Fort Air Partnership

2017

Ambient Air Quality Monitoring Annual Network Report And Data Summary

FORT AIR PARTNERSHIP

We Monitor the Air You Breathe

FAP Technical Working Group March 23, 2018

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Table of Contents

List of Tables

List of Figures

Abbreviations

24-hours	A calendar day, beginning at midnight
AAAQG	Alberta Ambient Air Quality Guideline
AAAQO	Alberta Ambient Air Quality Objective
AER	Alberta Energy Regulator
AMD	Air Monitoring Directive
AQM	Air Quality Monitoring
AQMS	Air Quality Management System
BTEX/S	Benzene, toluene, ethylbenzene, xylenes and styrene
CAAQS	Canadian Ambient Air Quality Standards
Calm	1-hour average wind speed is lower than 5 km/hour
CASA	Clean Air Strategic Alliance
CH_4	Methane
CWS	Canada-Wide Standard
EPEA	Alberta's Environmental Protection and Enhancement Act
FAP	Fort Air Partnership
H_2S	Hydrogen sulphide
MST	Mountain Standard Time
NAPS	National Air Pollution Surveillance
NMHC	Non-methane hydrocarbons
NH_3	Ammonia
NO_2	Nitrogen dioxide
NO	Nitric oxide
NO_X	Oxides of nitrogen
O_3	Ozone (present at ground level)
$PM_{2.5}$	Particulate matter with aerodynamic diameter less than 2.5 µm in diameter, referred to as respirable particles
QA/QC	Quality assurance / quality control
SO_2	Sulphur dioxide
THC	Total hydrocarbons
TWG	Technical Working Group
VOC	Volatile organic compound

WD or WDR	Wind direction
WS or WSP	Wind speed

Units of Measurement

µg/m^3	micrograms per cubic meter
km/hr	kilometers per hour
ppb	parts per billion by volume
ppm	parts per million by volume

Note: Where the Alberta Government is mentioned in this report, the reference is to the Department that has authority over and regulates the industrial approvals of air monitoring and reporting. As of December 31, 2017, this department was Alberta Environment and Parks.

2017 Network Summary

Network Overview

During 2017 Fort Air Partnership (FAP) operated nine continuous ambient air quality monitoring stations. Table 1 describes the parameters measured at continuous stations as of the end of 2017.

In addition to the continuous network, FAP operated a regional passive monitoring network in 2017, monitoring for sulphur dioxide (SO_2) and hydrogen sulphide (H_2S) at 57 sites throughout the network.

Table 1: FAP continuous monitoring stations and parameters 2017

	Bruder-heim 1	Elk Island Park	Fort Saskat-chewan	Gibbons	Lamont County	Range Road 220	Redwater *	Ross Creek	Scotford Temp-orary
Ammonia (NH_3)			✓			✓	✓	✓	
Carbon Monoxide (CO)			✓						
Ethylene (C_2H_4)						✓		✓	
Ozone (O_3)	✓	✓	✓	✓	✓		✓		
Total Hydrocarbons (THC)	✓		✓		✓	✓			
Non-methane Hydrocar-bons (NMHC)	✓		✓		✓	✓			
Methane (CH_4)	✓		✓		✓	✓			
Hydrogen Sulphide (H_2S)			✓	✓	✓				✓
Oxides of Nitrogen (NO_X)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nitric Oxide (NO)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nitrogen Dioxide (NO_2)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Respirable Particulate ($PM_{2.5}$)	✓	✓	✓	✓	✓		✓		

	Bruder-heim 1	Elk Island Park	Fort Saskat-chewan	Gibbons	Lamont County	Range Road 220	Redwater *	Ross Creek	Scotford Temp-orary
Sulphur Dioxide (SO_2)	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 1: FAP continuous monitoring stations and parameters 2017 (continued)

	Bruder-heim 1	Elk Island Park	Fort Saskat-chewan	Gibbons	Lamont County	Range Road 220	Redwater *	Ross Creek	Scotford Temp-orary
Benzene (C_6H_6)									✓
Ethylbenzene (C_8H_{10})									✓
Styrene (C_8H_8)									✓
Toluene (C_7H_8)									✓
Xylene ($C_{24}H_{30}$)									✓
Air Temperature @ 2 meters	✓	✓	✓	✓	✓	✓	✓	✓	✓
Air Temperature @ 10 meters								✓	
Delta Temperature								✓	
Barometric Pressure						✓		✓	
Relative Humidity	✓	✓	✓	✓	✓	✓		✓	✓
Solar Radiation								✓	
Vertical Wind Speed								✓	
Wind Speed and Wind Direction	✓	✓	✓		✓	✓	✓	✓	✓

*Note the Redwater station began operation in October 2017, replacing the Redwater Industrial Station. Previous to October 2017, the Redwater Industrial Station monitored for ammonia, fine particulate matter, nitrogen oxides, sulphur dioxide, air temperature at two heights, delta temperature, barometric pressure, relative humidity and wind speed and direction.

Continuous Monitoring Performance Measures

In 2017 the average monthly uptime of all continuous monitoring equipment in the network was **99.04%.** FAP's uptime target is 98.5% while the Alberta Government requires that monitoring equipment be fully operational a minimum of 90% of the time each month.

There were seven instances in 2017 where individual instrument operation uptimes fell below the minimum 90% monthly average required by the Alberta Government. These were reported to the Alberta Government and the operation problems promptly resolved.

Table 2: Data completeness 2017 (percent)

	Bruder-heim1	Elk Island	Fort Sask.	Gibbons	Lamont County	Range Road 220	Redwater	Ross Creek	Scotford Temp.
Wind Speed & Direction	99.6	99.5	99.7	99.5	99.1	99.1	100	99.0	99.6
Sulphur Dioxide SO_2	99.9	99.8	99.9	99.8	99.5		99.4	99.9	100
Nitric Oxide NO	99.0	99.2	99.4	99.8	99.3	99.2	98.8	99.8	99.9
Nitrogen Dioxide NO_2	99.0	99.2	99.4	99.8	99.3	99.2	98.8	99.8	99.9
Oxides of Nitrogen NOx	99.0	99.2	99.4	99.8	99.3	99.2	98.8	99.8	99.9
Ammonia NH_3			99.3				98.9	99.3	
Ozone O_3	99.9	99.7	100				99.8		
Hydrogen Sulphide H_2S			99.9	99.4	92.4				100
Ethylene C_2H_4						99.0		99.3	
Total Hydrocarbon THC	93.3		99.4		99.6	99.3			
Methane CH_4	93.3		99.4		99.6	99.3			
Non-Methane Hydrocarbon NMHC	93.3		99.4		99.6	99.3			
Particulate Matter $PM_{2.5}$	99.5	98.4	94.9	99.3	99.6		97.8		
Carbon Monoxide CO			99.6						
Benzene C_6H_6									98.2
Toluene C_7H_8									98.2
Ethylbenzene C_8H_{10}									98.2
Xylene $C_{24}H_{30}$									98.2
Styrene C_8H_8									98.2
Site Average	**97.58**	**99.29**	**99.20**	**99.61**	**98.73**	**99.21**	**99.1**	**99.55**	**99.13**

*The Redwater statistics combine both Redwater and Redwater Industrial stations

Monitoring Network Changes in 2017

FAP made the following changes to the continuous monitoring network in 2017, including improvements to the infrastructure and equipment.

- A new continuous monitoring station was installed in the Town of Redwater in October of 2017. This replaced the old Redwater Industrial station that had been located on the property of one of the industries south of Redwater. The Redwater Industrial station was originally sited as a fence-line station many years ago and did not meet two of FAP's current monitoring objectives: Understanding regional air quality, and monitoring air quality where people live. The new Redwater station allows data to be collected to better meet these two primary objectives.

- New non-methane hydrocarbon and oxides of nitrogen analyzers were purchased for deployment in the network as per the FAP Capital Equipment Replacement Plan. Also purchased was a replacement station computer and support equipment, a zero air source and power back-up supplies.

- Continuous measurement of two compounds, sulphur dioxide (SO_2) and ammonia (NH_3), were stopped at the Range Road 220 station in January 2017 after approval was received from Alberta Environment and Parks.

Air Quality Events and Exceedances Summary

Air quality measurements are compared hourly to Alberta Ambient Air Quality Objectives (AAAQO). Any exceedance of an AAAQO is reported to the Alberta Government and the cause of the exceedance investigated.

A complete listing of the AAAQO compounds and values can be found at:

http://aep.alberta.ca/air/legislation/ambient-air-quality-objectives/default.aspx.

Table 3: 2017 1-hour average exceedances of the AAAQO

One Hour Exceedances			
Parameter	**Exceedances**	**Dates**	**Attributed Cause**
Ammonia (NH_3)	1	July 9	Local Industry
Respirable Particulate ($PM_{2.5}$)	8	January 2, 25, March 29	Regional effects from winter inversion
	1	May 21	Campfire smoke
	1	June 3	Undetermined local source
	2	July 16	Forest Fires
	1	August 11	Undetermined local source
	52	August 13-14	Forest Fires
	2	August 31	Local Construction /Harvesting
	1	September 6	Harvesting
	1	December 22	Undetermined local source
Sulphur Dioxide (SO_2)	2	February 9, March 1	Local Industry
	26	April 5,9,17,18,23,24,26,27 May 5,10,11,29	Local Industry
	4	July 7,12,27,30	Local Industry
	6	August 7, 23, 25, 29, 30, 31	Local Industry
Total	**108**		

Table 4: 2017 24-hour average exceedances of the AAAQO

24 Hour Exceedances			
Parameter	**Exceedances**	**Dates**	**Attributed Cause**
Respirable Particulate ($PM_{2.5}$)	2	January 2, 25	Regional effects from winter inversion
	5	July 16	Forest Fires
	6	July 20	Forest Fires
	9	August 13-14	Forest Fires
	6	August 18	Forest Fires
	1	November 11	Regional effects
Sulphur Dioxide (SO_2)	9	April 5, 13, 17, 18, 22, 23, 24, 27 May 11	Local Industry
Total	**38**		

Air Quality Health Index Summary

The Air Quality Health Index (AQHI) was reported from six FAP stations in 2017. The AQHI is calculated by the Government of Alberta using FAP collected data. In Alberta the AQHI is calculated using fine particulate matter ($PM_{2.5}$), ozone (O_3), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and hydrogen sulphide (H_2S) data.

Table 5: Air Quality Health Index in FAP region by percent - 2017

		Risk Level (% of time)			
Station Name	Hours Monitored	Low Risk	Moderate Risk	High Risk	Very High Risk
Bruderheim	8,465	97.68%	2.16%	0.15%	0.00%
Elk Island	8,166	97.07%	2.78%	0.11%	0.04%
Fort Saskatchewan	8,056	93.05%	6.93%	0.02%	0.00%
Gibbons	8,493	94.97%	4.83%	0.15%	0.05%
Lamont County	8,431	98.11%	1.73%	0.15%	0.00%
Redwater *	1,403	97.36%	2.64%	0.00%	0.00%

Table 6: Air Quality Health Index in FAP region number of hours - 2017

		Risk Level (# of hours)			
Station Name	Hours Monitored	Low Risk	Moderate Risk	High Risk	Very High Risk
Bruderheim	8,465	8,269	183	13	0
Elk Island	8,166	7,927	227	9	3
Fort Saskatchewan	8,056	7,496	558	2	0
Gibbons	8,493	8,066	410	13	4
Lamont County	8,431	8,272	146	13	0
Redwater *	1,403	1,366	37	0	0

**The new Redwater station began operating in October 2017 and began reporting the AQHI, November 1.*

The higher the AQHI number, the greater the health risk. The index describes the level of health risk associated with the AQHI number as 'low', 'moderate', 'high' or 'very high', and suggests steps people can take to reduce exposure.

The following table details the occurrence of air quality events in 2017 and the number of hours with a high risk AQHI rating at each station during each event.

Table 7: Distribution of hours with an AQHI High or Very High Risk rating

	FAP Continuous Air Quality Monitoring Station													
	Bruder-heim 1		Elk Island		Fort Sask.		Lamont County		Gibbons		Red-water *			
Air Quality Event Dates	High Risk	High Risk	Very High Risk	High Risk	Very High Risk	High Risk	Very High Risk	High Risk	High Risk	Very High Risk	High Risk	Very High Risk	Total Hours	Attributed Cause
Jan. 2	2	-		-	-	-	2	-	-	-	-	-	4	Winter Inversion
Jan. 25	-	-	-	-	1	-	-	-	-	-	-	-	1	Winter Inversion
March 29	-	-	-	-	1	-	-	-	-	-	-	-	1	Winter Inversion
May 21	-	-	1	-	-	-	-	-	-	-	-	-	1	Campfire smoke
June 3	-	-	-	-	-	-	1	-	-	-	-	-	1	Undetermined
July 16	-	-	1	-	-	-	1	-	-	-	-	-	2	Forest Fires
Aug. 13, 14	11	-	7	3	-	-	6	4	11	-	-	-	42	Forest Fires
Aug. 31	-	-	-	-	-	-	2	-	-	-	-	-	2	Local Construction /Harvesting
Sept. 6	-	-	-	-	-	-	2	-	-	-	-	-	2	Harvesting
Dec. 22	-	-	-	-	-	-	1	-	-	-	-	-	1	Undetermined local source
Total Hours	13	-	9	3	2	-	15	4	11	-	-			

2017 Summary of Exceedances

The data Fort Air Partnership collects is compared to Alberta Ambient Air Quality Objectives (AAAQO) set by the Government of Alberta. Exceedances are reported to the Government of Alberta and follow up information provided within seven days. If the source is likely local, industry operators nearby are notified so they can take whatever corrective action may be necessary.

Table 8: Summary of 2017 Exceedances and 5 years previous

Parameter Measured		2017	2016	2015	2014	2013	2012
Ammonia (NH_3)	1-hr	1	0	4	0	0	0
Benzene (C_6H_6)	1-hr	0	0	2	5	0	1
Carbon Monoxide (CO)	1-hr	0	0	0	0	0	0
	8-hr	0	0	0	0	0	0
Ethyl Benzene ($C_6H_5CH_2CH_3$)	1-hr	0	0	0	0	0	0
Ethylene (C_2H_4)	1-hr	0	0	0	0	0	0
	3-day	0	0	0	0	0	0
	Annual	0	0	0	0	0	0
Hydrogen Sulphide (H_2S)	1-hr	0	0	3	0	147	163
	24-hr	0	0	1	0	29	28
Nitrogen Dioxide (NO_2)	1-hr	0	0	0	0	0	0
	24-hr	0	0	0	0	0	0
	Annual	0	0	0	0	0	0
Ozone (O_3)	1-hr	0	0	3	0	0	0
Styrene ($C_6H_5CH=CH_3$)	1-hr	0	0	0	0	0	0
Sulphur Dioxide (SO_2)	1-hr	38	51	34	26	6	7
	24-hr	9	9	6	3	2	0
	30-day	1	2	0	0	0	0
	Annual	0	0	0	0	0	0
Respirable Particulate Matter ($PM_{2.5}$)	1-hr	69	35	144	13	15	28
	24-hr	29	11	27	12	11	9
Toluene ($C_6H_5CH_3$)	1-hr	0	0	0	0	0	0
Xylenes (o-, m- and p- isomers)	1-hr	0	0	0	0	0	0
Total		**147**	**108**	**224**	**59**	**210**	**236**

Note: The Scotford 2 station was moved in April of 2014 because of pipeline construction beginning in May. The new location for the station, named Scotford Temporary had no nearby wetlands, hence the decrease in H_2S exceedances from 2014 to 2015.

Introduction

The FAP Organization (2017)

The Fort Air Partnership (FAP) is a registered not-for-profit society established in 1997 to operate an air quality monitoring network in a 4,500-square kilometer area northeast of Edmonton that includes Fort Saskatchewan, Gibbons, Bon Accord, Bruderheim, Lamont, Redwater, Waskatenau, Thorhild, and Elk National Island Park. In November 2000, FAP became the fourth Airshed in Alberta recognized by the Clean Air Strategic Alliance (CASA).

FAP is a multi-stakeholder group with members from industry, government, and the public. FAP members see the benefit of working collaboratively to meet its vision and mission.

The FAP Board holds regular meetings that are open to the public. Decisions of the Board and its committees are made by consensus.

FAP vision is:

"*Public, industry and government have a clear shared understanding of ambient air quality in the region".*

FAP mission is:

"To operate a regional network to monitor and report credible and comprehensive ambient air quality information".

FAP uses a governance organizational structure, such that the Board of Directors establishes policy and strategic direction for the organization, and contracted staff and committees manage the operational details in accordance with the set direction. In 2017 FAP continued to operate with several committees: An Executive Committee, a Technical Working Group (TWG) and related subcommittees, an External Relations Committee, a Finance Committee and a Governance Committee, which all make recommendations to the FAP Board of Directors. FAP operations were managed by an Executive Director, with contracted staff consisting of a Network Manager, a Communications Director, and an Administrative Assistant. FAP contracts air monitoring service providers who perform monitoring equipment operation, maintenance, calibration, and data validation and reporting.

Fort Air Partnership's monitoring and communications programs are funded by:

Northeast Capital Industrial Association,

- Alberta Government
- Alberta's Industrial Heartland Association
- Environment and Climate Change Canada provides monitoring equipment for two continuous monitoring stations.

FAP works with other Airsheds provincially as part of the Alberta Airsheds Council. Airsheds in Alberta collaborate with both the provincial and federal government to implement successful air monitoring, reporting, and education within Alberta. Timely execution of environmental monitoring, and the provision of scientifically credible monitoring data to the public and policy makers for informed decision making are critical functions provided by Airsheds. An important aspect to this collaborative work is sharing of technical expertise and information through the Airsheds Council Technical Committee.

Fort Air Partnership Technical Working Group

FAP's TWG is primarily responsible for oversight of the implementation and operation of the monitoring network and provides technical guidance to FAP. The TWG meets once each month to review the data and network operations. The TWG also works under the leadership of the Network Manager to ensure that appropriate protocols are in place to assure data quality and guide air monitoring projects.

TWG members represent a wide range of technical air quality roles from industry, the Alberta Government (health and environment), the Government of Canada (environment), FAP's primary monitoring and data validation contractors, and members of the public. Committee members have substantial combined experience including monitoring technology, data analysis, laboratory analysis, quality systems, engineering, air quality modeling and regulatory reporting. Additionally, the TWG membership draws upon outside expertise from industry, air quality consultants, academia and government. Members of the TWG collaborate with other air monitoring agencies in Alberta and Canada. The FAP TWG chair also plays a leading role in a member committee of technical leads from all Airsheds in Alberta, which reports to the Alberta Airsheds Council. A list of TWG committee members on December 31, 2017 can be found in Appendix A. Lists of industry approval holders participating in FAP, as required in many cases by Environmental and Protection Enhancement Act (EPEA) operating approval clauses can be found in Appendix C.

2017 Ambient Air Quality Monitoring Program

2017 Continuous Monitoring Network

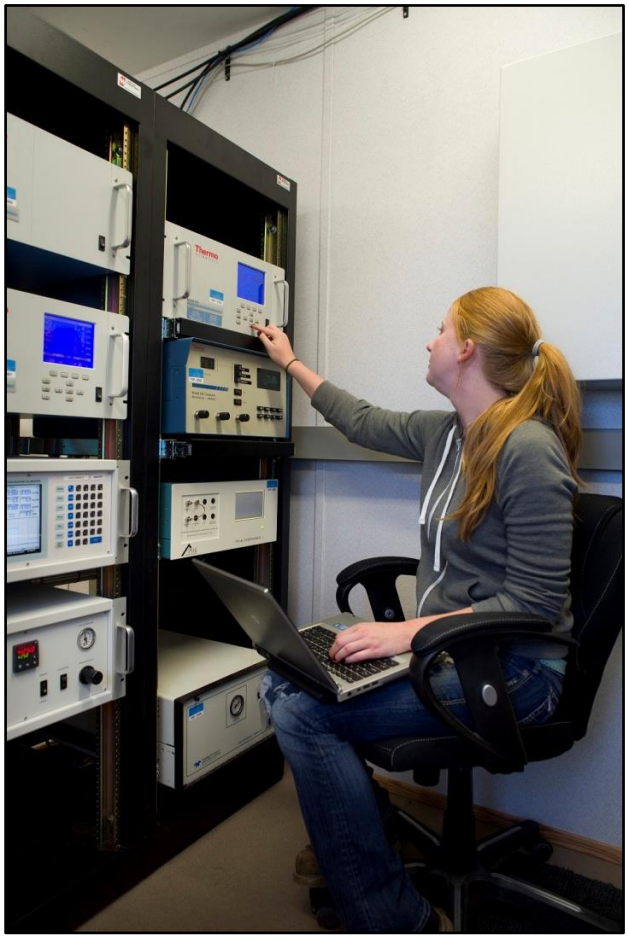
Continuous Monitoring Description

A continuous air monitoring station is a temperature-controlled shelter typically housing several different continuous ambient air analyzers. Continuous analyzers, as the name implies, run continuously, and store data in one-minute averages. Continuous analyzers are designed to measure ambient air for specific compounds. FAP uses different combinations of these analyzers at the various stations depending on the monitoring objectives of each station.

Every FAP station has a wind sensor atop a tower that is at least 10 meters tall. Stations also measure several meteorological conditions including wind speed and direction and ambient temperature.

Data acquisition and data quality control at these stations is discussed elsewhere in this report.

Figure 1: Continuous air monitoring station



Network Overview

Continuous Monitoring and Reporting Requirements

FAP's monitoring and reporting program was originally designed to meet licensing requirements of industrial facilities in the region. Five stations, including Fort Saskatchewan Station, Elk Island Station, Bruderheim Station and Gibbons Station and now Redwater have been added to the monitoring network since FAP's formation. Monitoring and reporting protocols are structured to meet the requirements of the Alberta Government Air Monitoring Directive.

Several industrial facilities hold Environmental Protection and Enhancement Act (EPEA) operating approvals, or authorizations, and are required to either conduct, or fund through an Airshed such as FAP, ambient air quality monitoring as part of their conditions to operate. The FAP continuous monitoring stations, with the corresponding Approval holders as of December 31, 2017, are listed in Appendix C.

The FAP Network Monitoring Objectives

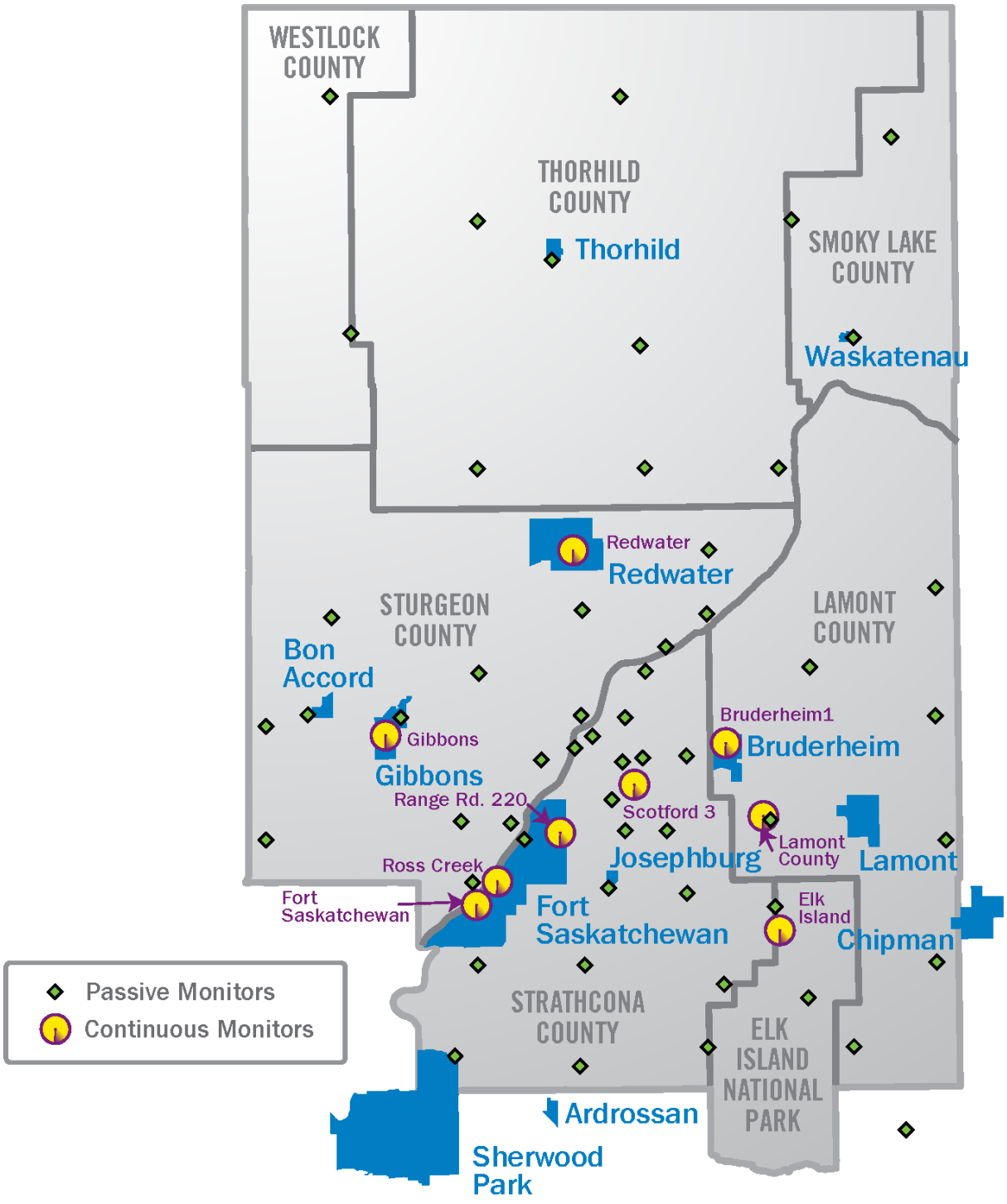
FAP has established several monitoring objectives to ensure that it meets the needs of all of its stakeholders. These objectives guided a Network Assessment completed by an independent third party in 2012. A five-year monitoring plan was developed using the findings of that network assessment. This monitoring plan was submitted to and approved by Alberta Environment and Parks in 2015. While the design and operation of the monitoring network strives to meet these objectives, the overarching objective is that the monitoring must, at a minimum, meet regulatory requirements as set out by the Alberta Government including both Alberta Environment and Parks and the Alberta Energy Regulator.

The monitoring objectives for the FAP network are as follows:

- Understand spatial distribution of pollutants in the region
- Identify regional air quality trends
- Provide flexibility to characterize emerging issues, sources, and locations
- Provide appropriate information for evaluating population exposure to ambient air quality
- Provide information required to understand air quality impacts on the health of the environment
- Improve the ability to identify and apportion pollutant sources for purposes of air quality management
- Provide suitable input and validation information for air quality models

A clear, multi-layer, fine resolution map of the FAP Airshed with selectable layers can be downloaded at www.fortair.org or requested at info@fortairmail.org.

Figure 2: FAP Monitoring sites at December 31, 2017



FAP Continuous Monitoring Site Descriptions

Bruderheim 1 Station

Primary Monitoring Objective: To monitor ambient air quality where people live. For a complete list of monitoring objectives, see table in Appendix B.

Continuous Parameters Monitored: Methane and non-methane hydrocarbons, $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, ambient temperature, wind speed and direction. This station collects the data required to calculate the Air Quality Health Index.

Figure 3: Bruderheim 1 Station

Site Description: FAP has been operating a station in Bruderheim and reporting data to the Provincial Air Monitoring data warehouse since 2010. This station, formerly named Bruderheim was moved to the northwest corner of the Bruderheim school sports fields in 2016 and renamed Bruderheim 1. Bruderheim population is listed as 1,348 in the most recent census (2014).

Elk Island Station

Primary monitoring objective: Understand the air quality impacts of a large Canadian city and concentrated heavy industry on a protected area. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and wind direction. A wet deposition sampler is also at the site. This station collects the data required to calculate the Air Quality Health Index.

Figure 4: Elk Island Station

Site Description: This station is located within the boundaries of Elk Island National Park, between the administration building and Astotin Lake, near the west entrance to the park at Township Road 544 near Range Road 203. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003. This station was designated a National Air Pollution Surveillance (NAPS) station in 2008.

Fort Saskatchewan Station

Primary monitoring objective: Monitor air quality where people live and to establish air quality compliance to the AAAQOs. With the longest operational history and data record in the FAP network, it is an important station for understanding historical trends. It is a designated NAPS station. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: Ammonia, carbon monoxide, H_2S, methane and non-methane hydrocarbons, $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and direction. This station collects the data required to calculate the Air Quality Health Index.

Site description: This station is in the Airshed's largest population center (24,569 in 2016 census). It is located adjacent to a residential area of the City of Fort Saskatchewan near 92nd Street and 96th Avenue, 80 meters west of Highway 15, a major traffic artery, with an annual average daily traffic count of 20,770 vehicles per day in 2013. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003. Data from this site goes back to 1993 in the Provincial Air Monitoring data warehouse.

Figure 5: Fort Saskatchewan Station

Gibbons Station

Primary Monitoring Objective: To monitor ambient air quality where people live. For a complete list of monitoring objectives, see table in Appendix B.

Continuous Parameters Monitored:
H_2S, $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and direction. This station collects the data required to calculate the Air Quality Health Index.

Figure 6: Gibbons Station

Site Description: This station began operating and reporting data to the Provincial Air Monitoring data warehouse in February 2016. Alberta Environment and Parks has loaned FAP a $PM_{2.5}$ analyzer to enable the collection of data required to calculate the AQHI for this station. This station is at the rear of the Gibbons Town office located on 50th Avenue at 48th Street. Gibbons population is listed as 3,030 in the most recent census (2011).

Lamont County Station

Primary monitoring objective: Understand impacts of multiple pollutant sources in the region, which may include sources from Alberta's Industrial Heartland and from Strathcona industrial area, as well as from other sources in the City of Edmonton. This site was selected because modeling indicated that this elevated area of the region may experience higher concentrations of SO_2. The Lamont County Station is an EPEA compliance station. For a complete list of monitoring objectives, see table in Appendix B.

Figure 7: Lamont County Station

Continuous parameters monitored: H_2S, methane and non-methane hydrocarbons, $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and direction. This station collects the data required to calculate the Air Quality Health Index. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003.

Site description: This station is in a rural area located in a hay field, several kilometers away from industrial facilities and other large pollutant sources, approximately 6 km west of the town of Lamont. The station is on a hill, 1.5 kilometers south of Highway 15, about 250 meters west of Range Road 202.

Range Road 220 Station

Primary monitoring objective: Monitor the impacts of local industrial emissions on air quality. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: Ethylene, methane and non-methane hydrocarbons, $NO/NO_X/NO_2$, barometric pressure, outdoor temperature and relative humidity, wind speed and direction.

Site description: The station is located off Range Road 220 in an open area along the facility fence line east of the Dow Chemical ethylene production facilities. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003.

Figure 8: Range Road 220 Station

Station changes (2017): After prior approval by the Alberta Government, ammonia and SO_2, monitoring ceased at this station in mid-January 2017.

Redwater Industrial Station

Primary monitoring objective: Monitor the impacts of local industrial emissions on air quality. The Redwater Industrial Station was an EPEA compliance station. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: ammonia, $NO/NO_X/NO_2$, $PM_{2.5}$, SO_2, ambient temperature at 2m and 10m, outdoor temperature and relative humidity, wind speed and direction.

Figure 9: Redwater Industrial Station

Site description: The station was located adjacent to the truck loading area along the western fence line of the Agrium Redwater Fertilizer Plant, adjacent to Highway 643. It was approximately twelve kilometers south of the community of Redwater, Alberta. FAP had been operating this station and reporting data to the Provincial Air Monitoring data warehouse since 2004.

Station changes (2017): This station was removed from the FAP network in October 2017.

Redwater Station

Primary monitoring objective: To monitor ambient air quality where people live. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: **A**mmonia, $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and direction.

Figure 10: Redwater Station

Site description: The Redwater air quality monitoring station was established in October 2017, replacing the Redwater Industrial station. A suitability assessment that was commissioned by FAP in 2017 identified this location as appropriate for enabling FAP to meet the set monitoring objectives. It is located near the center of the town of Redwater at 47th street and 49th avenue, just south of the town administration offices.

Station changes (2017): This station began operations in the FAP network in October 2017.

Ross Creek Station

Primary monitoring objective: To monitor the impacts of local industrial emissions on air quality. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: Ammonia, ethylene, $NO/NO_X/NO_2$, SO_2, barometric pressure, solar radiation, relative humidity, temperature at 2 meters and 10 meters, vertical wind speed, wind speed and direction.

Figure 11: Ross Creek Station

Site description: The station is located west of the Sherritt Fort Saskatchewan site, between the industrial facility and the City of Fort Saskatchewan. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003.

Scotford Temporary Station

The Scotford Temporary Station began operation at the current location in 2014. It is a relocation of the former Scotford 2 station.

Primary objective: The station is intended to monitor the impacts of local industrial emissions on air quality. The Scotford Temporary station is intended to meet EPEA operating approval conditions of two Approval holders. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: H_2S, $NO/NO_X/NO_2$, SO_2, benzene, toluene, ethylbenzene, xylenes (o-, m- and p- isomers), styrene, outdoor temperature and relative humidity, wind speed and direction.

Figure 12: Scotford Temporary Station

Site description: The monitoring site is located to the south east of industrial facilities on Range Road 212, approximately 2 kilometers south of Highway 15. The station is in an open area located within a farmyard. The monitoring station was moved from the Scotford 2 location and began operation at this site in April 2014.

This location is regarded as suitable for meeting the requirements of the Air Monitoring Directive and FAPs Monitoring Objectives for this station. A permanent location that will better meet the objectives of this station is being secured and developed during 2018.

Monitoring Station Coordinates

Longitude and latitude coordinates for the FAP monitoring stations in 2017 are found in the following table.

Table 9: Continuous monitoring station locations

Station	Latitude	Longitude	Elevation	Year Established	Land Use
Bruderheim 1	53.805629 N	-112.925851 W	630 m	Mar 2016	Residential
Elk Island	53.68236 N	-112.86806 W	711 m	2003	Parkland
Fort Saskatchewan	53.69883 N	-113.22319 W	629 m	Jan 2003	Residential
Gibbons	53.827241 N	-113.327174W	673 m	Feb 2016	Residential
Lamont County	53.76036 N	-112.88017 W	727 m	Jan 2003	Agricultural
Range Road 220	53.75245 N	-113.12582 W	625 m	Jan 2003	Industrial
Redwater	53.951834 N	-113.105857 W	627 m	Oct 2017	Residential
Redwater Industrial	53.84369 N	-113.09922 W	629 m	Jan 2003	Industrial
Ross Creek	53.71622 N	-113.19994 W	624 m	Jan 2003	Industrial
Scotford Temporary	53.756786 N	-113.028947 W	626 m	May 2014	Agricultural

Note: the year established reflects the date when data from that station was first reported to the Alberta Government Air Monitoring data warehouse

Continuous Monitoring Methods

Continuous monitoring methods are generally prescribed by the Alberta Government's Air Monitoring Directive. Details of the monitoring methods used by FAP are summarized in Appendix F.

Data Reporting

FAPs air monitoring data is reported in several ways:

- FAP maintains a near-real-time data portal for raw un-validated data for use by its members and the public at http://data.fortair.org/fortair.php
- Live, un-validated data is also reported hourly to the Alberta Government and retained for 225 days on the real-time website at: http://maps.srd.alberta.ca/AQHI/
- If the Air Quality Health Index approaches the *High Risk* to health category, medical officers from the local health authority are notified by Alberta Environment and Parks. Medical officers then decide whether to issue a public health or air quality advisory.
- Validated historical data, suitable for use in analysis and reports, is available from the Alberta Government air data warehouse website at: http://airdata.alberta.ca/
- Passive monitoring data tables are available upon request at info@fortairmail.org and at http://airdata.alberta.ca/

2017 Passive Monitoring Network

Passive Monitoring Description

Passive monitoring is a cost-effective solution for monitoring air quality at locations where continuous monitoring is not practical. Passive sampling devices can monitor air pollutants without the need for electricity, data loggers or pumps. Passive sampling devices are lightweight, portable and relatively simple to operate. No active movement of air through the sampler is necessary.

Passive sampling involves the exposure of a reactive surface to the air. Transfer of the pollutant occurs by diffusion from the air to the surface via naturally occurring air movement. The surface consists of a membrane that is impregnated with a reactive solution. The sampling devices are mounted under a hood to protect it from rain or snow. Samplers are exposed for one month and analysis is completed in a laboratory.

A major advantage of using a passive sampling system is that a network of multiple samplers can be used over a large area to determine the spatial variation of pollutant levels. Passive samplers are also useful for looking at long-term trends of air pollutants at specific locations. However, since a sample is exposed for a month, events that last for a short time may be "averaged out".

Figure 13: Passive monitoring site

Figure 14: Changing passive monitoring devices

FAP Passive Monitoring Network

The passive samplers used by FAP monitor for monthly average concentrations of pollutants. In 2017 FAP operated a network of passive monitors at 57 different locations. Thirty-seven (37) of these sites measure both sulphur dioxide (SO_2) and hydrogen sulphide (H_2S). Fourteen sites measure just SO_2 while 6 measure only H_2S. Samples are exchanged within three days of the end of each month and sent to a laboratory for analysis. Results from the passive monitors are submitted each month to the Alberta Government.

Passive Monitoring Network Site Descriptions

Passive samplers are intended to gather information over a broad spatial area and to measure trends over time. The majority of FAP passive monitoring sites are not selected based on a high likelihood of impingement, but rather on a spatial grid to establish a picture of comparative air quality throughout the Airshed. A few passive monitoring sites are located near local emission sources instead of on the spatial grid, which should be considered when interpreting the data.

The site coordinates and parameters measured at each passive monitoring site are listed in Table 10. Some sites are named if there is a recognizable nearby landmark or reference. To locate the sites, see the map in Figure 2.

Table 10: FAP passive monitoring sites in 2017

Site	Location	Longitude	Latitude	SO_2	H_2S	Date Started
1	Stocks Greenhouses	-113.246659	53.59633	1		July 1, 2005
2	Ardrossan northeast	-113.098671	53.58718	1		July 1, 2005
3	NE of Bruderheim	-112.82701	53.86667	1		July 1, 2005
4	Waskatenau	-112.77622	54.09875	1	1	July 1, 2005
5	Thorhild	-113.1331	54.15233	1		July 1, 2005
7	Bon Accord	-113.42423	53.83382	1		July 1, 2005
8	Gibbons	-113.31595	53.83163	1		July 1, 2005
10	Fort Augustus	-113.188293	53.75116	1		July 1, 2005
11	North of BA	-113.04892	53.83195	1		Jan 1,2006
12	TwpRd 564A RgeRd 212	-113.02542	53.86578	1	1	Jan 1,2006
14	Astotin Creek	-113.02553	53.80367		1	Jan 1,2006
15	Hwy 830 Twp Rd 560	-112.9765	53.80435	1		Jan 1,2006
17	Rge Rd 213 TwpRd 552	-113.04988	53.75373		1	Jan 1,2006
18	Rge Rd 211 TwpRd 552	-113.00044	53.74747	1	1	Jan 1,2006
20	Rge Rd 202	-112.87668	53.75937	1	1	Jan 1,2006
21	Josephburg east	-112.97535	53.70952	1	1	Jan 1,2006
22	Elk Island Park west gate	-112.87693	53.6876	1	1	Jan 1,2006

Table 10: FAP passive monitoring sites in 2017 - continued

Site	Location	Longitude	Latitude	SO_2	H_2S	Date Started
23	Goodhope	-112.95082	53.65668	1	1	Jan 1,2006
24	North of Scotford	-113.08703	53.82035	1	1	Jan 1,2006
26	Twp Rd 560 Rge Rd 221	-113.15109	53.8034	1	1	Jan 1,2006
27	N Sask. boat launch	-113.00035	53.88125	1	1	Jan 1,2006
28	Redwater Natural Area S	-112.95077	53.90445	1		Jan 1,2006
29	Redwater Natural Area N	-112.95213	53.94892	1	1	Jan 1,2006
30	Redwater south	-113.10012	53.9343	1	1	Jan 1,2006
31	Northwest of Scotford	-113.10838	53.81068	1	1	Aug 1,2006
32	Degussa	-113.1322	53.83328	1	1	Aug 1,2006
33	Twp Rd 552 Rge Rd 225	-113.24816	53.74508	1	1	Aug 1,2006
34	C&C Tree Farm	-113.48362	53.74538	1		Aug 1,2006
35	Bon Accord southwest	-113.47148	53.82524	1	1	Aug 1,2006
36	Galloway Seed	-113.22421	53.6576		1	Aug 1,2006
37	Twp Rd 564 Rge Rd 224	-113.22356	53.86307	1	1	Aug 1,2006
38	Peno	-112.67866	53.92182	1	1	Aug 1,2006
39	Saint Michael	-112.67831	53.83245	1	1	Aug 1,2006
40	Lamont east	-112.70287	53.74522	1	1	Aug 1,2006
41	Lily Lake	-113.39769	53.91981		1	Nov 1,2007
42	Radway - Val Soucy	-113.02451	54.00701	1	1	Nov 1,2007
43	Keyera Site	-113.16707	53.74515	1	1	Nov 1,2007
45	Scotford east	-113.06388	53.77449	1		Nov 1,2007
46	Josephburg	-113.0693	53.71279	1	1	Nov 1,2007
47	Southeast of FAP	-112.71777	53.54142	1		Nov 1,2007
48	Highway 63	-113.03010	54.09331	1	1	Aug 1,2008
49	Namepi Creek	-112.86401	54.00712	1	1	Aug 1,2008
50	Sprucefield	-112.84794	54.18045	1	1	Aug 1,2008
51	Hollow Lake	-112.72578	54.23882	1	1	Aug 1,2008
52	Abee	-113.05062	54.26821	1	1	Aug 1,2008
53	Tawatinaw - Clearbrook	-113.40057	54.26815	1	1	Aug 1,2008
54	Elbridge	-113.22504	54.18131	1	1	Aug 1,2008
55	Taylor Lake	-113.37483	54.10185	1	1	Aug 1,2008
56	Opal	-113.22475	54.00706	1	1	Aug 1,2008
57	Scotford 2	-113.05088	53.80118	1	1	Aug 1,2008
58	Ft Saskatchewan	-113.22319	53.69883	1	1	July 1,2015
59	Partridge Hill	-113.09843	53.65791	1	1	June 1, 2010
60	Oxbow Lake	-112.95166	53.59954	1	1	June 1, 2010
61	Drygrass Lake	-112.77896	53.59954		1	June 1, 2010
62	FAP East boundary	-112.68102	53.65779	1	1	June 1, 2010
63	Elk Island Park	-112.85717	53.63338		1	June 1, 2010
64	Agrium Redwater	-113.09922	53.84369	1		July 1, 2015

Passive Monitoring for Compliance to EPEA Approvals

FAP performs passive monitoring on behalf of approval holders, per Table 11. Air quality monitoring reports are submitted monthly to the Alberta Government. Data is archived in the Government data warehouse.

Table 11: Passive monitoring requirements (December 31, 2017)

Passive Monitoring Network	Facility	EPEA Approval Number
FAP operates a total of **51 SO_2 locations** **43 H_2S locations**	Shell Canada Ltd. Scotford Upgrader (25 sites H_2S, 25 sites SO_2)	49587-01-05
	Pembina Pipelines (2 sites H_2S, 2 sites SO_2)	9995-02-05
	Keyera Energy (4 sites H_2S, 4 sites SO_2)	10235-02-03

2017 Monitoring Results

2017 Ambient Air Monitoring Data and Discussion

Continuous Monitoring Results by Compound

Ammonia

Ammonia (NH_3) is a colourless gas with the well-known pungent odour found in household cleaners. NH_3 can be produced by both natural and anthropogenic sources. Some natural sources of NH_3 include the decay of plant material and animal waste. A small portion is also released during respiration. In Alberta, the fertilizer industry is the main industrial source of NH_3. This industry produces synthetic NH_3 for either direct application to soil as a fertilizer, or as a raw material for use in the production of other high nitrogen fertilizer products. The other significant source of NH_3 in Alberta is commercial livestock feedlots, specifically from their large amounts of animal waste.

Sources of ammonia in the Airshed are primarily from industrial sources in the production of fertilizer but can also be formed from natural sources such as the decay of plant material and animal waste.

The AAAQO for ammonia is:

- 1-hour average concentration 2 ppm (2000 ppb)

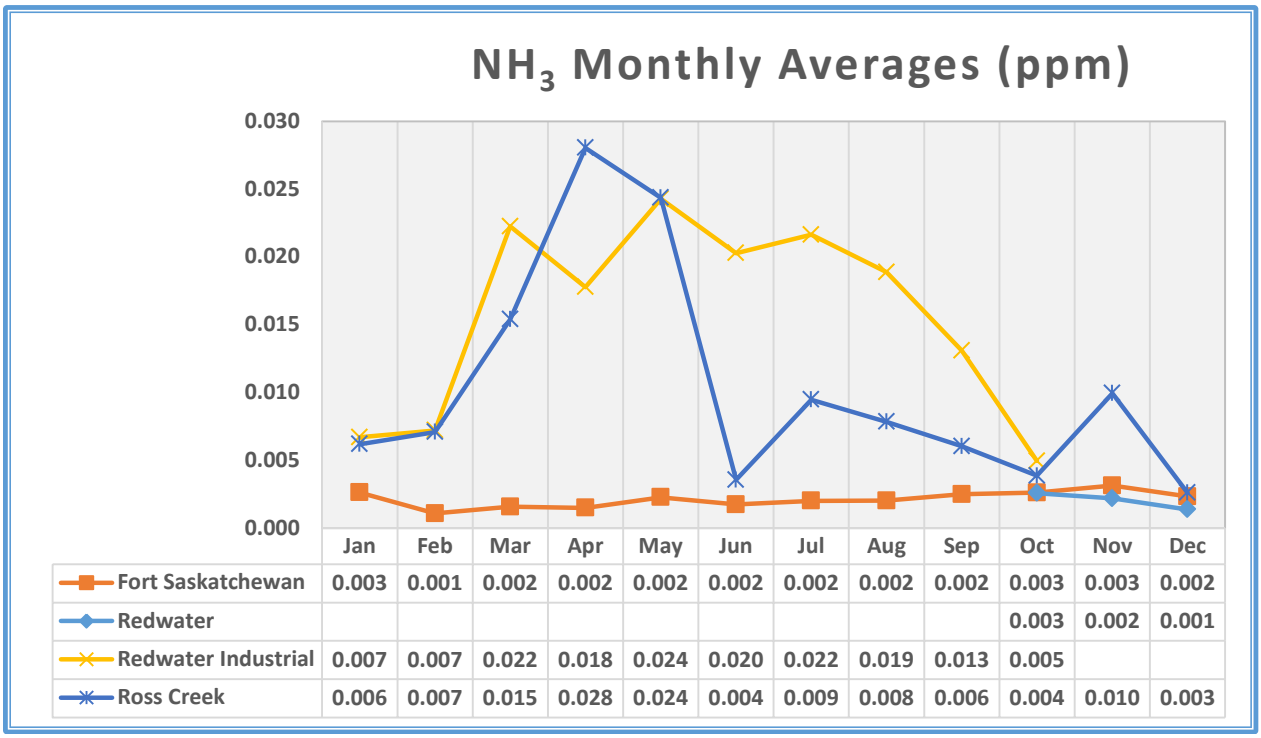
There was one exceedance of the AAAQO recorded for NH_3 at a FAP station in 2017. A 1-hour average of 2.798 PPM was recorded July 9 at the Redwater Industrial Station

Comparing air quality monitoring data at the other stations that measure NH_3 in the FAP region for 2017 against the ammonia AAAQO, it was observed that the maximum 1-hour average concentration of NH_3 was 0.0182 ppm, less than 1% of the 1-hr AAAQO.

A summary of NH_3 concentrations recorded in 2017 at individual stations and a comparison with the previous 4 years is presented in the figures and tables below. For additional information see also the station by station summaries in the appendices of this report.

Ammonia (continued)

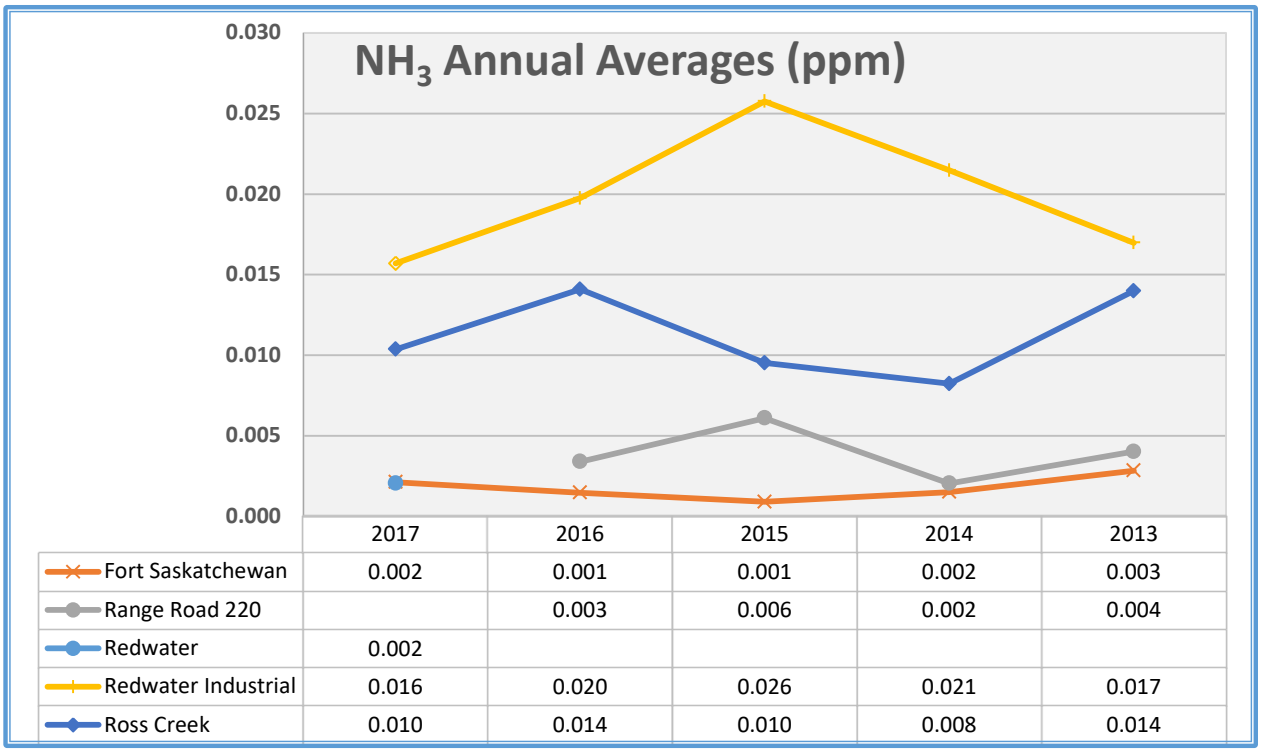
Figure 15: Monthly average NH_3 concentrations (ppm) in 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	0.003	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.002
Redwater										0.003	0.002	0.001
Redwater Industrial	0.007	0.007	0.022	0.018	0.024	0.020	0.022	0.019	0.013	0.005		
Ross Creek	0.006	0.007	0.015	0.028	0.024	0.004	0.009	0.008	0.006	0.004	0.010	0.003

Note: NH_3 monitoring was stopped at Range Road 220 in January 2017
The Redwater Industrial station ceased operations in October 2017
The Redwater station began operation October 2017

Figure 16: Annual average NH_3 concentrations (ppm) - historical



	2017	2016	2015	2014	2013
Fort Saskatchewan	0.002	0.001	0.001	0.002	0.003
Range Road 220		0.003	0.006	0.002	0.004
Redwater	0.002				
Redwater Industrial	0.016	0.020	0.026	0.021	0.017
Ross Creek	0.010	0.014	0.010	0.008	0.014

Note: NH_3 monitoring was stopped at Range Road 220 in January 2017
The Redwater Industrial station ceased operations in October 2017
The Redwater station began operation October 2017

Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless gas present in small amounts in the atmosphere primarily from incomplete combustion of carbon-based fuels such as gasoline, oil and wood. The major source of CO in urban locations is motor vehicle exhaust emissions. Minor sources include fireplaces, industry, aircraft and natural gas combustion. Forest fires are also a significant natural source of CO.

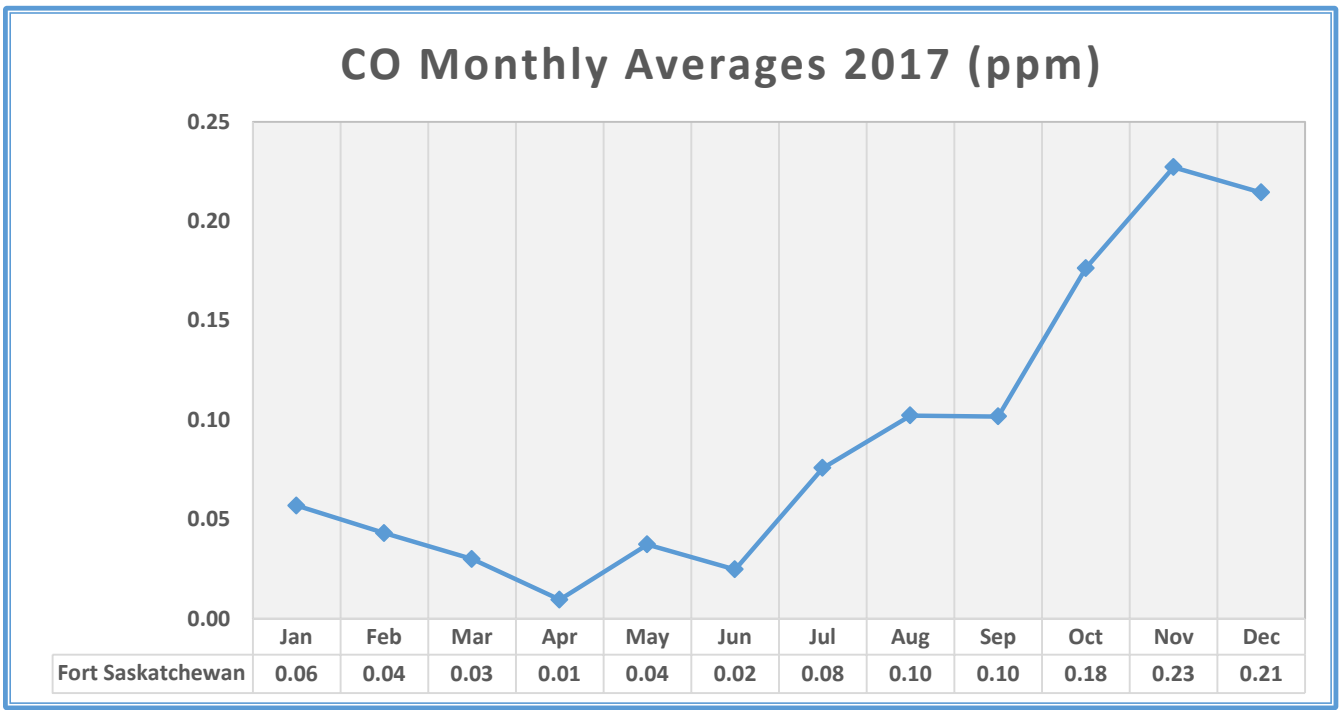
The AAAQOs for carbon monoxide are:

- 1-hour average concentration 13 ppm
- 8-hour average concentration 5 ppm

Comparing air quality monitoring data for 2017 at Fort Saskatchewan station against the AAAQOs for carbon monoxide, it was observed that the maximum 1-hour average concentration of CO was 1.18 ppm in November, about 9% of the 1-hr AAAQO.

Graphs of CO concentrations recorded at the only FAP station that monitors CO and a comparison with the previous 4 years is presented in the figures below. For additional information refer to the station by station summaries in the appendices of this report.

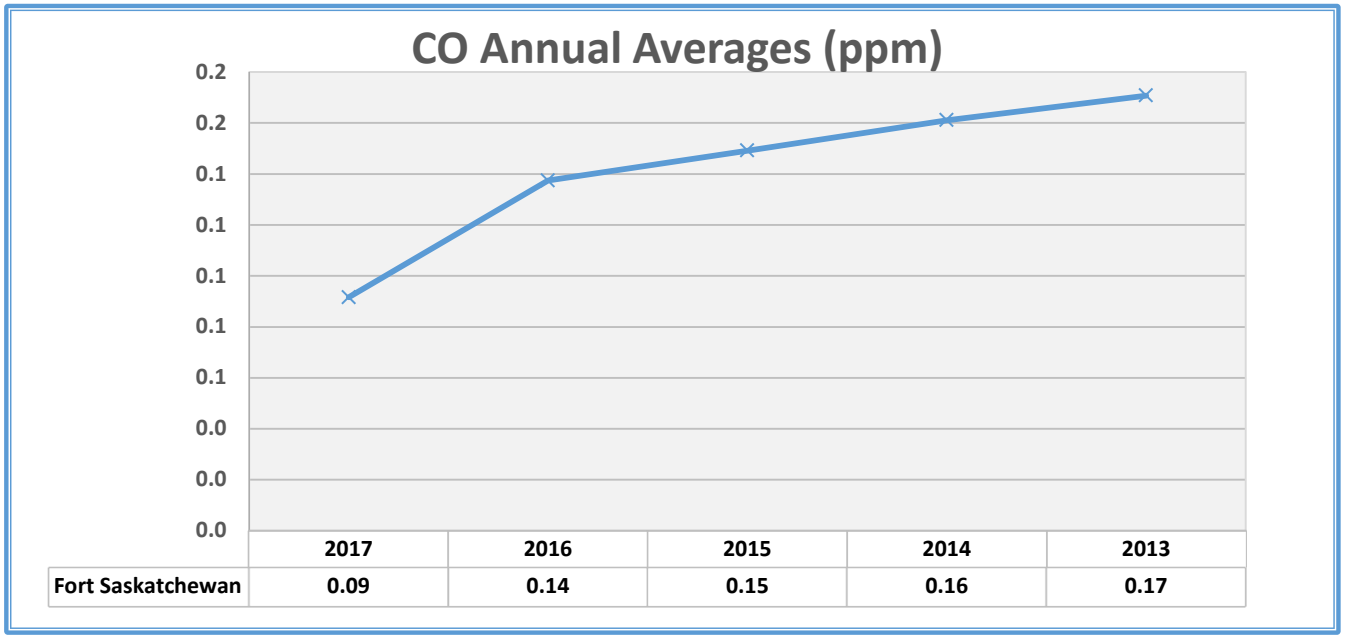
Figure 17: Monthly average CO concentrations Fort Saskatchewan – 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	0.06	0.04	0.03	0.01	0.04	0.02	0.08	0.10	0.10	0.18	0.23	0.21

Carbon Monoxide (continued)

Figure 18: Annual average CO concentrations Fort Saskatchewan (ppm) – historical



	2017	2016	2015	2014	2013
Fort Saskatchewan	0.09	0.14	0.15	0.16	0.17

Ethylene

Ethylene is a naturally occurring compound in ambient air. It is produced at low levels by soil microorganisms, algae, lichens and plants. Other natural sources of ethylene include volcanic activity and combustion in forest and grass fires. In Alberta, the concentration in ambient air resulting from these natural sources is typically low.

Anthropogenic sources of ethylene include combustion of fossil fuels, and processing of natural gas in petrochemical facilities (e.g. production of plastics).

The AAAQOs for ethylene are:

- 1-hour average concentration 1044ppb
- 3-day average 40 ppb
- Annual mean 26 ppb

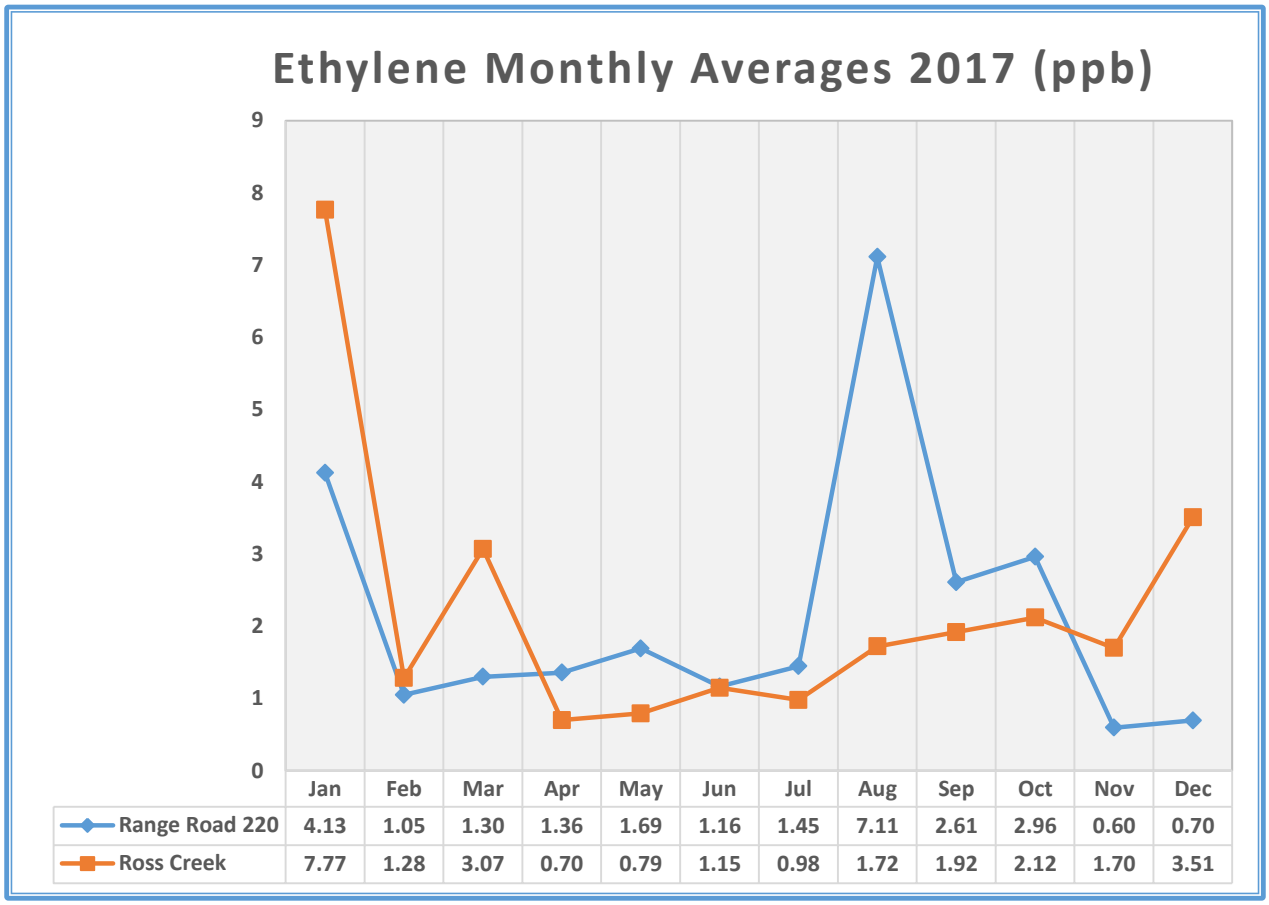
Comparing air quality monitoring data for 2017 in the FAP region against the AAAQOs for ethylene, it was observed that:

- There were no exceedances of the AAAQO for ethylene in 2017.
- The maximum one-hour concentration measured in 2017 was 216.4 ppb at Range Road 220 station on March 4th (21% of the AAAQO).
- The annual average at Range Road 220 was 2.23 ppb (8.5% of the annual objective) and Ross Creek 2.18 ppb (8.3% of the annual objective).

A summary of ethylene concentrations recorded in 2017 at individual stations and a comparison with the previous 4 years are presented in the figures and tables below. For additional information see also the station by station summaries in the appendices of this report.

Ethylene (continued)

Figure 19: Monthly average ethylene concentrations (ppb) in 2017



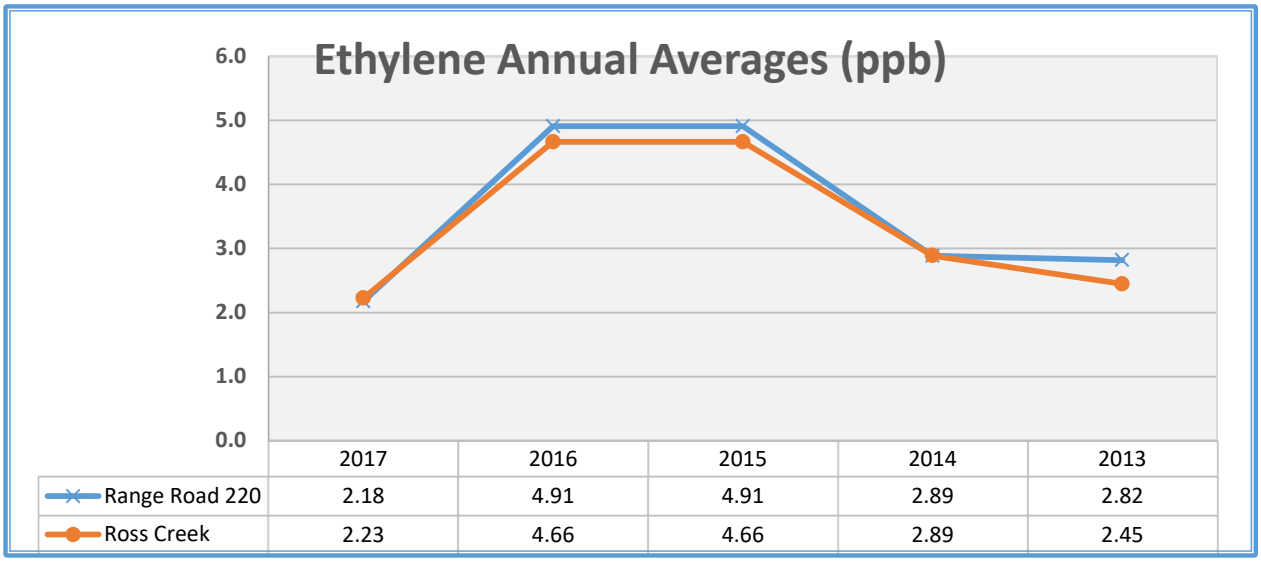
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Range Road 220	4.13	1.05	1.30	1.36	1.69	1.16	1.45	7.11	2.61	2.96	0.60	0.70
Ross Creek	7.77	1.28	3.07	0.70	0.79	1.15	0.98	1.72	1.92	2.12	1.70	3.51

Ethylene (continued)

Table 12: Maximum 1 Hour average ethylene concentrations (ppb) in 2017

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Range Road 220	55.6	41.3	36.5	28.5	21.6	9.6	10.8	17.2	18.3	46.1	15.2	62.2
Ross Creek	81.7	77.5	216.4	24.4	32.9	111.0	42.6	84.1	101.1	68.7	50.6	77.6

Figure 20: Annual average Ethylene concentrations (ppb) - historical



Hydrocarbons

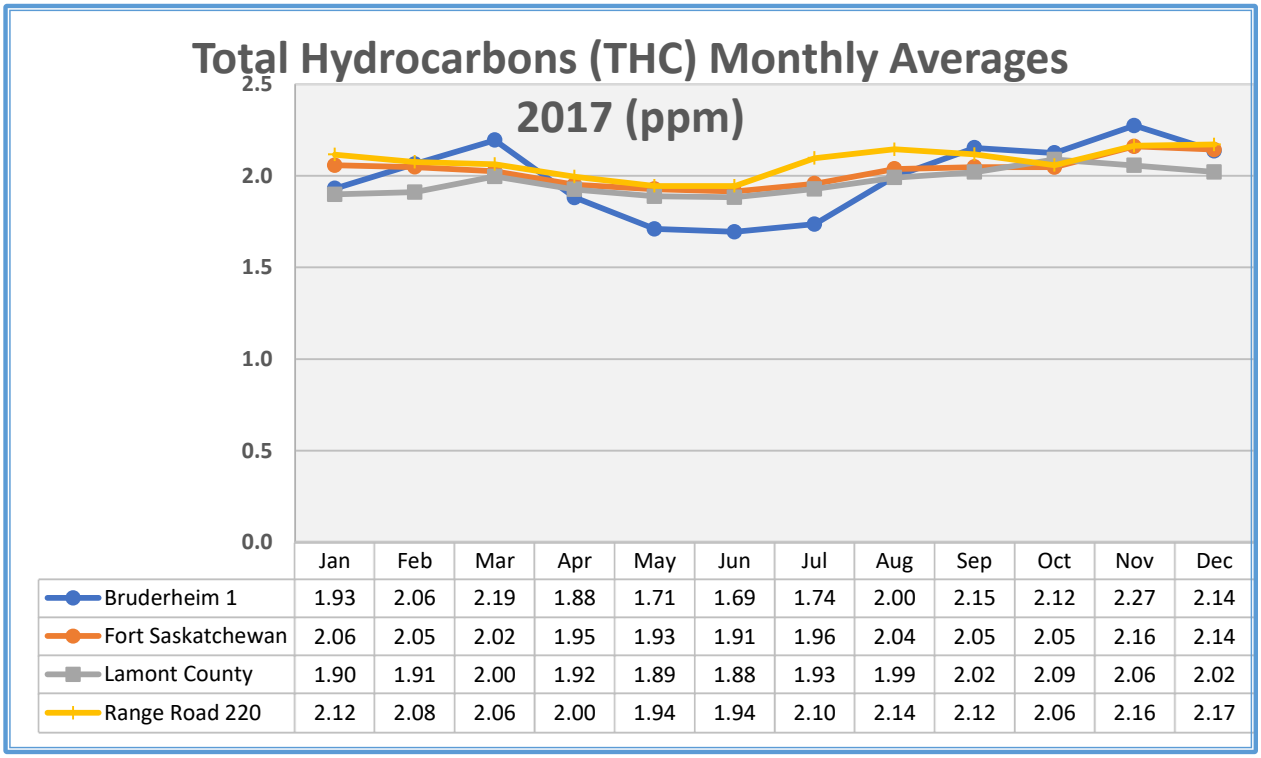
Total hydrocarbons (THC) refer to a broad family of chemicals that contain carbon and hydrogen atoms. Total hydrocarbons are the sum of non-reactive and reactive hydrocarbons.

The major reactive hydrocarbon in the atmosphere is methane. Major worldwide sources of atmospheric methane include wetlands, ruminants such as cows, energy use, landfills, and burning biomass such as wood. Methane is the primary component of natural gas.

The reactive (or non-methane) hydrocarbons consist of many volatile organic compounds (VOC's), some of which react with oxides of nitrogen in the atmosphere to form ozone. While Alberta does not have ambient air quality objectives (AAAQO) for total hydrocarbons, methane or non-methane hydrocarbons, the oxidation of hydrocarbons in the atmosphere contributes to an increased amount of nitrogen oxides and ozone, which do have objectives. Additionally, there are objectives for specific reactive hydrocarbons such as benzene, toluene, ethylbenzene, xylenes, styrene and ethylene.

A summary of hydrocarbon concentrations recorded in 2017 at individual stations and a comparison with the previous 4 years are presented in the figures and tables below. For additional information see also the station by station summaries in the appendices of this report. Note that the Bruderheim station was moved in March 2016 and renamed Bruderheim1.

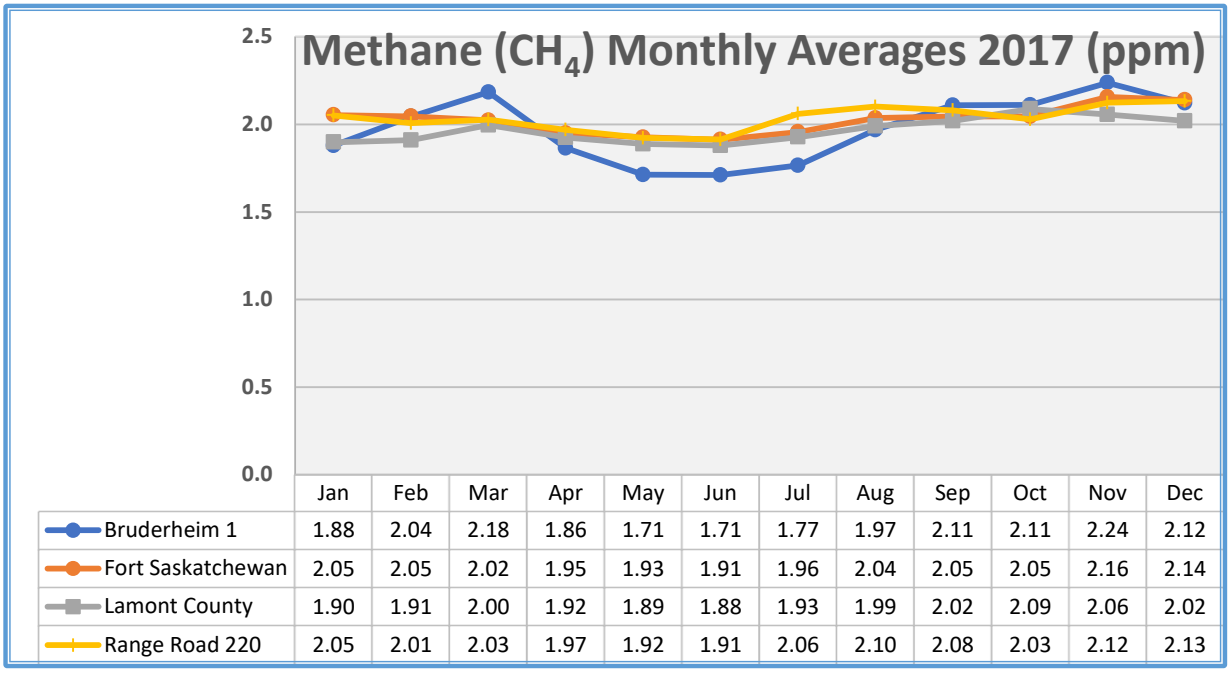
Figure 21: Monthly average Total Hydrocarbons (ppm) in 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	1.93	2.06	2.19	1.88	1.71	1.69	1.74	2.00	2.15	2.12	2.27	2.14
Fort Saskatchewan	2.06	2.05	2.02	1.95	1.93	1.91	1.96	2.04	2.05	2.05	2.16	2.14
Lamont County	1.90	1.91	2.00	1.92	1.89	1.88	1.93	1.99	2.02	2.09	2.06	2.02
Range Road 220	2.12	2.08	2.06	2.00	1.94	1.94	2.10	2.14	2.12	2.06	2.16	2.17

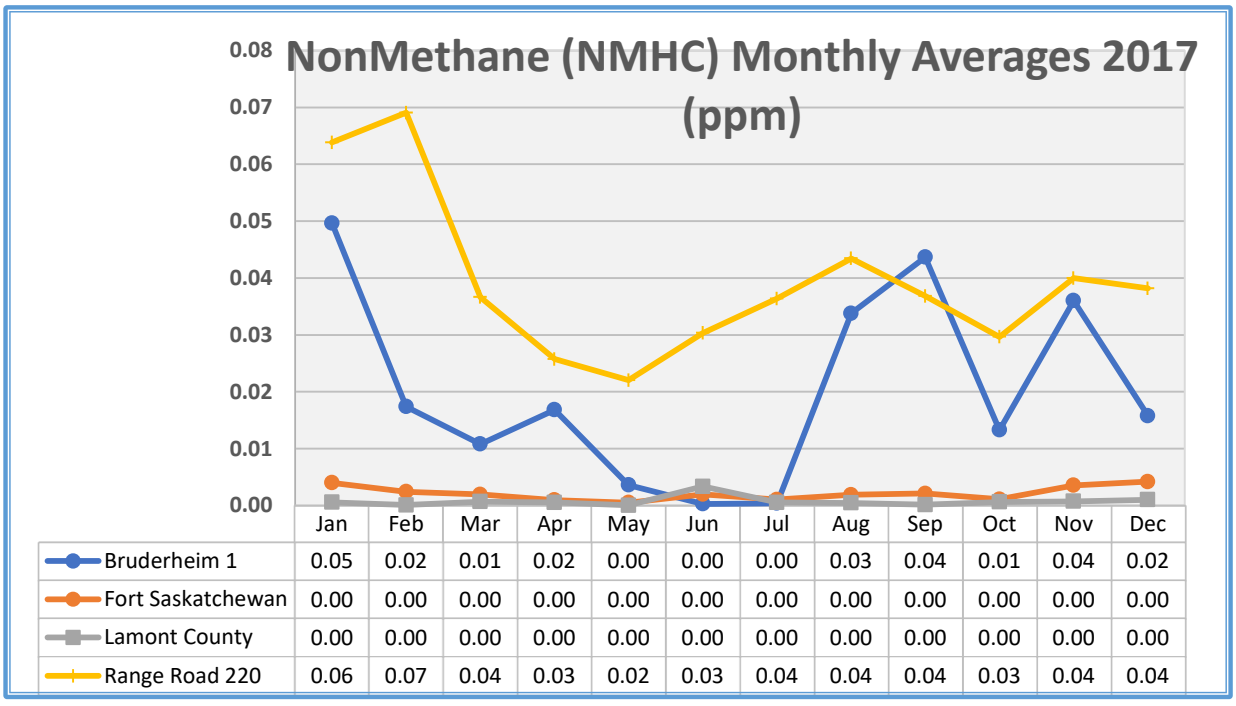
Hydrocarbons (continued)

Figure 22: Monthly average Methane concentrations (ppm) in 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	1.88	2.04	2.18	1.86	1.71	1.71	1.77	1.97	2.11	2.11	2.24	2.12
Fort Saskatchewan	2.05	2.05	2.02	1.95	1.93	1.91	1.96	2.04	2.05	2.05	2.16	2.14
Lamont County	1.90	1.91	2.00	1.92	1.89	1.88	1.93	1.99	2.02	2.09	2.06	2.02
Range Road 220	2.05	2.01	2.03	1.97	1.92	1.91	2.06	2.10	2.08	2.03	2.12	2.13

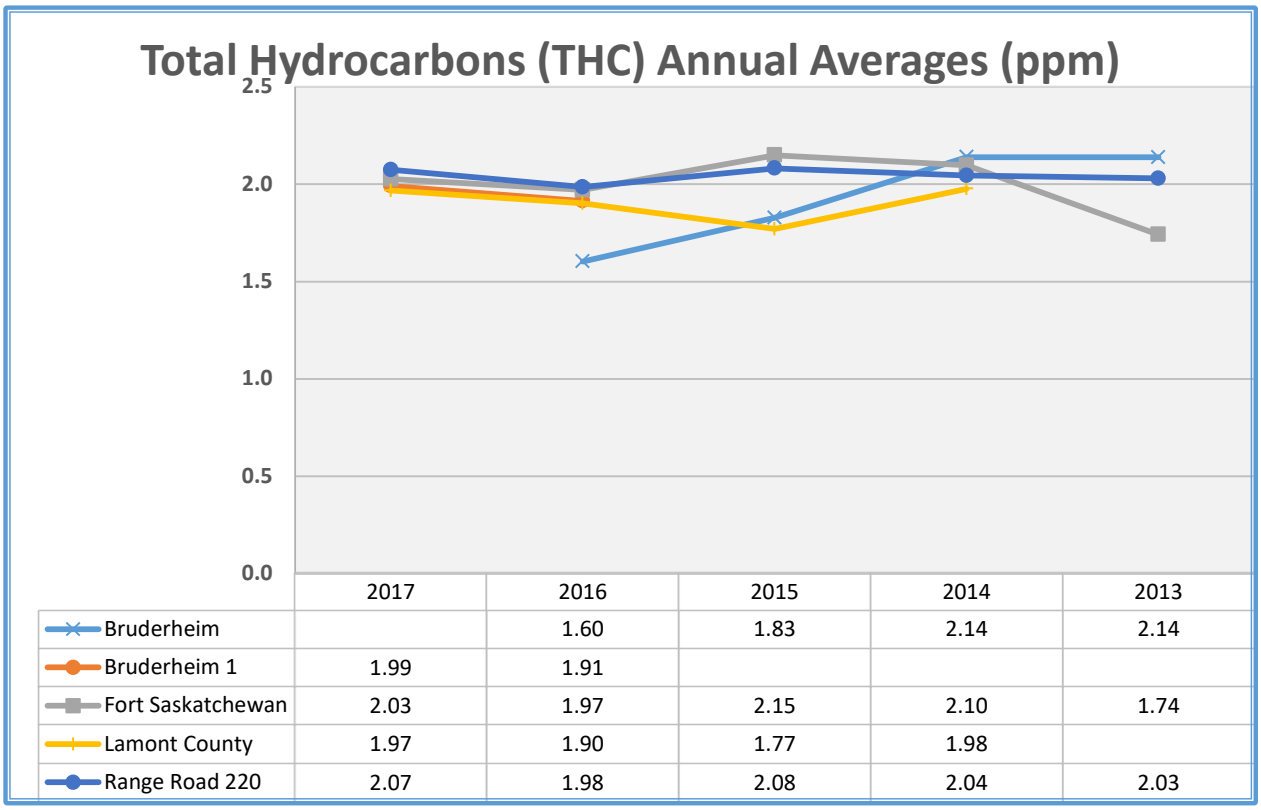
Figure 23: Monthly average Non-Methane Hydrocarbon concentrations (ppm) in 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	0.05	0.02	0.01	0.02	0.00	0.00	0.00	0.03	0.04	0.01	0.04	0.02
Fort Saskatchewan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lamont County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Range Road 220	0.06	0.07	0.04	0.03	0.02	0.03	0.04	0.04	0.04	0.03	0.04	0.04

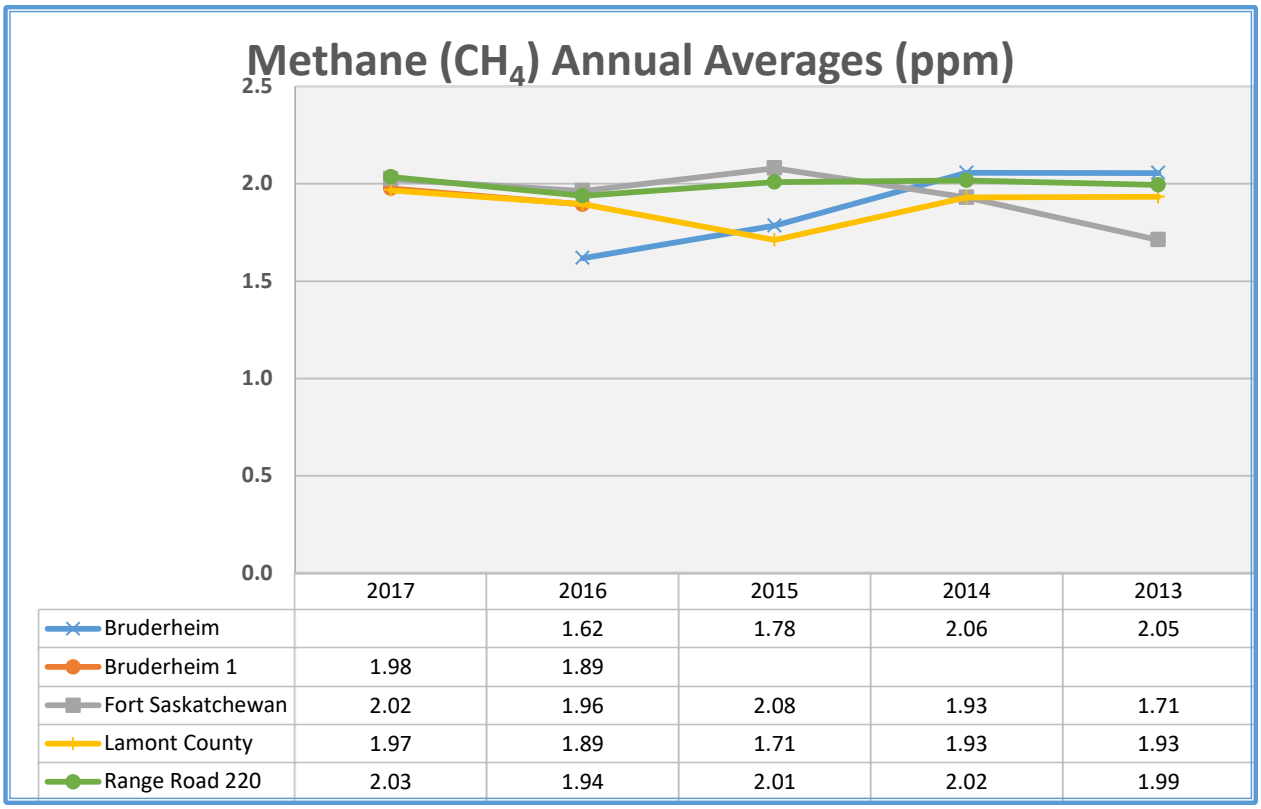
Hydrocarbons (continued)

Figure 24: Annual average THC concentrations (ppm) – historical



	2017	2016	2015	2014	2013
Bruderheim		1.60	1.83	2.14	2.14
Bruderheim 1	1.99	1.91			
Fort Saskatchewan	2.03	1.97	2.15	2.10	1.74
Lamont County	1.97	1.90	1.77	1.98	
Range Road 220	2.07	1.98	2.08	2.04	2.03

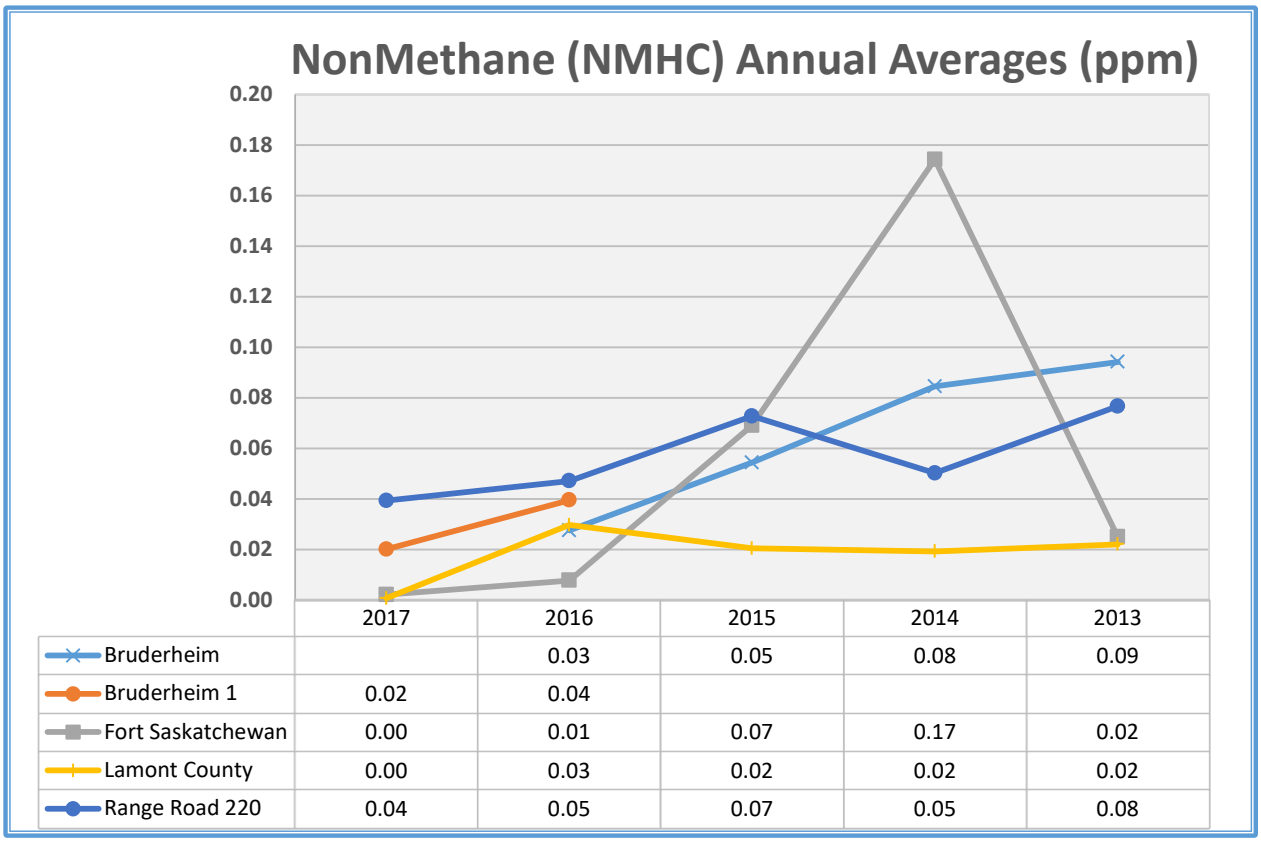
Figure 25: Annual average CH_4 concentrations (ppm) – historical



	2017	2016	2015	2014	2013
Bruderheim		1.62	1.78	2.06	2.05
Bruderheim 1	1.98	1.89			
Fort Saskatchewan	2.02	1.96	2.08	1.93	1.71
Lamont County	1.97	1.89	1.71	1.93	1.93
Range Road 220	2.03	1.94	2.01	2.02	1.99

Hydrocarbons (continued)

Figure 26: Annual average NMHC concentrations (ppm) – historical



	2017	2016	2015	2014	2013
Bruderheim		0.03	0.05	0.08	0.09
Bruderheim 1	0.02	0.04			
Fort Saskatchewan	0.00	0.01	0.07	0.17	0.02
Lamont County	0.00	0.03	0.02	0.02	0.02
Range Road 220	0.04	0.05	0.07	0.05	0.08

Hydrocarbons (continued)

Although the average and maximum hydrocarbon values recorded are similar at the various monitoring sites, it should be noted that the Bruderheim station has historically measured brief hydrocarbon "spikes" that the other stations have not. The source has not been determined but it is likely from a nearby source due to the short duration of these events and the volatile nature of hydrocarbons.

Table 13: Maximum 1-hour average hydrocarbon concentrations (ppm) in 2017

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Hydrocarbons THC (PPM)												
Bruderheim 1	5.14	6.12	8.27	5.72	4.36	3.39	4.55	5.59	7.33	5.71	5.02	4.13
Fort Saskatchewan	3.08	3.53	2.67	2.52	2.44	2.74	2.82	4.58	2.97	3.02	3.22	2.86
Lamont County	2.62	2.41	2.62	3.01	2.12	3.96	2.75	2.80	2.42	2.89	2.52	2.78
Range Road 220	3.26	3.83	3.74	4.10	3.56	3.39	4.06	4.01	3.12	3.96	3.60	2.87
Methane CH_4 (PPM)												
Bruderheim 1	3.93	6.13	7.31	4.64	4.07	3.40	4.53	4.20	5.84	4.59	4.15	3.42
Fort Saskatchewan	3.08	3.53	2.58	2.28	2.44	2.31	2.82	4.31	2.50	3.02	2.99	2.63
Lamont County	2.60	2.41	2.61	2.65	2.12	2.22	2.74	2.58	2.42	2.84	2.52	2.42
Range Road 220	2.89	3.32	2.62	2.62	2.86	2.50	3.47	3.10	2.81	2.68	3.06	2.68
Non-Methane Hydrocarbons NMHC (PPM)												
Bruderheim 1	1.20	0.63	1.04	1.07	0.68	0.07	0.11	1.38	1.51	1.12	0.87	0.70
Fort Saskatchewan	0.58	0.43	0.29	0.39	0.15	0.90	0.13	0.26	0.54	0.17	0.91	0.65
Lamont County	0.25	0.02	0.14	0.37	0.01	2.16	0.17	0.21	0.11	0.14	0.33	0.67
Range Road 220	1.37	1.51	1.68	2.11	1.63	1.43	2.00	1.43	1.08	1.79	1.53	0.65

Hydrogen Sulphide

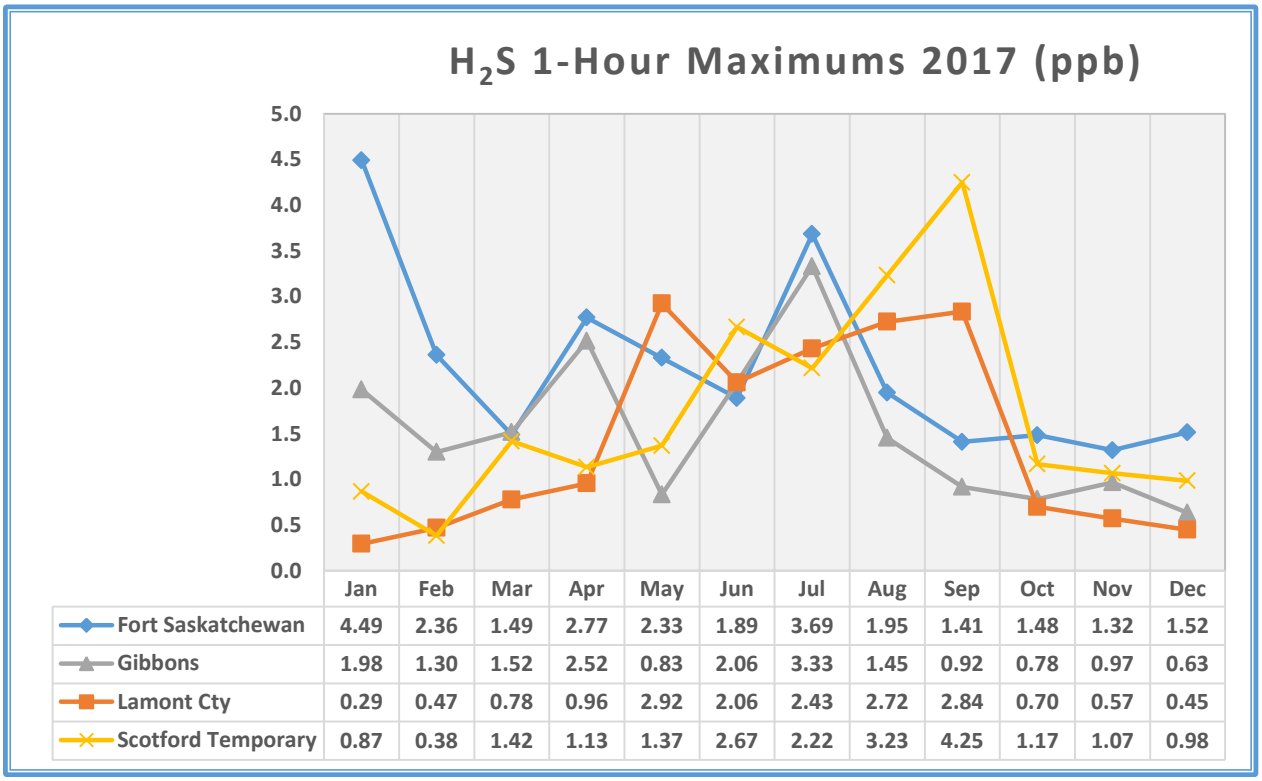
Hydrogen sulphide (H_2S) is a colourless gas with a rotten egg odour. Industrial sources of H_2S include fugitive emissions (leakages) from petroleum refineries, tank farms for unrefined petroleum products, natural gas plants, petrochemical plants, sewage treatment facilities, and animal feedlots. Natural sources of H_2S include sloughs, swamps and lakes.

The AAAQOs for H_2S are:

- 1-hour average concentration 10ppb
- 24-hour average concentration 3ppb

There were no exceedances of the 1-hour or 24-hour AAAQO for H_2S in 2017.

Figure 27: Maximum 1-hour average H_2S concentrations (ppb) in 2017

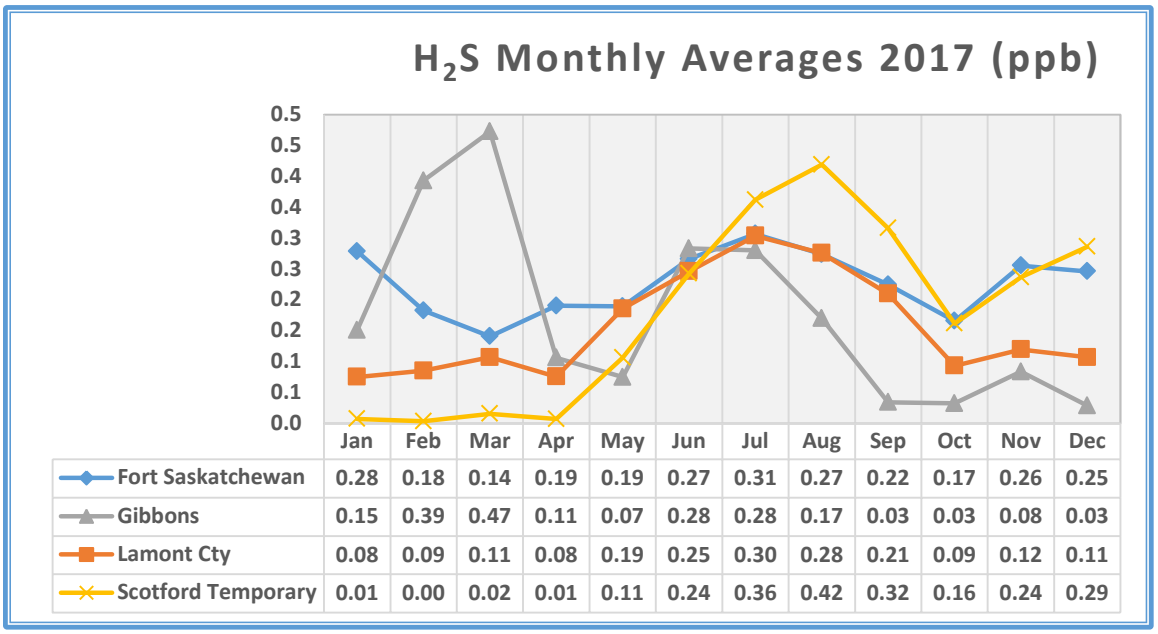


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	4.49	2.36	1.49	2.77	2.33	1.89	3.69	1.95	1.41	1.48	1.32	1.52
Gibbons	1.98	1.30	1.52	2.52	0.83	2.06	3.33	1.45	0.92	0.78	0.97	0.63
Lamont Cty	0.29	0.47	0.78	0.96	2.92	2.06	2.43	2.72	2.84	0.70	0.57	0.45
Scotford Temporary	0.87	0.38	1.42	1.13	1.37	2.67	2.22	3.23	4.25	1.17	1.07	0.98

A summary of H_2S concentrations recorded in 2017 at individual stations and a comparison with the previous 4 years are presented in the figures and tables below. For additional information see also the station by station summaries in the appendices of this report.

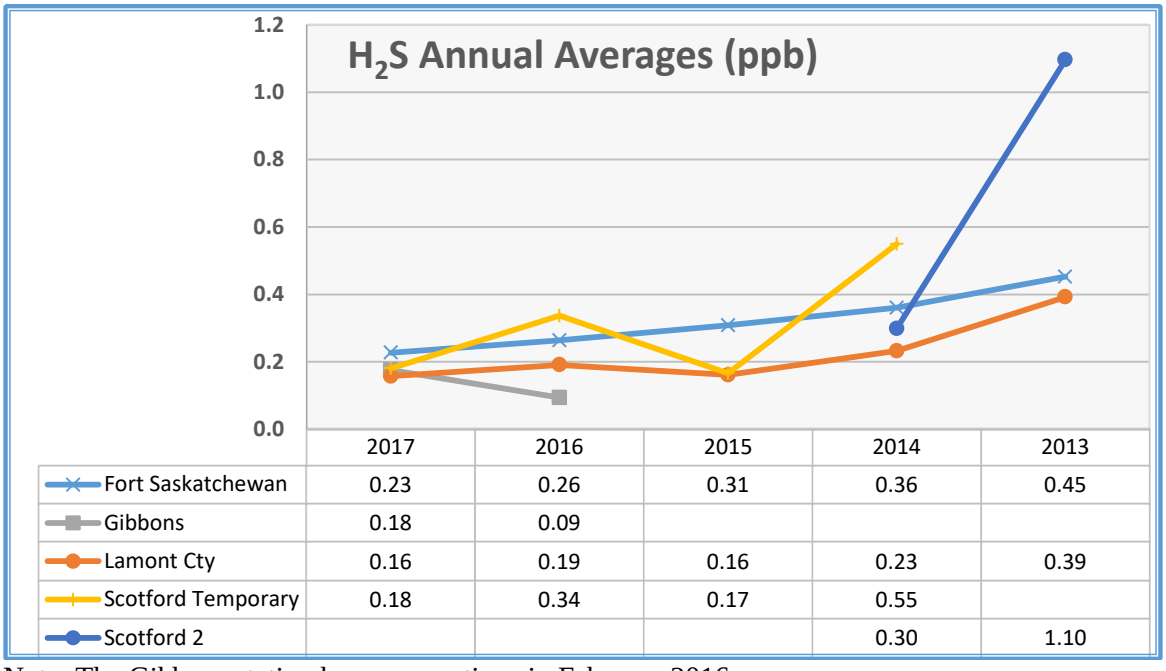
Hydrogen Sulphide (continued)

Figure 28: Monthly average H_2S concentrations (ppb) in 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	0.28	0.18	0.14	0.19	0.19	0.27	0.31	0.27	0.22	0.17	0.26	0.25
Gibbons	0.15	0.39	0.47	0.11	0.07	0.28	0.28	0.17	0.03	0.03	0.08	0.03
Lamont Cty	0.08	0.09	0.11	0.08	0.19	0.25	0.30	0.28	0.21	0.09	0.12	0.11
Scotford Temporary	0.01	0.00	0.02	0.01	0.11	0.24	0.36	0.42	0.32	0.16	0.24	0.29

Figure 29: Annual average H_2S concentrations at FAP stations (ppb) - historical



	2017	2016	2015	2014	2013
Fort Saskatchewan	0.23	0.26	0.31	0.36	0.45
Gibbons	0.18	0.09			
Lamont Cty	0.16	0.19	0.16	0.23	0.39
Scotford Temporary	0.18	0.34	0.17	0.55	
Scotford 2				0.30	1.10

Note: The Gibbons station began operations in February 2016.
The Scotford 2 station was moved in April 2014 and became Scotford Temporary

Oxides of Nitrogen

Oxides of nitrogen (NO_x) are the total of nitrogen dioxide (NO_2) and nitric oxide (NO). During high temperature combustion, such as burning of natural gas, coal, oil and gasoline, atmospheric nitrogen may combine with molecular oxygen to form NO. NO is colourless and odourless. Most NO in the ambient air will react with O_3 to form NO_2. NO_2 is a reddish-brown gas with a pungent odour and is partially responsible for the "brown haze" observed near large cities.

Transportation (automobiles, locomotives and aircraft) is the major source of NO_x in Alberta. Other significant sources include industrial sources (oil and gas industries). Smaller sources of NO_x include natural gas combustion, heating fuel combustion, and forest fires.

The AAAQOs for NO_2 are:

- 1-hour average concentration 159 ppb
- Annual average concentration 24 ppb

Comparing the air quality monitoring data in the FAP region during 2017 against the AAAQOs, it was observed that there were no exceedances of the 1-hour AAAQO for NO_2. The annual average concentration at each FAP station was well below the AAAQO.

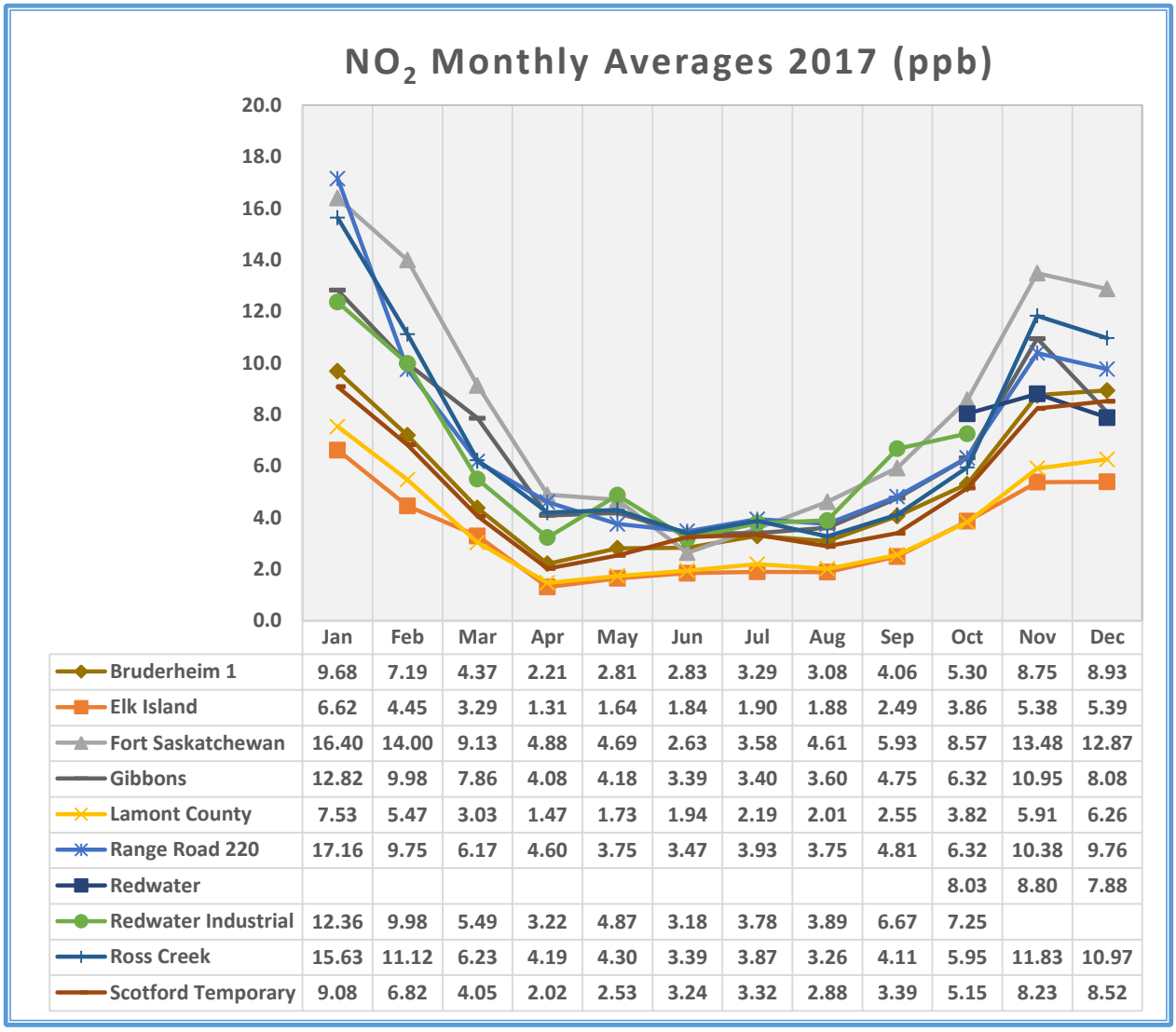
The maximum annual average NO_2 concentration measured was 8.4 ppb at the Fort Saskatchewan station (35% of the annual AAAQO).

While there is no AAAQO for monthly average concentrations of NO_2, the monthly averages values are useful to show that variation in NO_2 concentrations is seasonal. The maximum monthly NO_2 values occur during the winter months of November to February (refer to Figure 30). This normally occurs due to lower atmospheric mixing heights during colder weather where emissions tend to accumulate near the ground and not disperse as readily, this is commonly referred to as a temperature inversion.

A summary of NO_2 concentrations recorded at individual stations and a comparison with the previous 4 years are presented in the figures and tables below. For additional information see also the station by station summaries in the appendices of this report.

Oxides of Nitrogen (continued)

Figure 30: Monthly average NO_2 concentrations (ppb) in 2017

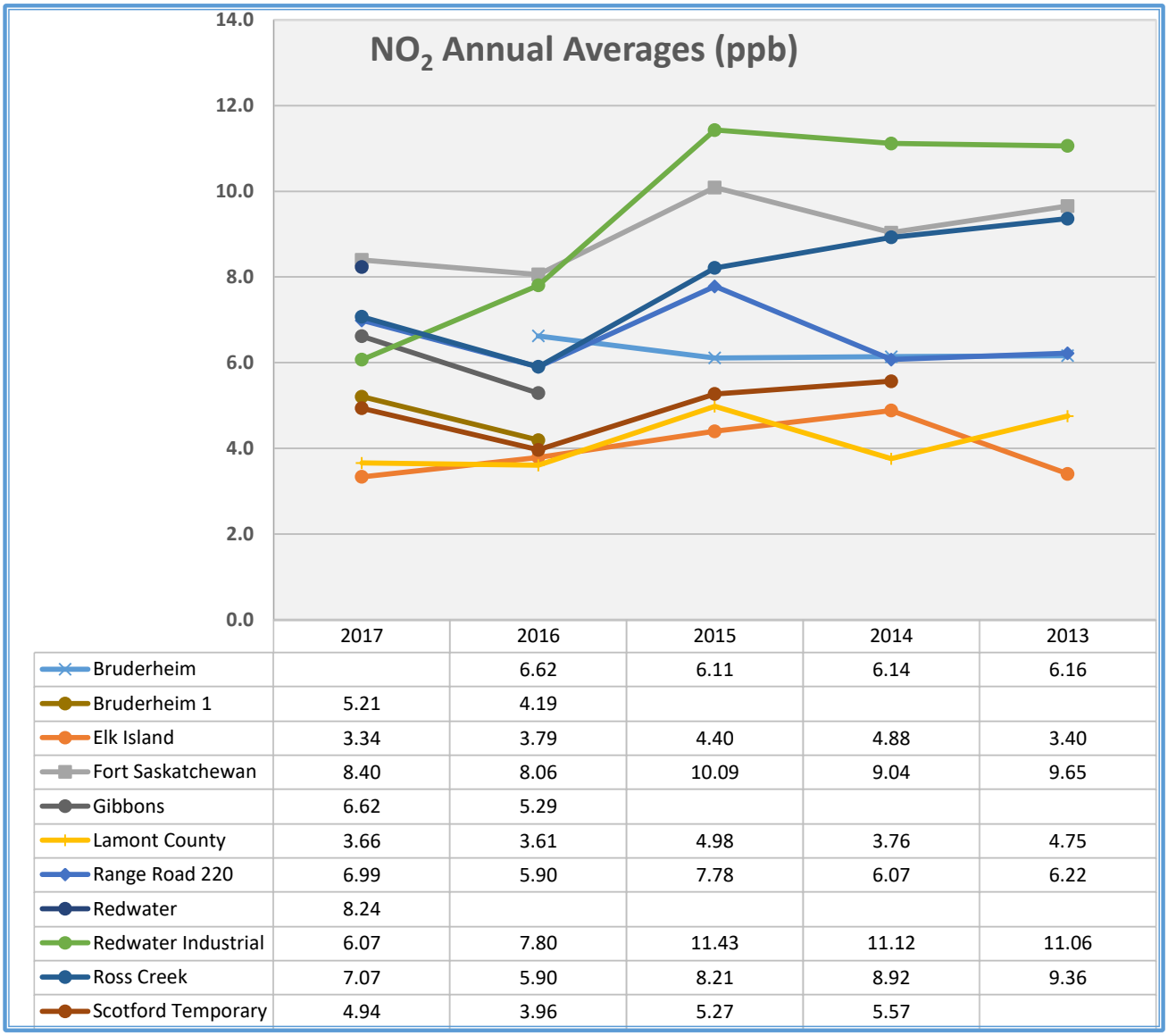


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	9.68	7.19	4.37	2.21	2.81	2.83	3.29	3.08	4.06	5.30	8.75	8.93
Elk Island	6.62	4.45	3.29	1.31	1.64	1.84	1.90	1.88	2.49	3.86	5.38	5.39
Fort Saskatchewan	16.40	14.00	9.13	4.88	4.69	2.63	3.58	4.61	5.93	8.57	13.48	12.87
Gibbons	12.82	9.98	7.86	4.08	4.18	3.39	3.40	3.60	4.75	6.32	10.95	8.08
Lamont County	7.53	5.47	3.03	1.47	1.73	1.94	2.19	2.01	2.55	3.82	5.91	6.26
Range Road 220	17.16	9.75	6.17	4.60	3.75	3.47	3.93	3.75	4.81	6.32	10.38	9.76
Redwater										8.03	8.80	7.88
Redwater Industrial	12.36	9.98	5.49	3.22	4.87	3.18	3.78	3.89	6.67	7.25		
Ross Creek	15.63	11.12	6.23	4.19	4.30	3.39	3.87	3.26	4.11	5.95	11.83	10.97
Scotford Temporary	9.08	6.82	4.05	2.02	2.53	3.24	3.32	2.88	3.39	5.15	8.23	8.52

Note: The Redwater Industrial station ceased operations in October 2017
The Redwater station began operation October 2017

Oxides of Nitrogen (continued)

Figure 31: Annual average NO_2 concentrations at FAP stations (ppb)

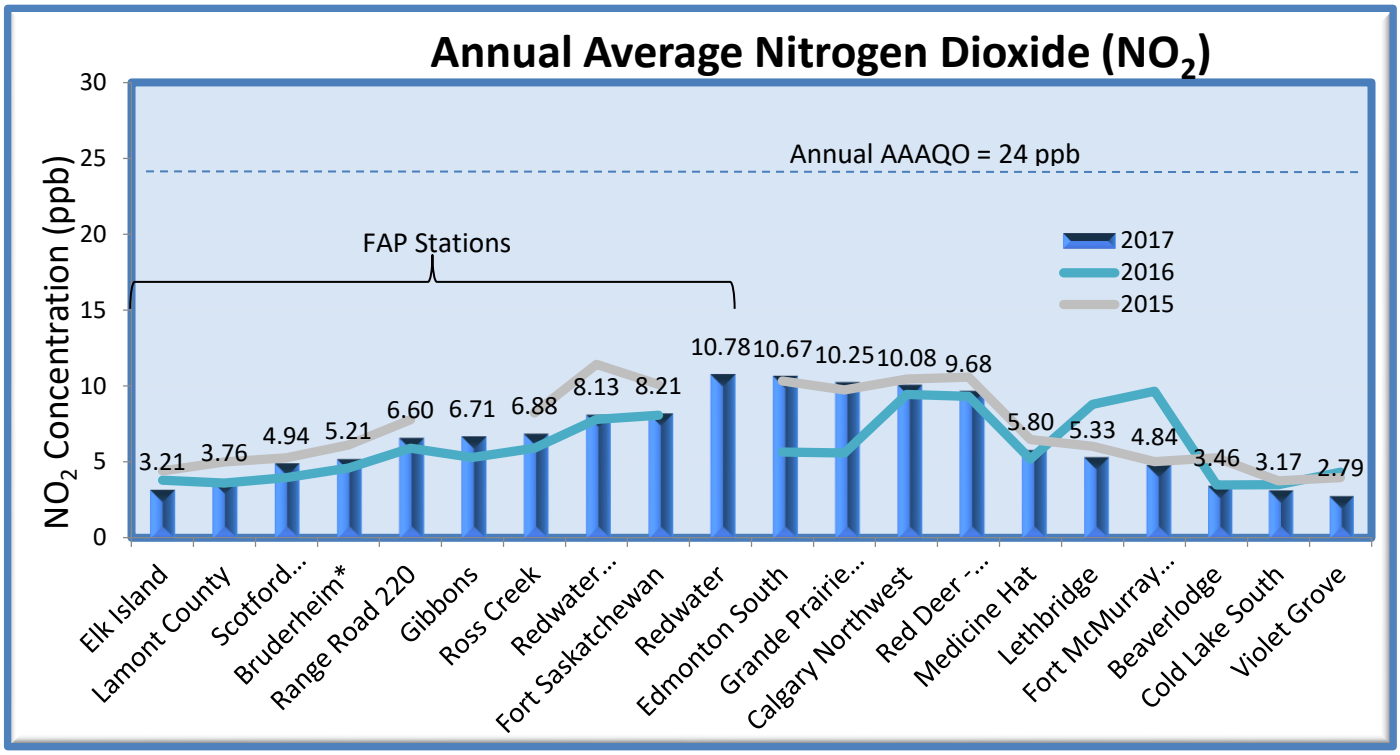


	2017	2016	2015	2014	2013
Bruderheim		6.62	6.11	6.14	6.16
Bruderheim 1	5.21	4.19			
Elk Island	3.34	3.79	4.40	4.88	3.40
Fort Saskatchewan	8.40	8.06	10.09	9.04	9.65
Gibbons	6.62	5.29			
Lamont County	3.66	3.61	4.98	3.76	4.75
Range Road 220	6.99	5.90	7.78	6.07	6.22
Redwater	8.24				
Redwater Industrial	6.07	7.80	11.43	11.12	11.06
Ross Creek	7.07	5.90	8.21	8.92	9.36
Scotford Temporary	4.94	3.96	5.27	5.57	

Note: The Bruderheim station was moved and was renamed Bruderheim 1 in March 2016
The Gibbons station began operations in February 2016
The Redwater Industrial station ceased operations in October 2017
The Redwater station began operation October 2017

Oxides of Nitrogen (continued)

Figure 32: Annual average NO_2 concentrations in Alberta (ppb)



*The Bruderheim station was moved in 2016 and renamed Bruderheim 1
Bruderheim 2016 average includes data from both Bruderheim and Bruderheim1 stations

Nitric oxide (NO) and oxides of nitrogen (NO_x) are also measured at FAP monitoring stations. Data for these parameters are available through the Government of Alberta data warehouse at http://airdata.alberta.ca/

Ozone

Unlike other pollutants, ozone (O_3) is not emitted directly by anthropogenic activities. O_3 in the lower atmosphere is produced by a complicated set of chemical reactions involving oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. O_3 is also transported to the ground from the "ozone rich" upper atmosphere by natural weather processes. O_3 and its precursors, such as NO_x and VOCs, may also be carried from upwind sources such as urban centers and industrial complexes. This phenomenon can be observed particularly in summer in Alberta when warm temperatures (~30 °C) coupled with light winds and abundant sunshine result in an air quality condition referred to as summertime smog.

O_3 concentrations are generally lower at urban locations than at rural locations. This is due to the destruction of O_3 by nitric oxide (NO) that is emitted by the combustion of fossil fuels. A significant natural source of VOCs in remote and rural areas in Alberta is emissions from trees and vegetation. O_3 levels are usually higher during the spring and summer months due to increased transport from the upper atmosphere and more sunlight, which allows O_3 forming chemical reactions to occur more rapidly.

At normal outdoor concentrations, O_3 is a colourless, odourless gas. However, O_3 does have a characteristic sharp 'very fresh air' odour at very high concentrations, such as that experienced immediately after lightning storms.

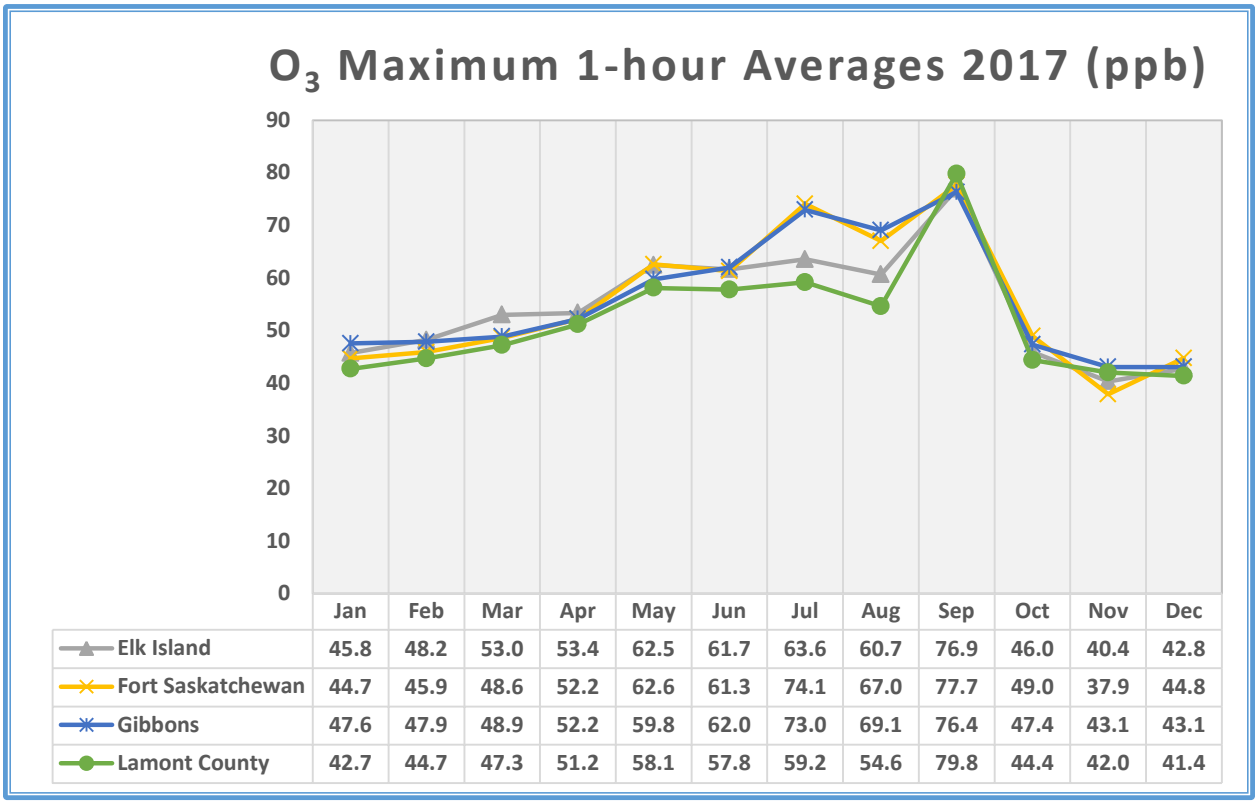
The AAAQO for ozone is:

- 1-hour average concentration 82 ppb

There were no exceedances of the 1-hour AAAQO for ozone at any FAP stations in 2017. The highest 1-hour average for ozone was 79.8 ppb occurring on September 6th at the Lamont County station (97.3% of the 1-hour AAAQO).

The following figure shows the maximum 1-hour average concentrations recorded in each month at all FAP stations that measure ozone.

Figure 33: Maximum 1-hour average Ozone concentrations (ppb) in 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Elk Island	45.8	48.2	53.0	53.4	62.5	61.7	63.6	60.7	76.9	46.0	40.4	42.8
Fort Saskatchewan	44.7	45.9	48.6	52.2	62.6	61.3	74.1	67.0	77.7	49.0	37.9	44.8
Gibbons	47.6	47.9	48.9	52.2	59.8	62.0	73.0	69.1	76.4	47.4	43.1	43.1
Lamont County	42.7	44.7	47.3	51.2	58.1	57.8	59.2	54.6	79.8	44.4	42.0	41.4

Ozone (continued)

There is also a national standard for ozone. The Air Quality Management System (AQMS) is a national approach to air quality management in Canada with the goal of achieving better air quality and significant health and environmental benefits for Canadians through keeping clean areas clean and continuous improvement. A component of the system is the Canadian Ambient Air Quality Standards (CAAQS), which have been developed for fine particulate matter ($PM_{2.5}$) and ozone. These more stringent standards replace the previous Canada-wide Standards for $PM_{2.5}$ and O_3.

The following figure summarizes the CAAQS management level and threshold for ozone. Alberta's six air zones will be assessed for achievement against these values. Fort Air Partnership falls within the North Saskatchewan Air Zone

Figure 34: Air Quality Management System Thresholds

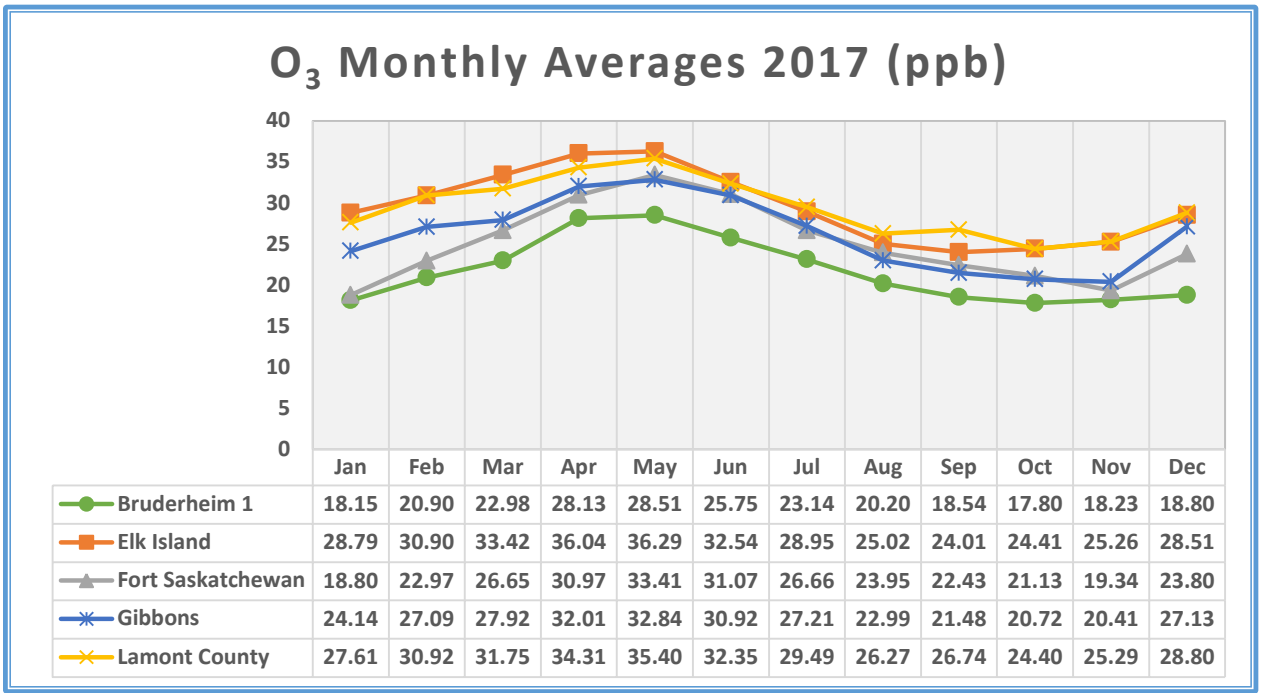
Air Management Threshold Values				
	Substance:	Ozone	$PM_{2.5}$	
	Averaging time:	8 Hours	Annual	24 Hours
Management Level	Red	Actions for Achieving Air Zone CAAQS		
	Threshold:	63 ppb	10.0 µg/m^3	28 µg/m^3
	Orange	Actions for Preventing CAAQS Exceedance		
	Threshold:	56 ppb	6.4 µg/m^3	19 µg/m^3
	Yellow	Actions for Preventing Air Quality Deterioration		
	Threshold:	50 ppb	4.0 µg/m^3	10 µg/m^3
	Green	Actions for Keeping Clean Areas Clean		

All provinces and territories including Alberta must annually report the status of air quality as compared to the new national standards. 2015 was the first year that $PM_{2.5}$ and O_3 levels were evaluated and reported against the new Canadian Ambient Air Quality Standards (CAAQS), using data collected from 2011 to 2013. The 2016 CAAQS evaluation report using 2014-2016 data will be released in 2018.

A summary of O_3 concentrations recorded in 2017 at individual stations and a comparison with the previous 4 years are presented in the figures and tables below. For additional information see also the station by station summaries in the appendices of this report.

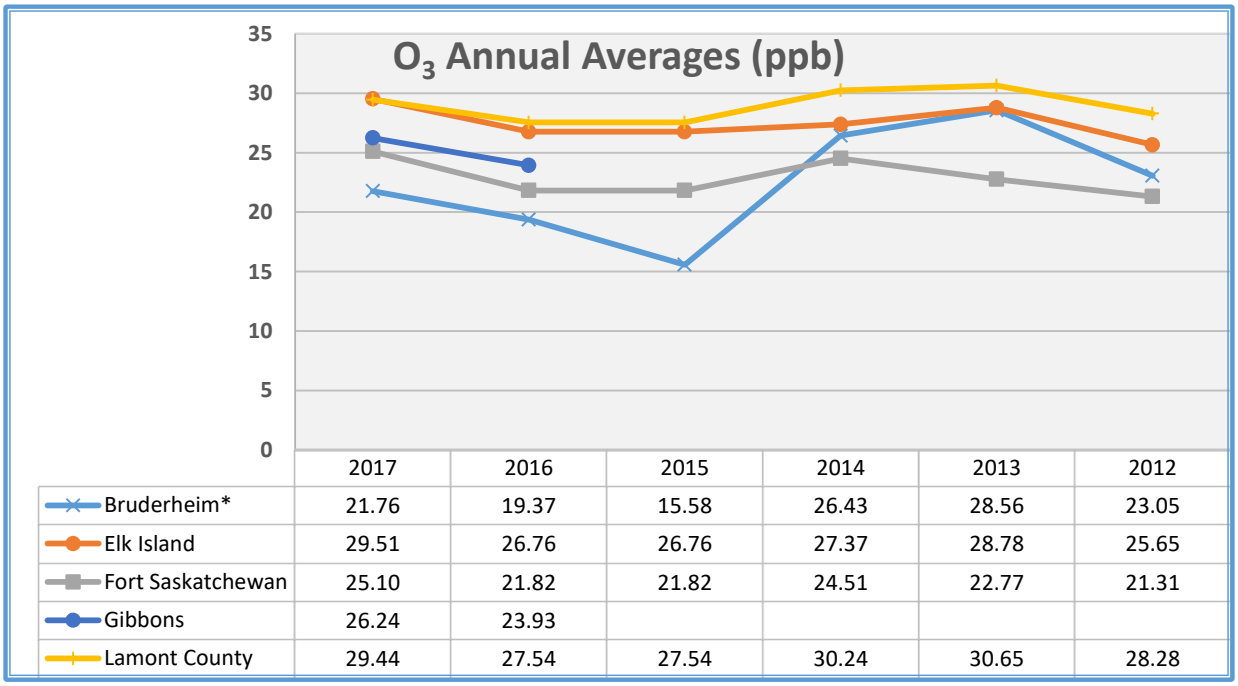
The highest monthly average concentrations tend to occur during the spring months, when the overall background levels are highest. The highest maximum one-hour values tend to occur later in the summer, during hot summer afternoons under low wind conditions. Peak concentrations for ozone are relevant because of potential health effects.

Figure 35: Monthly average ozone concentrations (ppb) in 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	18.15	20.90	22.98	28.13	28.51	25.75	23.14	20.20	18.54	17.80	18.23	18.80
Elk Island	28.79	30.90	33.42	36.04	36.29	32.54	28.95	25.02	24.01	24.41	25.26	28.51
Fort Saskatchewan	18.80	22.97	26.65	30.97	33.41	31.07	26.66	23.95	22.43	21.13	19.34	23.80
Gibbons	24.14	27.09	27.92	32.01	32.84	30.92	27.21	22.99	21.48	20.72	20.41	27.13
Lamont County	27.61	30.92	31.75	34.31	35.40	32.35	29.49	26.27	26.74	24.40	25.29	28.80

Figure 36: Annual average O_3 concentrations at FAP stations (ppb)

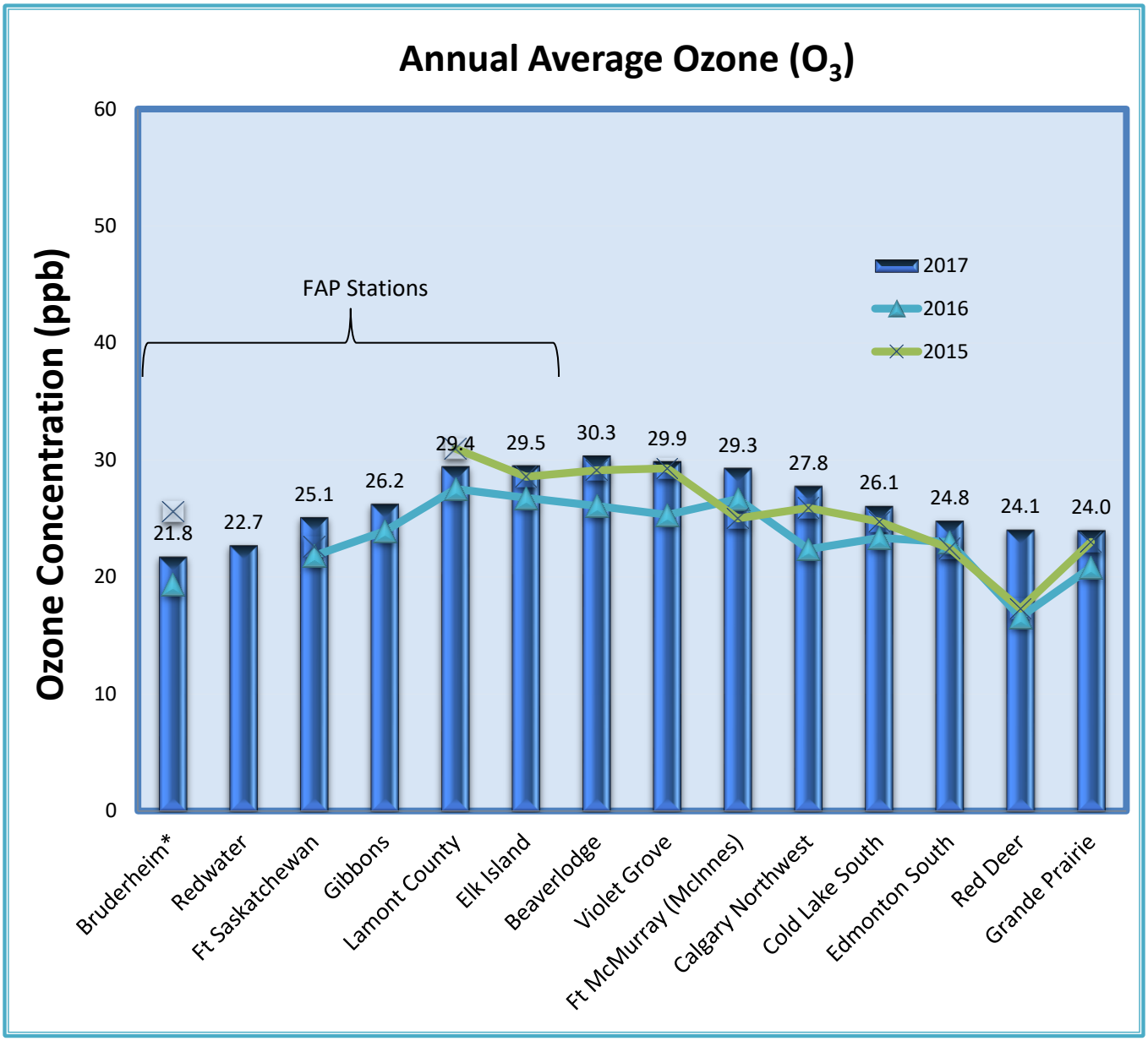


	2017	2016	2015	2014	2013	2012
Bruderheim*	21.76	19.37	15.58	26.43	28.56	23.05
Elk Island	29.51	26.76	26.76	27.37	28.78	25.65
Fort Saskatchewan	25.10	21.82	21.82	24.51	22.77	21.31
Gibbons	26.24	23.93				
Lamont County	29.44	27.54	27.54	30.24	30.65	28.28

*The Bruderheim station was moved in 2016 and renamed Bruderheim 1
Bruderheim 2016 average includes data from both Bruderheim and Bruderheim1 stations

Ozone (continued)

Figure 37: Annual average O_3 concentrations in Alberta (ppb)



Respirable Particulates ($PM_{2.5}$)

Respirable particulates are tiny particles that are smaller than 2.5 microns ($PM_{2.5}$). As a comparison, a strand of human hair is about 70 microns in width. Fine particulates in this size range are referred to as $PM_{2.5}$. Sources include soil, roads, agricultural dust, vehicles, industrial emissions, smoke from forest fires, cigarettes, household fireplaces and barbecues. Secondary particulate matter may also be produced in the atmosphere through a number complex chemical processes. Particulates can come from both solid matter and liquid aerosols.

In high concentrations, suspended particulates may lead to human health problems. The amount of damage depends on the chemical composition of the particles. Inhaling particulate matter can make breathing more difficult or may aggravate existing lung and heart problems. Smaller particles have the ability to travel deeper into the lungs where they may cause permanent lung damage.

Higher values of $PM_{2.5}$ typically occur during winter temperature inversions when air movement is limited, or in summer during periods of very warm weather with little or no wind coupled with smoke from forest fires. Periods of higher particulate measurements in 2017 occurred through July and August when Alberta experienced smoke from wildfires in British Columbia for extended periods. When higher particulate measurements did occur, it was most often seen throughout the Airshed and the larger Capital Region area. These higher values were measured at several stations at the same time and were often slow to disperse depending on weather patterns in British Columbia and Alberta.

The AAAQO for $PM_{2.5}$ is:

- 24-hour average concentration 30 µg/m^3

There is also an Air Quality Guideline for $PM_{2.5}$:

- 1-hour average concentration 80 µg/m^3

A one-hour average concentration of 80µg/m^3 will trigger an AQHI in the “High Risk' category.

There is also a national standard (CAAQS) for $PM_{2.5,}$ just as there is for ozone (O_3) as described in the section above.

The following figure summarizes the CAAQS management level and threshold for $PM_{2.5}$. Alberta’s six air zones will be assessed for achievement against these values. Fort Air Partnership falls within the North Saskatchewan Air Zone.

Figure 38: Air Quality Management System Thresholds

Air Management Threshold Values				
	Substance:	Ozone	$PM_{2.5}$	
	Averaging time:	8 Hours	Annual	24 Hours
Management Level	Red	Actions for Achieving Air Zone CAAQS		
	Threshold:	63 ppb	10.0 µg/m^3	28 µg/m^3
	Orange	Actions for Preventing CAAQS Exceedance		
	Threshold:	56 ppb	6.4 µg/m^3	19 µg/m^3
	Yellow	Actions for Preventing Air Quality Deterioration		
	Threshold:	50 ppb	4.0 µg/m^3	10 µg/m^3
	Green	Actions for Keeping Clean Areas Clean		

All provinces and territories including Alberta must annually report the status of air quality as compared with the new national standards. 2015 was the first year that $PM_{2.5}$ and O_3 levels were evaluated and reported against the new Canadian Ambient Air Quality Standards (CAAQS), using data collected from 2011 to 2013. The 2016 CAAQS evaluation report using 2014-2016 data will be released in 2018.

Respirable Particulates (continued)

Comparing air quality monitoring data in the Fort Air Partnership region for 2017 against the AAAQO, it was observed that there were 69 1-hour Guideline exceedances and 29 24-hour AAAQO exceedances throughout the network. The majority of exceedances were in July and attributed to smoke from wildfires in British Columbia. Six of the 69 1-hour average exceedances (9%) could not be attributed to a specific cause or event. Analysis showed however, where causes for exceedances could not be determined, that these were localized events with a source relatively near the station and were not region-wide.

The following tables break down the exceedances and the attributed causes at each station.

Table 14: 2017 1-hour average exceedances of the AAAQG for $PM_{2.5}$

Station	Highest 1 hour average ($\mu gr/m^3$)	Exceedances	Date(s)	Attributed Cause
Bruderheim1 Ft Saskatchewan Lamont Cnty, Redwater Industrial	129.3	8	January 2, 25, March 29	Regional effects from winter inversion
Elk Island	97.6	1	May 21	Campfire smoke
Gibbons	107.1	1	June 3	Undetermined local source
Gibbons, Elk Island	86.8	2	July 16	Forest Fires
Redwater Industrial	110.7	1	August 11	Undetermined local source
Bruderheim1 Elk Island, Ft Saskatchewan Gibbons, Lamont Cnty, Redwater Industrial	270.7	52	August 13-14	Forest Fires
Gibbons	97.7	2	August 31	Undetermined local source
Gibbons	87.3	1	September 6	Undetermined local source
Gibbons	90	1	December 22	Undetermined local source

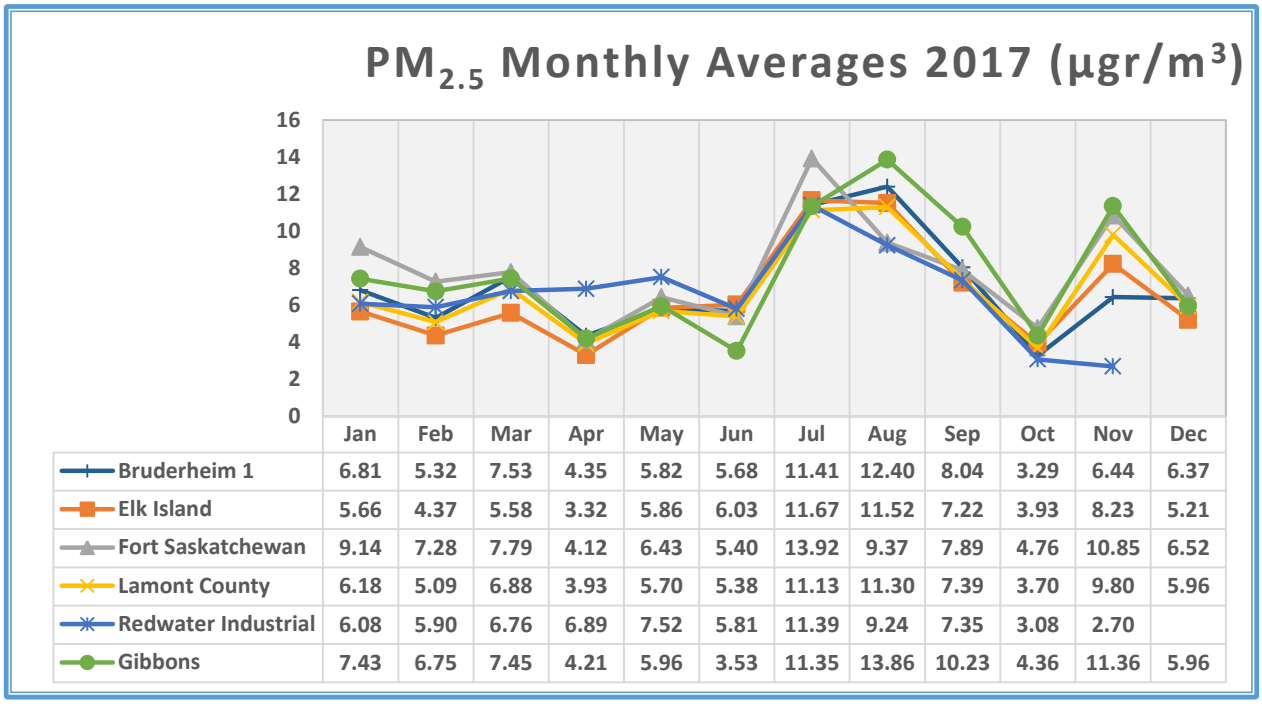
Table 15: 2017 24-hour average exceedances of the AAAQO for $PM_{2.5}$

Station	Highest 24 hour average ($\mu gr/m^3$)	Exceedances	Date(s)	Attributed Cause
Lamont County Redwater Industrial	31	2	January 2, 25	Regional effects from winter inversion
Bruderheim 1, Elk Island, Fort Saskatchewan, Gibbons, Lamont County	42.8	5	July 16	Forest Fires
Bruderheim 1, Elk Island, Fort Saskatchewan, Gibbons, Lamont County Redwater Industrial	43.6	6	July 20	Forest Fires
Bruderheim 1, Elk Island, Gibbons, Lamont County Redwater Industrial	61.9	9	August 13-14	Forest Fires
Bruderheim 1, Elk Island, Fort Saskatchewan, Gibbons, Lamont County Redwater Industrial	37.6	6	August 18	Forest Fires
Redwater	30.4	1	November 11	Regional effects from winter inversion

Respirable Particulates (continued)

A summary of $PM_{2.5}$ concentrations recorded in 2017 at individual stations and a comparison with the previous 4 years are presented in the figures and tables below. For additional information see also the station by station summaries in the appendices of this report.

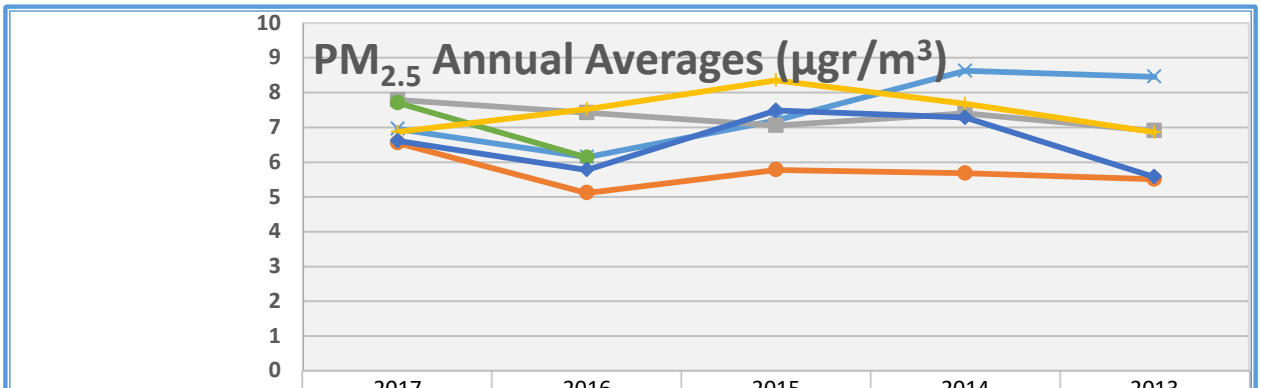
Figure 39: Average $PM_{2.5}$ concentrations (µg/m3) in 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	6.81	5.32	7.53	4.35	5.82	5.68	11.41	12.40	8.04	3.29	6.44	6.37
Elk Island	5.66	4.37	5.58	3.32	5.86	6.03	11.67	11.52	7.22	3.93	8.23	5.21
Fort Saskatchewan	9.14	7.28	7.79	4.12	6.43	5.40	13.92	9.37	7.89	4.76	10.85	6.52
Lamont County	6.18	5.09	6.88	3.93	5.70	5.38	11.13	11.30	7.39	3.70	9.80	5.96
Redwater Industrial	6.08	5.90	6.76	6.89	7.52	5.81	11.39	9.24	7.35	3.08	2.70	
Gibbons	7.43	6.75	7.45	4.21	5.96	3.53	11.35	13.86	10.23	4.36	11.36	5.96

Particulates (continued)

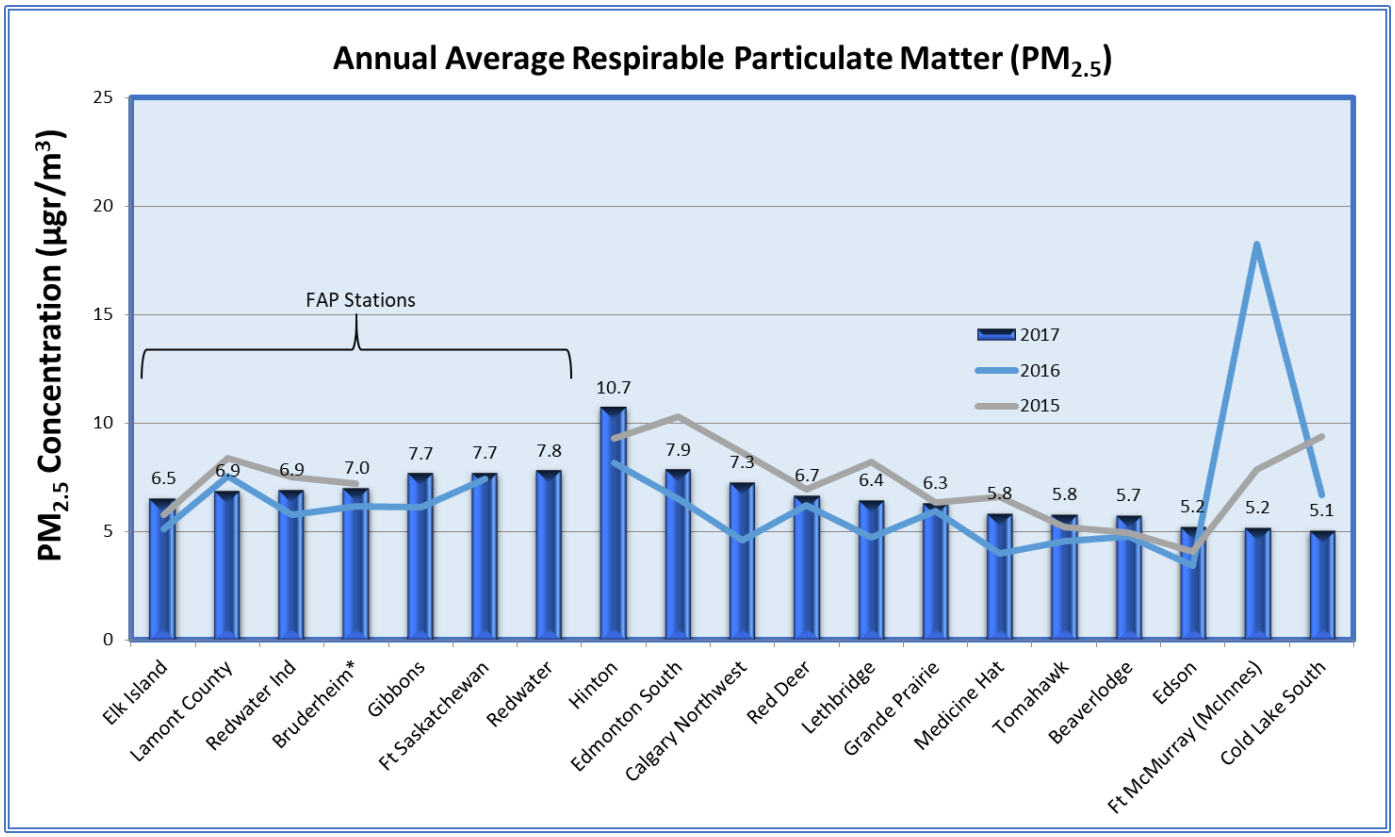
Figure 40: Annual average $PM_{2.5}$ concentrations at FAP stations (µgr/m3) - historical



	2017	2016	2015	2014	2013
Bruderheim*	6.95	6.15	7.20	8.63	8.46
Elk Island	6.55	5.11	5.78	5.68	5.51
Fort Saskatchewan	7.79	7.42	7.05	7.41	6.90
Gibbons	7.70	6.13			
Lamont County	6.87	7.53	8.35	7.68	6.86
Redwater Industrial	6.61	5.78	7.48	7.28	5.58

*The Bruderheim station was moved in 2016 and renamed Bruderheim 1
Bruderheim 2016 average includes data from both Bruderheim and Bruderheim1 stations

Figure 41: Annual average $PM_{2.5}$ concentrations in Alberta (µgr/m^3)



*Bruderheim 2016 average includes data from both Bruderheim and Bruderheim 1 stations

Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless gas with a pungent odour. In Alberta, natural gas processing plants are responsible for close to half of the SO_2 emissions in the province. Sources of SO_2 in the Airshed are primarily industrial sources, from both within and outside the FAP boundary.

The AAAQOs for sulphur dioxide are:

- 1-hour average concentration 172 ppb
- 24-hour average concentration 48 ppb
- 30-day average concentration 11 ppb
- Annual average concentration 8 ppb

Comparing air quality monitoring data in the Fort Air Partnership region for 2017 against the AAAQO, it was observed that there were 38 exceedances of the 1-hour average AAAQO, 9 exceedances of the 24-hour average AAAQO. And one exceedance of the 30-day AAAQO, in April when the average was 22.29 ppb. The 2017 annual average did not exceed the AAAQO.

Table 16: 2017 1-hour average exceedances of the AAAQO for SO_2

Station	Highest 1 hour average (ppb)	Exceedances	Date(s)	Attributed Cause
Redwater Industrial	173.13	1	February 9	Local Industry
Redwater Industrial	194.39	1	March 1	Local Industry
Redwater Industrial	469.91	18	April 5,9,17,18,23,24,26,27	Local Industry
Redwater Industrial	345.86	8	May 5,10,11,29	Local Industry
Redwater Industrial	302.20	4	July 7,12,27,30	Local Industry
Redwater Industrial	304.31	6	August 7, 23, 25, 29, 30, 31	Local Industry

Sulphur Dioxide (continued)

Table 17: 2017 24-hour average exceedances of the AAAQO for SO_2

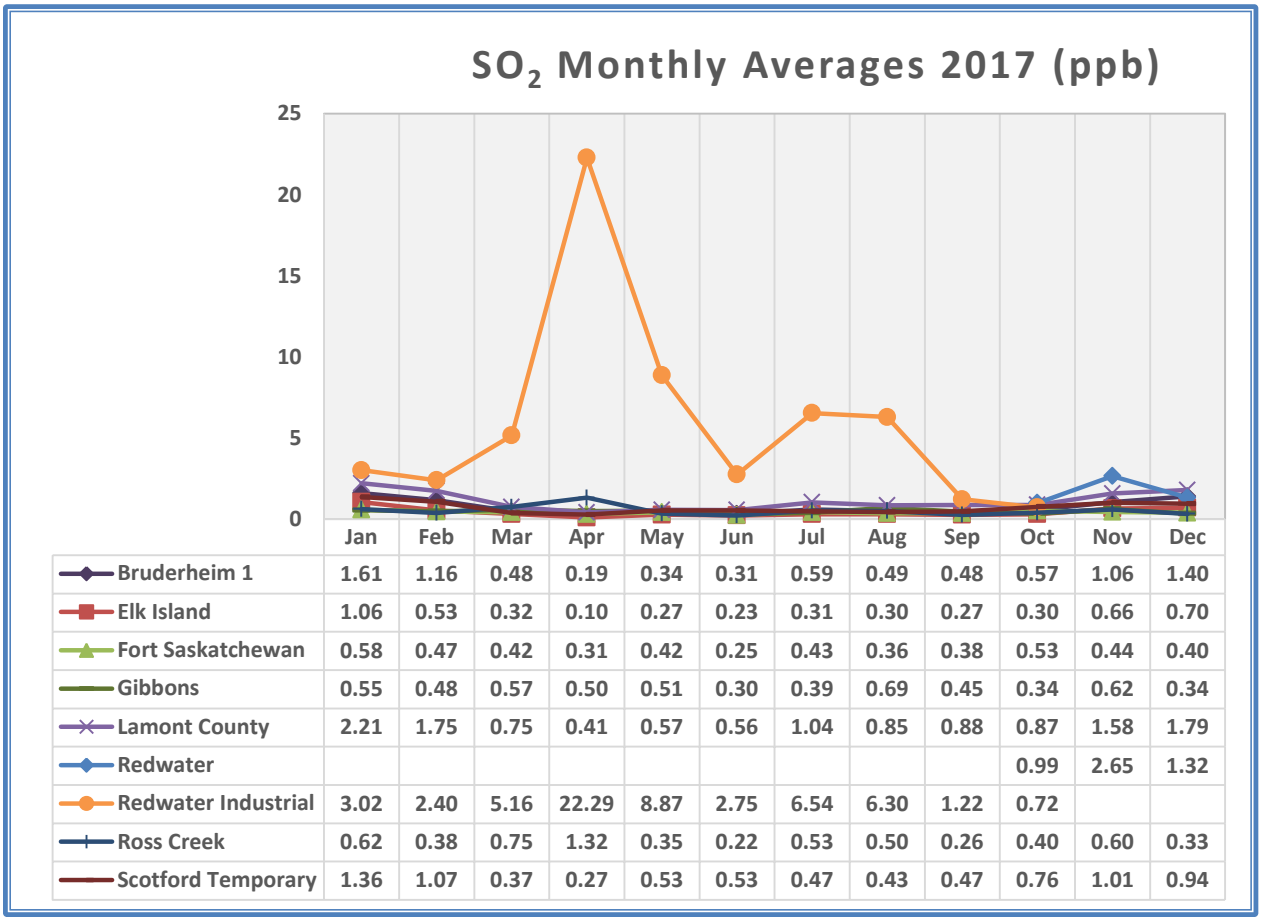
Station	Highest 24 hour average (ppb)	Exceedances	Date(s)	Attributed Cause
Redwater Industrial	72.73	8	April 5, 13, 17, 18, 22, 23, 24, 27	Local Industry
Redwater Industrial	60.42	1	May 11	Local Industry

At most monitoring locations within the FAP network, the sulphur dioxide concentrations are well below AAAQOs. In 2017 the only monitoring location to exceed the 1-hour SO_2 AAAQO was the Redwater Industrial Station. Note that the Redwater Industrial Station is located on an industrial property and is therefore not representative of regional air quality. Therefore comparison of monitoring results at this station to AAAQOs is not considered to be informative for regional air quality as per FAPs objectives.

A summary of SO_2 concentrations recorded in 2017 at individual stations and a comparison with the previous 4 years are presented in the figures and tables below. For additional information see also the station by station summaries in the appendices of this report.

Figure 42: Monthly average SO_2 concentrations (ppb) in 2017

S u lphur Dioxide (continued)

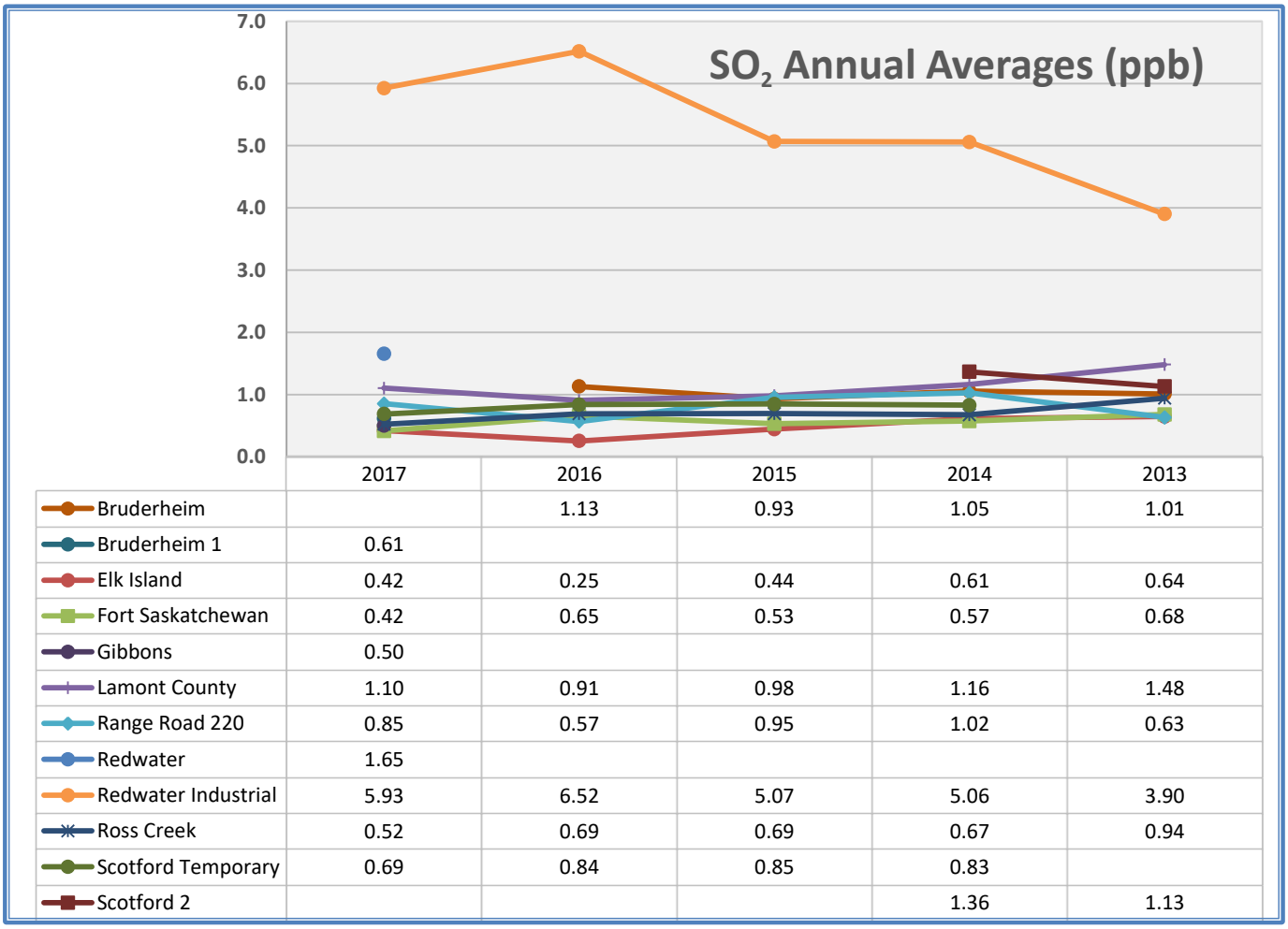


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	1.61	1.16	0.48	0.19	0.34	0.31	0.59	0.49	0.48	0.57	1.06	1.40
Elk Island	1.06	0.53	0.32	0.10	0.27	0.23	0.31	0.30	0.27	0.30	0.66	0.70
Fort Saskatchewan	0.58	0.47	0.42	0.31	0.42	0.25	0.43	0.36	0.38	0.53	0.44	0.40
Gibbons	0.55	0.48	0.57	0.50	0.51	0.30	0.39	0.69	0.45	0.34	0.62	0.34
Lamont County	2.21	1.75	0.75	0.41	0.57	0.56	1.04	0.85	0.88	0.87	1.58	1.79
Redwater										0.99	2.65	1.32
Redwater Industrial	3.02	2.40	5.16	22.29	8.87	2.75	6.54	6.30	1.22	0.72		
Ross Creek	0.62	0.38	0.75	1.32	0.35	0.22	0.53	0.50	0.26	0.40	0.60	0.33
Scotford Temporary	1.36	1.07	0.37	0.27	0.53	0.53	0.47	0.43	0.47	0.76	1.01	0.94

Note: SO_2 monitoring was stopped at Range Road 220 in January 2017
The Redwater Industrial station ceased operations in October 2017
The Redwater station began operation October 2017

Sulphur Dioxide (continued)

Figure 43: Annual average SO_2 concentrations at FAP stations (ppb)

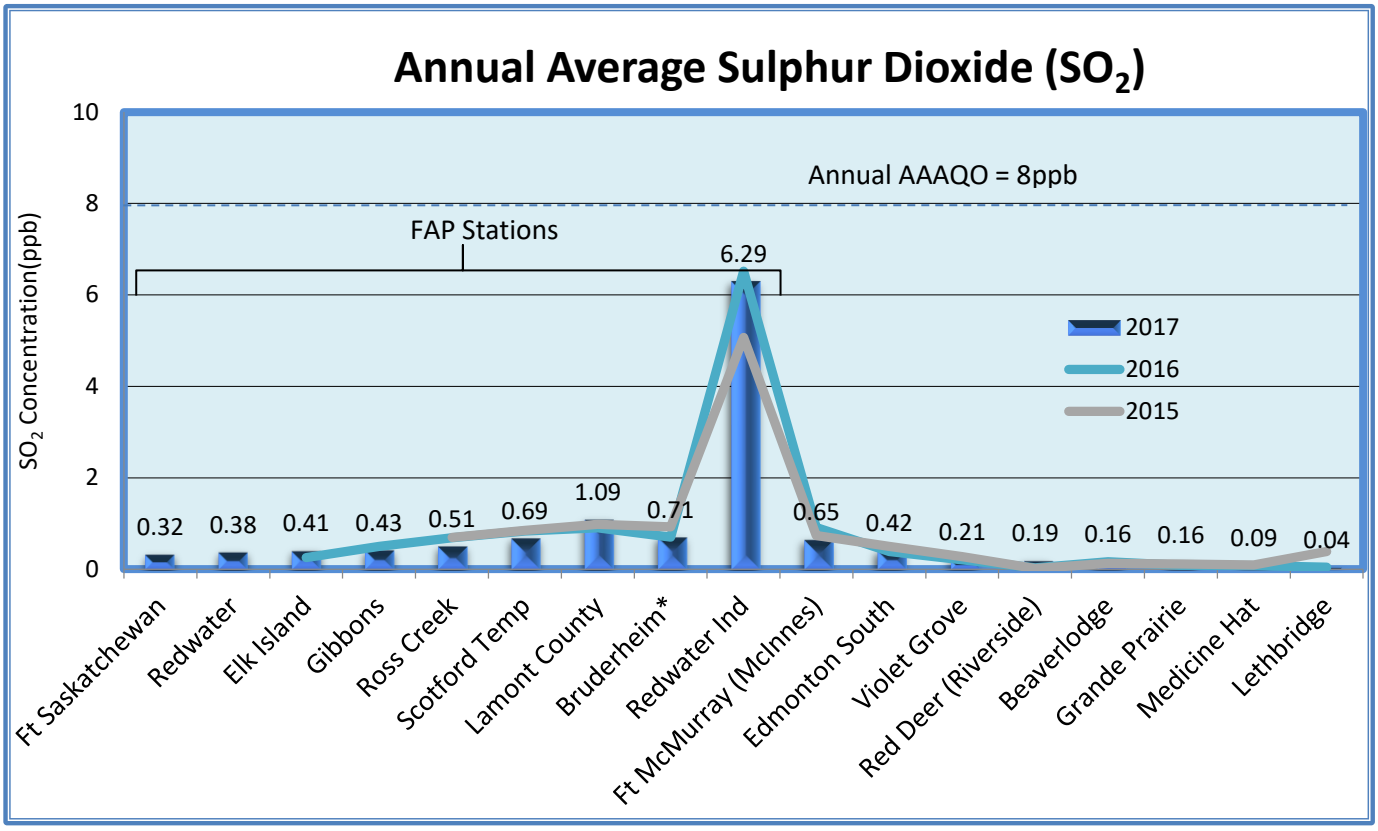


	2017	2016	2015	2014	2013
Bruderheim		1.13	0.93	1.05	1.01
Bruderheim 1	0.61				
Elk Island	0.42	0.25	0.44	0.61	0.64
Fort Saskatchewan	0.42	0.65	0.53	0.57	0.68
Gibbons	0.50				
Lamont County	1.10	0.91	0.98	1.16	1.48
Range Road 220	0.85	0.57	0.95	1.02	0.63
Redwater	1.65				
Redwater Industrial	5.93	6.52	5.07	5.06	3.90
Ross Creek	0.52	0.69	0.69	0.67	0.94
Scotford Temporary	0.69	0.84	0.85	0.83	
Scotford 2				1.36	1.13

Note: SO_2 monitoring was stopped at Range Road 220 in January 2017
The Redwater Industrial station ceased operations in October 2017
The Redwater station began operation October 2017

Sulphur Dioxide (continued)

Figure 44: Annual average SO_2 concentrations in Alberta (ppb)



*Bruderheim station moved in 2016, data combines both locations

Volatile Organic Compounds (VOCs)

Benzene, toluene, ethylbenzene, o-xylene, mp-xylenes, and styrene (BTEX/S)

BTEX/S fall into the group of compounds known as non-methane or VOC's. These compounds are typically found in petroleum products, such as gasoline and diesel fuel and have a characteristic strong odour. Significant sources of VOCs in Alberta are vegetation, automobile emissions, gasoline dispensing and storage tanks, petroleum and chemical industries, dry cleaning, fireplaces, natural gas combustion. The major source of VOCs in most urban areas is vehicle exhaust emissions.

BTEX/S has been measured on a semi-continuous (four samples per hour) basis at the Scotford 2 and subsequently at Scotford Temporary stations since January 2007.

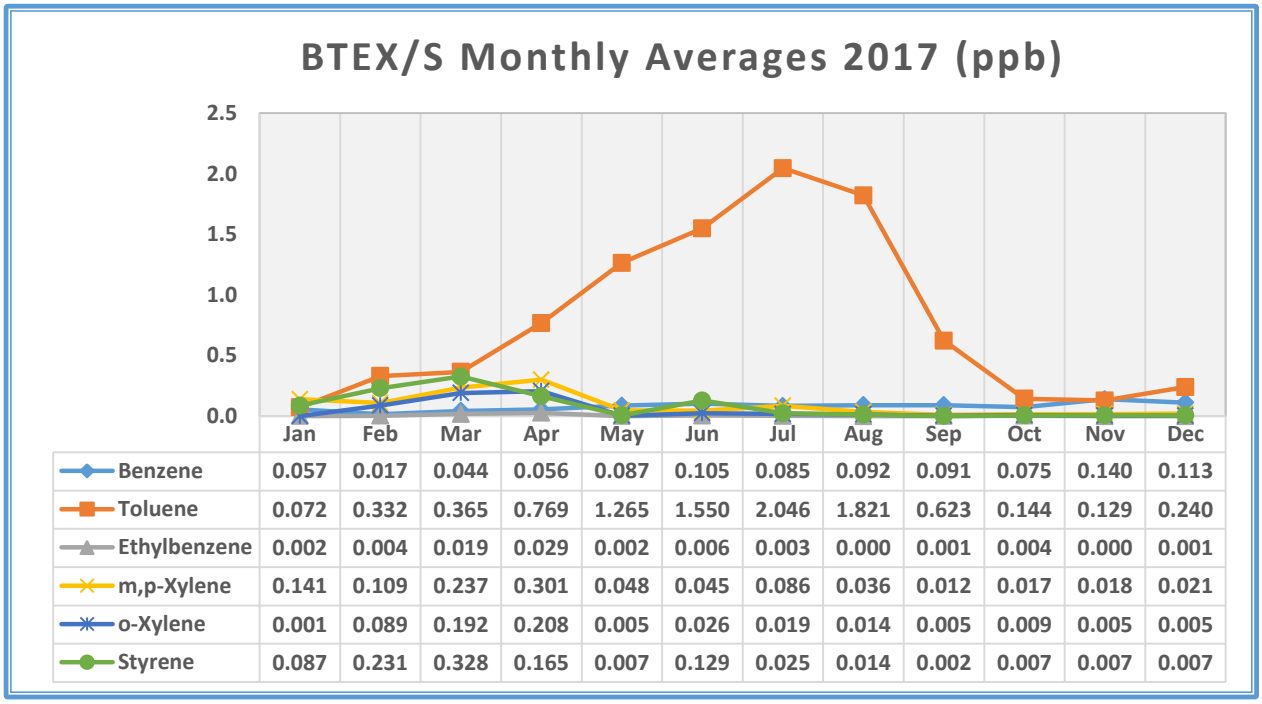
There were no exceedances for any of the BTEX/S compounds in 2017.

A summary of the BTEX and styrene concentrations recorded in 2017 at Scotford Temporary and a comparison with the previous 4 years are presented in the figures and tables below. For additional information see also the station by station summaries in the appendices of this report.

The slight increase in toluene in 2017 is due to off-gassing of a sealant used on the roof of the monitoring station shelter itself.

Volatile Organic Compounds (continued)

Figure 45: Monthly average BTEX/S concentrations (ppb) in 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benzene	0.057	0.017	0.044	0.056	0.087	0.105	0.085	0.092	0.091	0.075	0.140	0.113
Toluene	0.072	0.332	0.365	0.769	1.265	1.550	2.046	1.821	0.623	0.144	0.129	0.240
Ethylbenzene	0.002	0.004	0.019	0.029	0.002	0.006	0.003	0.000	0.001	0.004	0.000	0.001
m,p-Xylene	0.141	0.109	0.237	0.301	0.048	0.045	0.086	0.036	0.012	0.017	0.018	0.021
o-Xylene	0.001	0.089	0.192	0.208	0.005	0.026	0.019	0.014	0.005	0.009	0.005	0.005
Styrene	0.087	0.231	0.328	0.165	0.007	0.129	0.025	0.014	0.002	0.007	0.007	0.007

2017 Passive Monitoring Results

Figure 47: 2017 Map of Annual average SO_2 concentrations (ppb)

S

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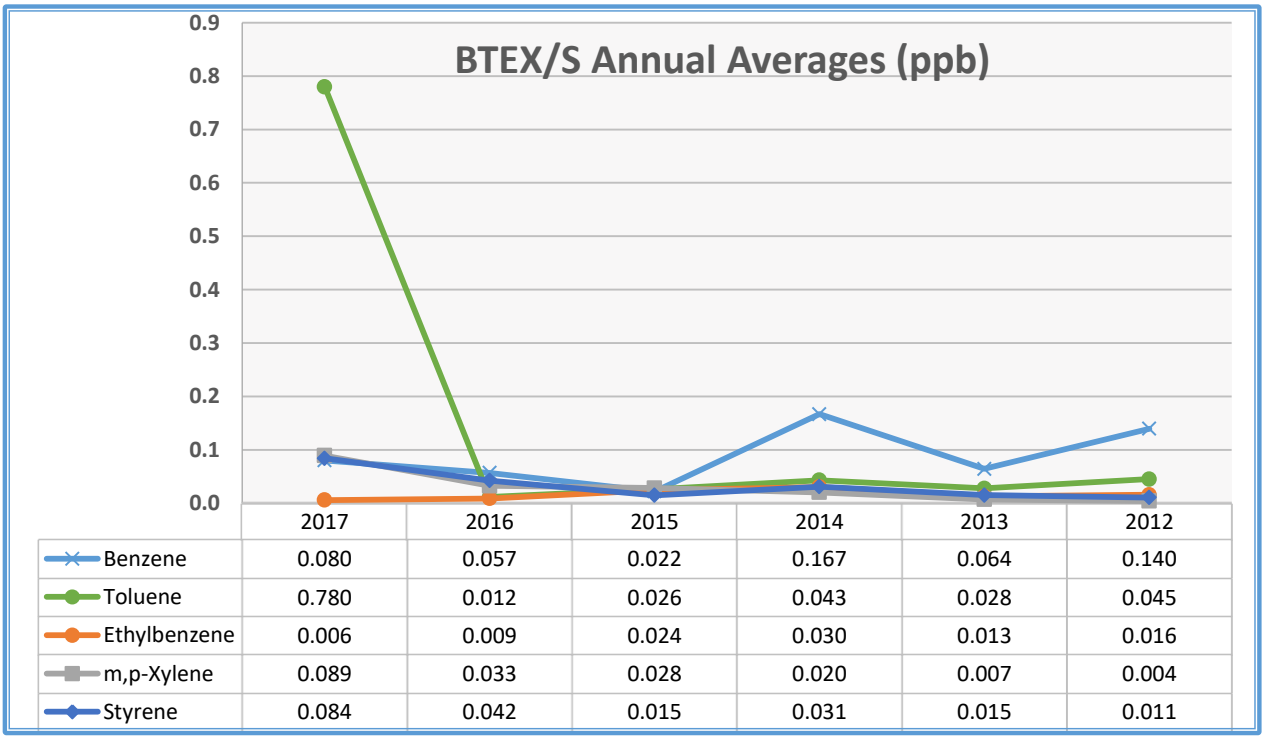
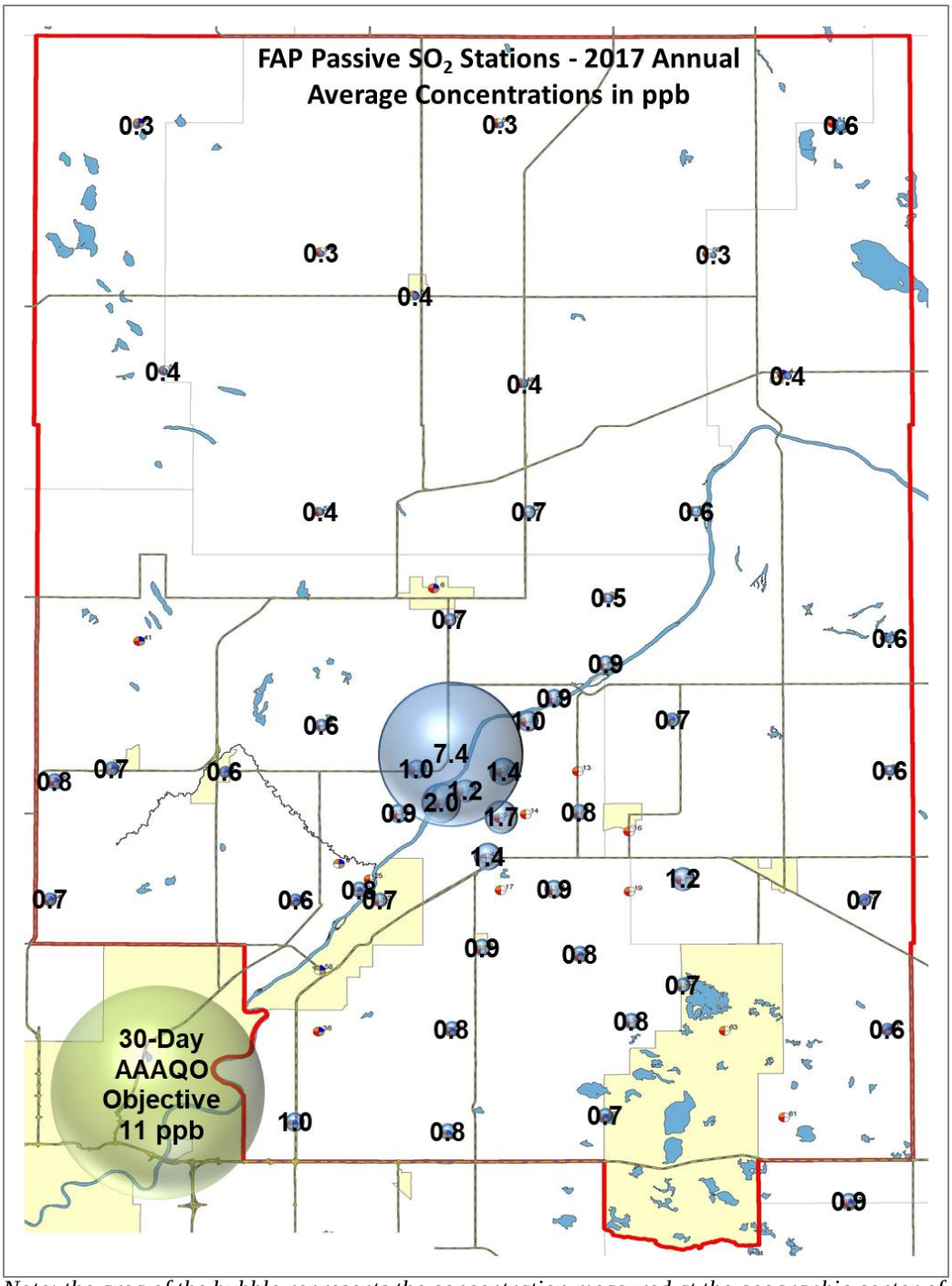
lphur Dioxide



	2017	2016	2015	2014	2013	2012
Benzene	0.080	0.057	0.022	0.167	0.064	0.140
Toluene	0.780	0.012	0.026	0.043	0.028	0.045
Ethylbenzene	0.006	0.009	0.024	0.030	0.013	0.016
m,p-Xylene	0.089	0.033	0.028	0.020	0.007	0.004
Styrene	0.084	0.042	0.015	0.031	0.015	0.011



Note: the area of the bubble represents the concentration measured at the geographic center of the bubble, not the geographic area impacted

Figure 48: Passive monitoring annual averages: SO_2 (ppb) - historical

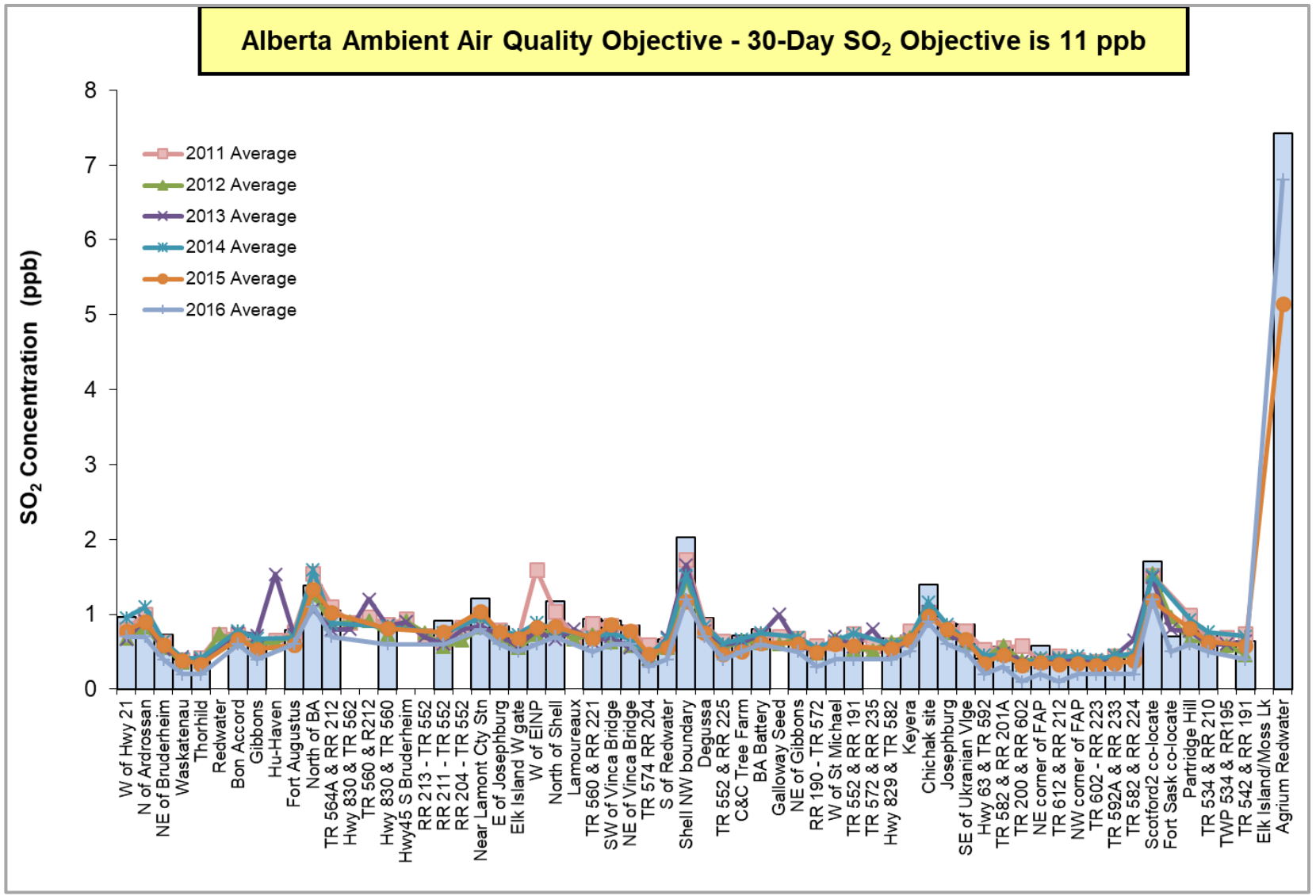
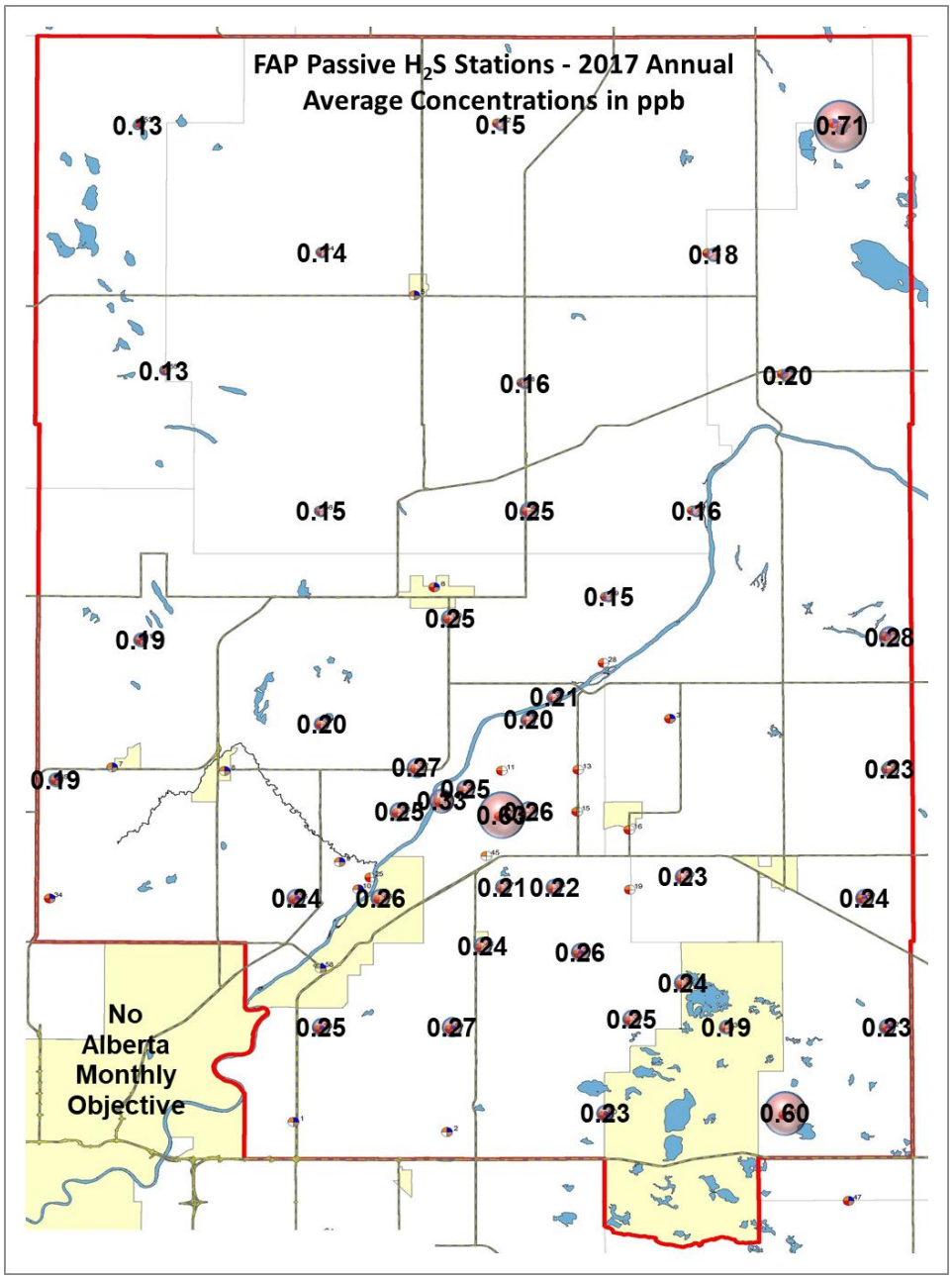

Alberta Ambient Air Quality Objective - 30-Day SO2 Objective is 11 ppb
SO2 Concentration (ppb)
0
1
2
3
4
5
6
7
8
2011 Average
2012 Average
2013 Average
2014 Average
2015 Average
2016 Average
W of Hwy 21
N of Ardrossan
NE of Bruderheim
Waskatenau
Thorhild
Redwater
Bon Accord
Gibbons
Hu-Haven
Fort Augustus
North of BA
TR 564A & RR 212
Hwy 830 & TR 562
TR 560 & R212
Hwy 830 & TR 560
Hwy45 S Bruderheim
RR 213 - TR 552
RR 211 - TR 552
RR 204 - TR 552
Near Lamont Cty Stn
E of Josephburg
Elk Island W gate
W of ElNP
North of Shell
Lamoureaux
TR 560 & RR 221
SW of Vinca Bridge
NE of Vinca Bridge
TR 574 RR 204
S of Redwater
Shell NW boundary
Degussa
TR 552 & RR 225
C&C Tree Farm
BA Battery
Galloway Seed
NE of Gibbons
RR 190 - TR 572
W of St Michael
TR 552 & RR 191
TR 572 & RR 235
Hwy 829 & TR 582
Keyera
Chichak site
Josephburg
SE of Ukranian Vlge
Hwy 63 & TR 592
TR 582 & RR 201A
TR 200 & RR 602
NE corner of FAP
TR 612 & RR 212
NW corner of FAP
TR 602 - RR 223
TR 592A & RR 233
TR 582 & RR 224
Scotford2 co-locate
Fort Sask co-locate
Partridge Hill
TR 534 & RR 210
TWP 534 & RR195
TR 542 & RR 191
Elk Island/Moss Lk
Agrium Redwater

Figure 49: 2017 Map of Annual average H_2S concentrations (ppb)

H

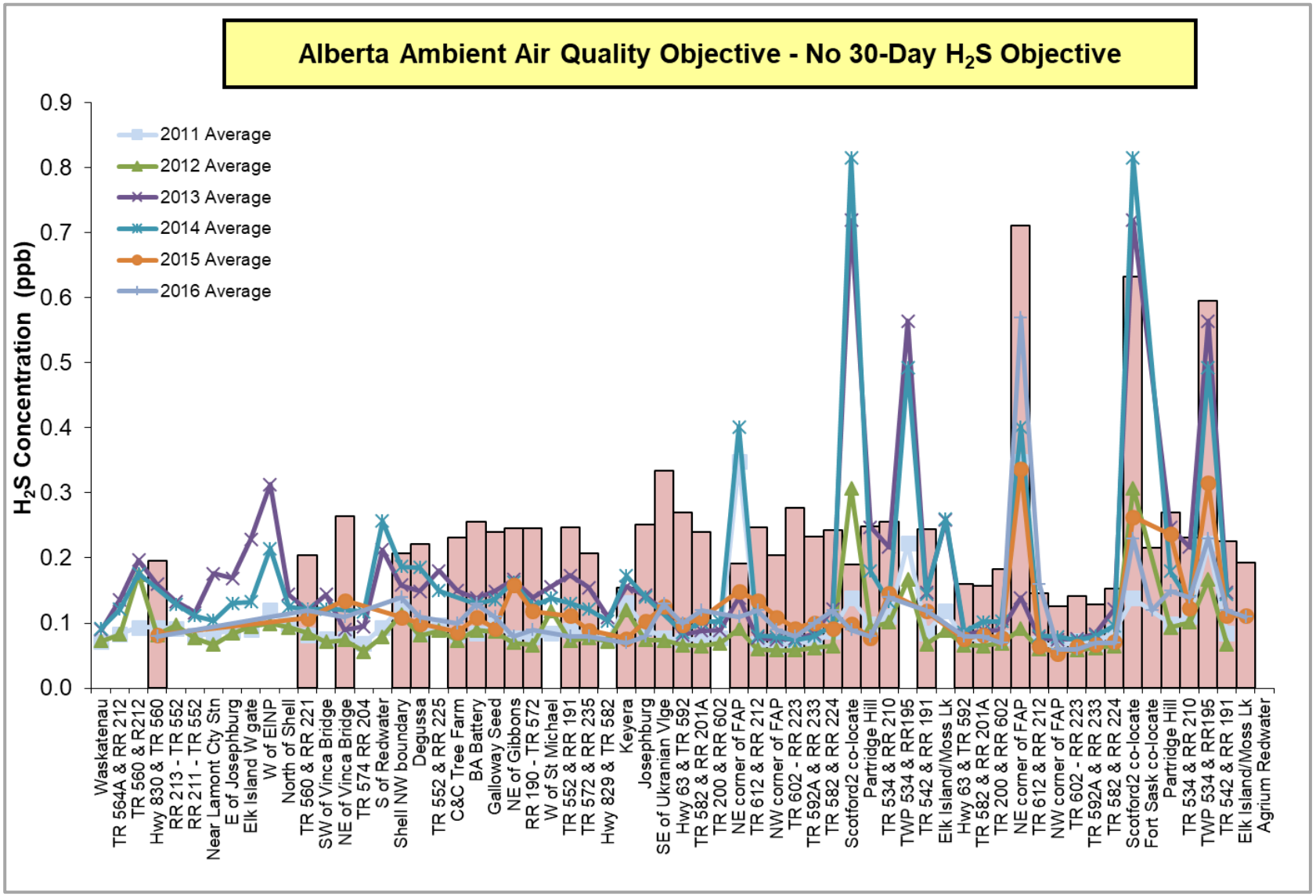
y

drogen Sulphide



Note: the area of the bubble represents the concentration measured at the geographic center of the bubble, not the geographic area impacted

Figure 50: Passive monitoring annual averages: H_2S (ppb) - historical



Other Technical Airshed Programs and Activities

Monitoring Plan Update

Airsheds in Alberta, including FAP, are required to file monitoring plans with the Alberta Government. In 2015, a detailed 5-year FAP Monitoring Plan was submitted and approved by the Alberta Government. Updates to the monitoring plan are filed every 6 months detailing progress towards proposed changes in monitoring and identifying any further new projects or changes to the monitoring network.

Following is a listing of the FAP network changes or new projects proposed in the 2015 Monitoring Plan. All changes have been approved by the Alberta Government. The date of implementation or status is included in italics.

- New permanent station in the vicinity of Gibbons
  (new station in Gibbons began operation February 2016)
- New Portable Monitoring Station
  (station purchased in 2017, expect to begin operation February 2018)
- Relocation of the Redwater Industrial Monitoring Station
  (new station in Redwater began operations October 2017)
- Relocation of the Scotford 2 Monitoring Station
  (site identified and approved, proceeding toward site construction and station move late 2018)
- Discontinue Redundant Monitoring Analyzers
  (SO_2 and NH_3 removed from Range Rd 220 station January 2017)
- Organic Hydrocarbons Sampling
  - Subproject 1: VOC Sampling project at Bruderheim
    (Phase 1 of the sampling had been completed July 2014-March 2015)
    (Phase 2 sampling began Sept 2017 and will run till August 2018)
  - Subproject 2: VOC Sampling in Area of Oil and Gas Development
    (nonmethane hydrocarbon sampling will be added to the portable station depending on sampling objectives at a given site)
- Upgrade $PM_{2.5}$ Technology
  (Completed October 2017 with start-up of the Redwater station. All stations with PM2.5 now operate approved equivalent method samplers)
- $PM_{2.5}$ Co-located Filter Sampling
  (2-year project, sampling from July 2015 to August 2017. Report completed December 2017)

The majority of planned projects have been implemented or are underway. FAP will be required to file a new 5-year monitoring plan in 2020.

Particulate Monitoring Technology Comparison Project

FAP conducted a fine particulate matter sampling comparison project at the Bruderheim 1 station from July 2015 to August 2017. A Partisol 2000 integrated filter-based particulate sampler was co-located with a continuous $PM_{2.5}$ Thermo Scientific SHARP 5030i monitor already at the station. The purpose of the study was to compare the two monitoring methods and investigate relationships between the reported concentrations from each sampler and ambient factors such as temperature, relative humidity and particulate composition. More than 80% of the $PM_{2.5}$ mass concentrations in both sampling data sets were less than 10 $\mu g/m^3$.

Figure 51 shows the daily variation of $PM_{2.5}$ concentrations for the Partisol and SHARP instruments (all data).

Figure 51: Daily variation of $PM_{2.5}$ mass concentrations – all data.

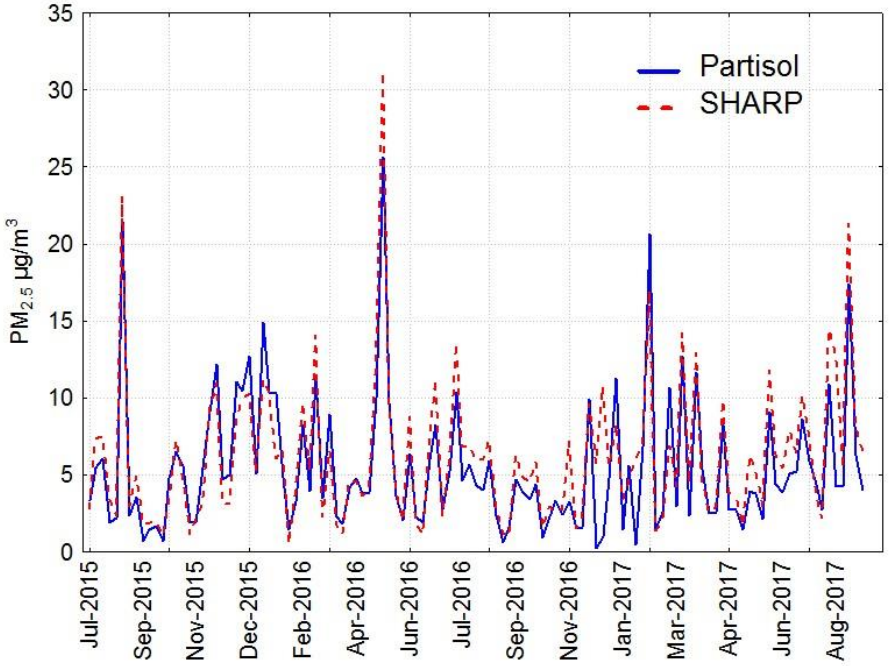


Figure 52 shows the percent differences (mean and 95th confidence interval) between the $PM_{2.5}$ mass concentrations (SHARP – Partisol) as a function of Partisol concentration using all data. Figure 53 shows results when days < 3 $\mu g/m^3$ and outliers are excluded. The largest variability and largest average percent difference occurs at low Partisol mass concentrations with positive percent differences (SHARP higher). There was also substantial variability at high mass loadings but there were very few observations.

Figure 52: Percent differences - all data

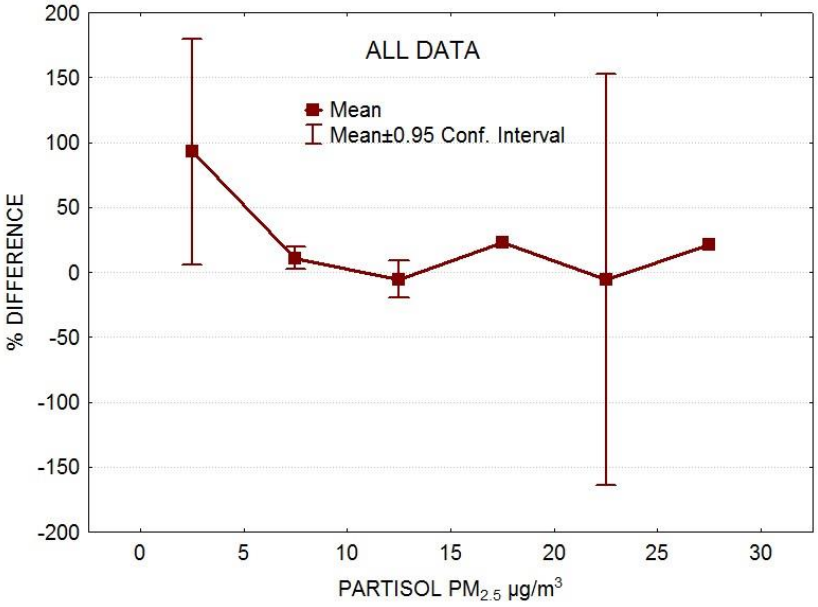
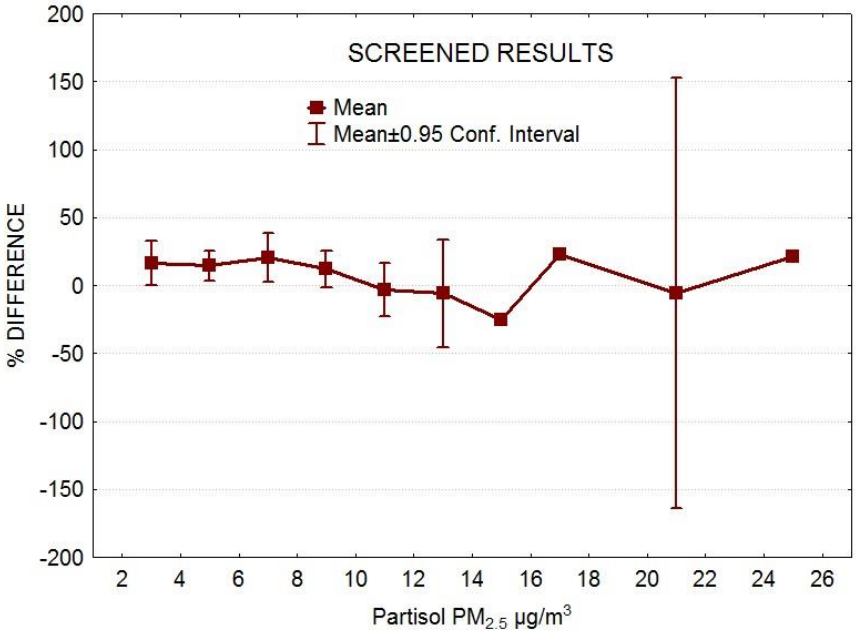


Figure 53: Percent differences with values < 3 µg/m^3 and outliers excluded.



Among the reports' findings, results from co-located FRM and SHARP 5030 FEM instruments from U.S. sites for the 2014 to 2016 time period, as well as co-located Partisol and SHARP 5030 results from seven Ontario sites for 2013-2015, were very similar to the Bruderheim results with SHARP $PM_{2.5}$ mass concentrations higher than filter based results. Also, $PM_{2.5}$ concentrations were similar on many days at both the Edmonton speciation site and at Bruderheim (especially on the highest concentration days). This suggests that similar particle composition would be expected at Bruderheim.

A more detailed discussion of the results is available in the report: *Comparison of SHARP 5030i and Partisol 2000 $PM_{2.5}$ Concentrations at Fort Air Partnership (FAP) Bruderheim Monitoring Station* (2015 – 2017)

Volatile Organics Speciation Project

FAP began a Volatile organic compound (VOC) sampling project at the Bruderheim 1 station in August of 2017. 24-hour samples are taken every 6 days while additional 1-hour samples are triggered on elevated measurements of the continuous non-methane hydrocarbon analyzer on site. The project will continue for 1 year.

VOC Speciation was recommended in a network assessment completed for the FAP network in 2012 and included as a project in the FAP Monitoring Plan submitted to Alberta Environment and Parks in 2015. This type of monitoring may be valuable to help understand the impact of the oil and gas wells on air quality in the region, especially a populated area such as Bruderheim.

The Air Quality Health Index (AQHI) is currently the primary means to report potential air quality impact to human health. In the 2012 Network Assessment, it was noted that while acute exposures are the most important from a public health awareness perspective, chronic exposures also need to be considered. These long-term exposures expand the list of pollutants of interest.

In a previous 19-month, short-term monitoring study of volatile organic compounds (VOCs) in the airshed in 2006, it was determined that most VOCs were at much lower concentrations than at other National Air Pollutant Surveillance (NAPS) sites throughout Canada where VOCs had been monitored. However, all other monitoring sites compared were in much more populated areas (with much higher urban emissions) than at the FAP sites (e.g., Edmonton, Ontario). Moreover, the addition and expansion of industrial facilities and increase in oil and gas wells within the airshed may have increased local VOC emissions since 2006.

Phase 1 of the project ran from October 2014 to March 2015. The second phase will add additional data for a better understanding of the air quality in the vicinity of this concentrated area of oil and gas wells.

Fine Particulate Matter Response Plan

In January 2015, a Fine Particulate Matter Response Plan for the Capital Region was finalized. The Fine Particulate Matter Response Plan includes recommended actions to:

- reduce $PM_{2.5}$ concentrations in the outside air
- improve knowledge of $PM_{2.5}$ in the Capital Region
- engage with people about their responsibilities to reduce ambient $PM_{2.5}$

Implementation of the Fine Particulate Matter Response Plan will be evaluated and reported against the new Canadian Ambient Air Quality Standards (CAAQS) that have been adopted nationally for $PM_{2.5}$. Measurements of $PM_{2.5}$ taken by Fort Air Partnership and other airsheds will be compared to these new CAAQS.

Fort Air Partnership's air monitoring stations measure the amount of fine particulate matter in the air. Higher measurements are often recorded in cold winter months. Cold temperatures and stagnant air can create a build-up of pollutants near the ground, particularly during a weather phenomenon called a temperature inversion where cold air is trapped near the ground by a layer of warm air. The warm air acts like a lid, holding these pollutants down until wind, rain or snow storms helps to disperse them. Some examples of actions that people can take during the wintertime to reduce their contribution to $PM_{2.5}$ include carpooling, not idling their cars when parked and working from home if possible.

In 2017 Fort Air Partnership continued to participate on the Capital Region Oversight Advisory Committee that is overseeing the implementation of the Capital Region Particulate Matter Response Plan.

FAP is planning a fine particulate matter speciation project in Fort Saskatchewan. Sampling for the 2-year project will begin in 2018. Results from this project will add an additional piece of information that can help to inform the committee and implementation of the Particulate Matter Response Plan for the Capital Region of which our region is a part of .

Live to Web Data Feed

FAP continues to provide a free, on-line data feed that allows anyone to check out air quality readings at any time. People can search by station, or by substance, and get hour-by-hour current or historic raw data in an easy-to-understand format. The technical sister to this public service allows regulators, technical group users and emergency responders to receive minute-by-minute data in near real time.

The data available on the FAP live data site are raw numbers but quality controls ensure the data is validated before being permanently stored in the Alberta Government Air Data Warehouse.

Appendices

Appendix A: Technical Working Group Members

(As of December 31, 2017)

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Shell Scotford

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Appendix B: Monitoring Objectives

Table 18: FAP Monitoring Objectives

Ranking	Objective
Priority 1	Understand spatial distribution of pollutants in the region
	Identify regional air quality trends
	Provide flexibility to characterize emerging issues, sources, and locations.
Priority 2	Provide appropriate information for evaluating population exposure to ambient air quality
	Provide information required to understand air quality impacts on the health of the environment
Priority 3	Improve the ability to identify and apportion pollutant sources for purposes of air quality management
	Provide suitable input and validation information for air quality models

Appendix C: Industry Participants in FAP

Table 19: Industry Participants in FAP (Dec. 31, 2017)

A.
As funders of FAP through Northeast Capital Industrial Association and participation on the FAP Board of Directors

- Agrium Redwater
- ME Global

B.
As funders of FAP through Northeast Capital Industrial Association and participation in the Technical Working Group

- Agrium
- ARC Resources
- Cenovus Energy
- Chemtrade Logistics
- Dow Chemical Canada ULC
- North West Redwater Partnership
- Pembina Pipeline Corp.
- Shell Scotford (Shell Chemicals, Shell Refinery and Shell Upgrader)
- Sherritt International Corp.
- Oerlikon Metco (Canada) Inc.
- Umicore Canada Inc.

C. As funders of FAP through Northeast Capital Industrial Association

- Access Pipeline
- Agrium Fort Saskatchewan
- Agrium Redwater
- Air Liquide Canada Inc.
- ARC Resources
- Aux Sable Canada
- Cenovus Energy
- Chemtrade Logistics (CSC)
- Chemtrade Logistics (Sulphides)
- Dow Chemical Canada ULC
- Enbridge Pipelines Inc.
- Evonik
- Keyera Energy
- MEGlobal Canada Inc.
- MEG Energy
- North West Redwater Partnership
- Oerlikon Metco (Canada)
- Pembina Pipeline Corp.
- Plains Midstream Canada
- Praxair Canada Inc.
- Shell Scotford (Shell Chemicals, Shell Refinery and Shell Upgrader)
- Sherritt International Corp.
- Umicore Canada Inc.
- Value Creation

Appendix D: Continuous Station Data Summary Tables

Table 20: Bruderheim 1 Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values				Operational Time (%)	Readings above AAAQO	
		24-hr	Date	1-hr	Date/Hour		24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	0.72	6.99	Jan 14	46.47	Jan 25 09:00	99.9	0	0
Nitrogen Dioxide NO_2 measured in ppb	5.21	22.42	Dec 08	36.98	Nov 04 18:00	99.0	-	0
Ozone O_3 measured in ppb	21.76	38.98	Jun 08	65.94	Sep 06 17:00	99.9	-	0
Total Hydrocarbon THC measured in ppm	1.99	3.19	Mar 14	8.27	Mar 05 22:00	93.3	-	-
Methane CH_4 measured in ppm	1.98	3.19	Mar 14	7.31	Mar 05 22:00	93.3	-	-
Non-Methane Hydrocarbon NMHC measured in ppm	0.02	0.31	Jan 25	1.51	Sep 07 07:00	93.3	-	-
Particulate Matter $PM_{2.5}$ measured in µg/m³	6.95	61.86	Aug 14	175.61	Aug 14 05:00	99.5	5	13

Table 21: Elk Island Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values				Operational Time (%)	Readings above AAAQO	
		24-hr	Date	1-hr	Date/Hour		24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	0.42	4.89	Jan 14	20.73	Jan 24 04:00	99.8	0	0
Nitrogen Dioxide NO_2 measured in ppb	3.34	15.76	Jan 03	38.26	Jan 03 17:00	99.2	-	0
Ozone O_3 measured in ppb	29.51	51.54	Sep 07	76.94	Sep 06 14:00	99.7	-	0
Particulate Matter $PM_{2.5}$ measured in µg/m³	6.55	54.64	Aug 14	271.23	Aug 13 23:00	98.4	5	12

Table 22: Fort Saskatchewan Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values				Operational Time (%)	Readings above AAAQO	
		24-hr	Date	1-hr	Date/Hour		24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	0.42	2.94	Jul 27	26.65	Jul 27 12:00	99.9	0	0
Hydrogen Sulphide H_2S measured in ppb	0.31	1.73	Feb 12	8.27	Aug 02 06:00	99.8	0	0
Nitrogen Dioxide NO_2 measured in ppb	8.40	37.16	Jan 13	53.53	Mar 14 09:00	99.4	-	0
Ammonia NH_3 measured in ppm	0.00	0.016	Aug 11	0.066	Aug 11 10:00	99.3	0	0
Ozone O_3 measured in ppb	25.10	49.28	Jun 08	77.72	Sep 07 15:00	100.0	-	0
Total Hydrocarbon THC measured in ppm	2.03	2.463	Nov 18	4.578	Aug 09 06:00	99.4	-	-
Methane CH_4 measured in ppm	2.02	2.459	Nov 18	4.312	Aug 09 06:00	99.4	-	-
Non-Methane Hydrocarbon NMHC measured in ppm	0.00	0.07	Nov 10	0.91	Nov 10 22:00	99.4	-	-
Carbon Monoxide CO measured in ppm	0.09	0.52	Nov 18	1.42	Aug 13 23:00	99.6	-	0
Particulate Matter $PM_{2.5}$ measured in µg/m³	7.79	42.84	Jul 16	89.27	Mar 29 14:00	94.9	3	2

Table 23: Gibbons Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values				Operational Time (%)	Readings above AAAQO	
		24-hr	Date	1-hr	Date/Hour		24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	0.48	3.10	Jan 24	19.53	Mar 29 16:00	99.8	0	0
Hydrogen Sulphide H_2S measured in ppb	0.20	0.87	Mar 14	3.33	Jul 07 05:00	99.4	0	0
Nitrogen Dioxide NO_2 measured in ppb	6.05	25.70	Nov 28	43.57	Feb 09 07:00	99.8	-	0
Ozone O_3 measured in ppb	26.24	47.46	Jun 08	76.36	Sep 07 15:00	99.8	-	0
Particulate Matter $PM_{2.5}$ measured in µg/m³	7.65	53.45	Aug 14	268.46	Aug 13 22:00	99.3	5	16

Table 24: Lamont County Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values				Operational Time (%)	Readings above AAAQO	
		24-hr	Date	1-hr	Date/Hour		24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	1.10	9.38	Jan 14	30.14	Jan 16 14:00	99.5	0	0
Hydrogen Sulphide H_2S measured in ppb	0.31	1.73	Feb 12	8.27	Aug 02 06:00	99.8	0	0
Nitrogen Dioxide NO_2 measured in ppb	3.66	18.37	Dec 08	36.07	Feb 16 22:00	99.3	-	0
Ozone O_3 measured in ppb	29.44	56.30	Sep 07	79.82	Sep 06 17:00	99.9	-	0
Total Hydrocarbon THC measured in ppm	1.97	2.195	Nov 12	3.959	Jun 01 09:00	99.6	-	-
Methane CH_4 measured in ppm	1.97	2.195	Nov 12	2.835	Oct 20 10:00	99.6	-	-
Non-Methane Hydrocarbon NMHC measured in ppm	0.00	0.10	Jun 01	2.16	Jun 01 09:00	99.6	-	-
Particulate Matter $PM_{2.5}$ measured in µg/m³	6.87	58.40	Aug 14	166.91	Aug 14 00:00	99.6	6	13

Table 25: Range Road 220 Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values				Operational Time (%)	Readings above AAAQO	
		24-hr	Date	1-hr	Date/Hour		24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	0.74	1.58	Jan 03	7.78	Jan 03 04:00	100.0	0	0
Nitrogen Dioxide NO_2 measured in ppb	6.99	38.41	Jan 25	85.28	Jan 29 08:00	99.2	-	0
Ammonia NH_3 measured in ppm	0.00	0.001	Jan 11	0.007	Jan 11 06:00	100.0	-	0
Ethylene C_2H_4 measured in ppb	2.23	59.51	Mar 19	216.41	Mar 19 03:00	93.9	0	0
Total Hydrocarbon THC measured in ppm	2.07	2.516	Nov 11	4.096	Apr 19 08:00	99.3	-	-
Methane CH_4 measured in ppm	2.03	2.445	Nov 11	3.472	Jul 29 22:00	99.3	-	-
Non-Methane Hydrocarbon NMHC measured in ppm	0.04	0.19	Mar 23	2.11	Apr 19 08:00	99.3	-	-

Table 26: Redwater Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values 24-hr	Date	1-hr	Date/Hour	Operational Time (%)	Readings above AAAQO 24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	0.41	2.65	Nov 04	11.32	Nov 22 15:00	99.6	0	0
Hydrogen Sulphide H_2S measured in ppb	-8332.45	0.74	Feb 16	2.65	Dec 31 20:00	16.7	0	0
Nitrogen Dioxide NO_2 measured in ppb	8.24	26.47	Dec 01	38.13	Nov 30 22:00	98.6	-	0
Ozone O_3 measured in ppb	22.65	39.12	Dec 07	43.66	Dec 10 12:00	99.0	-	0
Ammonia NH_3 measured in ppm	2.05	10.090	Dec 10	182.508	Dec 10 02:00	98.7	-	0
Particulate Matter $PM_{2.5}$ measured in µg/m³	7.08	30.31	Nov 11	45.88	Nov 04 10:00	99.9	1	0

Note the Redwater station began operations October 2017

Table 27: Redwater Industrial Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values				Operational Time (%)	Readings above AAAQO	
		24-hr	Date	1-hr	Date/Hour		24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	5.93	72.73	Apr 13	469.91	Apr 17 06:00	99.2	9	38
Nitrogen Dioxide NO_2 measured in ppb	6.07	26.84	Jan 17	60.81	Jan 17 17:00	99.1	-	0
Ammonia NH_3 measured in ppm	0.02	0.271	Jul 09	2.758	Jul 09 15:00	99.0	-	0
Particulate Matter $PM_{2.5}$ measured in µg/m³	-827.19	43.62	Jul 20	123.79	Mar 29 14:00	79.8	3	2

Note the Redwater Industrial station ceased operations October 2017

Table 28: Ross Creek Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values				Operational Time (%)	Readings above AAAQO	
		24-hr	Date	1-hr	Date/Hour		24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	0.52	8.77	Apr 17	43.52	Apr 18 14:00	99.9	0	0
Nitrogen Dioxide NO_2 measured in ppb	7.07	38.16	Jan 13	56.90	Jan 13 17:00	99.8	-	0
Ammonia NH_3 measured in ppm	0.01	0.186	May 16	0.830	Aug 11 09:00	99.3	-	0
Ethylene C_2H_4 measured in ppb	2.18	15.22	Jan 19	62.15	Dec 06 10:00	97.1	0	0

Table 29: Scotford Temporary Station Continuous Monitoring Data - 2017 Summary

Parameter	Annual Average	Maximum Values				Operational Time (%)	Readings above AAAQO	
		24-hr	Date	1-hr	Date/Hour		24-hr	1-hr
Sulphur Dioxide SO_2 measured in ppb	0.69	6.20	Jan 14	17.54	Jan 24 05:00	100.0	0	0
Hydrogen Sulphide H_2S measured in ppb	0.31	1.73	Feb 12	8.27	Aug 02 06:00	99.8	0	0
Nitrogen Dioxide NO_2 measured in ppb	4.94	27.27	Dec 08	40.23	Nov 11 17:00	99.9	-	0
Benzene measured in ppb	0.08	1.01	Jan 31	2.48	Apr 14 16:00	98.2	0	0
Toluene measured in ppb	0.78	2.81	Jul 22	4.05	Jul 27 18:00	98.2	0	0
Ethylbenzene measured in ppb	0.01	0.25	Apr 03	0.72	Feb 16 07:00	98.2	0	0
o-Xylene measured in ppb	0.05	1.97	Mar 25	6.76	Mar 24 20:00	98.2	0	0
m,p-Xylene measured in ppb	0.09	2.15	Apr 03	7.85	Jan 13 13:00	98.2	0	0
Styrene measured in ppb	0.08	2.44	Mar 25	7.62	Mar 24 20:00	98.2	0	0

Appendix E: Passive Data Summary Tables

Table 30: 2017 Passive monitoring monthly averages: SO_2 (ppb)

Site	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.	Max
1	Stocks Greenhouses	1.4	1.0	0.9	0.6	0.9	0.9	1.5	0.8	0.7	0.8	1.0	1.6	1.0	1.5
2	Ardrossan northeast	1.3	1.2	0.9	0.4	0.7	0.7	1.0	0.6	0.7	0.6	1.1	1.8	0.8	1.3
3	Bruderheim northeast	1.1	1.2	0.6	0.3	0.7	0.7	1.0	0.6	0.5	0.4	0.9	1.0	0.7	1.2
4	Waskatenau	0.7	0.6	0.4	0.2	0.3	0.3	0.4	0.2	0.3	0.3	0.6	0.4	0.4	0.7
5	Thorhild	0.4	0.4	0.5	0.3	MISSING		0.4	0.2	0.4	0.3	0.4	0.2	0.4	0.5
7	Bon Accord	0.8	0.9	1.2	0.6	0.5	0.5	0.9	0.7	0.5	0.5	1.0	0.8	0.7	1.2
8	Gibbons	0.5	0.7	0.9	0.7	0.4	0.4	0.9	0.7	0.4	0.4	0.7	0.4	0.6	0.9
10	Fort Augustus	0.7	0.9	0.9	0.7	0.5	0.5	1.0	0.8	0.7	0.9	1.1	0.6	0.8	1.1
11	North of BA	1.7	1.6	0.8	1.3	1.5	1.5	1.9	1.0	1.4	0.6	1.9	3.7	1.4	1.9
12	TwpRd 564A RgeRd 212	1.9	1.9	0.7	0.5	0.6	0.6	1.3	0.8	1.2	0.6	1.4	1.8	1.0	1.9
15	Hwy 830 Twp Rd 560	1.2	1.5	0.6	0.4	0.6	0.6	1.0	0.6	0.7	0.5	1.2	1.6	0.8	1.5
18	Rge Rd 211 TwpRd 552	1.3	1.7	0.9	0.4	0.7	0.7	0.7	0.8	0.6	0.9	1.3	1.2	0.9	1.7
20	Rge Rd 202	1.7	2.5	1.1	0.6	0.7	0.7	1.2	0.7	0.9	1.2	2.0	2.0	1.2	2.5
21	Josephburg east	1.3	1.4	0.7	0.4	0.7	0.7	0.8	0.7	0.6	0.7	1.3	1.2	0.8	1.4
22	Elk Island Park west gate	1.1	1.3	0.6	0.3	0.7	0.7	0.8	0.6	0.5	0.5	1.0	1.2	0.7	1.3
23	Goodhope	1.3	1.3	0.8	0.4	0.7	0.7	0.9	0.6	0.7	0.6	1.0	1.3	0.8	1.3
24	North of Scotford	1.3	1.5	1.0	0.8	0.7	0.7	1.2	0.9	1.3	1.7	1.9	1.4	1.2	1.9
26	Twp Rd 560 Rge Rd 221	0.7	1.3	1.6	1.3	0.5	0.5	0.9	0.9	0.7	0.7	1.2	0.4	0.9	1.6
27	Boat Launch	1.8	1.7	0.8	0.4	0.6	0.6	0.7	0.8	0.6	0.7	1.3	1.5	0.9	1.8
28	Redwater Natural Area S	1.7	1.4	0.6	0.4	0.7	0.7	0.7	0.7	0.8	0.6	1.1	1.5	0.9	1.7
29	Redwater Natural Area N	1.2	1.0	0.5	0.2	0.4	0.4	0.3	0.3	0.2	0.4	0.7	0.5	0.5	1.2
30	Redwater south	0.6	0.7	0.8	0.6	0.8	0.8	0.8	0.5	0.5	0.5	0.8	0.4	0.7	0.8
31	Northwest of Scotford	1.2	0.9	2.6	1.7	2.7	2.7	1.8	2.2	2.6	1.9	2.0	1.8	2.0	2.7
32	Degussa	0.6	0.7	1.0	1.7	0.7	0.7	1.4	1.2	0.9	0.6	1.0	0.5	1.0	1.7
33	Twp Rd 552 Rge Rd 225	0.5	0.8	0.9	0.6	0.4	0.4	0.8	0.6	0.5	0.6	0.9	0.4	0.6	0.9
34	C&C Tree Farm	0.6	0.9	1.0	0.8	0.6	0.6	0.9	0.5	0.6	0.5	0.9	0.6	0.7	1.0
35	Bon Accord southwest	0.9	1.1	1.4	0.8	0.9	0.9	0.9	0.6	0.6	0.5	0.2	0.8	0.8	1.4
37	Twp Rd 564 Rge Rd 224	0.6	0.8	0.9	0.6	0.6	0.6	0.7	0.7	0.4	0.4	0.8	0.3	0.6	0.9
38	Peno	1.1	0.9	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.3	0.8	1.5	0.6	1.1
39	Saint Michael	1.0	0.9	0.5	0.3	0.4	0.4	0.6	0.5	0.4	0.3	0.9	1.4	0.6	1.0
40	Lamont east	1.0	1.0	0.5	0.3	0.5	0.5	0.6	0.6	0.6	0.5	1.1	2.1	0.7	1.1
42	Radway - Val Soucy	1.1	1.0	0.5	0.5	0.5	0.5	0.7	0.5	0.4	1.0	0.8	0.7	0.7	1.1
43	Keyera Site	0.7	0.8	0.7	0.8	0.6	0.6	0.8	0.6	0.7	0.8	0.8	0.9	0.7	0.8
45	Scotford east	Station not in operation									1.3	1.5	1.2	1.4	1.5
46	Josephburg	1.4	1.5	0.9	0.6	0.7	0.7	0.7	0.5	0.6	0.8	1.3	1.1	0.9	1.5
47	Southeast of FAP	1.6	0.9	0.7	0.4	1.0	1.0	1.1	0.5	0.6	0.6	1.1	1.4	0.9	1.6
48	Highway 63	0.5	0.5	0.6	0.5	0.4	0.4	0.2	0.2	0.3	0.5	0.4	0.2	0.4	0.6
49	Namepi Creek	1.3	0.7	0.6	0.5	0.4	0.4	0.5	0.3	0.3	0.4	0.8	0.5	0.6	1.3
50	Sprucefield	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.4	0.4	0.2	0.3	0.5
51	Hollow Lake	0.4	0.5	0.6	0.4	0.4	0.4	1.2	1.1	0.6	0.3	0.5	0.3	0.6	1.2
52	Abee	0.4	0.5	0.5	0.4	0.2	0.2	0.3	0.2	0.3	0.3	0.4	0.2	0.3	0.5
53	Tawatinaw - Clearbrook	0.4	0.5	0.4	0.4	0.3	0.3	0.4	0.2	0.2	0.3	0.4	0.3	0.3	0.5
54	Elbridge	0.4	0.4	0.4	0.2	0.4	0.4	0.2	0.2	0.5	0.2	0.5	0.2	0.3	0.5
55	Taylor Lake	0.4	0.4	0.6	0.3	0.5	0.5	0.3	0.3	0.3	0.2	0.7	0.2	0.4	0.7
56	Opal	0.6	0.5	0.5	0.3	0.3	0.3	0.5	0.2	0.3	0.3	0.4	0.2	0.4	0.6
57	Scotford 2	1.7	1.8	1.1	0.7	1.6	1.6	2.5	2.8	1.8	1.2	1.9	2.7	1.7	2.8
58	Fort Saskatchewan	0.8	0.9	0.7	0.6	0.4	0.4	0.6	0.6	0.5	0.9	1.3	0.7	0.7	1.3
59	Partridge Hill	1.4	1.1	0.7	0.4	0.6	0.6	0.8	0.7	0.6	0.7	1.0	1.5	0.8	1.4
60	Oxbow Lake	1.0	0.9	0.6	0.5	0.8	0.8	1.0	0.7	0.6	0.4	0.9	1.1	0.7	1.0
62	FAP East Boundary	0.9	0.9	0.6	0.3	0.6	0.6	0.8	0.4	0.5	0.4	1.0	1.4	0.6	1.0
64	Agrium Redwater	2.8	4.1	7.2	28.4	3.0	3.0	13.5	7.5	1.7	1.2	9.3	4.5	7.4	28.4
	Average	1.0	1.1	0.9	1.1	0.7	0.7	1.1	0.8	0.7	0.6	1.2	1.1	0.9	
	Maximum	2.8	4.1	7.2	28.4	3.0	3.0	13.5	7.5	2.6	1.9	9.3	4.5		28.4

Reportable Detection Limit: 0.2 ppb
n/a: no sample

Table 31: 2017 Passive monitoring monthly averages: H_2S (ppb)

Site	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.	Max
4	Waskatenau	0.06	0.16	0.11	0.13	0.18	0.26	0.28	0.30	0.34	0.14	0.19	0.20	0.2	0.3
12	TwpRd 564A RgeRd 212	0.07	0.17	0.11	0.14	0.17	0.26	0.28	0.31	0.27	0.16	0.28	0.22	0.2	0.3
14	Astotin Creek	0.09	0.20	0.16	0.13	0.22	0.30	0.49	0.53	0.36	0.19	0.26	0.24	0.3	0.5
17	Rge Rd 213 TwpRd 552	0.08	0.18	0.15	0.16	0.24	0.38	0.29	0.33	0.26	0.00	0.22	0.20	0.2	0.4
18	Rge Rd 211 TwpRd 552	0.08	0.18	0.19	0.14	0.23	0.27	0.34	0.33	0.24	0.17	0.22	0.26	0.2	0.3
20	Rge Rd 202	0.10	0.18	0.11	0.12	0.29	0.36	0.38	0.36	0.27	0.17	0.22	0.22	0.2	0.4
21	Josephburg east	0.08	0.16	0.13	0.13	0.27	0.47	0.62	0.32	0.32	0.16	0.20	0.21	0.3	0.6
22	Elk Island Park west gate	0.06	0.15	0.14	0.11	0.21	0.42	0.56	0.48	0.28	0.13	0.16	0.17	0.2	0.6
23	Goodhope	0.08	0.17	0.11	0.15	0.41	0.45	0.38	0.39	0.31	0.15	0.18	0.17	0.2	0.5
24	North of Scotford	0.11	0.24	0.13	0.19	0.21	0.30	0.33	0.41	0.26	0.21	0.28	0.28	0.2	0.4
26	Twp Rd 560 Rge Rd 221	0.09	0.20	0.18	0.19	0.29	0.32	0.36	0.36	0.31	0.16	0.28	0.22	0.2	0.4
27	Boat Launch	0.09	0.23	0.15	0.17	0.15	0.27	0.26	0.34	0.26	0.13	0.23	0.21	0.2	0.3
29	Redwater Natural Area N	0.08	0.15	0.14	0.09	0.14	0.18	0.25	0.26	0.16	0.08	0.20	0.12	0.2	0.3
30	Redwater south	0.07	0.18	0.16	0.11	0.19	0.59	0.58	0.41	0.24	0.14	0.18	0.17	0.3	0.6
31	Northwest of Scotford	0.12	0.23	0.27	0.25	0.34	0.38	0.40	0.53	0.38	0.29	0.53	0.30	0.3	0.5
32	Degussa	0.10	0.18	0.15	0.15	0.25	0.43	0.50	0.44	0.41	0.18	0.27	0.19	0.3	0.5
33	Twp Rd 552 Rge Rd 225	0.12	0.21	0.17	0.22	0.26	0.32	0.35	0.38	0.27	0.20	0.19	0.20	0.2	0.4
35	Bon Accord southwest	0.10	0.18	0.16	0.15	0.25	0.30	0.29	0.25	0.12	0.15	0.20	0.16	0.2	0.3
36	Galloway Seed	0.12	0.18	0.18	0.18	0.32	0.40	0.43	0.24	0.22	0.24	0.25	0.20	0.2	0.4
37	Twp Rd 564 Rge Rd 224	0.06	0.15	0.15	0.12	0.23	0.33	0.35	0.34	0.21	0.14	0.22	0.14	0.2	0.4
38	Peno	0.06	0.16	0.11	0.11	0.57	0.49	0.59	0.43	0.27	0.17	0.18	0.18	0.3	0.6
39	Saint Michael	0.07	0.17	0.15	0.08	0.23	0.32	0.55	0.43	0.27	0.15	0.18	0.19	0.2	0.6
40	Lamont east	0.03	0.20	0.16	0.12	0.28	0.40	0.51	0.38	0.35	0.13	0.15	0.20	0.2	0.5
41	Lily Lake	0.09	0.15	0.16	0.10	0.17	0.25	0.35	0.37	0.26	0.11	0.14	0.13	0.2	0.4
42	Radway - Val Soucy	0.08	0.17	0.11	0.13	0.24	0.64	0.51	0.36	0.26	0.14	0.18	0.16	0.2	0.6
43	Keyera Site	0.15	0.24	0.16	0.17	0.21	0.40	0.39	0.38	0.30	0.20	0.27	0.20	0.3	0.4
46	Josephburg	0.06	0.18	0.14	0.11	0.31	0.40	0.48	0.35	0.35	0.16	0.19	0.20	0.2	0.5
48	Highway 63	0.08	0.14	0.11	0.09	0.15	0.20	0.20	0.25	0.25	0.13	0.16	0.16	0.2	0.3
49	Namepi Creek	0.07	0.15	0.10	0.07	0.15	0.21	0.23	0.24	0.20	0.11	0.18	0.18	0.2	0.2
50	Sprucefield	0.07	0.14	0.12	0.11	0.22	0.26	0.30	0.29	0.24	0.10	0.15	0.19	0.2	0.3
51	Hollow Lake	0.07	0.19	0.10	0.10	0.26	1.40	2.48	2.23	1.02	0.26	0.17	0.25	0.7	2.5
52	Abee	0.09	0.14	0.10	0.10	0.20	0.14	0.21	0.20	0.19	0.10	0.14	0.14	0.1	0.2
53	Tawatinaw - Clearbrook	0.07	0.14	0.12	0.08	0.10	0.17	0.14	0.18	0.15	0.08	0.15	0.13	0.1	0.2
54	Elbridge	0.07	0.12	0.11	0.07	0.15	0.19	0.16	0.24	0.17	0.11	0.16	0.15	0.1	0.2
55	Taylor Lake	0.09	0.11	0.11	0.07	0.13	0.17	0.17	0.18	0.14	0.08	0.18	0.12	0.1	0.2
56	Opal	0.10	0.16	0.12	0.12	0.15	0.12	0.22	0.26	0.17	0.11	0.16	0.14	0.2	0.3
57	Scotford 2	0.12	0.26	0.15	0.18	0.49	1.05	2.04	1.20	1.14	0.39	0.29	0.28	0.6	2.0
58	Fort Saskatchewan	0.12	0.21	0.19	0.13	0.17	0.24	0.33	0.32	0.26	0.15	0.26	0.20	0.2	0.3
59	Partridge Hill	0.08	0.16	0.18	0.16	0.21	0.41	0.49	0.56	0.52	0.13	0.18	0.16	0.3	0.6
60	Oxbow Lake	0.06	0.15	0.10	0.14	0.31	0.51	0.55	0.36	0.23	0.12	0.16	0.09	0.2	0.6
61	Drygrass Lake	0.08	0.22	0.18	0.14	1.08	1.66	1.44	1.02	0.71	0.22	0.18	0.22	0.6	1.7
62	FAP East Boundary	0.06	0.17	0.10	0.09	0.32	0.21	0.51	0.45	0.32	0.17	0.17	0.13	0.2	0.5
63	Elk Island Park	0.06	0.14	0.09	0.08	0.24	0.43	0.32	0.32	0.22	0.11	0.16	0.14	0.2	0.4
	Average	0.08	0.18	0.14	0.13	0.26	0.40	0.49	0.43	0.31	0.15	0.21	0.19	0.25	
	Maximum	0.15	0.26	0.27	0.25	1.08	1.66	2.48	2.23	1.14	0.39	0.53	0.30		2.48

n/a: no sample
Reportable Detection Limit: 0.02 ppb

Appendix F: Continuous Monitoring Methods, Limits and Sampling Details

Table 32: Continuous monitoring methods, limits, and sampling details (Dec 31, 2017)

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Ammonia (NH_3)	Thermo 17C Thermo17i	ppm	1-second samples averaged to 1-hr, 5 min, and 1-min	0 - 10 ppm	1.0 ppb	Chemi-luminescence with total nitrogen converter	Dynamic dilution of compressed gas standard	17C NA 17i ± 0.4ppb 500 ppb range	17C NA 17i NA
Carbon Monoxide (CO)	Thermo 48CTL	ppm	1-second samples averaged to 1-hr, 5-min, and 1-min	0 - 50 ppm	0.04 ppm	Gas filter correlation	Dynamic dilution of compressed gas standard	±1% or 0.02 ppm	±1% or 0.02 ppm
Ethylene	Peak Performer	ppb	200 seconds (18 samples per hour)	0 - 2000 ppb	1 ppb	Gas chromatography with flame ionization detector	Dynamic dilution of compressed gas standard	NA	NA
Hydrocarbons (methane-NMHC or THC)	Thermo 55C Thermo 55i	ppm	2.5 minutes with 24 samples per hour	0 - 20 ppm methane 0 - 20 ppm NMHC 0 - 40 ppm THC	20 ppb Methane 50 ppb NMHC (as propane)	Gas chromatography with flame ionization detector	Dynamic dilution of compressed gas standard	±2% of measured value	±2% of measured value
Hydrogen Sulphide (H_2S)	Thermo 45C Thermo 450i	ppb or ppm	1-second samples averaged to 1-hr and 1-min	0 - 100 ppb 0 - 0.1 ppm	1 ppb 0.4 ppb RMS	Pulsed fluorescence with converter	Dynamic dilution of compressed gas standard	45C and 450i 1% of reading or 1ppb (whichever is greater)	45C NA 450i NA

Table 32: Continuous monitoring methods, limits, and sampling details (Dec 31, 2017) - continued

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Nitric Oxide, Oxides of Nitrogen, Nitrogen Dioxide (NO, NO_x, NO_2)	Thermo 42C Thermo 42i Thermo 17C Thermo 17i	ppb or ppm	1-second samples averaged to 1-hr and 1-min	0 - 500 ppb	0.4 ppb 0.4 ppb 1.0ppb	Chemi-luminescence	Dynamic dilution of compressed gas standard	42C and 42i ± 0.4ppb (500 ppb range) 17C NA	42C NA 42i NA 17C NA 17i NA
Ozone (O_3)	Thermo 49i	ppb or ppm	1-second samples averaged to 1-hr, 5-min, and 1- min	0 - 500 ppb	1.0 ppb 0.5ppb RMS	Ultraviolet photometry	O_3 Reference Bench	49i 1.0ppb	NA
Particulates $PM_{2.5}$ (preheated to 30°C)	TEOM 1400AB (Redwater Ind)	µg/m^3	1-second samples averaged to 1-hr, 5-min, and 1-min	0 - 450 µg/m^3	0.2 µg/m^3	Continuous weighing of sample filter	Pre-weighed filter method	±1.5 µg/m^3 -1-hr ±0.5 µg/m^3 - 24-hr	±0.75%
Sulphur Dioxide (SO2)	Thermo 43i	ppb or ppm	1-second samples averaged to 1-hr and 1-min	0 - 500 ppb or 0 - 1 ppm	1 ppb 0.4ppb RMS 0.5ppb RMS	Pulsed fluorescence	Dynamic dilution of compressed gas standard	1% of reading or 1ppb (whichever is greater)	NA

Table 32: Continuous monitoring methods, limits, and sampling details (Dec 31, 2017) - continued

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Particulates $PM_{2.5}$	SHARP 5030 SHARP 5030i	$\mu g/m^3$	Continuous sampling data stored in 1-min & 1-hr averages	0 - 1000 $\mu g/m^3$	0.2 $\mu g/m^3$	Hybrid beta attenuation and nephelometer	Light transmitting foils	±2 $\mu g/m^3$<80 $\mu g/m^3$ ±5 $\mu g/m^3$>80 µg/m-3	±5% (compared to 24-hr FRM)
Particulates $PM_{2.5}$ PM_{10}	Grimm 180	$\mu g/m^3$	Continuous sampling data stored in 1-min & 1-hr averages	0 - 1000 $\mu g/m^3$	0.2 $\mu g/m^3$	Spectrometry	Factory	±5%	±2%
Benzene, Toluene, Ethylbenzene, Xylene, Styrene	Spectras GC955	ppb	Samples taken every 15 or 30 minutes	Benzene & Ethylbenzene 0 – 20ppb Toluene, Styrene Xylene	0.02ppb	Gas chromatography with FID detection	Dynamic dilution of compressed gas standard	<3% at 1 ppb for benzene	NA
Wind Speed Wind Direction (WS / WD)	RM Young 5305	km/hr	1-second samples averaged to 1-hr, 5-min, and 1-min	0 – 100 km/hr 0 - 360 degrees	WSP 0.4 m/s WDR 0.5 m/s	3 cup anemometer and wind vane	Known RPM Standard or Factory	NA	NA
	Met One 50.5H (Elk Island only)			0 – 100 km/hr 0 - 360 degrees	0.9 km/hr	Ultrasonic		NA	Speed ±0.2m/s <11.3m/s ±2%>11.3m/s Dir ±3 degrees

Table 32: Continuous monitoring methods, limits, and sampling details (Dec 31, 2017) - continued

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Temperature	Vaisala HMP60	°C	1-second samples	-40 to +60	NA	Platinum resistance detector	Comparison to Reference Standard	NA	±0.6°C
Barometric Pressure	Serta 270	mmHg	Data stored in 1- min and 1-hr averages	500 - 900 mmHg	±2 mmHg	Ceramic sensing capsule coupled with capacitive sensor	Comparison to Reference Standard	±0.01	±0.05%
Relative Humidity	Campbell Scientific Vaisala HMP60	%	Data stored in 1-hour and 1-min averages	0 - 100%	NA	capacitive relative humidity sensor	Factory	NA	0°to +40°C ±3% (0 to 90% RH) ±5% (90 to 100% RH) -40° to 0°C and +40° to +60°C: ±5% (0 to 90% RH)
Solar Radiation	Kipp and Zonen SP Lite	watts/m^2	1-second samples		60 to 100 µV/W/m^2 (Sensitivity)	Photodiode detector	Factory	NA	NA

Appendix G: Data Acquisition, Validation and Reporting Procedures

Air quality monitoring instrumentation is connected digitally to a data logger at each station. The data logger stores monitoring information in engineering units each second. One minute and one-hour average values are calculated by the data logger. These one-minute and hourly-average data packets along with operational information on each sensor and the site itself are retrieved every minute from the data logger through the internet via microwave polling.

Automatic alarm set points trigger a notification to technicians of any data that is outside of a predetermined range, (including levels that might exceed the AAAQOs). The technician will assess the situation and notify the Alberta Government and local facility operators as necessary.

Data Quality Control Procedures

In order to assure data collection quality and operational uptime, the following general procedures are performed.

- Gas analyzers are automatically subjected to a daily zero and single high point test.
- The data acquisition system automatically flags data that are outside normal operating ranges.
- Daily review of the daily zero and single point tests from each analyzer is completed by FAP's contractors, with technicians dispatched to investigate/correct as necessary.
- Daily review of the data, including inspection for anomalies and any flags that may have been applied automatically by the data logger, with technicians dispatched to investigate/correct as necessary.
- For compounds that are subject to Alberta Guidelines or Objectives, alarm set-points are automatically triggered when ambient concentrations exceed the Guidelines or Objectives. This initiates a reporting protocol to AEP, including an investigation into the likely cause.
- Each analyzer is subjected to an up scale and zero as-found test and at least a 4-point calibration each month. BTEX and ethylene analyzers that are non-linear by design are tested with a zero and 5 upscale points. Calibration reports are retained and copies are submitted to AEP monthly. Calibration factors arising from this calibration may be applied to the data as appropriate.
- Alberta Environment and Parks personnel conduct performance audits of analyzers once a year, verifying that each analyzer is working properly in accordance with the

AMD. Auditors also make suggestions for improvements to the monitoring operation at the stations. Follow-up actions to the audit, if necessary, are defined and implemented per the AEP Audit Follow-up Protocol.

- FAP may conduct internal ad-hoc audits of analyzer performance.
- The FAP TWG conducts reviews of data and zero/span charts at each meeting.
- FAP uses a subcommittee of the TWG to review data validation outcomes at selected stations for selected months from time to time. FAP also may contract an independent data validation contractor to run a parallel data validation on selected months and stations.
- Operations contractors are observed performing calibrations. The procedure they use is compared to the AMD and their own applicable SOPs. Where noted, corrections are recorded and made and reported to the TWG.
- FAP uses a process to verify operation and validity of the in-situ calibrators and dedicated gases used at each continuous monitoring station. This includes:
  - Calibration system verifications at AEP labs against AEP standards.
  - Calibration gases used in FAP network are EPA protocol grade of 1 per cent accuracy where available for the mixture and verified by AEP.
  - Third party calibrations using equipment and gases owned by the contractor from time to time.
  - Cylinders are replaced when they expire (normally 2 years) even if they are not empty.
  - Photometer verifications by AEP for NO_2 and O_3 calibrations if Gas Phase Titration (GPT) procedure is not used.
  - Regular Flow Measurements, flow calibrations and calibration system maintenance as specified by the AMD and manufacturer specificaations, or if flow anomalies are suspect.

Data Validation Processes

Data validation is conducted by a contractor to FAP. Secondary checks of data reports are done by the FAP Network Manager as well as Technical Working Group members every month. Validated data and daily span tests are reviewed holistically by the Technical Working Group monthly to identify any possible anomalies and trends that may warrant another look.

The follow data validation procedures are performed by the Data Validation Contractor to FAP every month.

- One-minute, five-minute, 60-minute, 24-hr, and monthly averages are calculated from 1-second data the data logger gathers from each sensor.

- Data is baseline-corrected by interpolation between consecutive valid zero points.
- Data is reviewed in several ways:
  - Data is plotted and examined together, comparing complementary or related parameters within a station.
  - Information in the station logs, the daily zeroes and spans, and calibration reports are considered.
  - Outliers, flat lines, and other data irregularities are investigated.
  - Data flags are applied as required.

Raw data is maintained unaltered within the central database.

Higher level data validation is performed monthly by the FAP Network Manager for all station in in the network, with an additional validation step by Approval Holders for some stations, prior to submitting reports or posting data to the Government data warehouse.

Reporting Protocol

Reporting of FAP's continuous and passives data and monitoring operations is required by the Alberta Government is accomplished in a number of ways:

- Near real time raw un-verified data is sent hourly to the Alberta Government website for public availability. This data is used for AQHI reporting and forecasting and is available on several subsequent websites across Canada and North America.

- Exceedances of AAAQOs are reported as soon as they are known to Alberta Government's Environmental Service Response Centre, and are followed up with further information within 7 days, as appropriate.

- Instrument operational time below 90% in a month is reported to Alberta Government's Environmental Service Response Centre as soon as it is known, and followed up with further information and a corrective action letter within 7 days as appropriate.

- An ambient air quality monitoring report is prepared with validated data for each monitoring station and all passive sites and submitted monthly to the Alberta Government. The report's contents are prescribed by the Air Monitoring Directive.

- Validated data is posted to the Alberta Government ambient air quality database each month.

- Validated data from FAP stations is downloaded from the Alberta Government

database annually by Environment and Climate Change Canada and incorporated into the national database managed for use in national trend analysis and policy construct.

- A summary report is prepared for each monitoring station and all passive sites and submitted annually to the Alberta Government. The report's contents are prescribed by the Air Monitoring Directive.

- This Technical Annual Report provides additional information. It documents the status of the monitoring network and summarizes the regional air monitoring results with historical comparisons and details of AAAQO exceedances as well as comparisons of key parameters over time and with other locations across Alberta.

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