away from any industrial sources of sulphur dioxide.

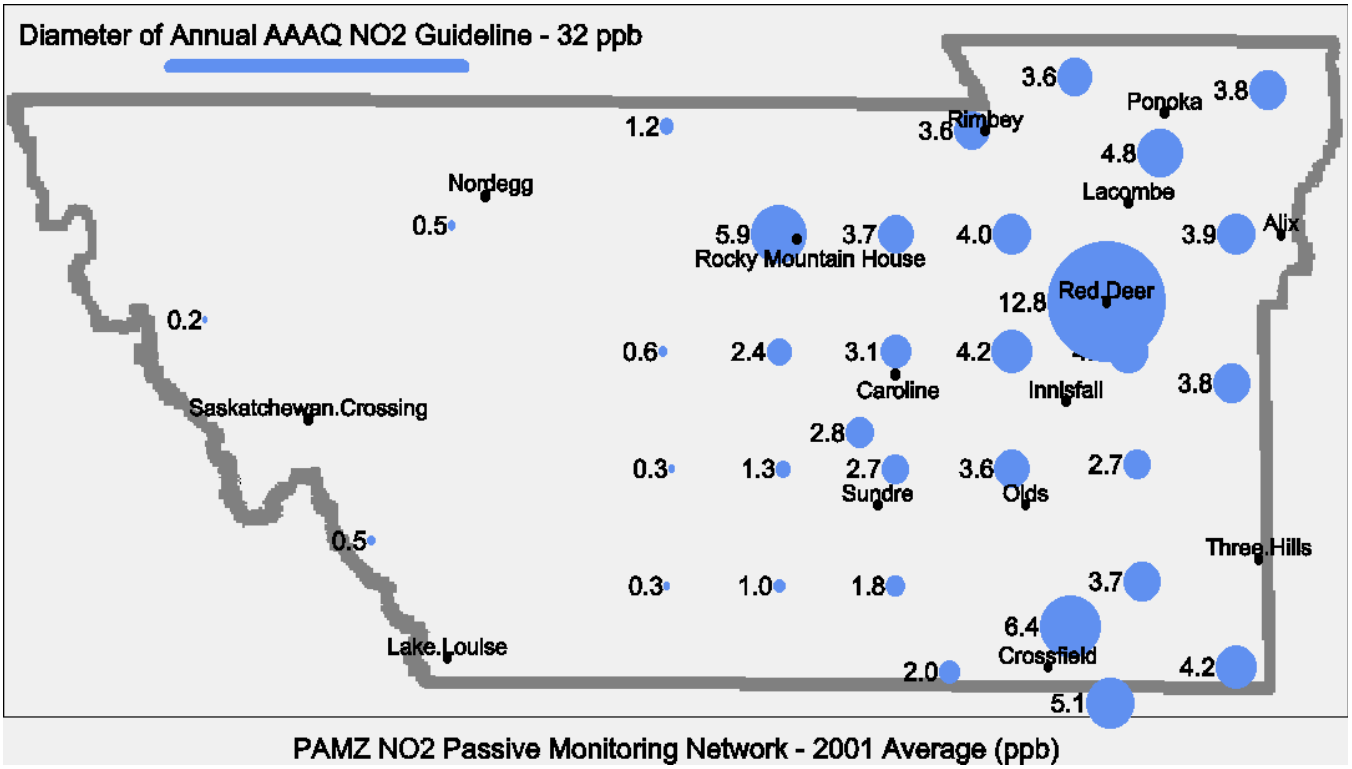


Passive SO_2 Monitoring
Monthly Averages



PAMZ SO2 Passive Monitoring Network - 2001 Average (PPB)

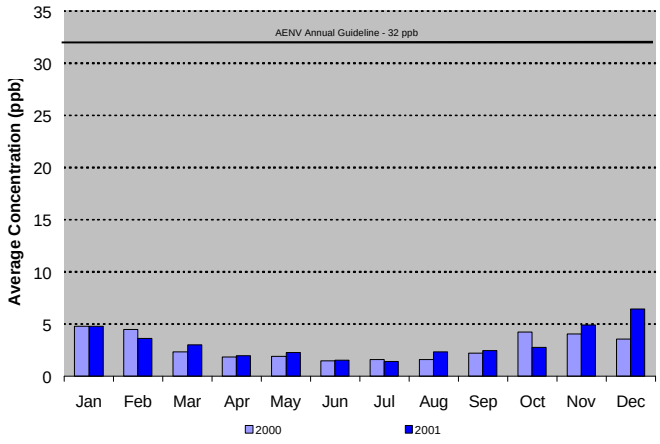
7.2.2 Nitrogen Dioxide



PAMZ NO2 Passive Monitoring Network - 2001 Average (ppb)

Ambient NO_2 concentrations observed throughout the Zone displayed predictable seasonal variations. Similar to SO_2, the highest monthly averages for the passive nitrogen dioxide network were observed during the coldest months of the year, when the amount of thermally-induced mixing of the atmosphere was at the minimum. The lowest monthly averages were observed in late spring and early fall when there was much higher dispersion of nitrogen oxides due to the greater amount of thermal mixing brought about by higher solar radiation levels.

The 2001 annual average NO_2 concentration for the entire network was 3.1 ppb, which was slightly greater than the 2000 average of 2.8 ppb but still significantly below the Alberta Environment annual guideline of 32 ppb. The reason for the increase is most likely the effect of the data from the Red Deer Station which was included in the PAMZ AQM Network for first time in 2001. Without Red Deer the 2001 network average would be 2.9, just slightly above the 2000 average.



Passive NO_2 Monitoring
Monthly Averages

In general, NO_2 levels are higher in the east of the zone than in the west. This is attributable to the greater population density and traffic volumes that occur in and around the Highway 2 corridor. The Red Deer site is an urban site and also the site with the greatest annual average concentration, measuring 12.8 ppb. This site is located within the city of Red Deer in the Red Deer River Valley downwind from the downtown area to the south. The high concentrations observed at this site are consistent with the effect of NO_X emissions from motor vehicle traffic in and around the city. Moderately high levels of NO_2 found at Site 11 (Twin Lakes) may be influenced by its proximity to Highway 11 as well as the town of Rocky Mountain House. Similarly both Highway 2 and urban development may influence NO_2 levels at Site 19 (Crossfield-Carstairs) and Site 35 (Kersey).

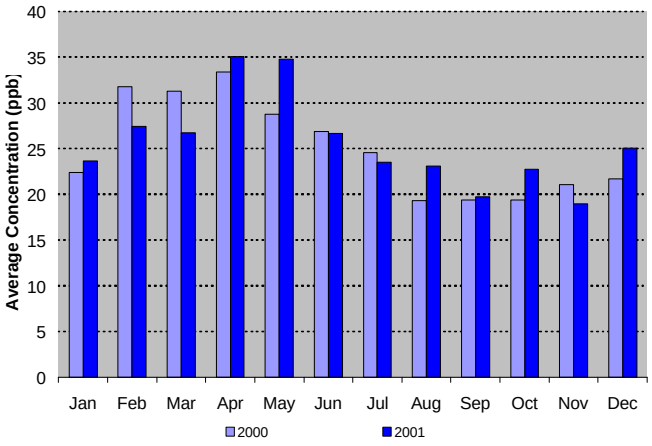
The site with the lowest annual average NO_2 concentrations was site 2 (Parker Ridge) measuring 0.2 ppb. This site is located in Banff National Park some distance upwind of the Icefields Highway, the only significant source of NO_X emissions in the area.

7.2.3 Ozone

Ambient O_3 concentrations observed in the more populated eastern regions of the zone indicated seasonal variations consistent with anthropogenic ozone, with the highest values observed in late spring. Concentrations observed in the western region of the zone at more remote locations indicated seasonal variations that may be attributable to tropopause folding and/or episodes of stratospheric ozone intrusion, as discussed previously.

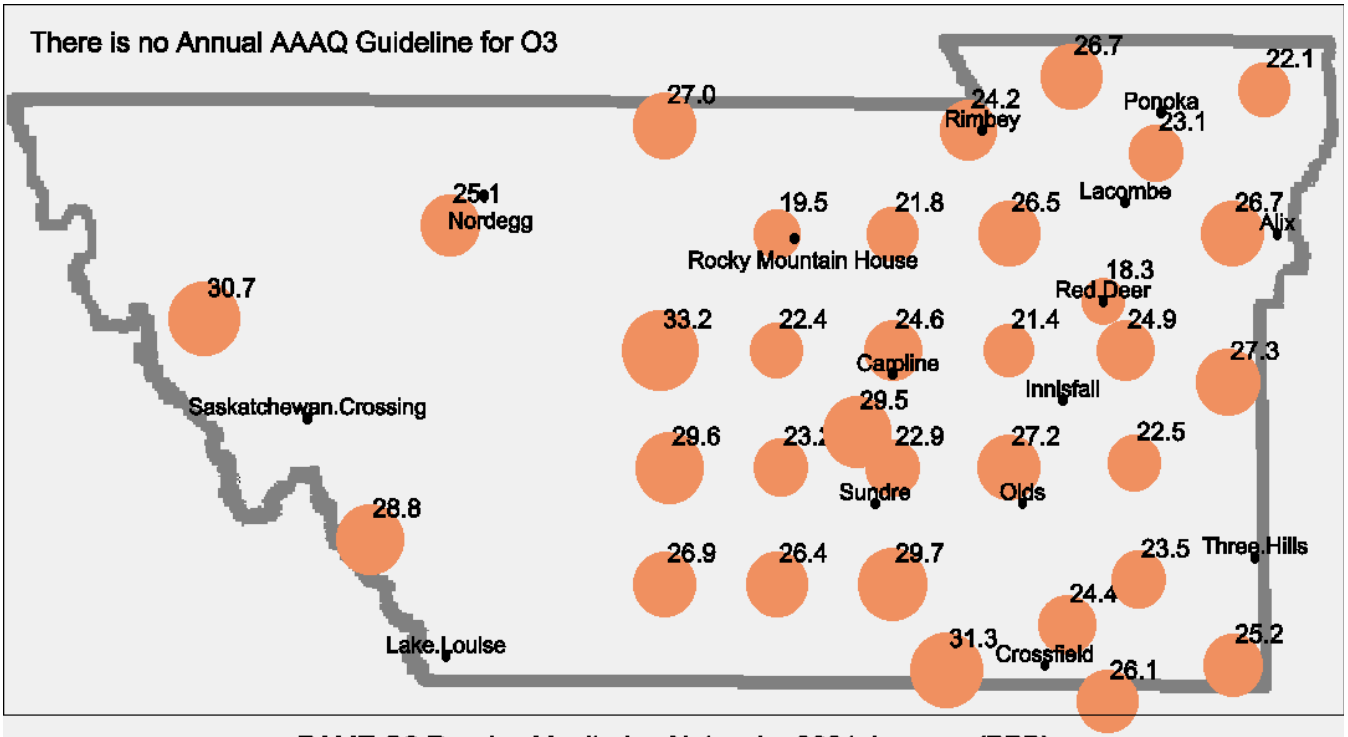
The 2001 annual average O_3 concentration for the entire network was 25.6 ppb, which was slightly greater than the 2000 average of 25.0 ppb. There is no Alberta Environment Guideline for annual O_3 concentrations. The site with the greatest annual average concentration was again Site 5 (Baseline Mountain) measuring 33.2 ppb. This site is located at high altitude at treeline on a mountainous ridge approximately 40 km southwest of Rocky Mountain House. The high concentrations observed at the site are relatively consistent throughout the year and may be associated with tropopause folding and stratospheric ozone intrusion.

In 2002, continuous monitoring of O_3 concentrations will be undertaken at Harlech, a new site similar to the Baseline Mountain site in topography and elevation but with better all-season access and power availability. The monitoring should help to provide a better understanding of the high concentrations and their possible source(s) at both the Baseline Mountain and Harlech sites. The site with the lowest annual average O_3 concentration was Red Deer Site measuring 18.3 ppb, consistent with its location within the City of Red Deer and the reaction of ozone with NO_X emissions from motor vehicle traffic.



Passive O_3 Monitoring
Monthly Averages

It is interesting that O_3 levels at Site 11 (Twin Lakes), near Rocky Mountain House, are also among the lowest in the region. As discussed previously, NO_2 levels at this site are moderately high.



PAMZ O3 Passive Monitoring Network - 2001 Average (PPB)

8. Links to the Clean Air strategic Alliance

CASA Particulate Matter & Ozone Project Team Meeting

The Parkland Airshed Management Zone Association was established under the umbrella of the Clean Air Strategic Alliance (CASA), adopting the CASA principles of consensus-based multi-stakeholder representation and following its Zone Air Quality Management Guidelines. PAMZ is an independent entity that provides progress updates to CASA, shares some common members and directors, and whose members contribute significantly to the following CASA project teams:

- **Acidifying Emissions Management Implementation Team (AEMIT)**
- **Ambient Air Quality Monitoring Operations Steering Committee**
- **Climate Change**
- **Flaring**
- **Human Health**
- **Pollution Prevention**
- **Animal Health**
- **Particulate Matter and Ozone.**

The Parkland Airshed Management Zone actively shares information with the other existing regional airshed management zones and new Zones as they establish their management plans and develop their monitoring programs.

The West Central Airshed Society (WCAS), shares a significant portion of PAMZ's northern boundary. WCAS was established in January 1995 and was the first air quality management zone to be formed in Alberta. In 2002, PAMZ will again provide financial support towards the operating costs associated with WCAS's Hightower Ridge AQM Station. The high priority issues identified by this zone's stakeholders are:

- **Human Health**
- **Odours**
- **Data Management**

The Wood Buffalo Zone, operated by the Wood Buffalo Environmental Association, has implemented a monitoring network in the Regional Municipality of Wood Buffalo. This Zone covers an area of 68,500 square kilometers, stretching south from the Alberta/Northwest Territories border to south of Fort McMurray and includes the regions two major population centers, Fort Chipewyan and Fort McMurray. The high priority issues for this zone are:

- **Soil Acidification**
- **Crops and Forests**
- **Human Health**

The Fort Air Partnership Zone located northeast of Edmonton covers an area of 6,000 square kilometers, encompassing Fort Saskatchewan and the surrounding area. This zone is currently in the early stages of establishing a regional air quality monitoring network. The area's stakeholders will use the information gathered from the network to manage regional air quality, protect environmental health and influence policy.

A fifth Airshed Management Zone, the Peace Air Shed Zone Association (PASZA) was registered as a non-profit society, similar to PAMZ, in 2001. The zone covers an area of 38,500 square kilometers stretching south from the Peace River to the top of Township 64 and includes the area's major population center, the City of Grande Prairie. PASZA is also are currently in the early stages of establishing a regional air quality monitoring network. Their 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."

Human health issues have been identified by CASA and all the airshed management zones as a high priority issue. Through its air quality monitoring program, data management system and the work of its Human Health Committee, the Parkland Airshed Management Zone expects to strengthen its links with other organizations through the sharing of the data and information that it collects.

9. Financial Report

Parkland Airshed Management Zone
Financial Report* for the Year Ended December 31, 2001

	2001	2000
Revenue:	448,827	417,301
Expenses:		
Monitoring Contracts	290,304	145,407
Consultant fees	66,000	66,000
Repairs and maintenance	18,481	16,299
Office	15,887	9,583
Travel	14,396	8,284
Equipment rental	2,500	4,800
Meetings and workshops	982	2,666
Insurance	4,327	2,345
Advertising	398	1,439
Professional fees	1,062	900
Secretarial	2,040	1,280
	416,377	259,003
Excess of Revenues over Expenses Before Amortization	32,450	158,298
Amortization	73,110	37,177
Excess of Revenues over Expenses	$ (40,660)	$ 121,121
Net change in non-cash working capital	35,254	7,254
Cash from (used for) operating activities	67,704	165,552
Investing Activities:		
Purchase of Capital Assets	(85,952)	(273,382)
Increase (Decrease) in Cash	(18,248)	(107,830)
Cash, Beginning of Year	39,193	147,023
Cash, End of Year	$ 20,945	$ 39,193

*** A copy of the audited financial report is available from the PAMZ Treasurer upon request.**

Board of Directors

	Member	Alternate
Government	David Lloyd Alberta Environment	Wayne Boyd Alberta Environment
	Jeff Strem Alberta Energy & Utilities Board	Jim Benum Alberta Energy & Utilities Board
	Greg Ritz David Thompson Health Region	Darren Barber David Thompson Health Region
	Linda Burrell Mountain View County	Robert Szasz Lacombe County
Non-Gov. Organizations	Martha Kostuch Prairie Acid Rain Coalition	Lenore Harris Red Deer River Naturalists
	Doug Jones Albertans for a Clean Environment	Rose Balcom Albertans for a Clean Environment
Public	Lloyd Cumming Burnstick Lake	Carrie Nanninga Olds
	Reg Watson Eagle Hill	Ila Johnston Sundre
	Damien Kajnc Red Deer	Harold Kenney Rimbey
Industry	Ed Szymanek N.A.L. Resources	Jim Dixon NOVA Chemicals
	Brian Goliss Shell Canada Ltd.	James Brown Dow Chemical Canada Inc.
	Greg Calpas Husky Oil Operations Ltd.	Robin Shropshire Duke Energy

Funding Members

Industries

Acclaim Energy
Addison Energy Inc.
Agrium
Alberta Energy Company Ltd.
Apache Canada
ARC Resources
Baytex Energy Ltd.
Border Paving Ltd.
BP Canada Energy Company
Burlington Resources Canada Energy Ltd.
Calpine Canada Resources Ltd.
Canadian 88 Energy Corp.
Canadian Natural Resources Limited
Conoco Canada Ltd.
Devon Canada Corp.
Dow Chemical Canada Inc.
Due West Resources Inc.
Duke Energy Midstream Canada Ltd.
EnerMark Inc.
Enerplus Group of Companies
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Grey Wolf Exploration
Hunt Oil Company of Canada Inc.
Husky Oil Operations Ltd.
Imperial Oil Resources Ltd.
Johns Mannville
Keyspan Energy Canada
Mancal Energy Inc.
Marathon Canada Limited
Murphy Oil Company Ltd.
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NCE Resources Group Inc.
Northrock Resources Ltd.
Northstar Energy Corporation
NOVA Chemicals
Parkland Refining
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Plains Marketing
Pogo Canada Ltd.
Prime West Energy Inc.
Response Energy Corporation
Rosetta Exploration Ltd.
Samson Canada, Ltd.
Shell Canada Ltd.
Shiningbank Energy Ltd.
Star Oil & Gas Ltd.
Storm Energy Inc.
Suncor Energy Inc.
Talisman Energy Inc.
TransCanada Midstream
Triumph Energy Corporation
Trysol Refining Inc.
Westcan Malting

Municipalities

Clearwater County	Lacombe County	Mountain View County
Ponoka County	Town of Rimbey	Town of Rocky Mountain House
Town of Sundre		

Committee Members

Executive Committee

Chairman	Brian Goliss	Industry	
1st Vice-Chair	David Lloyd	Government	
2nd Vice-Chair	Reg Watson	Public	
Treasurer	Greg Calpas	Industry	
Secretary	Martha Kostuch	NGO	
Program Manager	Kevin Warren	Program Manager	

Issues Response Group

Martha Kostuch	Prairie Acid Rain Coalition	NGO	(Chair)
David McCoy	Husky Oil Operations	Industry	
Robin Shropshire	Duke Energy	Industry	
Wayne Johnston	Sundre	Public	
Ila Johnston	Sundre	Public	
Wayne Boyd	Alberta Environment	Government	
Jeff Strem	Alberta Energy & Utilities Board	Government	
Kevin Warren	Amarok Consulting	Program Manager	

Human Health Committee

Greg Ritz	David Thompson Health Region	Government	(Chair)
Linda Burrell	County of Mountain View	Government	
Martha Kostuch	Prairie Acid Rain Coalition	NGO	
Margaret Coutts	Red Deer River Naturalists	NGO	
Betty Harvey	Rimbey and District Clean Air People	NGO	
Sherry Scheunert	Red Deer	Public	
Elizabeth Gentry	Cremona	Public	
Ila Johnston	Sundre	Public	
Wayne Johnston	Sundre	Public	
Damian Kajnc	Red Deer	Public	
Dr. Abimbola Abiola	Olds College	Public	
Darrell Myroniuk	PetroCanada	Industry	
Paul Walker	Keyspan Energy Canada	Industry	
Kevin Warren	Amarok Consulting	Program Manager	

Communications Committee

Lloyd Cumming	Burnstick Lake	Public	(Chair)
Lenore Harris	Red Deer River Naturalists	NGO	
Sue Arrison	Conoco Canada Ltd.	Industry	
Alice Murray	Shell Canada Ltd.	Industry	
Kevin Warren	Amarok Consulting	Program Manager	

Technical Working Group

Brian Goliss	Shell Canada Ltd.	Industry	(Chair)
Carrie Nanninga	Olds	Public	
David McCoy	Husky Oil Operations	Industry	
Dale Nylund	TransCanada Midstream	Industry	
Donald Wainwright	Husky Oil Operations	Industry	
Dwight Jenkinson	ExxonMobil Canada	Industry	

Technical Working Group continued

Ed Szymanek	NAL Resources	Industry
Greg Ritz	David Thompson Health Region	Government
Helga Shield	Imperial Oil Resources ltd.	Industry
Jeff Strem	Alberta Energy & Utilities Board	Government
Jim Dixon	NOVA Chemicals Corp.	Industry
Karen McCallion	Alberta Environment	Government
Larry Stockman	Alberta Energy & Utilities Board	Government
Lloyd Cumming	Burnstick Lake	Public
Lynn Huntley	Amoco Canada Petroleum	Industry
Michael Maynard	Imperial Oil Ltd.	Industry
Paul Walker	Keyspan Energy Canada	Industry
Reg Watson	Eagle Hill	Public
Rod Sikora	Keyspan Energy Canada	Industry
Sandy Holmes	ExxonMobil Canada	Industry
Kevin Warren	Amarok Consulting	Program Manager

Landowners

The Parkland Airshed Management Zone expresses their appreciation for the invaluable assistance of the cooperating landowners who have allowed PAMZ to locate the continuous and passive monitoring stations on their property and are providing year-round access to these sites.

Jim & Jackie Anderson - Rimbey
Jim & Marian Cole - Leslieville
Ken & Krista Waters - Stauffer
Wayne & Ila Johnston - Sundre
Brian & Mary Brietsche - Grainger
Don Buckner - Sundre
Bill Hodgkinson - Elnora
Eskild Jacobsen - Olds
Gail Kinsey - Sylvan Lake
Mr. Page - Sunnyslope
Joe & Anne Teeuwsen - Ferrybank
Tony & Cheryl Peresinni - Crossfield
Roy Westfall - Crossfield
Wade Meston - Tees
Glen & Phyllis Kneiper - Stauffer
Henry Schmiemann - Caroline
Shieling Mountain Lodge - Nordegg
Peter Smith - Leslieville
Mr. Teynor - Bergen
Simon & Ann Swier - Morningside
Eldon Knight - Kersey

Acknowledgements

Thank-you to the West Central Airshed Society, the Wood Buffalo Environmental Association, the Fort Air Partnership and the fledgling Peace Airshed Zone Association for sharing information about their organizations and programs and, where applicable, supplying the data collected by their regional air quality monitoring networks that appear in this report. Special thanks to the following individuals within or working for those organizations: Lisa Schaldemose WBEA, Bob Scotten and Barb Johnson WCAS, Warren Sarchuk FAP. Special thanks also to Bob Myrick of Alberta Environment and Mike Porisky of Canadian Courseware , the administrator and contractor for the CASA Data Warehouse and to Geoff Williams, the CASA Communications Advisor.

Thanks are due to Environment Canada for providing PAMZ with Meteorological Data collected from the Atmospheric Environment Services' Meteorological Stations located within the Zone's boundaries. Special thanks to the following individuals within that organization: Patrick Kyle and Monique Lapalme.

Special thanks to David Kliman, the Husky Co-op Student from the University of Regina, who spent three months diligently compiling the 2001 Emissions Inventory. Special thanks also to Jim Spangelo at the AEUB for his assistance in this endeavor.

Special thanks are also due to the following people who made significant contributions of their time and spirit and have been valuable resources for PAMZ during the year 2001 and also in previous years.

Andy Milne, AEUB
Dwight Jenkinson, ExxonMobil
Lois Garret, Devon Canada Corp.
August Liivam, Lacombe County
George Neeley, Duke Energy
Rudy Zimmer, DTHR
Donna Hamilton, Public-Olds
Karla Berg, Devon Canada Corp.
Sheila Lockrem, Mountain View County

GLOSSARY OF TERMS

Acid Deposition: A comprehensive term for the various ways acidic compounds precipitate from the atmosphere and deposit onto surfaces. It can include: 1) wet deposition by means of acid rain, fog, and snow; and 2) dry deposition of acidic particles (aerosols).
Acute Exposure: One or a series of short-term exposures generally lasting for a short period of time (e.g. minutes or hours).
Acute Health Effect: A health effect that appears for a brief period of time and, in general, promptly after exposure.
Alberta Ambient Air Quality Guideline (AAAQG) : Concentration value adopted by the province of Alberta with the intention of preventing deterioration of air quality. Guidelines for SO2, NO2, O3 and several other pollutants are based on the prevention of adverse human health and vegetation effects. Guidelines may be for 1 hour, 24 hours, or 1-year average concentrations.
Ambient Air Quality: The concentration of pollutants in the ambient air. Generally the concentrations of gases or particles to which the general population would be exposed, as opposed to the concentration of pollutants emitted by a specific source.
Anthropogenic: Made by or arising from man, not of natural origin.
Aromatic: A type of hydrocarbon, such as benzene or toluene. Some aromatics are toxic.
Average Annual Concentration: The sum of the 1-hour average concentration measurements for the year divided by the number of hours that measurements were made within that year. It can be compared against the Alberta Ambient Air Quality Guideline for the same period to assess absolute air quality, against data collected at other locations with similar characteristics (sources, population, etc.) for the same period for assessment purposes or against other years' data to assess improvement or degradation of air quality at the same location.
Bio-monitoring: The monitoring of a living organism, plant or animal, to measure its health and document any visible symptoms of coincident air quality effects.
Carbon Dioxide (CO_2): A colorless, odorless gas that occurs naturally in the Earth's atmosphere. Significant quantities are also emitted into the air by fossil fuel combustion.
Carbon Monoxide (CO): A colorless, odorless gas resulting from the incomplete combustion of hydrocarbon fuels. CO interferes with the blood's ability to carry oxygen to the body's tissues and results in numerous adverse health effects. Over 80% of the CO emitted in urban areas is contributed by motor vehicles.
Chronic Exposure: Long-term exposure, usually lasting for a relatively long period of time (e.g. months or years).
Chronic Health Effect: A health effect that occurs over a relatively long period of time (e.g. months or years).
Greenhouse Gases: Atmospheric gases such as carbon dioxide, methane, chlorofluorocarbons, nitrous oxide, ozone, and water vapor that slow the passage of re-radiated heat through the Earth's atmosphere.
Hydrocarbons: Compounds containing various combinations of hydrogen and carbon atoms. They may be emitted into the air by natural sources (e.g., trees) and as a result of fossil and vegetative fuel combustion, fuel volatilization, and solvent use. Hydrocarbons are a major contributor to smog. Hydrocarbons include aromatics and volatile organic compounds, many of which are toxic.
Hydrogen Sulphide (H_2S): A colorless, flammable, poisonous compound having a characteristic rotten-egg odor. About one third of the gas produced in Alberta contains H_2S.
Inversion: The atmospheric property of temperature increasing with height.
Micron (μm): One one-millionth of a meter ($1X\ 10^{-6}$ m)
Mobile Sources: Sources of air pollution such as automobiles, motorcycles, trucks, off-road vehicles, boats, and airplanes.
Natural Sources: Non-manmade emission sources, including biological and geological sources, wildfires, and windblown dust.
Nitric Oxide (NO): Precursor of ozone, NO_2, and nitrate; nitric oxide is usually emitted from combustion processes. Nitric oxide is converted to nitrogen dioxide (NO_2) in the atmosphere, and then becomes involved in the photochemical processes and/or particulate formation.
Nitrogen Oxides (Oxides of Nitrogen, NO_X): A general term pertaining to compounds of nitric oxide (NO), nitrogen dioxide (NO_2), and other oxides of nitrogen. Nitrogen oxides are typically created during combustion processes, and are major contributors to smog formation and acid deposition. NO_2 at higher concentrations is associated with numerous adverse health effects.
Non-Methane Hydrocarbon (NMHC): The sum of all hydrocarbon air pollutants except methane. NMHCs are significant precursors to ozone formation.
Ozone (O_3): A strong smelling, pale blue, reactive toxic chemical gas consisting of three oxygen atoms. It is a product of the photochemical process involving the sun's energy and ozone precursors, such as hydrocarbons and oxides of nitrogen. Ozone exists in the upper atmosphere ozone layer (stratospheric ozone) as well as at the Earth's surface in the troposphere (ozone). Ozone in the troposphere is associated with numerous adverse health effects. It is a major component of smog.
Particulate Matter (PM): Any material, except pure water, that exists in the solid or liquid state in the atmosphere. The size of particulate matter can vary from coarse, wind-blown dust particles to fine particle combustion products.
PPB or PPM: Parts per billion by volume or parts per million by volume
$PM_{2.5}$: Includes tiny particles with an aerodynamic diameter less than or equal to a nominal 2.5 microns. Their small size allows them to make their way to the air sacs deep within the lungs where they may be deposited and result in adverse health effects.
PM_{10}: An air pollutant consisting of small particles with an aerodynamic diameter less than or equal to a nominal 10 microns (about 1/7 the diameter of a single human hair). Their small size allows them to be inhaled but they do not reach the lungs.
Stratosphere: The layer of the Earth's atmosphere above the troposphere. It extends between 10 and 50 kms above the Earth's surface and contains the ozone layer in its lower portion. The stratospheric layer mixes relatively slowly; pollutants that enter it may remain for long periods of time.
Sulfur Dioxide (SO_2): A strong smelling, colorless gas that is formed by the combustion of fossil fuels. Sour gas processing plants, oil sands processing plants and coal-fired power generating plants are major sources of SO_2. SO_2 and other sulfur oxides contribute to the problem of acid deposition.
Total Hydrocarbons (THC): The sum of all hydrocarbon air pollutants.
Total Organic Compounds (TOC): Gaseous organic compounds, including reactive organic gases and the relatively unreactive organic gases such as methane.
Total Reduced Sulphur Compounds (TRS): Sulphur-containing family of compounds consisting of hydrogen sulphide, mercaptans and others.
Tropopause: The boundary layer between the troposphere and the stratosphere characterized by its isothermal properties.
Troposphere: The lowest 10 km to 20 km of the earth's atmosphere characterized by decreasing temperature with height.
Volatile Organic Compounds (VOCs): Carbon-containing compounds that evaporate into the air (with a few exceptions). VOCs contribute to the formation of smog and/or may themselves be toxic. VOCs often have an odor, and some examples include gasoline, alcohol, and the solvents used in paints.

For more information on the Parkland Airshed Management Zone Association please contact:

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Fax: (780) 422-3127
E-mail: marlene.brenda@casahome.org
Website: http://www.casahome.org