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TOWN OF FALHER

AIR QUALITY SUMMARY REPORT

SEPTEMBER 2006 TO AUGUST 2007

Date: August 24, 2013

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Executive Summary

The Town of Falher, Alberta is located in the north central part of the Peace Airshed Zone Association. PAZA conducted an air quality survey just outside Falher from September 2006 to August 2007. The reasons for this air quality survey were that passive data identified concentration anomalies that required more data to evaluate.

A continuous monitoring station was used to monitor total reduced sulphur compounds (TRS), sulphur dioxide (SO_2), nitric oxide (NO), nitrogen dioxide (NO_2), total oxides of nitrogen (NO_x), ozone (O_3) and meteorology during that period.

There were no exceedances of Alberta Ambient Air Quality Objectives (AAAQO) or Canada Wide Standard Triggers (CWS) for SO_2,NO_2, or O_3 measured at the monitoring station. Of NO, NO_2 and NO_x, only NO_2 has an AAAQO. The TRS measurements show that the AAAQO (for H_2S and CS_2) were exceeded infrequently during the monitoring period. The results are summarized as follows:

- The TRS measurements may be influenced by municipal or agricultural activities around the Town of Falher. Specific events or episodes likely lead to the infrequent exceedances of the AAAQO (for H_2S and CS_2).
- The SO_2 measurements suggest there were no significant sources of SO_2 in the area although the main emission source seems to be near the Town of Falher. The measurements were low compared to other areas in the province.
- NO_2 measurements were only available from April 2007 to August 2007. Data indicated NO_2 levels were lower than other areas of the province and likely influenced by the Town of Falher. This was supported by comparison to the closest passive monitor to the site which showed lower monthly averaged NO_2 values during the period during the months available for comparison. The ability to draw conclusions from the data is limited by the fact only 5 months of NO_2 measurements were recorded.
- Ozone measurements are comparable with other areas in province. A typical diurnal profile is present in the ozone measurements and relates with the diurnal patterns of NO and NO_2. This pattern shows the photo-chemical formation and decomposition of ozone through complex reactions with NO_x and volatile organic compounds.
- Meteorology measurements indicate that months of November and March were the coldest months. The most frequent winds were from the southeast sector.

The summary of the air quality monitoring data is limited to the parameters measured in this study. Air quality surrounding the Town of Falher may be affected by other compounds some of which PAZA was not equipped to measure such as volatile organic compounds (VOCs), ammonia or fine particulate matter.

The volume of data collected indicates that this area is comparable of air quality in other rural Alberta areas and is relatively good. Infrequent elevated TRS concentrations measured during

the monitoring survey do not necessarily indicate poor air quality in the area but do suggest that there are emissions sources in the area that can influence the quality of the local air from time to time. General source contributions can be inferred but not definitively determined without more information on industrial, agricultural and municipal activity in the area. Therefore it is recommended that PAZA look into the possible contributors of elevated TRS measurements and identify the appropriate jurisdiction to assist with source mitigation. If PAZA chooses to conduct additional monitoring in the Falher area, it is recommended to consider collecting air samples for analysis of speciated TRS. In addition, NO_2 data was only available for a 5 month period and although the measured data did not indicate any air quality problems, a full year of measured data would be ideal for completeness.

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1. INTRODUCTION

The Peace Airshed Zone Association (PAZA) is a nonprofit, multi-stakeholder organization that conducts ambient air quality monitoring in northwestern Alberta. PAZA is an unbiased, open and transparent organization, and our members collaborate to provide local solutions to local air quality concerns.

PAZA was formed in March 1999 in response to air quality concerns in the Peace region. As an independent third-party, PAZA has invested ten years into building trust among members of the public, industry, non-governmental organizations, Alberta Environment and Sustainable Resource Development (AESRD), Energy Resources Conservation Board, and Alberta Health Services.

The air quality monitoring program is a resource for the public to become informed about local air quality. Members work collaboratively to produce scientifically defensible data that can be used by stakeholders to ensure continuous improvement of regional air quality, protect environmental health, and influence public policy.

In 2003, PAZA became the fifth airshed zone in Alberta recognized by the Clean Air Strategic Alliance (CASA).

PAZA operates under the guidelines developed in the *CASA Airshed Zone Guidelines*. These guidelines include management by consensus, representation from affected stakeholders and public accessibility to data and information from monitoring activities.

Consensus is reached when there is unanimous agreement among our stakeholders, ensuring each one can live with the outcome of the decision. Stakeholders may not achieve all their goals, but the objective is to find the optimal solution that includes something for everyone. Decisions made through consensus processes are likely to be more innovative and longer lasting than those reached through traditional negotiation or top-down hierarchy.

Air Quality Management Zones are a key component in Alberta's strategy for the management of air quality within Alberta.

PAZA is funded by compulsory and voluntary membership through a funding mechanism which is based on calculated relative impacts to air quality within the PAZA boundaries. For more information about PAZA and regional air quality, please visit PAZA's web site[1].

[1] http://www.paza.ca/

2. SITE SETTTING

The air quality monitoring station was proposed to be located near the Town of Falher and the final site location was based on the following considerations while accounting for AESRD's siting criteria. The PAZA siting criteria can be obtained from PAZA.

- Considerations
  - Current and future landowner(s)
  - Potential future land use change (avoid roads and right-of-ways)
  - All weather access
  - Power availability
  - Maximum security
- AESRD Siting Criteria
  - Away from nearby emission sources such as roads, oil and gas wells/batteries, gas processing plants, maintenance/fueling areas, etc.
  - Avoid low-lying areas and high areas to prevent local air flow biases
  - An open area away from buildings and tree canopies to ensure representative flows are recorded and to ensure passive samplers are suitable exposed
  - Stations cannot be located in pastures because of potential damage

Accounting for the above criteria and considerations, the monitor that was used for the air quality survey was placed in a farmer's yard 300 m east of Range Road 220 about 750 m north of Township Road 782. The Town of Falher is located 4.5 km southeast. The geographic and projected coordinates of the site are:

- 55° 45' 35.24" N, 117° 15' 27.65" W (NAD 83)
- 55.759789° N, 117.257681° W (NAD 83)
- 483,830 m E, 6,179,375 m N (UTM Zone 11 – NAD 83)

A regional area map is shown in Figure 2.1. The PAZA monitoring network is shown in Figure 2.2.

Photos of the monitoring station and views from it are shown in Figure 2.3. Other than a shed and a few smallish trees nearby, no significant airflow restrictions were noted. The resident's house is approximately 100 m from the monitor. The nearest tree was 50 m distance with a height of 3 m.

Figure 2.4 shows the local setting around the monitoring station. Agriculture is the major activity in the area although there are some small oil and gas facilities that were identified from the Environment Canada National Pollution Release Inventory for 2008. The closest oil and gas facility to the monitoring station was over 6 km away. The Town of Falher is located 4.5 km southeast and the Village of Girouxville is 5 km to the east of the monitor. As noted previously, the closest roads are Range Road 220 located 300 m to the west and Township Road 782 located 750 m south. The closest major roads are Highway 49 located 4 km south and Highway 2 located 8 km east. According to Alberta Transportation, the Average Annual Daily Traffic Volume on

that section of Highway 2 in 2010[2] was 2130 vehicles/day. The Average Annual Daily Traffic Volume on that section of Highway 49 in 2010 was 1960 vehicles/day.

[2] http://www.transportation.alberta.ca/Content/docType181/production/HTVH2001-2010.pdf

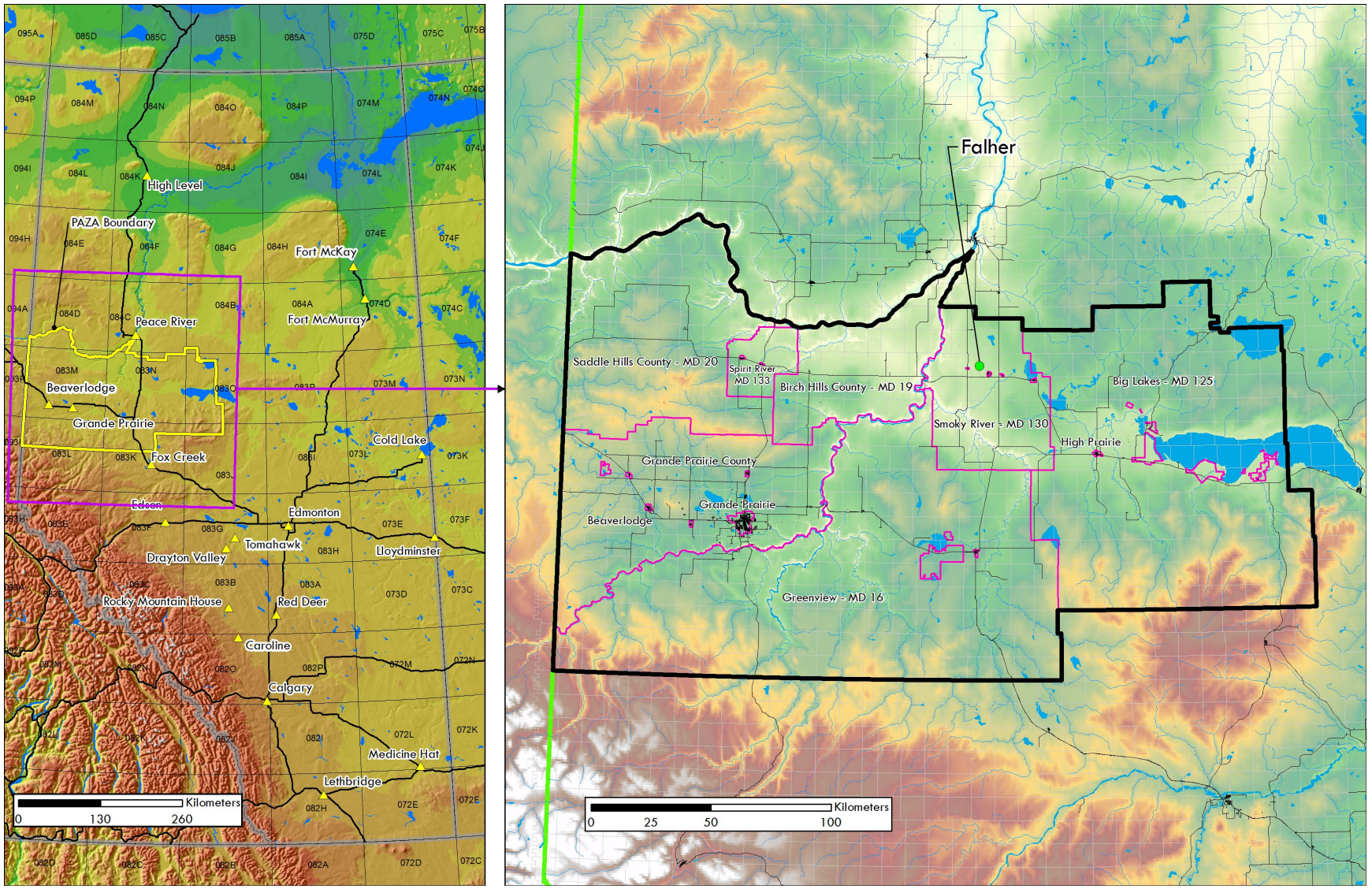

Figure 2.1 Regional Area Map showing location of Falher and PAZA

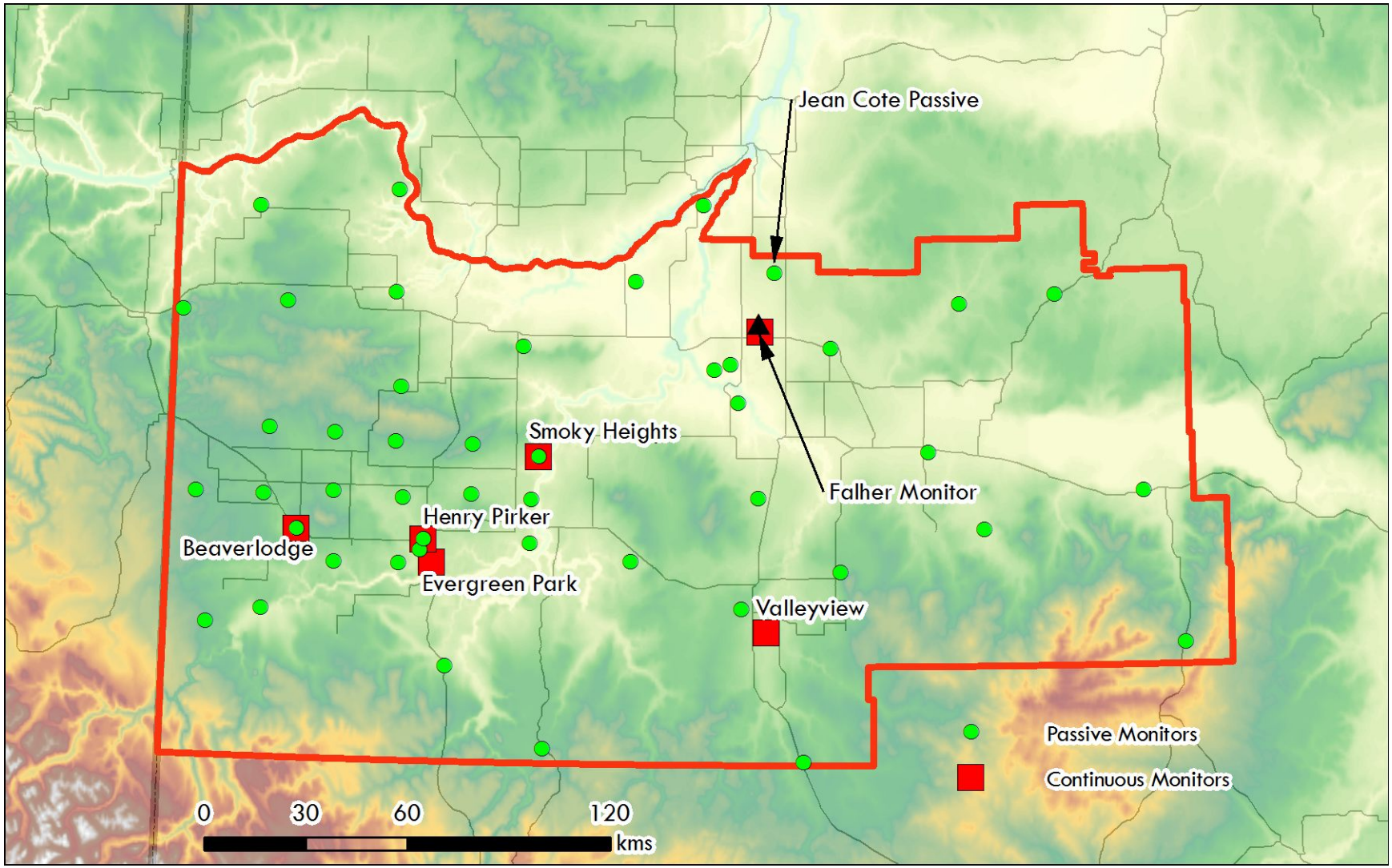

Figure 2.2 PAZA Monitoring Network

Looking North

Looking South

Looking East

Looking West

Monitoring Trailer

Analyzers

Figure 2.3 Views from and of Falher Monitoring Station

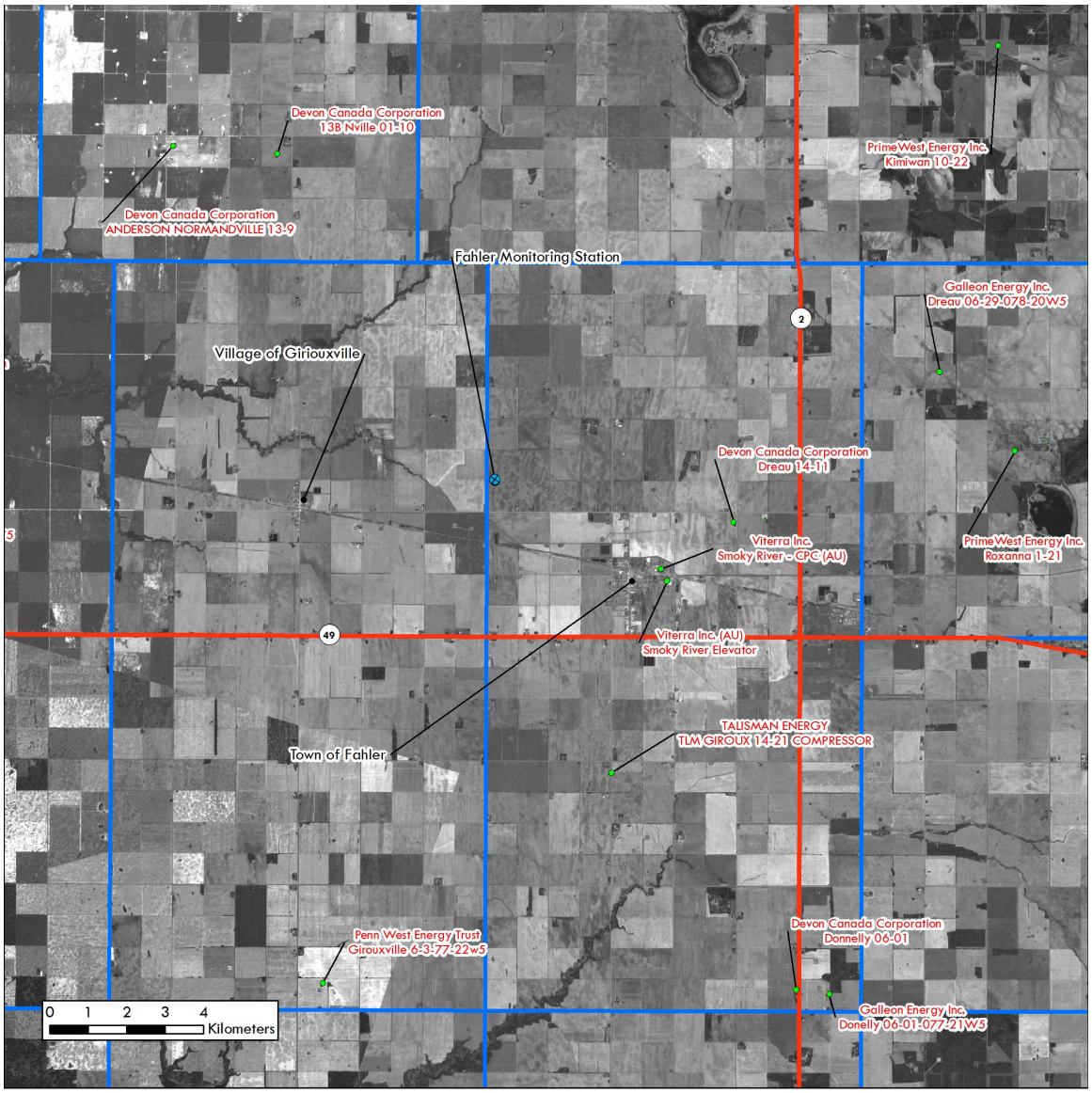

Figure 2.4 Local setting around Falher Monitor

3. AIR MONITORING (PARAMETERS, EQUIPMENT, ETC)

The monitoring station equipment is described in Table 3.1. The continuous monitoring station sampled for TRS, SO_2, NO_x (including NO and NO_2), O_3, and meteorology (wind speed, wind direction, and ambient temperature). Sampling occurred every second and 1-hour averages were calculated from the 1 second samples. The data acquisition system used was the Focus DACS-AP1000. The monitoring station operated from September 1, 2006 00:00 to August 31, 2007 23:00 (8760 hours). The continuous monitoring equipment was operated according to the Alberta Environment Air Monitoring Directive[3] (AMD) including daily instruments checks, monthly multipoint calibrations, and annual audits conducted by AESRD. The monitoring station was audited on June 26, 2007 and again on August 23, 2007 by AESRD.

The Contractor's Standard Operating Procedures (SOPs) contain information on completeness, lower detection limits, ranges, accuracy, detection and calibration methods, and zero and span deviations. SOPs for each of the parameters measured are listed in Table 3.1. For more information on SOPs please contact PAZA.

Continuous monitoring equipment uptime and downtime during the Falher air quality monitoring survey is presented in Table 3.2.

It is noted that TRS analyzer failed the audit on June 26, 2007 due to degraded calibration gas. The analyser was re-calibrated in July with a newly recertified gas cylinder in July and the re-audit on August 23, 2007 passed. Data was measured and logged after the failed audit and was not removed from the analysis.

The NO_x analyser was installed on January 30, 2007 and the startup calibration was completed on February 3, 2007 at which time recording of data began. However, the zero and span configurations were not initiated until late March 2007 as there was a delay in receiving some parts for the analyzer. The official start date of NO, NO_2, and NO_x measurements is considered to be April 1, 2007.

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[3] http://environment.alberta.ca/0996.html

Table 3.1 Monitoring Station Equipment Description

Parameter	Instrument Make and Model	Units of Measure	Sampling Height (m)	Standard Operating Procedures Document
TRS	TEI/43C with converter	Parts per billion (ppb)	4	FAQP-1.002
SO_2	TECO/43C	ppb	4	FAQP-1.001
NO_x	TECO/42i	ppb	4	FAQP-1.003
O_3	TECO/49c	ppb	4	FAQP-1.004
Wind Speed	Gill MetPak	km/hr	10	FAQP-2.001
Wind Direction	Gill MetPak	Degrees direction from	10	FAQP-2.001
Temperature	Gill MetPak	°C	10	FAQP-2.006

Table 3.2 Monitoring Equipment Uptime

Measurement	TRS	SO_2	NO_x	O_3	Temperature	Wind Speed	Wind Direction
Valid Reading	92.27%	92.36%	38.26%	92.48%	96.16%	92.42%	92.42%
Not in Service	4.37%	4.35%	2.18%	4.33%	0.00%	0.00%	0.00%
Daily Automated Zero/Span Sequence	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%
Calibration	0.62%	0.57%	0.35%	0.46%	0.00%	0.00%	0.00%
Not Valid[a]	1.97%	1.97%	0.05%	1.97%	3.06%	6.70%	6.70%
Maintenance	0.02%	0.02%	0.11%	0.02%	0.08%	0.17%	0.14%
Span (Used for Manual Span)	0.67%	0.65%	0.90%	0.67%	0.65%	0.65%	0.65%
Power Failure	0.07%	0.07%	0.06%	0.07%	0.05%	0.06%	0.06%
No Data/Data Acquistion Failure	0.00%	0.00%	58.08%[b]	0.00%	0.00%	0.00%	0.00%

a) Not Valid is defined as data collected when the instrument is operating outside normal conditions
b) The NO_x analyzers did not commence until April 1, and the downtime while waiting for parts is reflected here

4. ALBERTA AMBIENT AIR QUALITY OBJECTIVES

The AAAQOs for the pollutants that were measured are shown in Table 4.1. There are currently no AAAQOs for TRS. However, hydrogen sulphide (H_2S) and carbon disulphide (CS_2) are classified as reduced sulphur compounds and have AAAQOs. Of the NO_x compounds measured, only NO_2 has AAAQOs. Although, there is currently a 1-hour AAAQO for O_3, compliance or achievement is usually determined by the Canada-Wide Standards for O_3 which is an 8-hour average of 65 ppb based on the 4th highest daily 8-hr measurement annually, averaged over 3 consecutive years. Since the Falher monitoring station only measured O_3 for one year, direct comparison to the CWS cannot be made. Also included in the CWS for O_3 are provisions for "Keeping Clean Areas Clean and Continuous Improvement" that apply at ambient concentrations below the numeric CWS, as well as provisions on monitoring and reporting of progress and activities.

Table 4.1 Alberta Ambient Air Quality Objectives.

Pollutant	Averaging Period				
	1-hr (ppb)	8-hr (ppb)	24-hr (ppb)	30 day (ppb)	Annual (ppb)
TRS	10 (H_2S) 10 (CS_2)	-	3 (H_2S)		
SO_2	172	-	48	11	8
NO_2	159	-	-	-	24
O_3	82	65 (CWS)[1] 58 (CWS)[1]	-	-	-

Note: 1 CWS Exceedance Trigger is 65 ppb, CWS Planning Trigger is 58 ppb, both based on the 4th highest 8-hour daily measurement annually, averaged over 3 years

5. MONITORING RESULTS

This report provides an overall summary of the monitoring data; the detailed one-hour monitoring data results are available on the PAZA website and at the CASA Data Warehouse[4].

In the sections that follow, several summary statistics are used in the discussion of monitoring results including the average, maximum, minimum, and percentile concentrations. An nth percentile concentration indicates that n percent of data are less than that concentration, and (100 – n) percent of data are greater than that concentration. For example, a dataset with a 90th percentile concentration of 50 ppb indicates that 90 % of the data will be less than 50 ppb and 10 % percent of the data will be greater than 50 ppb.

Frequency distributions and data distributions by wind direction known as wind, pollution or data roses depending on the data being analyzed are presented to help identify potential sources of pollutants.

Comparison with other areas of the province was undertaken using ambient measurements from the following locations for the same time period as the Falher monitoring. The locations of these stations are shown in Figure 2.1 and Figure 2.2.

- Beaverlodge (PAZA)
  - Small urban
- Evergreen Park (PAZA) (TRS only)
  - Small urban
- Henry Pirker (PAZA) (TRS only)
  - Small urban
- Caroline
  - Rural
- Calgary NW
  - Urban
- Cold Lake South
  - Small urban
- Fort McKay
  - Rural – near oil sands
- Tomahawk
  - Rural

Also included is a comparison of monthly averages from the closest PAZA passive monitoring station for SO_2, NO_2, and O_3. The closest passive station to the Falher monitoring location is the Jean Cote passive monitoring station which is 15.6 km north-northeast. The closest current passive monitor that measures TRS or H_2S is located 15 km southwest and was not included in the comparison as it was not operating at the time of the Falher monitor.

[4] http://www.casadata.org/Reports/SelectCategory.asp

5.1 Meteorology

The following figures illustrate the meteorological conditions recorded at the Falher monitoring station during the period September 1, 2006 00:00 to August 31, 2007 23:00. Figure 5.1 shows that the most frequent winds are from the south-southeast and southeast. As well, the highest wind speeds most frequently occur from the west-southwest and west. Figure 5.2 shows the monthly temperature and wind speed distributions. It is noted that on average the coldest months were November and February and the winter months (December to February) were the windiest on average during the monitoring period.

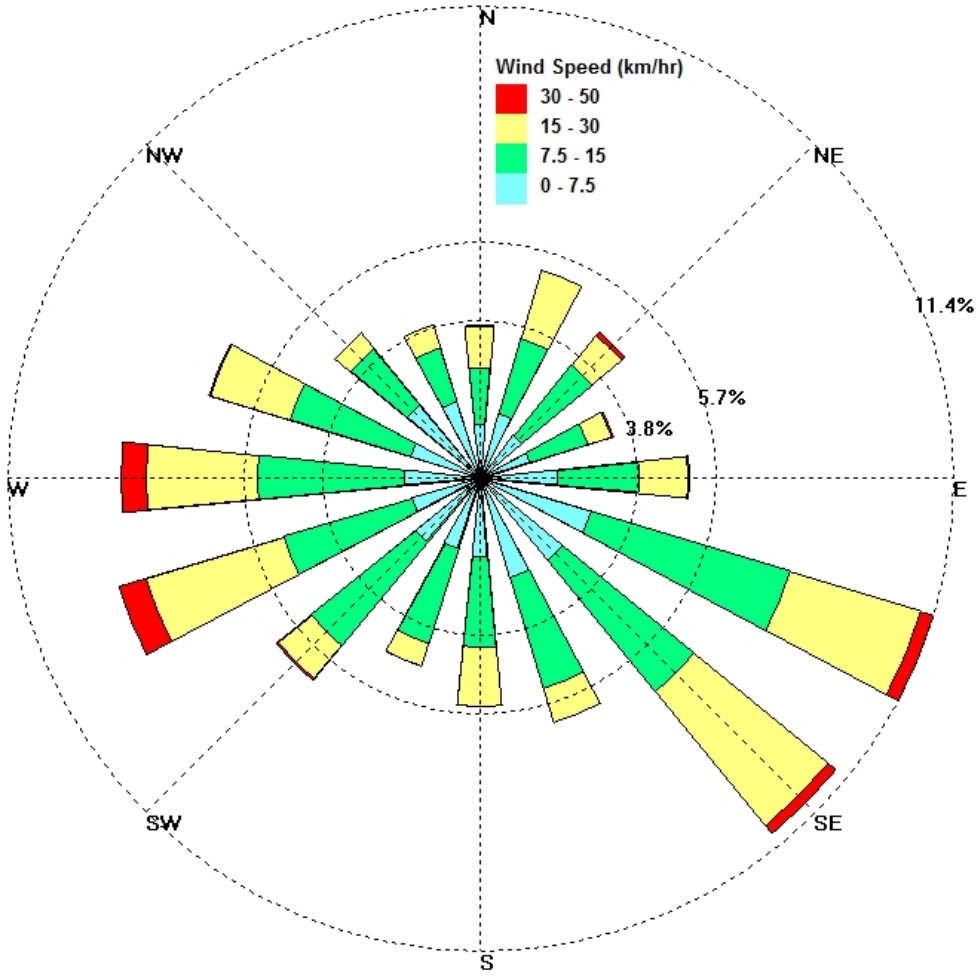

Figure 5.1 Wind Frequency Distribution at Falher Monitoring Station

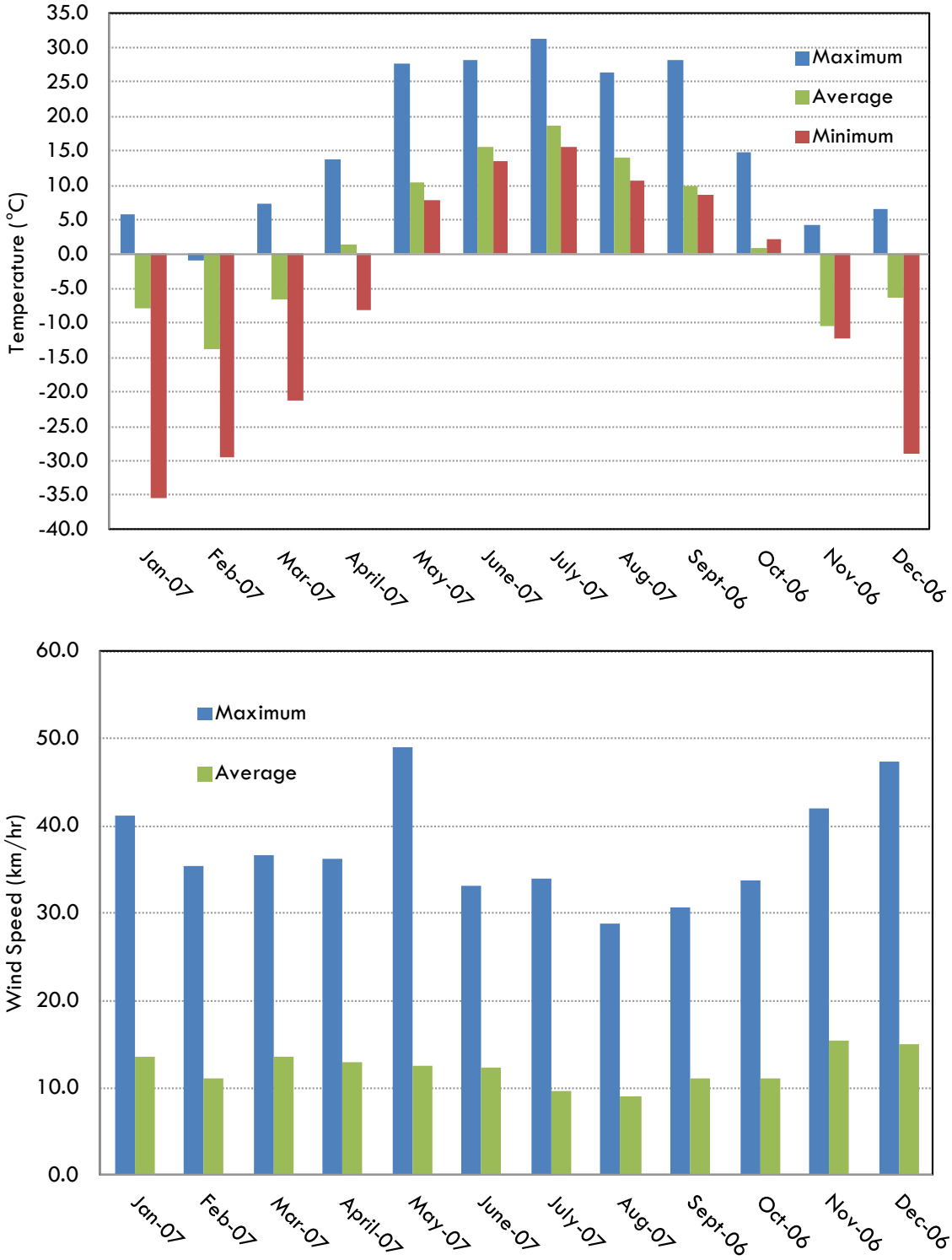

Figure 5.2 Monthly Temperature and Wind Speed Distribution Measured at Falher Monitoring Station

5.2 Total Reduced Sulphur Compounds

Reduced sulphur compounds are a complex family of substances. They are defined by the presence of sulphur in a reduced state and are generally characterized by strong odours at relatively low concentrations. Total reduced sulphur compounds (TRS) includes hydrogen sulphide (H_2S), carbon disulphide (CS_2), mercaptans, dimethyl sulphide, dimethyl disulphide and other sulphur compounds. Sulphur dioxide (SO_2) is not a reduced sulphur compound.

As noted earlier in Table 4.1, currently there are no AAAQO for TRS. However, there are AAAQOs for H_2S and CS_2 which are based on odour thresholds. H_2S is known to have highly toxic properties, and can cause negative health effects at low concentrations.[5]

Natural sources of reduced sulphur compounds in air include volcanoes and sulphur springs, oceans and estuaries, and exposed faces of sulphur-containing oil and coal deposits. The primary anthropogenic sources include oil and gas processing facilities, Kraft pulp mills, chemical manufacturing plants, and livestock operations. TRS can be produced when manure undergoes anaerobic (absence of oxygen) fermentation.

In the area around the monitor, the main sources of TRS emissions would be agricultural sources. As well, municipal sources such as landfills and sewage lagoons could also have contributed to the TRS measurements but that assumption needs to be verified. As well, swamps and sloughs can be natural sources of TRS. Although there is sour oil and gas activity in the area, it is widely dispersed, at least 6 km from the monitor and therefore, would not likely have a significant effect on the measurements. However, that cannot be definitively determined from the data collected.

A summary of TRS measurements are shown in Table 5.1 and the time series of measurements are shown in Figure 5.3. The measurements show that the AAAQO for H_2S and CS_2 were exceeded during the monitoring period indicating a high likelihood of nuisance odours. There were 13 hourly TRS measurements above 5 ppb. Of these 13, 9 measurements can likely be attributed to two distinct events: one on September 3, 2006 and the other on Oct 13, 2006. Other distinct events or periods can be seen in Figure 5.3.

Figure 5.4 shows that concentrations above 1 ppb were most frequently recorded for winds from the southeast quadrant. Figure 5.5 presents the maximum and average TRS measurements by wind direction. These figures are showing a bias of highest concentrations from the east to southeast directions.

Figure 5.6 presents the maximum and average measured TRS concentrations as a function of month and hour of day. The figures show a trend toward higher average concentrations occurring during the warmer months and during night-time hours.

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[5] http://environment.gov.ab.ca/info/library/6664.pdf

Figure 5.7 provides a comparison of TRS measurements from other monitoring stations in the province for the same time period. TRS is not a commonly measured suite of pollutants and would usually measured in areas where TRS compounds are present and considered important from an air quality perspective. The figure shows that the measurements at Falher are comparable to other areas where TRS are measured with the exception of the maximum measurement which was much higher.

Overall the main contributor to elevated TRS concentrations cannot be positively determined from the measured data; however, the Town of Falher is the main upwind source for the highest measurements. Therefore, it is likely that municipal, agricultural or industrial activities close to the town lead to the elevated measurements. Further, more thorough analysis of the measured data coupled with detailed information about industrial, agricultural and municipal activity in the area may yield more definitive conclusions on source contributions.

Table 5.1 Summary of TRS Measurements (ppb) at Falher Monitoring Station

1-hour AAAQO	10 (H_2S and CS_2)
Maximum 1-hour Measurement	25.23
99.9th Percentile Measurement	6.6
99th Percentile Measurement	1.96
90th Percentile Measurement	0.74
Median Measurement	0.51
Average Measurement	0.56
24-hour AAAQO	3 (H_2S)
Maximum 24-hour Average Measurement	3.30

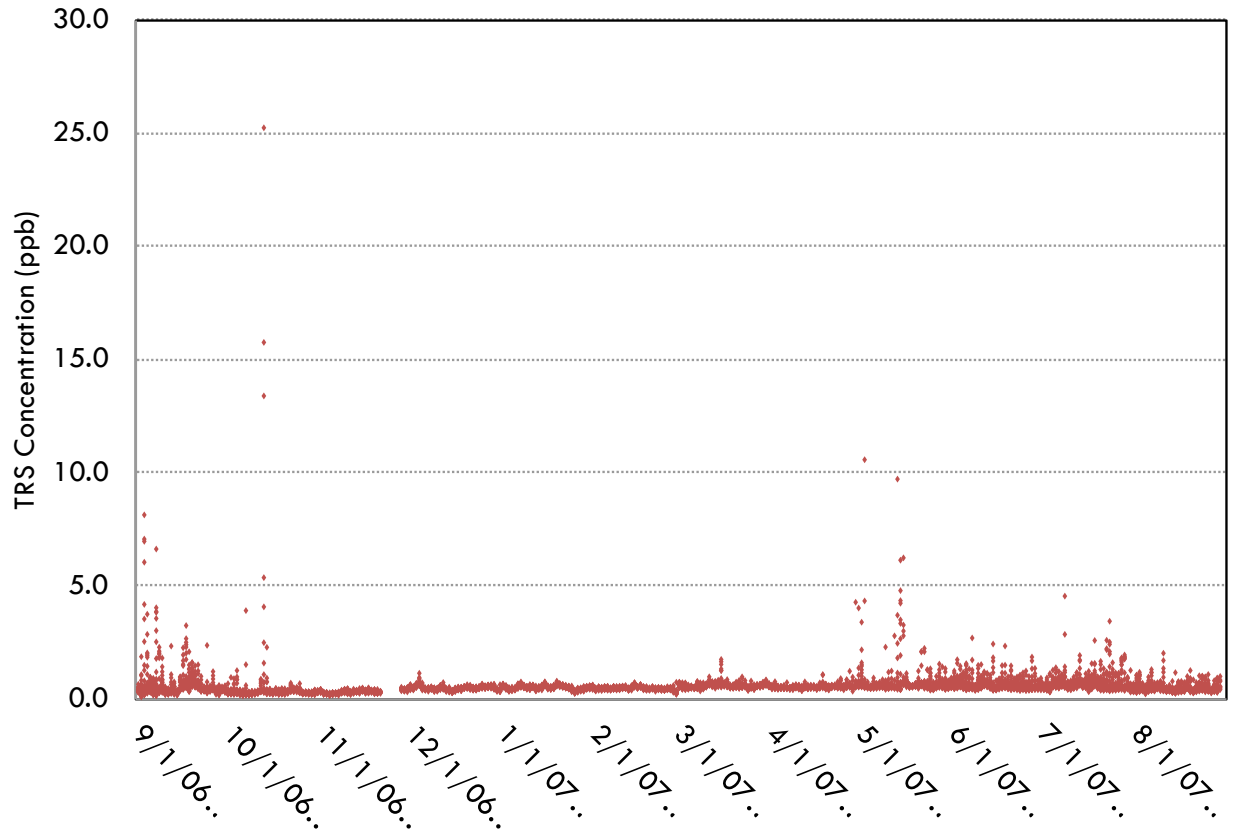

Figure 5.3 Time Series of the Falher TRS Measurements (non-zero values)

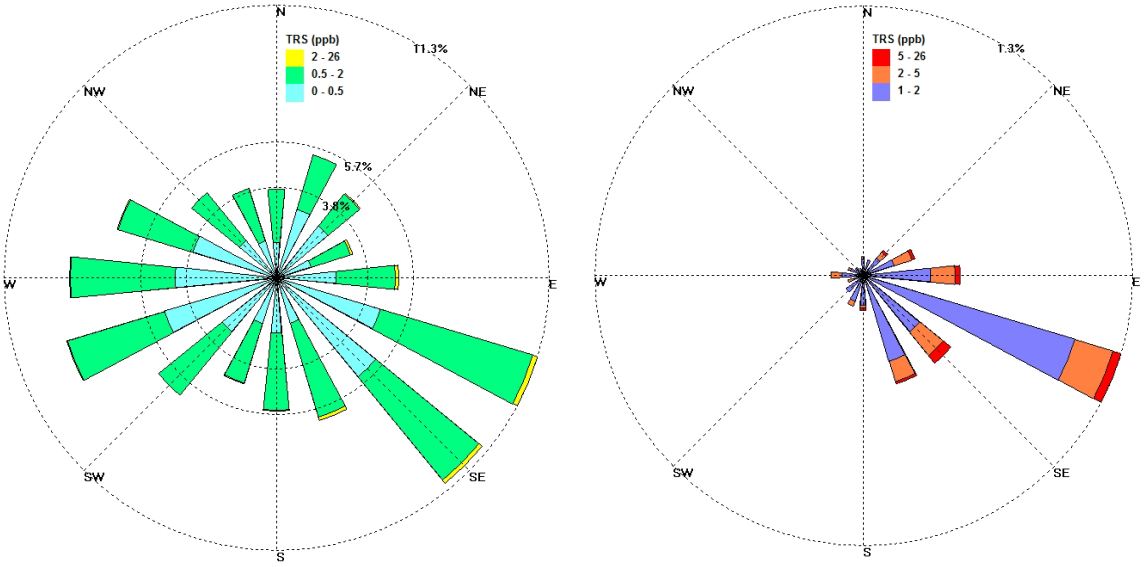

Figure 5.4 Frequency Distribution of TRS Measurements by Wind Direction

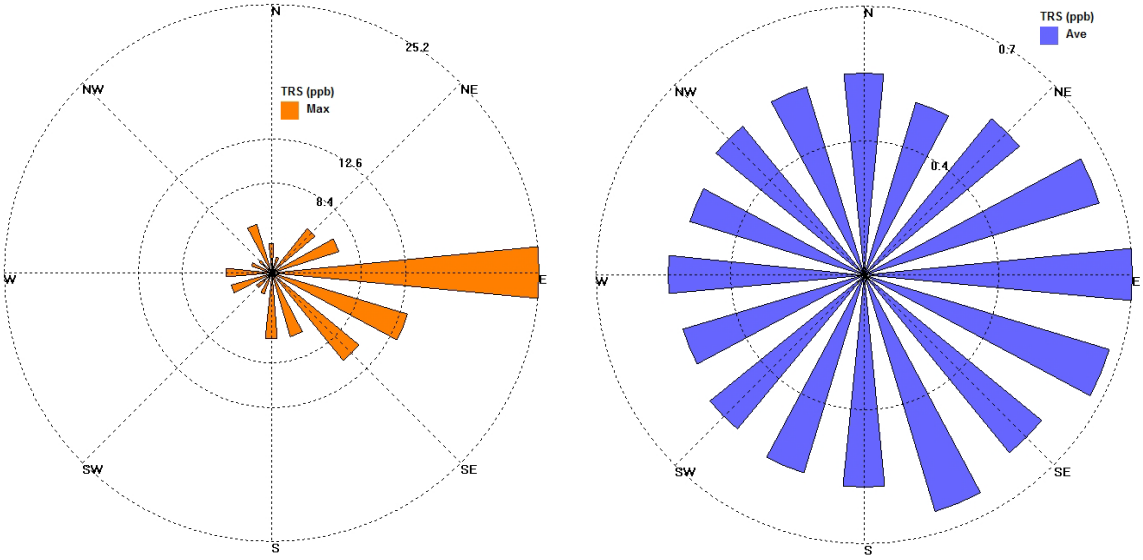

Figure 5.5 Maximum and Average TRS measurements by Wind Direction

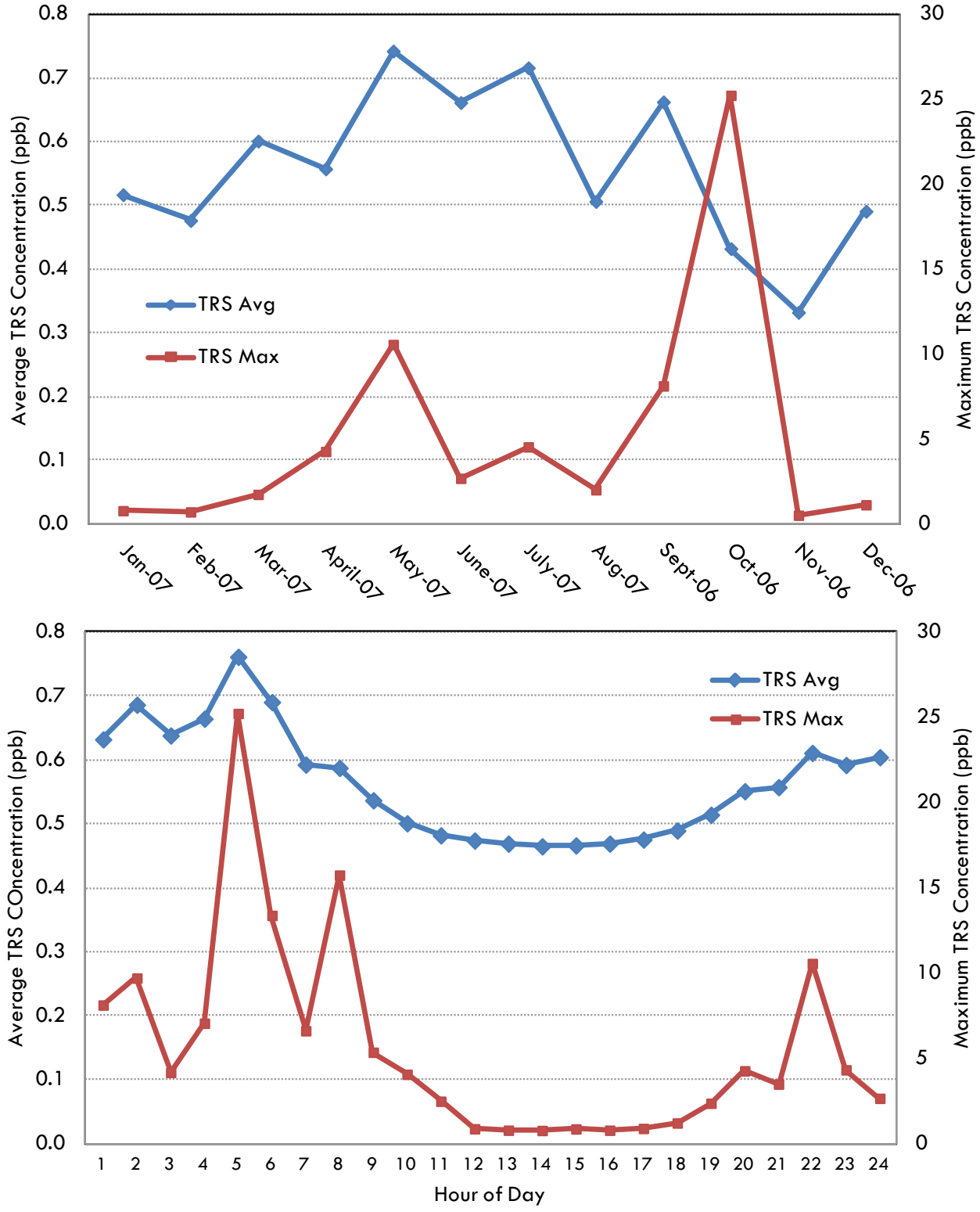

Figure 5.6 Maximum and Average TRS Measurements by Month and Hour of Day

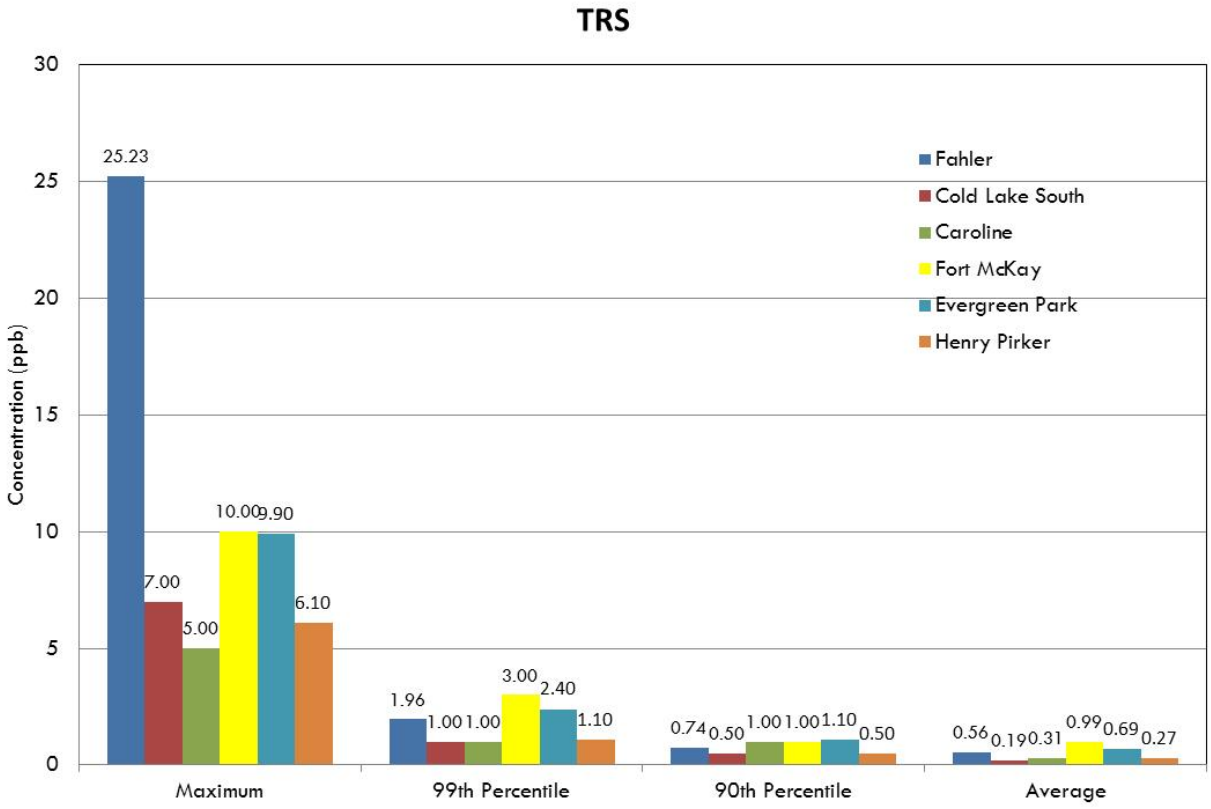

Figure 5.7 Comparison of TRS Measurements from other Continuous Monitoring Stations

5.3 Sulphur Dioxide

Sulphur dioxide is a colourless, non-flammable gas with a sharp, pungent odour. Natural sources include volcanoes, decaying organic matter and solar action on seawater. The most significant anthropogenic emission sources of sulphur dioxide are from combustion of sulphur-containing fossil fuels, smelting sulphide ores, and petroleum refining. Other less significant sources include chemical and allied products manufacturing, metal processing, other industrial processes, and vehicle emissions.

Once sulphur dioxide is released into the atmosphere, it may be converted to other compounds and/or removed from the atmosphere by various mechanisms. Processes such as oxidation, wet deposition, dry deposition, absorption by vegetation and by soil, dissolution into water and other processes contribute to the removal of sulphur dioxide from the atmosphere. Exposure to high enough concentrations of SO_2 can affect human and environmental health.[6]

[6] http://environment.gov.ab.ca/info/library/8304.pdf

A summary of SO_2 measurements are shown in Table 5.2 and the time series of measurements are shown in Figure 5.8. The measurements were well below the SO_2 AAAQO in all instances. Figure 5.9 shows that most concentrations were less than 1 ppb. Figure 5.9 and Figure 5.10 indicate that the maximum measured SO_2 concentrations, the most frequent high concentrations and the highest average concentrations occur for winds from the southeast sector. Also noted in the figures are elevated concentrations occurring for winds from the east-northeast.

Figure 5.11 presents the maximum and average measured SO_2 concentrations as a function of month and hour of day. The figures show the average concentrations have a slight bias toward higher average concentrations in the colder months and in the late mornings. The figure shows that the average monthly concentrations are fairly consistent with the measurements from the closest passive monitor.

Figure 5.12 provides a comparison of SO_2 measurements from other monitoring stations in the province for the same time period. The figure shows that the measurements at Falher were lower when compared to other areas where SO_2 is measured.

The data indicates that SO_2 levels around Falher are generally low inferring that there are no significant sources of SO_2 in the area. The bias of higher concentrations toward winds from the southeast is likely a sign of low level sources near the town and may be a sign of long range transport from other industrial sources. Further, more thorough analysis of the measured data coupled with detailed information about activity in the area may yield more definitive conclusions in regard to the main emission contributors.

Table 5.2 Summary of SO_2 Measurements (ppb) at Falher Monitoring Station

1-hour AAAQO	172
Annual AAAQO	20
Maximum 1-hour Measurement	13.62
99.9th Percentile Measurement	5.11
99th Percentile Measurement	2.32
90th Percentile Measurement	0.78
Median Measurement	0.20
Average Measurement	0.33
24-hour AAAQO	48
Maximum 24-hour Average Measurement	3.43

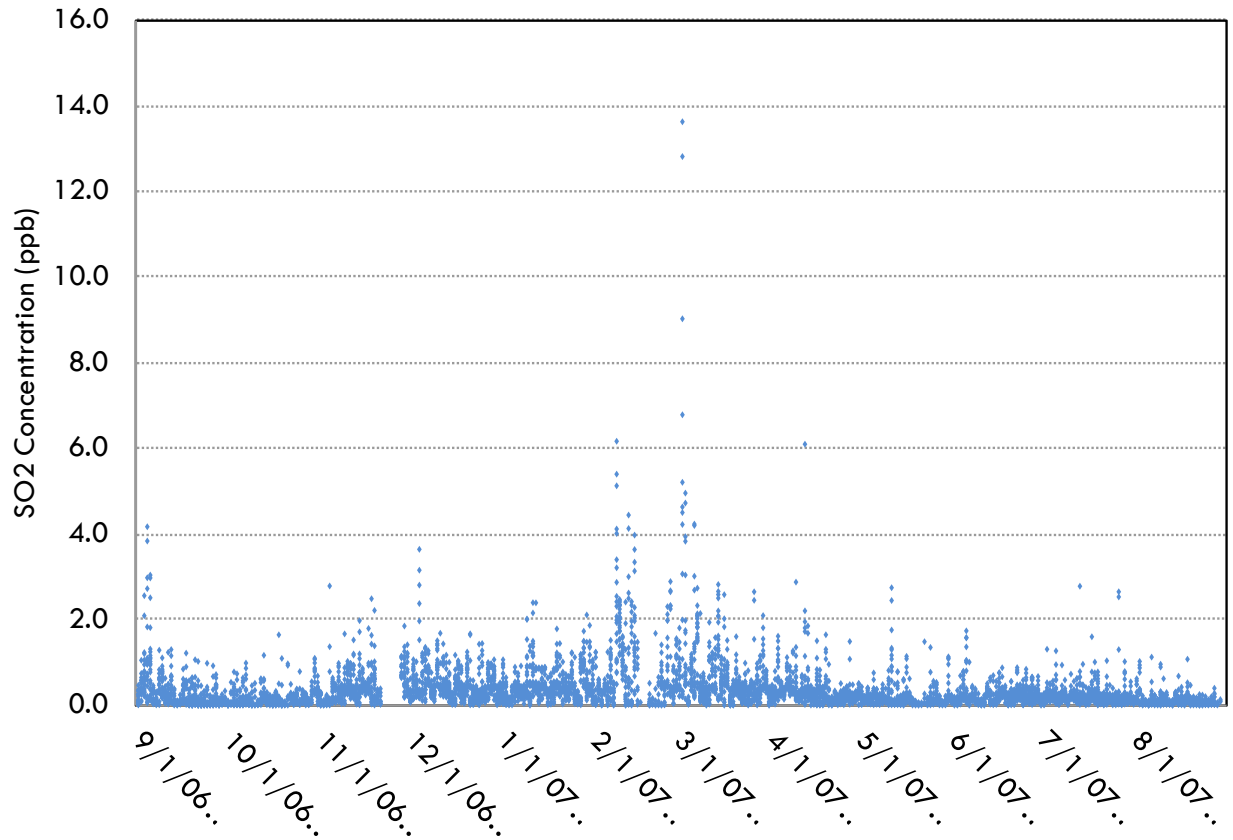

Figure 5.8 Time Series of the Falher SO_2 Measurements (non-zero values)

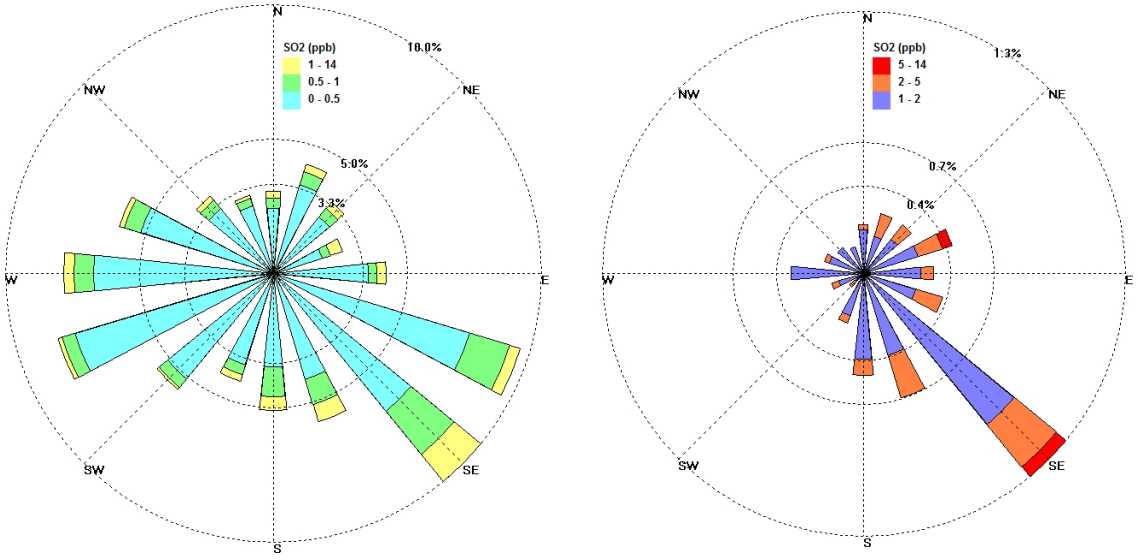

Figure 5.9 Frequency Distribution of SO_2 Measurements by Wind Direction

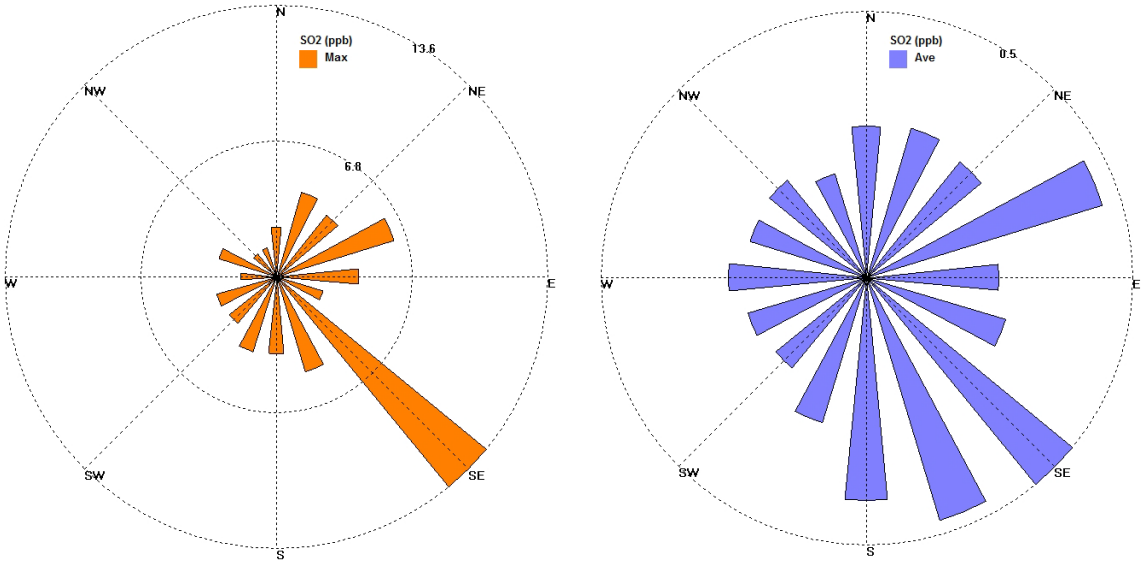

Figure 5.10 Maximum and Average SO_2 measurements by Wind Direction

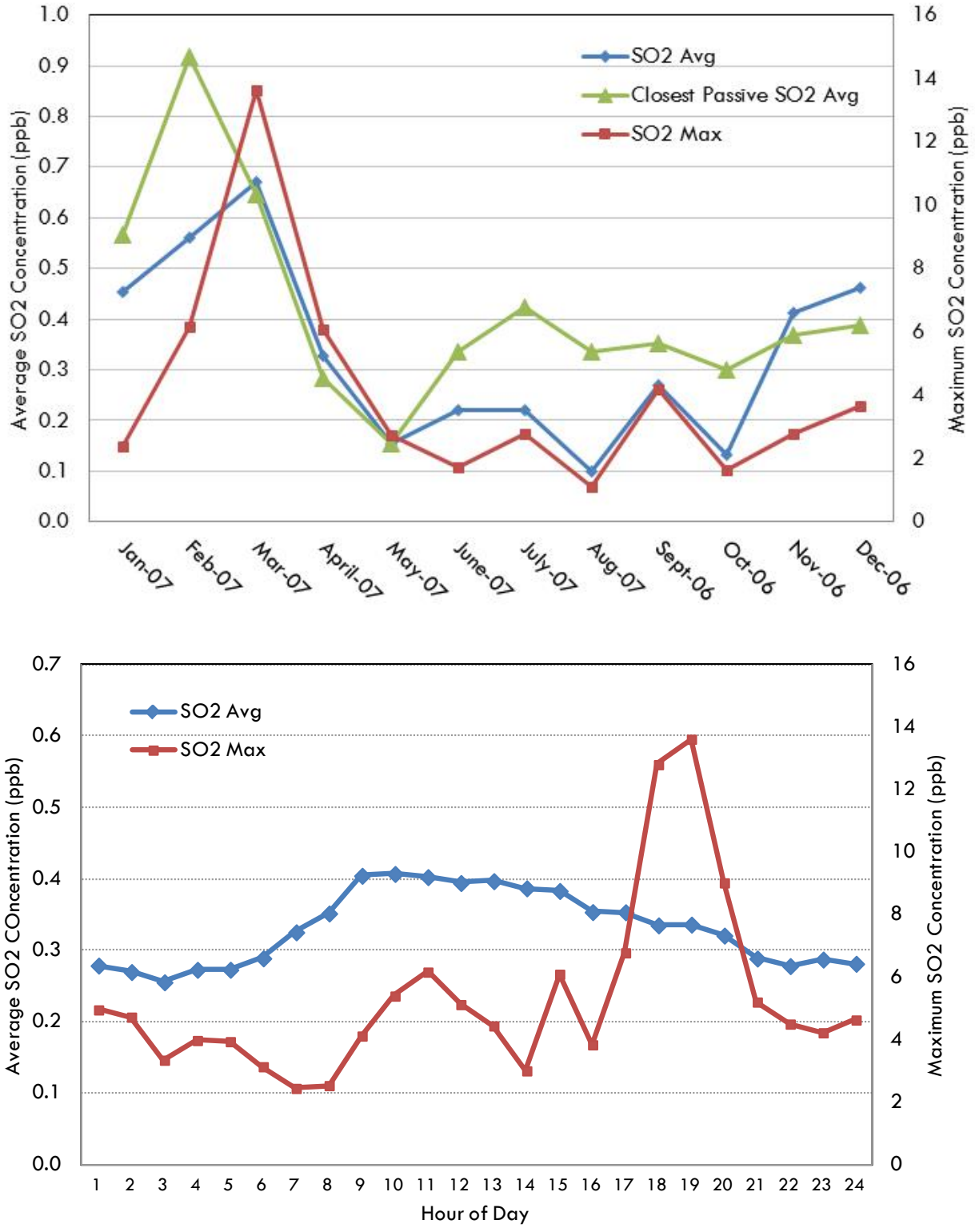

Figure 5.11 Maximum and Average SO_2 Measurements by Month and Hour of Day

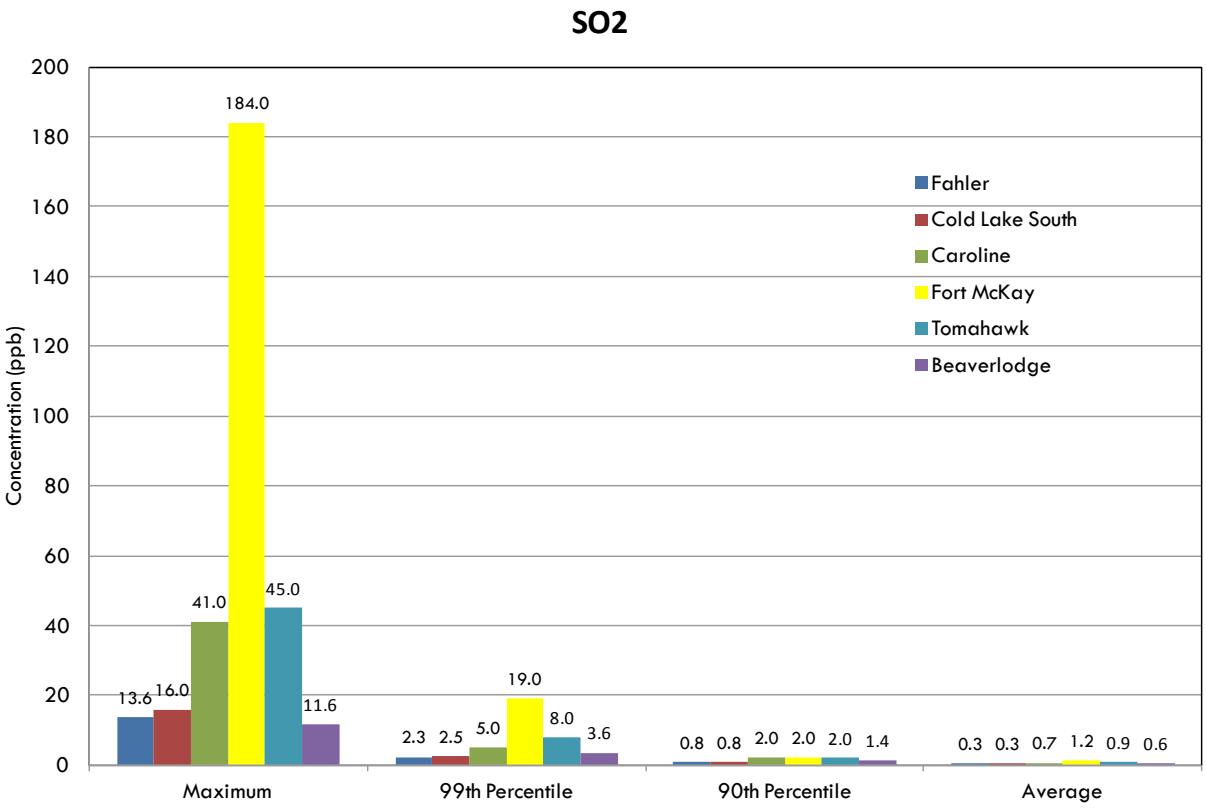

Figure 5.12 Comparison of SO_2 Measurements from other Continuous Monitoring Stations

5.4 Nitrogen Oxides

Nitrogen dioxide (NO_2) and nitric oxide (NO) are known collectively as oxides of nitrogen (NO_x). NO_x occurs naturally in the environment as a result of forest fires, atmospheric lightning discharges and biogenic oxidation of nitrogen containing compounds present in soil. Anthropogenic NO_x emissions are mainly the result of combustion processes, such as the combustion of fuel for vehicles or the combustion of coal, oil and natural gas for industrial processes. Emissions of NO_x from combustion processes are initially about 90 to 95% NO and about 5 to 10% NO_2. NO is oxidized to NO_2 in the atmosphere, and through further complex atmospheric chemical reactions can lead to the formation of ozone (see next section), nitric acid and nitrate-containing particles.

Of the NO_x species, an AAAQO exists for NO_2 only. Therefore, a summary of the NO_x measurements is restricted to NO_2. NO_2 is a reddish-orange-brown gas with an irritating, acrid, characteristic pungent odour. It is corrosive, highly oxidizing and non-combustible. At high enough concentrations, NO_2 can have respiratory effects on humans on which the 1-hour

AAAQO is based. On a long term basis, NO_2 can have detrimental effects on vegetation which is reflected in the annual AAAQO.[7]

A summary of NO_2 measurements are shown in Table 5.3 and the time series of measurements are shown in Figure 5.13. As indicated previously, NO_2 measurements were recorded from only April to August 2007.

The measurements were below the NO_2 AAAQO in all instances. Figure 5.14 shows that most concentrations were less than 5 ppb. Figure 5.14 and Figure 5.15 indicate that the maximum concentrations, the most frequent high concentrations, and the highest average concentrations are occurring for winds from the southeast quadrant.

Figure 5.16 presents the maximum and average measured NO_2 concentrations as a function of month and hour of day. The figures show the average and maximum concentrations have a slight bias toward higher concentrations at night. The figure shows that the average monthly concentrations are greater than the measurements from the closest passive monitor for the months available for comparison. The measurements at the Falher monitor may have been influenced by the town of Falher.

Figure 5.17 provides a comparison of NO_2 measurements from other monitoring stations in the province for the period (September 2006 to August 2007). The figure shows that other than the peak measurements, NO_2 levels at Falher were slightly lower when compared to other areas in the province. This might be due to NO_2 data being recorded only during April to August. Highest average NO_2 values usually occur in the coldest months and data that was not recorded from November to March would likely reduce overall averages.

The ambient NO_2 data measured in Falher appears to adequately reflect the general rural setting with a close proximity to a rural town. Further, more thorough analysis of the measured data coupled with detailed information about activity in the area may yield more definitive conclusions. As well, NO_2 was only recorded for 5 months which limits the ability to draw conclusions from the data.

[7] http://environment.gov.ab.ca/info/library/8303.pdf

Table 5.3 Summary of NO_2 Measurements (ppb) at Falher Monitoring Station

1-hour AAAQO	159
Annual AAAQO	24
Maximum 1-hour Measurement	24.64
99.9th Percentile Measurement	20.79
99th Percentile Measurement	15.27
90th Percentile Measurement	6.06
Median Measurement	1.56
Average Measurement	2.57

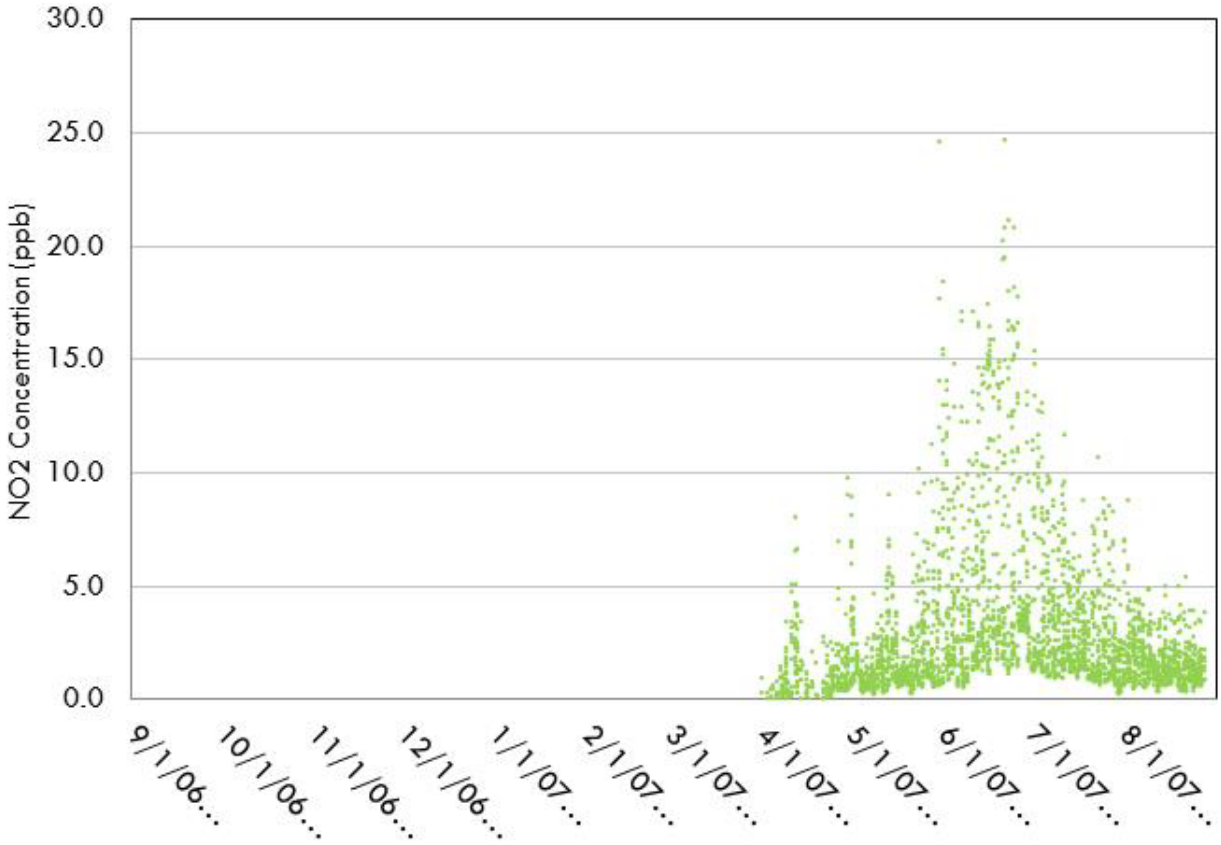

Figure 5.13 Time Series of the Falher NO_2 Measurements (non-zero values)

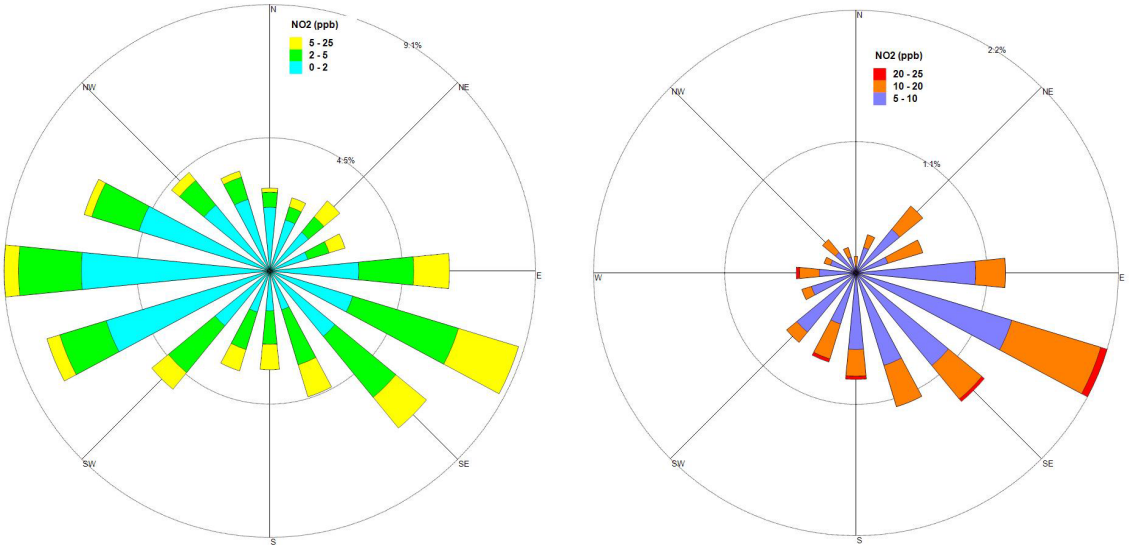

Figure 5.14 Frequency Distribution of NO_2 Measurements by Wind Direction

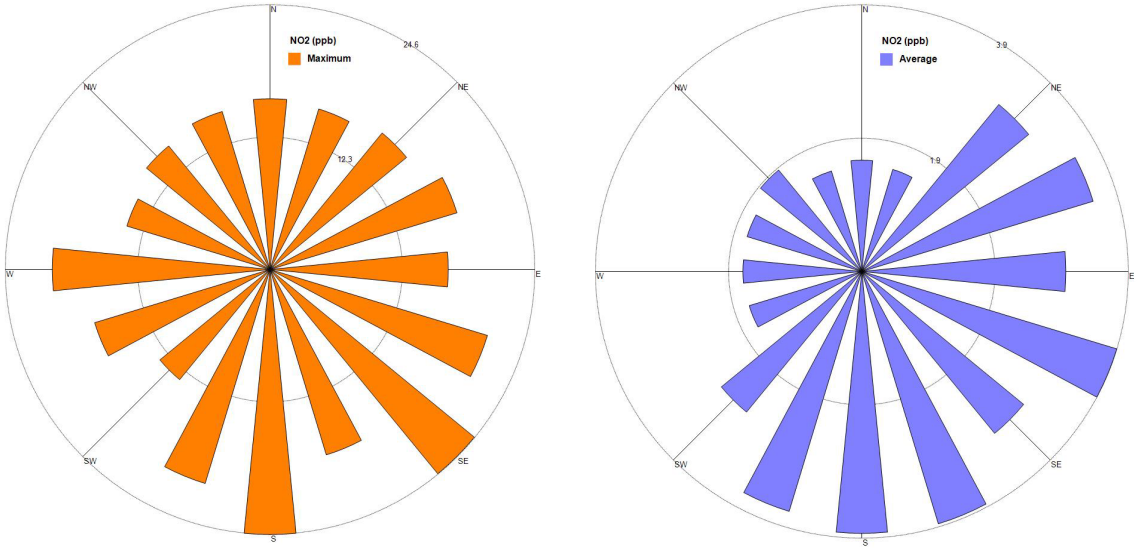

Figure 5.15 Maximum and Average NO_2 measurements by Wind Direction

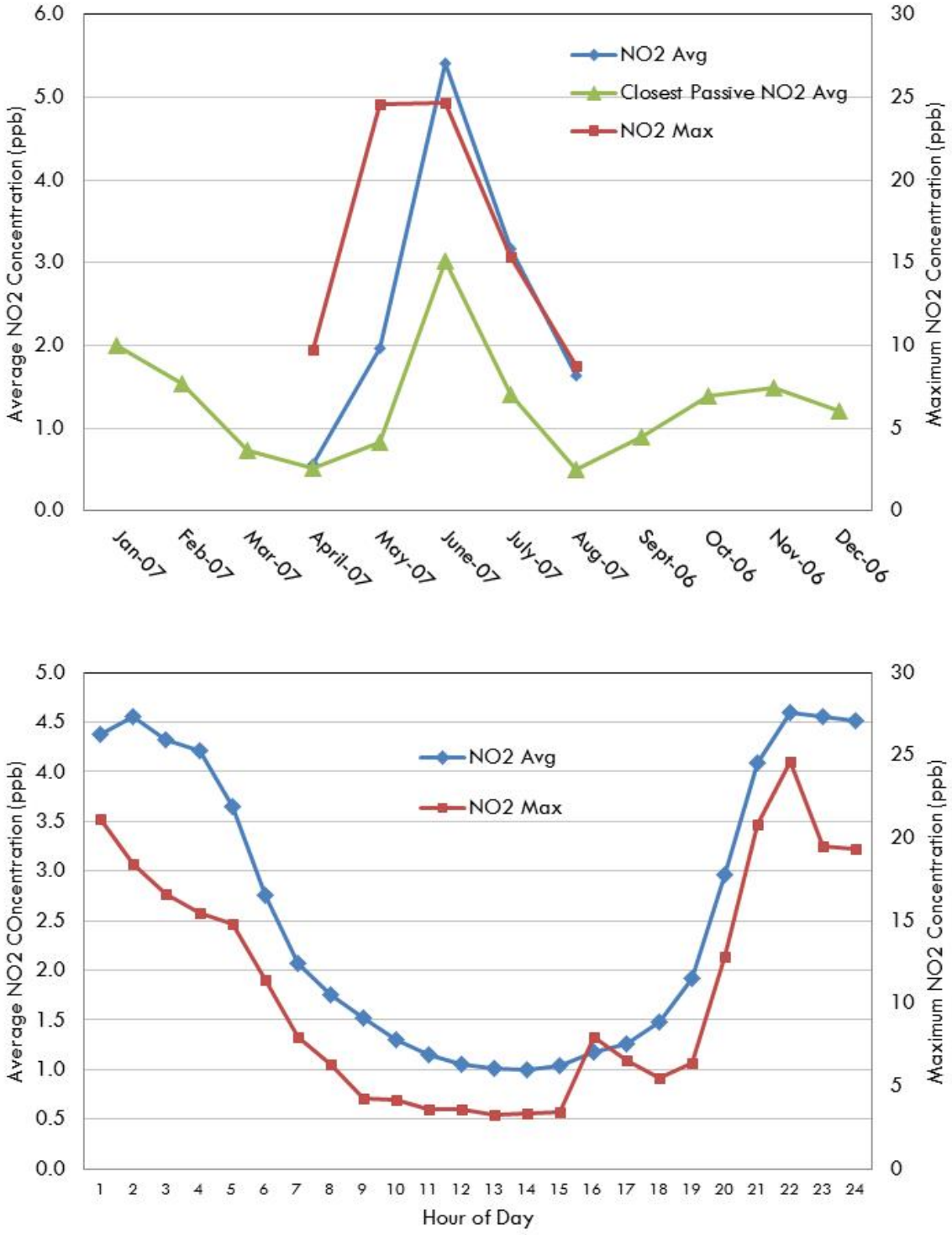

Figure 5.16 Maximum and Average NO_2 Measurements by Month and Hour of Day

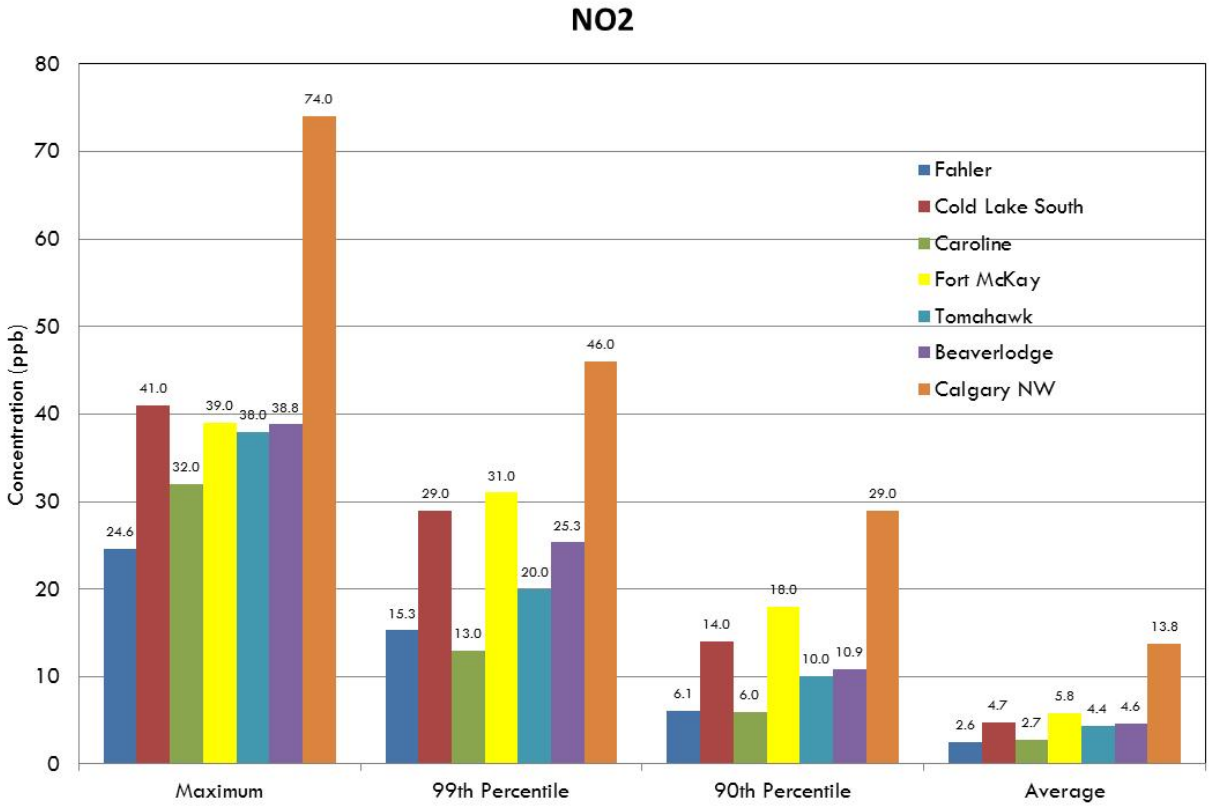

Figure 5.17 Comparison of NO_2 Measurements from other Continuous Monitoring Stations

5.5 Ozone

Ozone is a chemical whose effect on the environment is either beneficial or detrimental depending on where it occurs. Stratospheric ozone protects us from the sun's ultraviolet light, but can be toxic in the troposphere (atmospheric layer encompassing ground level). Ozone is a highly reactive, colourless gas. It has a sharp, clean odour that can often be detected around running electric motors, after lightning storms, and around new mown hay.

Ozone is not emitted by anthropogenic or natural processes. It is normally present in the troposphere as a result of naturally occurring photochemical and meteorological processes. Ground level ozone is formed through complex chemical reactions between precursor emissions of volatile organic compounds (VOCs) and NO_x in the presence of heat and sunlight. Combustion exhausts emit both VOCs and NO_x and in rural areas, trees and other vegetation naturally emit VOCs that can contribute to ozone formation. Changing weather patterns contribute to yearly differences in ozone concentrations from city to city. Ozone and the

precursor substances that cause ozone also can be transported into an area from pollution sources hundreds of miles upwind.

Extensive scientific studies indicate that there can be significant health and environmental effects associated with ozone. Potential short-term effects include pulmonary function reductions, increased airway sensitivities, and airway inflammation on which the 1-hour AAAQO for ozone is based. [8]

A summary of O_3 measurements are shown in Table 5.4 and the time series of measurements are shown in Figure 5.18. The measurements were below the 1-hour AAAQO in all instances and although, the CWS are not directly comparable, the 4th highest 8-hr daily averages is less than the planning trigger of 58 ppb.

Figure 5.19 presents the frequency distribution of O_3 measurements by wind direction. The most frequent concentrations above 40 ppb occur for winds from the west. Figure 5.20 presents the maximum and average O_3 measurements by wind direction. The highest average O_3 concentrations occur for winds from southwest to northwest quadrant.

Figure 5.21 presents the maximum and average measured O_3 concentrations as a function of month and hour of day. The figures show a definite pattern of the highest average and maximum values in the spring and lowest in the fall. The maximum overall concentration recorded in September 2006 is likely due to forest fires. Also seen is a distinctive diurnal pattern of O_3 where O_3 is decomposed to O_2 through a reaction with NO in the early morning and then created during the day in complex reactions with VOCs and NO_2 in the presence of sunlight. The figure shows that the average monthly concentrations are fairly consistent with the measurements from the closest passive monitor except for the November, and January to March measurements which showed that the passive measurements to be significantly higher. The reasons for this were not investigated in this report.

Figure 5.22 provides a comparison of O_3 measurements from other monitoring stations in the province for the same time period. The figure shows that O_3 levels at Falher were comparable to other areas in the province.

Figure 5.23 presents the diurnal relationships between NO, NO_2, and O_3 at the Falher monitoring station for the months of April and August. The figures show the complex relationship between these pollutants that lead to O_3 formation and decomposition. Although the formation of O_3 can be seen in both figures, it is most pronounced in August which has the highest temperatures and sunlight.

The ambient O_3 data measured in Falher appears to adequately reflect the general rural setting. Although the data is showing ozone formation and decomposition due to NO_x and VOC emissions from the local sources is occurring, the levels are below the AAAQO and CWS triggers.

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[8] http://environment.gov.ab.ca/info/library/7808.pdf

Table 5.4 Summary of O_3 Measurements (ppb) at Falher Monitoring Station

1-hour AAAQO	82
Maximum 1-hour Measurement	63.92
99.9th Percentile Measurement	57.53
99th Percentile Measurement	51.67
90th Percentile Measurement	40.81
Median Measurement	26.32
Average Measurement	26.29
8-hour CWS Exceedance Trigger	65
8-hour CWS Planning Trigger	58
4th Highest Daily 8-hour Measurement	55.5

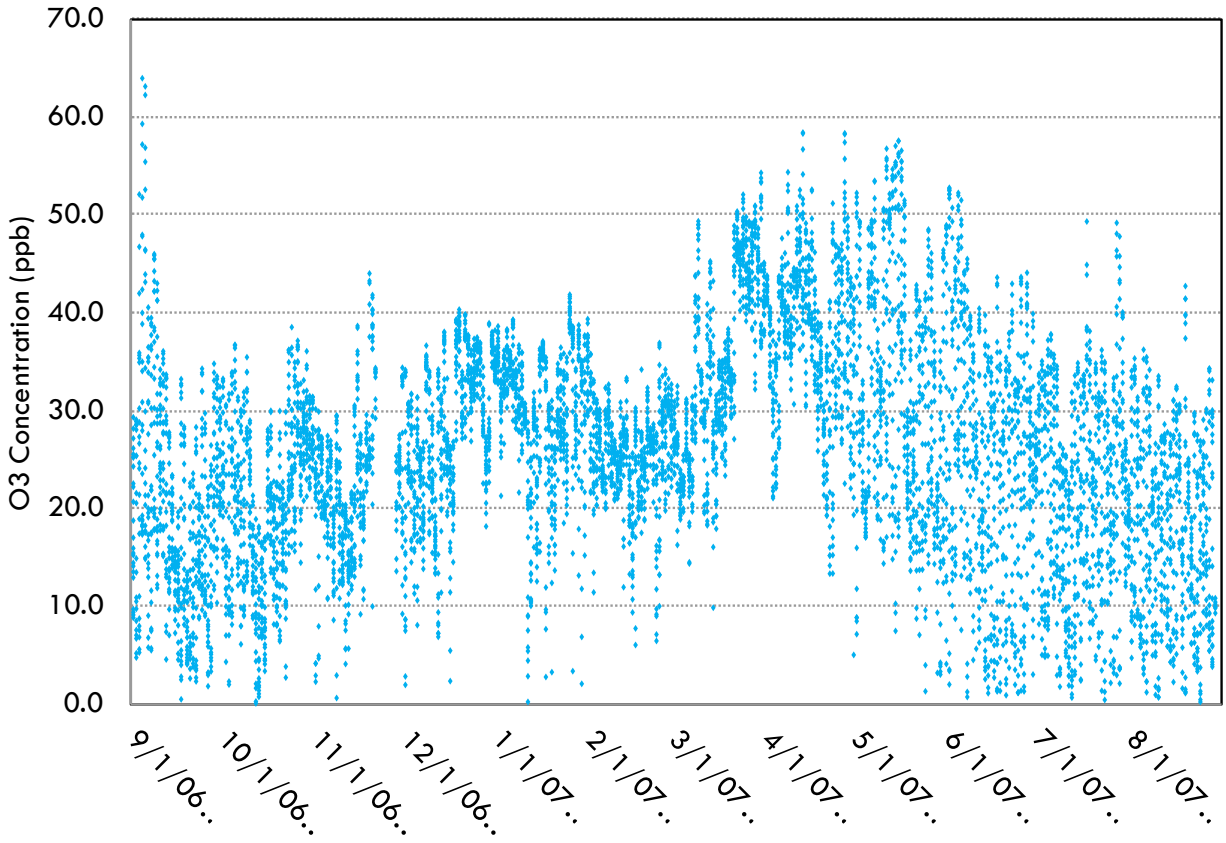

Figure 5.18 Time Series of the Falher O_3 Measurements (non-zero values)

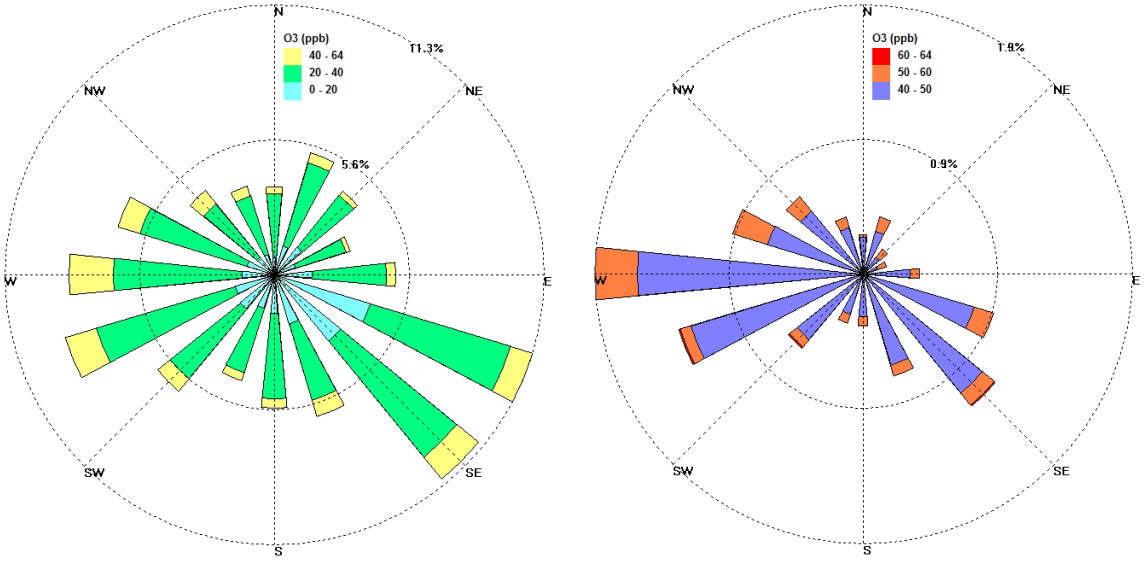

Figure 5.19 Frequency Distribution of O_3 Measurements by Wind Direction

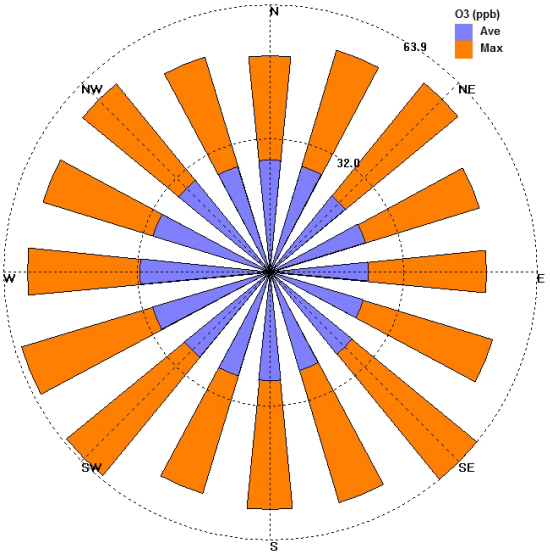

Figure 5.20 Maximum and Average O_3 Measurements by Wind Direction

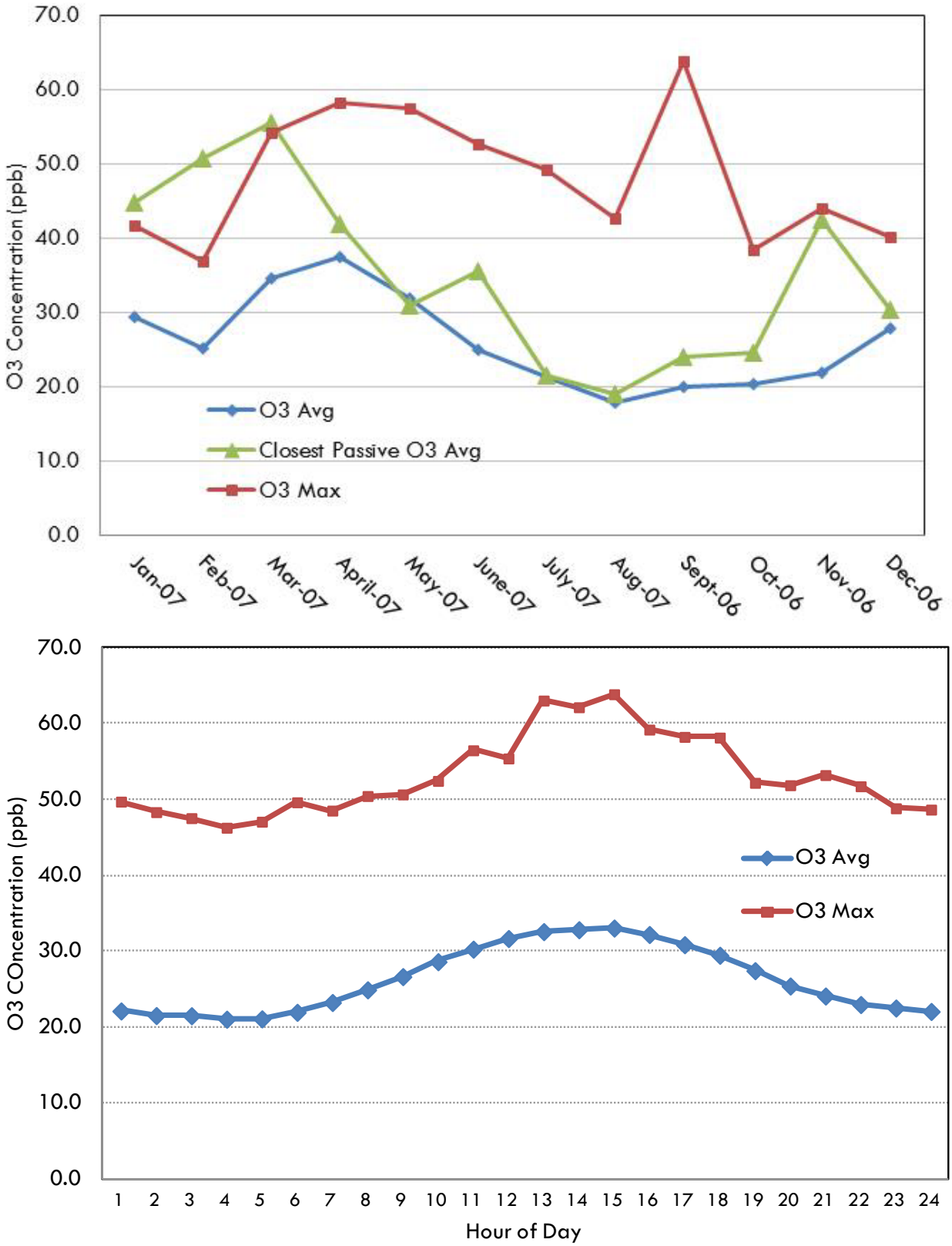

Figure 5.21 Maximum and Average O_3 Measurements by Month and Hour of Day

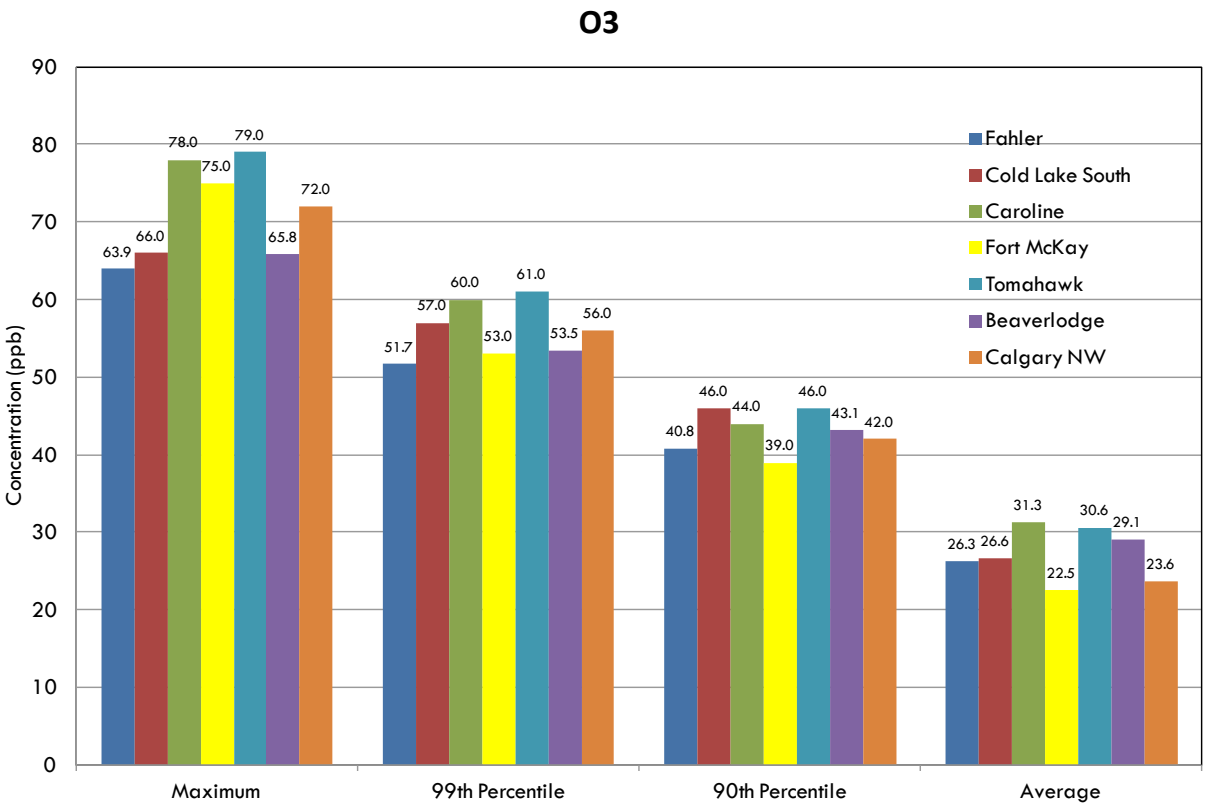

Figure 5.22 Comparison of O_3 Measurements from other Continuous Monitoring Stations

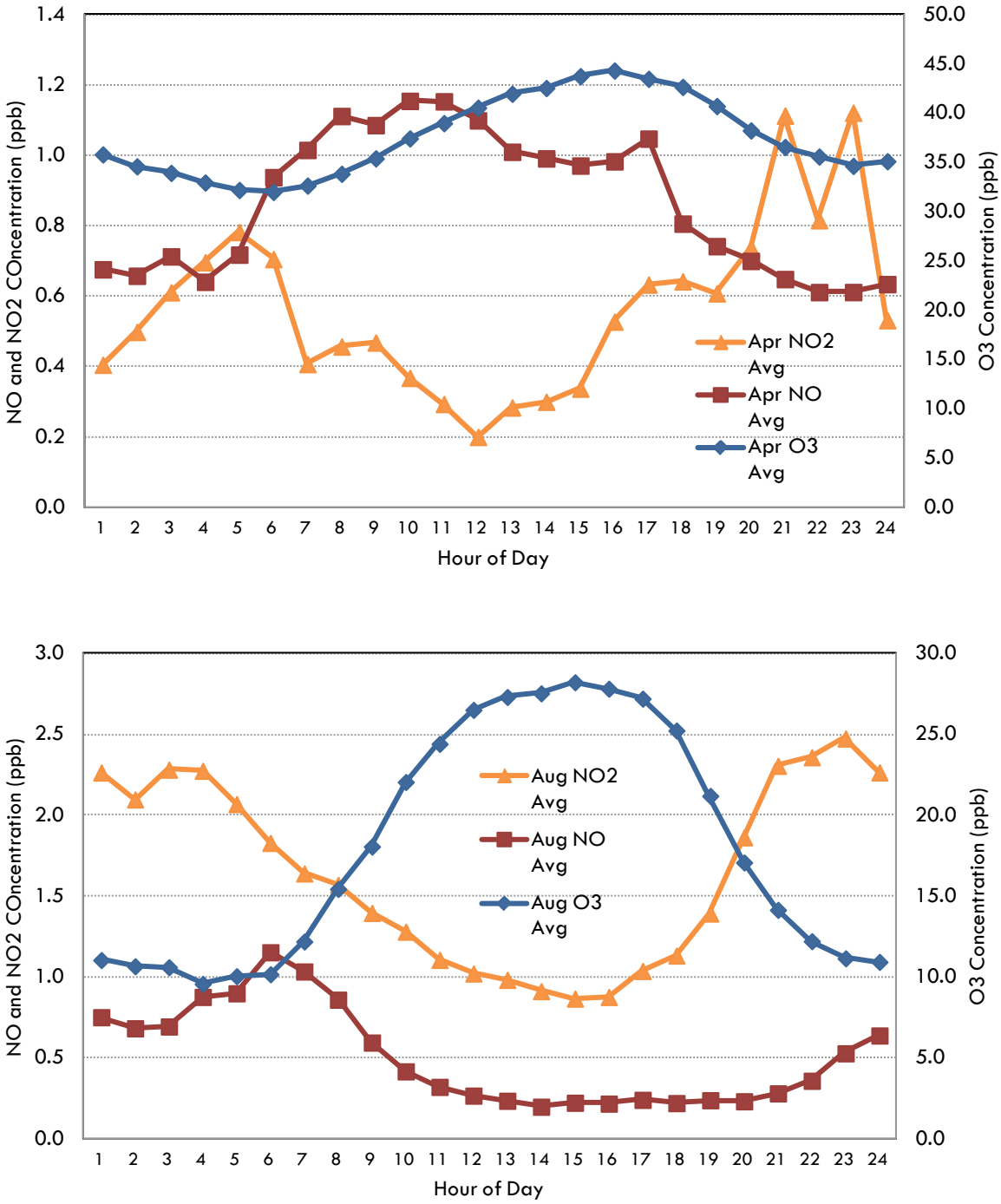

Figure 5.23 Diurnal Relationship between Measured O_3, NO, and NO_2 concentrations for selected months.

6. SUMMARY AND RECOMMENDATIONS

The monitoring data that PAZA collected through the Falher monitoring project suggests that overall, the air quality is relatively good. Measured concentrations of SO_2, NO_2, and O_3 were below the applicable AAAQOs and CWS Triggers. Diurnal profiles of O_3 and NO_2 measurements appear to show photo-chemical O_3 formation and decomposition.

However, TRS concentrations in excess of the representative AAAQO for two components of TRS (H_2S and CS_2) were measured infrequently. It is likely that the highest TRS measurements were influenced by municipal or agricultural sources near the town of Falher. Overall TRS averages were possibly influenced by agriculture but further detailed analysis of local area activities could provide more definitive conclusions on source contributions.

The summary of the air quality monitoring data is limited to the parameters measured in this study. Air quality surrounding the Town of Falher may be affected by other compounds some of which PAZA was not equipped to measure such as volatile organic compounds (VOCs), ammonia or fine particulate matter.

Infrequent elevated TRS concentrations measured during the monitoring survey do not necessarily indicate poor air quality in the area but do suggest that there are emissions sources in the area that can influence the quality of the local air from time to time. It is recommended that PAZA look into the possible contributors of elevated TRS measurements and identify the appropriate jurisdiction to assist with source mitigation. If PAZA chooses to conduct additional monitoring in the Falher area, it is recommended to consider collecting air samples for analysis of speciated TRS.

It is also noted that NO_2 measurements were only available for a 5 month period (April to August). Although the measured data did not indicate any air quality problems, a full year of measured data would be ideal for completeness.