Fort Air Partnership

2020

Ambient Air Quality Monitoring Annual Network Report And Data Summary

FORT AIR PARTNERSHIP

We Monitor the Air You Breathe

FAP Technical Working Group April 2021

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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
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
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, Also referred to as fine 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 or kph	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, 2020, this department was Alberta Environment and Parks.

2020 Network Summary

Network Overview

During 2020 Fort Air Partnership (FAP) operated ten continuous ambient air quality monitoring stations. One of the stations, a portable monitoring station, operated in two locations during 2020. Table 1 describes the parameters measured at continuous stations as of the end of 2020.

In addition to the continuous network, FAP operated a regional passive monitoring network in 2020. Compounds measured in the passive network include sulphur dioxide (SO_2) and hydrogen sulphide (H_2S). At the start of 2020 there were 47 passive sites operated throughout the FAP Airshed. During 2020 the passive network was rationalized and reduced to 16 sites.

Table 1: FAP continuous monitoring stations and parameters 2020

	Bruderheim 1	Elk Island	Fort Sask.	Gibbons	Lamont County	Range Road 220	Redwater	Ross Creek	Scotford*	Portable**
Alberta Health Quality Index	✓	✓	✓	✓	✓		✓			✓
Ammonia (NH_3)			✓				✓	✓		
Carbon Monoxide (CO)			✓							
Ethylene (C_2H_4)						✓		✓		
Ozone (O_3)	✓	✓	✓	✓	✓		✓			✓
Total Hydrocarbons (THC)	✓		✓		✓	✓				✓
Non-methane Hydrocarbons (NMHC)	✓		✓		✓	✓				✓
Methane (CH_4)	✓		✓		✓	✓				✓
Hydrogen Sulphide (H_2S)			✓	✓	✓		✓		✓	✓
Oxides of Nitrogen (NO_X)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nitric Oxide (NO)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 1: FAP continuous monitoring stations and parameters 2020 (continued)

	Bruderheim 1	Elk Island	Fort Sask.	Gibbons	Lamont County	Range Road 220	Redwater	Ross Creek	Scotford*	Portable**
Nitrogen Dioxide (NO_2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fine Particulates ($PM_{2.5}$)	✓	✓	✓	✓	✓		✓			✓
Sulphur Dioxide (SO_2)	✓	✓	✓	✓	✓		✓	✓	✓	✓
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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

*The Scotford station operated at the temporary location till February 25, 2020 and began operation at the new Scotford South site March 1, 2020.

**The Portable station operated at Chipman from until May 2020 and then moved to Sturgeon County for July through December of 2020.

Continuous Monitoring Performance Measures

In 2020 the average monthly uptime of all continuous monitoring equipment in the network was **98.7%.** FAP's overall average uptime target is 98.5% or better, while the Alberta Government requires that monitoring equipment be fully operational a minimum of 90% of the time each month.

2020 saw seven instances where operational uptime of an ambient air monitor or meteorological sensor fell below the minimum 90% in a month as required by the Alberta Government. Each of these were reported to the Alberta Government and the issue promptly resolved.

Table 2: Data completeness 2020 (percent)

	Bruderheim 1	Elk Island	Fort Sask.	Gibbons	Lamont County	Portable*	Range Road 220	Redwater	Ross Creek	Scotford* *
Wind Speed & Direction	*99.8*	*99.7*	*45.2*	*99.9*	*99.8*	*100.0*	*99.8*	*99.9*	*99.8*	*100.0*
Sulphur Dioxide SO_2	*99.9*	*99.5*	*99.9*	*100.0*	*99.6*	*100.0*		*99.8*	*99.9*	*99.6*
Nitric Oxide NO	*99.7*	*99.6*	*99.9*	*99.4*	*99.7*	*100.0*	*99.2*	*99.7*	*99.0*	*99.7*
Nitrogen Dioxide NO_2	*99.7*	*99.6*	*99.9*	*99.4*	*99.7*	*100.0*	*99.2*	*99.7*	*99.0*	*99.7*
Oxides of Nitrogen NOx	*99.7*	*99.6*	*99.9*	*99.4*	*99.7*	*100.0*	*99.2*	*99.7*	*99.0*	*99.7*
Ammonia NH3			*99.8*					*99.7*	*99.0*	
Ozone O_3	*99.9*	*99.7*	*94.5*	*99.9*	*99.6*	*100.0*				
Hydrogen Sulphide H_2S			*100.0*	*99.8*	*99.5*	*99.7*				*99.4*
Ethylene C_2H_4							*97.1*		*99.3*	
Total Hydrocarbon THC	*98.2*		*98.3*		*90.1*	*99.0*	*99.7*			
Methane CH_4	*98.2*		*98.3*		*90.1*	*99.0*	*99.7*			
Non-Methane Hydrocarbon NMHC	*98.2*		*98.3*		*90.1*	*99.0*	*99.7*			
Particulate Matter $PM_{2.5}$	*99.6*	*99.8*	*98.4*	*100.0*	*99.8*	*99.3*		*99.7*		
Carbon Monoxide CO			*100.0*							
Benzene (C6H6)										*94.3*
Toluene (C7H8)										*94.3*
Ethylbenzene (C8H10)										*94.3*
Xylene (C24H30)										*94.2*
Styrene (C8H8)										*94.3*
Average Site	**99.29**	**99.63**	**94.77**	**99.72**	**97.06**	**99.86**	**99.18**	**99.76**	**99.30**	**97.23**

*The Portable station uptime does not include the June 2020 when not in service.
** The Scotford uptime includes data from both the Scotford Temporary and Scotford South sites.

Monitoring Network Changes in 2020

FAP made the following changes to the continuous monitoring network in 2020, including improvements to infrastructure and equipment.

- The Portable continuous monitoring station operated at Chipman until June 1, 2020. It was then moved to a new project in Sturgeon County to begin operation as of July1st, where it remained for the remainder of 2020.
- Monitoring ended at the Scotford Temporary site on February 25, 2020. The shelter was moved to new site, Scotford South, and began operation there on March 1, 2020.
- New technology fine particulate monitors provided by Environment Canada were installed at the Elk Island and Fort Saskatchewan stations.
- A new generation ozone analyzer provided by Environment Canada was installed at the Elk Island station.
- A new delta temperature system was installed at the Ross Creek station.

Air Quality Events and Exceedances Summary

The data Fort Air Partnership collects is compared to Alberta Ambient Air Quality Objectives (AAAQOs) established by the Government of Alberta. Exceedances of AAAQOs are reported to the Alberta Government and the cause of the exceedance investigated. Follow up information is then provided to the Alberta Government within seven days. One-hour and 24-hour average exceedances in 2020 are listed in Table 3 and 4 respectively.

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

https://www.alberta.ca/ambient-air-quality-objectives.aspx.

Table 3: 2020 1-hour average exceedances of the AAAQO

One Hour Exceedances			
Parameter	**Exceedances**	**Dates**	**Attributed Cause**
Fine Particulate ($PM_{2.5}$)	1	January 27	Wintertime inversion
	1	April 24	Unknow localized source
	1	June 5	Structure fire near the air monitoring station
Hydrogen Sulphide (H_2S)	1	July 24	Natural due to wetlands
	3	July 31	
	1	August 5	Local industry
	1	August 23	Natural due to wetlands
	1	September 19	Town wastewater lagoons
Fine Particulate ($PM_{2.5}$)	1	September 27	Local residential yard waste burning
	2	December 27	Regional conditions
Total	**13**		

Table 4: 2020 24-hour average exceedances of the AAAQO

24 Hour Exceedances			
Parameter	**Exceedances**	**Dates**	**Attributed Cause**
Fine Particulates ($PM_{2.5}$)	7	January 25	Wintertime inversion
	2	January 26	
	1	January 27	
	2	January 28	
	1	January 29	
Hydrogen Sulphide (H_2S)	1	August 5	Industrial activity
Fine Particulates ($PM_{2.5}$)	6	September 19	Smoke from wildfires in U.S.
Total	**20**		

2020 Summary of Exceedances

Table 5 provides the total exceedances for each compound FAP measures that has a respective AAAQO in 2020 and the previous 5 years.

Table 5: Summary of 2020 Exceedances and 5 years previous

Parameter Measured		2020	2019	2018	2017	2016	2015
Ammonia (NH_3)	*1-hr*	-	-	-	1	-	4
Benzene (C_6H_6)	*1-hr*	-	-	-	-	-	2
Carbon Monoxide (CO)	*1-hr*	-	-	-	-	-	-
	8-hr	-	-	-	-	-	-
Ethyl Benzene ($C_6H_5CH_2CH_3$)	*1-hr*	-	-	-	-	-	-
Ethylene (C_2H_4)	*1-hr*	-	-	-	-	-	-
	3-day	-	-	-	-	-	-
	Annual	-	-	-	-	-	-
Fine Particulate Matter ($PM_{2.5}$)	*1-hr*	6	119	810	69	35	144
	24-hr	19	37	117	29	11	27
Hydrogen Sulphide (H_2S)	*1-hr*	7	9	20	-	-	3
	24-hr	1	1	4	-	-	1
Nitrogen Dioxide (NO_2)	*1-hr*	-	-	-	-	-	-
	24-hr	-	-	-	-	-	-
	Annual	-	-	-	-	-	-
Ozone (O_3)	*1-hr*	-	23	6	-	-	3
Styrene ($C_6H_5CH=CH_3$)	*1-hr*	-	-	-	-	-	-
Sulphur Dioxide (SO_2)	*1-hr*	-	-	-	38	51	34
	24-hr	-	-	-	9	9	6
	30-day	-	-	-	1	2	-
	Annual	-	-	-	-	-	-
Toluene ($C_6H_5CH_3$)	*1-hr*	-	-	-	-	-	-
Xylenes (o-, m- and p- isomers)	*1-hr*	-	-	-	-	-	-
Total Exceedances		**33**	**189**	**957**	**147**	**108**	**224**

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.

Air Quality Health Index Summary

The Air Quality Health Index (AQHI) was reported from seven FAP stations in 2020. The FAP portable station operated at Chipman from January through May and Sturgeon County July through December 2020. AQHI results for the two sites are listed separately. 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 6: Air Quality Health Index in FAP region by percent - 2020

		Risk Level (% of time)			
Station Name	Hours Monitored	Low Risk	Moderate Risk	High Risk	Very High Risk
Bruderheim 1	8459	94.60%	5.38%	0.02%	0.00%
Elk Island	8374	98.39%	1.61%	0.00%	0.00%
Fort Saskatchewan	8101	94.32%	5.58%	0.10%	0.00%
Gibbons	8407	92.24%	7.71%	0.05%	0.00%
Lamont County	8428	98.28%	1.72%	0.00%	0.00%
Redwater	8217	97.70%	2.30%	0.00%	0.00%
Chipman*	3543	97.21%	2.79%	0.00%	0.00%
Sturgeon County*	3500	98.91%	1.03%	0.06%	0.00%
Total hours	57029	54854	2159	16	0

*****FAP portable station operated at two sites during 2020.*

Table 7: Air Quality Health Index in FAP region number of hours - 2020

		Risk Level (# of hours)			
Station Name	Hours Monitored	Low Risk	Moderate Risk	High Risk	Very High Risk
Bruderheim 1	8459	8002	455	2	0
Elk Island	8374	8239	135	0	0
Fort Saskatchewan	8101	7641	452	8	0
Gibbons	8407	7755	648	4	0
Lamont County	8428	8283	145	0	0
Redwater	8217	8028	189	0	0
Chipman*	3543	3444	99	0	0
Sturgeon County*	3500	3462	36	2	0
Total hours	57029	54854	2159	16	0

**FAP portable station*

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. Table 8 details the occurrence of air quality events in 2020 and the number of hours with a high or very-high risk AQHI rating at each station.

Table 8: 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.**		**Gibbons**		**Lamont County**		**Redwater**		**Portable***			
Air Quality Event Dates	High Risk	Very High Risk	High Risk	Very High Risk	High Risk	Very High Risk	Very High Risk	High Risk	High Risk	Very High Risk	High Risk	Very High Risk	High Risk	Very High Risk	Total Hrs.	Attributed Cause
Jan. 25	2	-	-	-	3	-	-	-	-	-	-	-	-	-	**5**	Winter-time inversion
Jan. 26	-	-	-	-	2	-	-	-	-	-	-	-	-	-	**2**	
Jan. 27	-	-	-	-	-	-	1	-	-	-	-	-	-	-	**1**	
Jan. 29	-	-	-	-	3	-	-	-	-	-	-	-	-	-	**3**	
April 24	-	-	-	-	-	-	1	-	-	-	-	-	-	-	**1**	Unknown local source
June 5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	**1**	Structure fire near station
Sept. 27	-	-	-	-	-	-	1	-	-	-	-	-	-	-	**1**	Local residential yard waste burning
Dec. 27	-	-	-	-	-	-	-	-	-	-	-	-	2	-	**2**	Regional conditions
Total hours	**2**				**8**		**4**						**2**		**16**	

Introduction

The FAP Organization (2020)

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, Alberta that includes the city of Fort Saskatchewan, the communities of 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, provincial and municipal government, and the public. FAP members see the benefit of working collaboratively to meet the organization's 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.

The FAP Vision:

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

The FAP Mission:

"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 2020 FAP continued to operate with several committees including 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. Multi-stakeholder oversight of monitoring, data and analysis through Alberta's Airshed organizations is critical to ensuring a credible, science-based approach to understanding air quality in Alberta. stakeholders include all levels of government, industry, non-governmental organizations and the public. 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 Alberta 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 monthly to review the data and network operations. The TWG operates under the leadership of the Network Manager to ensure that appropriate protocols are in place to ensure data quality and guidance on air monitoring projects.

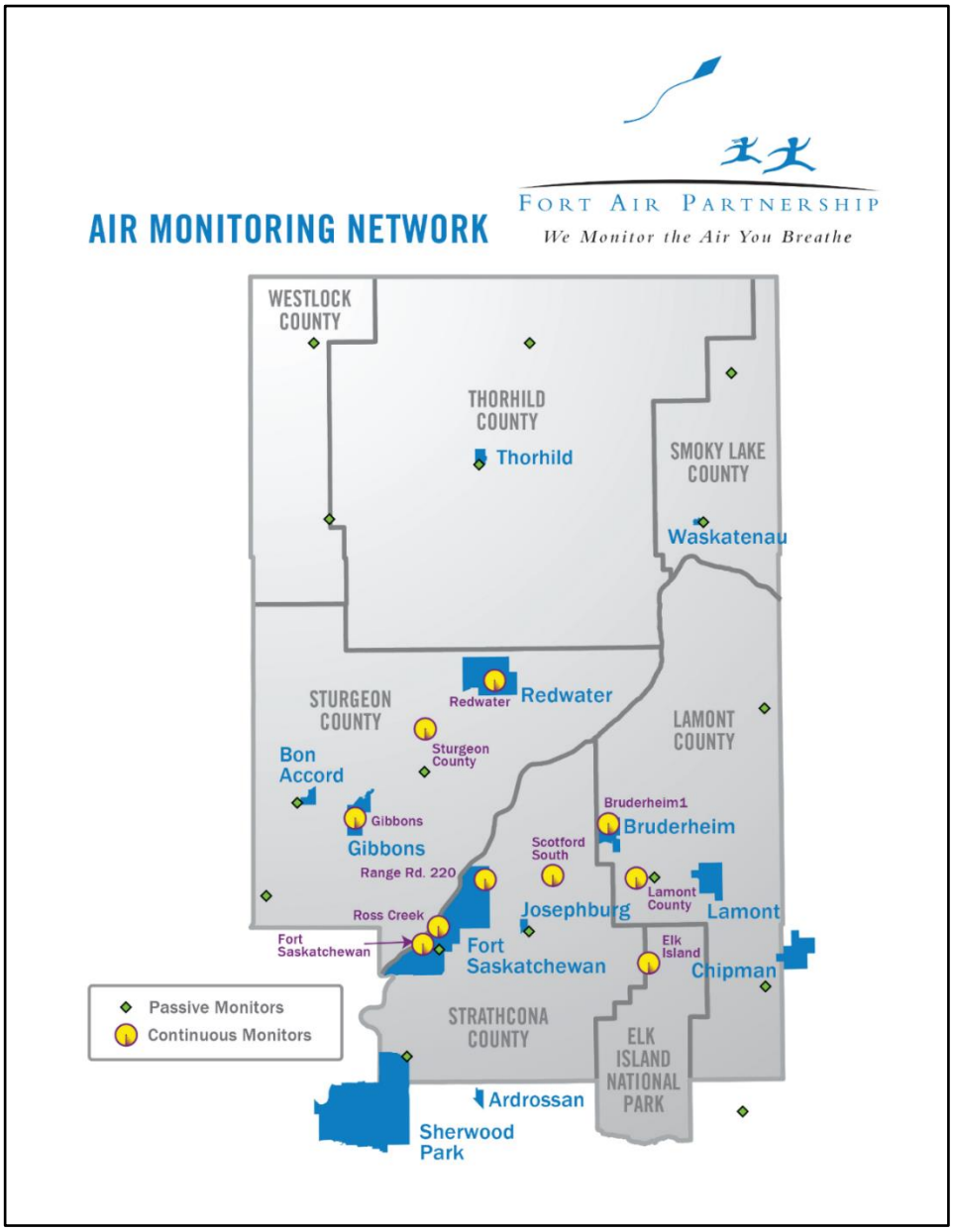
TWG members represent a wide range of technical air quality expertise from industry, the Alberta Government (Environment Ministry), and the Government of Canada (Environment Ministry), FAP's primary monitoring and data validation contractors, and members of the public. Committee members have substantial combined experience including monitoring technology, data analysis, laboratory analysis, quality systems, engineering, air quality modeling, environmental health and safety 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 as a member of the Alberta Airsheds Council Technical Committee, consisting of technical leads from all Airsheds in Alberta. A list of TWG committee members on December 31, 2020 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.

2020 Air Quality Monitoring Program

FAP Monitoring Sites

The FAP Airshed map in Figure 1 shows the locations of the continuous and passive air monitoring sites in the network as of the end of December 2020.

Figure 1: FAP Monitoring sites on December 31 2020



2020 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 2: Continuous air monitoring station interior

Network Overview

Continuous Monitoring and Reporting Requirements

The FAP continuous monitoring network is composed of nine fixed continuous monitoring stations along with a tenth portable station, that measure 18 different air quality parameters along with several meteorological conditions. The nine permanent continuous monitoring stations are all located in the southern portion of the Airshed around population centres, industrial facilities, or downwind of these source areas. These stations each have individual objectives to focus on monitoring where people live (population exposure), characterizing regional sources, local industrial emissions, or air quality in a protected national park. The portable station moves around the Airshed to deal with short term projects or emerging issues. 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 ambient air quality monitoring through participating in FAP. The FAP continuous monitoring stations, with the corresponding approval holders as of December 31, 2020, are listed in Appendix C.

Alberta Ambient Air Quality Objectives

Alberta Ambient Air Quality Objectives are intended to provide protection of the environment and human health to an extent technically and economically feasible, as well as socially and politically acceptable. Fort Air Partnership continuously compares the data it collects to these provincial Ambient Air Quality Objectives. This information is used to inform policy and management decisions by government and other organizations.

When air quality standards are exceeded, FAP alerts Alberta Environment and Parks. This information is also accessed by Alberta Health Services to determine if a health advisory should be issued. The cause of each exceedance is investigated and whenever possible attributed to a source or combination of sources. Often, natural causes lead to exceedances, including weather events such as temperature inversions, or smoke from wildfires.

Canadian Ambient Air Quality Standards

FAPs data is also compared to national standards known as Canadian Ambient Air Quality Standards (CAAQS). These standards are in place for fine particulate matter ($PM_{2.5}$), ozone (O_3), nitrogen dioxide (NO_2) and Sulphur dioxide (SO_2).

Table 9 summarizes the CAAQS threshold and management levels for these four substances. Alberta is divided into six separate air zones. Each is assessed separately for achievement against these values. Fort Air Partnership falls within the North Saskatchewan Air Zone.

Table 9: Air Quality Management System Thresholds

Pollutant	Averaging Time	Numerical Value			Statistical Form
		2015	2020	2025	
Fine Particulate Matter ($PM_{2.5}$)	24-hour	28 $\mu g/m^3$	27 $\mu g/m^3$		The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
	Annual	10.0 $\mu g/m^3$	8.8 $\mu g/m^3$		The 3-year average of the annual average of all 1-hour concentrations
Ozone (O_3)	8-hour	63 ppb	62 ppb	60 ppb	The 3-year average of the annual 4th highest of the daily maximum 8-hour average ozone concentrations
Sulphur Dioxide (SO_2)	1-hour	NA	70 ppb	65 ppb	The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
	Annual	NA	5 ppb	4ppb	The average over a single calendar year of all 1-hour average SO_2 concentrations
Nitrogen Dioxide (NO_2)	1-hour	NA	60 ppb	42 ppb	The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations
	Annual	NA	17 ppb	12 ppb	The average over a single calendar year of all 1-hour average concentrations

All provinces and territories including Alberta must annually report the status of air quality as compared to these national standards. The 2015-2017 Alberta Air Zones Report was released in November of 2019.

There are two levels of planning areas under CAAQS, larger airsheds that consist of six broad geographic regions for the entire country, and below that, air zones, which enable a place-based approach to managing local air quality. Provinces and territories delineate and manage air zones within their boundaries with the goal of driving continuous improvements in air quality and preventing exceedances of CAAQS, Alberta has 6 air zones.

These federal "airsheds" are not to be confused with Alberta Airsheds, which are regional air monitoring and reporting organizations operating throughout Alberta. Alberta's 10 Airsheds

operate extensive, integrated ambient air monitoring networks. Air quality data collected by the Airsheds is also used by the province of Alberta to report against the federal CAAQS for each of the six Alberta air zones.

The FAP Network Monitoring Objectives

FAP has established several monitoring objectives to ensure that it meets the needs of all its stakeholders. These objectives guided a Network Assessment completed by an independent third party in 2012. FAP developed a comprehensive monitoring plan using the findings of that network assessment in 2015. This monitoring plan was revised as needed according to the AMD requirements in place at the time, including continuous updates of progress made on monitoring projects from 2015 through to 2019. These updates were provided to AEP every six months or as the need dictated. However, the AMD requirement for Airsheds to have a monitoring plan in place ended in December of 2019. FAP has decided to continue to have a monitoring plan in place for internal purposes, the design of this ongoing plan will be decided in 2021. While the design and operation of the monitoring network strives to meet FAP monitoring 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 current 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.

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 1,395 in the most recent census available 2018.

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 (precipitation quality) sampler is also at the site part of a program run by the Alberta Government. 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 and part of the national network.

Elk Island changes (2020): A new generation ozone analyzer was installed in July. The fine particulate ($PM_{2.5}$) monitor was upgraded to a newer model with a different measurement method in August.

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.

Figure 5: Fort Saskatchewan Station

Site description: This station is in the Airshed's largest population center (26,942 in 2019 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 18,000 vehicles per day in 2019. 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. This station along with Elk Island is part of the NAPS network of stations across the country.

Fort Saskatchewan changes (2020): The fine particulate ($PM_{2.5}$) monitor was upgraded to a newer model with a different measurement method in June. The wind tower was destroyed in June when a nearby tree fell on it during a thunderstorm. As of the end of 2020 FAP is still awaiting the replacement of the tower by AEP. Wind speed and direction has not been measured at the site since the tower was lost. Ross Creek wind data 2.5 kilometers away is referenced instead.

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. The most recent census available (2016) lists the Gibbons population as 3,159.

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. 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.

Portable Station

Primary monitoring objective: The portable is used to meet various objectives depending on the specific location and/or project. Along with FAPs stated monitoring objectives the portable can also respond to local air quality concerns as is being done in the Town of Bon Accord. For a complete list of monitoring objectives, see table in Appendix B.

Figure 8: Portable Station at Chipman

Continuous parameters monitored: H_2S, $NO/NO_X/NO_2$, SO_2, methane and non-methane hydrocarbons, outdoor temperature and relative humidity, wind speed and direction. Other parameters can be added as required to meet project monitoring objectives.

Site description - Chipman: In January to May 2020 the station was located near Chipman on the FAP eastern border. The Chipman site was a fenced compound approximately 60 meters to the east of Range Road 185 (a gravel surface road) and 500 meters north of Highway 15. The compound encloses a water pump booster station for the John S. Batiuk Regional Water Commission and surrounded on four sides predominately by agricultural land. The station operated at this location and reported data to the Provincial data warehouse beginning in April 2018.

Site description - Sturgeon County: The portable was moved to a Sturgeon County site to begin monitoring on July 1, 2020 where it remains as of Dec 31, 2020. The site is on an unused farmstead along Range Road 223 approximately 1 kilometer. south of secondary highway 570.

Portable changes (2020): The portable monitoring project at Chipman ended at the end of May 2020. The portable station was situated at Chipman to address some local air quality questions and compare air quality in the community with others in FAP. A report on the findings of this project is available on the FAP website or by contacting FAP at info@fortairmail.org.

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 9: Range Road 220 Station

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 commissioned by FAP in 2017 identified this location as appropriate to enable FAP to meet the established monitoring objectives. The station is located near the center of the town of Redwater at 47th street and 49th avenue, just south of the town administration offices. The most recent census available (2016), lists the town of Redwater population of 2053.

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.

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.

Ross Creek changes (2020): The delta temperatre sensor was upgraded to a newer model at the son in August.

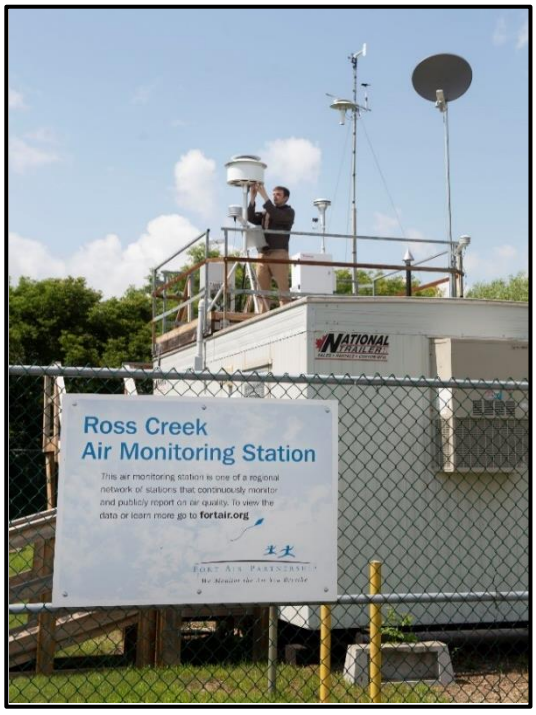


Figure 11: Ross Creek Station

Scotford Station

The Scotford station was moved from a site known as Scotford Temporary to the new Scotford South site in February 2020. The station had begun operation at the Temporary location in 2014 which at the time was a relocation of the former Scotford 2 station. The new Scotford South station began operation March 1, 2020.

Primary objective: The station is intended 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: H_2S, $NO/NO_X/NO_2$, SO_2, benzene, toluene, ethylbenzene, xylenes (o-, m- and p- isomers),

Figure 12: Scotford South Station

styrene, outdoor temperature and relative humidity, wind speed and direction.

Site description: The Scotford Temporary and South sites are both located to the south east of industrial facilities on Range Road 212, approximately 2 kilometers south of Highway 15. The Temporary site was in an open area located within a farmyard. The South site is in a cultivated field approximately 100 meters west of Range Road 212.

Scotford South changes (2020): The BTEX analyzer was upgraded to a newer model in June.

Monitoring Station Coordinates

Table 10 gives the longitude and latitude coordinates for the FAP monitoring stations active in 2020.

Table 10: 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
Portable at Chipman	53.70123 N	-112.63081 W	693 m	June 2019	Residential /Agricultural
Portable at Sturgeon County	53.880597 N	-113.200518 W	647 m	July 2020	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
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
Scotford South	53.759684 N	-113.027247 W	626 m	March 2020	Agricultural

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

2020 Capital Purchases for the Network

Life cycle replacement across the network:

In 2020 FAP owned approximately $2.2 M in equipment and shelters at the 8 stations it owned. Spare and backup equipment was valued at approximately an additional $0.7M. The capital replacement plan target is for purchases equaling approximately 10% of the total value of the active monitoring and support equipment within FAP each year.

- Equipment purchased as part of the capital equipment replacement plan in 2020 for deployment throughout the network included one analyzer each for ammonia, H_2S, NOx, ozone and ethylene.
- A new delta temperature system was purchased for Ross Creek station.

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 E.

Data Reporting

FAPs air monitoring data is reported and available 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 1 year on the real-time website at: http://airquality.alberta.ca/map
- 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. Alberta Government 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 data warehouse. at: Access air quality and deposition data | Alberta.ca
- Passive monitoring data tables are available upon request at info@fortairmail.org

2020 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

Since FAP was established in 2003, the passive network had grown as FAP assumed operation of several individual passive networks from industrial sites within the airshed. Two network reviews undertaken in 2012 and 2018 reduced the number of sites to 47 by the beginning of 2020. FAP undertook a wholistic review and extensive rationalization of the passive network in 2020. Given the increased number of continuous stations in the FAP network since 2012 and using criteria established for the evaluation it was determined that the network could be further reduced to 14 sites while still maintaining a representative network. The reduction occurred at the end of August 2020. All 14 sites now measure both SO_2 and H_2S. Two additional sites serve as co-located stations with continuous monitors.

Passive sampling devices 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 11. Some sites are named if there is a recognizable nearby landmark or reference. Table 13 shows the sites in operation as of the end of 2020 after the reduction of the network.

Table 11: FAP passive monitoring sites as of January 1, 2020

Site	Location	Longitude	Latitude	SO_2	H_2S	Date Started
1	Stocks Greenhouses	-113.246659	53.596325	1		Jul 1, 2005
2	Ardrossan northeast	-113.098671	53.587175	1		Jul 1, 2005
3	NE of Bruderheim	-112.82701	53.866674	1		Jul 1, 2005
4	Waskatenau	-112.77622	54.09875	1	1	Jul 1, 2005
5	Thorhild	-113.1331	54.15233	1		Jul 1, 2005
7	Bon Accord	-113.42423	53.83382	1		Jul 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
18	Rge Rd 211 TwpRd 552	-113.00044	53.74747	1	1	Jan 1, 2006
20	Rge Rd 202	-112.880153	53.76029	1	1	Jan 1, 2006

Table 12: FAP passive monitoring sites as of January 1, 2020 (continued)

Site	Location	Longitude	Latitude	SO_2	H_2S	Date Started
21	Josephburg east	-112.97535	53.709517		1	Jan 1, 2006
22	Elk Island Park west gate	-112.87693	53.68760		1	Jan 1, 2006
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	53.80340	1	1	Jan 1, 2006
27	N Sask. boat launch	-113.00035	53.88125	1		Jan 1, 2006
29	Redwater Natural Area N	-112.95213	53.94892	1	1	Jan 1, 2006
31	Northwest of Scotford	-113.10838	53.81068	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
36	Galloway Seed	-113.22421	53.65760		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
41	Lily Lake	-113.38755	53.91996		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		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
50	Sprucefield	-112.84794	54.18045		1	Aug 1, 2008
51	Hollow Lake	-112.72578	54.238822	1	1	Aug 1, 2008
52	Abee	-113.05062	54.268211		1	Aug 1, 2008
53	Tawatinaw - Clearbrook	-113.40057	54.268146	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
58	Ft Saskatchewan	-113.22319	53.69883	1	1	Jul 1, 2015
59	Partridge Hill	-113.09843	53.65791	1	1	Jun 1, 2010
60	Oxbow Lake	-112.95166	53.59954	1	1	Jun 1, 2010
61	Drygrass Lake	-112.77896	53.59954		1	Jun 1, 2010
62	FAP East boundary	-112.68102	53.65779	1	1	Jun 1, 2010
63	Elk Island Park	-112.85717	53.63338		1	Jun 1, 2010
64	Agrium Redwater	-113.09922	53.843689	1		Jul 1, 2015
66	Plains Midstream # 1	-113.14935	53.752583	1	1	Jan 1, 2018
68	ARC Resources Site 1	-113.07487	53.954450	1	1	Jan 1, 2018
71	ARC Resources Site 4	-113.02543	53.92183	1	1	Jan 1, 2018

Table 13: FAP passive monitoring sites as December 31, 2020

Site	Location	Longitude	Latitude	SO_2	H_2S	Date Started
1	Stocks Greenhouses	-113.246659	53.596325	1	1	Jul 1, 2005
4	Waskatenau	-112.77622	54.09875	1	1	Jul 1, 2005
5	Thorhild	-113.1331	54.15233	1	1	Jul 1, 2005
7	Bon Accord	-113.42423	53.83382	1	1	Jul 1, 2005
20	Range Rd 202	-112.880153	53.76029	1	1	Jan 1, 2006
34	C&C Tree Farm	-113.48362	53.74538	1	1	Aug 1, 2006
36	Galloway Seed	-113.22421	53.65760	1	1	Aug 1, 2006
37	Township Rd 564 & Range Rd 224	-113.22356	53.86307	1	1	Aug 1, 2006
38	Peno	-112.67866	53.92182	1	1	Aug 1, 2006
46	Josephburg	-113.0693	53.71279	1	1	Nov 1, 2007
47A	Southeast of FAP	-112.705296	53.54175	1	1	Sept 1, 2020
51	Hollow Lake	-112.72578	54.238822	1	1	Aug 1, 2008
52	Abee	-113.05062	54.268211	1	1	Aug 1, 2008
53A	Tawatinaw - Clearbrook	-113.40057	54.268146	1	1	Sept 1, 2020
55	Taylor Lake	-113.37483	54.10185	1	1	Aug 1, 2008
62	FAP East Boundary	-112.68102	53.65779	1	1	Jun 1, 2010
72	Redwater	-113.105857	53.95183	1	1	Sept 1, 2020

Passive Monitoring for Compliance to EPEA Approvals

FAP performs passive monitoring on behalf of approval holders listed in Table 14. Air quality monitoring reports are submitted monthly to the Alberta Government.

Table 14: Passive monitoring requirements (December 31, 2020)

Passive Monitoring Network	Facility	EPEA Approval Number
FAP operates a total of 14 SO_2 and H_2S locations on behalf of partners	ACCEL Energy (4 sites H_2S, 4 sites SO_2)	150-03-02

2020 Monitoring Results

2020 Ambient Air Monitoring Data and Discussion

The following sections provide a brief analysis of the results of the 2020 monitoring data compound by compound. Not all stations measure every substance. The sections below provide information on all current stations, as well as some historical decommissioned stations. Annual averages are calculated for stations in operation for at least nine months (75%) of the calendar year. Data from the portable station is given but not included in annual average plots since the portable has not been at one location for the required percentage (75%) of the calendar year to calculate a valid annual average. 2020 data is compared to Alberta Ambient Air Quality Objectives where applicable. Monthly averages and maximum 1-hour averages are shown in charts and tables. Also provided are comparisons of 2020 data with the previous 5 years.

For substances used in AQHI calculations, data from FAP stations in 2020 is compered to selected stations across Alberta. For longer term trend analysis and comparison of FAP stations with Canadian sites and others around the world back as far as 1991, refer to the FAP Air Quality Trending and Comparison Report. The report is available for download on the FAP website library.

The Covid-19 Pandemic and Effects on Air Quality in the FAP Airshed

During the global pandemic that led to widespread lockdowns of most public activities, Fort Air Partnership remained committed to continuing to effectively deliver air quality monitoring and reporting in the region. This included providing data to Alberta Environment and Parks to enable the calculation and communication of a daily and forecast Air Quality Health Index.

FAP and its contractors followed Government of Alberta COVID-19 requirements as they evolved throughout 2020 and employed Business Continuity Plans to ensure air quality data remained available to all stakeholders. With the appropriate measures in place to protect the health of our dedicated staff and contractors, FAP maintained a high level of data quality during this unprecedented time.

A cursory assessment of air quality data at our Fort Saskatchewan station was conducted to determine if the COVID-19 pandemic restrictions had any impact on air quality. The Fort Saskatchewan station was chosen since it is the most urban station in the FAP network and more likely to show changes due to reduced traffic volumes. Overall, traffic volumes in FAP dropped by approximately 1/3 during the March to May 2020 time period when compared to the same time period in 2019.

The data comparison looked at daily averages, which were then averaged out over each of the months of March, April, and May 2020. These were then compared to 2013-2019 historical

averages for each month for key substances used in the Air Quality Health Index calculation. The following was observed:

- Nitrogen Dioxide (NO_2) – 2020 daily averages were quite a bit lower than historical averages.
    - March levels were 27% below the historical average,
    - April levels were 29% below the historical average,
    - May levels were 47% below the historical average.
    - The significant difference is likely due to a decrease in traffic after March 15 when COVID-19 restrictions came into effect.
- Fine Particulate Matter ($PM_{2.5}$) – 2020 data was slightly lower but tracked more closely to the historical average.
- Sulphur Dioxide (SO_2) – 2020 data compared to historical values. Daily averages were very similar to any previous year.
- Ozone (O_3) – 2020 data was similar to historical averages.

Continuous Monitoring Results by Compound

Ammonia

Ammonia (NH_3) is a colourless gas with the well-known pungent odour often 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 2000 ppb

Ammonia is measured at three stations in FAP. There were no exceedances of the NH_3 AAAQO recorded at any FAP stations in 2020.

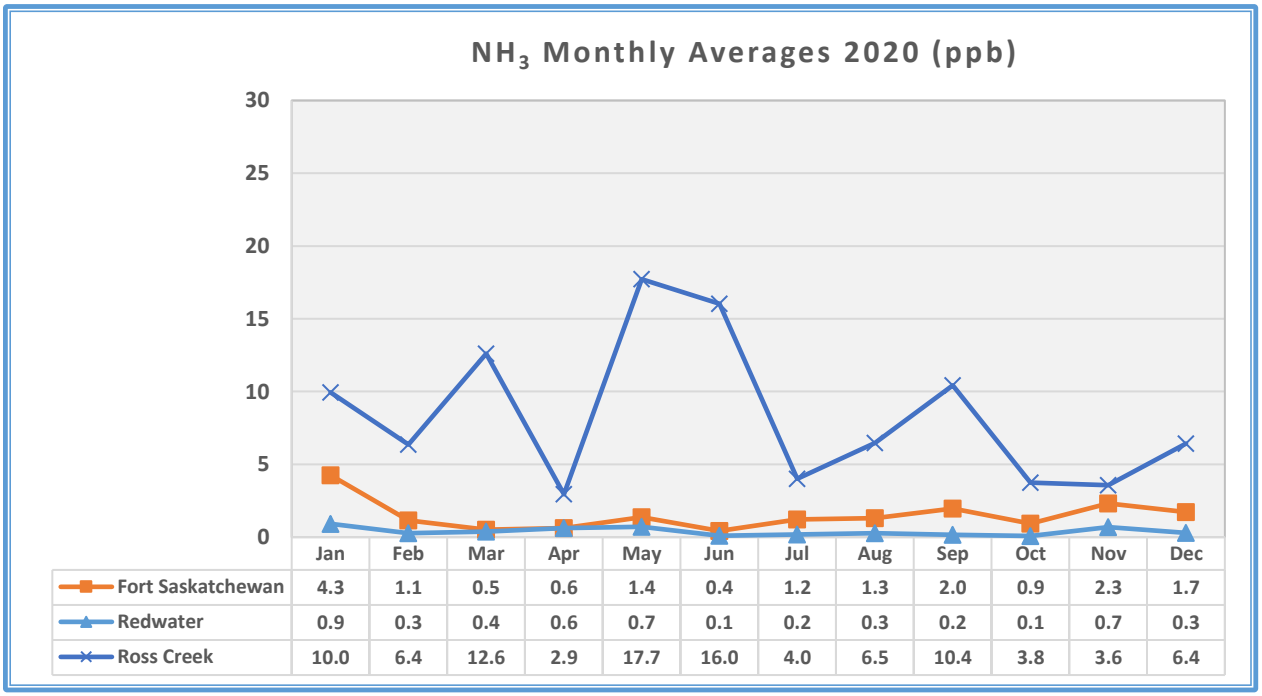
Table 15 below**Error! Reference source not found.** provides maximum 1-hour averages of NH_3 in 2020 with comparisons to the applicable AAAQO.

Table 15: 2020 maximum NH_3 averages compared with applicable AAAQO

Station	Highest 1-hour average (ppb)	% of AAAQO	Date Time
Fort Saskatchewan	82.3	4.1%	Jan 24 14:00
Redwater	37.2	1.9%	Aug 20 17:00
Ross Creek	551.2	27.6%	Aug 05 05:00

Figure 15 below presents a summary of NH_3 concentrations recorded in 2020 at individual stations. Figure 16 shows annual NH_3 averages for 2020 and the five years previous.

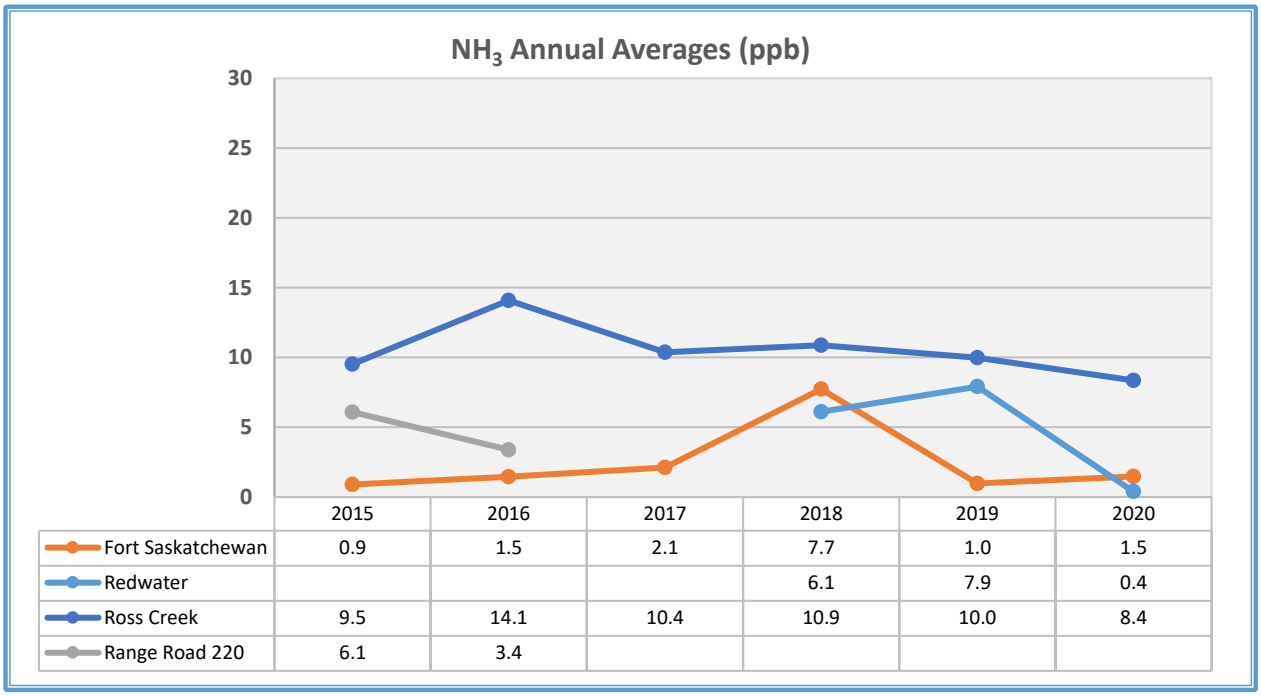
Figure 15: Monthly average NH_3 concentrations (ppm) in 2020



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	4.3	1.1	0.5	0.6	1.4	0.4	1.2	1.3	2.0	0.9	2.3	1.7
Redwater	0.9	0.3	0.4	0.6	0.7	0.1	0.2	0.3	0.2	0.1	0.7	0.3
Ross Creek	10.0	6.4	12.6	2.9	17.7	16.0	4.0	6.5	10.4	3.8	3.6	6.4

Ammonia (continued)

Figure 16: Annual average NH_3 concentrations at FAP stations (ppm)



	2015	2016	2017	2018	2019	2020
Fort Saskatchewan	0.9	1.5	2.1	7.7	1.0	1.5
Redwater				6.1	7.9	0.4
Ross Creek	9.5	14.1	10.4	10.9	10.0	8.4
Range Road 220	6.1	3.4				

Notes:

- The Redwater station began operation October 2017.
- Ammonia monitoring was stopped at Range Road 220 in January 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. Wildfires 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

In FAP only the Fort Saskatchewan station measures CO.

Table 16 below provides maximum 1-hour and 8-hour averages of CO in 2020 at the Fort Saskatchewan station, with comparisons to the applicable AAAQOs.

Table 16: 2020 maximum CO averages compared with applicable AAAQO

Station	Highest 1-hour average (ppb)	% of AAAQO	Date Time	Highest 8-hour average (ppb)	% of AAAQO	Date
Fort Saskatchewan	1.62	12%	Jan 25 21:00	1.16	23%	Jan 26

The CO monthly average concentrations recorded at Fort Saskatchewan station is given in Figure 17 while Figure 18 provides a comparison of annual averages for 2020 and the five years previous.

Figure 17: Monthly average CO concentrations Fort Saskatchewan (ppm) in 2020

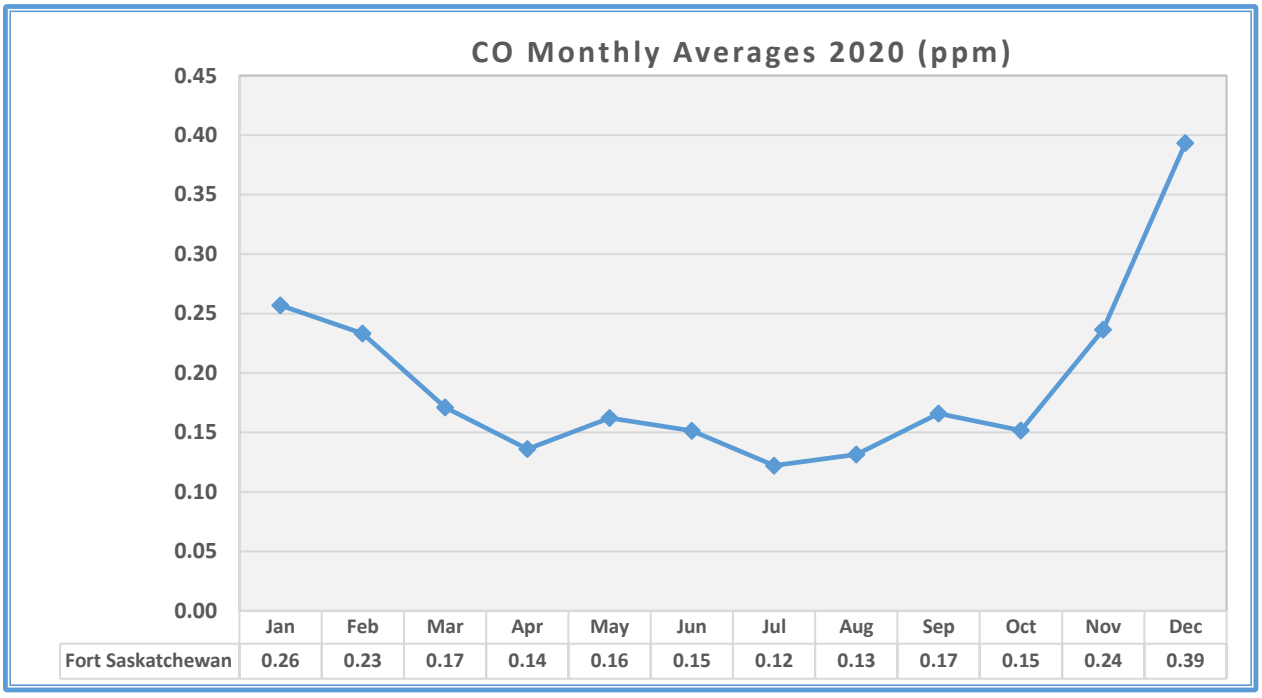
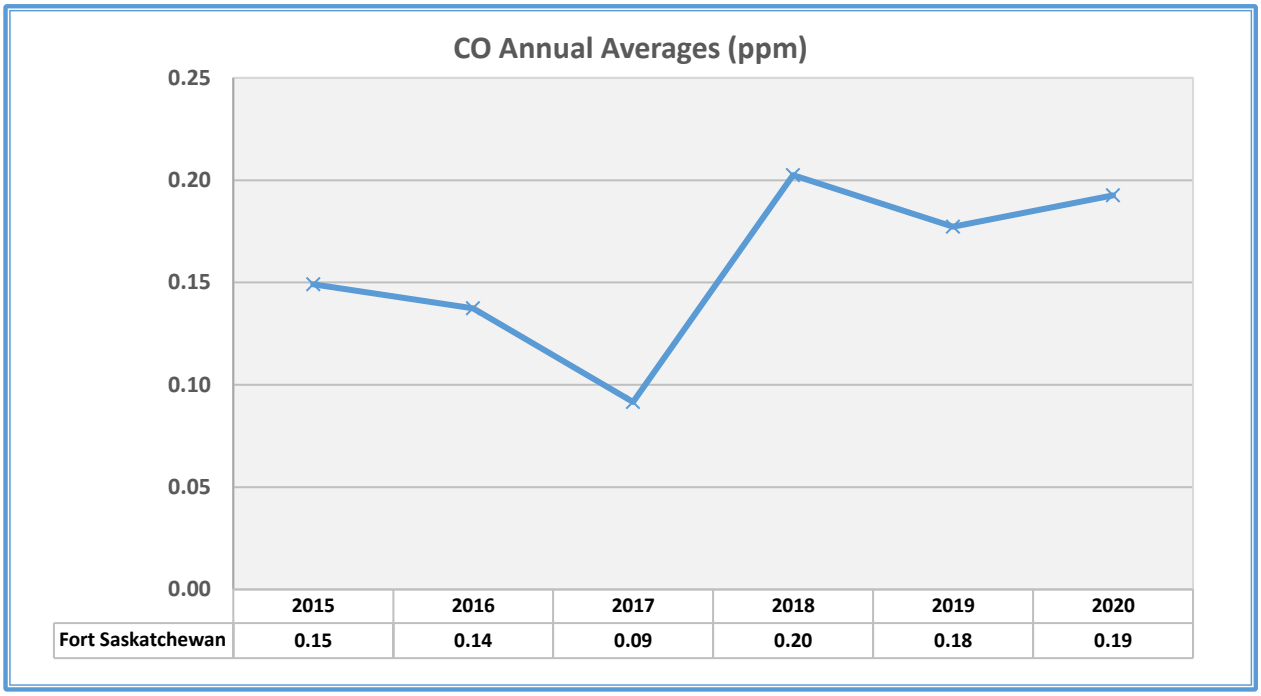


Figure 18: Annual average CO concentrations Fort Saskatchewan (ppm)



	2015	2016	2017	2018	2019	2020
Fort Saskatchewan	0.15	0.14	0.09	0.20	0.18	0.19

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 1050 ppb
- 3-day average 40 ppb
- Annual mean 26 ppb

Ethylene is measured at two stations in FAP. There were no exceedances of any of the three average periods AAAQO for ethylene.

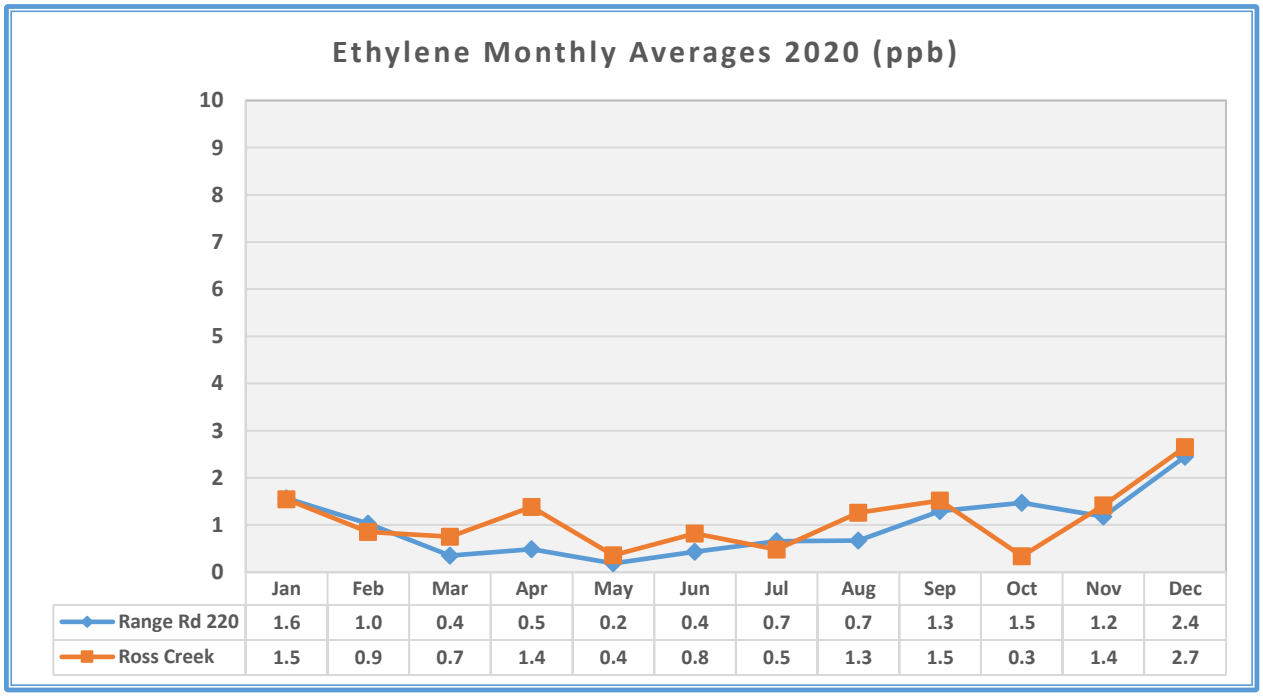
Table 17 below provides maximum 1-hour, 72-hour and annual averages of ethylene in 2020 with comparisons to the applicable AAAQOs.

Table 17: 2020 maximum ethylene averages compared with applicable AAAQO

Station	Highest 1-hour average (ppb)	% of AAAQO	Date Time	Highest 72-hour average (ppb)	% of AAAQO	Date	Annual average (ppb)	% of AAAQO
Range Road 220	176.5	17%	Oct 29 07:00	7.7	10%	Dec 09	0.99	3.8%
Ross Creek	106.3	10%	Dec 16 23:00	13.1	33%	Dec 07	1.11	4.3%

Figure 19 gives a summary of ethylene concentrations recorded each month in 2020 at the two stations that record it.

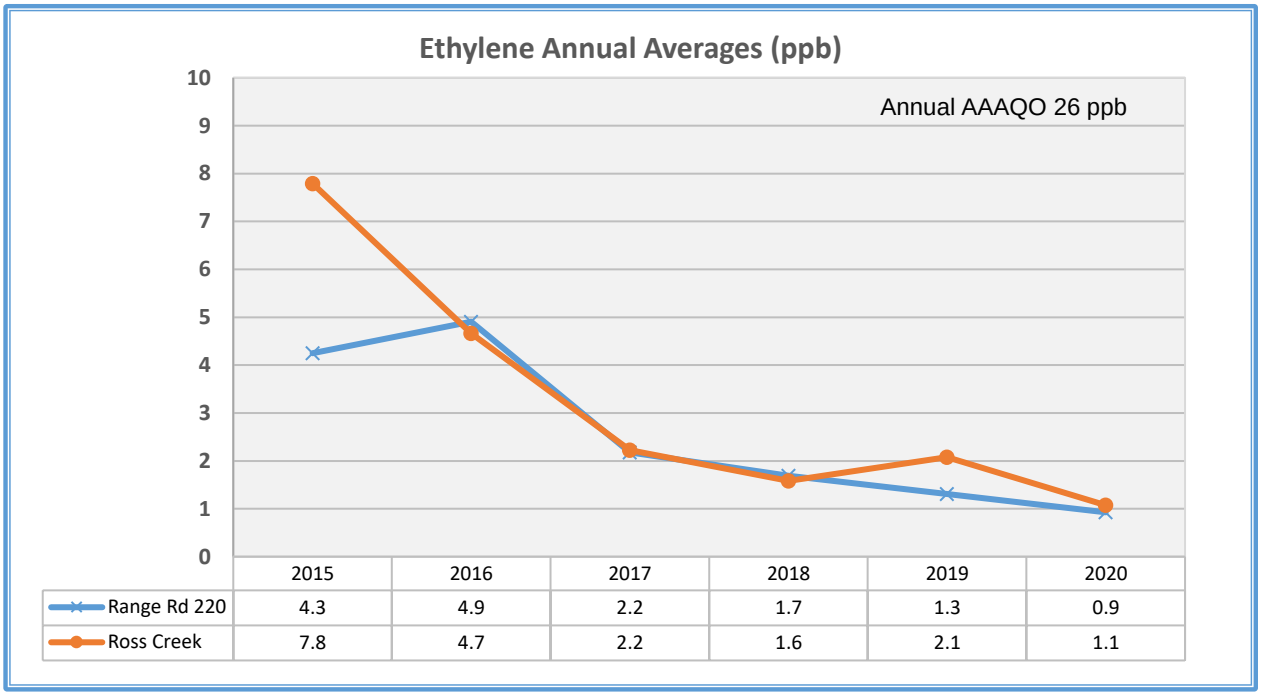
Figure 19: Monthly average ethylene concentrations (ppb) in 2020



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Range Rd 220	1.6	1.0	0.4	0.5	0.2	0.4	0.7	0.7	1.3	1.5	1.2	2.4
Ross Creek	1.5	0.9	0.7	1.4	0.4	0.8	0.5	1.3	1.5	0.3	1.4	2.7

Ethylene (continued)

Figure 20: Annual average ethylene concentrations at FAP stations (ppb)



	2015	2016	2017	2018	2019	2020
Range Rd 220	4.3	4.9	2.2	1.7	1.3	0.9
Ross Creek	7.8	4.7	2.2	1.6	2.1	1.1

Figure 20 shows the annual ethylene averages at the two stations for 2020 and the five years previous. The annual ethylene average downward trend since 2015 is largely due to reduced flaring activities at a nearby industrial facility during this time.

Fine Particulates ($PM_{2.5}$)

Fine particulate matter ($PM_{2.5}$) consists of tiny particles, 2.5 microns in size and smaller. In comparison, a strand of human hair is about 70 microns in width. Sources of $PM_{2.5}$ include soil, roads, agricultural dust, vehicles, industrial emissions, smoke from forest fires, cigarettes, household heating, fireplaces and barbecues. Secondary particulate matter may also be produced in the atmosphere through complex chemical processes involving other substances. Particulates can come from both solid matter and liquid aerosols.

In high concentrations, suspended particulates may lead to human health problems. Inhaling particulate matter can make breathing more difficult or may aggravate existing lung and heart problems. Smaller particles can travel deep 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 with impact from long range transport of forest fire smoke often coupled with warm weather and little or no wind.

The AAAQO for $PM_{2.5}$ is:

- 24-hour average concentration 29 $\mu g/m^3$

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

- 1-hour average concentration 80 $\mu g/m^3$

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

Fine Particulates (continued)

Comparing air quality monitoring data in the Fort Air Partnership region in 2020 against the Alberta ambient guideline and objectives (AAAQG/AAAQO), there were six 1-hour Guideline exceedances and 19 24-hour AAAQO exceedances of fine particulates ($PM_{2.5}$) experienced throughout the network.

Table 18 and Table 18Table 19 group the exceedances by date and station with the attributed causes.

Fine particulate matter is measured at seven continuous monitoring stations in FAP. Table 20 below provides the maximum 1-hour and 24-hour $PM_{2.5}$ averages in 2020 at each station with the applicable AAAQO and AAAQG.

Table 18: Exceedances of the 1-hour average AAAQG for $PM_{2.5}$ in 2020

Station	Highest 1 hour average (µg/m^3)	Exceedances	Date(s)	Attributed Cause
Gibbons	112.6	1	Jan 27	Multiple sources east of monitoring station
Gibbons	93.5	1	Apr 24	Undetermined
Gibbons	206.5	1	June 5	Local structure fire
Gibbons	106.4	1	Sept 27	Local yard waste burning
Portable (Sturgeon County	84.6	2	Dec 27	Wintertime inversion

Fine Particulates (continued)

Table 19: Exceedances of the 24-hour average AAAQO for $PM_{2.5}$ in 2020

Station	Highest 24 hour average ($\mu g/m^3$)	Exceedances	Date(s)	Attributed Cause
All stations measuring fine particulate	48.8 (Gibbons)	13	Jan 25-29	Wintertime inversion
Bruderheim, Elk Island, Ft Saskatchewan, Gibbons, Lamont County, Redwater	38.3 (Fort Saskatchewan)	6	Sept 19	Wildfire smoke

Table 20: 2020 maximum $PM_{2.5}$ averages compared with applicable AAAQO(G)

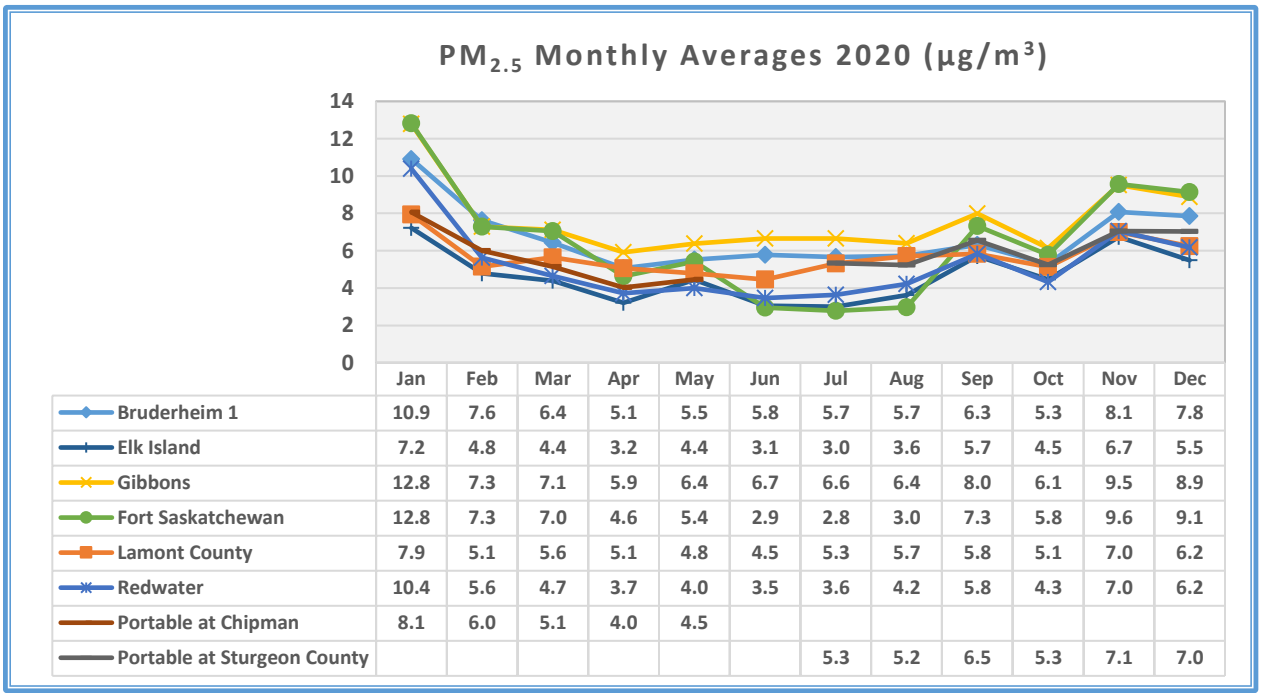
Station	Highest 1-hour average ($\mu g/m^3$)	% of AAAQG	Date Time	Highest 24-hour average ($\mu g/m^3$)	% of AAAQO	Date
Bruderheim 1	72.3	90%	Apr 30 16:00	48.8	168%	Jan 25
Elk Island	66.5	83%	Jan 25 13:00	31.8	110%	Sep 19
Fort Saskatchewan	66.1	83%	Jan 25 23:00	47.3	163%	Jan 25
Gibbons	205.4	257%	Jun 5 02:00	47.8	165%	Jan 28
Lamont County	54.3	68%	Jan 25 16:00	33.5	116%	Jan 25
Redwater	63.1	79%	Jan 26 05:00	45.1	156%	Jan 25
Portable (Chipman)	59.6	75%	Jan 25 08:00	39.3	135%	Jan 25
Portable (Sturgeon County	84.6	106%	Dec 27 17:00	28.2	97%	Sep 19

Fine Particulates (continued)

Figure 21 below shows monthly average $PM_{2.5}$ concentrations recorded in 2020 at individual FAP monitoring stations. Figure 22 shows the annual average at each station in 2020 and the five years previous. Figure 23 shows annual averages at FAP stations compared to others across Alberta for the past 3 years.

Fine Particulates (continued)

Figure 21: Monthly average $PM_{2.5}$ concentrations (µg/m^3) in 2020

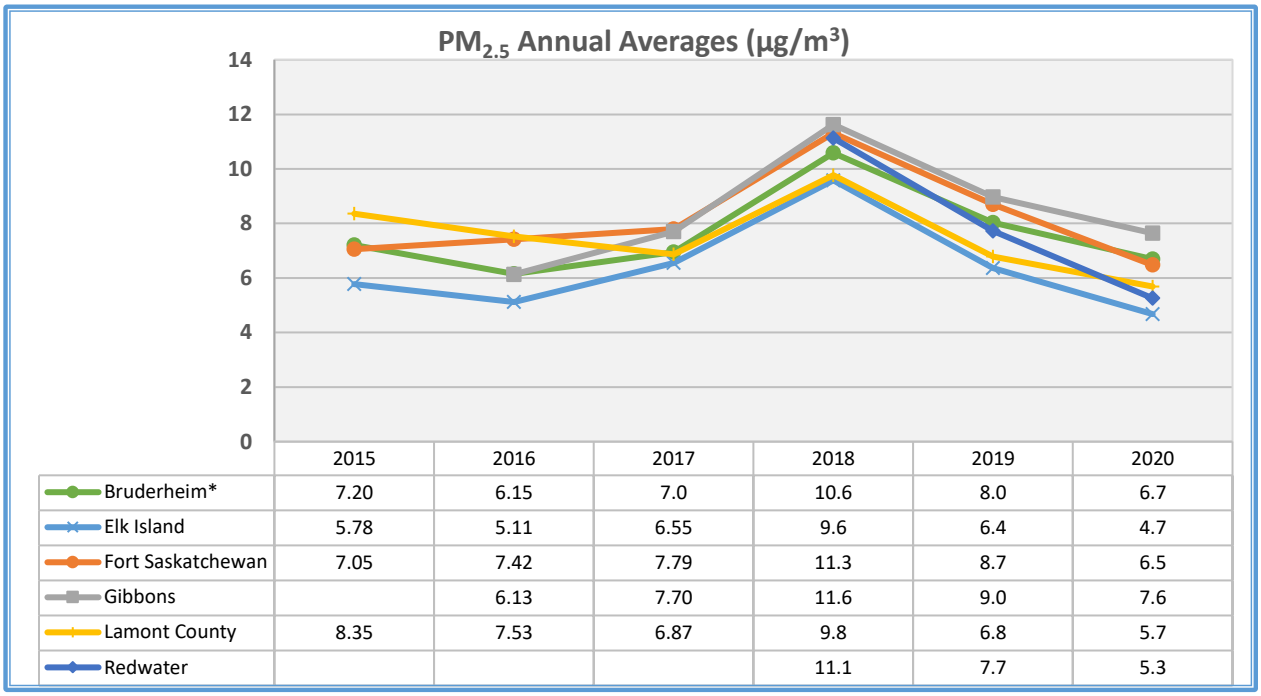


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	10.9	7.6	6.4	5.1	5.5	5.8	5.7	5.7	6.3	5.3	8.1	7.8
Elk Island	7.2	4.8	4.4	3.2	4.4	3.1	3.0	3.6	5.7	4.5	6.7	5.5
Gibbons	12.8	7.3	7.1	5.9	6.4	6.7	6.6	6.4	8.0	6.1	9.5	8.9
Fort Saskatchewan	12.8	7.3	7.0	4.6	5.4	2.9	2.8	3.0	7.3	5.8	9.6	9.1
Lamont County	7.9	5.1	5.6	5.1	4.8	4.5	5.3	5.7	5.8	5.1	7.0	6.2
Redwater	10.4	5.6	4.7	3.7	4.0	3.5	3.6	4.2	5.8	4.3	7.0	6.2
Portable at Chipman	8.1	6.0	5.1	4.0	4.5							
Portable at Sturgeon County							5.3	5.2	6.5	5.3	7.1	7.0

Note: The Portable stopped operating at Chipman in May and began again at the Sturgeon County location in July 2020.

Fine Particulates (continued)

Figure 22: Annual average $PM_{2.5}$ concentrations at FAP stations (µg/m^3)



	2015	2016	2017	2018	2019	2020
Bruderheim*	7.20	6.15	7.0	10.6	8.0	6.7
Elk Island	5.78	5.11	6.55	9.6	6.4	4.7
Fort Saskatchewan	7.05	7.42	7.79	11.3	8.7	6.5
Gibbons		6.13	7.70	11.6	9.0	7.6
Lamont County	8.35	7.53	6.87	9.8	6.8	5.7
Redwater				11.1	7.7	5.3

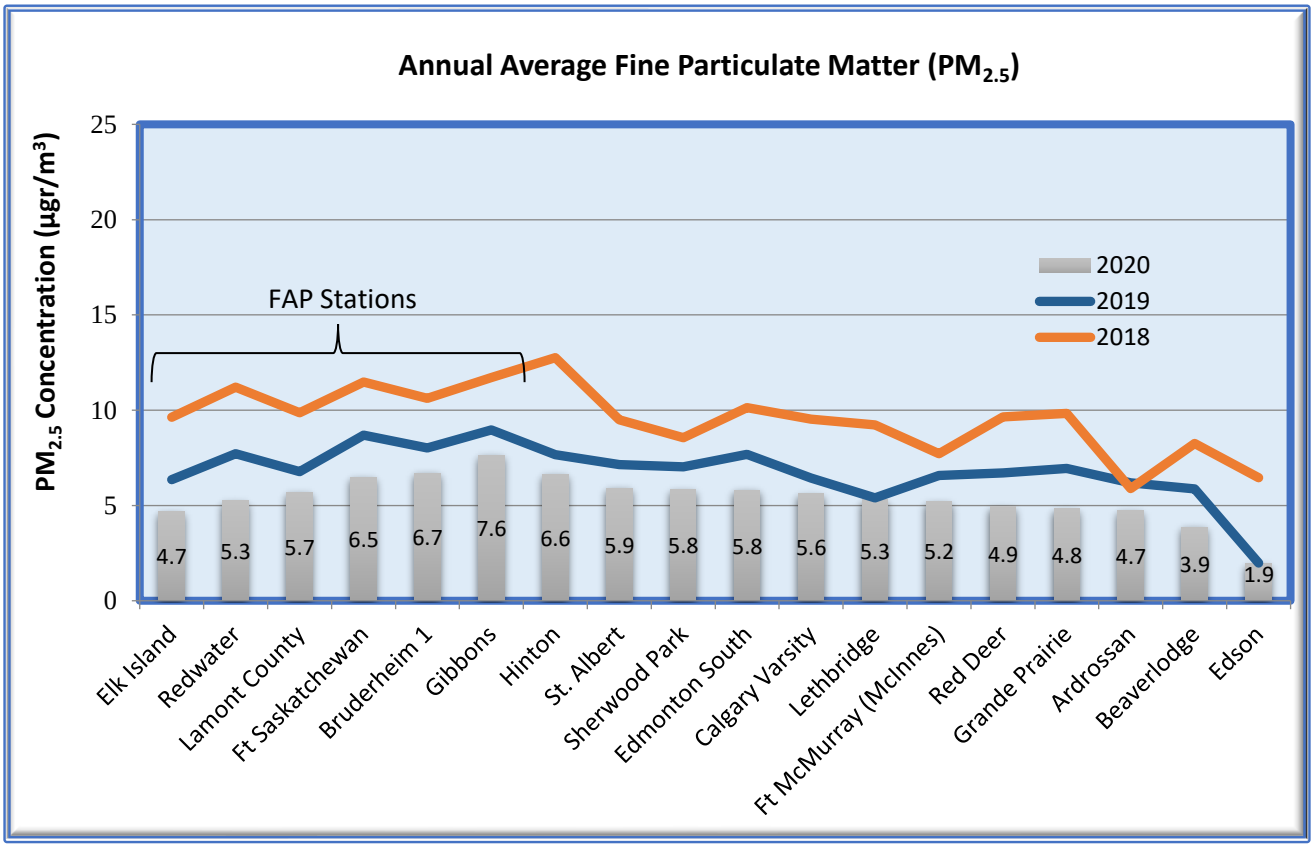
Notes:

- *The Bruderheim station was moved in 2016 and renamed Bruderheim 1. Bruderheim 2016 average includes data from both Bruderheim and Bruderheim1 stations.
- The Gibbons station began operations in 2016.
- The Redwater station began operations in late 2017.
- The Portable station is not shown here as it is not at any location for the minimum 75% of a calendar year required to calculate an annual average.

$PM_{2.5}$ annual averages in 2018 were higher than other years due to the impact of wildfire smoke from British Columbia for most of August that year.

Fine Particulates (continued)

Figure 23: Annual average $PM_{2.5}$ concentrations in Alberta (µgr/m^3)



Significant wildfire smoke episodes across Alberta in both 2018 and 2019 contributed to overall higher annual average $PM_{2.5}$ values in those years as seen in Figure 23 above when compared to the 2020 annual average.

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.

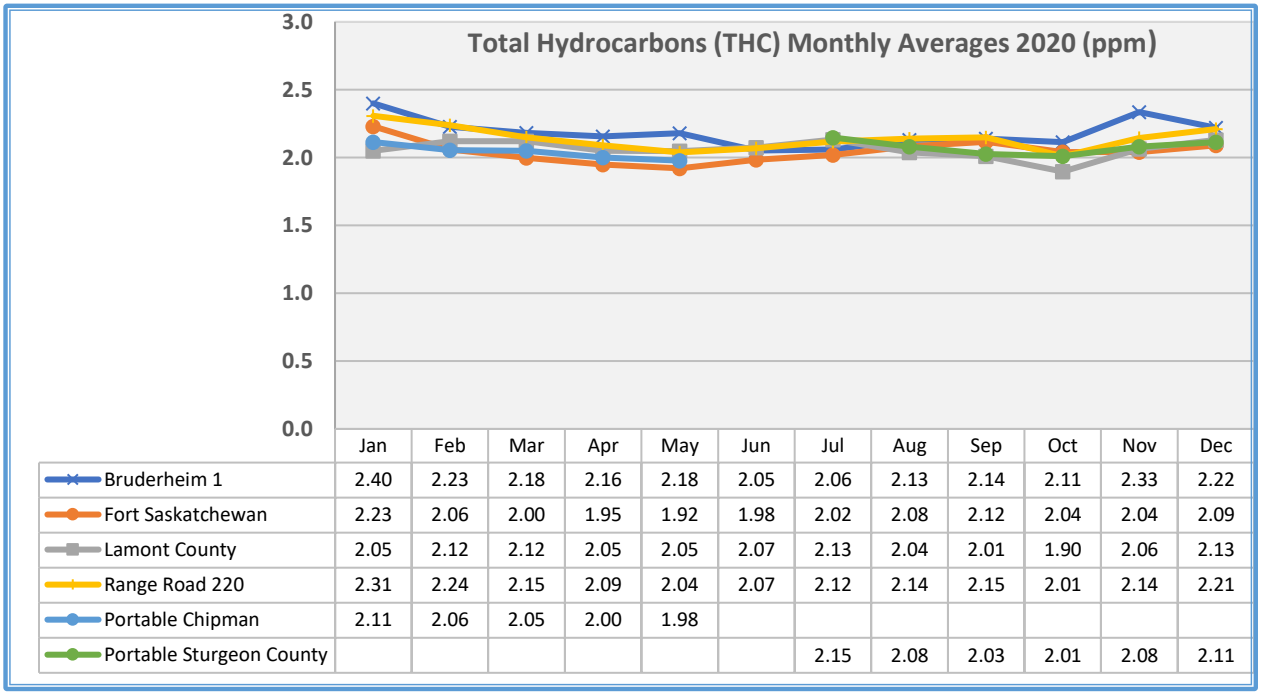
The major reactive hydrocarbon in the atmosphere is methane. Major worldwide sources of atmospheric methane include wetlands, ruminants such as cows, energy use, landfills, and burning biomass such as wood. Methane is the primary component of natural gas.

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. FAP measures a group of these non-methane or VOC hydrocarbons at one station. These are detailed later in this section under Volatile Organic Compounds. 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 2020 at individual stations is presented in Figure 24 though Figure 26 below. Note that for these plots, the Portable stopped operating at Chipman in May and began again at the Sturgeon County location in July 2020.

Plots showing 2020 along with the previous 5 years are presented in Figure 27 through Figure 29 below. The portable data is not shown in annual averages since each year spans two distinct sites and not at any location for the minimum 75% of a calendar year required to calculate an annual average.

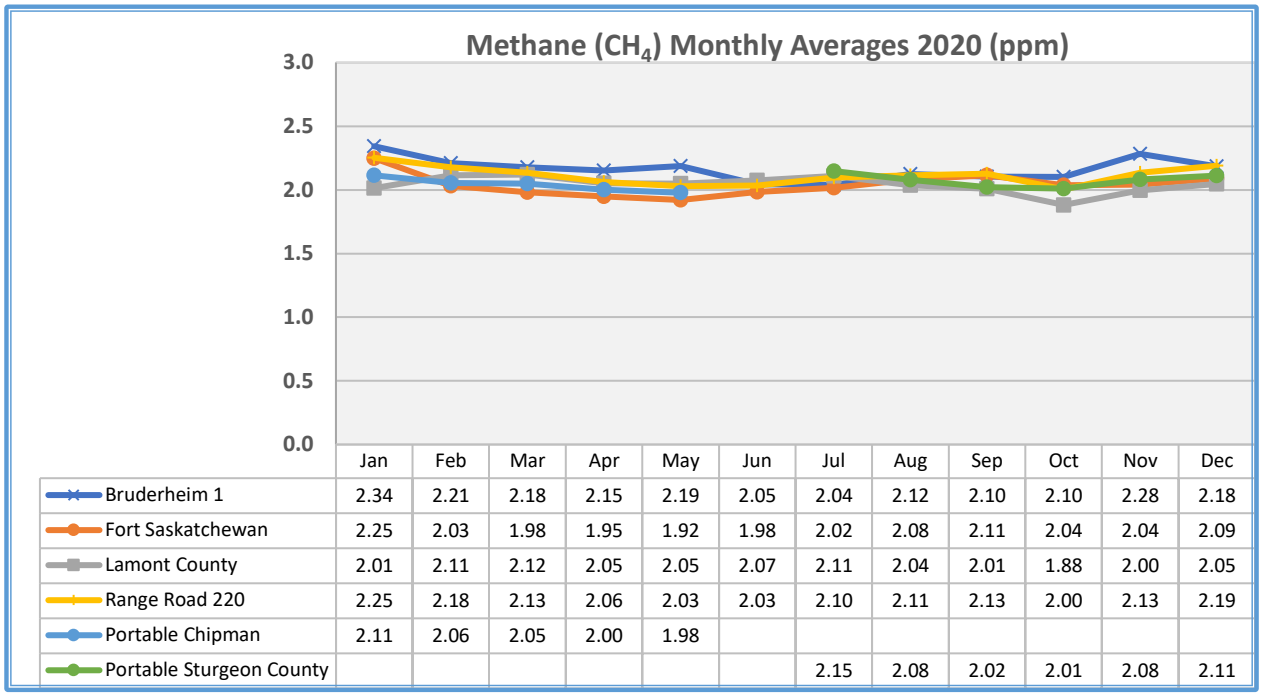
Figure 24: Monthly average Total Hydrocarbons (ppm) in 2020



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	2.40	2.23	2.18	2.16	2.18	2.05	2.06	2.13	2.14	2.11	2.33	2.22
Fort Saskatchewan	2.23	2.06	2.00	1.95	1.92	1.98	2.02	2.08	2.12	2.04	2.04	2.09
Lamont County	2.05	2.12	2.12	2.05	2.05	2.07	2.13	2.04	2.01	1.90	2.06	2.13
Range Road 220	2.31	2.24	2.15	2.09	2.04	2.07	2.12	2.14	2.15	2.01	2.14	2.21
Portable Chipman	2.11	2.06	2.05	2.00	1.98							
Portable Sturgeon County							2.15	2.08	2.03	2.01	2.08	2.11

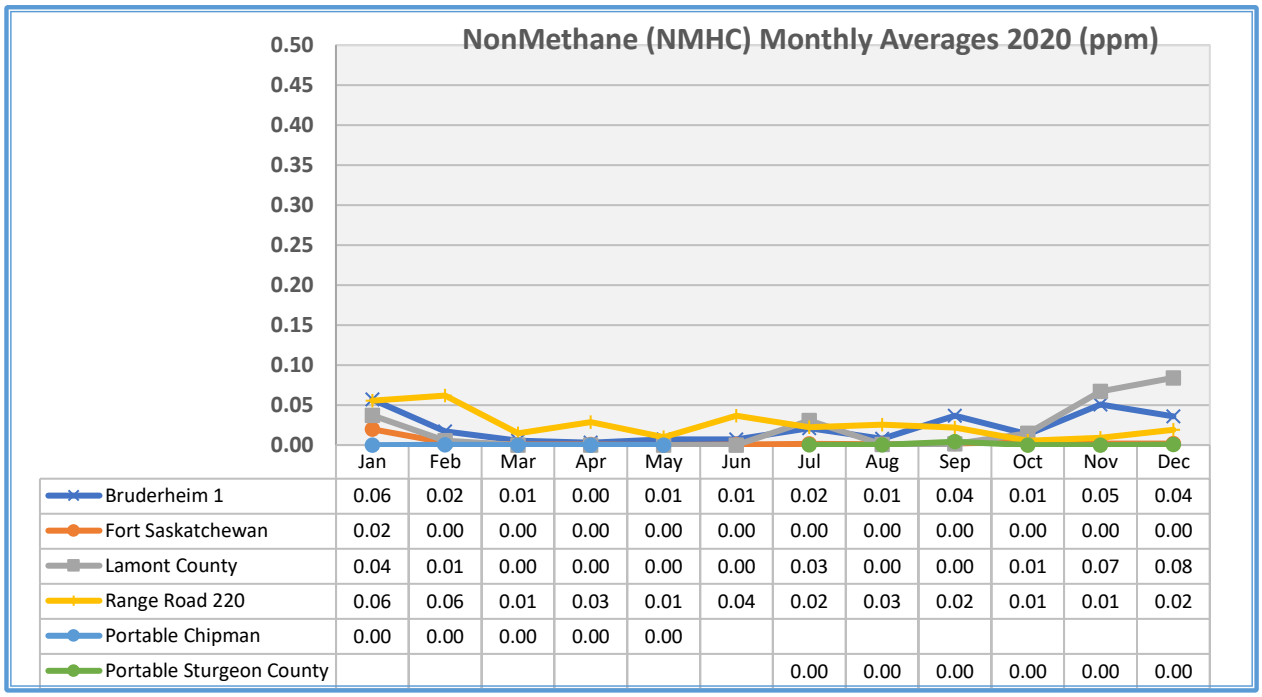
Hydrocarbons (continued)

Figure 25: Monthly average Methane concentrations (ppm) in 2020



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	2.34	2.21	2.18	2.15	2.19	2.05	2.04	2.12	2.10	2.10	2.28	2.18
Fort Saskatchewan	2.25	2.03	1.98	1.95	1.92	1.98	2.02	2.08	2.11	2.04	2.04	2.09
Lamont County	2.01	2.11	2.12	2.05	2.05	2.07	2.11	2.04	2.01	1.88	2.00	2.05
Range Road 220	2.25	2.18	2.13	2.06	2.03	2.03	2.10	2.11	2.13	2.00	2.13	2.19
Portable Chipman	2.11	2.06	2.05	2.00	1.98							
Portable Sturgeon County							2.15	2.08	2.02	2.01	2.08	2.11

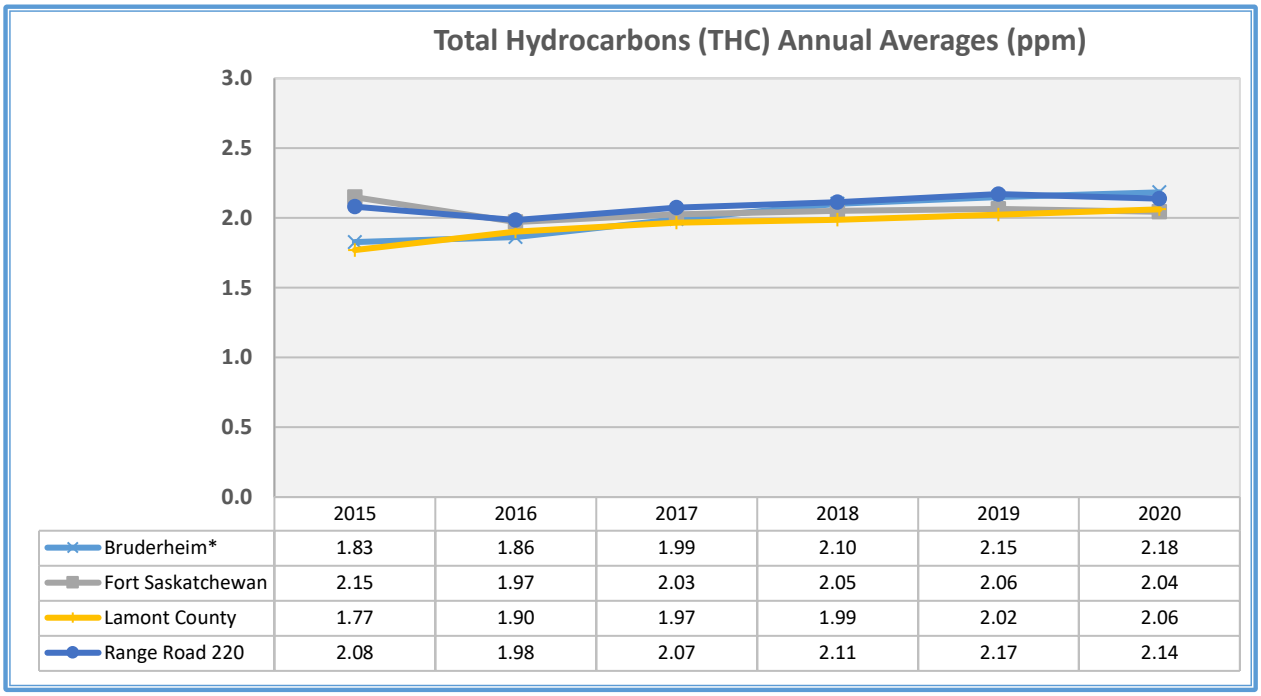
Figure 26: Monthly average Non-Methane Hydrocarbon concentrations (ppm) in 2020



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	0.06	0.02	0.01	0.00	0.01	0.01	0.02	0.01	0.04	0.01	0.05	0.04
Fort Saskatchewan	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lamont County	0.04	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.07	0.08
Range Road 220	0.06	0.06	0.01	0.03	0.01	0.04	0.02	0.03	0.02	0.01	0.01	0.02
Portable Chipman	0.00	0.00	0.00	0.00	0.00							
Portable Sturgeon County							0.00	0.00	0.00	0.00	0.00	0.00

Hydrocarbons (continued)

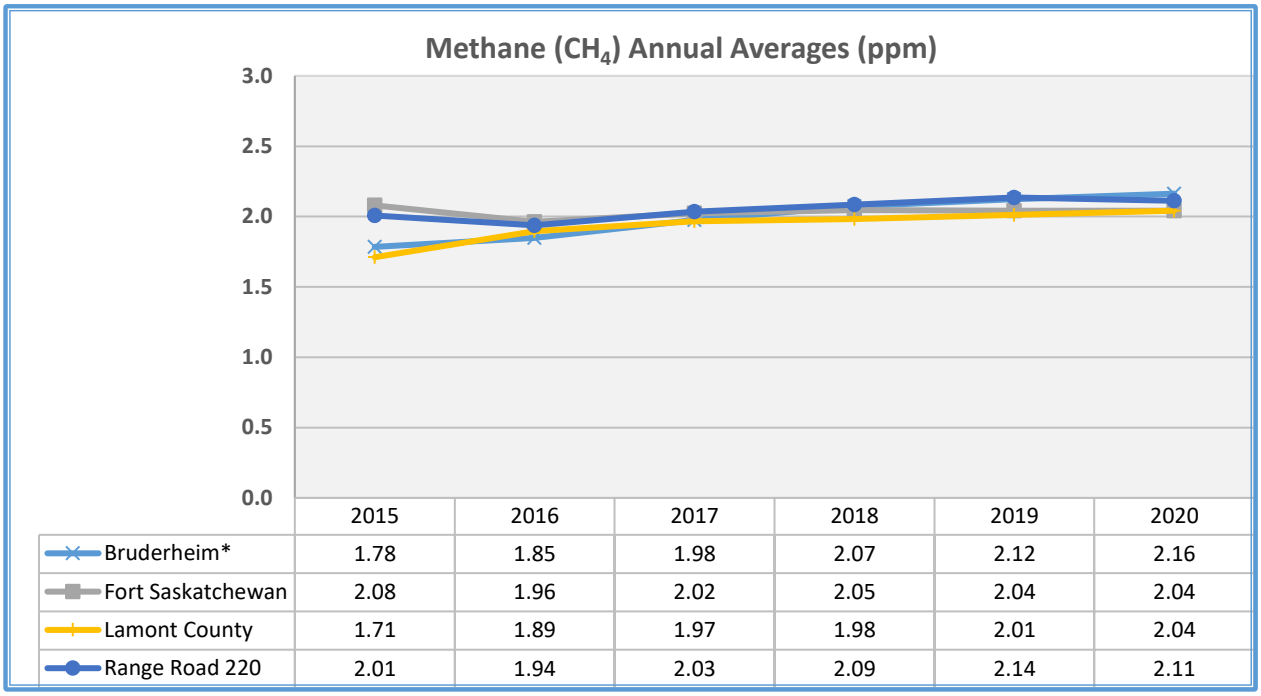
Figure 27: Annual average THC concentrations (ppm)



	2015	2016	2017	2018	2019	2020
Bruderheim*	1.83	1.86	1.99	2.10	2.15	2.18
Fort Saskatchewan	2.15	1.97	2.03	2.05	2.06	2.04
Lamont County	1.77	1.90	1.97	1.99	2.02	2.06
Range Road 220	2.08	1.98	2.07	2.11	2.17	2.14

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

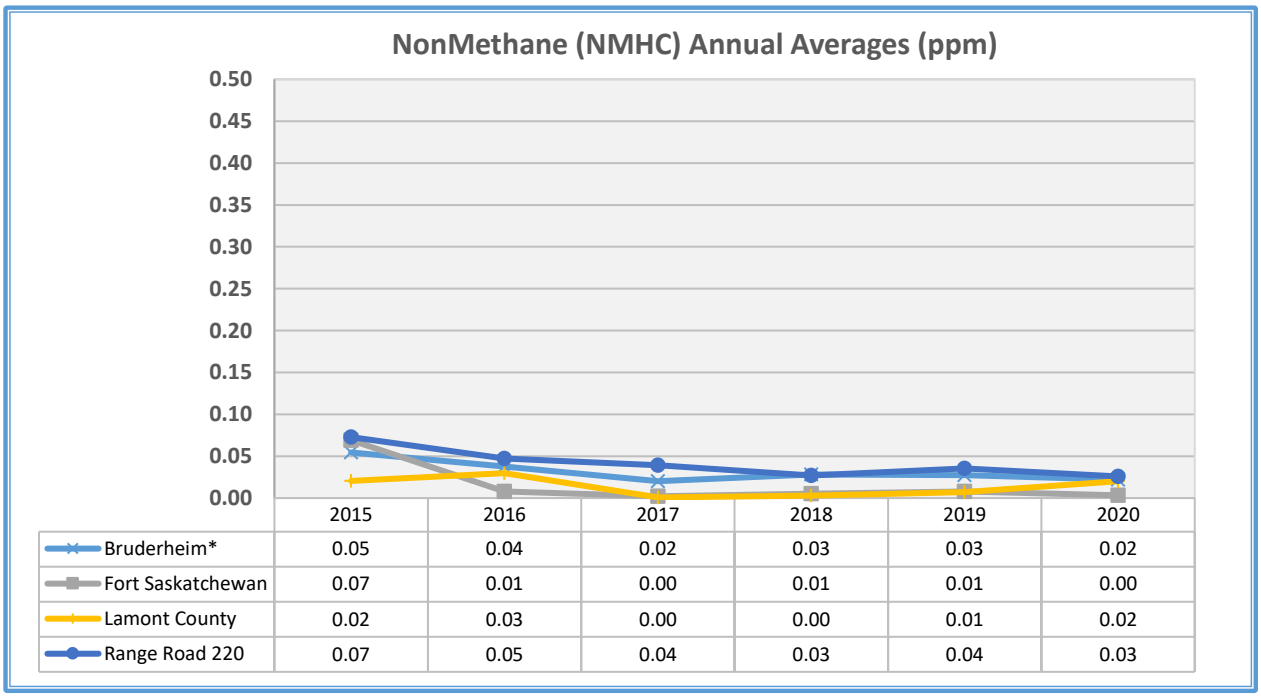
Figure 28: Annual average CH_4 concentrations (ppm)



	2015	2016	2017	2018	2019	2020
Bruderheim*	1.78	1.85	1.98	2.07	2.12	2.16
Fort Saskatchewan	2.08	1.96	2.02	2.05	2.04	2.04
Lamont County	1.71	1.89	1.97	1.98	2.01	2.04
Range Road 220	2.01	1.94	2.03	2.09	2.14	2.11

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

Figure 29: Annual average NMHC concentrations (ppm)



	2015	2016	2017	2018	2019	2020
Bruderheim*	0.05	0.04	0.02	0.03	0.03	0.02
Fort Saskatchewan	0.07	0.01	0.00	0.01	0.01	0.00
Lamont County	0.02	0.03	0.00	0.00	0.01	0.02
Range Road 220	0.07	0.05	0.04	0.03	0.04	0.03

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

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 21 below provides the maximum 1-hour average for each hydrocarbon species in 2020 as measured at each FAP station each month.

Table 21: 2020 Maximum 1-hour average hydrocarbon concentrations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Hydrocarbons THC (PPM)												
Bruderheim 1	6.68	4.51	3.88	3.42	4.95	3.38	3.89	3.86	5.76	4.71	4.93	4.17
Fort Saskatchewan	3.87	2.65	2.53	2.57	2.44	2.78	2.76	2.91	4.53	4.17	3.05	2.87
Lamont County	2.99	2.45	2.60	2.26	2.43	2.45	2.91	2.80	2.56	2.76	2.61	2.92
Range Road 220	4.79	12.7	4.37	7.71	2.98	8.49	7.38	11.5	4.08	2.74	2.94	4.41
Portable at Chipman	3.05	3.16	3.11	2.86	2.69	-	-	-	-	-	-	-
Portable at Sturgeon County	-	-	-	-	-	-	4.82	3.70	3.50	2.37	2.58	2.59
Methane CH_4 (PPM)												
Bruderheim 1	5.48	3.80	3.48	3.09	4.25	2.95	3.55	3.73	3.74	4.01	4.24	3.60
Fort Saskatchewan	3.73	2.66	2.53	2.57	2.44	2.78	2.59	2.91	4.48	2.45	3.05	2.87
Lamont County	2.60	2.45	2.60	2.26	2.43	2.45	2.91	2.80	2.56	2.76	2.39	2.61
Range Road 220	3.53	3.08	3.06	2.56	2.41	2.70	3.49	10.0	3.66	2.48	2.85	4.35
Portable at Chipman	3.05	2.92	3.11	2.86	2.69	-	-	-	-	-	-	-
Portable at Sturgeon County	-	-	-	-	-	-	4.82	3.70	3.50	2.37	2.58	2.59
Non-Methane Hydrocarbons NMHC (PPM)												
Bruderheim 1	1.21	0.71	0.40	0.33	0.70	0.43	0.92	0.36	2.96	0.69	0.69	0.65
Fort Saskatchewan	0.85	0.59	0.27	0.30	0.02	0.29	0.45	0.28	0.63	2.00	0.34	0.61
Lamont County	0.41	0.10	0.00	0.00	0.00	0.00	0.37	0.05	0.32	0.20	0.44	0.32
Range Road 220	2.54	10.4	2.28	5.61	1.02	6.39	5.33	1.73	1.01	0.39	0.80	1.70
Portable at Chipman	0.00	0.23	0.01	0.00	0.00	-	-	-	-	-	-	-
Portable at Sturgeon County	-	-	-	-	-	-	0.03	0.08	0.65	0.00	0.01	0.35

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 seven exceedances of the 1-hour AAAQO and one 24-hour exceedance of the AAAQO for H_2S in 2020. Details of the H_2S exceedances recorded in 2020 are listed in Table 22: Exceedances of the 1-hour average AAAQO for H2S in 2020Table 22 and Table 23.

Table 22: Exceedances of the 1-hour average AAAQO for H_2S in 2020

Station	Highest 1 hour average (ppb)	Exceedances	Date	Attributed Cause
Redwater	16.7	1	July 24	Natural due to wetlands
Redwater	12.2	3	July 31	Natural due to wetlands
Redwater	37.4	1	August 5	Industry responsible
Portable Sturgeon County	19.2	1	August 23	Natural due to wetlands
Redwater	17.9	1	September 19	Town wastewater lagoons

Table 23: Exceedances of the 24-hour average AAAQO for H_2S in 2020

Station	Highest 24 hour average (ppb)	Date	Attributed Cause
Redwater	17.9	August 5	Town wastewater lagoons

Hydrogen sulphide is measured at six continuous monitoring stations in FAP. Table 24Table 20 below provides the maximum 1-hour and 24-hour H_2S averages in 2020 with comparisons to the applicable AAAQOs.

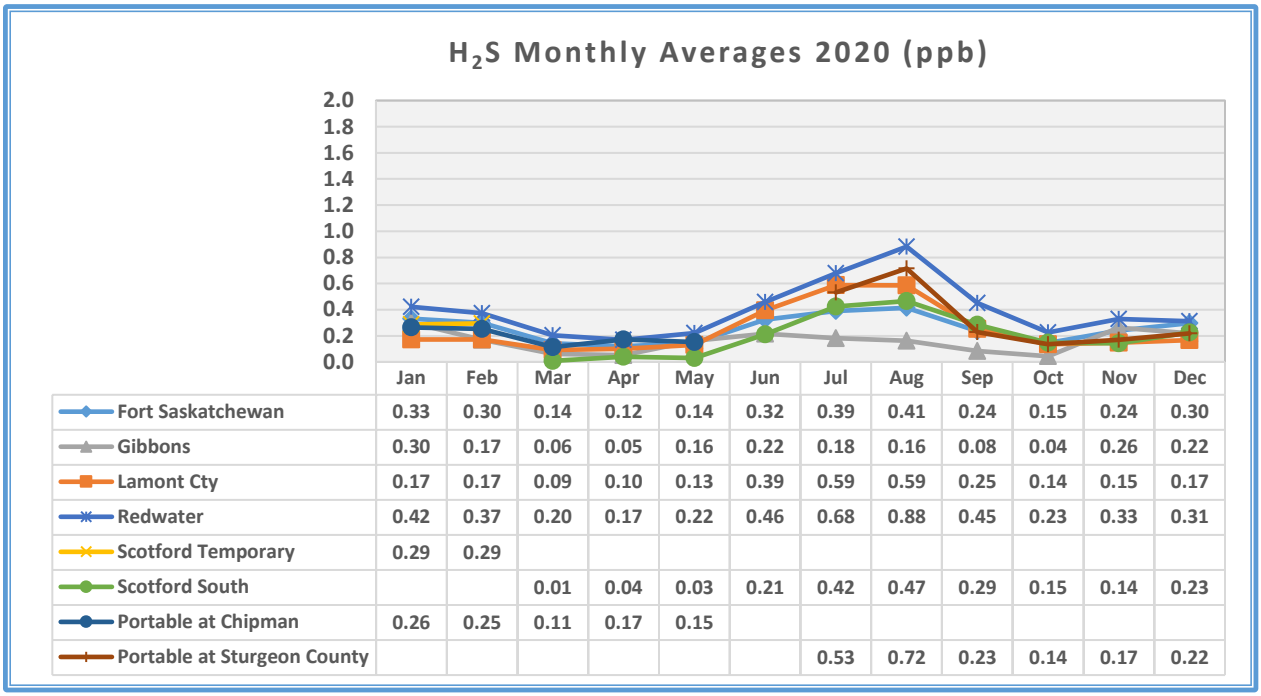
Table 24: 2020 maximum H_2S averages compared with applicable AAAQO

Station	Highest 1-hour average (ppb)	% of AAAQO	Date Time	Highest 24-hour average (ppb)	% of AAAQO	Date
Fort Saskatchewan	3.9	39%	Aug 08 06:00	1.3	43%	Jul 31
Gibbons	6.0	60%	Aug 23 07:00	0.8	25%	Jan 29
Lamont County	8.3	83%	Aug 05 06:00	1.7	56%	Aug 03
Redwater	37.0	370%	Aug 05 07:00	3.2	108%	Aug 05
Scotford Temporary	1.4	14%	Jan 28 10:00	0.6	21%	Jan 25
Scotford South	4.3	43%	Jul 31 06:00	1.2	41%	Aug 03
Portable at Chipman	8.2	82%	Apr 26 21:00	1.2	41%	Feb 18
Portable at Sturgeon County	19.2	192%	Aug 23 07:00	1.8	60%	Aug 23

A summary of the monthly average H_2S concentrations recorded in 2020 at individual stations and annual averages for 2020 with the 5 years previous is shown in Hydrogen Sulphide (continued)
Figure 30 and Figure 31 below.

Hydrogen Sulphide (continued)

Figure 30: Monthly average H_2S concentrations (ppb) in 2020



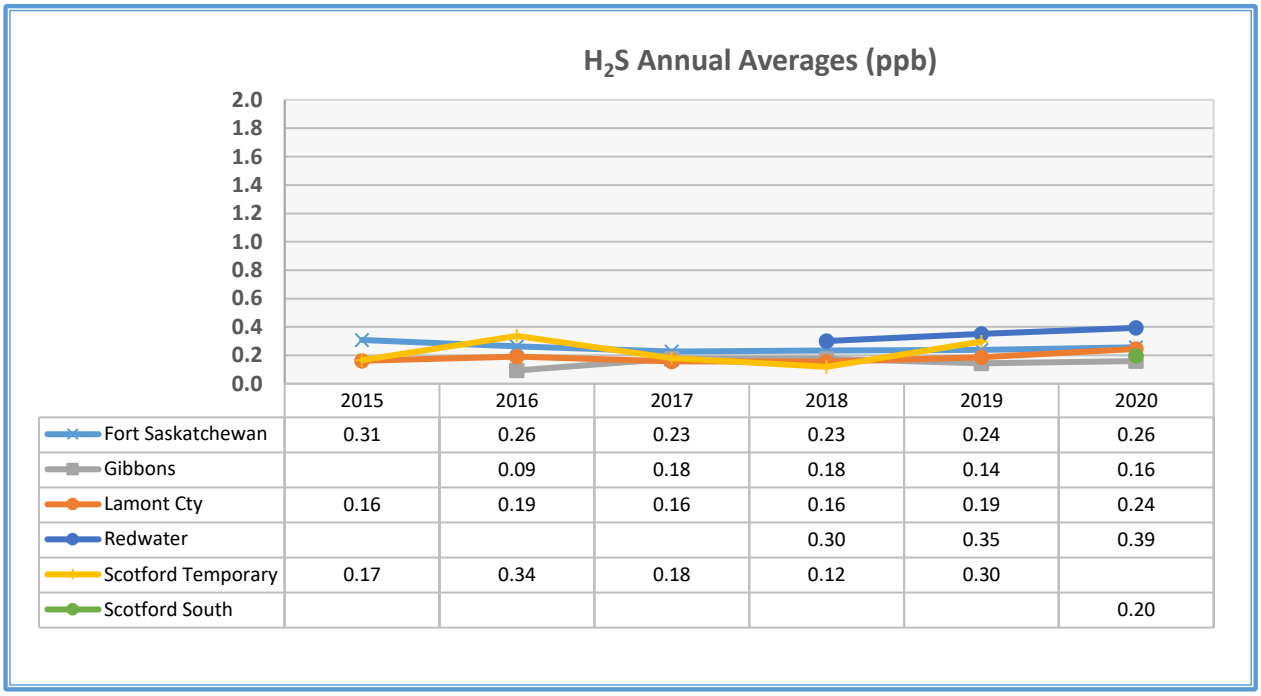
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	0.33	0.30	0.14	0.12	0.14	0.32	0.39	0.41	0.24	0.15	0.24	0.30
Gibbons	0.30	0.17	0.06	0.05	0.16	0.22	0.18	0.16	0.08	0.04	0.26	0.22
Lamont Cty	0.17	0.17	0.09	0.10	0.13	0.39	0.59	0.59	0.25	0.14	0.15	0.17
Redwater	0.42	0.37	0.20	0.17	0.22	0.46	0.68	0.88	0.45	0.23	0.33	0.31
Scotford Temporary	0.29	0.29										
Scotford South			0.01	0.04	0.03	0.21	0.42	0.47	0.29	0.15	0.14	0.23
Portable at Chipman	0.26	0.25	0.11	0.17	0.15							
Portable at Sturgeon County							0.53	0.72	0.23	0.14	0.17	0.22

Notes:

- The Scotford Temporary station was moved in March 2020 and became Scotford South.
- The Portable stopped operating at Chipman in May and began again at the Sturgeon County location in July 2020.

Hydrogen Sulphide (continued)

Figure 31: Annual average H_2S concentrations (ppb)



	2015	2016	2017	2018	2019	2020
Fort Saskatchewan	0.31	0.26	0.23	0.23	0.24	0.26
Gibbons		0.09	0.18	0.18	0.14	0.16
Lamont Cty	0.16	0.19	0.16	0.16	0.19	0.24
Redwater				0.30	0.35	0.39
Scotford Temporary	0.17	0.34	0.18	0.12	0.30	
Scotford South						0.20

Notes:

- The Redwater station began operations late in 2017.
- The Gibbons station began operations in February 2016.
- The Scotford Temporary station was moved in March 2020 and became Scotford South.
- The Portable station is not shown here as it is not at any location for the minimum 75% of a calendar year required to calculate an annual average.

Nitrogen Dioxide

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 readily 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

NO_2 is measured at all ten continuous monitoring stations in FAP. There were no exceedances of either the NO_2 1-hour or annual average AAAQO at any of the FAP stations in 2020.

Nitrogen Dioxide (continued)

Table 25 below provides the maximum 1-hour and annual NO_2 averages in 2020 with comparisons to the applicable AAAQO. Due to the timing of station moves, the Scotford Temporary, and Portable station at both locations did not record the minimum 75% data in 2020 to calculate a valid annual average.

Nitrogen Dioxide (continued)

Table 25: 2020 maximum NO_2 averages compared with applicable AAAQO

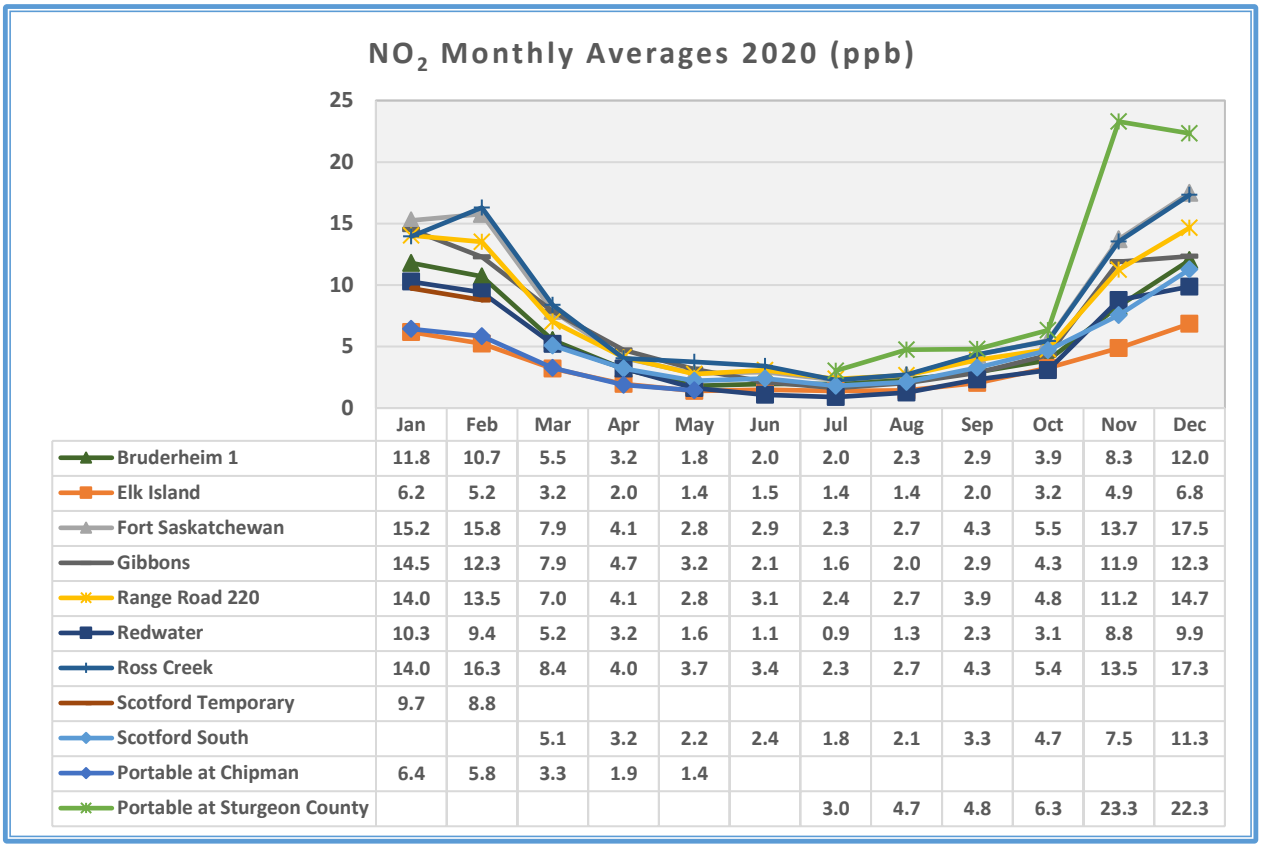
Station	Highest 1-hour average (ppb)	% of AAAQO	Date Time	Annual average (ppb)	% of AAAQO
Bruderheim 1	49.0	31%	Jan 20 22:00	5.5	23%
Elk Island	35.5	22%	Jan 21 01:00	3.3	14%
Fort Saskatchewan	56.1	35%	Feb 25 09:00	7.8	33%
Gibbons	55.1	35%	Jan 29 10:00	6.6	28%
Lamont County	41.9	26%	Jan 20 21:00	3.8	16%
Range Road 220	54.9	35%	Feb 20 21:00	6.9	29%
Redwater	43.1	27%	Jan 21 09:00	4.7	20%
Ross Creek	55.5	35%	May 17 22:00	7.9	33%
Scotford Temporary	45.7	29%	Jan 25 18:00	-	N/A
Scotford South	72.5	0%	Mar 27 10:00	4.4	18%
Portable at Chipman	32.0	20%	Jan 15 19:00	-	N/A
Portable at Sturgeon	40.7	26%	Nov 12 19:00	-	N/A

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 32). 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 monthly average NO_2 concentrations recorded at individual stations and a comparison with the previous 5 years are presented in Figure 32 and Figure 33 below respectively. Figure 34 is a chart of the annual averages in 2020 and the previous 2 years recorded at FAP stations compared with averages from a cross section of other monitoring sites around Alberta.

Nitrogen Dioxide (continued)

Figure 32: Monthly average NO_2 concentrations (ppb) in 2020



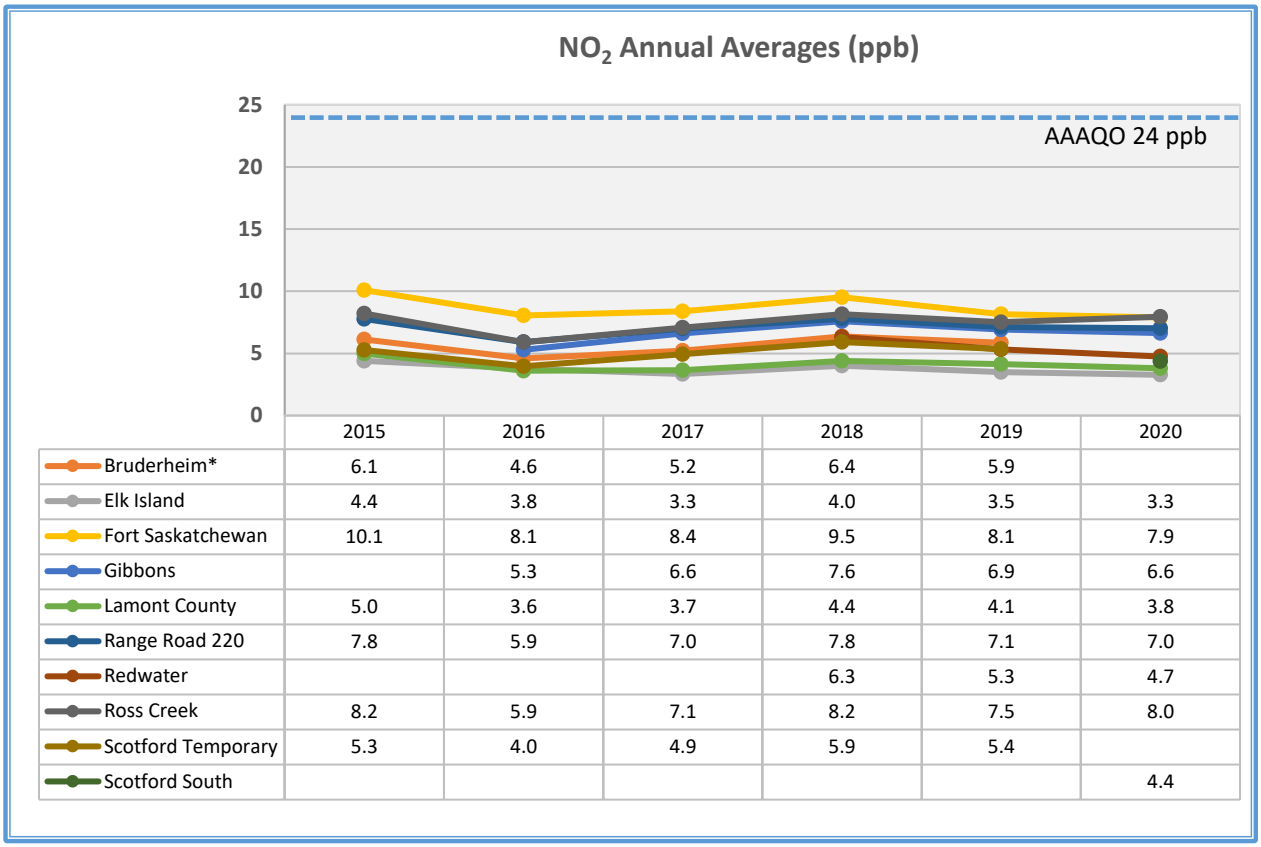
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	11.8	10.7	5.5	3.2	1.8	2.0	2.0	2.3	2.9	3.9	8.3	12.0
Elk Island	6.2	5.2	3.2	2.0	1.4	1.5	1.4	1.4	2.0	3.2	4.9	6.8
Fort Saskatchewan	15.2	15.8	7.9	4.1	2.8	2.9	2.3	2.7	4.3	5.5	13.7	17.5
Gibbons	14.5	12.3	7.9	4.7	3.2	2.1	1.6	2.0	2.9	4.3	11.9	12.3
Range Road 220	14.0	13.5	7.0	4.1	2.8	3.1	2.4	2.7	3.9	4.8	11.2	14.7
Redwater	10.3	9.4	5.2	3.2	1.6	1.1	0.9	1.3	2.3	3.1	8.8	9.9
Ross Creek	14.0	16.3	8.4	4.0	3.7	3.4	2.3	2.7	4.3	5.4	13.5	17.3
Scotford Temporary	9.7	8.8										
Scotford South			5.1	3.2	2.2	2.4	1.8	2.1	3.3	4.7	7.5	11.3
Portable at Chipman	6.4	5.8	3.3	1.9	1.4							
Portable at Sturgeon County							3.0	4.7	4.8	6.3	23.3	22.3

Notes:

- The Scotford Temporary station was moved in March 2020 and became Scotford South.
- The Portable stopped operating at Chipman in May and began again at the Sturgeon County location in July 2020.

Nitrogen Dioxide (continued)

Figure 33: Annual average NO_2 concentrations at FAP stations (ppb)



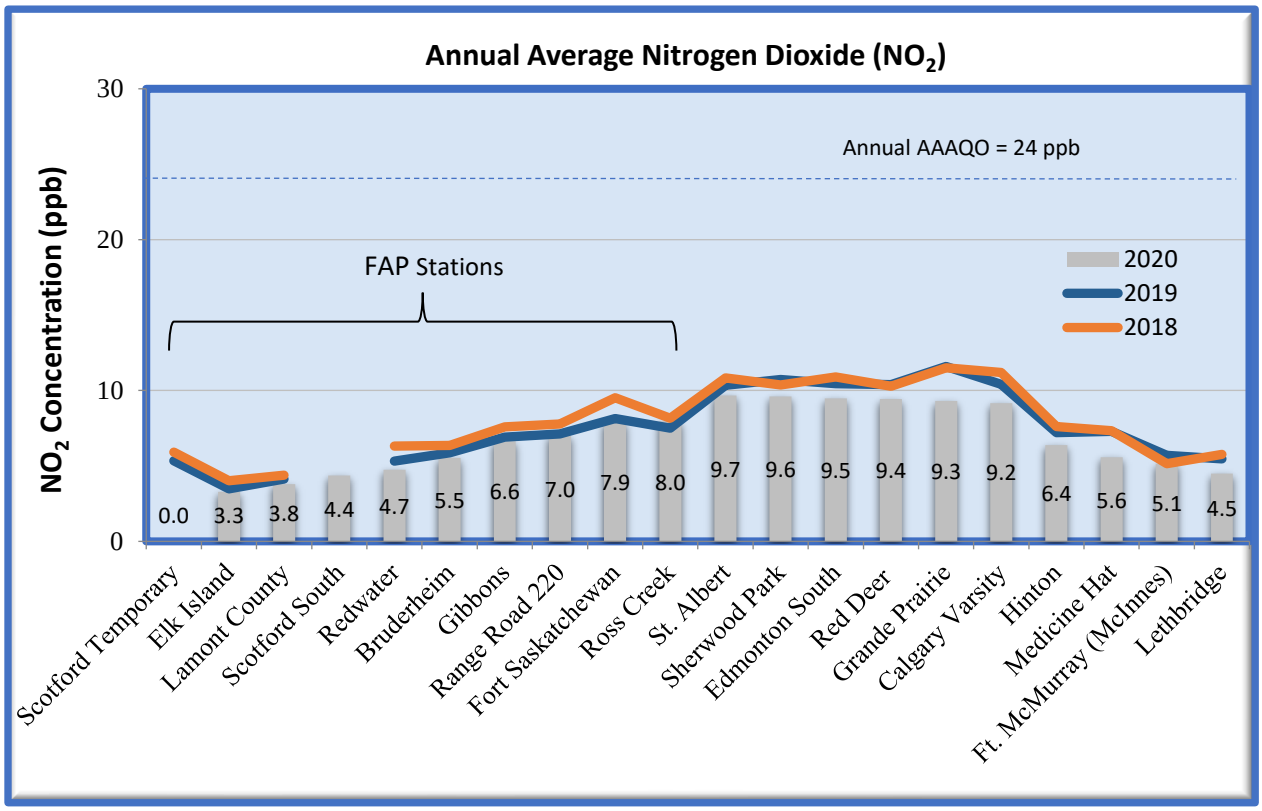
	2015	2016	2017	2018	2019	2020
Bruderheim*	6.1	4.6	5.2	6.4	5.9	
Elk Island	4.4	3.8	3.3	4.0	3.5	3.3
Fort Saskatchewan	10.1	8.1	8.4	9.5	8.1	7.9
Gibbons		5.3	6.6	7.6	6.9	6.6
Lamont County	5.0	3.6	3.7	4.4	4.1	3.8
Range Road 220	7.8	5.9	7.0	7.8	7.1	7.0
Redwater				6.3	5.3	4.7
Ross Creek	8.2	5.9	7.1	8.2	7.5	8.0
Scotford Temporary	5.3	4.0	4.9	5.9	5.4	
Scotford South						4.4

Notes:

- *The Bruderheim station was moved in 2016 and renamed Bruderheim 1. The Bruderheim 2016 average includes data from both Bruderheim and Bruderheim1 stations.
- The Gibbons station began operations in February 2016.
- The Redwater station began operations late in 2017.
- The Scotford Temporary station was moved in March 2020 and became Scotford South.
- The Portable station is not shown here as it is not at any location for the minimum 75% of a calendar year required to calculate an annual average.

Nitrogen Dioxide (continued)

Figure 34: Annual average NO_2 concentrations in Alberta (ppb)



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.

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 highest maximum one-hour values tend to occur in the summer, during hot afternoons and under low wind conditions, a condition often referred to as summertime smog. In 2020 this occurred during warm weather in July as shown in Table 26**Error! Reference source not found.**. Peak concentrations for ozone are relevant because of potential health effects. However, the highest monthly average concentrations tend to occur during the spring months, April 2020 as seen in Figure 35, when the overall background ozone levels are highest. Figure 35

The AAAQO for ozone is:

- 1-hour average concentration 76 ppb

O_3 is measured at seven continuous monitoring stations in FAP. There were no exceedances of the O_3 1-hour average AAAQO at any of the FAP stations in 2020.

Table 26 below provides the maximum 1-hour O_3 averages in 2020 with comparison to the applicable AAAQO.

Ozone (continued)

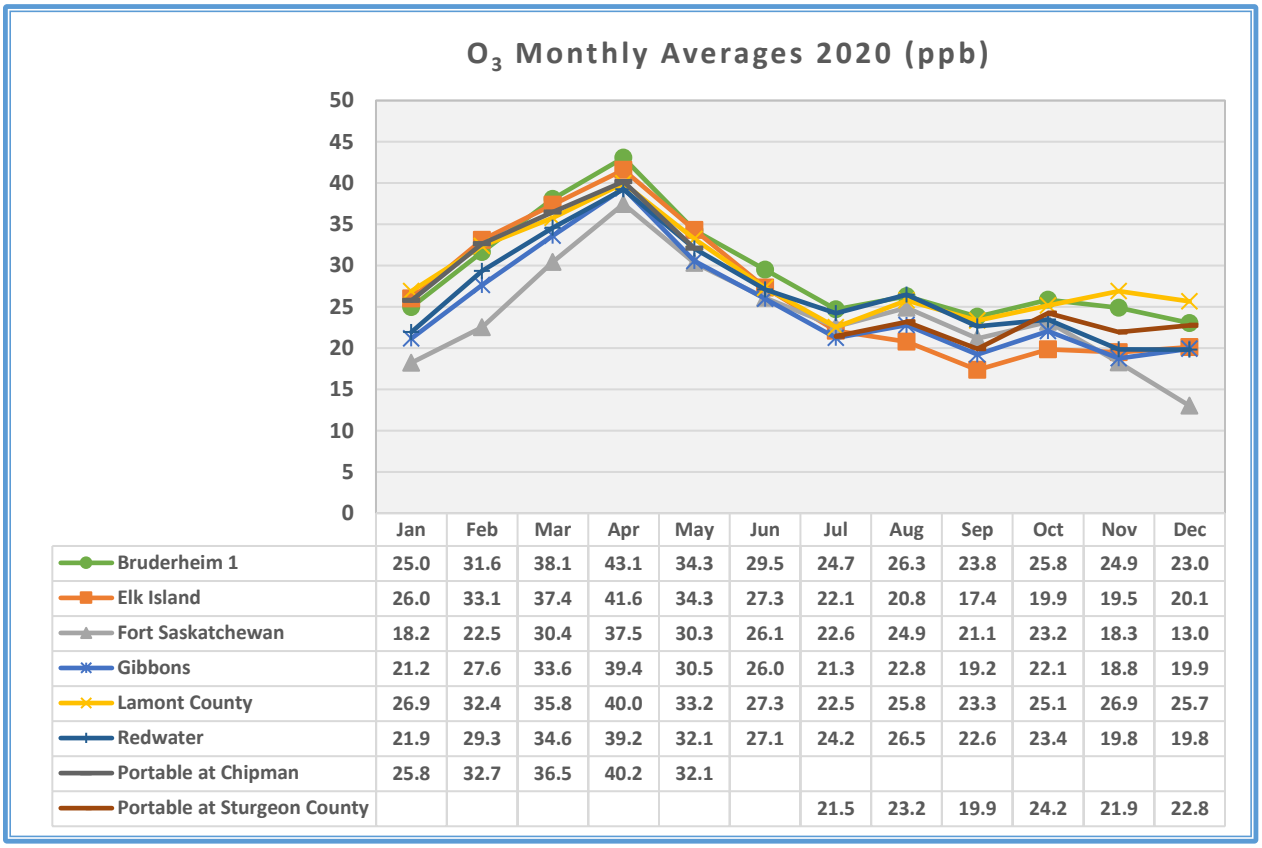
Table 26: 2020 maximum O_3 averages compared with applicable AAAQO

Station	Highest 1-hour average (ppb)	% of AAAQO	Date Time
Bruderheim 1	67.7	89%	Jul 28 14:00
Elk Island	74.0	97%	Jul 28 15:00
Fort Saskatchewan	60.5	80%	Aug 18 16:00
Gibbons	62.8	83%	Jul 27 14:00
Lamont County	69.5	91%	Jul 28 14:00
Redwater	62.5	82%	Aug 17 14:00
Portable at Chipman	57.5	76%	Apr 29 16:00
Portable at Sturgeon County	56.8	75%	Jul 27 14:00

A summary of monthly average O_3 concentrations recorded at individual stations is shown in Figure 35 below while Figure 36 shows the annual average O_3 concentrations in the FAP network in 2020 and the 5 years previous. Figure 37 plots annual averages at FAP sites alongside selected stations across Alberta for the last 3 years.

Ozone (continued)

Figure 35: Monthly average O_3 concentrations (ppb) in 2020

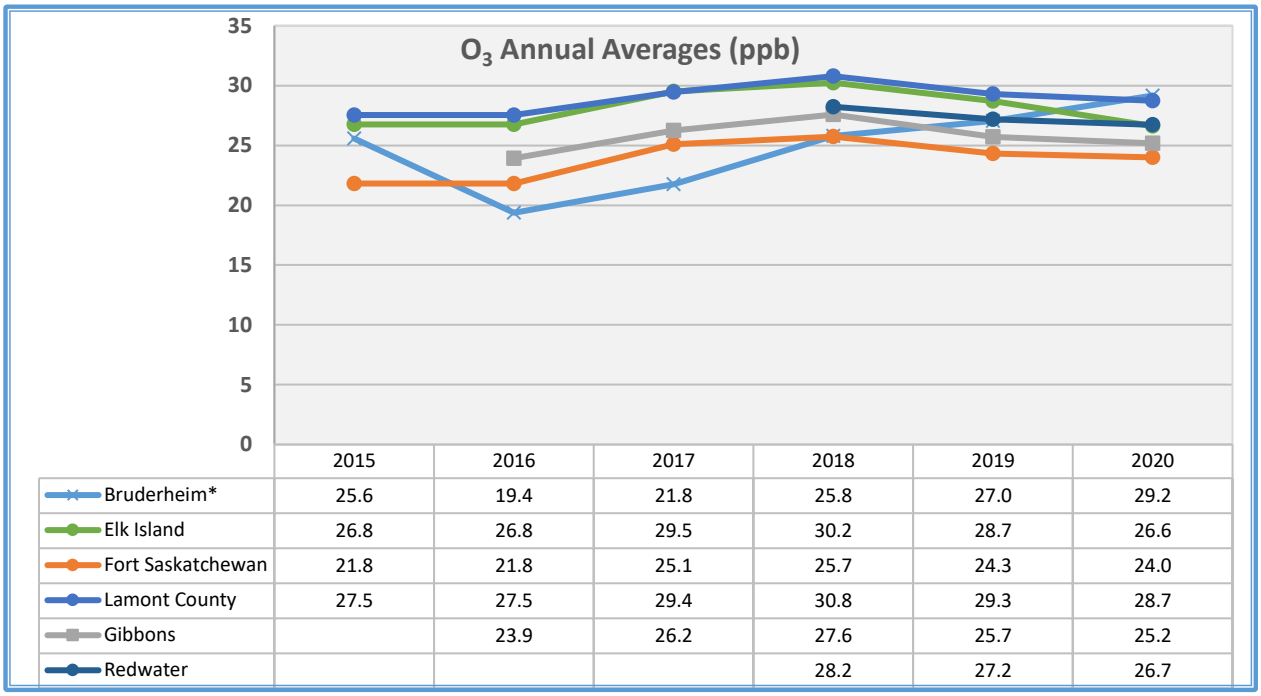


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	25.0	31.6	38.1	43.1	34.3	29.5	24.7	26.3	23.8	25.8	24.9	23.0
Elk Island	26.0	33.1	37.4	41.6	34.3	27.3	22.1	20.8	17.4	19.9	19.5	20.1
Fort Saskatchewan	18.2	22.5	30.4	37.5	30.3	26.1	22.6	24.9	21.1	23.2	18.3	13.0
Gibbons	21.2	27.6	33.6	39.4	30.5	26.0	21.3	22.8	19.2	22.1	18.8	19.9
Lamont County	26.9	32.4	35.8	40.0	33.2	27.3	22.5	25.8	23.3	25.1	26.9	25.7
Redwater	21.9	29.3	34.6	39.2	32.1	27.1	24.2	26.5	22.6	23.4	19.8	19.8
Portable at Chipman	25.8	32.7	36.5	40.2	32.1							
Portable at Sturgeon County							21.5	23.2	19.9	24.2	21.9	22.8

Note: The Portable stopped operating at Chipman in May and began again at the Sturgeon County location in July 2020.

Ozone (continued)

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



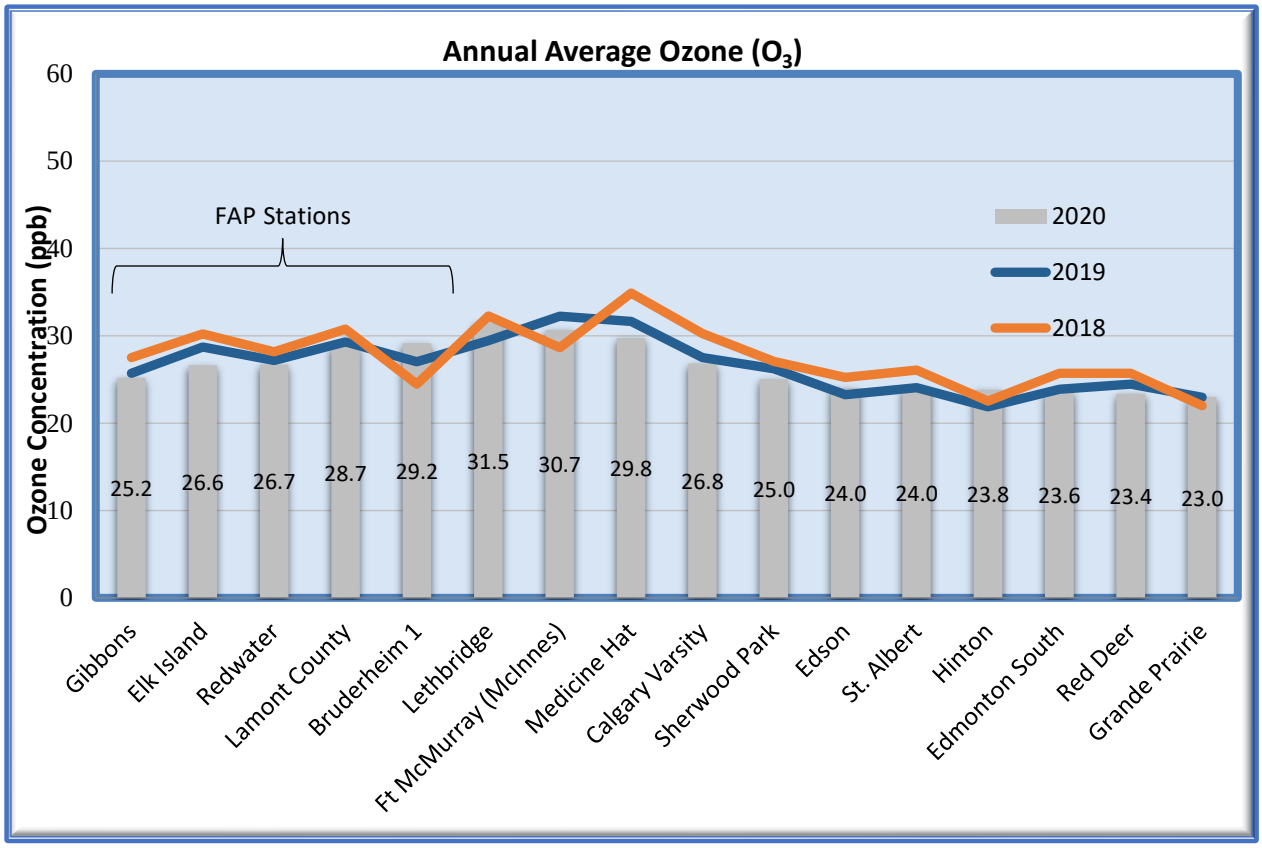
	2015	2016	2017	2018	2019	2020
Bruderheim*	25.6	19.4	21.8	25.8	27.0	29.2
Elk Island	26.8	26.8	29.5	30.2	28.7	26.6
Fort Saskatchewan	21.8	21.8	25.1	25.7	24.3	24.0
Lamont County	27.5	27.5	29.4	30.8	29.3	28.7
Gibbons		23.9	26.2	27.6	25.7	25.2
Redwater				28.2	27.2	26.7

Notes:

- *The Bruderheim station was moved in 2016 and renamed Bruderheim 1. Bruderheim 2016 average includes data from both Bruderheim and Bruderheim1 stations
- The Gibbons station began operations in February 2016.
- The Redwater station began operations late in 2017.
- The Portable station is not shown here as it is not at any location for the minimum 75% of a calendar year required to calculate an annual average.

Ozone (continued)

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



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. SO_2 measured in the Airshed is primarily from 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

There were no exceedances of any of the AAAQOs for SO_2 at any of the FAP monitoring stations in 2020.

Comparing air quality monitoring data in the Fort Air Partnership region for 2020 against the AAAQO, it was observed that the maximum 1-hour average was 96 ppb or 56% of the AAAQO recorded at the Bruderheim 1 station on September 16th. The highest 24-hour average was 6.5 ppb or 13.5% of the AAAQO recorded at the Lamont County station, also on September 16th.

Table 27 below provides the maximum 1-hour, 24-hour, 30 day and annual SO2 averages in 2020 with comparison to the applicable AAAQOs. For the purposes of this comparison, FAP uses the monthly averages as the 30-day average.

Table 27: 2020 maximum SO_2 averages compared with applicable AAAQO

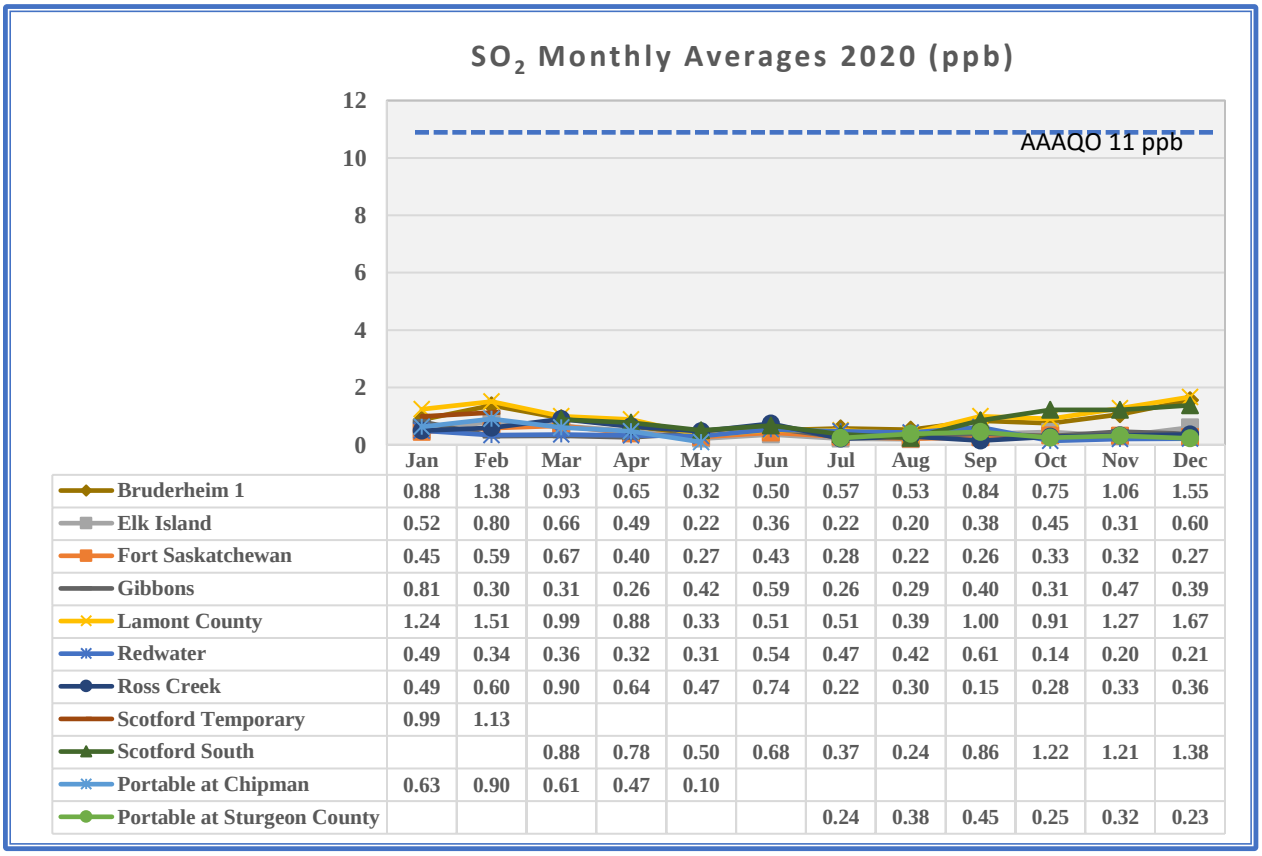
Station	Highest 1-hour average (ppb)	% of AAAQO	Date Time	Highest 24-hour average (ppb)	% of AAAQO	Date	Highest 30-day average (ppb)	% of AAAQO	Month	Annual average (ppb)	% of AAAQO
Bruderheim 1	96.0	55.8%	Sep 16 15:00	6.1	12.8%	Sept 16	1.6	14%	Dec	0.8	10%
Elk Island	21.7	12.6%	Mar 15 10:00	4.3	9.1%	Mar 15	0.8	7%	Feb	0.4	5%
Fort Saskatchewan	20.4	11.9%	Mar 10 13:00	4.6	9.6%	Mar 10	0.7	6%	Mar	0.4	5%
Gibbons	22.0	12.8%	Sep 12 16:00	3.2	6.8%	Jan 27	0.8	7%	Jan	0.4	5%
Lamont County	69.6	40.5%	Sep 16 16:00	6.5	13.5%	Sept 16	1.7	15%	Dec	0.9	12%
Redwater	35.1	20.4%	Sep 22 12:00	3.6	7.6%	Sept 22	0.6	6%	Sep	0.4	5%
Ross Creek	28.2	16.4%	Aug 24 18:00	5.4	11.3%	Jun 13	0.9	8%	Mar	0.5	6%
Scotford Temporary	14.9	8.6%	Feb 1 11:00	4.7	9.9%	Feb 4	1.1	10%	Feb		
Scotford South	80.8	47.0%	Nov 4 08:00	5.8	12.1%	Nov 4	1.4	13%	Dec	0.8	10%
Portable at Chipman	20.2	11.8%	Apr 7 19:00	3.6	7.6%	Mar 22	0.9	8%	Feb		
Portable at Sturgeon County	25.6	14.9%	Sep 28 13:00	3.0	6.3%	Sep 18	0.4	4%	Sep		

Sulphur Dioxide (continued)

A summary of monthly average SO_2 concentrations recorded in 2020 at individual stations is presented in Figure 38 below.

A comparison of annual averages for 2020 and the five years previous is shown in Figure 39. Figure 40 shows the annual averages of SO_2 at FAP stations and with a cross section of other stations in Alberta.

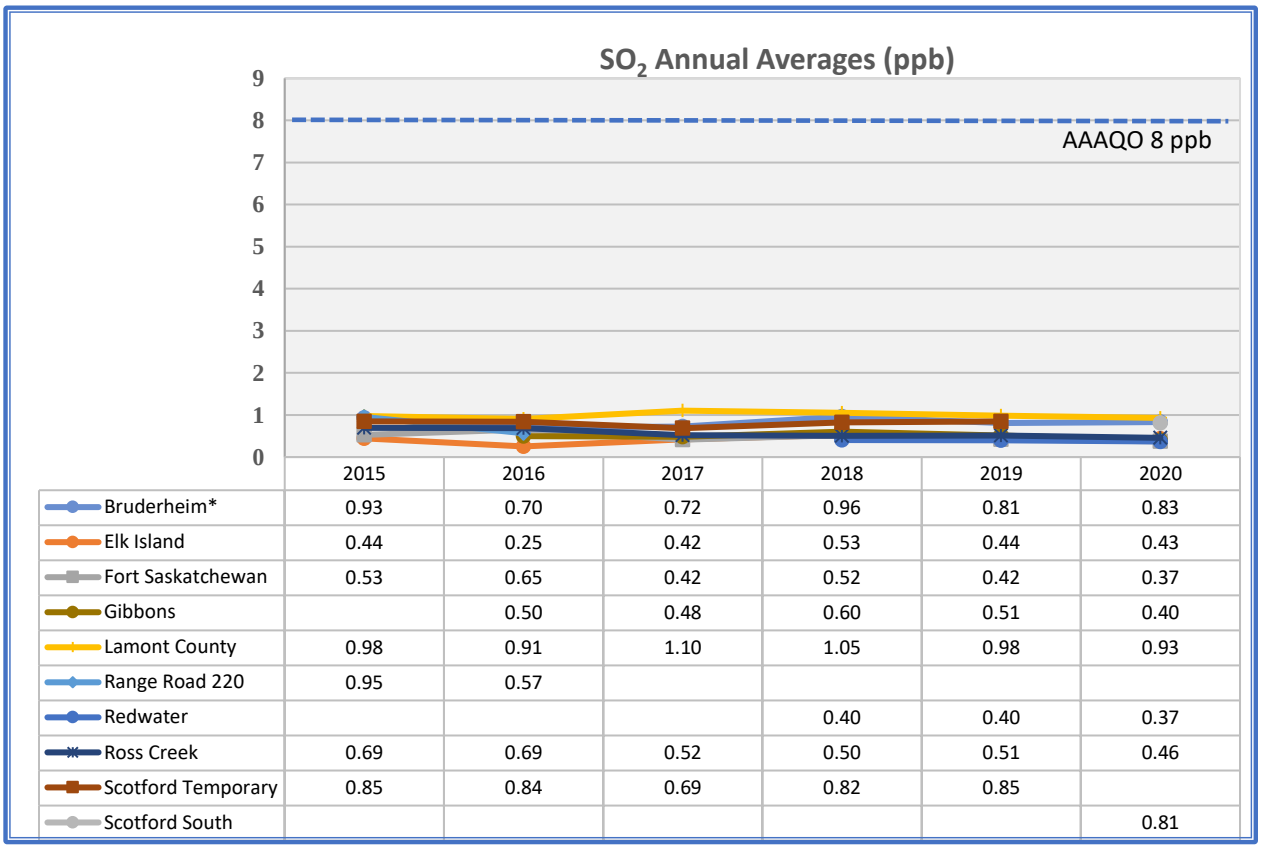
Figure 38: Monthly average SO_2 concentrations (ppb) in 2020



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	0.88	1.38	0.93	0.65	0.32	0.50	0.57	0.53	0.84	0.75	1.06	1.55
Elk Island	0.52	0.80	0.66	0.49	0.22	0.36	0.22	0.20	0.38	0.45	0.31	0.60
Fort Saskatchewan	0.45	0.59	0.67	0.40	0.27	0.43	0.28	0.22	0.26	0.33	0.32	0.27
Gibbons	0.81	0.30	0.31	0.26	0.42	0.59	0.26	0.29	0.40	0.31	0.47	0.39
Lamont County	1.24	1.51	0.99	0.88	0.33	0.51	0.51	0.39	1.00	0.91	1.27	1.67
Redwater	0.49	0.34	0.36	0.32	0.31	0.54	0.47	0.42	0.61	0.14	0.20	0.21
Ross Creek	0.49	0.60	0.90	0.64	0.47	0.74	0.22	0.30	0.15	0.28	0.33	0.36
Scotford Temporary	0.99	1.13										
Scotford South			0.88	0.78	0.50	0.68	0.37	0.24	0.86	1.22	1.21	1.38
Portable at Chipman	0.63	0.90	0.61	0.47	0.10							
Portable at Sturgeon County							0.24	0.38	0.45	0.25	0.32	0.23

Sulphur Dioxide (continued)

Figure 39: Annual average SO_2 concentrations at FAP stations (ppb)



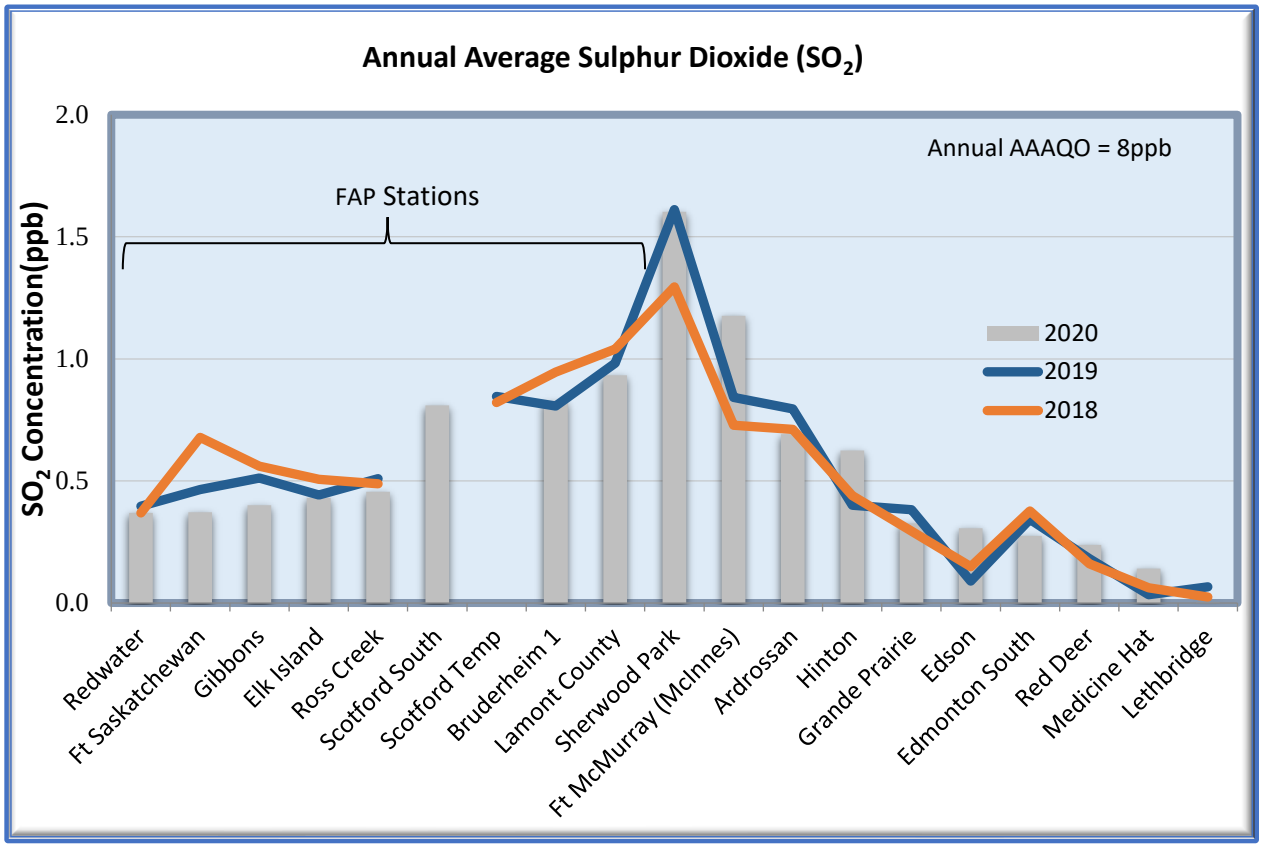
	2015	2016	2017	2018	2019	2020
Bruderheim*	0.93	0.70	0.72	0.96	0.81	0.83
Elk Island	0.44	0.25	0.42	0.53	0.44	0.43
Fort Saskatchewan	0.53	0.65	0.42	0.52	0.42	0.37
Gibbons		0.50	0.48	0.60	0.51	0.40
Lamont County	0.98	0.91	1.10	1.05	0.98	0.93
Range Road 220	0.95	0.57				
Redwater				0.40	0.40	0.37
Ross Creek	0.69	0.69	0.52	0.50	0.51	0.46
Scotford Temporary	0.85	0.84	0.69	0.82	0.85	
Scotford South						0.81

Notes:

- *The Bruderheim station was moved in 2016 and renamed Bruderheim 1. The Bruderheim 2016 annual average includes data from both Bruderheim and Bruderheim1 stations.
- SO_2 monitoring was stopped at Range Road 220 in January 2017
- The Redwater station began operation October 2017.
- The Scotford South station replaced Scotford Temporary in March 2020
- The Portable station is not shown here as it is not at any location for the minimum 75% of a calendar year required to calculate an annual average.

Sulphur Dioxide (continued)

Figure 40: Annual average SO_2 concentrations in Alberta (ppb)



Note: The Scotford South station replaced Scotford Temporary in March 2020

Volatile Organic Compounds (VOCs)

Benzene, toluene, ethylbenzene, o-xylene, mp-xylenes, and styrene (BTEX/S) fall into the group of compounds known as VOC's. These compounds are typically found in petroleum products, such as gasoline and diesel fuel with each having 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 (up to four samples per hour) basis at the Scotford 2 and subsequently at Scotford Temporary stations since January 2007.

The AAAQOs for the following VOCs are:

- Benzene
  - 1-hour average concentration 9 ppb
  - Annual average concentration 0.9 ppb
- Toluene
  - 1-hour average concentration 499 ppb
  - 24-hour average concentration 106 ppb
- Ethylbenzene
  - 1-hour average concentration 460 ppb
- Xylenes (all isomers)
  - 1-hour average concentration 530 ppb
  - 24-hour average concentration 161 ppb
- Styrene
  - 1-hour average concentration 52 ppb

There were no exceedances of any AAAQO for any of the BTEX/S compounds in 2020.

Table 28 below provides the maximum 1-hour and 24-hour BTEX/S averages with comparison to the applicable AAAQOs. The tables and charts below combine data from both the Scotford Temporary and Scotford South locations for the monitoring station in 2020.

Volatile Organic Compounds (continued)

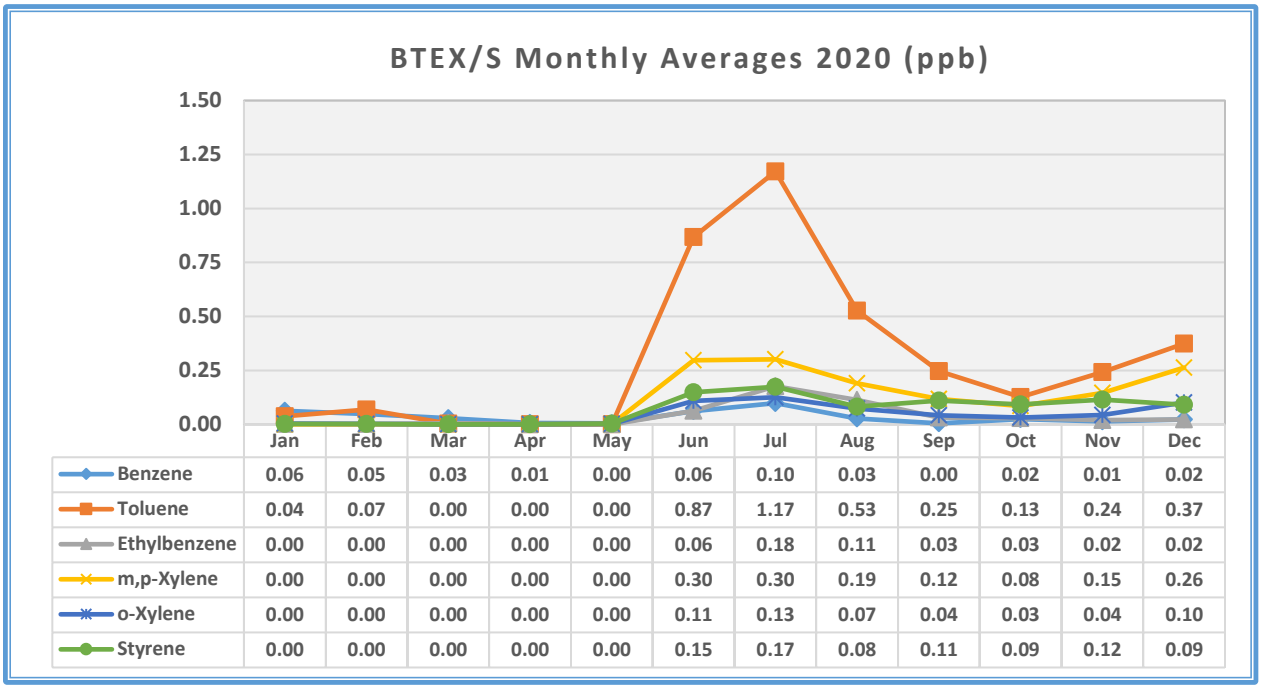
Table 28: 2020 maximum BTEX/S averages compared with applicable AAAQO

Station	Highest 1-hour average (ppb)	Date Time	% of AAAQO	Highest 24-hour average (ppb)	Date	% of AAAQO
Benzene	4.55	Mar 11 23:00	50.56%	0.7	August 06	N/A
Toluene	4.08	Jul 11 17:00	0.82%	2.3	July 11	2.15%
Ethylbenzene	1.87	Aug 12 17:00	0.41%	0.9	July 23	N/A
m, p-Xylene	3.26	Dec 17 15:00	0.61%	0.9	December 30	0.54%
o-Xylene	2.91	Dec 17 15:00	0.55%	0.5	June 04	0.30%
Styrene	4.24	Dec 17 15:00	8.16%	1.1	July 18	N/A

A plot of the monthly average BTEX/S concentrations recorded in 2020 at the Scotford Temporary station is presented in Figure 41. A comparison of 2020 annual average BTEX/S concentrations with the five years previous is shown in Figure 42 below. The increase of toluene the 2017 annual average as shown in Figure 42 was due to a sealant used to repair the roof of the monitoring station shelter itself off-gassing during warmer temperatures.

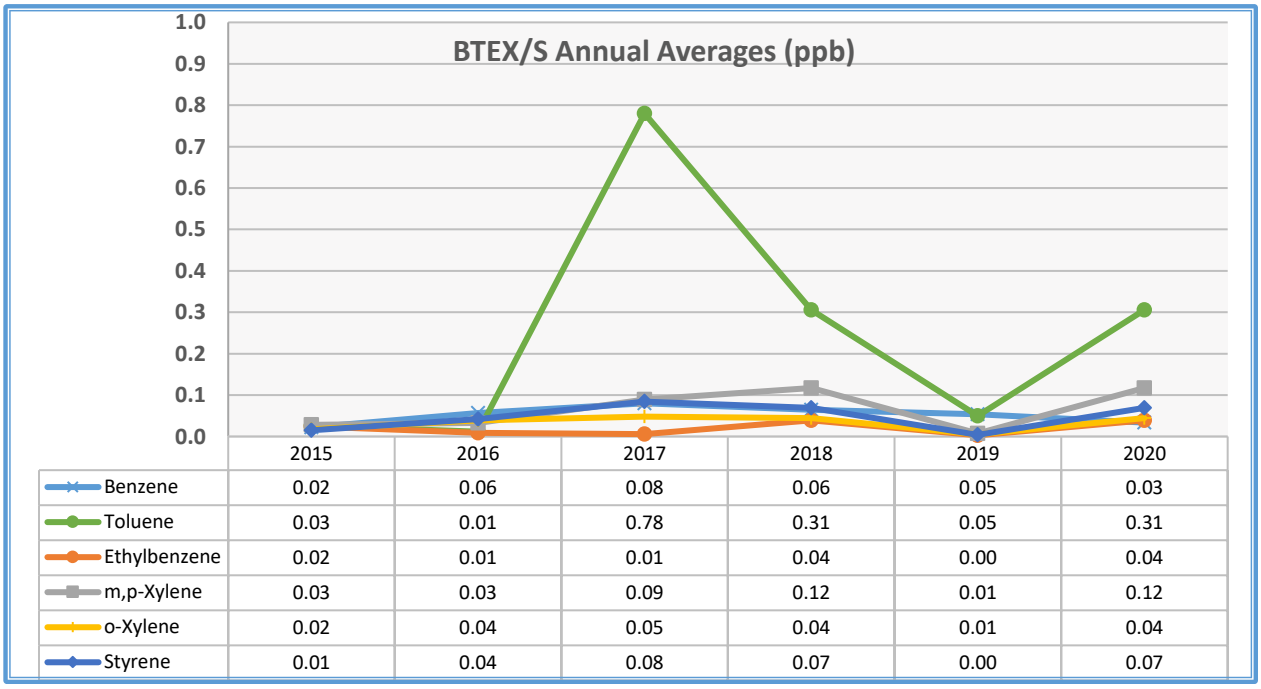
Volatile Organic Compounds (continued)

Figure 41: Monthly average BTEX/S concentrations (ppb) in 2020



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benzene	0.06	0.05	0.03	0.01	0.00	0.06	0.10	0.03	0.00	0.02	0.01	0.02
Toluene	0.04	0.07	0.00	0.00	0.00	0.87	1.17	0.53	0.25	0.13	0.24	0.37
Ethylbenzene	0.00	0.00	0.00	0.00	0.00	0.06	0.18	0.11	0.03	0.03	0.02	0.02
m,p-Xylene	0.00	0.00	0.00	0.00	0.00	0.30	0.30	0.19	0.12	0.08	0.15	0.26
o-Xylene	0.00	0.00	0.00	0.00	0.00	0.11	0.13	0.07	0.04	0.03	0.04	0.10
Styrene	0.00	0.00	0.00	0.00	0.00	0.15	0.17	0.08	0.11	0.09	0.12	0.09

Figure 42: Annual average BTEX/S concentrations (ppb)



	2015	2016	2017	2018	2019	2020
Benzene	0.02	0.06	0.08	0.06	0.05	0.03
Toluene	0.03	0.01	0.78	0.31	0.05	0.31
Ethylbenzene	0.02	0.01	0.01	0.04	0.00	0.04
m,p-Xylene	0.03	0.03	0.09	0.12	0.01	0.12
o-Xylene	0.02	0.04	0.05	0.04	0.01	0.04
Styrene	0.01	0.04	0.08	0.07	0.00	0.07

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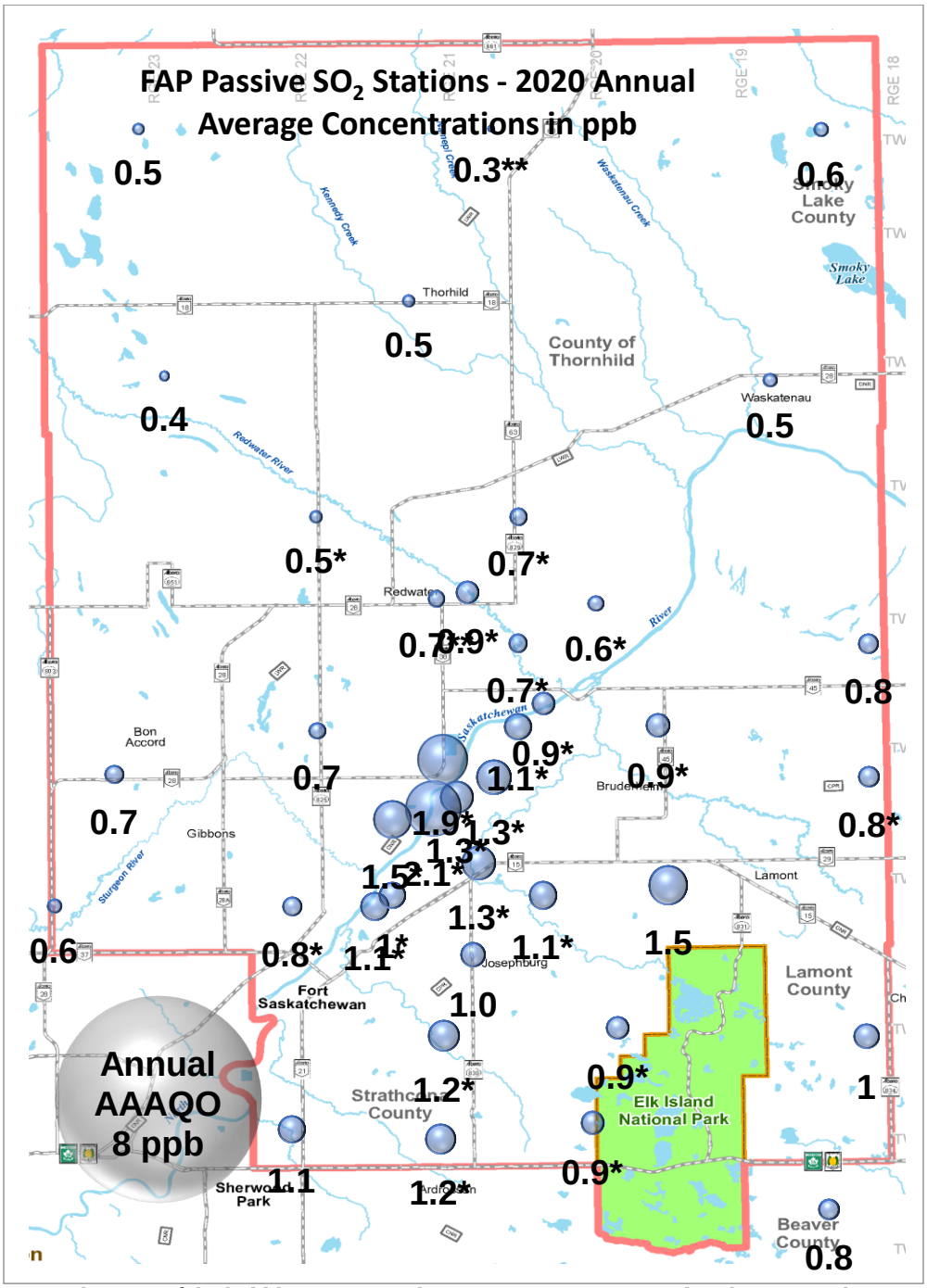
2020 Passive Monitoring Results

The following four figures show results from the passive monitoring sites. Figure 43 and Figure 45 are bubble charts showing annual average concentrations of SO_2 and H_2S respectively at the various sites geographically with the size of the bubble relative to the concentration measured. Figure 44 and Figure 46 chart the 2020 annual concentrations at each site plotted with the previous 5 years. Several sites were stopped or started during 2020. Some data given in these charts but noted with a * or ** indicates the data plotted is less than the required 9 months (75%) of the year for a valid average.

Sulphur Dioxide

Figure 43: 2020 Map of Annual average SO_2 concentrations (ppb)

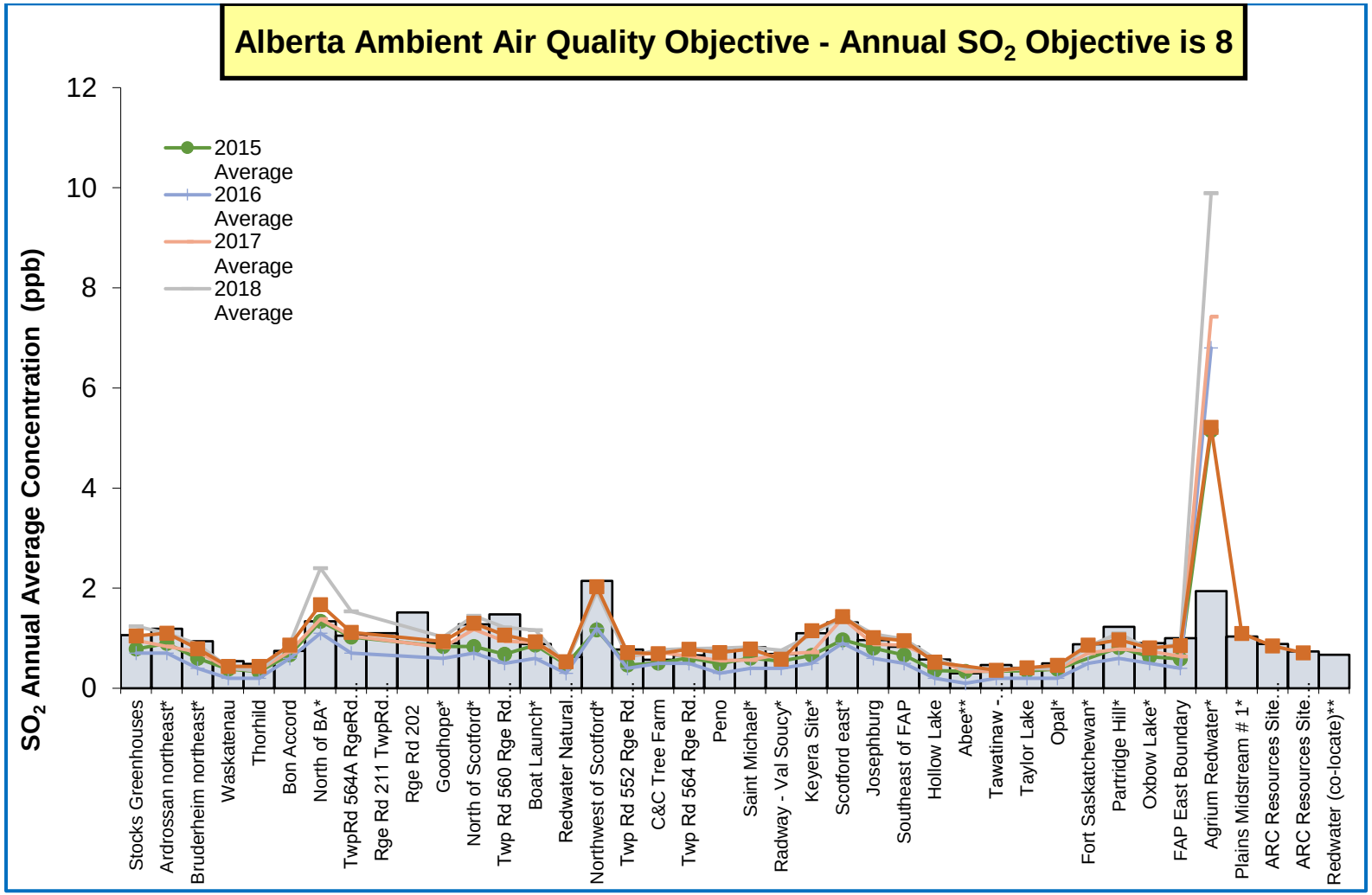


Note: The area of the bubble represents the concentration measured at the geographic center of the bubble, not the geographic area affected

**Site decommissioned in July 2020 - annual average is incomplete.*

***Site added August 2020 - annual average is incomplete.*

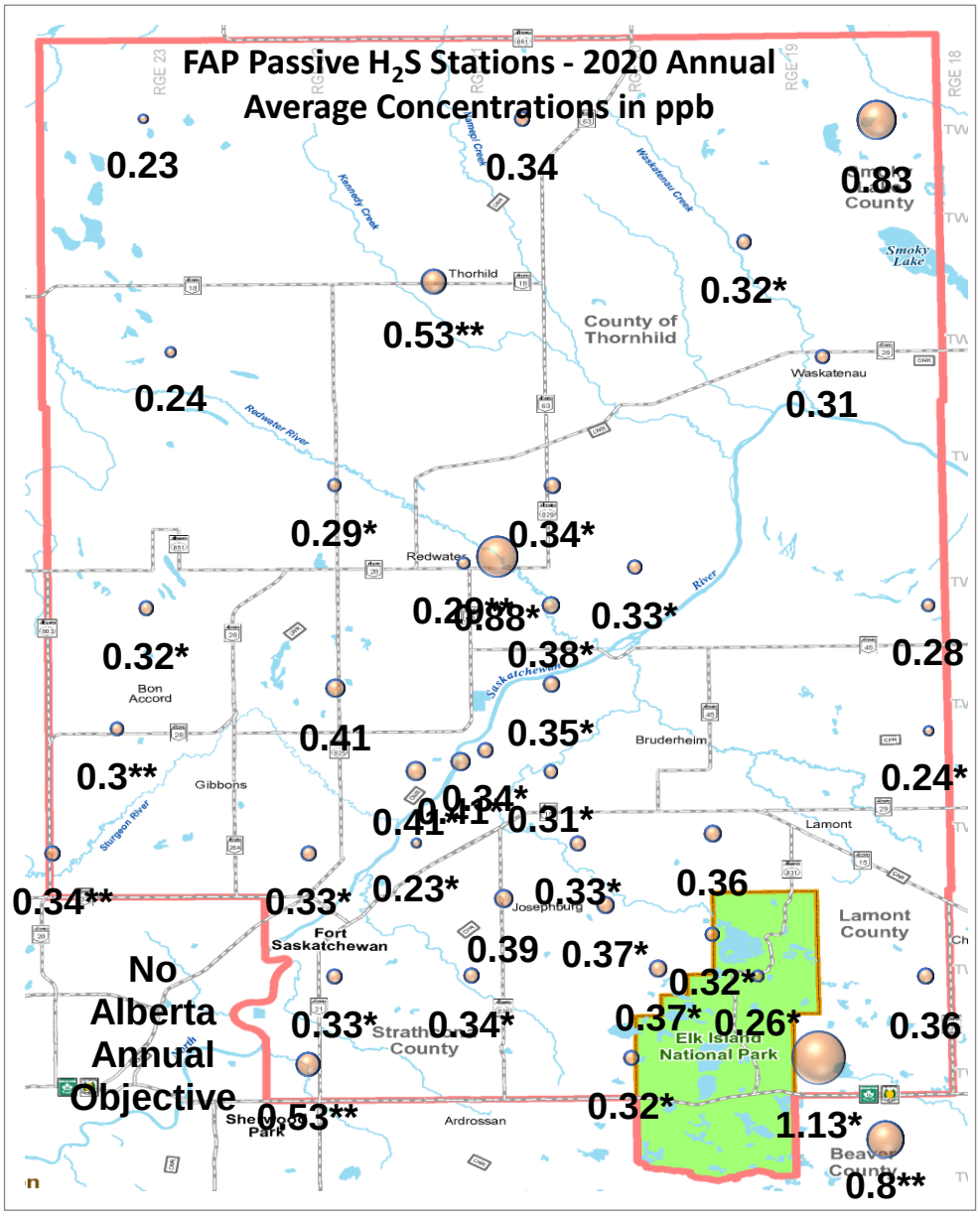
Figure 44: Passive monitoring annual averages: SO_2 (ppb) – historical



**Site decommissioned in July 2020 - annual average is incomplete.*
***Site added August 2020 - annual average is incomplete.*
Sites added to the network in 2019or 2020 do not show previous data

Hydrogen Sulphide

Figure 45: 2020 Map of Annual average H_2S concentrations (ppb)

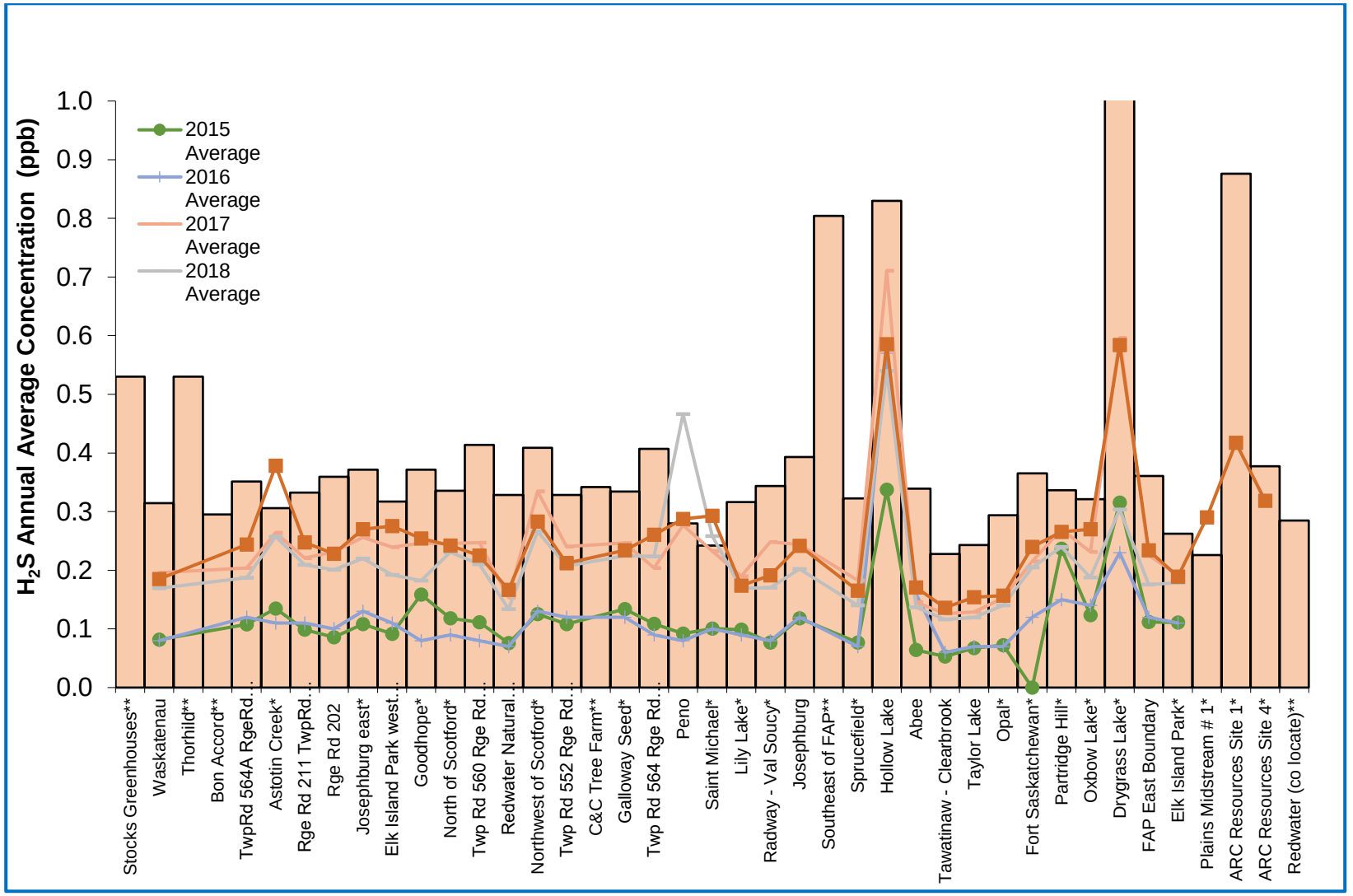


Note: The area of the bubble represents the concentration measured at the geographic center of the bubble, not the geographic area affected

**Site decommissioned in July 2020 - annual average is incomplete.*

***Site added August 2020 - annual average is incomplete.*

Figure 46: Passive monitoring annual averages: H_2S (ppb)



**Site decommissioned in July 2020 - annual average is incomplete.*
***Site added August 2020 - annual average is incomplete.*
Sites added to the network in 2019 do not show previous data

Other Technical Airshed Programs and Activities

Monitoring Plan Update

Airsheds in Alberta, including FAP, were required to file monitoring plans with the Alberta Government up until December 2019. Due to this requirement, in 2015, a detailed 5-year FAP Monitoring Plan was submitted and approved by the Alberta Government. Updates to the monitoring plan were filed every 6 months detailing progress towards proposed changes in monitoring and identifying any further new projects or changes to the monitoring network, up until June 2019. FAP has decided to continue the upkeep of a monitoring plan for internal purposes, the design of the plan will be determined in 2021.

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

- New permanent station in the vicinity of Gibbons began operation February 2016.
- New portable monitoring station began operation April 2018.
- Relocation of the Redwater Industrial monitoring station
  The new station in Redwater began operations October 2017.
- Relocation of the Scotford 2 Monitoring Station
  The shelter had been at the Scotford Temporary location since 2014. The shelter was finally moved to a new permanent site called Scotford South in March 2020.
- 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 ran from August 2017 till July 2018. A report is pending.
  - Subproject 2: VOC Sampling in Area of Oil and Gas Development
    Nonmethane hydrocarbon sampling was added to the portable station and is active 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 $PM_{2.5}$ now operate approved equivalent method samplers.
- $PM_{2.5}$ Co-located filter sampling
  A 2-year project was completed with sampling from July 2015 to August 2017. The report was completed in December 2017.

All projects identified in the 2015 monitoring plan have been completed as of the date this report was written.

Volatile Organics Speciation Project

FAP completed a Volatile Organic Compound (VOC) speciation project at the Bruderheim 1 station that ran from August 2017 to July 2018. 24-hour samples were taken every 6 days while additional 1-hour samples were triggered on elevated measurements of the continuous non-methane hydrocarbon analyzer on site.

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. The results of this project 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 expanded 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.

A report for the 2017-2018 VOC Speciation Project is under development as of the date of this report. The report will recommend that NMHC measurements at the Bruderheim 1 station be tracked over the coming years to attempt to discern a noticeable trend. a sufficient increase in trends could warrant consideration for a repeated VOC speciation project.

Several plots of the 1-hour average concentration distribution are provided in Figure 47 through Figure 49 below. The Bruderheim 1 station began operation in 2016 and was in operation for less than the full year with only 4875 1-hour measurements vs. over 8000 the other years in the plots. The relative distribution charts account for the fact that this would otherwise skew the data to 2016. As the distribution in Figure 47 shows, almost all 1-hour averages (about 93%) every year are below 0.1ppm. Figure 48 shows the distribution of measurements above 0.1ppm. Only less than 1% of all readings are over 0.5ppm.

Figure 49 shows the distribution of these measurements above 0.5ppm.

Figure 47: NMHC Relative Distribution

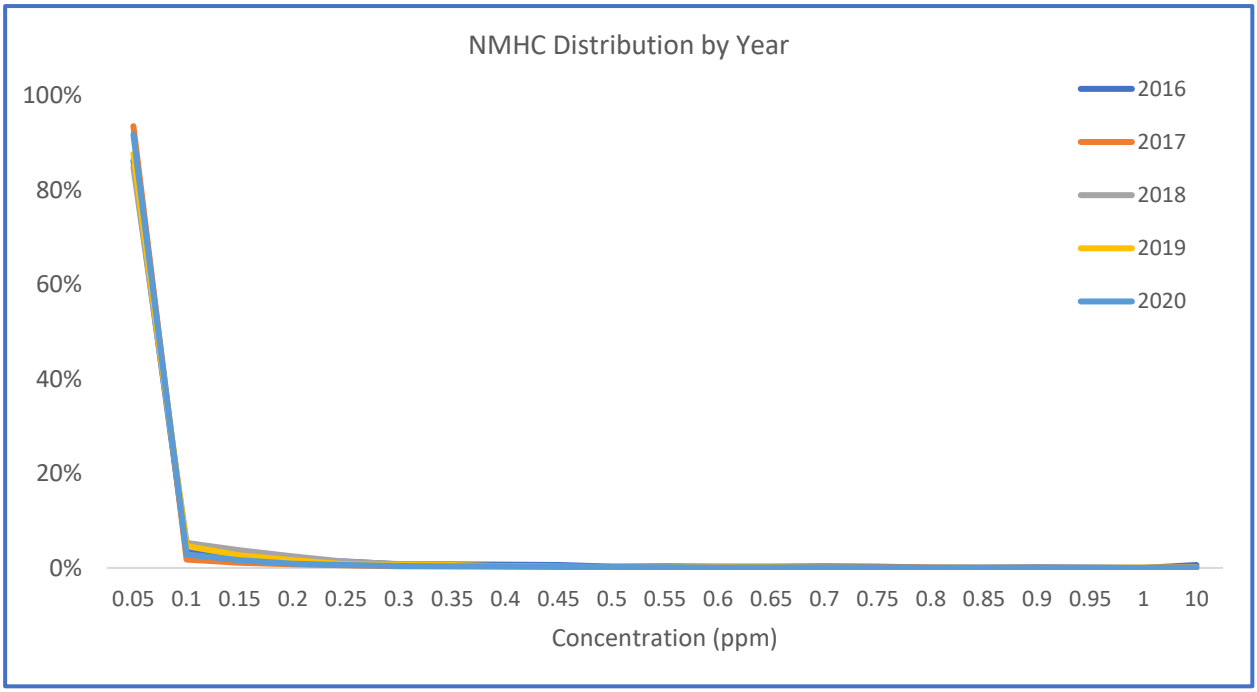


Figure 48: NMHC Relative Distribution above 0.1ppm

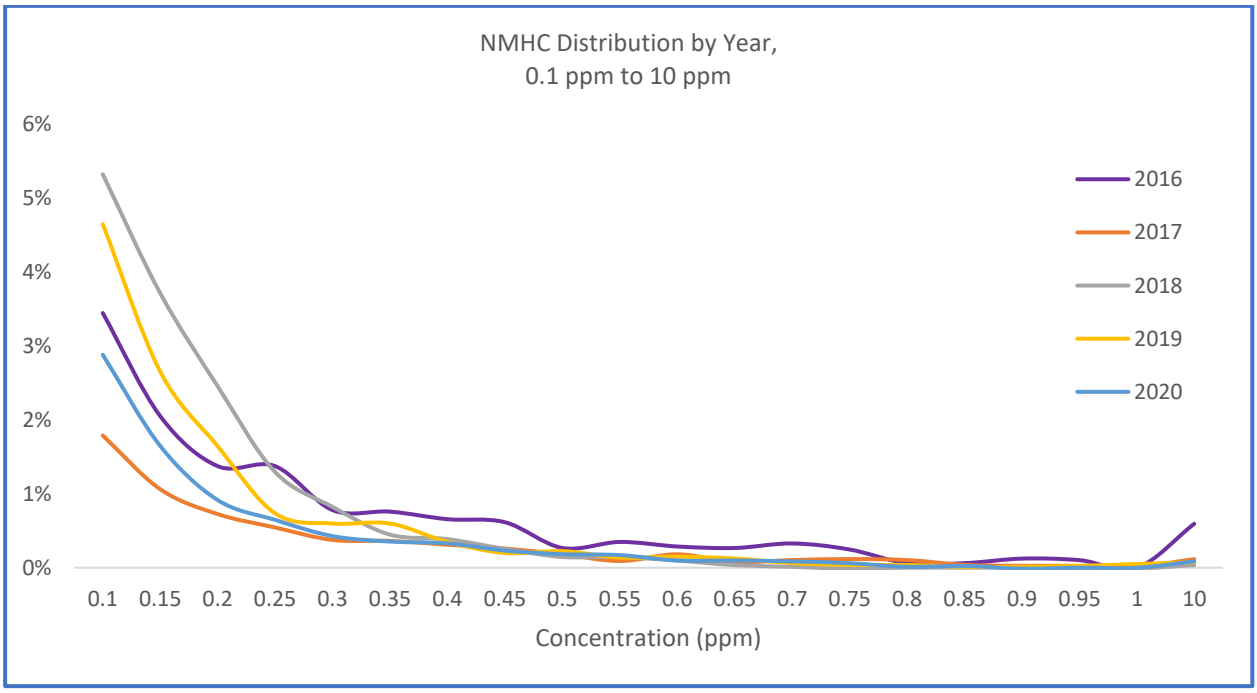
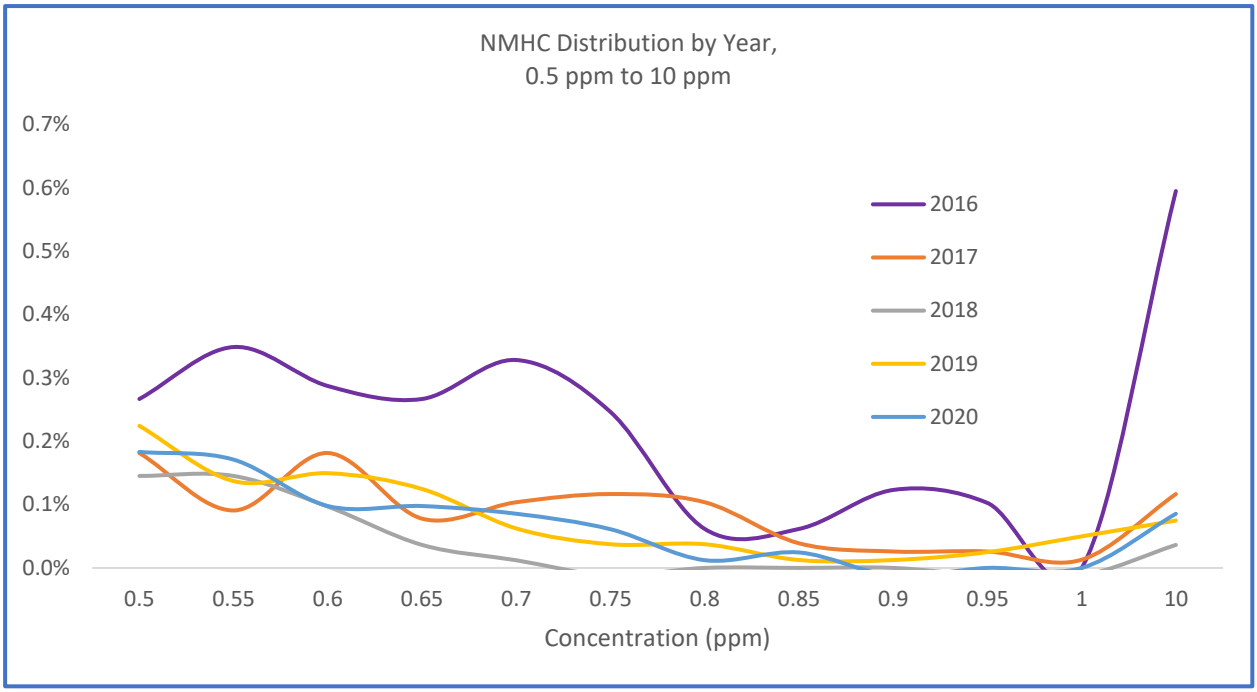


Figure 49: NMHC Relative Distribution above 0.5ppm



Fine Particulates Speciation Project

FAP began a 3-year fine particulate matter speciation project in Fort Saskatchewan in 2018. This speciation work was initiated to partially address a recommendation for a permanent "superstation" (a station that includes monitoring to address all monitoring questions in the network) in the 2012 network assessment. A report on the results will be compiled following the completion of the sampling phase of the project in 2021. Results from this project will add an additional piece of information that can help to inform the Capital Region Particulate Matter Response Plan of which FAP is a part.

Fine Particulate Matter Response Plan

Fort Air Partnership continued to support the Capital Region Oversight Advisory Committee implementation of a Fine Particulate Matter Response Plan throughout 2019. 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 are compared annually to the 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 and during wildfire season. 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.

Trending and Comparison Report

A Trending and Comparison Report was completed in 2019 to provide trending and comparison information for fine particulate matter, sulphur dioxide, nitrogen dioxide, carbon monoxide and ozone. All these substances, with the exception of ozone, are referred to as criteria air contaminants by the Government of Canada's Environment and Climate Change department. Criteria air contaminants are classified as such because they contribute to smog, poor air quality and acid rain. Ozone was also included in this report since it is a substance that has an established Canadian Ambient Air Quality Standard (CAAQS) and is used in the calculation of the Air Quality Health Index (AQHI).

Comparisons for each of these 5 substances were made among stations within FAP's Airshed. A comparison was also made between FAP's Fort Saskatchewan station (the longest operated station within the Airshed) with other cities in Alberta, as well as with national and international locations.

Many of the trends and comparisons show notable changes from year to year that can be tied to major natural events like forest fires, or changes over a longer time period attributed to the introduction of environmental policies or the application of new technologies. However, it should be noted that in some cases, there was insufficient data or supplementary information

available to draw conclusions about why certain trends were occurring, or the results of comparisons.

The full report can be found on the FAP website. This report will be updated in 2021 with 2019 and 2020 data.

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. Users can search by station, or by substance, and get hour-by-hour current or past 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.

In October 2020, FAP launched a new Live Air Quality Data site that is much faster and easier to use than the original. The public site features an interactive map with pop-up legends showing the substances that each of our 10 continuous air monitoring stations and 16 passive sites monitor. Hourly measurements from the continuous stations are available in near real time. The site also shows monthly results from our 16 passive monitors. The site also enables measurement comparisons to one-hour provincial objectives for substances where an objective exists.

Appendices

Appendix A: Technical Working Group Members

(As of December 31, 2019)

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(Chair)
Network Manager
Fort Air Partnership

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Andersen Science Consulting

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Air Monitoring Technologist
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Chemtrade Logisitic

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Dow Chemical Canada ULC

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Moe Ouellet
Environmental Specialist
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FAP Vice Chair and Public Member
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Technical Working Group Corresponding Members

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Executive Director
Northeast Capital Industrial Association

Kathryn Dragowska
Chemtrade Logistics

Jeff Hamilton
Pembina Pipeline Corp.

Appendix B: Monitoring Objectives

Table 29: 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

Industry Participants in FAP (Dec. 31, 2020)

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

- Sherritt International Corp.
- Dow Chemical Canada ULC

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

- Accel Energy
- Cenovus Energy
- Chemtrade Logistics
- Dow Chemical Canada ULC
- Inter Pipeline Ltd.
- North West Redwater Partnership
- Nutrien
- Pembina Pipeline Corp.
- Shell Scotford (Shell Chemicals, Shell Refinery and Shell Upgrader)
- Sherritt International Corp.
- Oerlikon Metco (Canada) Inc.

C. As funders of FAP through Northeast Capital Industrial Association

- Accel Energy
- Air Liquide Canada Inc.
- Aux Sable Canada
- Bunge Canada
- Cenovus Energy
- Chemtrade Logistics (CSC)
- Chemtrade Logistics (Sulphides)
- Dow Chemical Canada ULC
- Enbridge
- Evonik
- Interpipeline Ltd.
- Keyera Energy
- MEGlobal Canada Inc.
- MEG Energy
- North West Redwater Partnership
- Nutrien Fort Saskatchewan
- Nutrien Redwater
- Oerlikon Metco (Canada)
- Pembina NGL Corp.
- Plains Midstream Canada
- Praxair Canada Inc.
- Shell Scotford (Shell Chemicals, Shell Refinery and Shell Upgrader)
- Sherritt International Corp.
- Umicore Canada Inc.
- Wolf Midstream

Appendix D: Passive Data Summary Tables

Table 30: 2020 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	1.7	1.6	1.6	0.7	0.5	1.0	0.8	0.9	0.8	0.8	0.8	1.9	1.1	1.9
2	Ardrossan northeast	1.8	1.8	1.7	0.9	0.4	0.8	1.1	Site ended in July					I/D	1.8
3	Bruderheim northeast	1.1	1.4	1.0	0.5	0.5	0.8	1.3	Site ended in July					I/D	1.4
4	Waskatenau	0.8	0.8	0.7	0.6	0.2	0.4	0.6	0.5	0.4	0.3	0.6	0.6	0.5	0.8
5	Thorhild	0.6	0.6	0.4	0.5	0.3	0.5	0.8	0.7	0.4	0.2	0.4	0.3	0.5	0.8
7	Bon Accord	1.2	1.0	0.9	0.6	0.5	0.8	0.5	0.6	0.7	0.4	0.8	0.8	0.7	1.2
11	North of BA	1.5	2.0	1.2	1.6	0.6	1.0	1.3	Site ended in July					I/D	2.0
12	TwpRd 564A RgeRd 212	1.2	1.7	1.8	1.0	0.6	0.6	0.9	Site ended in July					I/D	1.8
18	Rge Rd 211 TwpRd 552	1.7	1.8	1.5	0.9	0.5	0.8	0.7	Site ended in July					I/D	1.8
20	Rge Rd 202	2.7	2.5	1.8	1.4	0.7	1.0	1.2	0.9	1.5	1.4	1.7	2.5	1.5	2.7
23	Goodhope	1.6	1.2	1.1	0.7	0.4	0.9	0.9	Site ended in July					I/D	1.6
24	North of Scotford	2.1	1.6	1.8	1.8	0.7	0.7	0.9	Site ended in July					I/D	2.1
26	Twp Rd 560 Rge Rd 221	1.2	1.3	1.2	1.5	1.3	2.4	0.6	Site ended in July					I/D	2.4
27	Boat Launch	1.2	1.2	1.2	1.1	0.4	0.6	0.8	Site ended in July					I/D	1.2
29	Redwater Natural Area N	0.7	1.3	0.8	0.7	0.2	0.4	0.5	Site ended in July					I/D	1.3
31	Northwest of Scotford	2.6	2.0	1.7	2.3	2.1	2.5	1.8	Site ended in July					I/D	2.6
33	Twp Rd 552 Rge Rd 225	1.3	0.9	1.0	0.6	0.4	0.6	0.7	Site ended in July					I/D	1.3
34	C&C Tree Farm	1.0	0.7	0.7	0.6	0.4	0.5	0.5	0.6	0.7	0.4	0.4	0.6	0.6	1.0
37	Twp Rd 564 Rge Rd 224	0.9	0.8	0.7	0.5	0.5	1.0	0.6	0.7	0.6	0.5	0.6	0.5	0.7	1.0
38	Peno	1.0	1.3	0.9	0.4	0.5	N/A	N/A	N/A	0.8	0.4	0.7	1.1	0.8	1.3
39	Saint Michael	0.9	1.4	0.9	0.6	0.3	N/A	N/A	Site ended in July					I/D	1.4
42	Radway - Val Soucy	0.8	1.3	0.8	0.5	0.3	0.4	0.7	Site ended in July					I/D	1.3
43	Keyera Site	1.4	1.3	1.1	0.9	0.7	1.0	1.3	Site ended in July					I/D	1.4
45	Scotford east	1.5	1.5	1.3	1.5	1.0	1.4	1.0	Site ended in July					I/D	1.5
46	Josephburg	1.3	1.4	1.3	0.7	0.4	0.9	0.8	0.7	0.9	0.7	1.1	1.2	1.0	1.4
47	Southeast of FAP	1.4	1.3	1.1	0.8	0.4	0.7	1.1	0.8	0.5	0.4	0.7	1.0	0.8	1.4
51	Hollow Lake	1.0	1.0	0.6	0.5	0.2	0.3	0.7	0.8	0.7	0.2	0.5	0.4	0.6	1.0
52	Abee	Site added in August							0.3	0.2	0.2	0.4	0.4	I/D	0.4
53	Tawatinaw - Clearbrook	0.8	0.7	0.5	0.3	0.3	0.3	0.3	0.4	0.4	0.2	0.4	0.6	0.5	0.8
55	Taylor Lake	0.6	0.7	0.5	0.4	0.2	0.3	0.4	0.5	0.3	0.2	0.3	0.4	0.4	0.7
56	Opal	0.7	0.8	0.4	0.4	0.4	0.3	0.4	Site ended in July					I/D	0.8
58	Fort Saskatchewan	1.4	1.3	1.2	0.8	0.4	0.7	0.6	0.5	0.6	Site ended			0.9	1.4
59	Partridge Hill	1.7	1.9	1.7	0.8	0.4	0.7	0.7	Site ended in July					I/D	1.9
60	Oxbow Lake	1.2	1.2	1.0	0.6	0.4	0.8	0.8	Site ended in July					I/D	1.2
62	FAP East Boundary	1.8	1.4	1.0	0.9	0.4	1.1	0.6	0.7	0.8	0.9	0.9	1.5	1.0	1.8
64	Agrium Redwater	2.7	2.7	1.5	1.4	N/A	N/A	N/A	Site ended in July					I/D	2.7
66	Plains Midstream # 1	1.2	1.1	1.3	0.8	0.6	N/A	N/A	Site ended in July					I/D	1.3
68	ARC Resources Site 1	0.9	1.1	0.9	0.7	0.8	1.0	1.0	Site ended in July					I/D	1.1
71	ARC Resources Site 4	0.8	1.3	1.0	0.7	0.4	0.5	0.6	Site ended in July					I/D	1.3
72	Redwater (co-locate)	Site began sampling in October									0.5	0.8	0.7	0.7	0.8
	Average	1.3	1.3	1.1	0.8	0.5	0.8	0.8	0.6	0.6	0.5	0.7	0.9	0.9	
	Max	2.7	2.7	1.8	2.3	2.1	2.5	1.8	0.9	1.5	1.4	1.7	2.5		2.7

N/A: not available - sample not retrievable due to flooding
I/D: insufficient data: at least 75% of data needed to calculate a valid average
Reportable Detection Limit: 0.2 ppb

Table 31: 2020 Passive monitoring monthly averages: H_2S (ppb)

Site	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	Max
1	Stocks Greenhouses	Site added in August							1.01	0.66	0.26	0.31	0.41	*I/D*	1.01
4	Waskatenau	0.20	0.22	0.11	0.16	0.16	0.56	0.71	0.88	0.44	0.18	0.20	0.27	0.31	0.88
5	Thorhild	Site added in August							1.36	0.62	0.22	0.17	0.19	*I/D*	1.36
7	Bon Accord	Site added in August							0.44	0.32	0.17	0.21	0.32	*I/D*	0.44
12	TwpRd 564A RgeRd 212	0.26	0.36	0.16	0.16	0.22	0.50	*I/D*	Site ended in July					*I/D*	0.85
14	Astotin Creek	0.34	0.47	0.20	0.26	0.26	N/A	N/A	Site ended in July					*I/D*	0.47
18	Rge Rd 211 TwpRd 552	0.26	0.36	0.18	0.21	0.22	0.34	*I/D*	Site ended in July					*I/D*	0.53
20	Rge Rd 202	0.20	0.29	0.12	0.17	0.17	0.65	0.84	0.95	0.39	0.20	0.18	0.32	0.36	0.95
21	Josephburg east	0.23	0.35	0.16	0.19	0.18	0.59	0.90	Site ended in July					*I/D*	0.90
22	Elk Island Park west gate	0.21	0.25	0.16	0.14	0.17	0.50	0.79	Site ended in July					*I/D*	0.79
23	Goodhope	0.20	0.33	0.15	0.22	0.19	0.75	0.76	Site ended in July					*I/D*	0.76
24	North of Scotford	0.43	0.38	0.20	0.20	0.22	0.41	0.51	Site ended in July					*I/D*	0.51
26	Twp Rd 560 Rge Rd 221	0.41	0.34	0.24	0.21	0.20	0.60	0.66	Site ended in July					*I/D*	0.66
29	Redwater Natural Area N	0.17	0.24	0.11	0.14	0.18	0.41	1.05	Site ended in July					*I/D*	1.05
31	Northwest of Scotford	0.32	0.58	0.32	0.22	0.30	0.44	0.68	Site ended in July					*I/D*	0.68
33	Twp Rd 552 Rge Rd 225	0.25	0.35	0.19	0.15	0.18	0.56	0.62	Site ended in July					*I/D*	0.62
34	C&C Tree Farm	Site added in August							0.55	0.50	0.17	0.21	0.28	*I/D*	0.55
36	Galloway Seed	0.26	0.32	0.16	0.20	0.20	0.56	NA	Site ended in July					*I/D*	0.64
37	Twp Rd 564 Rge Rd 224	0.23	0.27	0.11	0.17	0.21	0.53	0.69	1.12	0.82	0.30	0.25	0.30	*I/D*	1.12
38	Peno	0.22	0.27	0.19	0.14	0.55	N/A	N/A	N/A	0.38	0.29	0.19	0.28	0.28	0.55
39	Saint Michael	0.19	0.31	0.19	0.23	0.29	N/A	N/A	Site ended in July					*I/D*	0.31
41	Lily Lake	0.23	0.51	0.15	0.12	0.13	0.54	NA	Site ended in July					*I/D*	0.62
42	Radway - Val Soucy	0.23	0.28	0.11	0.14	0.18	0.65	NA	Site ended in July					*I/D*	0.93
46	Josephburg	0.22	0.38	0.14	0.17	0.18	0.76	0.73	1.16	0.45	0.22	0.21	0.28	0.39	1.16
47	Southeast of FAP	Site added in August							2.90	0.51	0.21	0.19	0.21	*I/D*	2.90
50	Sprucefield	0.18	0.23	0.11	0.15	0.16	0.49	1.04	Site ended in July					*I/D*	1.04
51	Hollow Lake	1.64	1.12	0.17	0.24	0.14	0.52	1.31	2.66	1.47	0.32	0.31	0.30	0.83	2.66
52	Abee	0.19	0.20	0.10	0.14	0.16	0.87	1.43	0.57	0.23	0.13	0.17	0.21	0.34	1.43
53	Tawatinaw - Clearbrook	0.19	0.17	0.11	0.07	0.08	0.36	0.41	0.43	0.29	0.16	0.15	0.24	0.23	0.43
55	Taylor Lake	0.16	0.22	0.11	0.10	0.13	0.44	0.56	0.59	0.25	0.13	0.14	0.23	0.24	0.59
56	Opal	0.23	0.37	0.14	0.14	0.15	0.64	0.54	Site ended in July					*I/D*	0.64
58	Fort Saskatchewan	0.26	0.40	0.18	0.18	0.19	0.52	0.60	0.63	0.37	0.26	Site ended		0.37	0.60
59	Partridge Hill	0.15	0.33	0.16	0.23	0.19	0.73	0.68	Site ended in July					*I/D*	0.73
60	Oxbow Lake	0.18	0.24	0.13	0.21	0.19	0.60	0.81	Site ended in July					*I/D*	0.81
61	Drygrass Lake	0.25	0.82	0.22	0.22	0.44	2.79	3.85	Site ended in July					*I/D*	3.85
62	FAP East Boundary	0.24	0.33	0.12	0.15	0.20	0.62	0.81	0.96	0.52	0.23	0.19	0.24	0.36	0.96
63	Elk Island Park	0.16	0.27	0.13	0.17	0.15	0.41	0.66	Site ended in July					*I/D*	0.66
66	Plains Midstream # 1	0.24	0.36	0.17	0.16	0.20	N/A	N/A	Site ended in July					*I/D*	0.36
68	ARC Resources Site 1	0.45	1.13	0.31	0.25	0.27	1.37	1.86	Site ended in July					*I/D*	1.86
71	ARC Resources Site 4	0.27	0.37	0.14	0.17	0.17	0.66	0.58	Site ended in July					*I/D*	0.66
72	Redwater (co locate)	Site began sampling in October									0.26	0.24	0.32	*I/D*	0.32
	Average	0.28	0.38	0.16	0.18	0.21	0.66	0.90	1.09	0.50	0.21	0.20	0.26	0.39	
	Max	1.64	1.13	0.32	0.26	0.55	2.79	3.85	2.90	1.47	0.32	0.31	0.32		**3.85**

N/A: not available - sample not retrievable due to flooding
I/D: insufficient data: at least 75% of data needed to calculate a valid average
Reportable Detection Limit: 0.02 ppb

Appendix E: Continuous Monitoring Methods, Limits and Sampling Details

Table 32: Continuous monitoring methods, limits, and sampling details (Dec 31, 2020)

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Sulphur Dioxide (SO_2)	Thermo 43i Thermo 43 iQ	ppb	1-second samples averaged to 1-min & 1-hr	0 - 500 ppb	43i 0.5, 1, 2 ppb (300, 60, 10 second averaging time) 43 iQ 0.25, 1, 2 ppb (300, 60, 10 second averaging time)	Pulsed fluorescence	Dynamic dilution of compressed gas standard	43i 1% of reading or 1ppb (whichever is greater) 43iQ +- 1% FS	Not available
Hydrogen Sulphide (H_2S)	Thermo 450i Thermo 450 iQ	ppb or ppm	1-second samples averaged to 1-min & 1-hr	0 - 100 ppb	0.5, 1, 2 ppb (300, 60, 10 second avg time)	Pulsed fluorescence with converter	Dynamic dilution of compressed gas standard	450i 1% of reading or 1ppb (whichever is greater)	Not available
Nitric Oxide, Oxides of Nitrogen, Nitrogen Dioxide (NO, NO_x, NO_2)	Thermo 42i Thermo 42 iQ Thermo 17C Thermo 17i	ppb	1-second samples averaged to 1-min & 1-hr	0 - 500 ppb	42 i & iQ 0.4 ppb 17 I & iQ 1.0ppb	Chemi-luminescence	Dynamic dilution of compressed gas standard	42i ± 0.4ppb (500 ppb range) 17C, i & IQ N/A	Not available

Table 32: Continuous monitoring methods, limits, and sampling details (Dec 31, 2020) - continued

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	ppb	1-second samples averaged to 1-min & 1-hr	0 - 5000 ppb	1.0 ppb	Chemi-luminescence with total nitrogen converter	Dynamic dilution of compressed gas standard	17C NA 17i ± 0.4ppb 500 ppb range	Not available
Ozone (O_3)	Thermo 49i Thermo 49 iQ	ppb	1-second samples averaged to 1-	0 - 500 ppb	0.50 ppb	Ultraviolet photometry	O_3 Reference Bench	49i 1.0ppb 49 iQ Not available	Not available
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	Not available	Not available
Carbon Monoxide (CO)	Thermo 48i	ppm	1-second samples averaged to 1-min & 1-hr	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
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
Particulates $PM_{2.5}$	SHARP 5030 SHARP 5030i	µg/m^3	Continuous sampling data stored in 1-min & 1-hr averages	0 - 1000 µg/m^3	0.2 µg/m^3	Hybrid beta attenuation and nephelometer	Light transmitting foils	±2 µg/m^3<80 µg/m^3 ±5 µg/m^3>80 µg/m-3	±5% (compared to 24-hr FRM)

Table 32: Continuous monitoring methods, limits, and sampling details (Dec 31, 2020) - continued

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Particulates $PM_{2.5}$	Grimm 180	µg/m^3	Continuous sampling data stored in 1-min & 1-hr averages	0 - 1000 µg/m^3	0.2 µg/m^3	Spectrometry	Factory	±5%	±2%
Particulates $PM_{2.5}$	API T640	µg/m^3	1-second samples averaged to 1-min & 1-hr	10,000 µg/m^3	<0.1 µg/m^3 (1-hour average)	Scattered light spectrometry	Calibrated SpanDust ™	± 0.5µg/m^3 (1-hour average)	Not available
Benzene, Toluene, Ethylbenzene, Xylene, Styrene	Spectras GC955	ppb	Samples taken every 15 or 30 minutes	Benzene & Ethylbenzene 0 – 20ppb Toluene, Styrene Xylene 0-100ppb or all at 0-1000 ppb	0.02ppb	Gas chromatography with FID detection	Dynamic dilution of compressed gas standard	<3% at 1 ppb for benzene	Not available
Benzene, Toluene, Ethylbenzene, Xylene, Styrene	AMA GC 5000	ppb	Samples taken every 15 minutes	Benzene & Ethylbenzene 0 – 20ppb Toluene, Styrene Xylene 0-100ppb or all at 0-1000 ppb	Specific to method	Gas chromatography with FID detection	Dynamic dilution of compressed gas standard	Specific to method	Specific to method

Table 32: Continuous monitoring methods, limits, and sampling details (Dec 31, 2020) - continued

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Wind Speed Wind Direction (WS / WD)	RM Young 5305	km/hr	1-second samples averaged to 1-min & 1-hr	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	Not available	Not available
Temperature	Vaisala HMP60	°C	1-second samples	-40 to +60	NA	Platinum resistance detector	Comparison to Reference Standard	Not available	±0.6°C
Barometric Pressure	Setra 270	mmHg	1-second samples averaged to 1-min & 1-hr	500 - 900 mmHg	±2 mmHg	Ceramic sensing capsule coupled with capacitive sensor	Comparison to Reference Standard	±0.01	±0.05%
Relative Humidity	Vaisala HMP60	%RH	1-second samples averaged to 1-min & 1-hr	0 – 100%	Not available	capacitive relative humidity sensor	Against traceable standard(s)	Not available	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) ±7% (90 to 100% RH)
Solar Radiation	Kipp and Zonen SP Lite	watts/m^2	1-second samples averaged to 1-min & 1-hr	400-1100 nm spectral range	60 to 100 µV/W/m^2 (Sensitivity)	Photodiode detector	Factory	Not available	Not available

Table 32: Continuous monitoring methods, limits, and sampling details (Dec 31, 2020) - continued

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Vertical Wind Speed	Gill Model 27106	km/hr	1-second samples averaged to 1-min & 1-hr	1	0.3 m/s	Helicoid propeller with tech-generator transducer	Mechanical RPM Standard	Not available	Not available
Delta Temperature	Met One 064-1 (two probes)	°C	1-second samples averaged to 1-min & 1-hr	-30 to +50	Not applicable	Solid state multi element thermistor	Comparison to Reference Standard	Not available	±0.15°C (0.27°F) throughout range
Delta Temperature	Met One T-200	°C	1-second samples averaged to 1-min & 1-hr	-50 to +100	Not applicable	Platinum resistance	Comparison to Reference Standard	Not available	$\alpha = 0.00385 \pm 0.00002\ \Omega/\Omega/°C$

Appendix F: 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 automatic polling.

Automatic alarm set points trigger a notification to technicians of any data that is above a predetermined set point, (including levels that exceed the AAAQOs). The technician will assess the situation and notify the Alberta Government and FAP.

Operation alarms are also configured so technicians get automatic alerts if the operational parameters of an analyzer are outside set points. These alarms also automatically invalidate the data. The operator can then verify these operational alarms and confirm the corrective actions.

Data Quality Control Procedures

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 analyzer operational parameters 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.
- Daily data review includes cross-network comparison of measurements of the same substances or meteorological conditions to look for anomalies at one station that might indicate a problem.
- 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 forms use automatic formatting to highlight results that approach the limits set by AEP. 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 and in accordance with the AMD. Auditors also make suggestions for improvements to monitoring operations at the stations. Follow-up actions to the audit, if necessary, are defined and implemented by FAP per the AEP Audit Follow-up Protocol
- FAP uses a subcommittee of the TWG to review data validation outcomes at selected stations for selected months at least every three years. FAP also may contract an independent data validation contractor to run a parallel data validation on selected months and stations.
- Technicians of the operations contractor 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 gas standards used in FAP network certified by the manufacturer to +/- 2% or better. These gases are subject to a further verification by the AEP audit lab prior to use in the network.
  - Annual calibration system verifications at the AEP audit lab against AEP standards.
  - Replacement of calibration cylinders before manufacturer posted expiry dates even if they are not empty. If a replacement cylinder is not available due to delays in shipping or AEP verification, the as-found high scale point concentrations are tracked each month to ensure the expired cylinder concentration is still within specifications.
  - Verifications of photometers used for gas phase titration (GPT) calibrations of NO_2 and O_3 is done by AEP.
  - Regular flow measurements, flow calibrations and calibration system maintenance is carried out as specified by the AMD and manufacturer specifications, or if flow anomalies are suspect.
- Test equipment such as flow and temperature measurement devices used by FAP contractor have current calibration certificates.

Data Validation Processes

Preliminary data validation is carried out daily by technicians for FAP's principle operations contractor. Primary data validation for FAP continuous data is conducted by an independent contractor in preparation of each monthly report. Secondary checks of data plots are done by a data review committee of the FAP Network Manager, the operations contractor lead technician and data validation contractor each month in advance of the Technical Working Group (TWG) meeting, where it is again reviewed by the group as a whole. Validated data and daily span tests are also reviewed by the data review committee and holistically by the Technical Working

Group monthly to identify any possible anomalies and trends that may warrant another look. Every three months a Data Subcommittee of the Technical Working Group reviews and tracks daily spans on key analyzers going back up to 12 months as compared to the expected and calculated span concentrations with the intention to explain or investigate any sudden hits or prolonged negative or positive trends.

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

- One-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 operational 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 in parallel with the validated data.

The FAP Network Manager conducts the final validation and report review monthly by for all stations in in the network, with an additional validation step by TWG members for some stations, prior to submitting reports or posting data to the Government data warehouse. Annual reports are primarily a compilation of monthly reports and also reviewed by the FAP Network Manager and TWG members.

FAP conducts regular reviews of data validation procedures and outcomes.

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 undergoes basic automatic error checking before being used for AQHI reporting and forecasting. The data is also available in near real time on several subsequent websites/platforms across Canada, North America, and even globally.

- Exceedances of AAAQOs are reported to Alberta Government's Environmental Service Response Centre as per timelines FAP has established and are followed up with further information within 7 days.

- 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.

- An ambient air quality monitoring report is prepared summarizing the validated data for each continuous monitoring station and submitted monthly to the Alberta Government. Also submitted each month are calibration reports for each station for the month in question and a laboratory report with analytical results of all passive devices. 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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