WYAMZ

2013 Annual Report

Western Yellowhead Air Management Zone

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List of Terms and Definitions

24-hour	A calendar day, average is calculated midnight-to-midnight.
30-day	Passive monitoring data is based on a 30-day average concentration
8-hour	8-hour running average for O_3 Canada-Wide Standards.
SAAQS	Saskatchewan Ambient Air Quality Standard
AIC	Automatic Instrument Check (instrument self-verification process)
AMG	Air Monitoring Guidelines for Saskatchewan, March 2012
BTEX	Benzene, toluene, ethylbenzene, and xylene
Calm	1-hour average wind speed lower than 1 km/hour
CWS	Canada-Wide-Standards
ET	Ambient temperature
H_2S	Hydrogen sulphide
NAPS	National Air Pollution Surveillance Program
NH_3	Ammonia
NO_2	Nitrogen dioxide
NO	Nitric oxide
NOx	Oxides of nitrogen
O_3	Ozone
$PM_{2.5}$	Particulate matter with aerodynamic diameter less than 2.5 µm, referred to as fine or respirable particles
QA/QC	Quality Assurance / Quality Control
RH	Relative humidity
SO_2	Sulphur dioxide
WD	Wind direction
WS	Wind speed

Units of Measurement

average	arithmetic average = n Xi / n geometric average = antilog of (n log Xi) / n
m/s	meter per second, or mps
µg/m^3	microgram per cubic meter
ppb	part per billion by volume
mm	millimeter of precipitation
C	degree centigrade
%	percent of relative humidity, instrument uptime, etc.
Degree	angle of wind direction from the north

MESSAGE FROM THE EXECUTIVE DIRECTOR

2013 was an excellent year for Western Yellowhead Air Management Zone (WYAMZ) and for air quality monitoring in the western Yellowhead region of Saskatchewan. WYAMZ is very pleased to inform our members that six (6) continuous air monitoring sites recording criteria air contaminant measurements are now operating in the region and providing real time data. Four of these stations were made possible through a matching grant provided to WYAMZ by the Western Economic Diversification Canada Office in Saskatoon. We also have the data from the airpointer operated by the Saskatchewan Ministry of Environment and the data from the National Air Pollution Surveillance Program (NAPS) Station in Saskatoon. This provides our region with six (6) real time air quality monitoring stations. We are exploring every opportunity to collaborate with other agencies in bringing additional monitoring into the region.

This monitoring initiative is multi-purpose it: a) collects real time air quality data throughout the WYAMZ region, b) demonstrates companies are operating in a safe, environmentally sound manner that is enabling sustainable growth, and c) provides companies considering to invest in operations in Saskatchewan with data that shows it is a safe place to invest being that the air quality is well understood and not an impediment to growth. WYAMZ is very excited about what the WEDC initiative has brought to the air zone's monitoring capabilities. The credibility and strength of the continuous monitoring network is scientifically and financially sound. The continuous data is available live on the internet; it includes hourly concentrations of SO_2, H_2S, $NO/NO_2/NOx$, $PM_{2.5}$ and O_3. The data was made available in November of 2013 on the WYAMZ website: http://www.wyamz.ca

We have and are continuing to communicate the work we do in many ways. When we do a presentation or place an article or a story in a newspaper we highlight our members wherever possible. We list our members on our website and do as much as we can to inform the public the names of our member companies. This communication work is very important to WYAMZ and to its members.
Here are some of our recent and upcoming communication initiatives:

- Regina Leader Post, Saskatoon Star Phoenix, Weyburn Review, Estevan Mercury, CTV Regina News interviews, March 2013
- CBC Radio, Saskatoon Star Phoenix, Lloydminster Meridian Booster interviews, Jan 2014
- Air Symposium in concert with SEIMA, Saskatoon Jan 2014
- Clean Air Day newspaper Campaign, Leader Post and Star Phoenix, Wednesday June 4, 2014
- The Lloydminster Heavy Oil Show, Lloydminster September of 2014 and planning to attend 2016
- Saskatchewan Association of Rural Municipalities (SARM) the Councillor Newsletter Article

All of these showcase the work we do and our members' involvement.

Future plans include determining the need for additional air monitoring stations, development of more communication materials, presentations to municipalities, Chambers of Commerce, high school classes, home and school meetings, etc.

The events of 2013 have positioned WYAMZ at a level that we all thought would take about 4 to 5 years to achieve. This development is excellent news for the people of the western Yellowhead area of Saskatchewan and for all of our valued members. WYAMZ thanks all of members for their participation.

Our goal is to collect credible and defensible air quality data and provide excellent service to our members.

EXECUTIVE SUMMARY

The Western Yellowhead Air Management Zone (WYAMZ), established in 2012, is the second air management association in Saskatchewan. WYAMZ is a collaborative group of industry, government, non-government organizations, and private citizens. The air management zone covers an area that stretches from east of Saskatoon to the Alberta border and from north of Meadow Lake to south of Rosetown, as shown in Figure 1 of the main report. Major economic activities in the region include agriculture, oil & gas, mining, power generation, and transportation.

In 2013, WYAMZ managed a continuous air monitoring network and a passive sampling network. Figure 2 of the main report illustrates spatial distribution of the air monitoring stations in the WYAMZ region. The continuous air monitoring network consists of five airpointers® at the North Battleford, Meadow Lake, Maidstone, Unity, and Kindersley stations. The North Battleford station is operated by the Ministry of Environment. A continuous air monitoring NAPS (National Air Pollution Surveillance Program) station is also operated by the Ministry of Environment in Saskatoon.

The WYAMZ network monitors sulphur dioxide (SO_2), hydrogen sulphide (H_2S), nitrogen oxides (NO, NO_2, NOx), ozone (O_3), fine particulate matter ($PM_{2.5}$), ambient temperature (ET), relative humidity (RH), precipitation, wind speed (WS) and wind direction (WD). The Meadow Lake, Maidstone, Unity, and Kindersley airpointers began operations® in December 2013. The airpointers® were greater than 90% operational for December, with the exception of the Meadow Lake station (72.2% for all parameter) and the NOx monitor (52.2%) of the Maidstone station.

Table ES-1 summarizes the average continuous measurement data for December 2013; there was no exceedance of the Saskatchewan Ambient Air Quality Standards (SAAQS). The measured air concentration was generally low in comparison with the SAAQS. According to the Air Quality Health Index and Air Quality Index, the air quality at all stations was rated Good or Low Risk for more than 95% of the time.

The WYAMZ passive sampling network included fifteen stations in 2013. The network measures 30-day average SO_2, NO_2, O_3, H_2S, NH_3 and BTEX (benzene, toluene, ethylbenzene, and xylene). Table ES-2 and ES-3 summarize the average concentrations for 30-day passive samples for 2013. Fourteen stations were operational this year. SO_2, NO_2, and O_3 samples were collected for six months (February, and May to September); H_2S, BTEX, and NH_3 were collected for February only. The sample capture rate was greater than 95% for all parameters. Generally, the measured concentrations were low in comparison to the SAAQS.

Table ES-1 Average concentrations for continuous parameters for December 2013

Pollutant	Conc. Unit	Average Concentration for Continuous Measurement Data			
		Meadow Lake	Maidstone	Unity	Kindersley
SO_2	ppb	-	1	-	<1
H_2S	ppb	-	0.2	-	<0.1
NO	ppb	0.2	2.4	1.2	-
NO_2	ppb	1.7	9.2	4.3	-
NOx	ppb	1.9	11.6	5.4	-
O_3	ppb	27	-	26	-
$PM_{2.5}$	$\mu g/m^3$	4	6	4	0.2

-: Parameter was not monitored.

Table ES-2 Average concentration for 30-day passive samples for 2013

Station No.	Station Name	Average Passive Concentrations (ppb)		
		SO_2	NO_2	O_3
1	Young	1.4	2.0	34
2	Cudworth	0.2	0.7	36
3	Laird	0.4	1.2	40
4	Shell Lake	0.2	1.0	33
5	Cater	0.2	0.5	34
6	St. Walburg	2.0	0.7	41
7	Maidstone	0.3	3.5	42
8	Neilburg	0.7	1.9	41
9	Denzil	0.2	1.4	36
10	Wilbert	0.3	1.2	37
11	Biggar	0.3	1.5	46
12	Saskatoon	-	-	-
13	Dorintosh	0.4	1.0	30
14	Kindersley	0.4	2.6	45
15	Rosetown	0.3	1.5	50

-: Parameter was not monitored.

Table ES-3 Summary for 30-day passive H_2S, BTEX and NH_3 samples for February 2013

Station Number	Station Name	Sampling Month	Summary for 30-day Passive Samples, February 2013					
			H_2S	Benzene	Toluene	Ethylbenzene	Xylene	NH_3
10	Wilbert	February	1.0	0.2	0.2	<0.2	<0.2	-
11	Biggar	February	-	-	-	-	-	2.1

- : Parameter was not monitored.

1.0 Introduction

The Western Yellowhead Air Management Zone (WYAMZ) is the second air management association in Saskatchewan. Figure 1 illustrates the WYAMZ zone which covers the west central region of the province. The air management zone encompasses an area from east of Saskatoon to the Alberta border; and from north of Meadow Lake to south of Rosetown. The WYAMZ design is in line with the directive from the Canadian Council of Ministers of the Environment under the Canada-wide Air Quality Management System. The association is designed to collect credible, continuous real-time air quality information through collaborative efforts.

Membership in the WYAMZ is currently voluntary. The current membership includes members of the agriculture, chemistry, oil & gas, mining and power generation sectors, as well as the public. The Government of Saskatchewan Ministries of Environment, Ministry of Economy, as well as representatives of the City of Saskatoon and the Saskatchewan Environmental Society also participate as members of the Board of Directors. WYAMZ's budget consists of membership fees, environmental footprint, and emissions-based fees assessed to facilities operating within the air management zone.

1.1 WYAMZ Mission

The WYAMZ mission is to collect credible, scientifically defensible air quality data for the west central Saskatchewan, and to make this data freely available to all stakeholders. The objective is to bring together stakeholders from all backgrounds to identify local air quality issues and to develop innovative solutions for managing these issues

1.2 WYAMZ Air Monitoring Network

In 2013, WYAMZ secured funds, purchased and installed four airpointers®. The equipment was only in operation for the month of December and as such, limited data is available. Figure 2 illustrates a spatial distribution map of the stations operated by WYAMZ and the Saskatchewan Ministry of Environment in the WYAMZ region. Real-time data for these stations is available through the WYAMZ website or the Saskatchewan Ministry of Environment. There are six continuous air monitoring stations in the region, four owned and operated by WYAMZ, and two owned and operated by the Ministry of Environment (North Battleford and Saskatoon). WYAMZ also ran fifteen passive air sampling stations at various times in 2013.

1.2.1 Continuous Network

The Western Yellowhead Air Management Zone operates four airpointers® at the Meadow Lake, Maidstone, Unity, and Kindersley stations. The network measures sulphur dioxide (SO_2), hydrogen sulphide (H_2S), nitrogen oxides (NO, NO_2, NOx), ozone (O_3), fine particulate matter

($PM_{2.5}$), ambient temperature (ET), relative humidity (RH), precipitation, wind speed (WS) and wind direction (WD). Table 1 presents a combination matrix of the monitoring stations and the measured parameters. The airpointers® have been operating since December 1, 2013. Publically available real-time air monitoring data is available on the WYAMZ website at: www.wyamz.ca.

The airpointer® introduces a new concept in air quality monitoring. In the past, a multi-gas and particle pollution monitoring system would have been housed in a large walk-in shelter; sometimes in a trailer-type unit. The airpointer® makes it possible to acquire real-time data in a small vault type, self-contained unit. The airpointer® has very low operating costs compared to other analyzers in the industry. This is important to our members because we can provide quality data collection at a considerable saving. Furthermore, it is easy to access the monitoring data. A standard internet connection and web browser is all that is required.

1.2.2 Passive Network

The WYAMZ passive sampling network included fifteen stations in 2013, collecting 30-day passive samples. In 2013, SO_2, NO_2 and O_3 were collected at fourteen stations; H_2S and BTEX (benzene, toluene, ethylbenzene, and xylene) samples were collected at the Wilbert station; and NH_3 samples were collected at the Biggar station. The passive air sampling network began operation in February 2013. SO_2, NO_2, and O_3 samples were collected for six months (February, and May to September); H_2S, BTEX, and NH_3 were collected for February only.

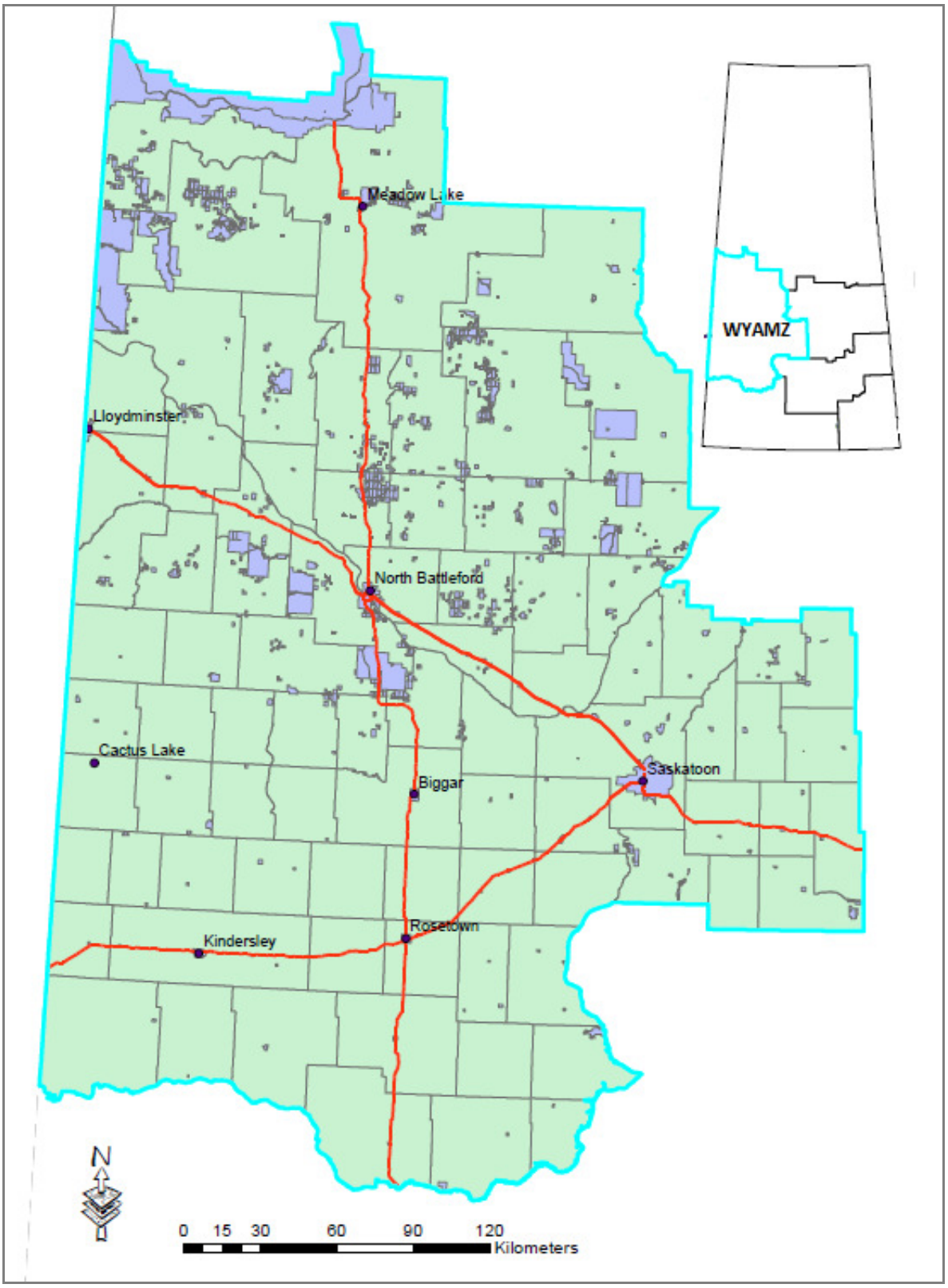


Figure 1. The Western Yellowhead Air Management Zone (WYAMZ)

Figure 2. **Locations of the air monitoring stations operated by WYAMZ and the Saskatchewan Ministry of Environment in the WYAMZ region in 2013**

Table 1. WYAMZ ambient air continuous monitoring stations and the measurement parameters

Monitoring Parameters	Continuous air quality parameters measured in the WYAMZ network			
	Meadow Lake	**Maidstone**	**Unity**	**Kindersley**
SO_2	-	√	-	√
H_2S	-	√	-	√
NO	√	√	√	-
NO_2	√	√	√	-
NOx	√	√	√	-
O_3	√	-	√	-
$PM_{2.5}$	√	√	√	√
Ambient Temperature	√	√	√	√
Relative Humidity	√	√	√	√
Precipitation	√	√	√	√
Wind Speed	√	√	√	√
Wind Direction	√	√	√	√

2.0 Air Quality Monitoring

2.1 Summary of Exceedances above the SAAQS

The WYAMZ ambient air monitoring network measures air pollutant concentrations to indicate the general quality of air in the management zone. Comparing measured air quality data with the Saskatchewan Ambient Air Quality Standards and Federal guidelines ensures public and environmental health is not impaired. Air quality data is used to evaluate the trends in air quality resulting from emissions of anthropogenic sources (industry, motor vehicles, etc) and natural processes (such as forest fires, decomposition of organic matter, etc).

Table 2 summarizes the SAAQS (Saskatchewan Ambient Air Quality Standards) and number of exceedances for December 2013. The airpointers® were only in operation for the month of December; limited data is available. There was no exceedance of the SAAQS for the WYAMZ continuous air monitoring network.

Table 2. Number of exceedance events for December 2013

Parameter	No. of Stations	Average Type	SAAQS	No. of Exceedance
SO_2	2	1-hour	172 ppb	0
		24-hour	57 ppb	0
		Annual	11 ppb	0
H_2S	2	1-hour	10.8 ppb	0
		24-hour	3.6 ppb	0
NO_2	3	1-hour	212 ppb	0
		Annual	53 ppb	0
O_3	2	1-hour	82 ppb	0
		8-hour	65 ppb CWS	0
$PM_{2.5}$	4	24-hour	30 $\mu g/m^3$	0

2.2 Wind

Wind speed and wind direction, as well as other meteorological parameters, are important factors that influence regional air quality. The diffusion and dispersion of air pollutant emissions are greatly impacted by variations in wind speed and corresponding air turbulence. Different degrees of turbulence are created by variable mixing conditions due to the vertical gradient of ambient temperatures and terrain roughness unique to each station.

Figure 3 presents the wind rose at the WYAMZ continuous monitoring stations for December. Generally, the prevailing wind speed was slow. As there is only one month of data available, data is not sufficient to draw conclusions as to the typical prevailing winds in the region. According to the international wind classification system, prevailing wind consisted of Light Air (<1.4 m/s), Light Breeze (<3.1 m/s), and Moderate Breeze (<7.8 m/s). Strong wind (>7.8 m/s) was recorded at the Kindersley station only; for 1.8% of the time. The frequency of calm wind was ranged from 0.4% (Kindersley) to 3.3% (Maidstone).

The prevailing wind direction was not consistent among the four air monitoring stations. The Meadow Lake station was characterized with west-southwest winds (17.9%) and east-southeast winds (11.4%). The remaining three stations were characterized with a prevalent wind from the northwest quadrant (30% to 38%). The Unity and Kindersley stations also exhibited a secondary prevalent wind from the east-northeast direction, which could be due to nearby obstacles. At the Maidstone station, a secondary prevalent wind was from the southeast quadrant, which could be related to local terrain features. This station is located in a valley, along the north-to-southeast orientation.

The detailed frequency distribution table and wind rose are presented in the Appendices: Table B-3, Table C-3, Table D-3, and Table E-3.

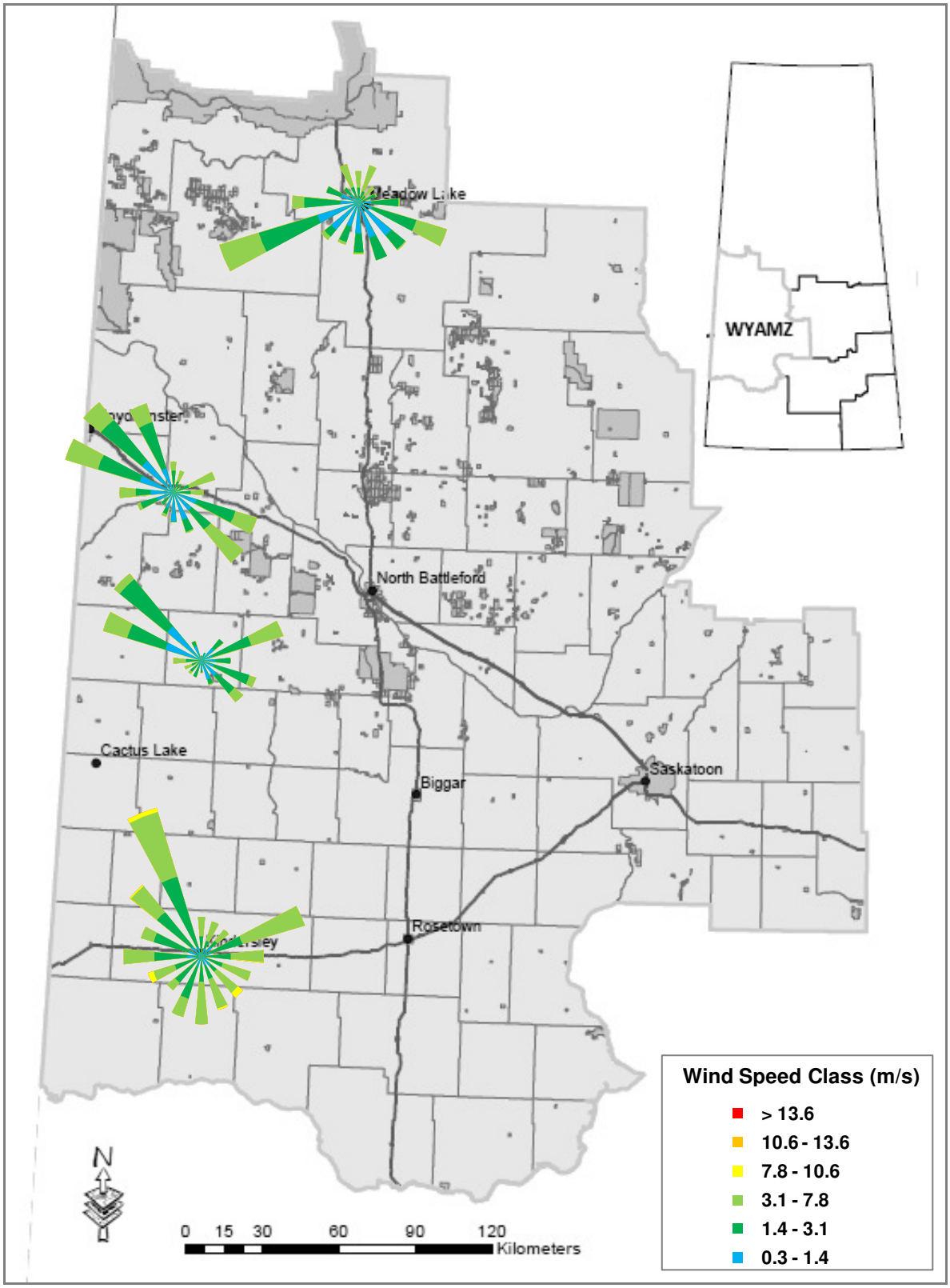


Figure 3. **Wind roses for 1-hour average wind data for December 2013**

2.3 Continuous Air Quality Data

2.3.1 Sulphur Dioxide (SO_2)

Sulphur dioxide (SO_2) is a colourless gas with a strong suffocating odour. It smells like burnt matches. At concentrations above 300 ppb, it can be detected by taste and odour. The health effects caused by exposure to high levels of SO_2 include breathing problems, respiratory illness, changes in lung function, and worsening respiratory and cardiovascular disease. People with asthma or chronic lung or heart disease are the most susceptible to SO_2. SO_2 also damages trees and crops.

SO_2, along with nitrogen oxides, are the main precursors of photochemical smog and acid rain, which contributes to the acidification of lakes and streams, accelerated corrosion of buildings, and reduced visibility. SO_2 in the air can form microscopic acid aerosols, which have serious health implications, as well as, contributing to climate change.

Anthropogenic SO_2 emission sources are primarily from combustion of sulphur containing fuels (e.g. gasoline, natural gas and coal) and processing of sulphur containing ores. The major emission sources for SO_2 include large industrial sources such as power plants, petroleum refineries, iron and steel mills, fertilizer plants, pulp and paper mills, and smelters, as well as small industries, such as small oil and gas plants, battery and well flares. .

The Saskatchewan Ambient Air Quality Standards (SAAQS) for sulphur dioxide are:

- 1-hour average SAAQS = 172 ppb
- 24-hour average SAAQS = 57 ppb
- annual average SAAQS = 11 ppb

Table 3 presents the summary statistics for 1-hour average concentrations for SO_2. The measured concentration was low at both stations. The monthly average concentration was 1 ppb at the Maidstone station and was less than 1 ppb at the Kindersley station. The maximum 1-hour average concentration of 3 ppb was detected at Maidstone; the maximum 24-hour average concentration was 1 ppb at both stations. There was no exceedance of the SAAAQS for 1-hour, 24-hour, and annual average concentrations (see Table 4).

Figures 3 and 4 present the pollutant roses for 1-hour average concentration for SO_2. For more than 80% of the time, SO_2 concentration was less than or equal to 1 ppb (blue petals); the concentration never exceeded 5 ppb (green petals). The higher concentration events tend to be associated with the northwest and southwest wind quadrants, which project to the area with more oil and gas industrial activities. This is the first month air monitoring program, and more data is required to examine the existence of any source-receptor relationships.

The detailed frequency distribution tables for the pollutant roses are presented in the Appendices: Table C-2 and Table E-2.

Table 3. Summary statistics for 1-hour average SO_2 for December 2013

Monitoring Station	December Average	Instrument Uptime	Maximum SO_2 Conc. and Occurrence Time			
			1-hour Max.		24-hour Max.	
	ppb	%	ppb	Time	ppb	Date
Maidstone	1	100.0%	3	Dec-22 20:00	1	Dec-19
Kindersley	< 1	99.9%	2	Dec-06 12:00	1	Dec-6

Table 4. Number of exceedance events for SO_2 for December 2013

Monitoring Station	No. of Exceedance to Saskatchewan Ambient Air Quality Standards (SAAQS)		
	1-hr SAAQS	24-hr SAAQS	Annual SAAQS
	172 ppb	57 ppb	11 ppb
Maidstone	0	0	0
Kindersley	0	0	0

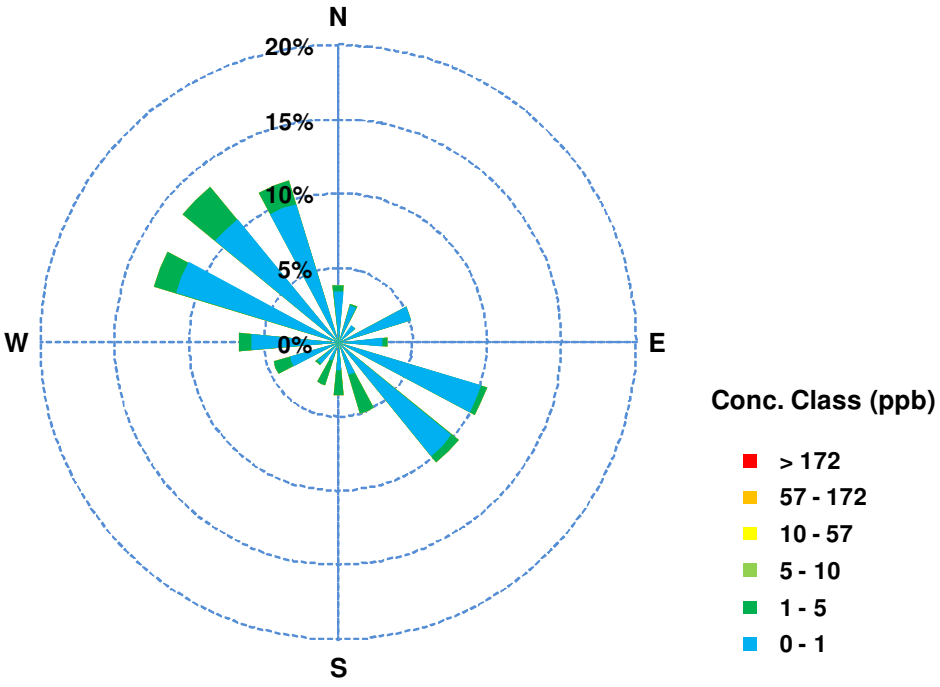


Figure 3. Pollutant rose for 1-hour average SO_2 data at the Maidstone station

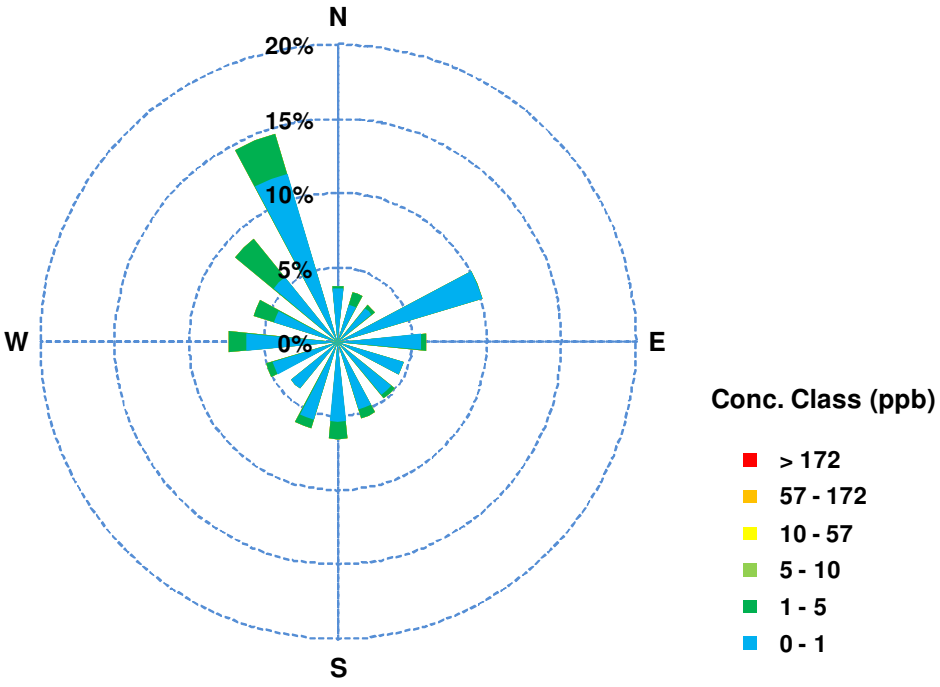


Figure 4. Pollutant rose for 1-hour average SO_2 data at the Kindersley station

2.3.2 Hydrogen Sulphide (H_2S)

Hydrogen sulphide (H_2S) is a colourless gas with a characteristic "rotten egg" odour. It is produced both naturally and through anthropogenic emission sources. H_2S occurs naturally in coal, crude oil, natural gas, oil, sulphur hot springs, volcanic gases, sloughs, swamps and lakes. The major anthropogenic emission sources include natural gas and petroleum production, wastewater treatment, pulp and paper mills, rayon textile manufacturing, and tar and asphalt manufacturing. Decomposition of organic matter by bacteria under anaerobic conditions releases H_2S as well, forming the characteristic odour commonly associated with sewers, sewage lagoons, and swamps.

Hydrogen sulfide is a highly toxic and flammable gas. It is heavier than air and tends to accumulate at the bottom of poorly ventilated spaces. Although very pungent at first, it quickly deadens the sense of smell. Potential victims may be unaware of its presence until it is too late.

The Saskatchewan Ambient Air Quality Standards (SAAQS) for hydrogen sulphide are:

- 1-hour average SAAQS = 10.8 ppb
- 24-hour average SAAQS = 3.6 ppb

Table 5 presents the summary statistics for 1-hour average concentrations for H_2S. The measured concentration was low at both stations; the monthly average concentration was 0.2 ppb. The maximum 1-hour average concentration of 1.3 ppb and the maximum 24-hour average concentration of 0.6 ppb were both measured at the Maidstone station. There was not exceedance of the SAAAQS for 1-hour and 24-hour average concentrations (see Table 4).

Figures 5 and 6 present the pollutant roses for 1-hour average H_2S. For more than 99% of the time, H_2S concentration was less than or equal to 1 ppb (blue petals) at both stations. The higher concentrations were detected at the Maidstone station when wind was from the southern directions. It has yet to be determined if a directional trend exists, as this is only a one-month data set, and is not sufficient to conclude if a trend exists.

The detailed frequency distribution tables for the pollutant roses are presented in the Appendices: Table C-2 and Table E-2.

Table 5. Summary statistics for 1-hour average H_2S for December 2013

Monitoring Station	December Average	Instrument Uptime	Maximum H_2S Conc. and Occurrence Time			
			1-hour Max.		24-hour Max.	
	ppb	%	ppb	Time	ppb	Date
Maidstone	0.2	100.0%	1.3	Dec-29 05:00	0.6	Dec-29
Kindersley	0.2	99.9%	1.0	Dec-20 06:00	0.3	Dec-22

Table 6. Number of exceedance events for H_2S for December 2013

Monitoring Station	No. of Exceedances to Saskatchewan Ambient Air Quality Standards (SAAQS)	
	1-hr SAAQS	24-hr SAAQS
	10 ppb	3 ppb
Maidstone	0	0
Kindersley	0	0

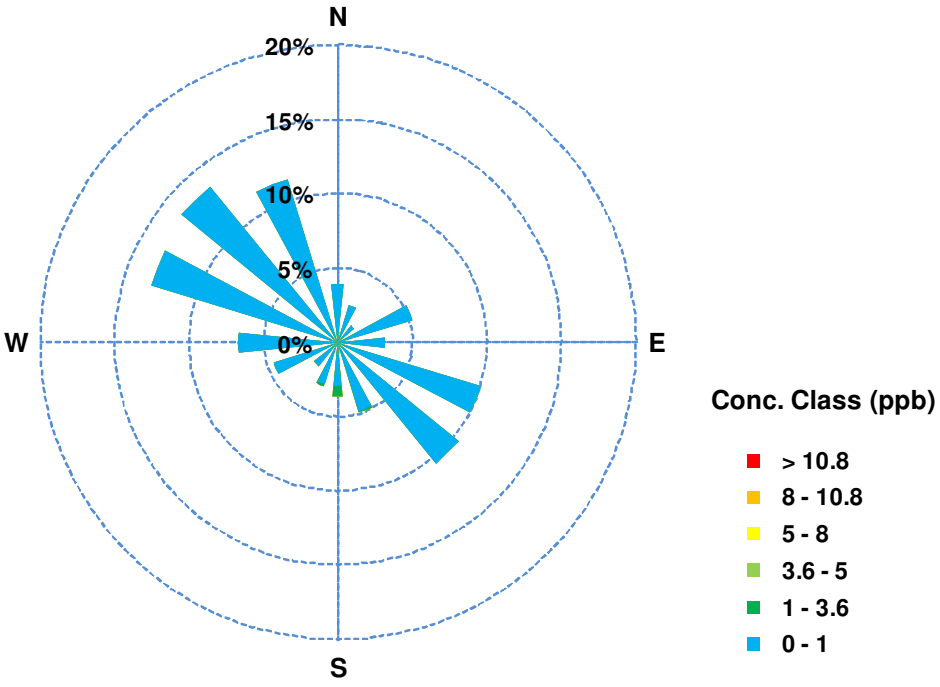


Figure 5. Pollutant rose for 1-hour average H_2S data at the Maidstone station

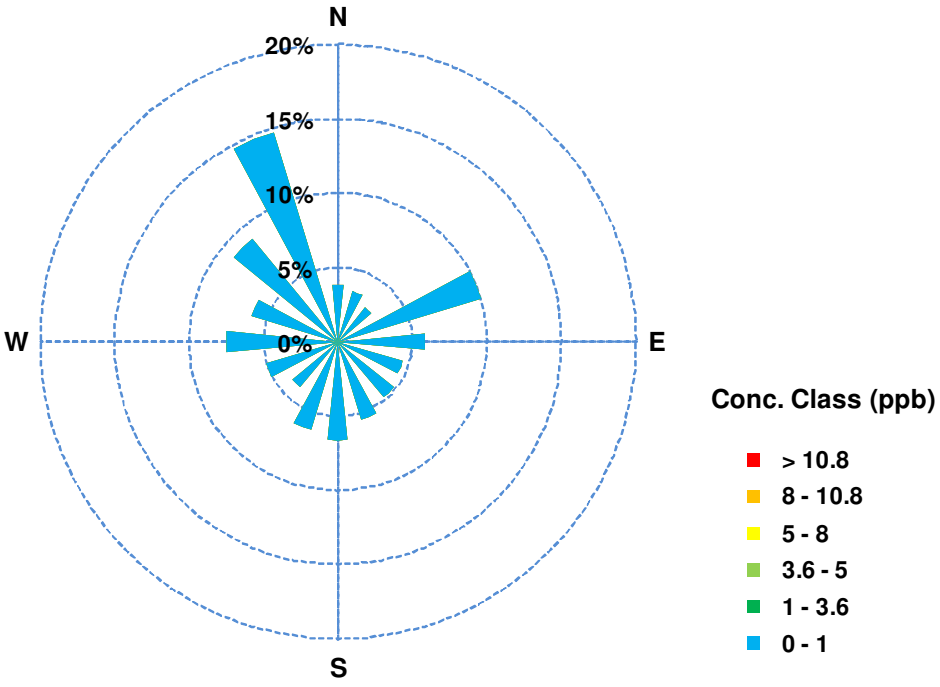


Figure 6. Pollutant rose for 1-hour average H_2S data at the Kindersley station

2.3.3 Nitrogen Dioxide (NO_2)

Nitrogen oxides, also known as oxides of nitrogen (NO_X), is a collective term for nitric oxide (NO) and nitrogen dioxide (NO_2). Nitric oxide is a colorless, flammable gas with a slight odour. Nitrogen dioxide is a reddish brown, non-flammable gas with a pungent irritating odour. NO_2 is of more interest than NO from both a health and acid rain perspective.

NO_X can cause respiratory disease, damage vegetation, and reduce visibility. The primary concern with NO_X emissions is their contribution to formation of ground-level ozone, smog and acid rain. To a lesser extent, some NO_X compounds (e.g. N_2O) contribute to stratospheric ozone layer depletion and global warming.

NO_X emissions are mainly produced by fossil fuel combustion. High temperature conditions during combustion result in the formation of NO_X as a by-product. The major anthropogenic emission sources for NO_X are associated with fuel combustion, including both stationary sources, such as power plants, oil and gas industries, incinerators, as well as mobile sources such as automobiles. Non-combustion sources, for example nitric acid manufacture, welding processes and the use of explosives, comprise the smaller emission sources. In large cities, motor vehicle emission is the major source of NO_X.

The Saskatchewan Ministry of Environment regulates ambient air concentration for nitrogen dioxide. The Saskatchewan Ambient Air Quality Standards (SAAQS) for nitrogen dioxide are:

- 1-hour average SAAQS = 212 ppb
- annual average SAAQS = 53 ppb

Table 7 presents the summary statistics for 1-hour average concentrations for NO_2. The Maidstone station measured a higher concentration than the other two stations. The monthly average was 9.2 ppb at the Maidstone station; it was followed by the Unity station (4.3 ppb) and Meadow Lake station (1.7 ppb). Both the maximum 1-hour and 24-hour concentrations were detected at the Maidstone station. There was no exceedance of the 1-hour or annual SAAQS (see Table 8).

Figures 7 to 9 present the pollutant roses for 1-hour average concentrations for NO_2. The concentration at the Meadow Lake station was the lowest among the three stations; for more than 95% of the time NO_2 concentration was less than 5 ppb, and the concentration never exceeded 15 ppb. At the Unity station, approximately 30% of the time NO_2 concentration was higher than 5 ppb, and 1.1% of the time the concentration was greater than 15 ppb. The concentration at the Maidstone station was the highest among the three stations. Approximately 20% of the data was greater than 15 ppb. It has yet determined if a directional trend exists at each station, as the one-month data set is not sufficient to make conclusions.

The detailed frequency distribution tables for the NO, NO_2 and NOx pollutant roses are presented in the Appendices: Table B-2, Table C-2, and Table D-2.

Table 7. Summary statistics for 1-hour average NO_2 for December 2013

Monitoring Station	December Average	Instrument Uptime	Maximum NO_2 Conc. and Occurrence Time			
			1-hour Max.		24-hour Max.	
	ppb	%	ppb	Time	ppb	Date
Meadow Lake	1.7	73.3%	9.7	Dec-20 00:00	4.1	Dec-20
Maidstone	9.2	52.2%	32.6	Dec-22 21:00	20.8	Dec-22
Unity	4.3	100.0%	22.1	Dec-07 18:00	9.0	Dec-22

Table 8. Number of exceedance events for NO_2 for December 2013

Monitoring Station	No. of Exceedances to Saskatchewan Ambient Air Quality Standards (SAAQS)	
	1-hr SAAQS	Annual SAAQS
	212 ppb	53 ppb
Meadow Lake	0	0
Maidstone	0	0
Unity	0	0

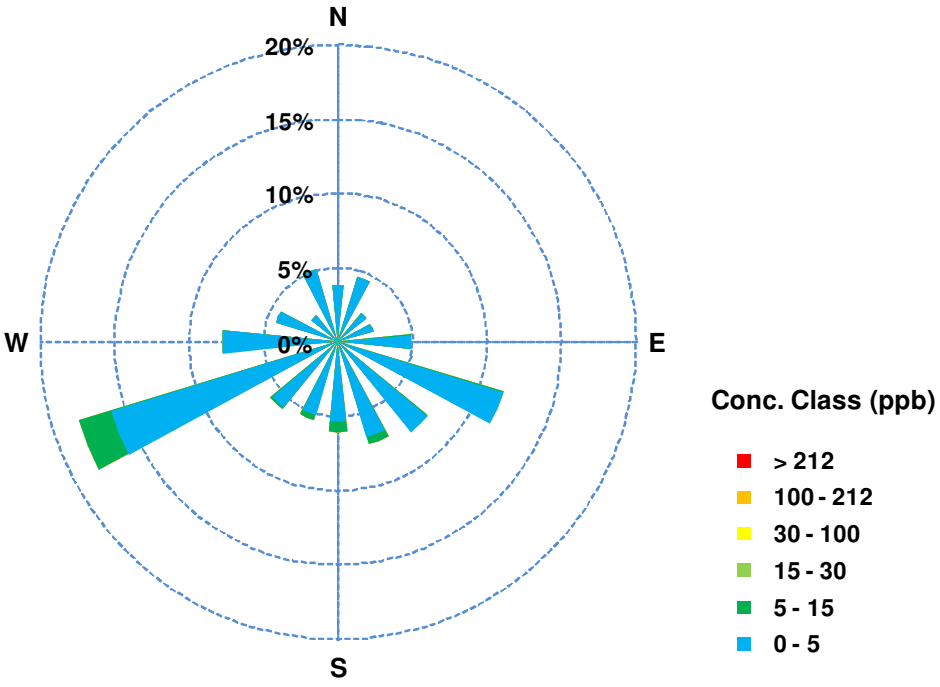


Figure 7. **Pollutant rose for 1-hour average NO_2 data at the Meadow Lake station**

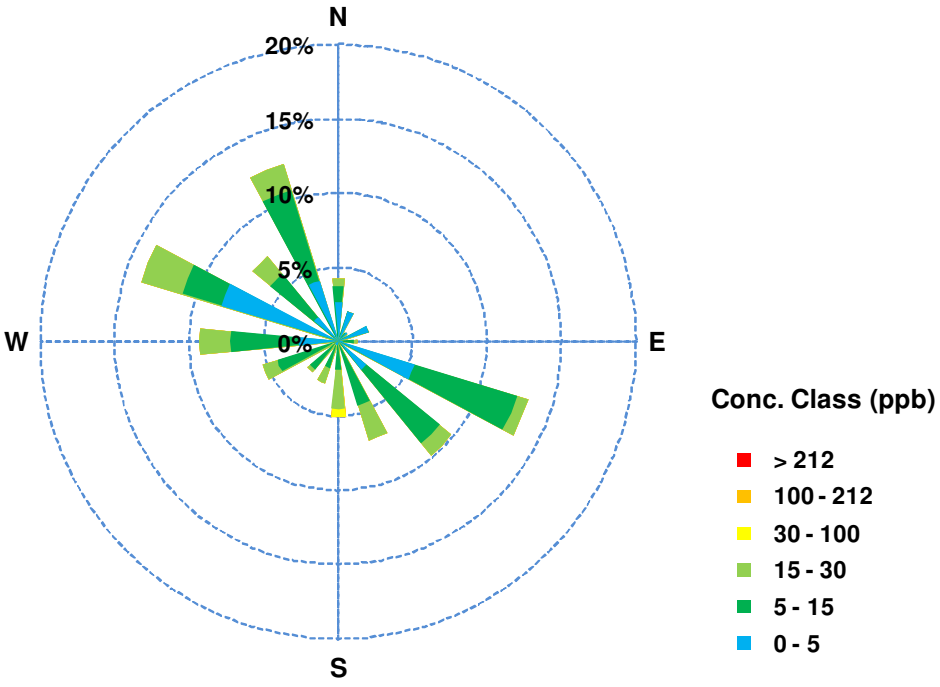


Figure 8. **Pollutant rose for 1-hour average NO_2 data at the Maidstone station**

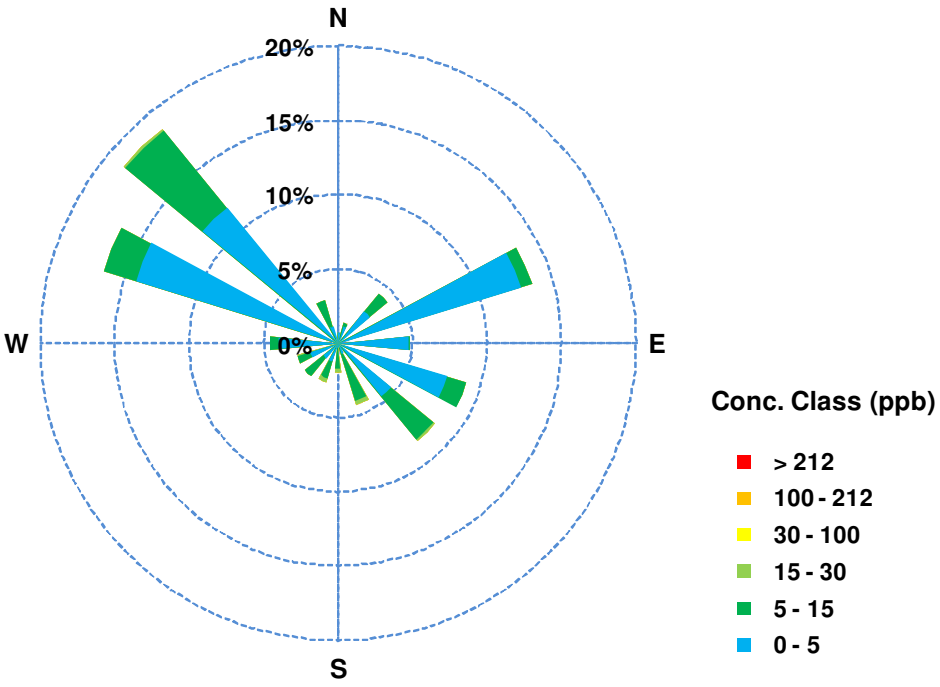


Figure 9. Pollutant rose for 1-hour average NO_2 data at the Unity station

2.3.4 Ozone (O_3)

Ozone (O_3) is a pale blue gas, slightly soluble in water. Most people can detect a sharp odour resembling chlorine bleach at about 10 ppb concentration. Ozone can be formed by electrical discharges and high energy electromagnetic radiation. In the indoor environments, ozone can be present as a result of electronic equipment such as ionic air purifiers, laser printers, photocopiers, and arc welders.

In the ambient air, O_3 is a "secondary" pollutant, meaning it is not directly emitted from a source. Instead, ozone is produced from photochemical reactions between oxides of nitrogen (NO_X) and volatile organic compounds (VOC) in the presence of sunlight. Some research suggests that ground-level ozone could be from intrusion of ozone from the stratosphere, mixing from the upper troposphere, local photochemistry and the medium and long-range transport. There are split opinions regarding relative importance of these mechanisms. A study in Regina suggested that high ozone events could be due to downward transport from the stratosphere for the reviewed data.

Exposure to ozone has been linked to premature mortality and a range of morbidity health end-points, such as hospital admissions and asthma symptoms. Acute exposure to high concentrations of ozone can cause eye irritation and breathing difficulty. Ozone can significantly impact vegetation and decrease the productivity of some crops. It damages cotton, acetate, nylon, polyester and other textile materials. Ozone can also damage other synthetic materials, cause cracks in rubber, accelerate fading of dyes, and speed deterioration of some paints and coatings.

The Saskatchewan Ambient Air Quality Standard (SAAQS) for ozone is:

- 1-hour average SAAQS = 82 ppb

The Canada-Wide Standard (CWS) for ozone is:

- 8-hour average CWS = 65 ppb; achievement evaluation s based on the 4th highest measurement annually, averaged over three consecutive years.

Table 9 presents the summary statistics for 1-hour average concentrations for O_3. The measured concentrations were in a similar range at the two stations. The December average concentrations were 26 ppb and 27 ppb; the maximum 1-hour concentrations were 42 ppb and 43 ppb; the 4th highest 8-hour running averages were 40 ppb and 41 ppb. There was no exceedance of the 1-hour SAAQS; the 8-hour running averages were also within the CWS (see Table 10).

Figures 10 and 11 present the pollutant roses for 1-hour average concentration of O_3. The measured concentrations were mostly within the 20 to 40 ppb range; the high concentration events were associated with western winds. It has yet to be determined if a directional trend is existent, as the one-month data set is not sufficient to make conclusions.

The detailed frequency distribution table for the pollutant roses are presented in the Appendices: Table B-2 and Table D-2.

Table 9. Summary statistics for 1-hour average O_3 for December 2013

Monitoring Station	December Average	Instrument Uptime	Maximum O_3 Conc. and Occurrence Time			
			1-hour Max.		8-hour 4th Highest	
	ppb	%	ppb	Time	ppb	Time
Meadow Lake	27	73.4%	42	Dec-16 17:00	41	Dec-16 11:00
Unity	26	100.0%	43	Dec-15 18:00	40	Dec-16 11:00

Table 10. Number of exceedance events for O_3 for December 2013

Monitoring Station	No. of Exceedances to Saskatchewan Ambient Air Quality Standards (SAAQS)	
	1-hr SAAQS	8-hr CWS
	82 ppb	65 ppb
Meadow Lake	0	0
Unity	0	0

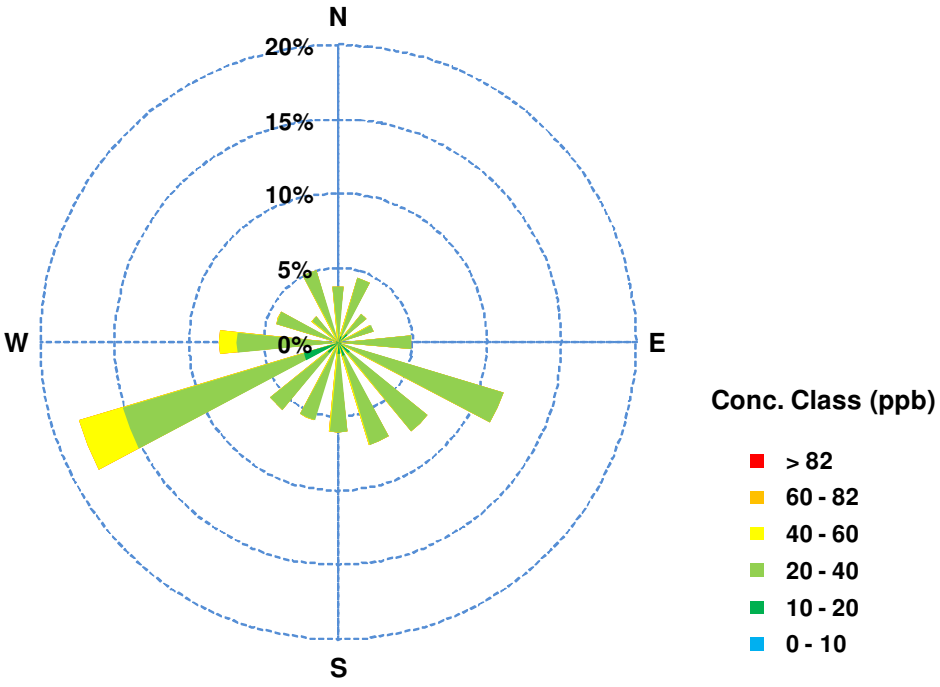


Figure 10. Pollutant rose for 1-hour average O_3 data at the Meadow Lake station

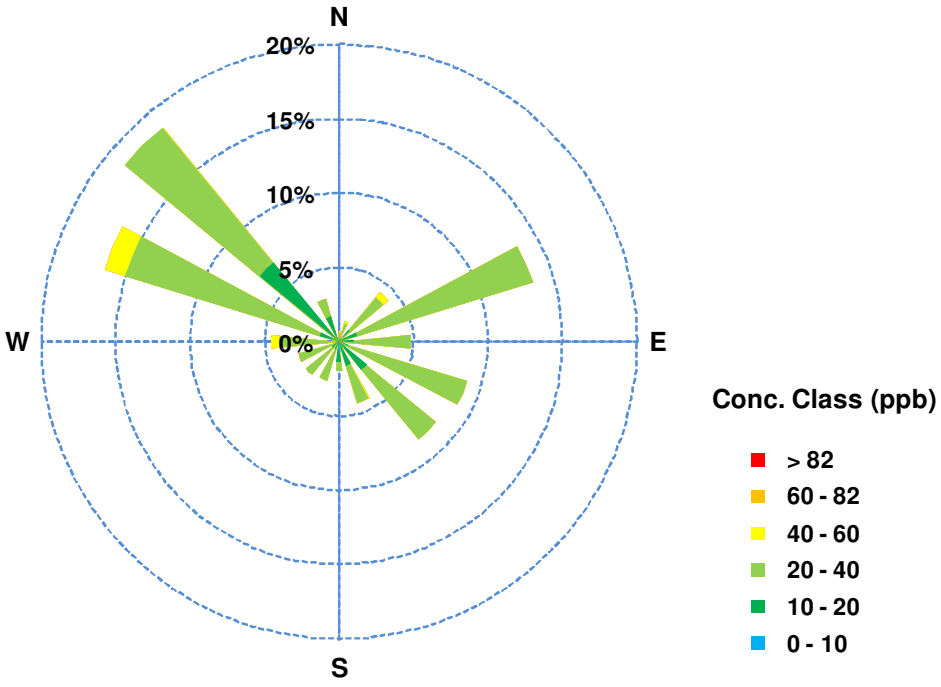


Figure 11. Pollutant rose for 1-hour average O_3 data at the Unity station

2.3.5 Fine Particulate Matter ($PM_{2.5}$)

Particulate matter is unique among air pollutants, as it is identified by its size rather than by its composition. The major concern for particulate matter deals with small particles referred to as inhalable particulate, or PM_{10}. PM_{10} is defined as particles that have an aerodynamic diameter less than 10 microns (or 0.01 mm). PM_{10} can be divided into two groups of particles based on size: fine particles and coarse particles. The fine particles are those particles with an aerodynamic diameter smaller than 2.5 microns (0.0025 mm) and are identified as $PM_{2.5}$. In contrast, coarse particles are those with aerodynamic diameter greater than 2.5 microns and less than 10 microns.

Fine particles are generally emitted from activities such as industrial and residential combustion, and from vehicle exhaust. Fine particles are also formed in the atmosphere when gases such as sulphur dioxide, nitrogen oxides, and volatile organic compounds, emitted by combustion activities, are transformed by chemical reactions in the air.

Adverse health effects from breathing air with a high $PM_{2.5}$ concentration include: premature death, increased respiratory symptoms and disease, chronic bronchitis, and decreased lung function particularly for individuals with asthma. Particulate matter can clog stomatal openings of plants and interfere with photosynthesis functions, leading to growth stunting or mortality in some plant species.

Saskatchewan endorses the Canada-Wide Standards (CWS) for fine particulate matter ($PM_{2.5}$):

- 30 µg/m3 averaged over a 24-hour period from midnight to midnight; the standard is based on the 98th percentile annually, averaged over three consecutive years.

Table 11 presents the summary statistics for 1-hour average concentrations for $PM_{2.5}$. The annual average concentrations range from 4 µg/m^3 to 6 µg/m^3. The maximum 1-hour concentration of 68 µg/m^3 and the maximum 24-hour concentration of 20 µg/m^3 were both detected at the Maidstone station. There was no exceedance of the 24-hour CWS (see Table 12).

Figures 12 through 14 present the pollutant roses for 1-hour average concentration for $PM_{2.5}$. Most concentration data recorded was less than 10 µg/m^3. There was no apparent directional trend for the high concentration events (>10 µg/m^3) at the Meadow Lake and Unity stations. The Madistone station, on the other hand, shows an association with the southern winds for the high concentration events. It has yet to be determined if a directional trend exists, as the one-month data set is not sufficient to conclude a trend.

The detailed frequency distribution tables for the pollutant roses are presented in the Appendices: Table B-2, Table C-2, and Table D-2.

Table 11. Summary statistics for 1-hour average $PM_{2.5}$ for December 2013

Monitoring Station	December Average	Instrument Uptime	Maximum $PM_{2.5}$ Conc. and Occurrence Time			
			1-hour Max.		24-hour Max.	
	$\mu g/m^3$	%	$\mu g/m^3$	Time	$\mu g/m^3$	Date
Meadow Lake	4	74.3%	22	Dec-01 09:00	9	Dec-1
Maidstone	6	100.0%	68	Dec-14 00:00	20	Dec-1
Unity	4	100.0%	25	Dec-29 06:00	12	Dec-1

Table 12. Number of exceedance events for $PM_{2.5}$ for December 2013

Monitoring Station	No. of Exceedance to Canada-Wide Standards (CWS)
	24-hr CWS 30 µg/m3
Meadow Lake	0
Maidstone	0
Unity	0

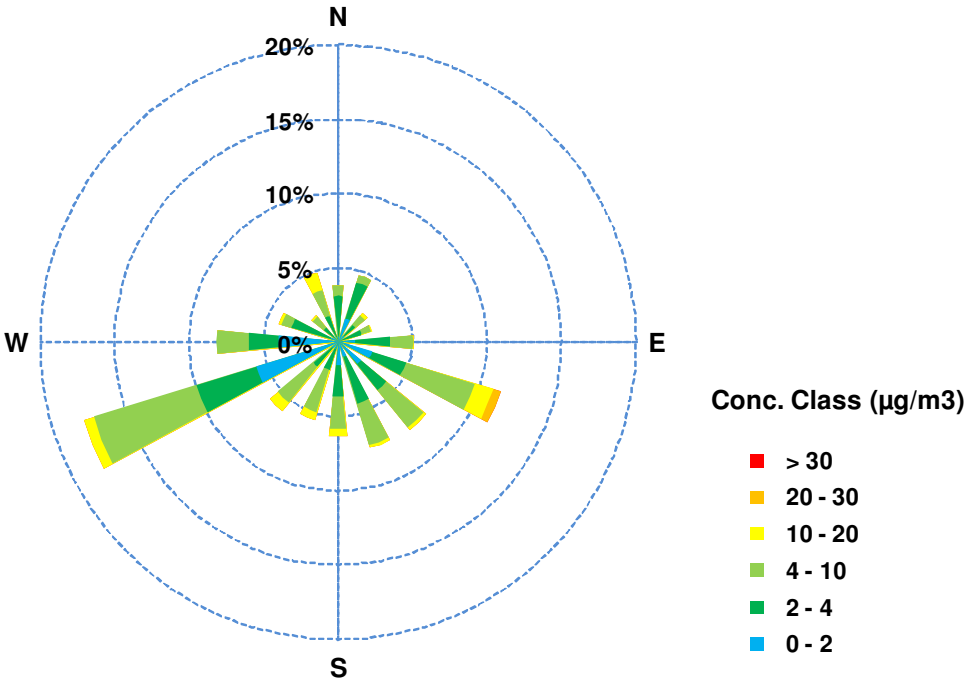


Figure 12. Pollutant rose for 1-hour average $PM_{2.5}$ data at the Meadow Lake station

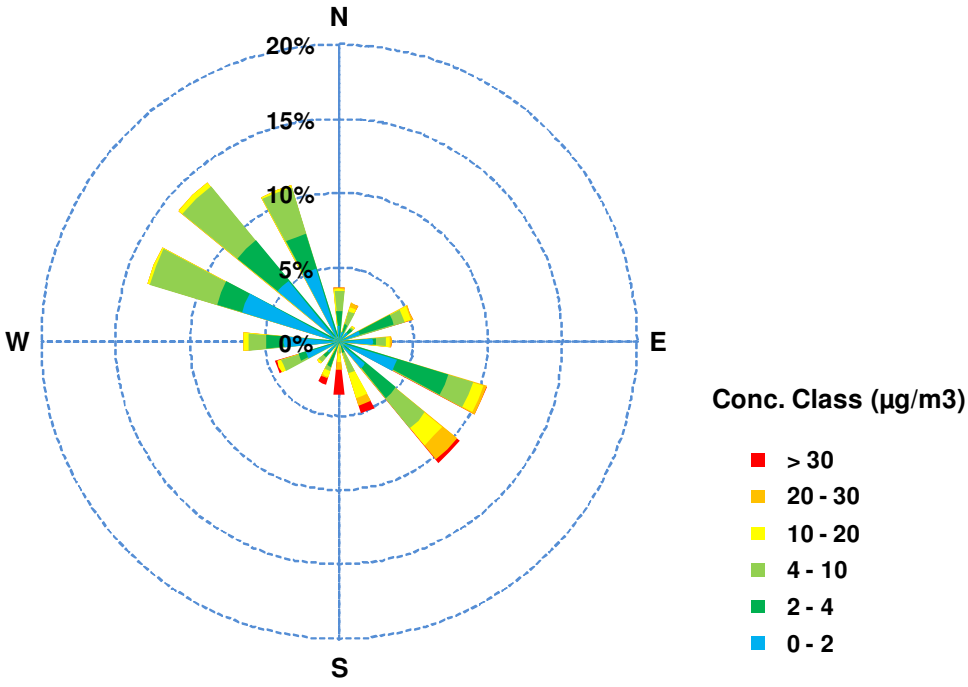


Figure 13. Pollutant rose for 1-hour average $PM_{2.5}$ data at the Maidstone station

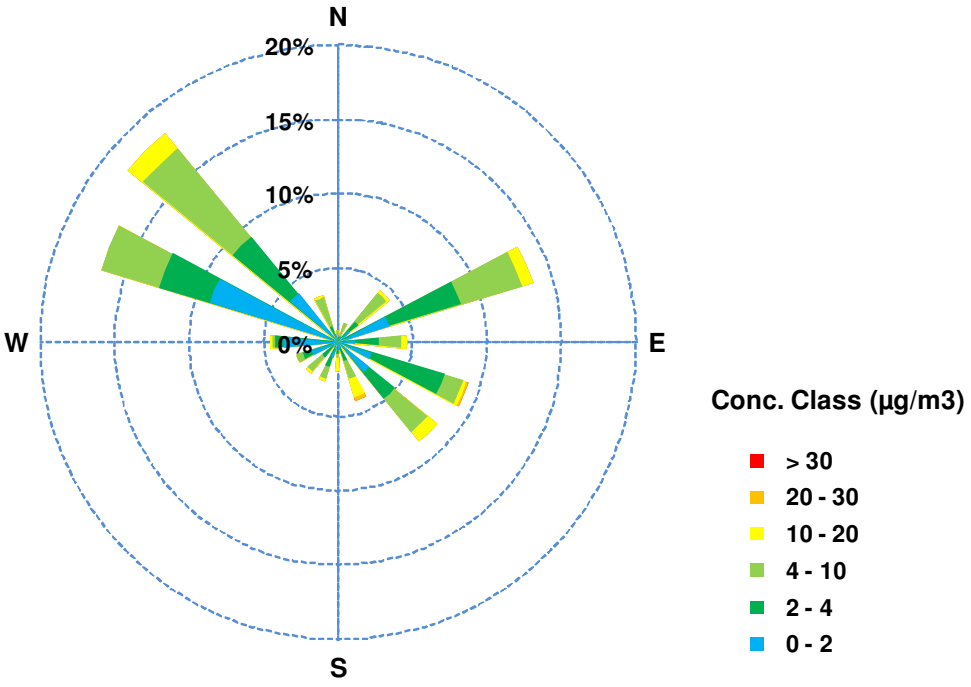


Figure 14. Pollutant rose for 1-hour average $PM_{2.5}$ data at the Unity station

2.4 Air Quality Health Index (AQHI)

Air Quality Health Index (AQHI) is a health protection tool that is designed to help the public make decisions to protect their health by limiting short-term exposure to air pollution and adjusting their activity levels during increased levels of air pollution. The AQHI uses readings from three air pollutants to calculate a single numerical value to evaluate the health risk associated with air pollution. The three pollutants are fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), and ground-level ozone (O_3). All three pollutants are required to calculate AQHI.

Figure 15 illustrates the risk categories and the health messages for the AQHI system. The health risk is classified in four categories: Low (1 to 3), Moderate (4 to 6), High (7 to 10), and Very High (higher than 10).

Among the WYAMZ air monitoring stations, Meadow Lake and Unity are eligible for AQHI reporting. Table 13 summarizes the summary statistics for AQHI rating. The air quality at both stations was rated Low Risk for December 2013.

Health Risk	Air Quality Health Index	Health Messages	
		At Risk Population	General Population
Low Risk	1 – 3	**Enjoy** your usual outdoor activities.	**Ideal** air quality for outdoor activities.
Moderate Risk	4 – 6	**Consider** reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	**No need to modify** your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High Risk	7 – 10	**Reduce or reschedule** strenuous activities outdoors. Children and the elderly should also take it easy.	**Consider** reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High Risk	Above 10	**Avoid** strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	**Reduce or reschedule** strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

Figure 15. Risk classification and health messages for Air Quality Health Index (Environment Canada)

Table 13. Summary of occurrence statistics for AQHI rating

Station Name	Occurrence Statistics	Number of Occurrence Hours and Frequency by AQHI Rating			
		Low Risk	Moderate Risk	High Risk	Very High Risk
Meadow Lake	Occurrence Hours	555	0	0	0
	Occurrence Frequency	100.0%	0.0%	0.0%	0.0%
Unity	Occurrence Hours	744	0	0	0
	Occurrence Frequency	100.0%	0.0%	0.0%	0.0%

2.5 Air Quality Index (AQI)

The Maidstone station does not meet the reporting requirements for AQHI, the Air Quality Index (AQI) is used as an alternative index. The Kindersley station is excluded from index analysis because this station does not meet the reporting requirements of either index system.

The Air Quality Index (AQI) is a system developed to provide the public with a meaningful and comparable measure of outdoor air quality. The AQI uses readings from five major air pollutants: SO_2, NO_2, O_3, $PM_{2.5}$, and carbon monoxide (CO), to calculate the AQI. A minimum of three pollutants is required to calculate AQI. The AQI is rated in four categories: Good (0 to 25), Fair (26 to 50), Poor (51 to 100), and Very Poor (>100). Table 14 summarizes the effects associated with the AQI ratings.

Table 15 summarizes the occurrence statistics for AQI rating. The air quality at the Maidstone station was rated Good for 96.5% of the time; 3.5% was rated Fair. There were no Poor or Very Poor ratings for December 2013.

Table 14. AQI rating and effect description

AQI	Air Quality Rating	Effect Description
0 – 25	Good	Desirable Range: No known harmful effects to soil, water, vegetation, animals, materials, visibility or human health. The long-term goal is for air quality to be in this range all of the time in Canada.
26 – 50	Fair	Acceptable Range: Adequate protection against harmful effects to soil, water, vegetation, animals, materials, visibility and human health.
51 – 100	Poor	Tolerable Range: Not all aspects of human health or the environment are adequately protected from possible adverse effects. Long-term control action may be necessary, depending on the frequency, duration and circumstances of the readings.
>100	Very Poor	Intolerable Range: Continued high readings could pose a risk to public health.

Table 15. Summary of occurrence statistics for AQI rating

Station Name	Occurrence Statistics	Number of Occurrence Hours and Frequency by AQI Rating			
		Good	Fair	Poor	Very Poor
Maidstone	Occurrence Hours	361	13	0	0
	Occurrence Frequency	96.5%	3.5%	0.0%	0.0%

2.6 Passive Monitoring Network

The WYAMZ passive monitoring program was initiated in February 2013. Tables 16 summarize the average concentrations for 30-day passive samples. Fourteen stations were operational this year. SO_2, NO_2, and O_3 samples were collected for six months (February, and May to September); H_2S, BTEX, and NH_3 were collected for February only. The sample capture rate was greater than 95% for all parameters.

Table 16. Sample capture rates for the SESAA passive monitoring network

Species	Number of Station	Number of Valid Passive Samples (no.)												Capture Rate (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
SO_2	14	-	13	-	-	14	13	13	14	14	-	-	-	96.4%
NO_2	14	-	12	-	-	14	13	13	14	14	-	-	-	95.2%
O_3	14	-	13	-	-	12	14	13	14	14	-	-	-	95.2%
H_2S	1	-	1	-	-	-	-	-	-	-	-	-	-	100.0%
NH_3	1	-	1	-	-	-	-	-	-	-	-	-	-	100.0%
Benzene	1	-	1	-	-	-	-	-	-	-	-	-	-	100.0%
Toluene	1	-	1	-	-	-	-	-	-	-	-	-	-	100.0%
Ethylbenzne	1	-	1	-	-	-	-	-	-	-	-	-	-	100.0%
Xylene	1	-	1	-	-	-	-	-	-	-	-	-	-	100.0%

- *:* Passive program inactive

2.6.1 Sulphur Dioxide (SO_2)

Figure 16 presents 30-day average concentration for the WYAMZ passive SO_2 network for 2013. The concentrations within the airshed zone were low in comparison to the SAAQS. The annual average concentrations at all stations were within the annual SAAQS (11 ppb).

Figure 17 presents a bubble chart showing spatial distribution of the annual average concentration for passive SO_2. The annual average concentration ranged from 0.2 ppb to 2.0 ppb. This is the first year of the monitoring program. The sample size is too small to conclude a spatial trend. It was noted that nearly 50% of the samples were below the method detection limit. The method detection limit is a statistically defined decision point such that measured results falling at or above this point are interpreted to indicate the presence of analyte in the sample with a specified probability. The annual average data was calculated from reportable samples only; results may be biased. It was also found the maximum concentration station varied by months; there was no consistent spatial trend.

Please refer to Appendix G: Table G-1 for the concentrations of individual samples. The measured 30-day average concentrations ranged from <0.1 ppb to 3.7 ppb.

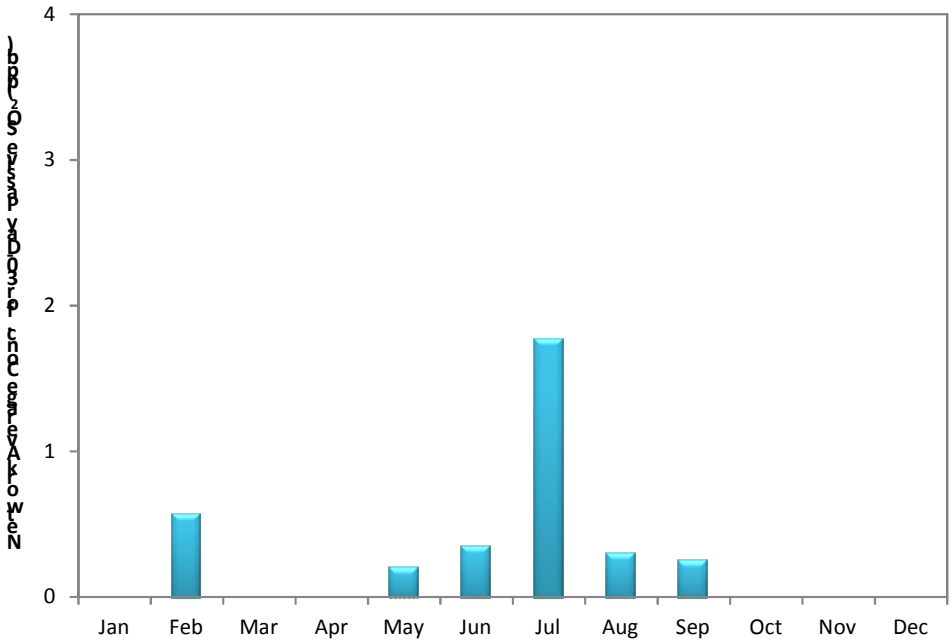


Figure 16. Monthly average concentration for the WYAMZ passive SO_2 network for 2013

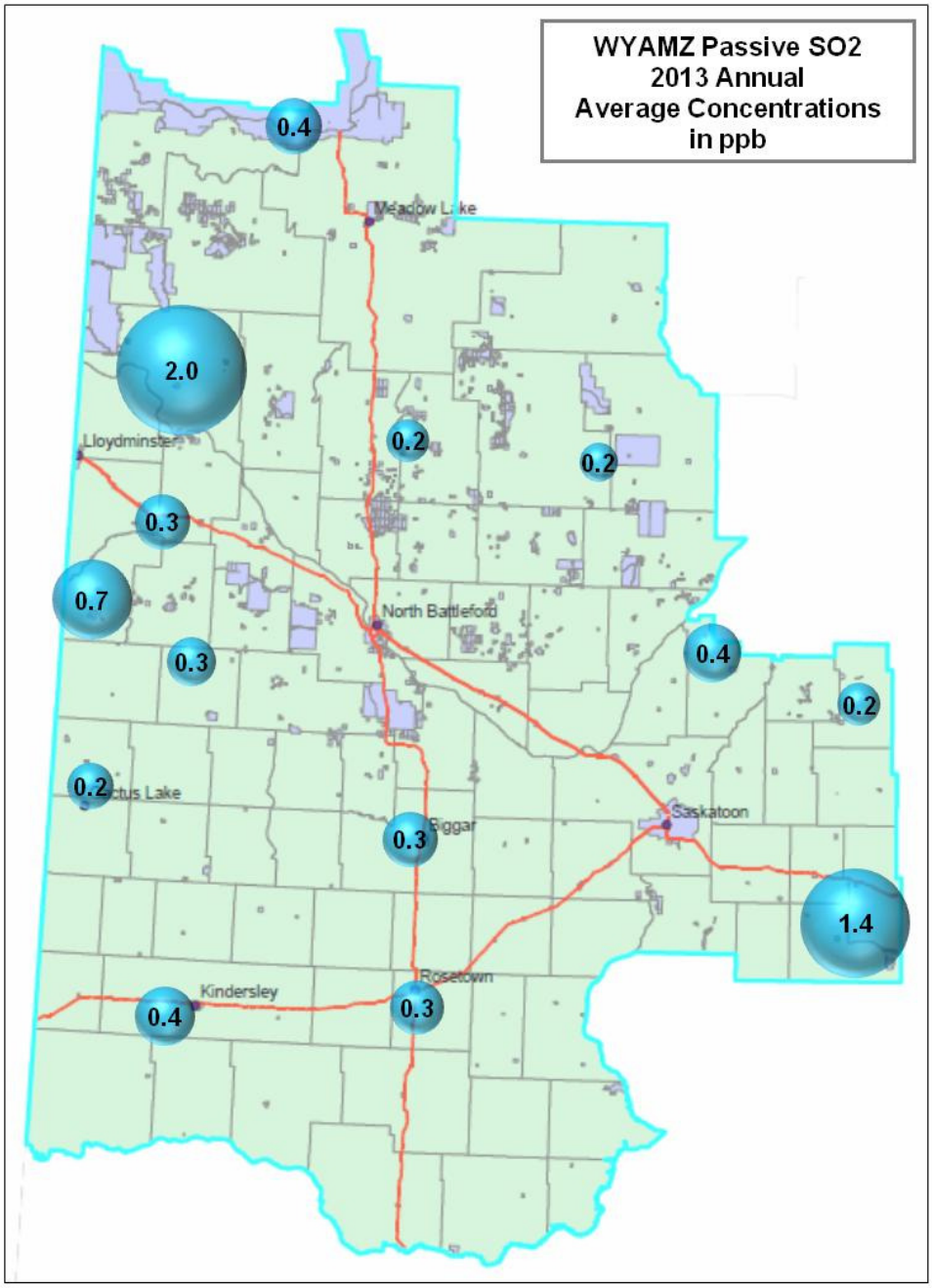


Figure 17. **Spatial distribution of annual average concentration for the WYAMZ passive SO_2 network**

2.6.2 Nitrogen Dioxide (NO_2)

Figure 18 presents 30-day average concentrations for the passive NO_2 network for 2013. NO_2 concentration within the WYAMZ was low in comparison to the SAAQS. The annual average concentrations at all stations were within the annual SAAQS (53 ppb).

Figure 19presents a bubble chart showing spatial distribution of annual average concentration for passive NO_2. The annual average concentration ranged from 0.5 ppb to 3.5 ppb. This is the first year of the monitoring program. The sample size is too small to conclude a spatial trend. The Maidstone station tends to detect a higher concentration than most other stations on a routine basis; the other stations did not exhibit a clear spatial trend among the monitoring months.

Please refer to Appendix G: Table G-2 for the concentrations of individual samples. The measured 30-day average concentrations ranged from <0.1 ppb to 8.5 ppb.

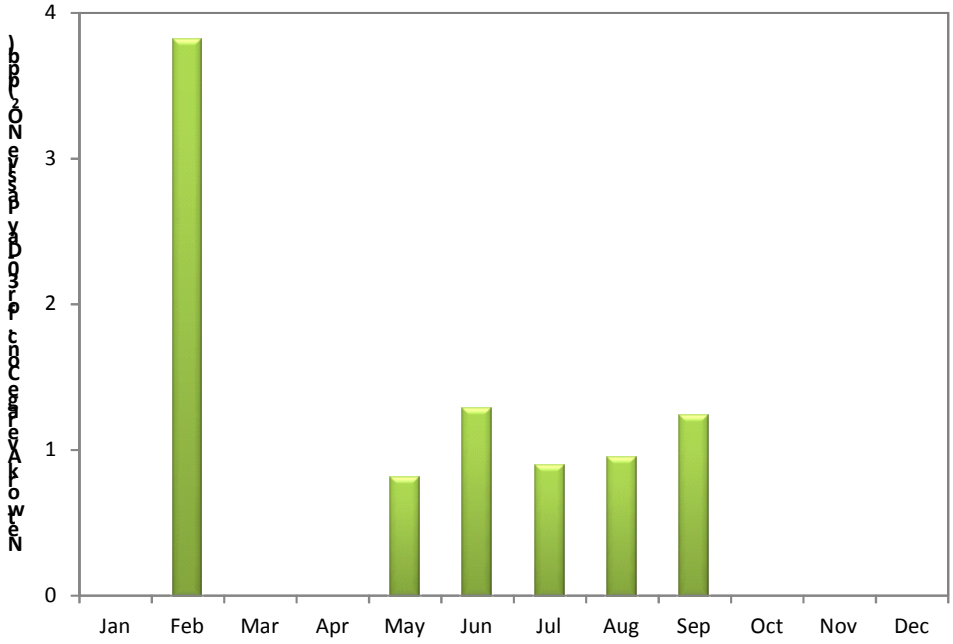


Figure 18. Monthly average concentration for the WYAMZ passive NO_2 network for 2013

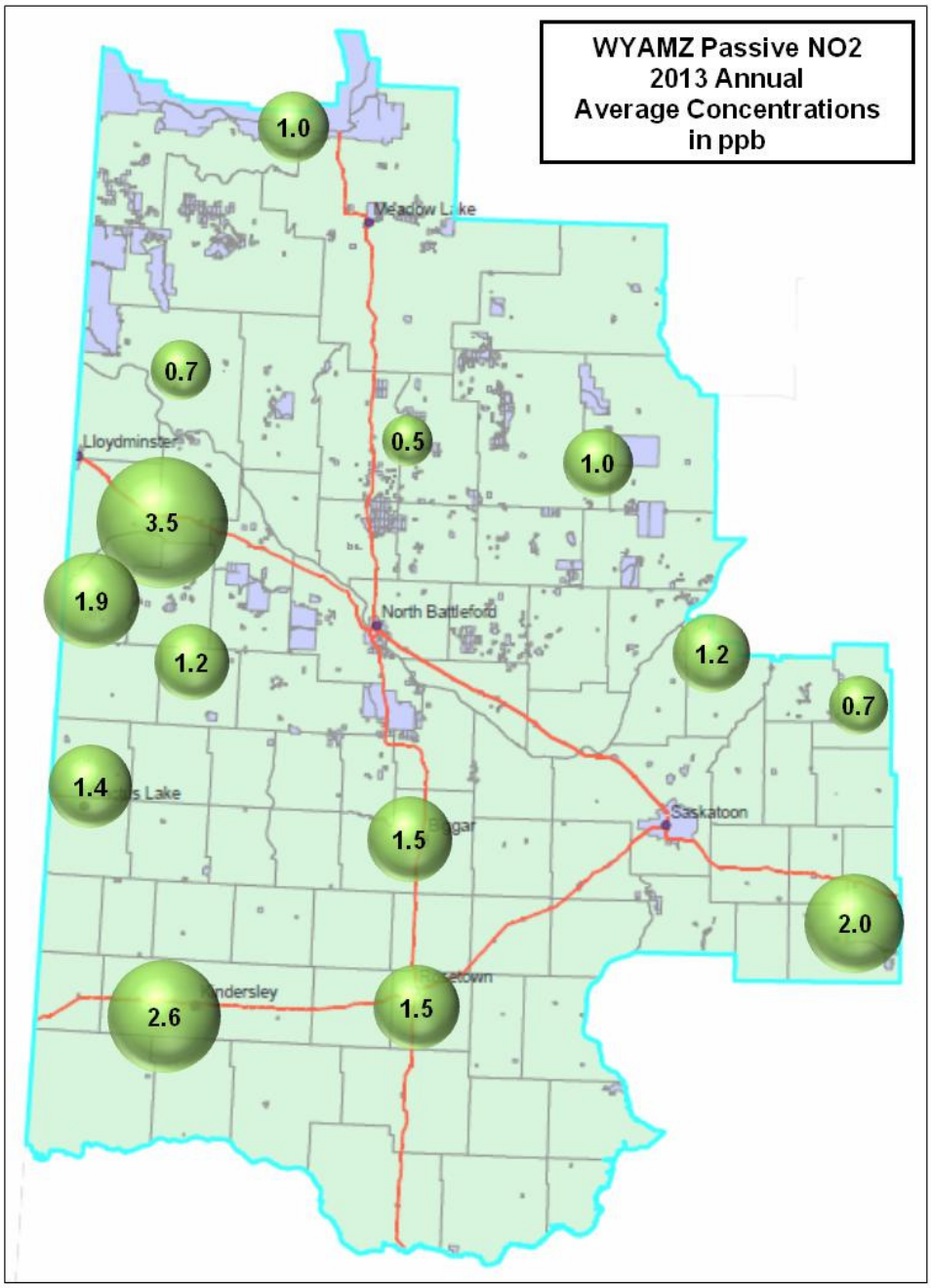


Figure 19. **Spatial distribution of annual average concentration for the WYAMZ passive NO_2 network**

2.6.3 Ozone (O_3)

Figure 20 presents 30-day average concentration for passive O_3 for 2013. The one-year data is not sufficient to conclude a seasonal trend. The annual average concentrations at all stations were within the CWS (65 ppb).

Figure 21 presents a bubble chart showing spatial distribution of annual average concentration for passive O_3. The annual average concentrations ranged from 30 ppb to 50 ppb. This is the first year of the monitoring program. The sample size is too small to conclude a spatial trend. It was found that the station that detected the maximum concentration varied by month; there was no consistent spatial trend among the monitoring months.

Please refer to Appendix G: Table G-3 for the concentrations of individual samples. The 30-day average concentrations ranged from 22 ppb to 67 ppb.

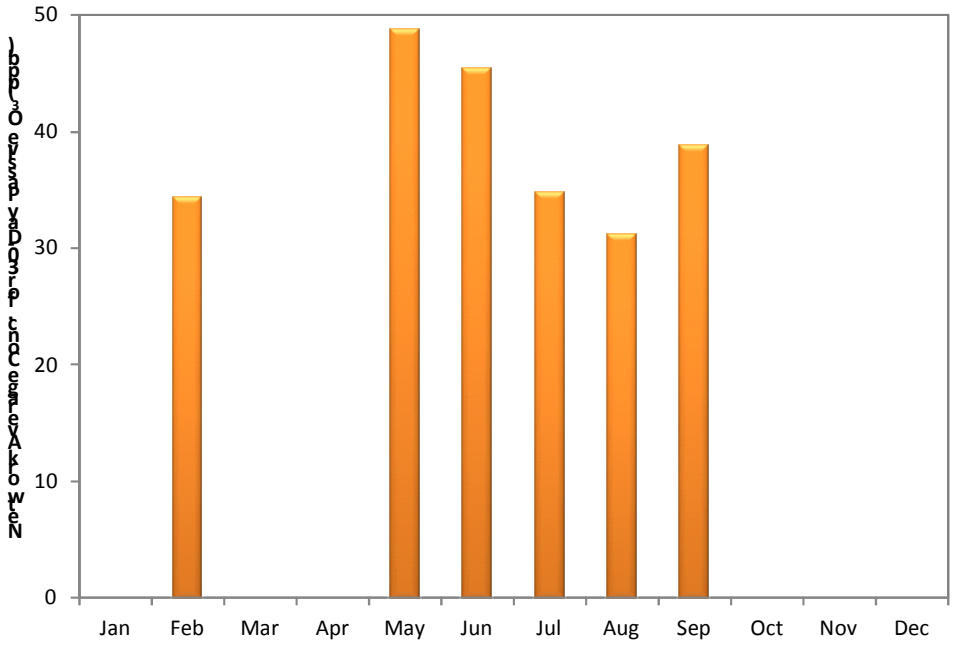


Figure 20. Monthly average concentration for the WYAMZ passive O_3 network for 2013

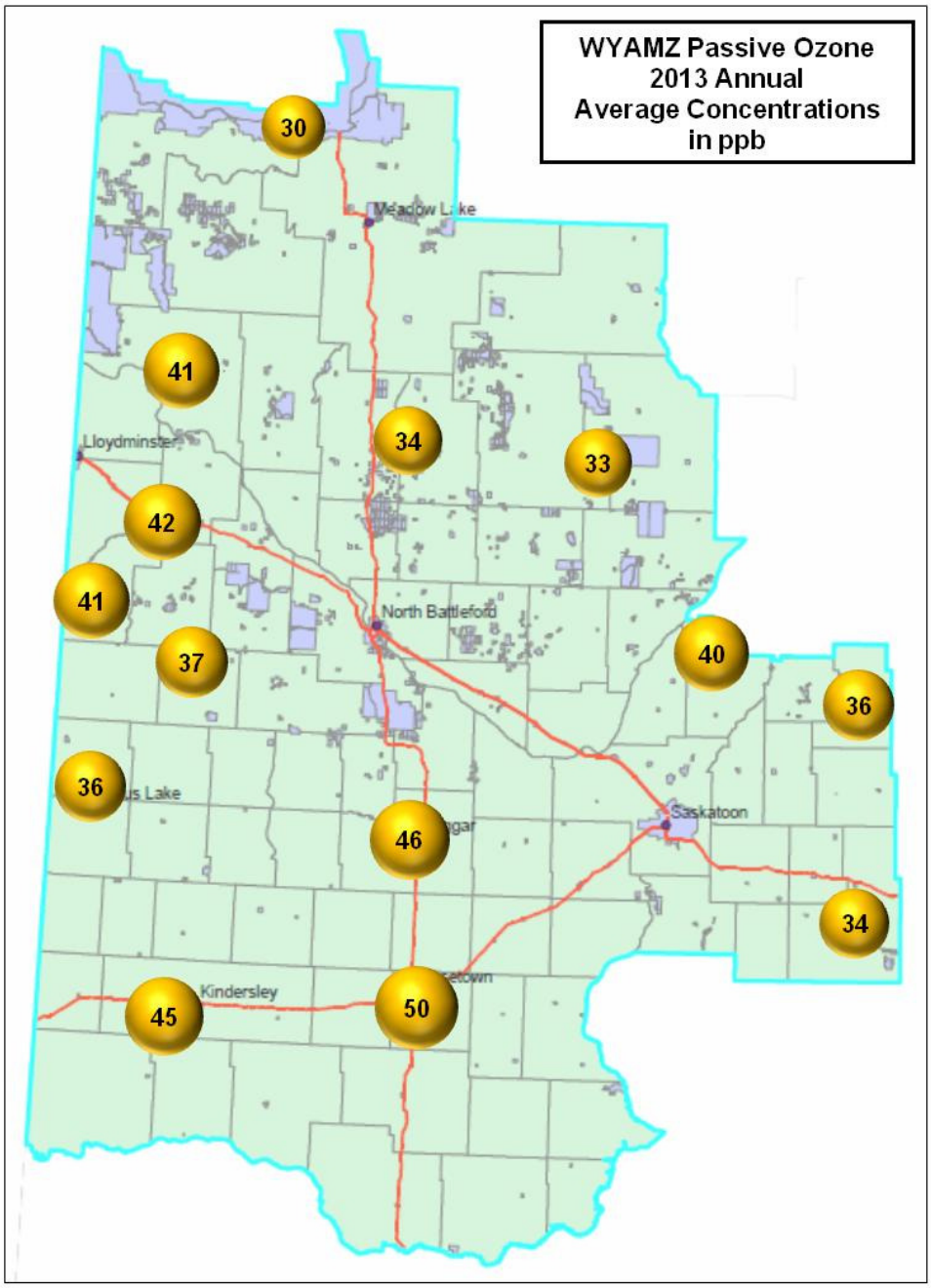


Figure 21. **Spatial distribution of annual average concentration for the WYAMZ passive O_3 network**

APPENDIX A. SASKATCHEWAN AMBIENT AIR QUALITY STANDARDS

Table A-1. Saskatchewan Ambient Air Quality Standards

Pollutant[1]	Average Concentration For Applicable Time Period				
	1 Hour	8 Hours	24 Hours	30 Days	Annual
Suspended Particulates			120 $\mu g/m^3$		*70 $\mu g/m^3$
Settleable Particulates				2.0 mg/cm^2	
Soil Index			1.5 COH units		
Sulphur Dioxide	450 (0.17) $\mu g/m^3$		150 (0.06) $\mu g/m^3$		**30 (0.01) $\mu g/m^3$
Sulphation				30 mg of SO_3 per 100 cm^2	
Carbon Monoxide	15 (13) mg/m^3	6 (5) mg/m^3			
Oxidants (Ozone)	160 (0.08) $\mu g/m^3$				
Nitrogen Dioxide	400 (.2) $\mu g/m^3$				**100 (0.05) $\mu g/m^3$
Hydrogen Sulphide	15 (10.8) $\mu g/m^3$		5 (3.6) $\mu g/m^3$		

NOTE: Volume units, in parts per million or parts per billion for H_2S, are in brackets
* Geometric Means, **Arithmetic Means
[1] Sampling will be in a manner and location specified by the Minister.

The Canada-wide Standards (CWSs) listed below are in addition to the above air quality standards.

- Particulate Matter
  - A CWS for $PM_{2.5}$ of 30 $\mu g/m^3$, 24-hour averaging time
  - Achievement to be based on the 98th percentile ambient measurement annually, averaged over three consecutive years

- Ozone
  - A CWS for ozone of 65 ppb, eight-hour averaging time
  - Achievement to be based on the 4th highest measurement annually, averaged over three consecutive years

- Benzene, Mercury, Dioxins & Furans
  - Information on numerical targets or emission limits for specific facilities or sectors is available from the Canadian Council of Ministers of the Environment website at http://www.ccme.ca/

APPENDIX B. MEADOW LAKE STATION: CONTINUOUS MONITORING DATA

Table B-1 Meadow Lake Station: Summary statistics for continuous air monitoring results for December 2013

Parameter	Unit	Calibration & AIC[a]	Valid Data	Uptime	Summary Statistics for Hourly Average Data		
		(hours)	(hours)	(%)	Average	Minimum	Maximum
NO	ppb	25	527	73.3%	0.2	< 0.1	3.9
NO_2	ppb	25	527	73.3%	1.7	< 0.1	9.7
NO_x	ppb	25	527	73.3%	1.9	0.1	9.8
O_3	ppb	25	528	73.4%	27	16	42
$PM_{2.5}$	µg/m^3	0	553	74.3%	4	< 1	22
Precipitation	mm	0	553	74.3%	0.7[b]	< 0.1	0.2
Ambient Temperature	°C	0	553	74.3%	-17.9	-36	4.0
Relative Humidity	%	0	553	74.3%	72	54	88
Wind Speed	m/s	0	553	74.3%	2.1	Calm	7.0

a. Automatic Instrument Check

b. Total precipitation.

Table B-2. Meadow Lake Station: Summary of airpointer® monitoring results for December 2013

Parameter	Unit	Number of 1-hr Data	Operational Time (%)	Mean of 1-Hr Avg	Maximum 1-Hour Value	Number 1-Hour Violations	Maximum 24-Hour Value	Number 24-Hour Violations	Percent of Data in each Data Range					
									<=5	>5-15	>15-30	>30-100	>100-212	>212
NO	ppb	527	73.3%	0.2	3.9	-	0.8	-	100.0	0.0	0.0	0.0	0.0	0.0
NO_2	ppb	527	73.3%	1.7	9.7	0 [a]	4.1	-	95.8	4.2	0.0	0.0	0.0	0.0
NOx	ppb	527	73.3%	1.9	9.8	-	4.7	-	93.9	6.1	0.0	0.0	0.0	0.0
									<=10	>10-20	>20-40	>40-60	>60-82	>82
O_3	ppb	528	73.4%	27	42	0 [b]	41 [c]	0 [c]	0.0	8.3	87.5	4.2	0.0	0.0
									<=2	>2-4	>4-10	>10-20	>20-30	>30
$PM_{2.5}$	µg/m^3	553	74.3%	4	22	-	9	0 [d]	23.0	34.0	36.5	6.0	0.5	0.0
									<=0	>0-5	>5-10	>10-30	>30-60	>60
Precipitation	mm	553	74.3%	0.7 [e]	0.2	-	0.3	-	98.2	1.8	0.0	0.0	0.0	0.0

Parameter	Unit	Number of 1-hr Data	Operational Time (%)	Mean of 1-Hr Avg	Minimum 1-Hour Value	Maximum 1-Hour Value	Percent of Data in each Data Range					
							<=-30	>-30~-15	>-15~0	>0~15	>15~30	>30
Temperature	°C	553	74.3%	-17.9	-35.5	4.0	6.5	56.6	34.4	2.5	0.0	0.0
							<=15	>15-30	>30-60	>60-80	>80-90	>90
Relative Humidity	%	553	74.3%	72	54	88	0.0	0.0	4.0	83.4	12.7	0.0

a. NO_2 1-hour Saskatchewan Ambient Air Quality Standard = 212 ppb

b. O_3 1-hour Saskatchewan Ambient Air Quality Standard = 82 ppb

c. Concentration is the maximum of 8-hour running average; number of violatiosn is compared against 8-hour Canada-Wide Standard = 65 ppb

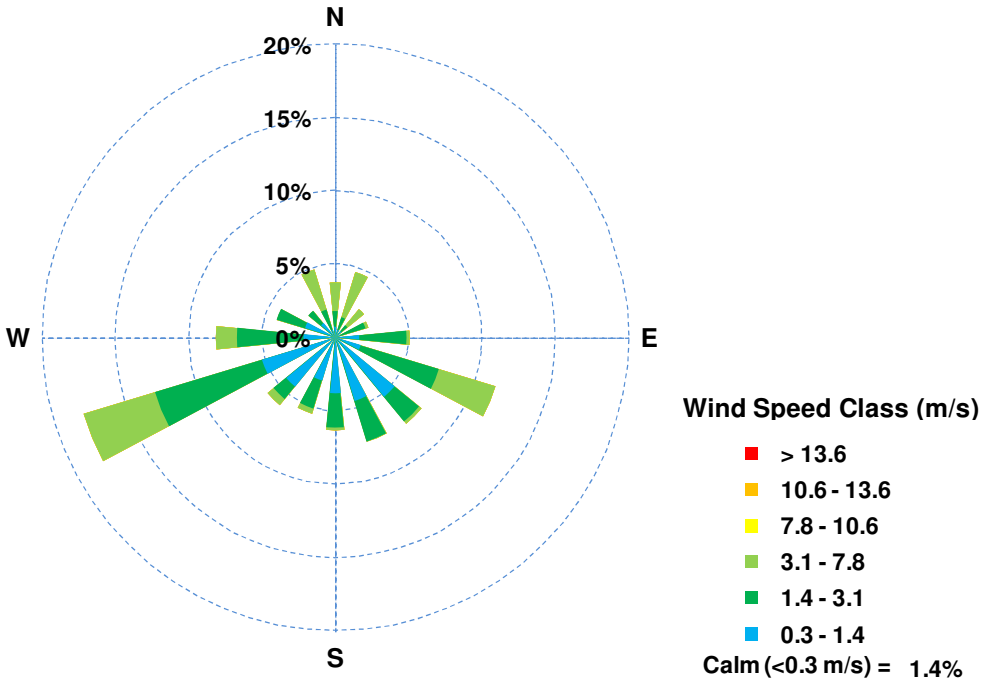
d. $PM_{2.5}$ 24-hour Canada-Wide Standard = 30 µg/m^3 (98th percentile annually, averaged over three consecutive years)

e. Total Precipitation for December 2013

Table B-3 Meadow Lake Station: Wind frequency table for December 2013

Wind Direction Sector	Percent of Data within Wind Speed Range, wind speed unit m/s						
	>0.3-1.4	>1.4-3.1	>3.1-7.8	>7.8-10.6	>10.6-13.6	>13.6	Totals
North NorthEast	0.5%	0.9%	3.3%	0.0%	0.0%	0.0%	4.7%
NorthEast	0.4%	0.5%	1.4%	0.0%	0.0%	0.0%	2.4%
East NorthEast	0.4%	1.8%	0.2%	0.0%	0.0%	0.0%	2.4%
East	1.6%	3.3%	0.2%	0.0%	0.0%	0.0%	5.1%
East SouthEast	1.6%	5.6%	4.0%	0.0%	0.0%	0.0%	11.2%
SouthEast	4.9%	2.2%	0.2%	0.0%	0.0%	0.0%	7.2%
South SouthEast	4.5%	2.9%	0.0%	0.0%	0.0%	0.0%	7.4%
South	3.8%	2.4%	0.2%	0.0%	0.0%	0.0%	6.3%
South SouthWest	3.1%	2.0%	0.4%	0.0%	0.0%	0.0%	5.4%
SouthWest	4.2%	1.1%	0.5%	0.0%	0.0%	0.0%	5.8%
West SouthWest	5.2%	7.6%	5.1%	0.0%	0.0%	0.0%	17.9%
West	2.2%	4.5%	1.4%	0.0%	0.0%	0.0%	8.1%
West NorthWest	2.0%	2.0%	0.0%	0.0%	0.0%	0.0%	4.0%
NorthWest	1.1%	1.1%	0.0%	0.0%	0.0%	0.0%	2.2%
North NorthWest	0.5%	1.4%	2.9%	0.0%	0.0%	0.0%	4.9%
North	0.5%	1.1%	2.0%	0.0%	0.0%	0.0%	3.6%
Total	36.5%	40.3%	21.7%	0.0%	0.0%	0.0%	98.6%

Percent Calm (<0.3 m/s)	1.4%
Number of Valid Hourly-Average Data	553
Total Workable Hours in Time Period	744



APPENDIX C. MAIDSTONE STATION: CONTINUOUS MONITORING DATA

Table C-1 Maidstone Station: Summary statistics for continuous air monitoring results for December 2013

Parameter	Unit	Calibration & AIC[a]	Valid Data	Uptime	Summary Statistics for Hourly Average Data		
		(hours)	(hours)	(%)	Average	Minimum	Maximum
SO_2	ppb	48	701	100.0%	1	< 1	3
H_2S	ppb	48	687	100.0%	0.2	< 0.1	1.3
NO	ppb	17	375	52.2%	2.4	< 0.1	35.2
NO_2	ppb	17	375	52.2%	9.2	0.2	32.6
NO_x	ppb	17	375	52.2%	11.6	0.2	52.3
$PM_{2.5}$	µg/m^3	0	735	100.0%	6	< 1	68
Precipitation	mm	0	737	100.0%	3.6[b]	< 0.1	1.0
Ambient Temperature	°C	0	737	100.0%	-19.1	-37	4.3
Relative Humidity	%	0	737	100.0%	73	52	90
Wind Speed	m/s	0	737	100.0%	2.2	Calm	7.0

a. Automatic Instrument Check

b. Total precipitation.

Table C-2. Maidstone Station: Summary of airpointer® monitoring results for December 2013

Parameter	Unit	Number of 1-hr Data	Operational Time (%)	Mean of 1-Hr Avg	Maximum 1-Hour Value	Number 1-Hour Violations	Maximum 24-Hour Value	Number 24-Hour Violations	Percent of Data in each Data Range					
									<=5	>5-15	>15-30	>30-100	>100-212	>212
NO	ppb	375	52.2%	2.4	35.2	-	8.2	-	86.1	10.1	3.2	0.5	0.0	0.0
NO_2	ppb	375	52.2%	9.2	32.6	0[a]	20.8	-	33.9	46.9	18.7	0.5	0.0	0.0
NOx	ppb	375	52.2%	11.6	52.3	-	28.9	-	25.3	46.1	22.7	5.9	0.0	0.0
									<=1	>1-5	>5-10	>10-57	>57-172	>172
SO_2	ppb	701	100.0%	1	3	0[b]	1	0[c]	83.7	16.3	0.0	0.0	0.0	0.0
									<=1	>1-3.6	>3.6-5	>5-8	>8-10.8	>10.8
H_2S	ppb	687	100.0%	0.2	1.3	0[d]	0.6	0[e]	99.0	1.0	0.0	0.0	0.0	0.0
									<=2	>2-4	>4-10	>10-20	>20-30	>30
$PM_{2.5}$	µg/m^3	735	100.0%	6.0	68.0	-	20.0	0[f]	37.4	22.6	26.3	7.3	3.4	3.0
									<=0	>0-5	>5-10	>10-30	>30-60	>60
Precipitation	mm	737	100.0%	3.6	1.0[g]	-	1.8	-	98.4	1.6	0.0	0.0	0.0	0.0

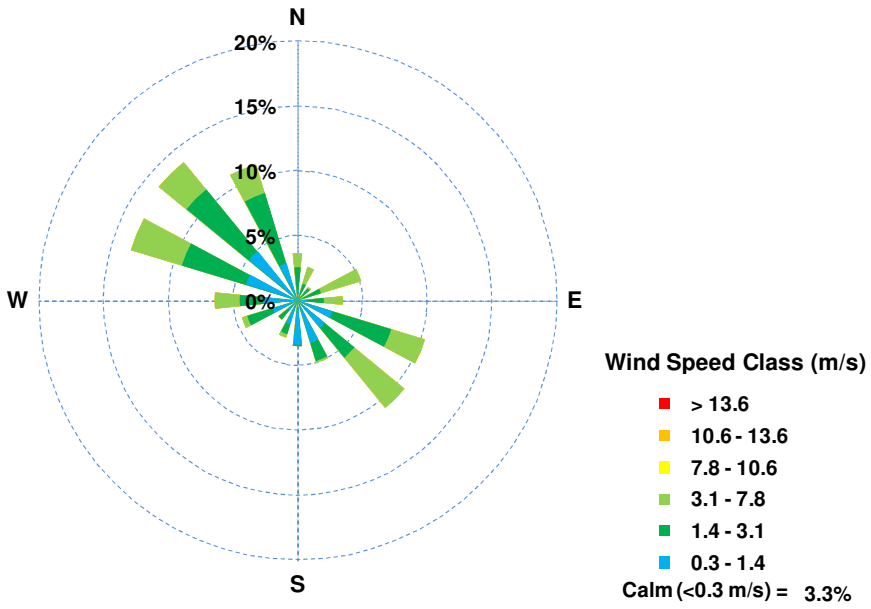
Parameter	Unit	Number of 1-hr Data	Operational Time (%)	Mean of 1-Hr Avg	Minimum 1-Hour Value	Maximum 1-Hour Value	Percent of Data in each Data Range					
							<=-30	>-30~-15	>-15~0	>0~15	>15~30	>30
Temperature	°C	737	100.0%	-19.1	-37.0	4.3	9.2	58.8	30.0	2.0	0.0	0.0
							<=15	>15-30	>30-60	>60-80	>80-90	>90
Relative Humidity	%	737	100.0%	73	52	90	0.0	0.0	1.2	89.0	9.6	0.1

a. NO_2 1-hour Saskatchewan Ambient Air Quality Standard = 212 ppb
b. SO_2 241-hour Saskatchewan Ambient Air Quality Standard = 172 ppb
c. SO_2 24-hour Saskatchewan Ambient Air Quality Standard = 57 ppb
d. H_2S 1-hour Saskatchewan Ambient Air Quality Standard = 10.8 ppb
e. H_2S 24-hour Saskatchewan Ambient Air Quality Standard = 3.6 ppb
f. $PM_{2.5}$ 24-hour Canada-Wide Standard = 30 µg/m^3 (98th percentile annually, averaged over three consecutive years).
g. Total Precipitation for December 2013

Table C-3 Maidstone Station: Wind frequency table for December 2013

Wind Direction Sector	Percent of Data within Wind Speed Range, wind speed unit m/s						
	>0.3-1.4	>1.4-3.1	>3.1-7.8	>7.8-10.6	>10.6-13.6	>13.6	Totals
North NorthEast	0.4%	0.9%	1.4%	0.0%	0.0%	0.0%	2.7%
NorthEast	0.3%	0.9%	0.1%	0.0%	0.0%	0.0%	1.4%
East NorthEast	0.0%	1.9%	3.3%	0.0%	0.0%	0.0%	5.2%
East	0.5%	1.4%	1.5%	0.0%	0.0%	0.0%	3.4%
East SouthEast	2.7%	4.7%	2.7%	0.0%	0.0%	0.0%	10.2%
SouthEast	2.4%	3.0%	5.0%	0.0%	0.0%	0.0%	10.4%
South SouthEast	2.8%	1.5%	0.1%	0.0%	0.0%	0.0%	4.5%
South	3.1%	0.1%	0.0%	0.0%	0.0%	0.0%	3.3%
South SouthWest	1.6%	0.8%	0.3%	0.0%	0.0%	0.0%	2.7%
SouthWest	0.8%	0.9%	0.0%	0.0%	0.0%	0.0%	1.8%
West SouthWest	1.6%	2.0%	0.4%	0.0%	0.0%	0.0%	4.1%
West	2.6%	1.8%	1.9%	0.0%	0.0%	0.0%	6.2%
West NorthWest	4.1%	5.2%	4.1%	0.0%	0.0%	0.0%	13.3%
NorthWest	4.7%	6.2%	2.7%	0.0%	0.0%	0.0%	13.7%
North NorthWest	2.6%	5.7%	2.3%	0.0%	0.0%	0.0%	10.6%
North	0.5%	1.8%	1.1%	0.0%	0.0%	0.0%	3.4%
Total	30.9%	38.9%	26.9%	0.0%	0.0%	0.0%	96.7%

Percent Calm (<0.3 m/s)	3.3%
Number of Valid Hourly-Average Data	737
Total Workable Hours in Time Period	737



APPENDIX D. UNITY STATION: CONTINUOUS MONITORING DATA

Table D-1 Unity Station: Summary statistics for continuous air monitoring results for December 2013

Parameter	Unit	Calibration & AIC[a]	Valid Data	Uptime	Summary Statistics for Hourly Average Data		
		(hours)	(hours)	(%)	Average	Minimum	Maximum
NO	ppb	0	711	100.0%	1.2	< 0.1	28.1
NO_2	ppb	0	711	100.0%	4.3	0.2	22.1
NO_x	ppb	0	711	100.0%	5.4	0.2	50.1
O_3	ppb	0	711	100.0%	26	4	43
$PM_{2.5}$	µg/m^3	0	744	100.0%	4	< 1	25
Precipitation	mm	0	744	100.0%	22.4[b]	< 0.1	17.8
Ambient Temperature	°C	0	744	100.0%	-18.1	-36	2.1
Relative Humidity	%	0	744	100.0%	74	56	88
Wind Speed	m/s	0	729	98.0%	2.0	Calm	7.2

a. Automatic Instrument Check

b. Total precipitation.

Table D-2. Unity Station: Summary of airpointer® monitoring results for December 2013

Parameter	Unit	Number of 1-hr Data	Operational Time (%)	Mean of 1-Hr Avg	Maximum 1-Hour Value	Number 1-Hour Violations	Maximum 24-Hour Value	Number 24-Hour Violations	Percent of Data in each Data Range					
									<=5	>5-15	>15-30	>30-100	>100-212	>212
NO	ppb	711	100.0%	1.2	28.1	-	5.3	-	94.5	4.9	0.6	0.0	0.0	0.0
NO_2	ppb	711	100.0%	4.3	22.1	0[a]	9.0	-	71.2	27.7	1.1	0.0	0.0	0.0
NOx	ppb	711	100.0%	5.4	50.1	-	14.0	-	59.2	36.8	3.7	0.3	0.0	0.0
									<=10	>10-20	>20-40	>40-60	>60-82	>82
O_3	ppb	711	100.0%	26	43	0[b]	41[c]	0[c]	1.3	21.1	75.0	2.7	0.0	0.0
									<=2	>2-4	>4-10	>10-20	>20-30	>30
$PM_{2.5}$	µg/m^3	744	100.0%	4	25	-	12	0[d]	32.8	27.6	32.3	7.0	0.4	0.0
									<=0	>0-5	>5-10	>10-30	>30-60	>60
Precipitation	mm	744	100.0%	22.4[e]	17.8	-	18.1	-	98.3	1.6	0.0	0.1	0.0	0.0

Parameter	Unit	Number of 1-hr Data	Operational Time (%)	Mean of 1-Hr Avg	Minimum 1-Hour Value	Maximum 1-Hour Value	Percent of Data in each Data Range					
							<=-30	>-30~-15	>-15~0	>0~15	>15~30	>30
Temperature	°C	744	100.0%	-18.1	-35.5	2.1	8.2	57.4	33.3	1.1	0.0	0.0
							<=15	>15-30	>30-60	>60-80	>80-90	>90
Relative Humidity	%	744	100.0%	74	56	88	0.0	0.0	0.8	84.3	14.9	0.0

a. NO_2 1-hour Saskatchewan Ambient Air Quality Standard = 212 ppb

b. O_3 1-hour Saskatchewan Ambient Air Quality Standard = 82 ppb

c. Concentration is the maximum of 8-hour running average; number of violations is compared against 8-hour Canada-Wide Standard = 65 ppb

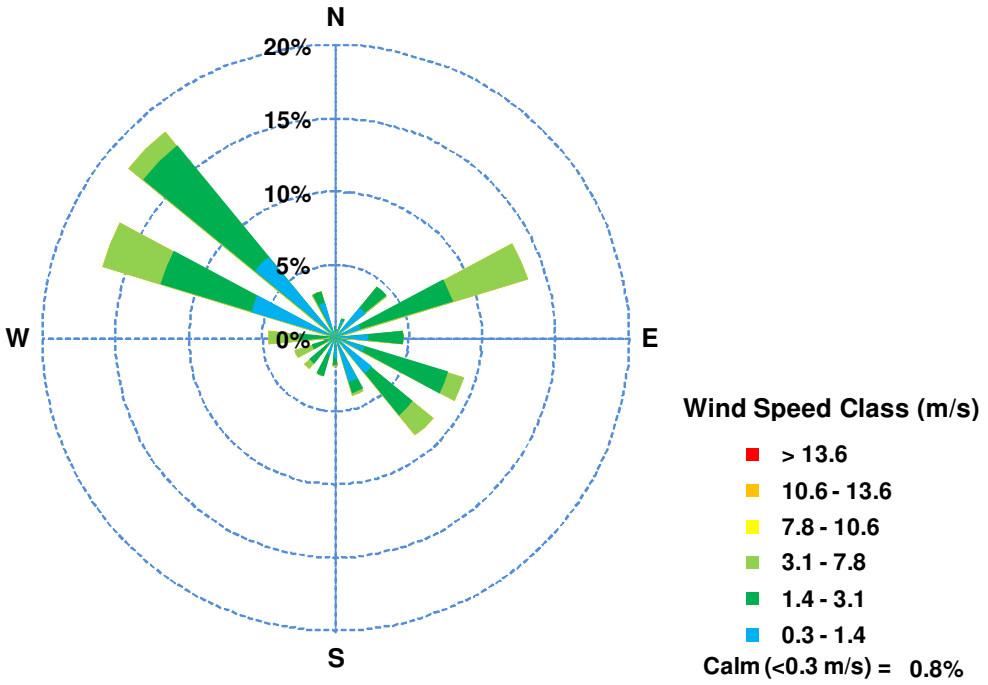
d. $PM_{2.5}$ 24-hour Canada-Wide Standard = 30 µg/m^3 (98th percentile annually, averaged over three consecutive years).

e. Total Precipitation for December 2013

Table D-3 Unity Station: Wind frequency table for December 2013

Wind Direction Sector	Percent of Data within Wind Speed Range, wind speed unit m/s						
	>0.3-1.4	>1.4-3.1	>3.1-7.8	>7.8-10.6	>10.6-13.6	>13.6	Totals
North NorthEast	1.1%	0.1%	0.0%	0.0%	0.0%	0.0%	1.2%
NorthEast	2.6%	1.9%	0.0%	0.0%	0.0%	0.0%	4.5%
East NorthEast	1.8%	6.6%	5.3%	0.0%	0.0%	0.0%	13.7%
East	2.2%	2.5%	0.0%	0.0%	0.0%	0.0%	4.7%
East SouthEast	2.1%	6.0%	1.1%	0.0%	0.0%	0.0%	9.2%
SouthEast	2.9%	3.7%	1.8%	0.0%	0.0%	0.0%	8.4%
South SouthEast	3.0%	0.8%	0.1%	0.0%	0.0%	0.0%	4.0%
South	1.2%	0.5%	0.0%	0.0%	0.0%	0.0%	1.8%
South SouthWest	1.2%	1.5%	0.0%	0.0%	0.0%	0.0%	2.7%
SouthWest	0.8%	1.5%	0.4%	0.0%	0.0%	0.0%	2.7%
West SouthWest	0.7%	1.0%	1.2%	0.0%	0.0%	0.0%	2.9%
West	0.4%	2.1%	2.1%	0.0%	0.0%	0.0%	4.5%
West NorthWest	6.0%	6.4%	4.1%	0.0%	0.0%	0.0%	16.6%
NorthWest	7.1%	9.9%	1.2%	0.0%	0.0%	0.0%	18.2%
North NorthWest	2.3%	0.8%	0.0%	0.0%	0.0%	0.0%	3.2%
North	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%
Total	36.4%	45.4%	17.4%	0.0%	0.0%	0.0%	99.2%

Percent Calm (<0.3 m/s)	0.8%
Number of Valid Hourly-Average Data	729
Total Workable Hours in Time Period	744



APPENDIX E. KINDERSLEY STATION: CONTINUOUS MONITORING DATA

Table E-1 Kindersley Station: Summary statistics for continuous air monitoring results for December 2013

Parameter	Unit	Calibration & AIC[a]	Valid Data	Uptime	Summary Statistics for Hourly Average Data		
		(hours)	(hours)	(%)	Average	Minimum	Maximum
SO_2	ppb	44	710	99.9%	< 1	< 1	2
H_2S	ppb	44	699	99.9%	0.2	< 0.1	1.0
$PM_{2.5}$	µg/m^3	0	743	99.9%	5	1.0	18
Precipitation	mm	0	743	99.9%	0.6[b]	< 0.1	0.2
Ambient Temperature	°C	0	743	99.9%	-16.6	-36	1.5
Relative Humidity	%	0	743	99.9%	75	60	90
Wind Speed	m/s	0	722	97.0%	3.3	Calm	9.5

a. Automatic Instrument Check

b. Total precipitation.

Table E-2. Kindersley Station: Summary of airpointer® monitoring results for December 2013

Parameter	Unit	Number of 1-hr Data	Operational Time (%)	Mean of 1-Hr Avg	Maximum 1-Hour Value	Number 1-Hour Violations	Maximum 24-Hour Value	Number 24-Hour Violations	Percent of Data in each Data Range					
									<=1	>1-5	>5-10	>10-57	>57-172	>172
SO_2	ppb	710	99.9%	< 1	2	0[a]	1	0[b]	87.0	13.0	0.0	0.0	0.0	0.0
									<=1	>1-3.6	>3.6-5	>5-8	>8-10.8	>10.8
H_2S	ppb	699	99.9%	0.2	1.0	0[c]	0.3	0[d]	100.0	0.0	0.0	0.0	0.0	0.0
									<=2	>2-4	>4-10	>10-20	>20-30	>30
$PM_{2.5}$	µg/m^3	743	99.9%	5	18	-	12	0[e]	17.0	35.4	41.5	6.2	0.0	0.0
									<=0	>0-5	>5-10	>10-30	>30-60	>60
Precipitation	mm	743	99.9%	0.6[f]	0.2	-	0.3	-	98.8	1.2	0.0	0.0	0.0	0.0

Parameter	Unit	Number of 1-hr Data	Operational Time (%)	Mean of 1-Hr Avg	Minimum 1-Hour Value	Maximum 1-Hour Value	Percent of Data in each Data Range					
							<=-30	>-30~-15	>-15~0	>0~15	>15~30	>30
Temperature	°C	743	99.9%	-16.6	-35.9	1.5	5.4	57.7	36.2	0.7	0.0	0.0
							<=15	>15-30	>30-60	>60-80	>80-90	>90
Relative Humidity	%	743	99.9%	75	60	90	0.0	0.0	0.0	84.8	15.1	0.1

a. SO_2 1-hour Saskatchewan Ambient Air Quality Standard = 172 ppb

b. SO_2 24-hour Saskatchewan Ambient Air Quality Standard = 57 ppb

c. H_2S 1-hour Saskatchewan Ambient Air Quality Standard = 10.8 ppb

d. H_2S 24-hour Saskatchewan Ambient Air Quality Standard = 3.6 ppb

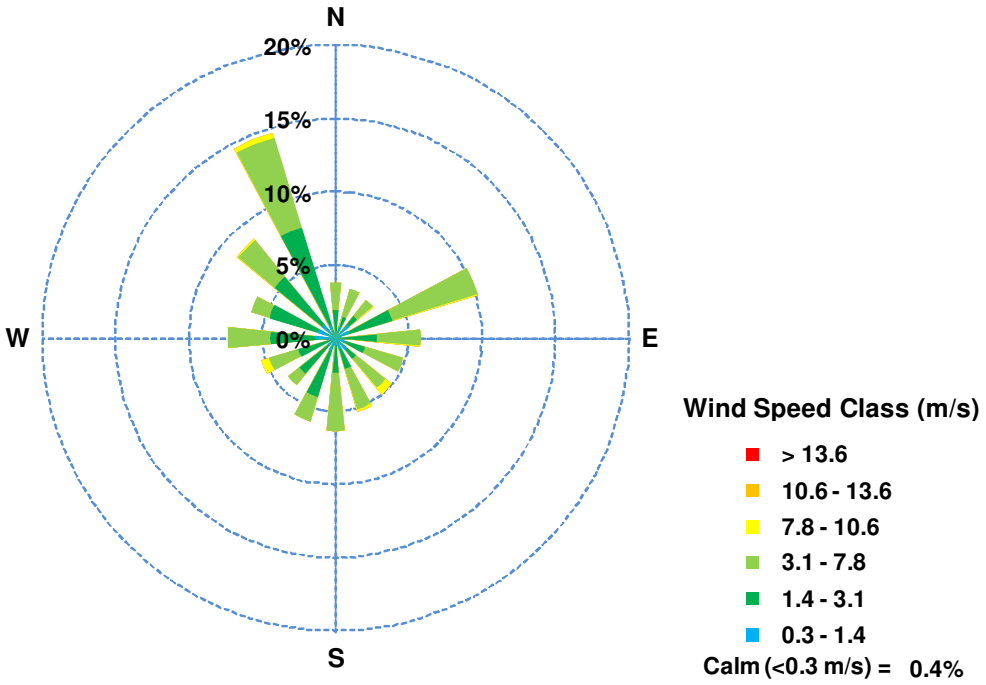
e. $PM_{2.5}$ 24-hour Canada-Wide Standard = 30 µg/m^3 (98th percentile annually, averaged over three consecutive years).

f. Total Precipitation for December 2013

Table E-3 Kindersley Station: Wind frequency table for December 2013

Wind Direction Sector	Percent of Data within Wind Speed Range, wind speed unit m/s						
	>0.3-1.4	>1.4-3.1	>3.1-7.8	>7.8-10.6	>10.6-13.6	>13.6	Totals
North NorthEast	0.8%	0.7%	1.9%	0.0%	0.0%	0.0%	3.5%
NorthEast	1.2%	0.7%	1.4%	0.0%	0.0%	0.0%	3.3%
East NorthEast	0.7%	3.0%	6.1%	0.0%	0.0%	0.0%	9.8%
East	0.4%	2.4%	3.0%	0.0%	0.0%	0.0%	5.8%
East SouthEast	0.7%	1.4%	2.8%	0.0%	0.0%	0.0%	4.8%
SouthEast	1.0%	0.7%	2.6%	0.6%	0.0%	0.0%	4.8%
South SouthEast	0.8%	1.4%	2.9%	0.1%	0.0%	0.0%	5.3%
South	0.6%	1.8%	4.0%	0.0%	0.0%	0.0%	6.4%
South SouthWest	1.0%	3.2%	1.8%	0.0%	0.0%	0.0%	6.0%
SouthWest	0.7%	2.5%	1.0%	0.0%	0.0%	0.0%	4.2%
West SouthWest	0.4%	2.2%	2.1%	0.6%	0.0%	0.0%	5.3%
West	1.4%	3.0%	2.9%	0.0%	0.0%	0.0%	7.3%
West NorthWest	1.2%	3.5%	1.2%	0.0%	0.0%	0.0%	6.0%
NorthWest	1.2%	4.2%	3.2%	0.1%	0.0%	0.0%	8.7%
North NorthWest	1.0%	6.9%	6.4%	0.4%	0.0%	0.0%	14.7%
North	0.4%	1.5%	1.8%	0.0%	0.0%	0.0%	3.7%
Total	13.6%	39.1%	45.2%	1.8%	0.0%	0.0%	99.6%

Percent Calm (<0.3 m/s)	0.4%
Number of Valid Hourly-Average Data	722
Total Workable Hours in Time Period	744



APPENDIX F. WYAMZ EXCEEDANCE SUMMARY

There is no air quality exceedances for the year 2013 (continuous air monitoring began December 1, 2013).

APPENDIX G. PASSIVE MONITORING DATA

Table G-1. 30-day average concentration for passive SO_2 samples for the year 2013

Passive Site		30-Day Passive SO_2 Concentration (ppb)												AVG	MAX	MIN
No.	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1	Young	-	0.3	-	-	0.1	< 0.1	3.7	< 0.1	< 0.1	-	-	-	1.4	3.7	< 0.1
2	Cudworth	-	NA	-	-	0.2	< 0.1	NA	< 0.1	< 0.1	-	-	-	0.2	0.2	< 0.1
3	Laird	-	0.4	-	-	0.2	0.1	< 0.1	0.3	0.9	-	-	-	0.4	0.9	< 0.1
4	Shell Lake	-	0.3	-	-	0.1	0.1	< 0.1	< 0.1	< 0.1	-	-	-	0.2	0.3	< 0.1
5	Cater	-	0.3	-	-	0.1	< 0.1	< 0.1	< 0.1	< 0.1	-	-	-	0.2	0.3	< 0.1
6	St. Walburg	-	1.4	-	-	< 0.1	2.5	< 0.1	< 0.1	< 0.1	-	-	-	2.0	2.5	< 0.1
7	Maidstone	-	0.8	-	-	< 0.1	0.1	< 0.1	< 0.1	0.1	-	-	-	0.3	0.8	< 0.1
8	Neilburg	-	0.5	-	-	0.1	0.1	2.8	< 0.1	0.1	-	-	-	0.7	2.8	< 0.1
9	Denzil	-	0.5	-	-	< 0.1	0.1	< 0.1	< 0.1	0.1	-	-	-	0.2	0.5	< 0.1
10	Wilbert	-	0.6	-	-	0.1	0.1	< 0.1	< 0.1	< 0.1	-	-	-	0.3	0.6	< 0.1
11	Biggar	-	0.2	-	-	0.8	0.1	0.5	< 0.1	0.1	-	-	-	0.3	0.8	< 0.1
12	Saskatoon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Dorintosh	-	0.5	-	-	< 0.1	NA	< 0.1	< 0.1	0.2	-	-	-	0.4	0.5	< 0.1
14	Kindersley	-	0.7	-	-	< 0.1	0.1	< 0.1	< 0.1	< 0.1	-	-	-	0.4	0.7	< 0.1
15	Rosetown	-	0.9	-	-	0.1	0.2	0.1	< 0.1	< 0.1	-	-	-	0.3	0.9	< 0.1
Network Average		-	0.6	-	-	0.2	0.4	1.8	0.3	0.3	-	-	-	0.5	3.7	< 0.1

F: Sample Failure
NA: Missing Sample or Missing Data
-: Passive Program Inactive

Table G-2. 30-day average concentration for passive NO_2 samples for the year 2013

Passive Site		30-Day Passive NO_2 Concentration (ppb)												AVG	MAX	MIN
No.	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1	Young	-	5.5	-	-	1.0	< 0.1	1.0	1.3	1.1	-	-	-	2.0	5.5	< 0.1
2	Cudworth	-	NA	-	-	1.0	0.8	NA	0.4	0.6	-	-	-	0.7	1.0	0.4
3	Laird	-	3.1	-	-	1.2	1.1	0.5	0.4	1.0	-	-	-	1.2	3.1	0.4
4	Shell Lake	-	2.4	-	-	1.1	0.4	0.6	0.5	0.8	-	-	-	1.0	2.4	0.4
5	Cater	-	1.1	-	-	0.4	0.4	0.4	0.3	0.5	-	-	-	0.5	1.1	0.3
6	St. Walburg	-	0.4	-	-	0.2	< 0.1	0.7	1.0	1.3	-	-	-	0.7	1.3	< 0.1
7	Maidstone	-	6.4	-	-	< 0.1	2.9	1.9	2.5	3.7	-	-	-	3.5	6.4	1.9
8	Neilburg	-	4.9	-	-	1.4	1.7	0.8	1.0	1.3	-	-	-	1.9	4.9	0.8
9	Denzil	-	3.6	-	-	0.2	1.4	1.1	0.8	1.1	-	-	-	1.4	3.6	0.2
10	Wilbert	-	F	-	-	1.2	1.5	1.0	0.9	1.2	-	-	-	1.2	1.5	0.9
11	Biggar	-	2.6	-	-	< 0.1	1.2	0.7	1.3	1.6	-	-	-	1.5	2.6	0.7
12	Saskatoon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Dorintosh	-	2.8	-	-	0.4	NA	0.9	0.6	0.5	-	-	-	1.0	2.8	0.4
14	Kindersley	-	8.5	-	-	1.0	1.4	1.4	1.5	1.7	-	-	-	2.6	8.5	1.0
15	Rosetown	-	4.5	-	-	0.6	1.3	0.6	0.8	0.9	-	-	-	1.5	4.5	0.6
Network Average		-	3.8	-	-	0.8	1.3	0.9	1.0	1.2	-	-	-	1.5	8.5	< 0.1

F: Sample Failure
NA: Missing Sample or Missing Data
-: Passive Program Inactive

Table G-3. 30-day average concentration for passive O_3 samples for the year 2013

Passive Site		30-Day Passive O_3 Concentration (ppb)												AVG	MAX	MIN
No.	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1	Young	-	22	-	-	53	42	28	26	34	-	-	-	34	53	22
2	Cudworth	-	NA	-	-	54	47	30	23	23	-	-	-	36	54	23
3	Laird	-	47	-	-	55	37	33	28	42	-	-	-	40	55	28
4	Shell Lake	-	31	-	-	44	30	31	27	36	-	-	-	33	44	27
5	Cater	-	35	-	-	51	31	30	28	30	-	-	-	34	51	28
6	St. Walburg	-	38	-	-	52	53	29	38	37	-	-	-	41	53	29
7	Maidstone	-	37	-	-	48	47	35	28	59	-	-	-	42	59	28
8	Neilburg	-	28	-	-	59	42	41	28	48	-	-	-	41	59	28
9	Denzil	-	30	-	-	48	49	31	29	33	-	-	-	36	49	29
10	Wilbert	-	29	-	-	39	52	39	29	34	-	-	-	37	52	29
11	Biggar	-	42	-	-	35	67	58	38	38	-	-	-	46	67	35
12	Saskatoon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Dorintosh	-	35	-	-	47	27	22	23	24	-	-	-	30	47	22
14	Kindersley	-	38	-	-	F	56	F	48	40	-	-	-	45	56	38
15	Rosetown	-	37	-	-	F	57	45	43	67	-	-	-	50	67	37
Network Average		-	34	-	-	49	45	35	31	39	-	-	-	39	67	22

F: Sample Failure
NA: Missing Sample or Missing Data
-: Passive Program Inactive.

Table G-4. 30-day average concentration for passive H_2S, BTEX and NH_3 samples for February 2013

Station Number	Station Name	Sampling Month	Summary for 30-day Passive Concentration (ppb)					
			H_2S	Benzene	Toluene	Ethylbenzene	Xylene	NH_3
10	Wilbert	February	1.0	0.2	0.2	< 0.2	< 0.2	-
11	Biggar	February	-	-	-	-	-	2.1

- : Sample Not Collected

APPENDIX H. 2013 FINANCIAL STATEMENTS

Western Yellowhead Air Management Zone Inc.
Financial Statements
December 31, 2013

ACCOUNTING › CONSULTING › TAX
800, 119 - 4TH AVENUE S; SASKATOON SK; S7K 5X2
1-877-500-0778 P: 306-665-6766 F: 306-665-9910 www.MNP.ca

Western Yellowhead Air Management Zone Inc.

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For the year ended December 31, 2013

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Management's Responsibility

To the Members of Western Yellowhead Air Management Zone Inc.:

Management is responsible for the preparation and presentation of the accompanying financial statements, including responsibility for significant accounting judgments and estimates in accordance with Canadian accounting standards for not-for-profit organizations. This responsibility includes selecting appropriate accounting principles and methods, and making decisions affecting the measurement of transactions in which objective judgment is required.

In discharging its responsibilities for the integrity and fairness of the financial statements, management designs and maintains the necessary accounting systems and related internal controls to provide reasonable assurance that transactions are authorized, assets are safeguarded and financial records are properly maintained to provide reliable information for the preparation of financial statements.

The Board of Directors is composed entirely of Directors who are neither management nor employees of the Organization. The Board is responsible for overseeing management in the performance of its financial reporting responsibilities, and for approving the financial information included in the annual report. The Board fulfils these responsibilities by reviewing the financial information prepared by management and discussing relevant matters with management and external auditors. The Board is also responsible for recommending the appointment of the Organization's external auditors.

MNP LLP is appointed by the members to audit the financial statements and report directly to them; their report follows. The external auditors have full and free access to, and meet periodically and separately with, both the Board and management to discuss their audit findings.

May 23, 2014

Executive Director

Independent Auditors' Report

To the Members of Western Yellowhead Air Management Zone Inc.:

We have audited the accompanying financial statements of Western Yellowhead Air Management Zone Inc., which comprise the statement of financial position as at December 31, 2013 and the statements of operations and changes in net assets and cash flows for the year then ended, and a summary of significant accounting policies and other explanatory information.

Management's Responsibility for the Financial Statements
Management is responsible for the preparation and fair presentation of these financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditors' Responsibility
Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditors' judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained in our audit is sufficient and appropriate to provide a basis for our audit opinion.

Opinion
In our opinion, the financial statements present fairly, in all material respects, the financial position of Western Yellowhead Air Management Zone Inc. as at December 31, 2013 and the results of its operations, changes in net assets and its cash flows for the year then ended in accordance with Canadian accounting standards for not-for-profit organizations.

Saskatoon, Saskatchewan

May 23, 2014

MNP LLP
Chartered Accountants

800 - 119 4th Ave South, Saskatoon, Saskatchewan, S7K 5X2, Phone: (306) 665-6766, 1 (877) 500-0778

MNP

Western Yellowhead Air Management Zone Inc.
Statement of Financial Position
As at December 31, 2013

	2013	2012
Assets		
Current		
Cash resources	9,673	21,284
Grants receivable	27,000	-
Goods and services tax receivable	15,118	-
Prepaid expenses and deposits	7,008	-
	58,799	21,284
Capital assets *(Note 3)*	372,366	-
	431,165	21,284
Liabilities		
Current		
Accounts payable and accruals	81,119	8,694
Deferred contributions *(Note 4)*	180,000	-
	261,119	8,694
Net Assets		
Unrestricted net assets	170,046	12,590
	431,165	21,284

Approved on behalf of the Board

Director **Director**

The accompanying notes are an integral part of these financial statements

MNP

Western Yellowhead Air Management Zone Inc.
Statement of Operations and Changes in Net Assets
For the year ended December 31, 2013

	2013	2012
Revenue		
Grant revenue	**128,000**	49,000
Membership fees	**179,280**	-
	307,280	49,000
Expenses		
Amortization	**41,374**	-
Insurance	**1,999**	-
Management fees	**50,600**	30,030
Meeting	**524**	1,120
Monitoring	**45,945**	-
Office supplies	**1,644**	924
Postage	**-**	364
Professional fees	**4,500**	2,500
Supplies	**-**	124
Telephone	**1,945**	846
Travel	**1,293**	502
	149,824	36,410
Excess of revenue over expenses	**157,456**	12,590
Net assets, beginning of year	**12,590**	-
Net assets, end of year	**170,046**	12,590

The accompanying notes are an integral part of these financial statements

MNP

Western Yellowhead Air Management Zone Inc.
Statement of Cash Flows
For the year ended December 31, 2013

	2013	2012
Cash provided by (used for) the following activities		
Operating		
Excess of revenue over expenses	**157,456**	12,590
Amortization	**41,374**	-
	198,830	12,590
Changes in working capital accounts		
Grants receivable	**(27,000)**	-
Goods and services tax receivable	**(15,118)**	-
Prepaid expenses and deposits	**(7,008)**	-
Accounts payable and accruals	**72,425**	8,694
Deferred contributions	**180,000**	-
	402,129	21,284
Investing		
Purchase of capital assets	**(413,740)**	-
Increase (decrease) in cash resources	**(11,611)**	21,284
Cash resources, beginning of year	**21,284**	-
Cash resources, end of year	**9,673**	21,284

The accompanying notes are an integral part of these financial statements

MNP

1. Incorporation and nature of the organization

Western Yellowhead Air Management Zone Inc. (the "Organization") was incorporated under The Non-Profit Corporations Act of Saskatchewan on February 14, 2012.

The Organization collects and monitors ambient air quality data in Northwest Saskatchewan and makes this data available to all members.

2. Significant accounting policies

The financial statements have been prepared in accordance with Canadian accounting standards for Not-for-profit organizations using the following significant accounting policies:

Revenue recognition

The Organization follows the deferral method of accounting for contributions. Restricted contributions are recognized as revenue in the year in which the related expenses are incurred. Unrestricted contributions are recognized as revenue when received. Membership fees are recognized when received.

Financial instruments

The Organization recognizes its financial instruments when the Organization becomes party to the contractual provisions of the financial instrument. All financial instruments are initially recorded at their fair value, including financial assets and liabilities originated and issued in related party transactions with management.

At initial recognition, the Organization may irrevocably elect to subsequently measure any financial instrument at fair value. The Organization has not made such an election during the year. All financial assets and liabilities are subsequently measured at amortized cost.

Transaction costs and financing fees are added to the carrying amount for those financial instruments subsequently measured at amortized cost or cost.

Financial asset impairment:

The Organization assesses impairment of all of its financial assets measured at cost or amortized cost. The Organization groups assets for impairment testing when available information is not sufficient to permit identification of each individually impaired financial asset in the group. Management considers whether there has been a breach in contract, such as a default or delinquency in interest or principal payments in determining whether objective evidence of impairment exists. When there is an indication of impairment, the Organization determines whether it has resulted in a significant adverse change in the expected timing or amount of future cash flows during the year. If so, the Organization reduces the carrying amount of any impaired financial assets to the highest of: the present value of cash flows expected to be generated by holding the assets; the amount that could be realized by selling the assets; and the amount expected to be realized by exercising any rights to collateral held against those assets. Any impairment, which is not considered temporary, is included in current year excess of revenues over expenses.

The Organization reverses impairment losses on financial assets when there is a decrease in impairment and the decrease can be objectively related to an event occurring after the impairment loss was recognized. The amount of the reversal is recognized in the excess of revenues over expenses in the year the reversal occurs.

Measurement uncertainty

The preparation of financial statements in conformity with Canadian accounting standards for not-for-profit organizations requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements, and the reported amounts of revenues and expenses during the reporting period.

Accounts receivable are stated after evaluation as to their collectability and an appropriate allowance for doubtful accounts is provided where considered necessary. Amortization is based on the estimated useful lives of capital assets.

These estimates and assumptions are reviewed periodically and, as adjustments become necessary they are reported in excess of revenues and expenses in the periods in which they become known.

2. Significant accounting policies *(Continued from previous page)*

Capital assets

Purchased capital assets are recorded at cost. Contributed capital assets are recorded at fair value at the date of contribution if fair value can be reasonably determined.

Amortization is provided using the declining balance method at rates intended to amortize the cost of assets over their estimated useful lives.

	Rate
Equipment	20 %

Long-lived assets

Long-lived assets consist of capital assets. Long-lived assets held for use are measured and amortized as described in the applicable accounting policies.

When the Organization determines that a long-lived asset no longer has any long-term service potential to the organization, the excess of its net carrying amount over any residual value is recognized as an expense in the statement of operations. Write-downs are not reversed.

Deferred contributions related to capital assets

Deferred contributions related to capital assets represent the unamortized portion of contributed capital assets and restricted contributions that were used to purchase the Organization's equipment. Recognition of these amounts as revenue is deferred to periods when the related capital assets are amortized.

3. Capital assets

	Cost	Accumulated amortization	2013 Net book value	2012 Net book value
Equipment	413,740	41,374	372,366	-

4. Deferred contributions

Deferred contributions consist of externally restricted grants for the reimbursement of the purchase of four airpointers. Recognition of these amounts as revenue is amortized over the useful life of the related assets. Changes in the deferred contribution balance are as follows:

	2013	2012
Amount received during the year	200,000	-
Less: Amount recognized as revenue during the year	(20,000)	-
Balance, end of year	180,000	-

5. Related party transactions

Included in expenses for the current year are $50,600 (2012 - $30,030) of management fees incurred to a company owned by management of the organization. The expenses were incurred in the normal course of operations and measured at the exchange amount, which is the amount of consideration established and agreed to by the related parties. At December 31, 2013, accounts payable and accruals includes $62,975 due to this company.

6. Financial Instruments

The Organization, as part of its operations, carries a number of financial instruments. It is management's opinion that the Organization is not exposed to significant interest, currency, credit, liquidity or other price risks arising from these financial instruments except as otherwise disclosed.

Liquidity risk

Liquidity risk is the risk that the Organization will encounter difficulty in meeting obligations associated with financial liabilities. The Organization's exposure to liquidity risk is dependent on the collection of fee revenue and obligations to sustain operations.

APPENDIX I. WYAMZ BOARD OF DIRECTORS

Brad Sigurdson Board Chair (Saskatchewan Mining Association)

Mr. Sigurdson is the Manager, Environment and Safety for the Saskatchewan Mining Association (SMA) and he brings nearly 25 years of mining, industrial and government experience to this role; including working in both Canadian and U.S. mining operations as well as previously with the Ministry of Environment as Manager of the Potash and Central Operations Section. During his time with the Ministry of Environment he acted as the advisor to the Industrial Content Committee during the development of the Saskatchewan Environmental Code. Mr. Sigurdson has indicated that "It is a privilege to be a member of the WYAMZ Board and I really enjoy working with a group of individuals that are committed to working in a collaborative and cooperative manner with a common goal of ensuring excellent air quality in our Air Management Zone".

Gerry Mooney Vice Chair (Akzo Nobel Chemicals Ltd.)

Gerry Mooney brings 35 years of chemical manufacturing experience, with a focus on Environmental Management and Community Engagement. He is a strong supporter of the collaborative approach to air quality management. He indicated that he is enthused to be part of a consensus based team which facilitates dialogue among regulators, public interest groups and industry while ensuring the availability of robust air quality data. As a member of the Chemistry Industry Association of Canada (CIAC), AkzoNobel is committed to Responsible Care® – CIAC's internationally recognized sustainability initiative.

Murray Hilderman Secretary Treasurer (Ministry of Environment)

Mr. Hilderman is a Senior Project Manager with the Ministry of Environment, Technical Resources Branch. He has 25 years of experience in environmental work related to air and water, working with industry, municipalities and other stakeholders on projects ranging from local to international. He is involved in the air management zone because he believes this is an excellent approach to engage all parties to better understand air issues in a region.

Darren Letkeman Member (Environmental Protection Branch – Ministry of Environment)

Mr. Letkeman is an Environmental Protection Officer with the Industrial Branch of the Ministry of Environment and has been with the ministry since 1998. He has extensive regulatory experience in Northwestern Saskatchewan, and has worked with municipal, commercial, and industrial operations. Prior to working for the ministry, Darren worked 6 years as an Environmental Co-ordinator for an industrial wood processing facility.

Phil Burry Member (Husky Energy Upstream)

Mr. Burry is the Team Lead, Upstream Environmental Operations for Husky Energy, based in Lloydminster, Saskatchewan. Phil is a Professional Agrologist with approximately 15 years environmental management experience. He provides technical/regulatory support regarding air, water, waste, biophysical, spill and site remediation projects. Actively engaging key stakeholders is another key responsibility of his current position with Husky. He is very interested in furthering his understanding of regional air quality issues.

Brenda Wallace Member (City of Saskatoon)

Brenda is the Director of Environmental & Corporate Initiatives with the City of Saskatoon where she leads a team of environmental professionals, engineers, and project managers to improve environmental performance and plan major city-building projects that enhance quality of life. Ms. Wallace has a background in urban planning and has worked in the economic development sector on affordable housing projects, and has spent 3 years as Resource Planning Manager with the Meewasin Valley Authority.

David Henry Member (Saskatchewan Environmental Society)

David Henry has been an active member of the Saskatchewan Environmental Society since 2008. In 2007, he retired from his position as conservation ecologist for Parks Canada in the Yukon Territory. In that work, he developed an ecological monitoring program for each national park in the Yukon. He is presently an Adjunct Professor, Faculty of Environmental Design, University of Calgary. In the past working with others, he coordinated the public campaigns that were instrumental in the establishment Grasslands National Park and the revision of Canada's National Parks Act.

Gary Ericson Member (Saskatchewan Ministry of the Economy)

Mr. Ericson is the Regional Manager of the Lloydminster Office of The Ministry of Economy and holds an AScT. Designation with the Saskatchewan Applied Science Technologists and Technicians. He graduated from Kelsey Institute of Applied Arts and Sciences in Saskatoon with a Diploma in Mechanical Engineering Technology in 1979. He has over 34 years of oil and gas development experience and considered to be one of our Ministry's foremost heavy oil well development and production expert. Mr. Ericson has extensive experience in the upstream Petroleum and Natural Gas Industry relating to drilling, servicing, and production issues gained through his years as a field technician and a manager

Dan Gauthier Member (Mosaic Potash Colonsay)

Mr. Gauthier joined Mosaic in 2008 and is a Professional Engineer registered in Saskatchewan. He has held various positions at the Mosaic Potash Colonsay mine including maintenance engineer, ISO 14001 and OHSAS 18001 Coordinator and most recently as the Senior Environmental Engineer. He is currently responsible for maintaining environmental compliance and improving environmental performance at the Mosaic Potash Colonsay mine. He has experience leading large projects which include a tailings area expansion and the Mosaic Colonsay site ISO 14001 and OHSAS 18001 management system certification.

Shelley Kirychuk Member (University of Saskatchewan)

Dr. Shelley Kirychuk is a nurse and holds Masters and PhD Degrees in Preventative Medicine and occupational hygiene. She is an Associate Professor at the University of Saskatchewan's Department of Medicine in the division of the Canadian Centre for Health and Safety in Agriculture. Her research and extension activities focus on environmental epidemiology and more specifically respiratory exposures and respiratory health of occupational, rural and agricultural populations.

Aaron Studer Member (Husky Energy Downstream)

Aaron Studer joined Husky in 2004, and is currently leading a team of 5 environmental specialists tasked with maintaining environmental compliance at Husky's Downstream Assets in the Lloydminster area. He has worked extensively in the environmental field for 6 years, and was previously working for an international environmental consulting firm. His areas of experience include project and office management; all aspects of groundwater well installation, monitoring, sampling, and reporting; Phase I and II assessments; contaminated site remediation; and licensing, construction and commissioning of new facilities. He has technical experience in reclamation assessments, lease construction, drilling, service, and operations.

Terry Gibson Executive Director

Mr. Gibson brings nearly 30 years of Public Health/Environmental Health experience to the position. He has held the positions of President of the Saskatchewan Public Health Association and Vice-Chair of the Saskatchewan Epidemiology Association. He teaches Public Health Protection at the University of Saskatchewan Master of Public Health Program and has served on many provincial and national boards and committees. Terry is committed to working with industry and regulators in a consensus decision making process to ensure that the health of the environment of south east Saskatchewan is always protected.

APPENDIX J. WYAMZ MEMBER COMPANIES

The Western Yellowhead Air Management Zone would like to express our gratitude to our members in good standing for their support of WYAMZ, for their very strong support regarding quality air data collection, and for their commitment to the citizens and environment of Saskatchewan.

For information on how to become a member, please contact Terry Gibson, Executive Director at (306) 491-9198.

- Agrium Inc.
- Akzo Nobel
- Black Pearl Resources
- Buzzard Resources
- Caltex Resources
- Canadian Natural Resources Limited
- Can-Expo
- Carrier Forest
- City of Saskatoon
- Crescent Point
- Crocotta Energy
- Crocus Oil
- Devon Canada Corporation
- Enerplus Corporation
- Gear Energy
- Halo Exploration
- Husky Oil Operations Limited
- Ish Energy
- Longhorn Oil and Gas
- Longview Oil
- Modexco Petroleum
- Mosaic
- NAL Resources Limited
- North West Bio Energy
- Northern Blizzard
- Novus Energy Inc.
- P&H Milling
- Palliser Oil and Gas
- Penn West Petroleum
- Plasti-Fab
- Potash Corp
- Prosper Petroleum
- Raven Resources
- Renegade Petroleum
- Saputo Products
- SaskEnergy Incorporated/ TransGas Limited
- Sask Power
- Smitty's Farms
- Sphere Energy
- SSSS Oil Partnership

End of the Report