2022 ANNUAL DATA REPORT

pramp
PEACE RIVER AREA MONITORING PROGRAM

September XX, 2023
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Executive Summary

The Peace River Area Monitoring Program (PRAMP) was created to satisfy air quality monitoring and modelling recommendations released following a proceeding called by the Alberta Energy Regulator (AER) in 2014. On March 31, 2014, the panel released its report titled *Report of Recommendations on Odours and Emissions in the Peace River Area.* The recommendations in the report called for regulatory change, regional air monitoring, and ongoing stakeholder engagement in the Peace River Area.

PRAMP collected concentration data of methane (CH_4), non-methane hydrocarbons (NMHC), total reduced sulphurs (TRS), and sulphur dioxide (SO_2) at Station 986-C, 842-B, Reno-B, and Peace River Complex (PRC) continuous monitoring stations in 2022; these parameters plus ozone (O_3), nitrogen dioxide (NO_2) and nitric oxide (NO), and fine particulate matter ($PM_{2.5}$) were also collected at the AQHI Station in the Town of Grimshaw. Hydrogen sulphide was also measured at the PRC station. This report summarizes and presents the data using different visualizations and summary statistics. Wind speed and direction were also monitored to further understand the potential sources of substances. Triggered volatile organic compound (VOC) sampling events provide additional concentration data for a variety of hydrocarbon species. In 2022, the PRC passive monitoring network became part of the PRAMP program producing a one month average concentration data for SO_2 and H_2S.

Hourly measurements of CH_4, NMHC, and SO_2 concentrations generally show incremental changes in the year-over-year summary statistics. In 2022, all stations had similar annual averages with a small increase compared to recent years; this may be due to recovery of upstream activities after the COVID-19 pandemic. Both 986-C and 842-B also show a very small step change or baseline shift in concentrations approximately in June 2022 and August 2022 respectively; this is due to an instrumentation change. The AQHI-Grimshaw and PRC stations measured the lowest overall concentrations of methane and the lowest number of isolated elevated methane concentration events in the PRAMP network. Like previous years' analyses, it should be noted that hydrocarbon concentrations remain low especially considering the historically elevated concentrations of Station 986-C and 842-B.

All stations showed a pattern of elevated TRS concentrations during the summer months; these elevated concentrations begin to decrease as cooler fall weather arrives. This observation may be attributed to a few factors including sulphur compounds being released by shallow sloughs and wetlands that contain decaying vegetation or sulphur compounds released by asphalt paving during the summer construction period.

In 2022 there were no odour complaints recorded by the AER across the entire network. Volatile organic compound sampling with canister devices were triggered five times in 2022; however, concentrations of VOC species were below Alberta Ambient Air Quality Objectives where applicable.

Acronyms

AAAQG - Alberta Ambient Air Quality Guideline

AAAQO - Alberta Ambient Air Quality Objective

AEP - Alberta Environment and Parks

AEPA - Alberta Environment and Protected Areas

AER - Alberta Energy Regulator

AQHI - Air Quality Health Index

CH_4 - methane

H_2S - hydrogen sulphide

NMHC - non-methane hydrocarbons

NO - nitric oxide

NO_2 - nitrogen dioxide

O_3 - ozone

OSM - Oil Sands Monitoring

PAZA - Peace Airshed Zone Association

$PM_{2.5}$ - fine pariculate matter

PRAMP - Peace River Area Monitoring Program

PRC - Peace River Complex

SO_2 - sulphur dioxide

TRS - total reduced sulphurs

VOC - volatile organic compound

1 - Introduction

1.1 Historical Context

The Peace River Area Monitoring Program (PRAMP) was created to satisfy air quality monitoring and modelling recommendations released following a proceeding called by the Alberta Energy Regulator (AER). The proceeding was called to address odour and emissions generated by heavy oil operations in the Peace River Area of Alberta (AER 2014a). The oral proceeding started on January 21 and ended on January 31, 2014, in Peace River, Alberta. On March 31, 2014, the panel released its report titled *Report of Recommendations on Odours and Emissions in the Peace River Area.* The recommendations in the report included calls for regulatory change, regional air monitoring, and ongoing stakeholder engagement in the Peace River Area.

1.2 Monitoring Program Overview

PRAMP has a well-established monitoring program that is critical to understanding the state of air quality in the Peace River Area. The continuous monitoring program has been active at Station 986 since 2010, Station 842 since 2012, Reno Station since 2014, and the Peace River Complex (PRC) Station since 2022. PRAMP's Air Quality Health Index (AQHI) station was deployed for the first time in 2019 in the community of Cadotte Lake. It is similar in construction and layout to other PRAMP continuous air monitoring stations; however, it is intended to be a portable monitoring unit. It is therefore moved regularly as the need and issues arise, approximately every 18 to 24 months. The AQHI station was moved to the Town of Grimshaw in late 2021 and was located there for all of 2022. More information about the AQHI is in Section 3 of this report.

Station 986 has been relocated twice while 842 and Reno have both been relocated once, during their deployment in the region. With each relocation event, PRAMP maintained a consistent naming convention by annotating an alphabetic identifier; Station 986 is currently 986-C, Station 842 is currently 842-B, and Reno is currently Reno-B (relocated in 2022). Despite moving the stations, the new monitoring sites are reasonably close to their original locations and are therefore considered to be representative of their earliest deployment locale.

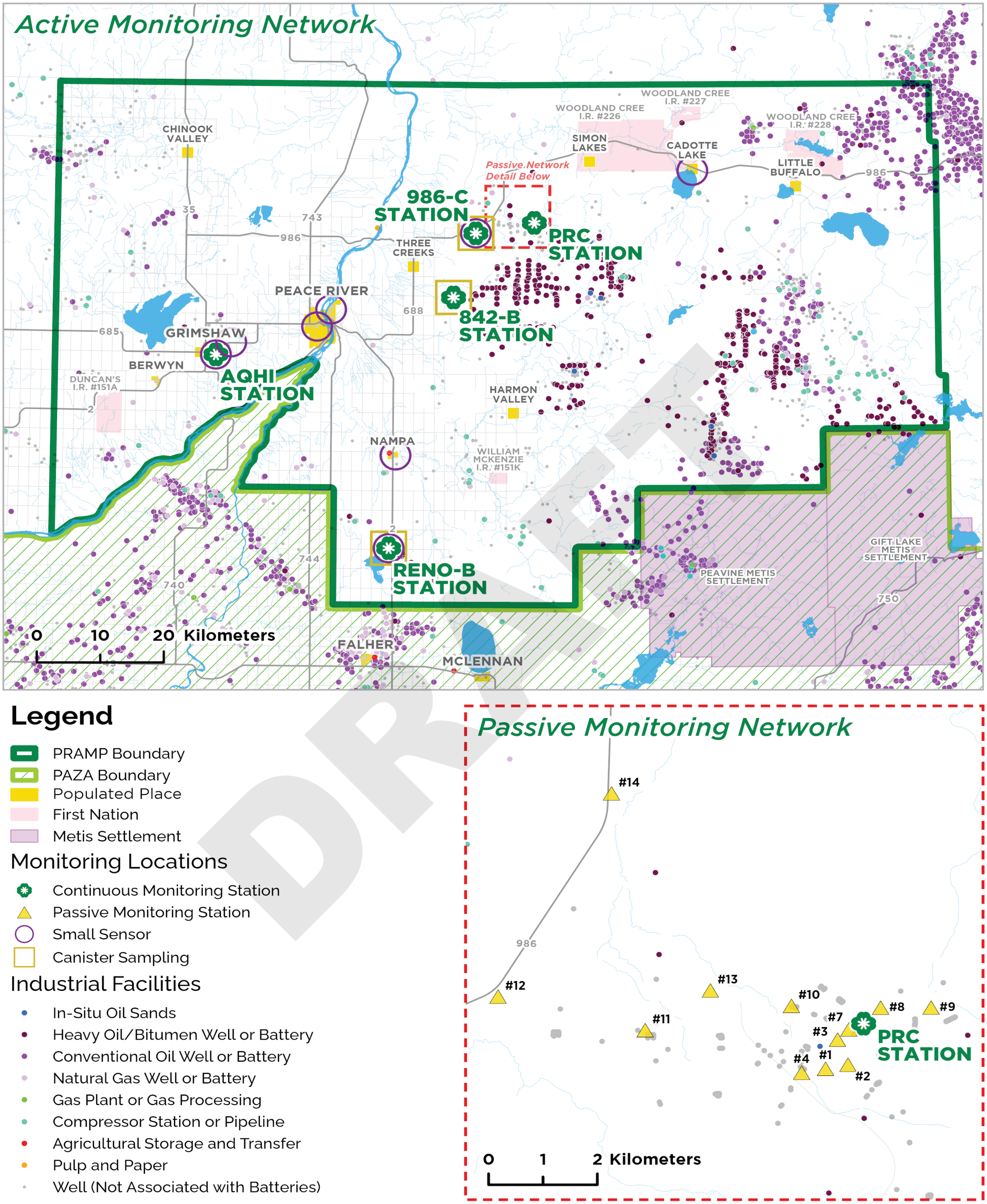


Figure 1: Map of the PRAMP Area

Sulphur dioxide (SO_2), total reduced sulphur (TRS), methane (CH_4), and non-methane hydrocarbons (NMHC) concentrations are monitored continuously at 986-C, 842-B, Reno-B, AQHI, and PRC stations. The PRC additionally monitors hydrogen sulphide (H_2S) while the AQHI Station also measures particulate matter ($PM_{2.5}$), oxides of nitrogen (NO_2, NO), and ozone (O_3). Canisters are intermittently collected at 986-C, 842-B, and Reno-B for detailed laboratory analysis of volatile organic compounds (VOCs).

PRAMP also operates a network of network of small senors for $PM_{2.5}$ however, data from these sensors is not summarized in this report.

PRAMP's continuous monitoring stations are located at:

- Station 842 (or 842-B) at 16-7-84-19 W5M
- Station 986 (or 986-C) at 5-15-85-19 W5M
- Reno Station (or Reno-B) at 01-28-79-20 W5M
- AQHI Station (located in Grimshaw) at 13-8-83-23 W5M
- Peace River Complex (or PRC) at 8-21-85-18 W5M

1.3 Air Quality Monitoring Goals

In 2021, PRAMP held strategic planning sessions and, as a result, established a new set of goals. The goals that are directly related to delivery of the air quality monitoring program are as follows:

GOAL 1: Evidence-driven verification that air quality in the Peace River area is at acceptable levels and that emissions are being minimized.

GOAL 2: Residents and stakeholders have timely access to air quality data and information in a manner that is readily understood.

GOAL 3: Educators, community groups, and citizens can access resources to increase understanding of and to promote healthy air quality.

GOAL 4: Recognized as an independent not-for-profit organization and Airshed that is focused on continuous improvement and responsible leadership in air quality monitoring.

There are several strategies associated with achieving these goals including:

- Maintain operation of all PRAMP air monitoring stations to achieve the objectives of the Oil Sand Monitoring (OSM) contract and to be in compliance with the Air Monitoring Directive.
- Data reporting meets or exceeds provincial requirements and regulatory compliance commitments
- Data is analyzed to confirm that results do not exceed Alberta Ambient Air Quality Objectives and Guidelines and Canadian Ambient Air Quality Standards where applicable.
- Deliver timely, relevant, and accessible air quality data so that residents can make informed choices in support of human health and the environment.

To accomplish PRAMP's goals, air quality in the Peace River Area is monitored through continuous and passive measurements as well as triggered canister samples. Continuous monitoring stations use substance-specific technology to detect concentrations in a sample stream of ambient air that is taken by the instrument at a set time interval. Wind speed and direction data are also collected at the continuous monitoring stations. Most of PRAMP's continuous monitoring instruments collect 1-second data; however, 1-minute average data are used for the quality assurance and quality control. One-hour average measurements are then calculated based on the post-data validation 1-minute average and provided to the EPA data warehouse system. Assessing concentration and wind data together allows investigation into the potential sources of substances affecting the local air quality. In this report, different visualizations of data are used to assist in understanding the spatial and temporal patterns and distribution of the data.

Discrete, 1-hour canister samples can be automatically collected at Station 986-C, 842-B, and Reno-B when the continuously monitored NMHC concentration data exceeds a set pre-determined value. The current value is 0.3 ppm based on real-time NMHC concentrations averaged over a five-minute period. After the 1-hour sample is collected, a field technician is notified, and the canister is sent to a laboratory for speciated hydrocarbon analysis.

In 2022, the 12-station PRC passive monitoring network, which monitors for H_2S and SO_2, was added to the PRAMP program. The advantages of passive sampling devices include simple design, low operating cost, and ease of use; they also require no power to collect a sample, making them useful for remote areas. Passive air sampling provides long-term average concentrations and can reveal spatial variation in air quality; however, they are not suitable for detecting maximums or short-term elevated levels of pollutants. Through laboratory analysis, the passive monitoring network produces monthly averages for H_2S and SO_2.

The provincial government develops the Alberta Ambient Air Quality Objectives and Guidelines (AAAQO/AAAQG; AEP 2019) to protect the environment and human health. AAAQO/Gs are developed through a multi-stakeholder process led by Alberta Environment and Protected Areas under Section 14 of Environmental Protection and Enhancement Act. The AAAQOs and AAAQGs are used as threshold values for comparing substance concentrations (at appropriate averaging periods) to assess potential impacts.

2 - Continuous Monitoring Results

2.1 Interpretation Key

This section provides interpretation guidance for the standalone charts and dashboard-style layouts of data
that are presented later in the report.

In 2022, Alberta's Airsheds collectively operated over 80 continuous monitoring stations across the province. Airsheds monitor a variety of pollutants and meteorological parameters. Each Airshed operates a monitoring program that is designed to meet local objectives including long-term trend analysis, air quality health index reporting, and compliance assurance.

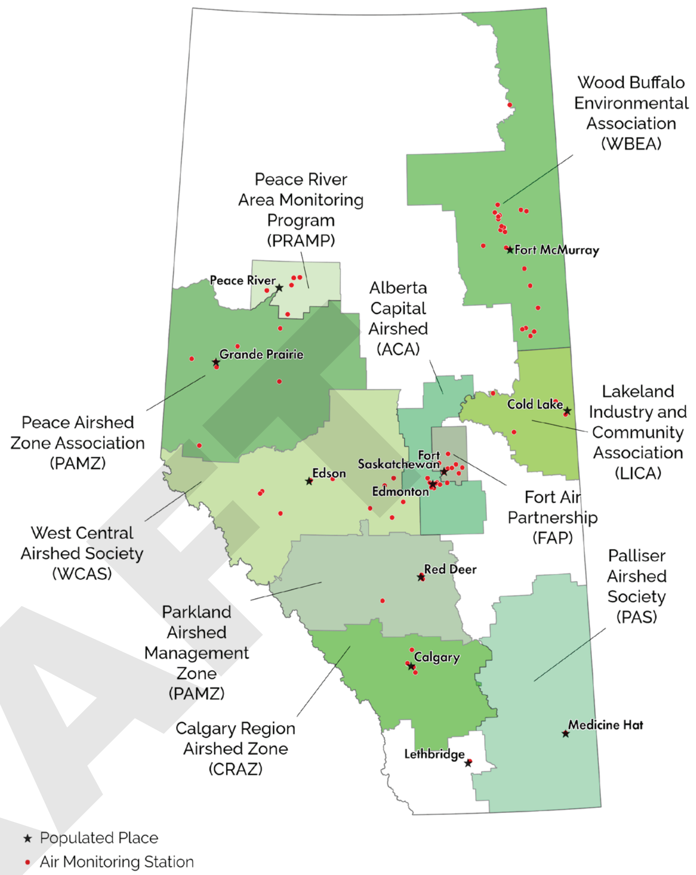


Figure 2: Alberta's Airshed Zones

Box plots are used to present summary statistics for 2022 continuous monitoring data collected by Alberta's Airsheds. Each monitoring location has a label that includes an acronym for the Airshed that operates the station; Airsheds' acronyms and their geographic location can be found on the map on this page. In some cases, Alberta Environment and Parks (AEP) also operates monitoring stations. Note in 2022, AEP evolved to become Alberta Environment and Protected Areas.

For each continuous monitoring location in Alberta, two concentrations are presented: the 'bar' represents the annual average of one-hour concentrations while the 'whiskers' represent 95th percentile. In statistics, the most common definition of a percentile is "a value below which a certain percentage of scores fall". For example, the 95^{th} percentile is the value below which 95% of the scores (in this case, concentrations) in the distribution may be found. When the data are presented this way, the average provides a useful and easily understood indicator of 'central tendency' while the 95th percentile excludes potential outlier data points collected during extreme events such as forest fires, facility upsets, and unique weather phenomena (data above 95% in this presentation of results are considered outliers).

If available, the relevant threshold (the acceptable provincial or federal levels) for the guideline or standard for the pollutant is presented below each pollutant summary in an information box.

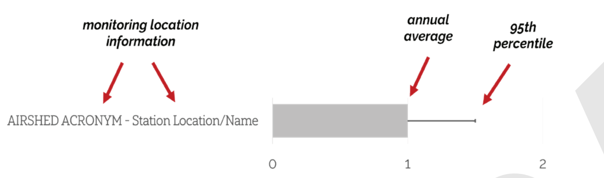


Figure 3: Box plot interpretation key

This section also presents wind roses formatted to present pollutant concentrations; when concentration data are presented this way, the resulting diagram is called a pollution rose or concentration rose. These concentration roses show the frequency of contaminant concentrations travelling with winds blowing from a particular direction over a specified period. The length of each 'spoke' around the circle is related to the frequency of that concentration of the contaminant occurring. Concentration roses will generally have the same shape as wind roses; however, the focus is on which direction the higher concentrations come from.

Each continuously monitored parameter in the following sections has a dashboard style data summary presentation. Each dashboard contains up to 25 smaller charts. The rows of charts in the dashboard present different summary statistics or frequency distributions to help elucidate patterns and other observations in the monitoring data across the network; each column of charts in the dashboard represents a monitoring station in the PRAMP network.

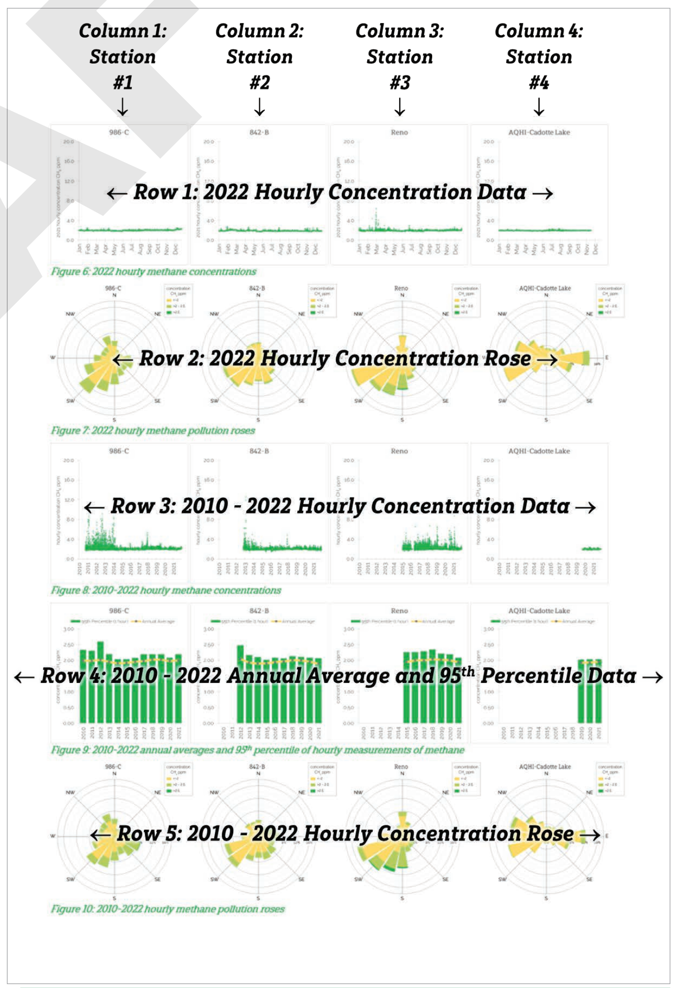


Figure 4: Dashboard Report interpretation key

2.2 Methane

Methane is a colourless and odourless gas emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices, land use, and by the decay of organic waste in municipal solid waste landfills. While there is no AAAQO for methane, background levels are typically around 1.8 ppm.

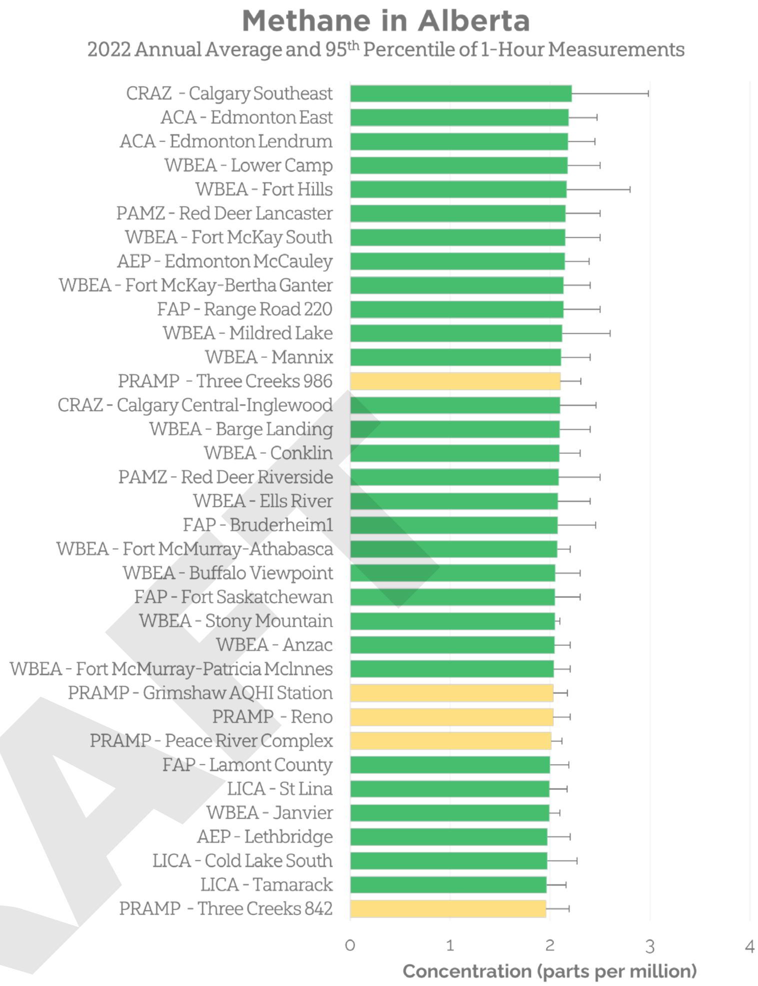


Figure 5: 2022 Methane in Alberta

There is an overall decrease in the frequency of elevated methane events at Stations 986-C, 842-B, and Reno-B, especially when compared to the early monitoring record at both sites. In 2022, all stations had similar annual averages with a small increase compared to recent years; this may be due to recovery of upstream activities after the COVID-19 pandemic. Both 986-C and 842-B show a very small step change or shift in concentrations approximately in June 2022 and August 2022 respectively; this is due to an instrumentation change. The AQHI-Grimshaw and PRC stations measured the lowest overall concentrations of methane and the lowest number of isolated elevated methane concentrations in the PRAMP.

In 2022, the highest concentrations of hydrocarbons were measured near the industrial complexes in Alberta's large cities including those east of Edmonton as well as oilsands mining areas north of Fort McMurray. PRAMP's monitoring stations have concentrations that are very close to the natural background for rural Alberta, with the AQHI, PRC, Reno, and 842-B Station being among the lowest in Alberta (see Figure 5).

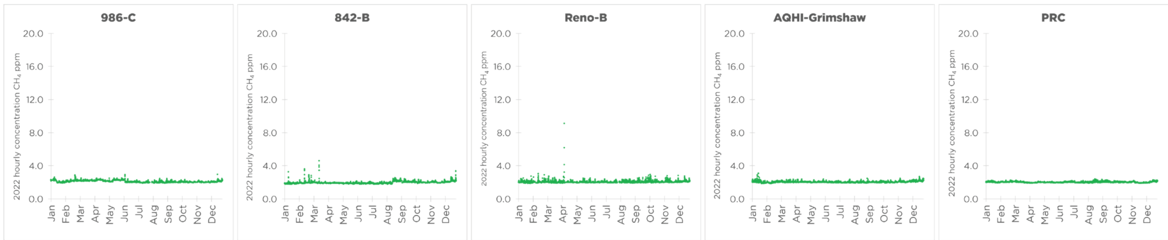


Figure 6: 2022 Hourly methane concentrations

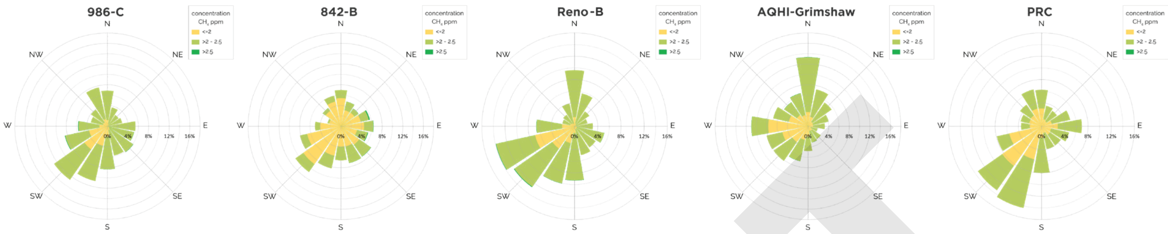


Figure 7: 2022 Hourly methane concentration wind roses

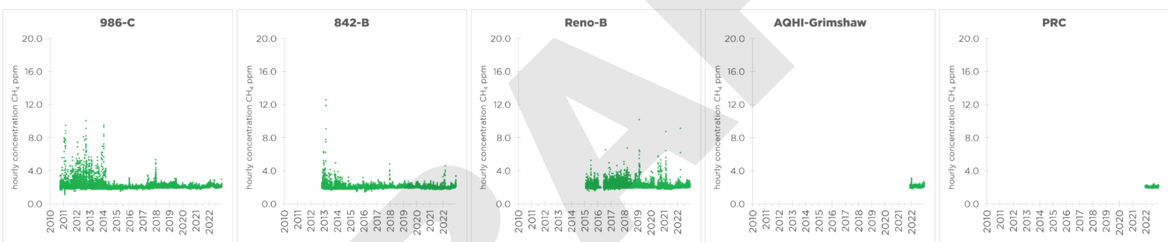


Figure 8: 2010-2022 Hourly methane concentrations

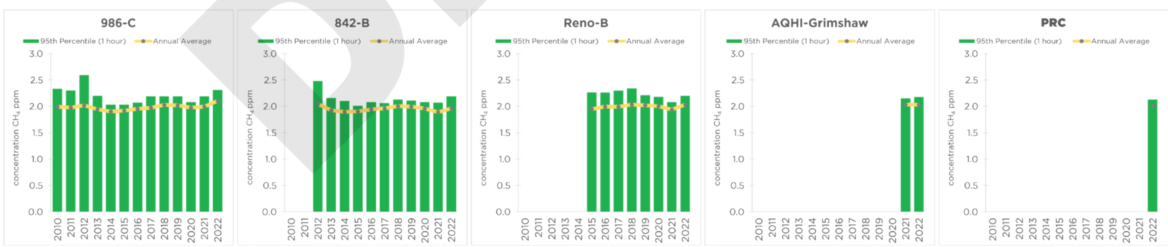


Figure 9: 2010-2022 Annual averages and 95th percentile of hourly measurements of methane

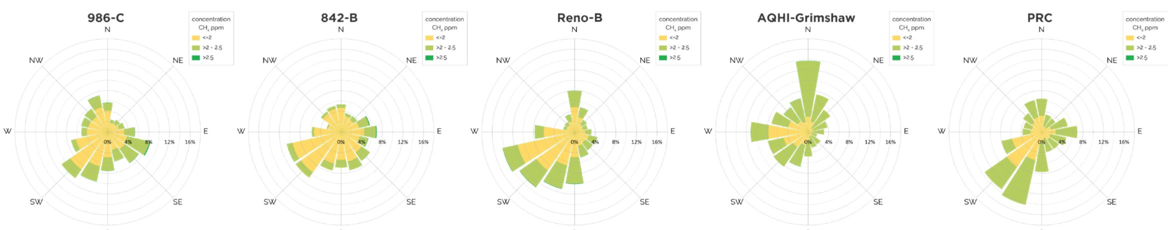


Figure 10: 2010-2022 Hourly methane concentration wind roses

2.3 Non-Methane Hydrocarbons

Non-methane hydrocarbons (NMHCs) are organic compounds that are typically photochemically reactive in the atmosphere; this group of hydrocarbons—as the name implies—is marked by the exclusion of methane. NMHCs are generally formed by a wide range of natural (e.g., vegetation, forest fires) and anthropogenic sources, including traffic, industrial complexes, and manufacturing.

In the PRAMP network, there were a small number of elevated concentrations throughout the year at all stations; some of these measurements were caused by wildfire smoke episodes during the summer and by stagnant meteorological condition in the winter. The AQHI-Grimshaw station shows consistently elevated concentrations throughout the year compared to PRAMP's other monitoring stations. The combination of local vehicle use, homes (heating), and commercial activity in Grimshaw all contribute to these elevated concentrations. The 986-C, 842-B, and Reno stations saw a decrease in the magnitude and frequency of elevated NMHC since monitoring began in the PRAMP area.

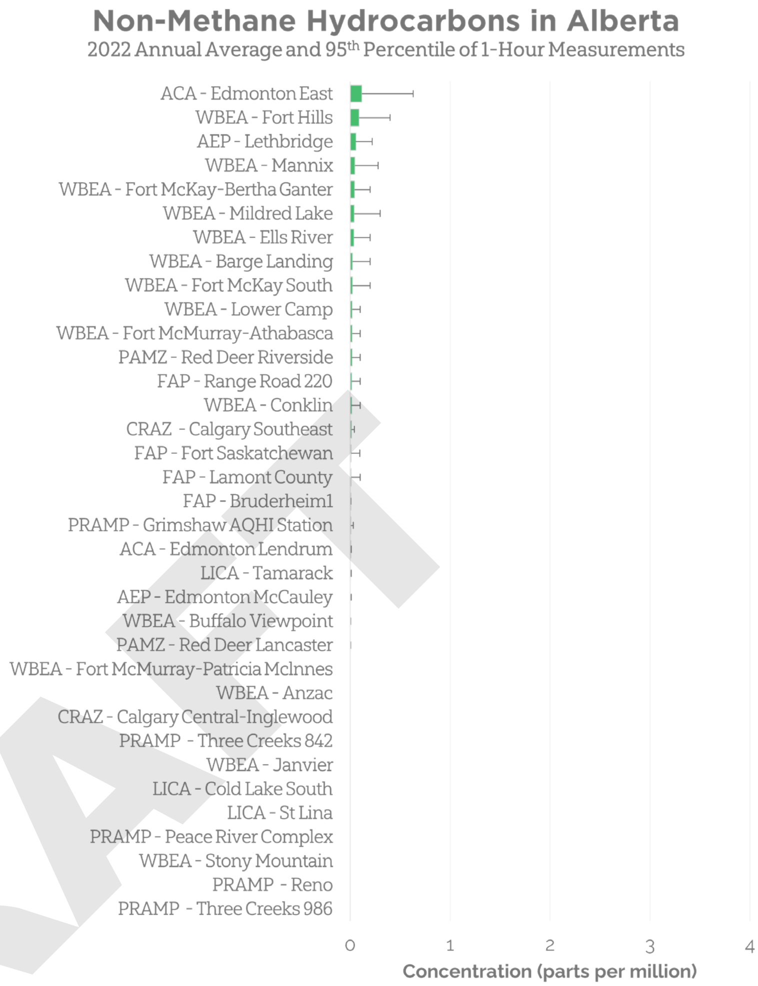


Figure 11: 2022 Non-methane hydrocarbons in Alberta

In Alberta, most annual average concentrations are very close to zero parts per million at nearly all monitoring locations across Alberta. Although low, some patterns emerge in the provincial data including elevated concentrations at stations in the Fort McMurray oil sands area and stations in or adjacent to large urban areas and industrial complexes. PRAMP's 986-C, 842-B, Reno, and PRC station are all in the lower 25% of annual averages among monitoring stations in Alberta (See Figure 11).

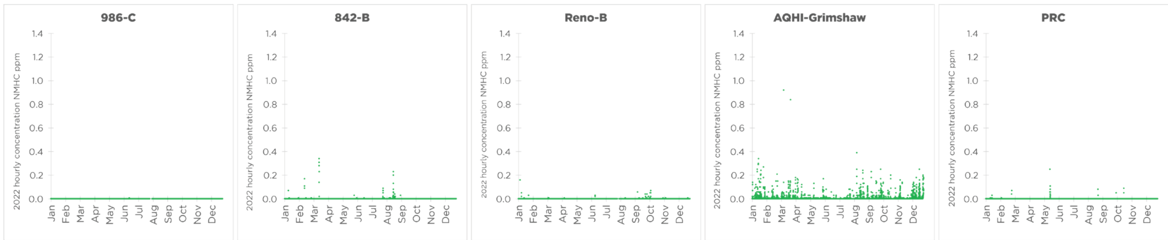


Figure 12: 2022 Hourly non-methane hydrocarbon concentrations

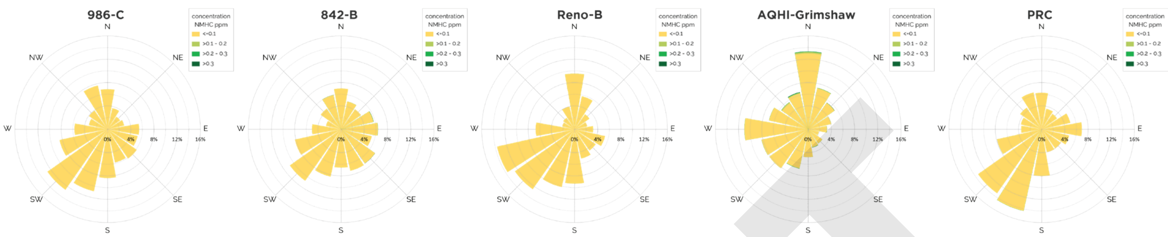


Figure 13: 2022 Hourly non-methane hydrocarbon concentration wind roses

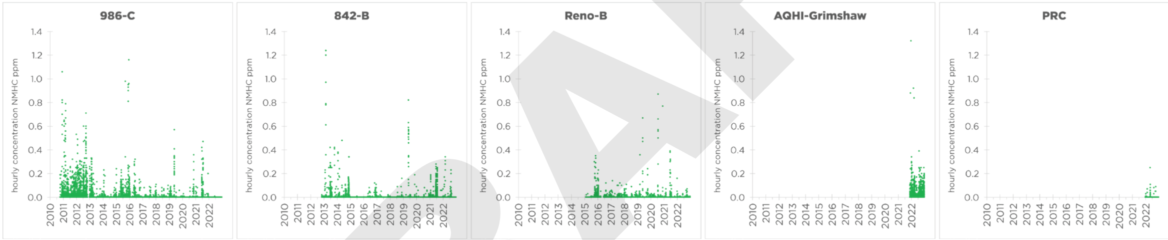


Figure 14: 2010-2022 Hourly non-methane hydrocarbon concentrations

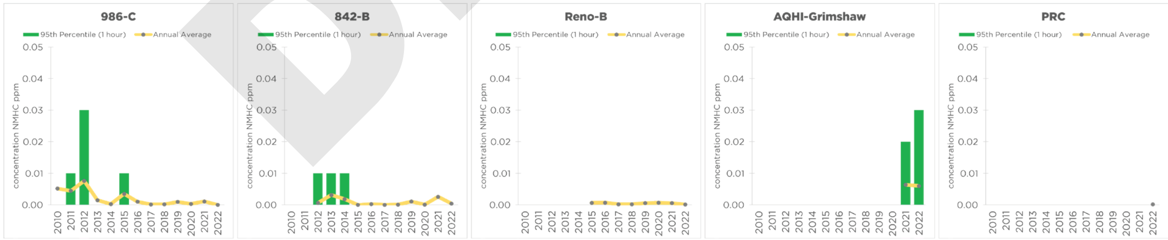


Figure 15: 2010-2022 Annual averages and 95th percentile of hourly measurements of non-methane hydrocarbons

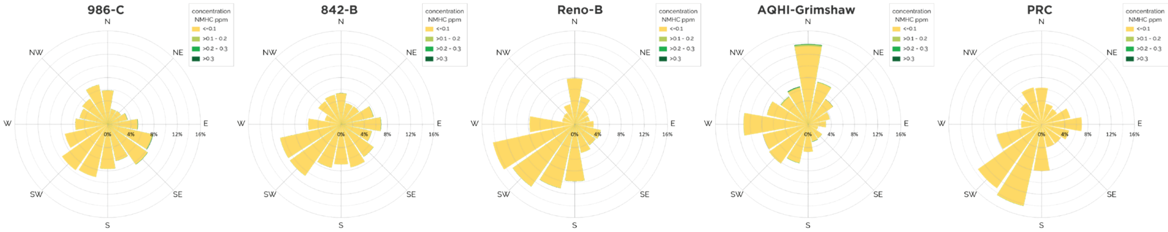


Figure 16: 2010-2022 Hourly non-methane hydrocarbon concentration wind roses

2.4 Sulphur Dioxide

Sulphur dioxide (SO_2) results from the combustion of sulphur compounds in fuel and flared/incinerated gas. In Alberta, oil and gas operations and their associated sulphur dioxide emissions range from relatively small (distributed well sites) to very large (oilsands operations or sour gas processing); many operations can be (and typically are) located close together resulting in higher localized concentrations of sulphur dioxide. This pattern of elevated concentrations near major sources or clusters of facilities is evident in the monitoring data. In 2022, the highest annual concentrations of sulphur dioxide were measured north of Fort McMurray near oilsands mines, east of Edmonton near refineries, and near Fort Saskatchewan's petrochemical operations.

AAAQO's for sulphur dioxide were 172 ppb (1 hour), and 8.0 parts per billion (annual); all of PRAMP's monitoring stations are well below these concentrations and there are no discernable trends in the monitoring data.

In 2022, all of PRAMP's monitoring locations had annual average sulphur dioxide concentrations in the lowest 10% of all stations in Alberta.

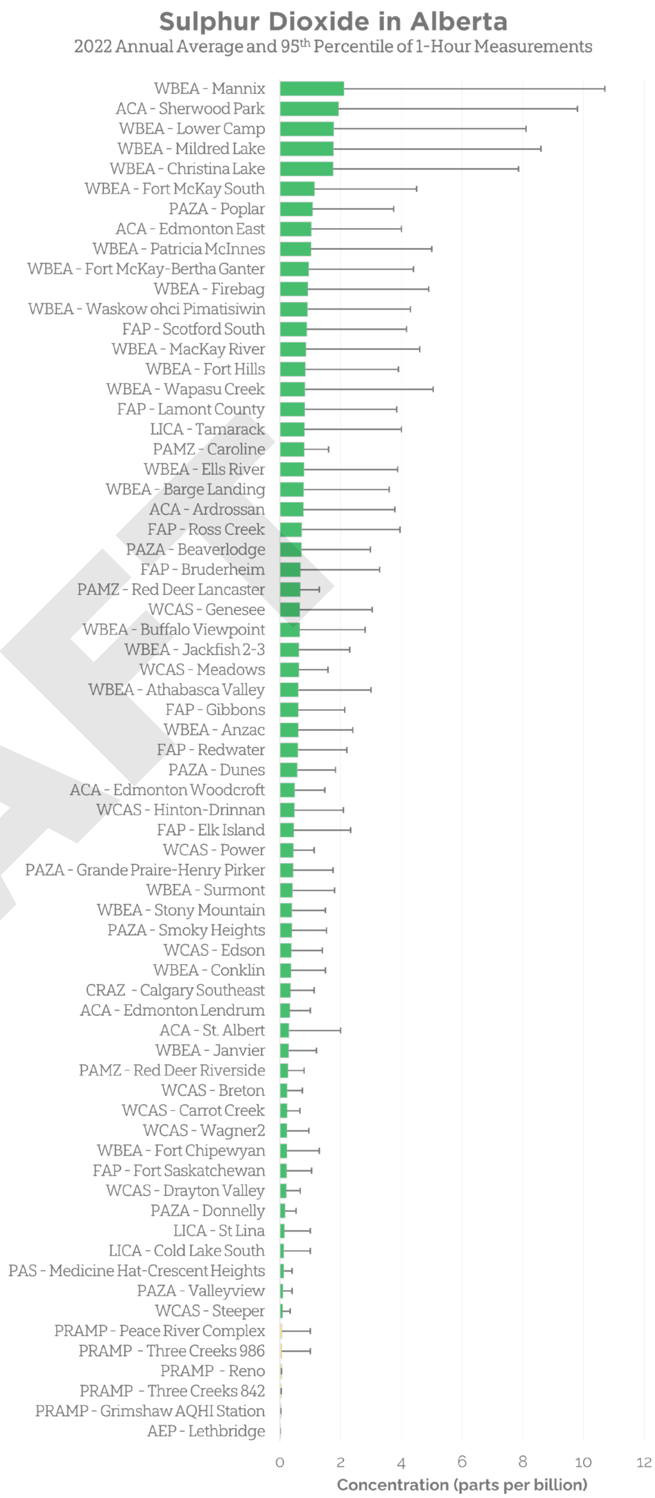


Figure 17: 2022 Sulphur dioxide in Alberta

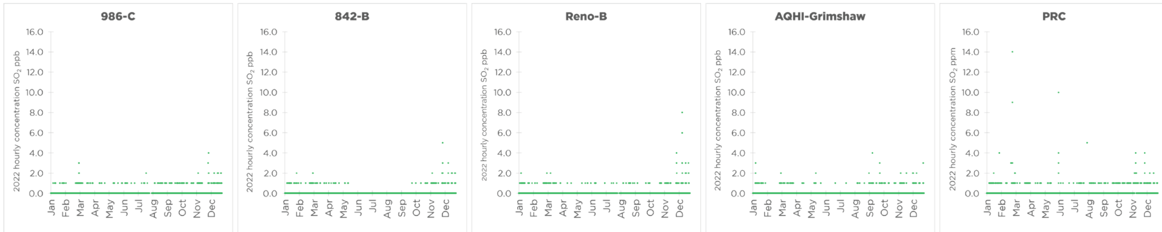


Figure 18: 2022 Hourly sulphur dioxide concentrations

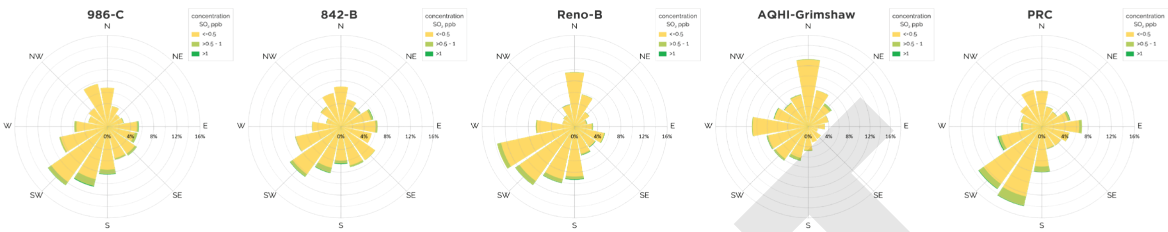


Figure 19: 2022 Hourly sulphur dioxide concentration wind roses

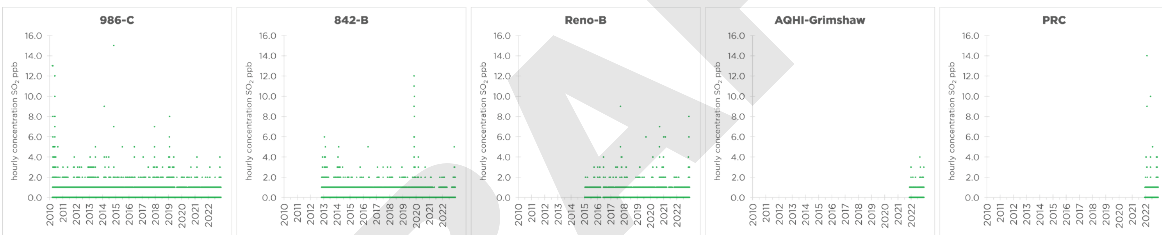


Figure 20: 2010-2022 Hourly sulphur dioxide concentrations

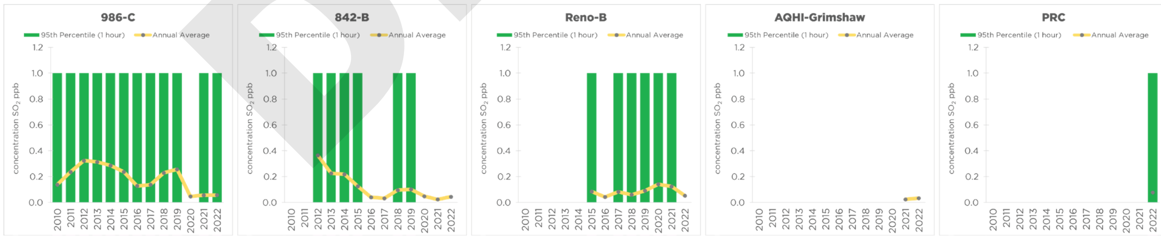


Figure 21: 2010-2022 Annual averages and 95th percentile of hourly measurements of sulphur dioxide

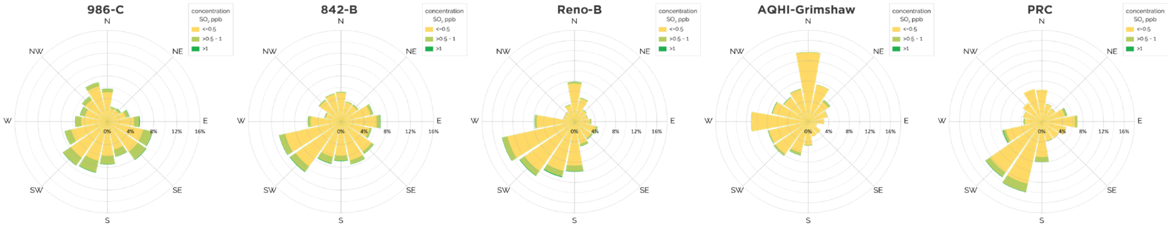


Figure 22: 2010-2022 Hourly sulphur dioxide concentration wind roses

2.5 Total Reduced Sulphur Compounds

Total reduced sulphur (TRS) compounds are a gaseous mixture of pollutants that contain sulphur in its reduced state. There is no AAAQO for TRS but the AAAQOs for hydrogen sulphide and carbon disulphide are both 10 ppb; both of these substances are members of the total reduced sulphur group of compounds.

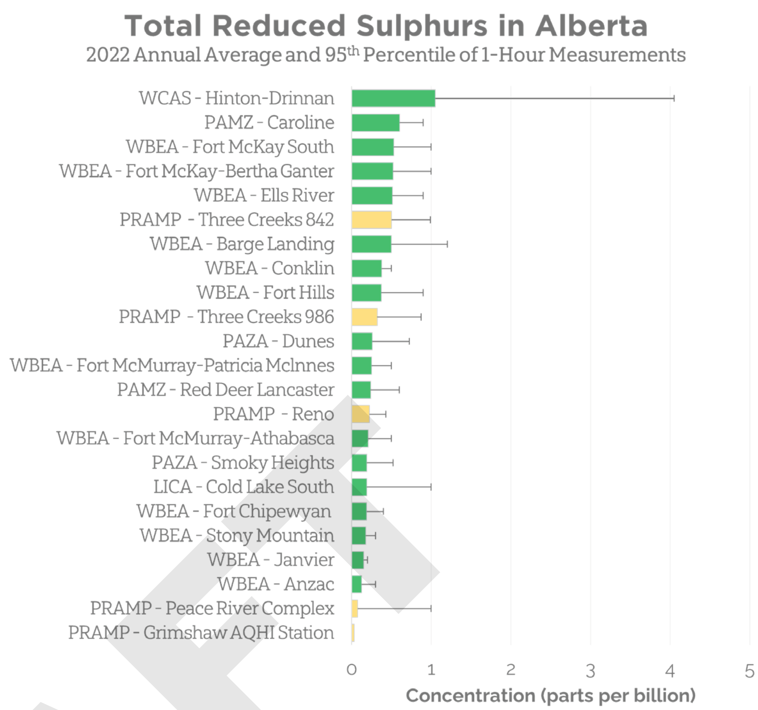


Figure 23: 2022 Total reduced sulphur compounds in Alberta

From 2021 to 2022, there is little change in the overall hourly and annual TRS concentrations at all stations in the PRAMP network; there is however an overall decrease when comparing data from the last 10 years of monitoring. Elevated measurements of TRS may be caused by local industrial sources, but other sources may include agriculture and natural features such as shallow lakes and sloughs. All stations show a pattern of elevated concentrations during the summer months which begin to decrease as cooler fall weather arrives. This observation may be attributed to a few factors including sulphur compounds being released by shallow sloughs and wetlands that contain decaying vegetation and/or sulphur compounds released by asphalt paving during the summer construction period.

In Alberta, monitoring locations that had elevated TRS concentrations were Hinton (due to pulp mill operations), Caroline (due to sour gas facilities), and the oil sands mining area north of Fort McMurray.

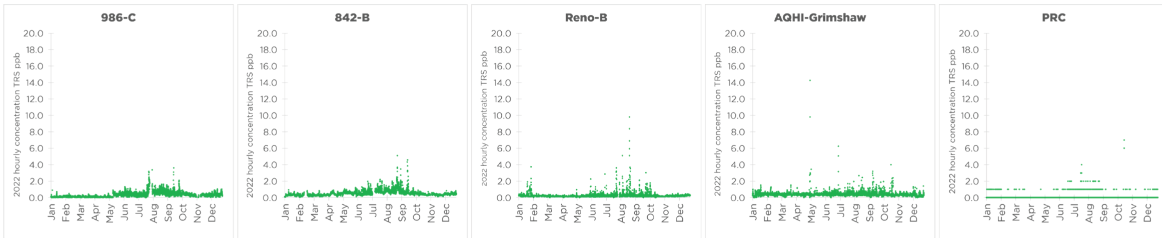


Figure 24: 2022 Hourly total reduced sulphur compounds concentrations

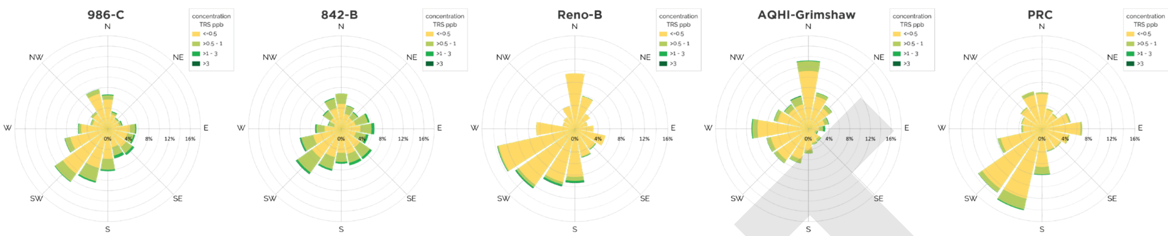


Figure 25: 2022 Hourly total reduced sulphur compounds concentration wind roses

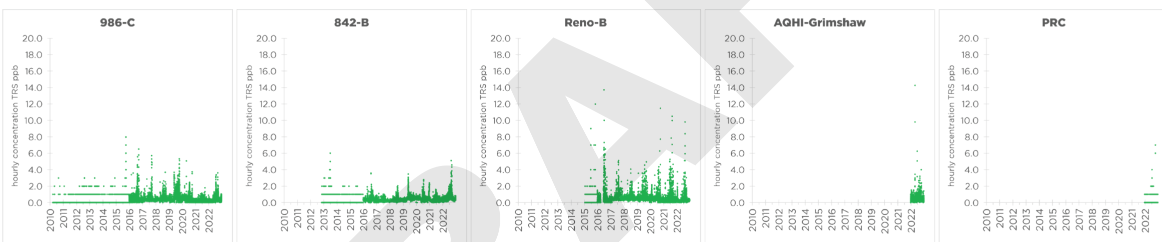


Figure 26: 2010-2022 Hourly total reduced sulphur compounds concentrations

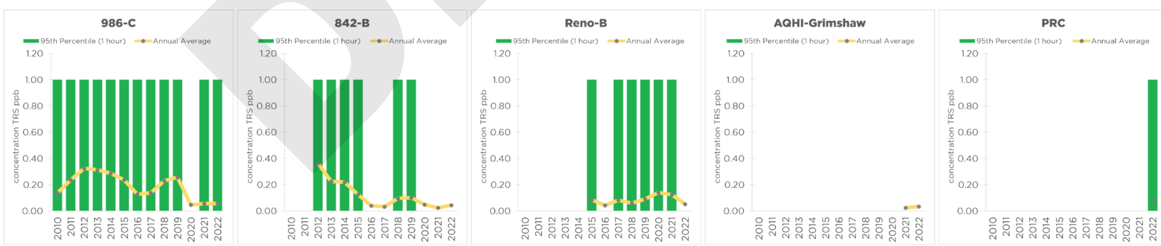


Figure 27: 2010-2022 Annual averages and 95th percentile of hourly measurements of total reduced sulphur compounds

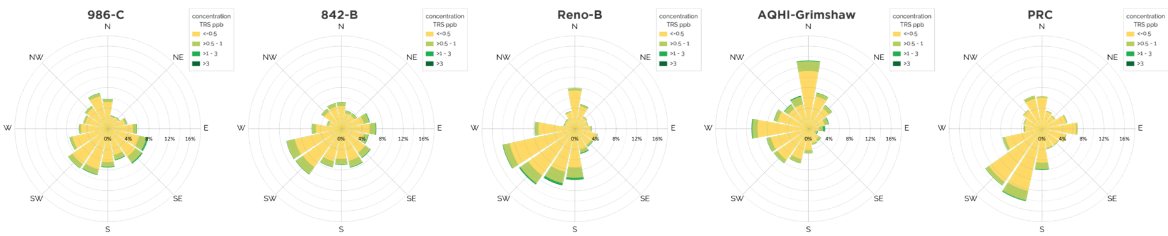


Figure 28: 2010-2022 Hourly total reduced sulphur compounds concentration wind roses

2.6 Hydrogen Sulphide

Hydrogen sulphide is considered an odour nuisance at low levels and can result in symptoms of headache and nausea. Under most weather conditions, hydrogen sulphide and total reduced sulphurs released from different sources are diluted by air movement, so health problems are not expected to occur. Odours may still be noticed because humans can smell sulphur-based chemicals (such as reduced sulphur compounds) at extremely low concentrations. The 1-hour Alberta Ambient Air Quality Objective AAAQO for hydrogen sulphide is 10 ppb.

Hydrogen sulphide is only monitored at the PRC station in the PRAMP network. PRAMP does not have a history of monitoring at this site for long-term data comparison since the PRC station was added to the network in 2022.

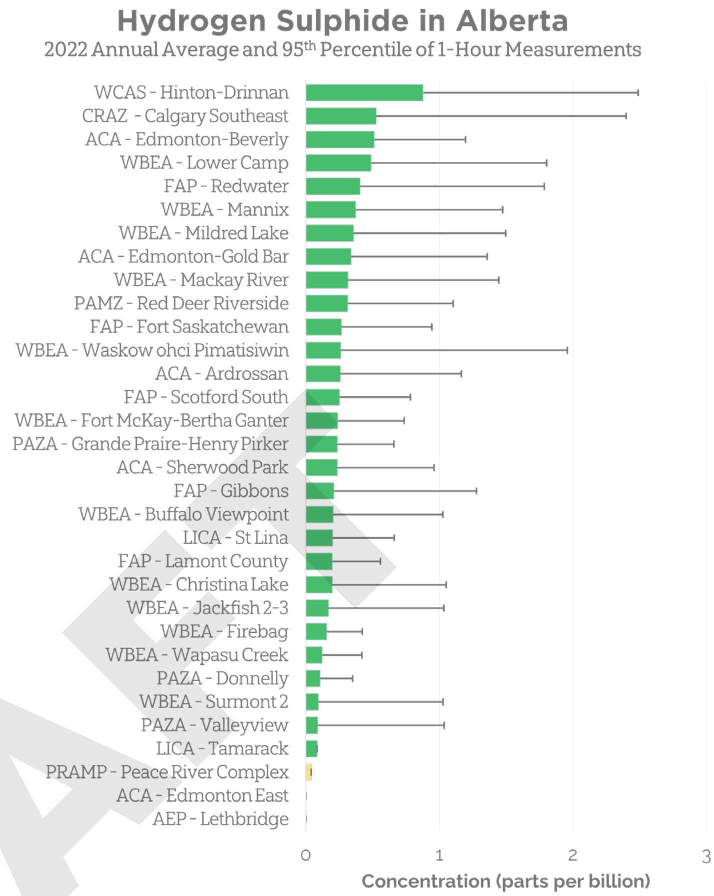


Figure 29: 2022 Hydrogen Sulphide in Alberta

Alberta monitoring locations that had elevated hydrogen sulphide concentrations were Hinton (due to pulp mill operations) the oil sands mining area north of Fort McMurray, Redwater (due to sour gas production), and Edmonton-Gold Bar (due to sewage treatment plant emission). PRAMP's PRC station had the third-lowest 2022 annual average hydrogen sulphide concentration in Alberta.

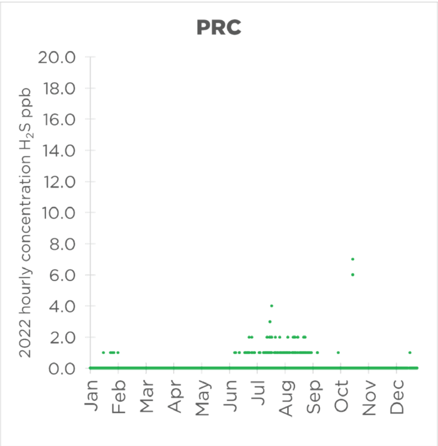


Figure 30: 2022 Hourly hydrogen sulphide concentrations

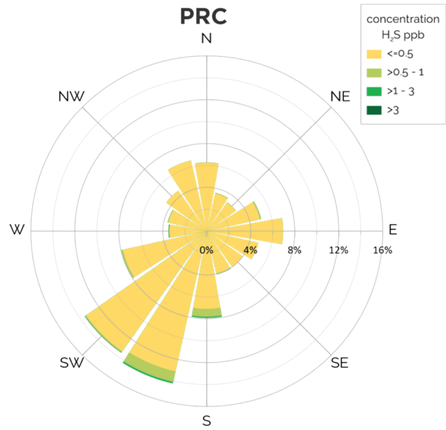


Figure 31: 2022 Hourly hydrogen sulphide concentration wind rose

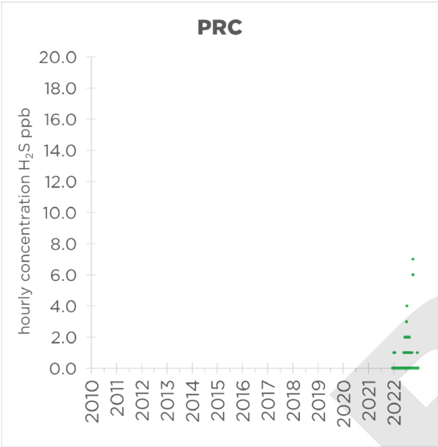


Figure 32: 2010-2022 Hourly hydrogen sulphide concentrations

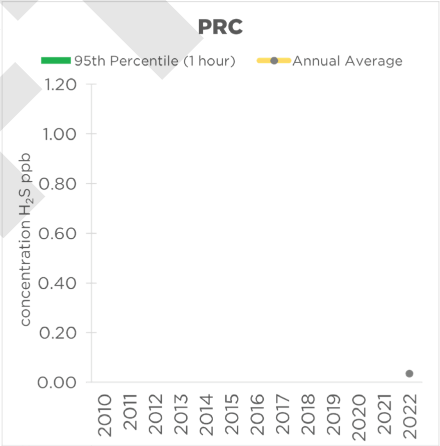


Figure 33: 2010-2022 Annual averages and 95th percentile of hourly measurements of Hydrogen Sulphide

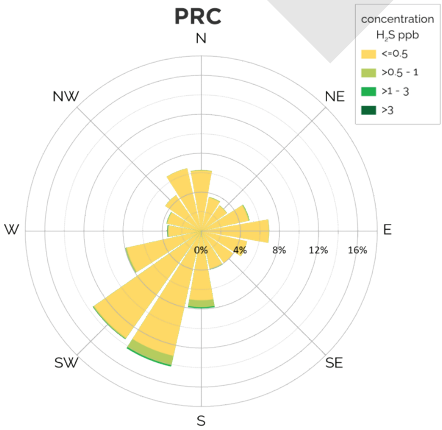


Figure 34: 2010-2022 Hourly hydrogen sulphide concentration wind rose

2.7 Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a reddish-brown gas with a pungent, acrid odour. Nitrogen dioxide is a oxide of nitrogen, which is a family of pollutants produced from the reaction of nitrogen and oxygen gases in the air during combustion, especially at high temperatures. Nitrogen dioxide is produced from fuel combustion in mobile and stationary sources. The combustion of gasoline in automobiles emits nitrogen dioxide into the atmosphere (mobile source). Stationary emissions sources include power plants, refineries, and pulp mills. The 1-hour nitrogen dioxide AAAQO is 159 ppb and annual AAAQO for dioxide is 24 ppb.

In 2022, PRAMP monitored nitrogen dioxide at the AQHI-Grimshaw station. PRAMP's monitoring data show that NO_2 has a distinct season pattern with higher concentrations occurring in the winter due to emissions from home heating and vehicles; pollutants from these sources tend to accumulate at ground level in the winter due to cold, stagnant meteorological conditions.

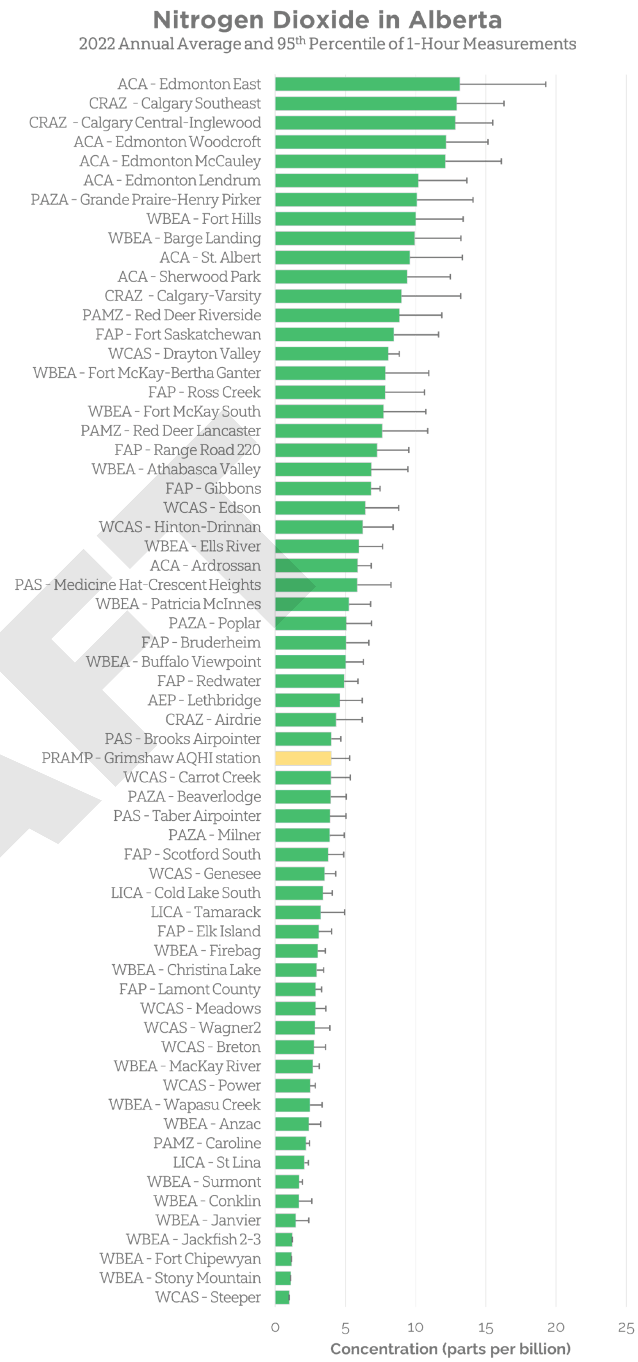


Figure 35: 2022 Nitrogen Dioxide in Alberta

The highest annual average concentrations in Alberta occur almost exclusively in Alberta's large cities including Edmonton, Calgary, St. Albert, Red Deer, and Grande Prairie. Elevated concentrations are also generally measured at smaller urban centers and monitoring stations in the vicinity of large industrial operations. Concentrations measured by PRAMP at the AQHI-Grimshaw station are comparable to similarly-sized population centres.

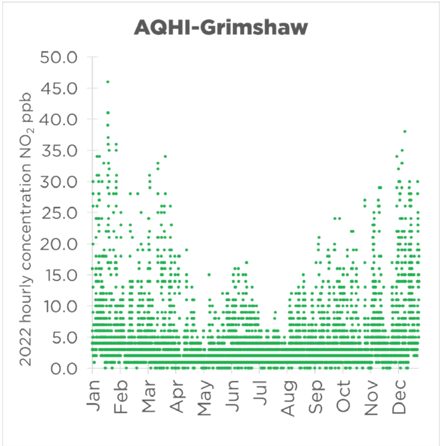


Figure 36: 2022 Hourly nitrogen dioxide concentrations

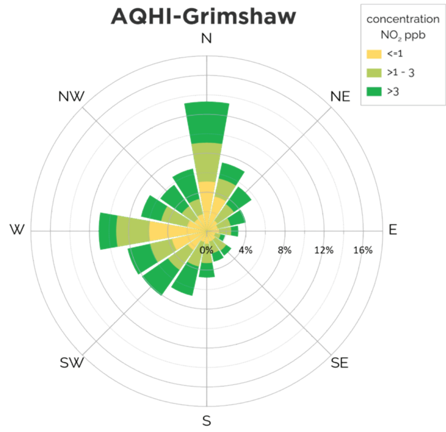


Figure 37: 2022 Hourly nitrogen dioxide concentration wind rose

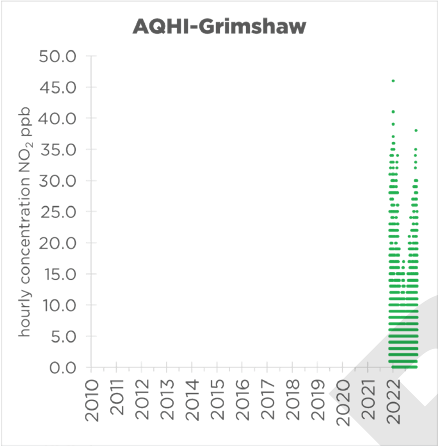


Figure 38: 2010-2022 Hourly nitrogen dioxide concentrations

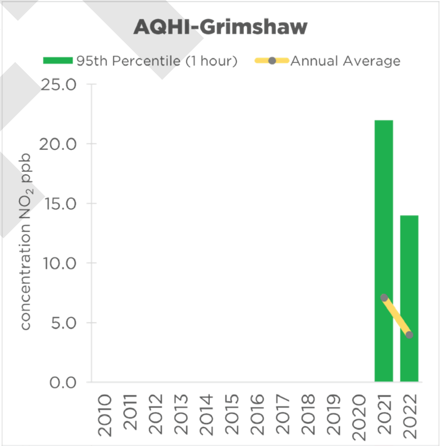


Figure 39: 2010-2022 Annual averages and 95th percentile of hourly measurements of nitrogen dioxide

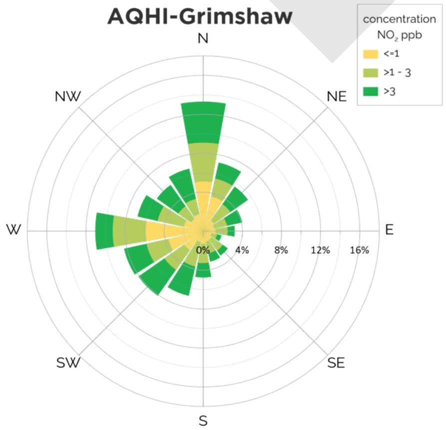


Figure 40: 2010-2022 Hourly nitrogen dioxide concentration wind rose

2.8 Ozone

Ozone is a colourless, odourless gas at ambient concentrations and is a major component of smog. While ozone in the upper atmosphere (the ozone layer) plays an important role protecting life on the planet from harmful ultraviolet radiation, ozone produced near the surface (ground-level ozone) of the earth has environmental, health, and economic impacts. The 1-hour AAAQO for ozone is 76 parts per billion.

Ground-level ozone is a secondary pollutant which means it is not directly emitted by industry or vehicles. It forms and degrades by complex atmospheric processes. Ozone is formed when nitrogen oxides and volatile organic compounds (the "precursor" chemicals) react in the presence of sunlight. However, under certain conditions, ozone can be degraded by some of the compounds by which it is also formed. This degradation occurs more often in cities than in rural areas because of the increased presence of key precursor compounds, chiefly nitric oxide. In Alberta, rural areas often have higher concentrations of ozone than urban areas. This is because ozone levels are generally higher downwind of ozone precursor sources (such as cities) at distances of hundreds or even thousands of kilometers.

PRAMP measured concentrations at the AQHI-Grimshaw station that were comparable to population centres of a similar size. Ozone at the AQHI-Grimshaw station has a season pattern with two periods of elevated measurements. The first is during the late winter or early spring when meteorological processes cause mixing of the atmosphere resulting in ozone being transported to ground level from higher altitudes. The second period in which elevated concentrations are observed is during late summer when conditions are favourable for formation of ground-level ozone due to heat and the presence of precursor substances.

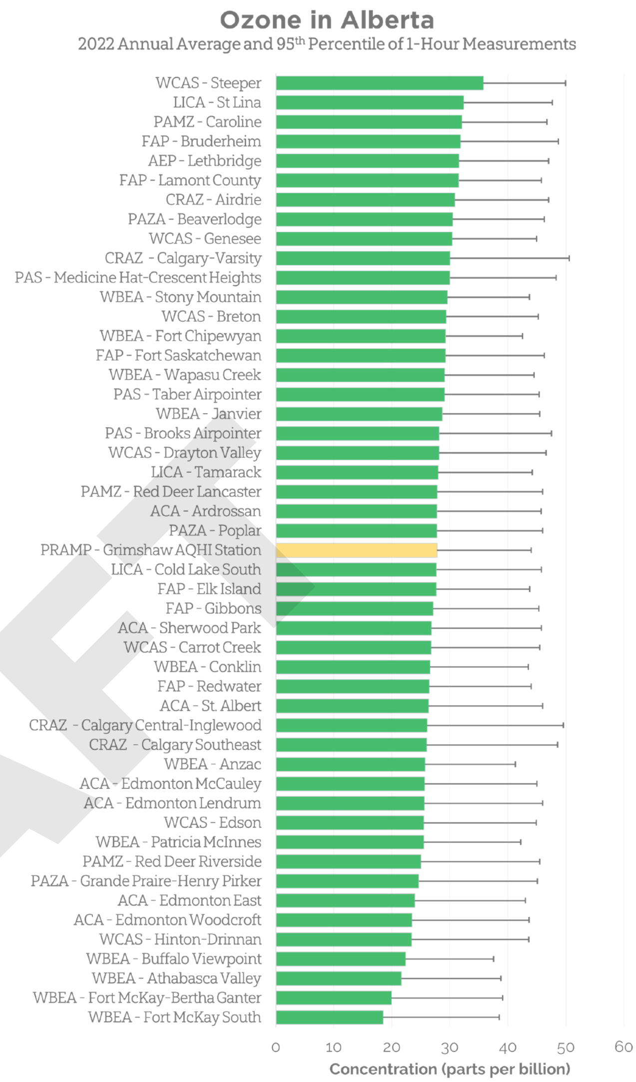


Figure 41: 2022 Ozone in Alberta

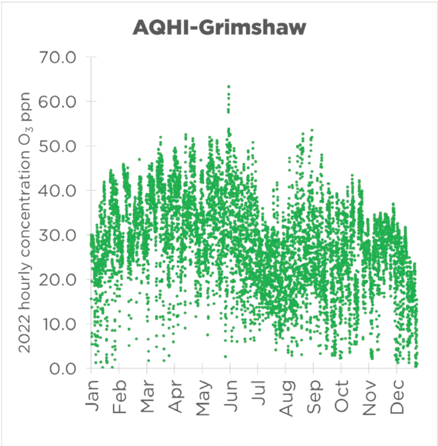


Figure 42: 2022 Hourly ozone concentrations

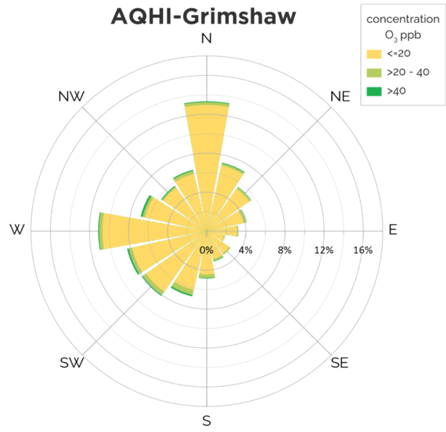


Figure 43: 2022 Hourly ozone concentration wind rose

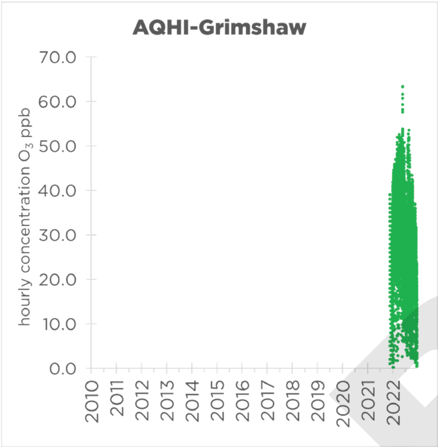


Figure 44: 2010-2022 Hourly ozone concentrations

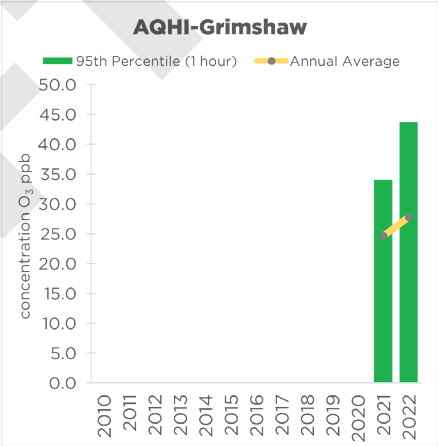


Figure 45: 2010-2022 Annual averages and 95th percentile of hourly measurements of ozone

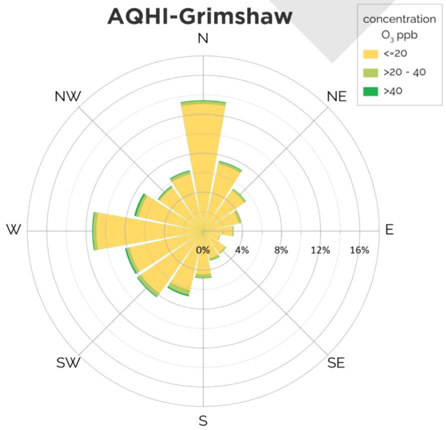


Figure 46: 2010-2022 Hourly ozone concentration wind rose

2.9 Particulate Matter

Particulate matter is characterized according to size, mainly because of the different health effects associated with particles of different diameters. "Particulate matter" is the general term used for a mixture of solid particles and liquid droplets in the air. It includes smoke, dust, ash, and pollen. The composition of particulate matter varies with place, season, and weather conditions. This chart presents fine particulate matter. Fine particulate matter is 2.5 microns in diameter and less; in comparison, a human hair is about 70 microns in diameter. It is also known as $PM_{2.5}$ (or "respirable particles") because it penetrates further into the respiratory system than larger particles. Fine particulate matter is primarily formed from chemical reactions in the atmosphere and through fuel combustion. Major sources of fine particulate matter in Alberta include forest fires, vehicles, power plants, oil and gas facilities, residential fireplaces and wood stoves, and agricultural burning. The 1-hour Ambient Air Quality Guideline for $PM_{2.5}$ is 80 µg/m3.

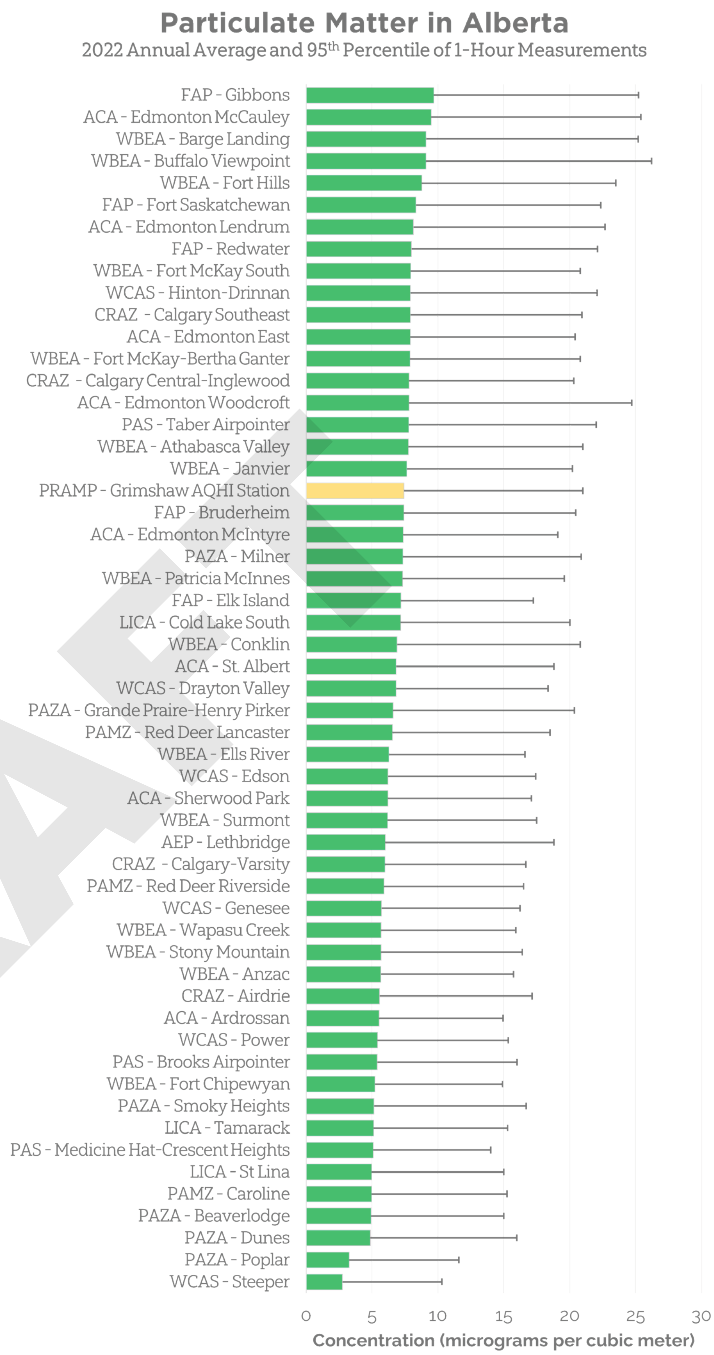


Figure 47: 2022 Particulate Matter in Alberta

In 2022, the highest overall concentrations were generally measured in Alberta's large cities and urban centres (Edmonton, Calgary Fort Saskatchewan, Red Deer) and the areas downwind of them (Gibbons, Lamont County). Past studies have determined that this is largely the result of secondary fine particulate matter formation; there is a greater frequency of days with fine particulate matter events between January and March driven by weather conditions associated with calm winds and temperature inversions. The other notable area that has elevated particulate matter concentrations is the oil sands mining area north of Fort McMurray; this is likely caused by dust from mining operations.

In the PRAMP network, particulate matter was monitored at the AQHI-Grimshaw station in 2022. The highest concentrations were measured when smoke was present in Grimshaw due to wildfires burning in other areas of western Canada.

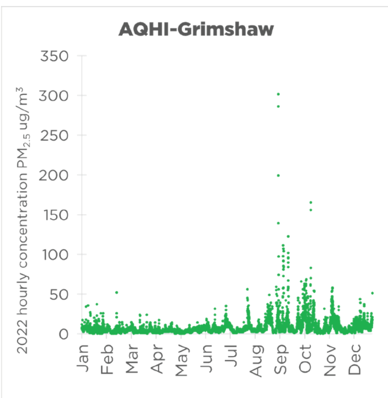


Figure 48: 2022 Hourly particulate matter concentrations

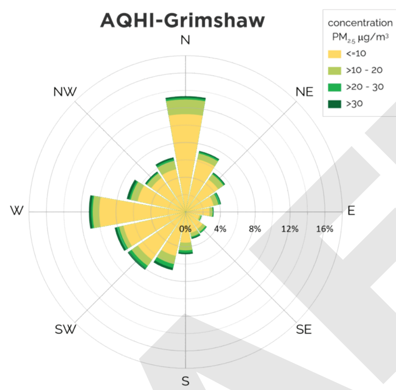


Figure 49: 2022 Hourly particulate matter concentration wind rose

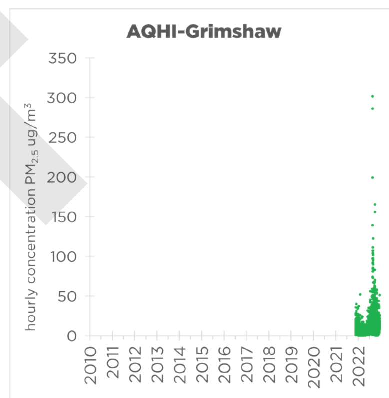


Figure 50: 2010-2022 Hourly particulate matter concentrations

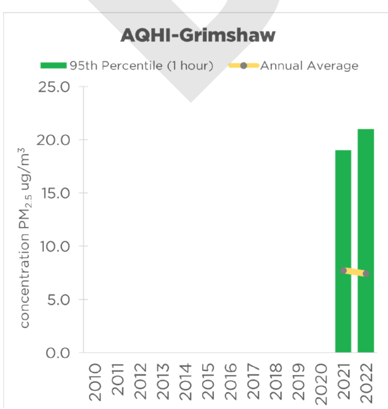


Figure 51: 2010-2022 Annual averages and 95th percentile of hourly measurements of particulate matter

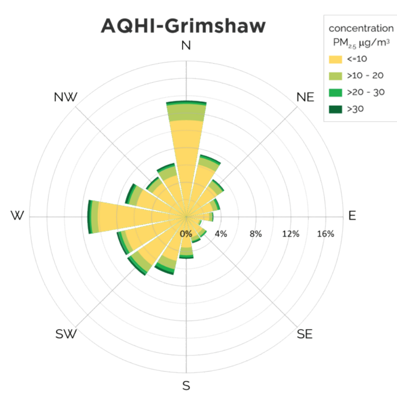


Figure 52: 2010-2022 Hourly particulate matter concentration wind rose

2.10 Triggered Volatile Organic Compound Sampling

The volatile organic compound (VOC) canister sampling program collects a 1-hour sample of air when the continuously measured non-methane hydrocarbons concentration reaches a specified trigger point; the current trigger point is 0.3 ppm. The trigger point is based on real-time monitoring data that are averaged over a five-minute period. Canister sample collection systems are in place at Station 986-C, 842-B, and the Reno-B Station; a canister sample collection system is not part of the suite of instruments currently deployed at the AQHI-Grimshaw Station.

All canister samples were taken to a laboratory for analysis of over 140 VOC compounds and total reduced sulphur compounds. Time and date of the canister sampling was recorded and used to cross-reference the sample to the monitored data and retrieve the associated wind direction and speed.

Five triggered samples were collected across the entire PRAMP network in 2022; this is the lowest total number of canisters collected since this program began. While not a direct measurement of air quality, the low number of triggered canisters indicates that the frequency of elevated hydrocarbon events has been drastically reduced since this sampling program began.

A high-level summary of 2022 triggered canister VOC sampling results is presented in the table below; this table includes a summary of compounds that are commonly found above the method detection. A complete list of species for each of the samples is provided in Appendix 1.

Station		AAAQO	842-B	842-B	Reno	Reno	Reno
Sampled Date (MM/DD/YYYY)			2022-03-15	2022-05-28	2022-09-10	2022-09-30	2022-10-08
Sampled Time			4:40	14:20	20:30	19:20	21:55
Triggered Concentration (ppm)			0.31	0.37	0.35	0.35	0.44
Parameter	Unit		Result	Result	Result	Result	Result
Acetone	ppbv	2400	4.3	7.3	12.3	4	3.6
Acrolein	ppbv	1.9	0.4	< 0.4	1.4	0.5	< 0.5
Benzene	ppbv	9.0	0.5	0.15	0.19	< 0.04	0.27
Ethanol	ppbv	none	4.2	2.6	7.2	3.5	2.2
Ethylbenzene	ppbv	460	0.2	< 0.04	0.09	< 0.04	< 0.05
Freon-113	ppbv	none	0.19	0.14	0.05	< 0.03	0.03
Isobutane	ppbv	none	10.7	0.49	0.5	0.95	0.87
Isopentane	ppbv	none	5.98	< 0.06	1.32	0.53	0.81
m,p-Xylene	ppbv	530	0.17	0.34	0.23	0.1	0.21
o-Xylene	ppbv	530	0.19	0.19	0.11	< 0.04	0.14
Methane	ppmv	none	5	2.8	3.2	2.1	3
n-Butane	ppbv	none	6	0.29	2.49	1.9	2.48
n-Pentane	ppbv	none	3.14	0.12	0.57	0.5	0.59
Toluene	ppbv	499	1.75	0.14	0.41	0.21	0.29

Table 1: Summary of 2022 VOC Sample Results for PRAMP Stations (842-B, 986-C, and Reno)

3 - Air Quality Health Index Summary

Monitoring data can be used to determine the Air Quality Health Index. The Air Quality Health Index (AQHI) provides a rating to indicate the level of relative health risk associated with local air quality using a colour-coded scale with associated values from 1 to 10. The index describes the level of health risk associated with each number as low (1 to 3), moderate (4 to 6), high (7 to 10) or very high (10+) and suggests exposure mitigation steps for each risk level.

The AQHI communicates four key pieces of information:

- The air quality in relation health on a scale from 1 to 10. The higher the number, the greater the health risk associated with the air quality. When the amount of air pollution is very high, the number will be reported as 10+.
- A category that describes the level of health risk associated with the index reading (e.g. Low, Moderate, High, or Very High Health Risk).
- Health messages customized to each category for both the general population and the 'at risk' population.
- Current hourly AQHI readings. (and at some locations, maximum forecast values for 'today', 'tonight', and 'tomorrow.')

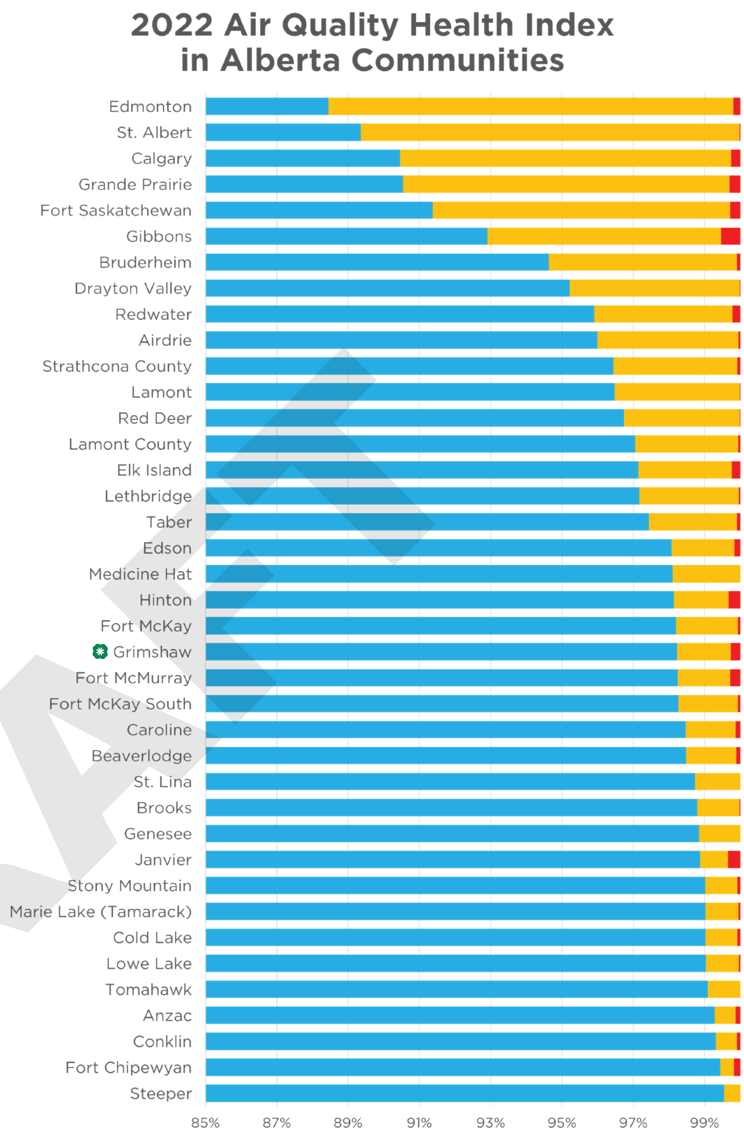
The AQHI is designed to give the above information along with some suggestions on how to adjust activity levels depending on individual health risk from air pollution.

The AQHI is calculated based on the relative risks of a combination of common air pollutants that are known to harm human health. These pollutants are:

- Ozone at ground level
- Particulate Matter ($PM_{2.5}$)
- Nitrogen Dioxide

The figure on this page helps illustrate the AQHI observations for different locations across Alberta in 2022, including the AQHI-capable air quality monitoring station in the PRAMP network. Each location on the chart has approximately 8500 hours of AQHI readings. Monitoring locations are Data are sorted in ascending order by the percentage of low-risk air quality data (the total number of hours of AQHI risk ratings 1, 2, and 3).

In general, large Alberta’s large cities (Edmonton, Calgary, etc.) had fewer days with low-risk AQHI days than more remote, sparsely populated locations (Fort Chipewyan, Beaverlodge, etc.). In 2022, PRAMP measured the AQHI in the Town of Grimshaw which had a low health risk rating over 98% of the time.



Health Risk	Low	Moderate	High	Very High
Colour Code				
Risk Value	1 - 3	4 - 6	7 - 10	11+

Figure 53: 2022 Air Quality Health Index in Alberta

4 - Odour Complaints

Albertans are encouraged to contact the AER's Emergency 24-Hour Response Line with energy and environmental concerns including odour complaints.

Each year, PRAMP tracks the number of odour complaints that have been recorded by the AER for the Peace River Cold Heavy Oil Production areas (Three Creeks, Reno, Seal, Walrus). Odour complaints related to any industrial, agricultural, or commercial operations may be received by a range of other government departments or agencies. PRAMP has access only to data about complaints recorded by the AER. It should be noted that with the current network design, it is not possible to monitor all areas of the airshed at all times; however, it is possible for area residents to detect odours at any place at any time.

In 2022, there were no odour complaints recorded by the AER for the Peace River Cold Heavy Production areas; this is the same number of complaints as in 2021 and is the lowest number of complaints to the AER since PRAMP began compiling these data.

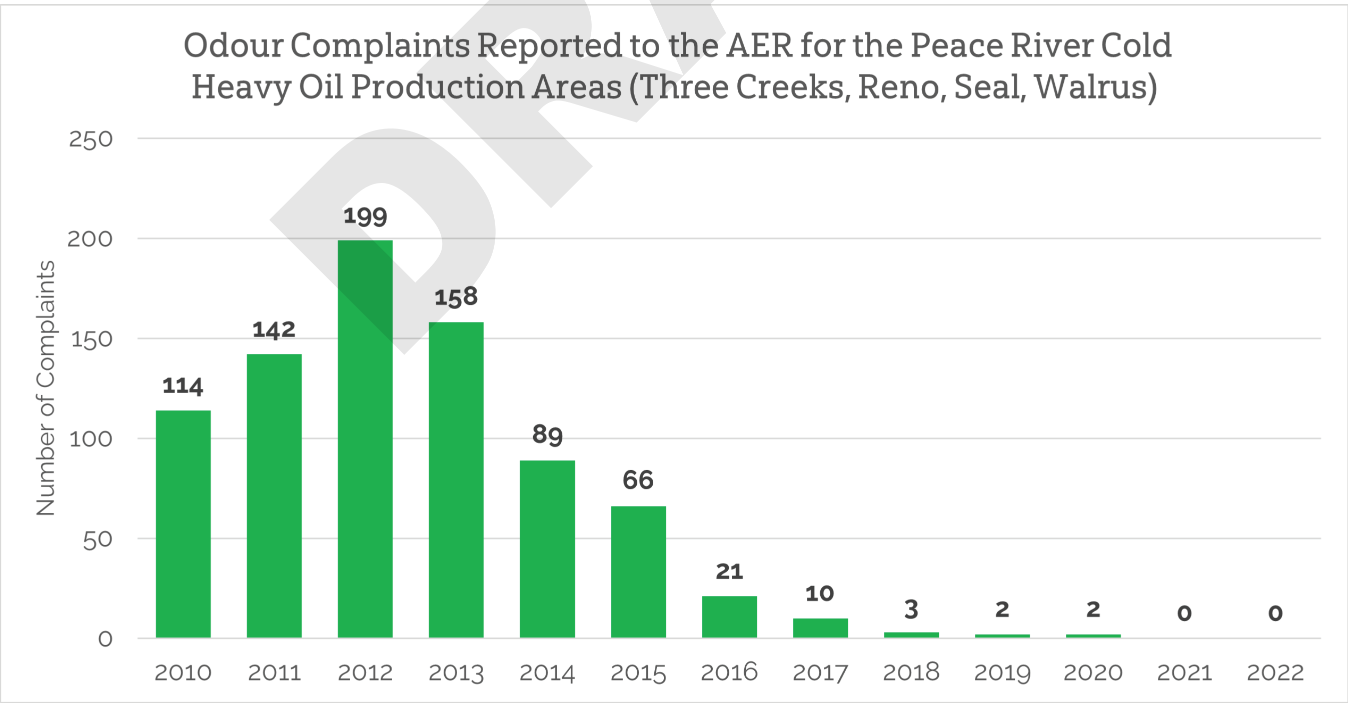


Figure 54: 2010-2022 Odour Complaints in the Peace River Cold Heavy Oil Production Area

5 - Passive Monitoring

PRAMP's passive stations are distributed in a small network around the Peace River Complex (PRC), east of Three Creeks. The following maps show the spatial pattern of monitoring results for 2022. On each map, the diameter of the bubble is representative of concentration (larger diameter = higher concentration). 2022 is the first year that PRAMP is reporting on data for the passive monitoring network.

5.1 Hydrogen Sulphide

Annual average concentrations of hydrogen sulphide in the PRAMP network appear to show a spatial pattern that is consistent with past observations; concentrations are higher on the east side of the nearby industrial sources. Previous data analysis has showed that nearby surface water features are the likely source of this pattern of elevated values; the decay of plant material in nearby waterbodies and wetlands may be formation and release of hydrogen sulphide. Elevated concentrations measured at the stations close to large oil sands operations are due to hydrogen sulphide being released from different facility processes. There is no current annual Alberta Ambient Air Quality Objective of for hydrogen sulphide.

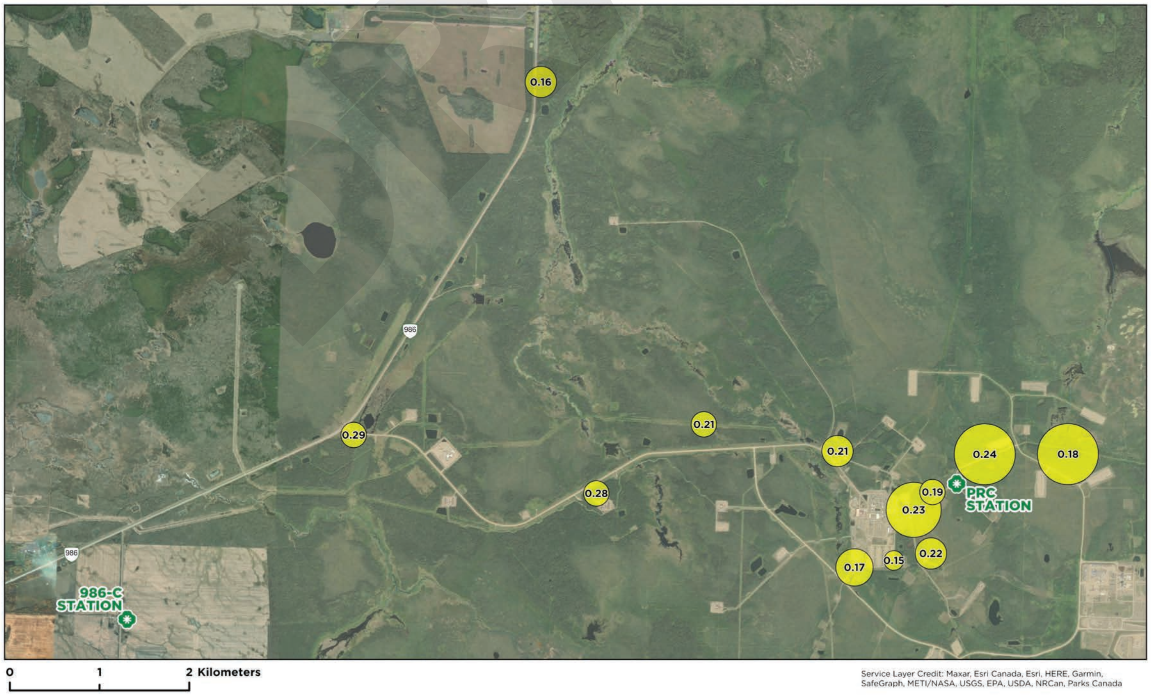


Figure 55: Annual average hydrogen sulphide measured by PRAMP's passive monitoring network. (in parts per billion)

5.2 Sulphur Dioxide

Annual average sulphur dioxide measurements of PRAMP's passive monitoring network show a spatial pattern consistent with similar networks; concentrations drop off to background levels very rapidly with increasing distance from the nearby sources. The highest annual average concentration measured was 0.8 ppb and was well below the annual Alberta Ambient Air Quality Objective of 8 ppb.

Figure 56: Annual average sulphur dioxide measured by PRAMP's passive monitoring network. (in parts per billion)

Appendix

VOC Canister Data

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
1-Butene	ppmv	< 0.14	< 0.14	< 0.14	< 0.15	< 0.15
Acetylene	ppmv	< 0.12	< 0.11	< 0.12	< 0.12	< 0.12
cis-2-Butene	ppmv	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Ethane	ppmv	< 0.1	< 0.1	< 0.1	< 0.1	< 0.2
Ethylacetylene	ppmv	< 0.09	< 0.08	< 0.09	< 0.09	< 0.09
Ethylene	ppmv	< 0.10	< 0.10	< 0.10	< 0.10	< 0.11
Isobutane	ppmv	< 0.1	< 0.1	< 0.1	< 0.1	< 0.2
Isobutylene	ppmv	< 0.1	< 0.1	< 0.1	< 0.1	< 0.2
Methane	ppmv	5.0	2.8	3.2	2.1	3.0
n-Butane	ppmv	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
n-Propane	ppmv	< 0.10	< 0.10	< 0.10	< 0.10	< 0.11
Propylene	ppmv	< 0.1	< 0.1	< 0.1	< 0.1	< 0.2
Propyne	ppmv	< 0.1	< 0.1	< 0.1	< 0.1	< 0.2

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
trans-2-Butene	ppmv	< 0.13	< 0.13	< 0.13	< 0.13	< 0.14
2,5-Dimethylthiophene	ppbv	< 0.4	< 0.4	< 0.3	< 0.4	< 0.5
2-Ethylthiophene	ppbv	< 0.3	< 0.3	< 0.2	< 0.3	< 0.3
2-Methylthiophene	ppbv	< 0.3	< 0.3	< 0.2	< 0.3	< 0.3
3-Methylthiophene	ppbv	< 0.4	< 0.4	< 0.3	< 0.4	< 0.5
Butyl mercaptan	ppbv	< 0.4	< 0.4	< 0.3	< 0.4	< 0.5
Carbon disulphide	ppbv	< 0.3	< 0.3	< 0.2	< 0.3	1.8
Carbonyl sulphide	ppbv	1.9	< 0.4	0.8	< 0.4	< 0.5
Dimethyl disulphide	ppbv	< 0.3	< 0.3	< 0.2	< 0.3	< 0.3
Dimethyl sulphide	ppbv	< 0.3	< 0.3	< 0.2	< 0.3	< 0.3
Ethyl mercaptan	ppbv	< 0.4	< 0.4	< 0.3	< 0.4	< 0.5
Ethyl sulphide	ppbv	< 0.4	< 0.4	< 0.3	< 0.4	< 0.5
Hydrogen sulphide	ppbv	2.2	< 0.4	< 0.3	2.0	< 0.5

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
Isobutyl mercaptan	ppbv	< 0.4	< 0.4	< 0.3	< 0.4	< 0.5
Isopropyl mercaptan	ppbv	< 0.4	< 0.4	< 0.3	< 0.4	< 0.5
Methyl mercaptan	ppbv	< 0.3	< 0.3	< 0.2	< 0.3	< 0.3
Pentyl mercaptan	ppbv	< 0.6	< 0.6	< 0.4	< 0.6	< 0.6
Propyl mercaptan	ppbv	< 0.6	< 0.6	< 0.4	< 0.6	< 0.6
tert-Butyl mercaptan	ppbv	< 0.4	< 0.4	< 0.3	< 0.4	< 0.5
Thiophene	ppbv	< 0.3	< 0.3	< 0.2	< 0.3	< 0.3
1,1,1-Trichloroethane	ppbv	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
1,1,2,2-Tetrachloroethane	ppbv	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
1,1,2-Trichloroethane	ppbv	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
1,1-Dichloroethane	ppbv	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
1,1-Dichloroethylene	ppbv	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
1,2,3-Trimethylbenzene	ppbv	0.09	0.24	0.13	< 0.07	< 0.08

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
1,2,4-Trichlorobenzene	ppbv	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5
1,2,4-Trimethylbenzene	ppbv	< 0.04	0.42	0.51	0.09	0.11
1,2-Dibromoethane	ppbv	< 0.03	< 0.03	0.03	< 0.03	< 0.03
1,2-Dichlorobenzene	ppbv	0.06	< 0.04	0.06	0.06	< 0.05
1,2-Dichloroethane	ppbv	0.05	< 0.04	< 0.04	< 0.04	< 0.05
1,2-Dichloropropane	ppbv	< 0.04	< 0.04	< 0.04	< 0.04	< 0.05
1,3,5-Trimethylbenzene	ppbv	< 0.04	0.13	0.14	< 0.04	< 0.05
1,3-Butadiene	ppbv	< 0.04	< 0.04	0.05	< 0.04	< 0.05
1,3-Dichlorobenzene	ppbv	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
1,4-Dichlorobenzene	ppbv	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
1,4-Dioxane	ppbv	< 0.7	< 0.7	2.1	< 0.7	< 0.8
1-Butene	ppbv	0.59	0.65	1.69	0.93	1.16
1-Hexene	ppbv	< 0.10	< 0.10	< 0.10	< 0.10	< 0.11

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
1-Pentene	ppbv	0.05	< 0.04	0.12	0.15	< 0.05
2,2,4-Trimethylpentane	ppbv	< 0.03	0.06	< 0.03	< 0.03	< 0.03
2,2-Dimethylbutane	ppbv	0.36	< 0.03	< 0.03	< 0.03	0.1
2,3,4-Trimethylpentane	ppbv	0.11	< 0.03	< 0.03	< 0.03	< 0.03
2,3-Dimethylbutane	ppbv	0.55	< 0.13	< 0.13	< 0.13	0.19
2,3-Dimethylpentane	ppbv	0.37	< 0.03	0.05	0.04	0.14
2,4-Dimethylpentane	ppbv	0.18	< 0.04	< 0.04	< 0.04	< 0.05
2-Methylheptane	ppbv	0.06	< 0.03	< 0.03	< 0.03	< 0.03
2-Methylhexane	ppbv	0.27	< 0.04	0.13	0.04	< 0.05
2-Methylpentane	ppbv	0.92	< 0.03	0.10	< 0.03	< 0.03
3-Methylheptane	ppbv	0.11	< 0.04	< 0.04	< 0.04	< 0.05
3-Methylhexane	ppbv	0.52	< 0.03	0.07	0.04	< 0.03
3-Methylpentane	ppbv	1.38	< 0.03	0.12	0.08	0.17

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
Acetone	ppbv	4.3	7.3	12.3	4.0	3.6
Acrolein	ppbv	0.4	< 0.4	1.4	0.5	< 0.5
Benzene	ppbv	0.50	0.15	0.19	< 0.04	0.27
Benzyl chloride	ppbv	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5
Bromodichloromethane	ppbv	< 0.04	< 0.04	< 0.04	< 0.04	< 0.05
Bromoform	ppbv	0.10	< 0.03	< 0.03	< 0.03	< 0.03
Bromomethane	ppbv	< 0.03	< 0.03	0.10	< 0.03	< 0.03
Carbon disulfide	ppbv	< 0.03	< 0.03	0.03	< 0.03	0.34
Carbon tetrachloride	ppbv	0.19	0.24	0.08	0.08	0.08
Chlorobenzene	ppbv	< 0.03	< 0.03	0.04	< 0.03	< 0.03
Chloroethane	ppbv	< 0.03	< 0.03	0.04	< 0.03	< 0.03
Chloroform	ppbv	0.05	< 0.03	< 0.03	< 0.03	< 0.03
Chloromethane	ppbv	0.92	1.20	0.47	0.67	0.62

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
cis-1,2-Dichloroethene	ppbv	< 0.03	< 0.03	0.18	0.07	0.05
cis-1,3-Dichloropropene	ppbv	< 0.04	< 0.04	< 0.04	< 0.04	< 0.05
cis-2-Butene	ppbv	< 0.04	< 0.04	0.05	< 0.04	0.12
cis-2-Pentene	ppbv	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Cyclohexane	ppbv	2.34	0.08	0.17	0.10	0.34
Cyclopentane	ppbv	0.85	0.43	0.79	0.39	0.2
Dibromochloromethane	ppbv	0.06	< 0.03	< 0.03	< 0.03	< 0.03
Ethanol	ppbv	4.2	2.6	7.2	3.5	2.2
Ethyl acetate	ppbv	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5
Ethylbenzene	ppbv	0.20	< 0.04	0.09	< 0.04	< 0.05
Freon-11	ppbv	0.39	0.41	0.25	0.18	0.19
Freon-113	ppbv	0.19	0.14	0.05	< 0.03	0.03
Freon-114	ppbv	0.07	0.05	< 0.04	< 0.04	< 0.05

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
Freon-12	ppbv	0.79	0.79	0.39	0.19	0.52
Hexachloro-1,3-butadiene	ppbv	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5
Isobutane	ppbv	10.70	0.49	0.50	0.95	0.87
Isopentane	ppbv	5.98	< 0.06	1.32	0.53	0.81
Isoprene	ppbv	< 0.03	< 0.03	1.27	0.16	< 0.03
Isopropyl alcohol	ppbv	< 0.4	< 0.4	1.4	2.0	< 0.5
Isopropylbenzene	ppbv	0.08	< 0.06	0.11	< 0.06	< 0.06
m,p-Xylene	ppbv	0.17	0.34	0.23	0.10	0.21
m-Diethylbenzene	ppbv	0.41	< 0.03	< 0.03	< 0.03	< 0.03
m-Ethyltoluene	ppbv	0.09	0.10	0.10	< 0.04	0.09
Methyl butyl ketone	ppbv	< 0.6	< 0.6	2.30	< 0.6	< 0.6
Methyl ethyl ketone	ppbv	0.70	< 0.4	0.90	< 0.4	< 0.5
Methyl isobutyl ketone	ppbv	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
Methyl methacrylate	ppbv	< 0.12	< 0.11	< 0.12	< 0.12	< 0.12
Methyl tert butyl ether	ppbv	< 0.04	< 0.04	< 0.04	< 0.04	< 0.05
Methylcyclohexane	ppbv	3.52	< 0.03	0.13	0.09	0.40
Methylcyclopentane	ppbv	2.60	< 0.07	0.16	0.10	0.32
Methylene chloride	ppbv	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5
n-Butane	ppbv	6.00	0.29	2.49	1.90	2.48
n-Decane	ppbv	< 0.09	< 0.08	< 0.09	< 0.09	< 0.09
n-Dodecane	ppbv	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5
n-Heptane	ppbv	0.22	< 0.06	< 0.06	< 0.06	0.18
n-Hexane	ppbv	1.01	< 0.04	0.08	0.06	0.22
n-Nonane	ppbv	0.08	< 0.06	< 0.06	< 0.06	< 0.06
n-Octane	ppbv	0.13	0.03	< 0.03	0.03	< 0.03
n-Pentane	ppbv	3.14	0.12	0.57	0.50	0.59

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
n-Propylbenzene	ppbv	< 0.09	< 0.08	0.10	< 0.09	< 0.09
n-Undecane	ppbv	< 0.7	< 0.7	< 0.7	< 0.7	< 0.8
Naphthalene	ppbv	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5
o-Ethyltoluene	ppbv	0.08	0.11	0.12	0.03	< 0.03
o-Xylene	ppbv	0.19	0.19	0.11	< 0.04	0.14
p-Diethylbenzene	ppbv	0.13	< 0.03	0.08	< 0.03	< 0.03
p-Ethyltoluene	ppbv	< 0.06	< 0.06	0.43	< 0.06	< 0.06
Styrene	ppbv	0.15	0.08	0.30	0.08	0.22
Tetrachloroethylene	ppbv	0.09	< 0.03	< 0.03	< 0.03	< 0.03
Tetrahydrofuran	ppbv	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5
Toluene	ppbv	1.75	0.14	0.41	0.21	0.29
trans-1,2-Dichloroethylene	ppbv	1.89	7.63	84.50	34.00	13.60

Station		986-C	986-C	842-B	Reno	986-C
Sampled Date		8-Jan	26-Feb	28-Jun	29-Jun	29-Jun
Sampled Time		11:30	9:10	19:35	18:50	19:55
Triggered Concentration (ppm)		0.30	0.30	0.31	0.32	0.32
Parameter	Unit	Result	Result	Result	Result	Result
trans-1,3-Dichloropropyl-ene	ppbv	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
trans-2-Butene	ppbv	0.39	< 0.04	0.14	0.11	0.24
trans-2-Pentene	ppbv	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Trichloroethylene	ppbv	0.04	< 0.03	0.12	< 0.03	< 0.03
Vinyl acetate	ppbv	0.9	< 0.4	< 0.4	< 0.4	< 0.5
Vinyl chloride	ppbv	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

References

Alberta Energy Regulator (AER). 2014a. Report of Recommendations on Odours and Emissions in the Peace River Area - AER Response. Calgary, Alberta. March 31, 2014. https://www.aer.ca/documents/decisions/2014/2014-ABAER-005.pdf

Alberta Energy Regulator (AER). 2014b. Evaluating Stakeholder Engagement Peace River https://static.aer.ca/prd/documents/about-us/Peace-River/PR_EvaluatingEngagement_20141017.pdf

Alberta Energy Regulator (AER). 2017. Directive 084: Requirements for Hydrocarbon Emission Controls and Gas Conservation in the Peace River Area. February 23, 2017. 28pp. https://static.aer.ca/prd/documents/directives/Directive084.pdf

Alberta Environment and Parks (AEP). 2015. Study of Ambient Hydrocarbon Concentrations in Three Creeks, Alberta. Air and Climate Change Policy Branch. August 2016. ISBN No. 978-1-4601-2379-9. https://open.alberta.ca/dataset/0ef15c67-844b-4914-8b3d-fc90af2de67e/resource/d63c081d-e0f8-46d7-887b-de39a30969bb/download/2015-ambienthydrocarbonthreecreeks-aug2015.pdf

Alberta Environment and Parks (AEP). 2019. Alberta Ambient Air Quality Objectives and Guidelines Summary. Air Policy Branch. July 2017. ISBN: 978-1-4601-3485-6. 6 pp. https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf