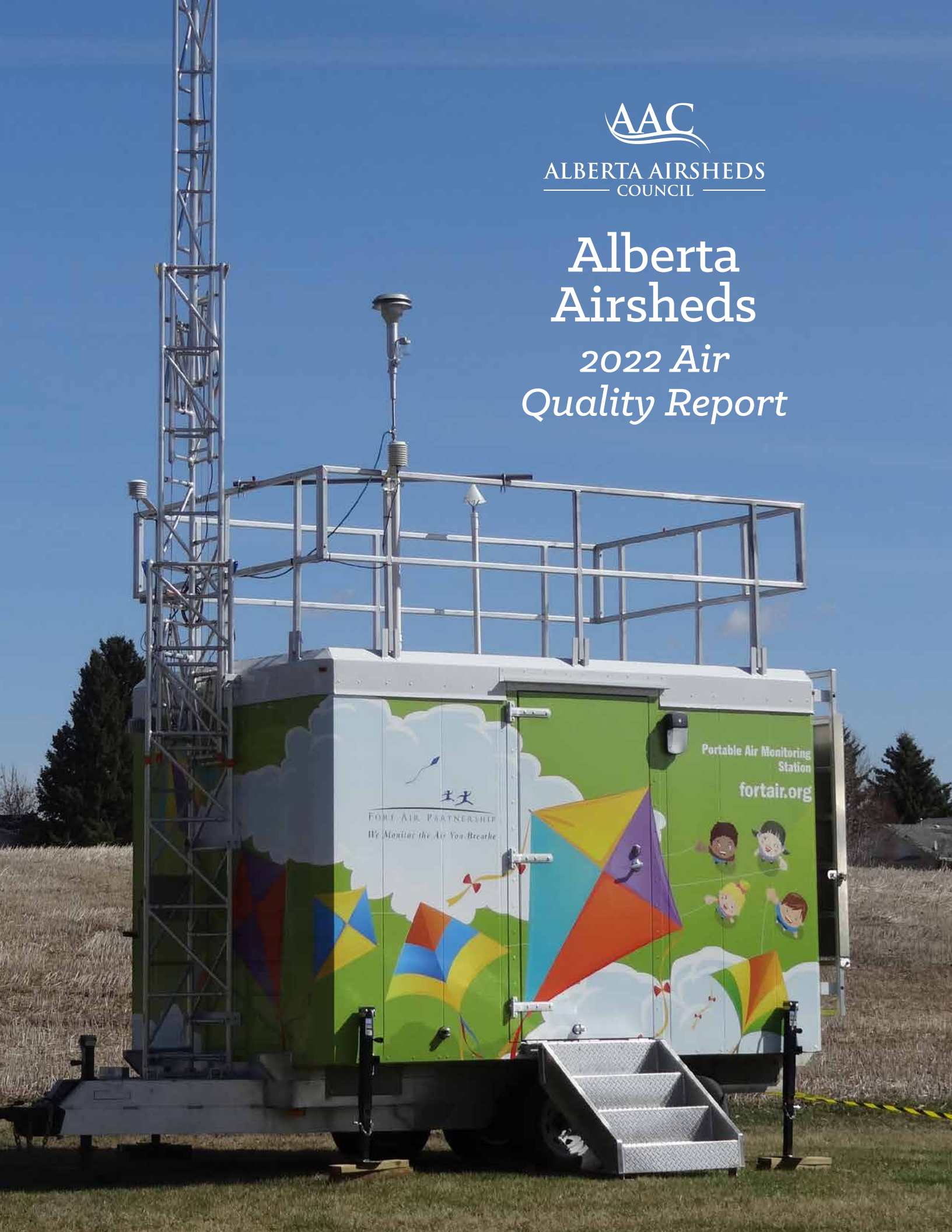# AAC

ALBERTA AIRSHEDS
COUNCIL

Alberta Airsheds

2022 Air Quality Report

Airsheds serve in the public interest by meeting or exceeding the highest air monitoring standards, ensuring unbiased data and analysis is available to all stakeholders and partners, being responsive to community concerns, and raising awareness through community engagement and education.

Contents

Clean Air for Albertans

Air quality has significant impacts on human health, animal health, and the environment.

Alberta's ten Airsheds are regional air quality organizations, responsible for independent ambient air monitoring as well as stakeholder engagement, public awareness, and education.

The Alberta Airsheds Council has prepared this 2022 Alberta Airsheds Air Quality Report to provide a summary of the air quality data collected and verified by Alberta's Airsheds, on behalf of all of Alberta's air quality stakeholders and partners.

Understanding air quality and its impacts helps Albertans make informed choices related to their health.

WHAT IS AN AIRSHED?

Alberta's Airsheds are multi-stakeholder, non-governmental organizations that monitor, evaluate, and report ambient air quality. A critical component of Alberta's Clean Air Strategy, Alberta's Airsheds were formed between 1996 and 2017 and today operate 88 continuous monitoring stations and an array of other sites using passive monitors and micro-sensors, in collaboration with air quality stakeholders and partners.

Refer to the map on page 8 to see the boundaries of the 10 Alberta Airsheds.

WHAT IS AIR QUALITY?

Air quality is determined by air pollutants and meteorology. Primary pollutants come from a variety of anthropogenic and non-anthropogenic sources and can mix with one another forming secondary pollutants.

What We Monitor and Why

Air quality is affected by pollutants, and the interaction between pollutants and meteorological conditions. For example, winds can disperse pollutants, bringing them in, or moving them out of an area, while barometric pressure can cause temperature inversions, trapping pollutants close to ground level. Airshed monitoring measures the air quality of communities, by monitoring common air pollutants, as well as measures the impact of large emission sources, by monitoring other, specific air pollutants close to industrial sources.

AIR QUALITY PARAMETERS MONITORED BY AIRSHEDS

COMMON AIR POLLUTANTS

- nitrogen dioxide (NO_2)
- ozone (O_3)
- particulate matter ($PM_{2.5}$)
- sulphur dioxide (SO_2)

METEOROLOGICAL CONDITIONS

- wind speed and direction
- air temperature
- relative humidity
- precipitation
- barometric pressure

OTHER AIR POLLUTANTS
(MONITORED AT SELECT SITES)

- ammonia (NH_3)
- benzene, toluene, ethylbenzene, xylene (BTEX)
- carbon dioxide (CO_2)
- carbon monoxide (CO)
- particulate matter (PM_{10})
- hydrogen sulphide (H_2S)
- methane/non-methane hydrocarbons (CH_4/NMHC)
- nitric oxide (NO)
- nitrogen oxides (NO_X)
- polycyclic aromatic hydrocarbons (PAH)
- total hydrocarbons (THC)
- total reduced sulfur (TRS)
- total suspended particulate (TSP)
- volatile organic compounds

Air Quality Monitoring Technology

Airsheds utilize a variety of technologies throughout the Province of Alberta to monitor air quality parameters and collect air quality monitoring data:

Continuous Monitoring Stations provide near instantaneous measurements of pollutants; many stations provide data for calculating the Air Quality Health Index (AQHI). Most continuous monitoring stations are located permanently at their respective sites; several Airsheds also employ portable continuous monitoring stations that monitor air quality at temporary sites.

Other monitoring technologies used throughout the province include:

Passive - These monitors do not require power and consist of a series of filters and chemicals that air passes through and reacts with. They detect low sample amounts and provide monthly average measurements of specific air quality parameters.

Intermittent - Time-integrated sampling methods, including canisters, specialized instruments and analyzers are used for measurement of specific air quality parameters over selected time periods of minutes to hours to days.

Sensor - Community-based sensors can be used to provide an indication of real-time air quality at the neighbourhood level. Stationary, handheld, or wearable air quality sensors can be utilized by the public as part of a citizen science or educational program to understand air quality.

Monitoring Guidelines and Standards

To understand and protect air quality, data collected for ambient levels of pollutants is compared to both National and Provincial guidelines and standards established to protect human health.

The National Air Quality Management System (AQMS) includes Canadian Ambient Air Quality Standards (CAAQS) and regional action plan management levels for each national air zone established within the AQMS.

There are 1-hour, 8-hour, 24-hour, 30-day and annual averages for AAAQOs and AAAQGs. In the Province of Alberta, comparisons are made against:

- Alberta Ambient Air Quality Objectives (AAAQO)
- Alberta Ambient Air Quality Guidelines (AAAQG)
- Alberta's Air Monitoring Directive requires a minimum operating time of 75% or more to calculate annual averages for air pollutants in a given location for a given year

More information on the guidelines and standards can be found at **AlbertaAirshedsCouncil.ca**.
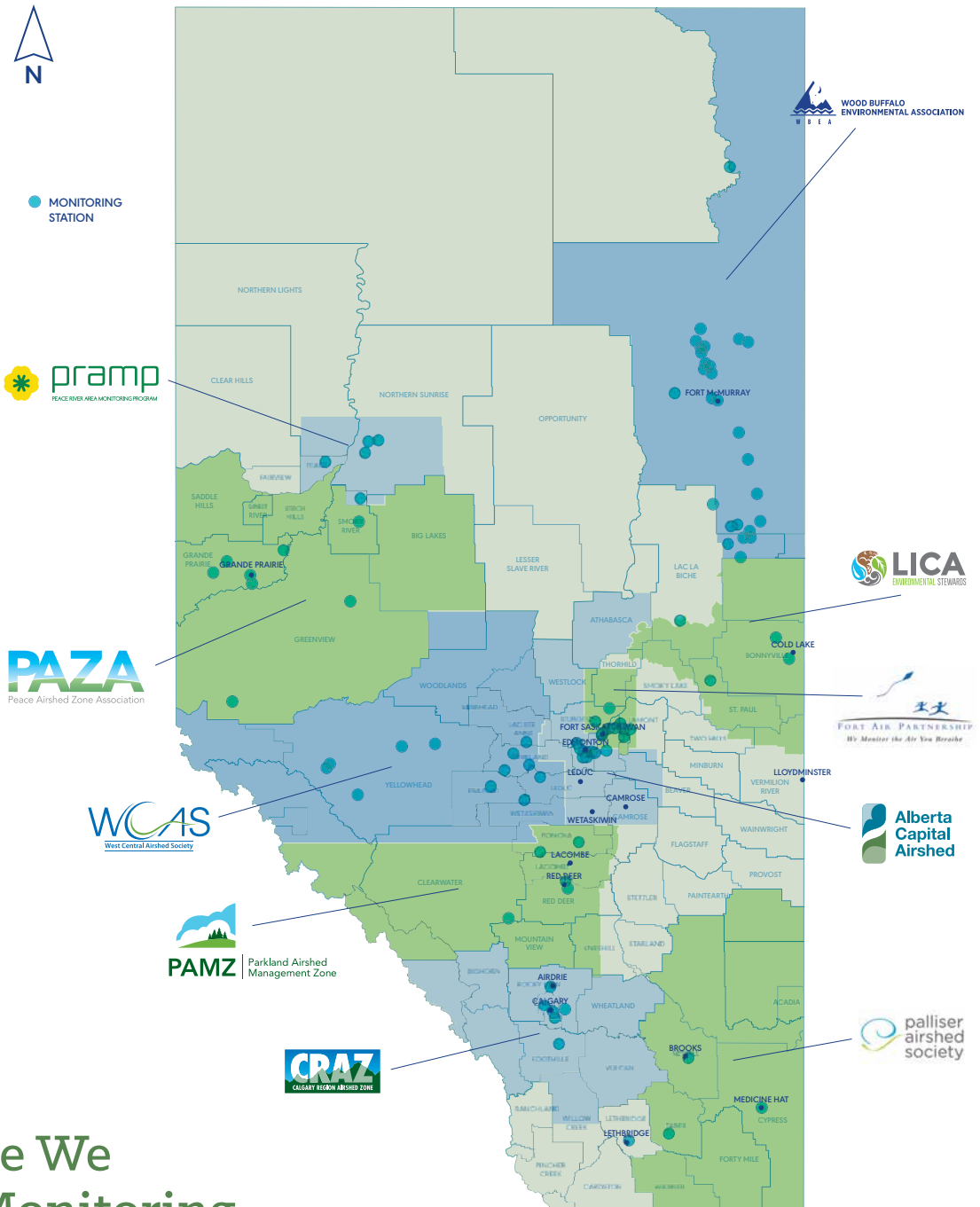
How Air Quality Monitoring Works

1 **Air Pollution Sources**
Pollution is emitted into the air from a variety of human-made and natural sources.

2 **Monitoring**
Technician oversight of ambient air monitoring stations to measure concentrations of pollutants in the air.

3 **Public Information**
The real-time data is streamed on Airshed websites and informs the Air Quality Heath Index, also available through the WeatherCAN mobile app.

4 **Quality Assurance and Validation**
All data and reports are scrutinized to ensure accuracy.

5 **Data Reports**
This data is used for reporting to regulators, stakeholders and partners. It is analyzed for insights and trends in air quality.

Graphic provided courtesy of Alberta Capital Airshed.

N

WOOD BUFFALO
ENVIRONMENTAL ASSOCIATION

● MONITORING
STATION

pramp
PEACE RIVER AREA MONITORING PROGRAM

PAZA
Peace Airshed Zone Association

LICA
ENVIRONMENTAL STEWARDS

FORT AIR PARTNERSHIP
We Monitor the Air You Breathe

Alberta
Capital
Airshed

WCAS
West Central Airshed Society

PAMZ | Parkland Airshed
Management Zone

CRAZ
CALGARY REGION AIRSHED ZONE

palliser
airshed
society

Where We Are Monitoring - Provincial Network Map

Within the 10 Alberta Airsheds there are 88 continuous monitoring stations and hundreds of other monitoring locations using various technologies to measure air quality parameters. The AAC Monitoring Network Map shows the geographical boundaries of the Airsheds, and the network of continuous monitoring stations located across the province.

2022 Air Quality Monitoring Profiles

HOW TO REVIEW 2022 RESULTS

The sources of the common air pollutants (NO_2, SO_2, $PM_{2.5}$ and O_3) are provided using pie charts, and the data from continuous monitoring stations are presented using graphs displaying **annual averages** (solid coloured bar) and 95th percentile markers (black line). The black lines, also known as "whiskers", show readings on the high end of the data collected at the monitoring stations, which helps to highlight the 95th percentile data. The highest five percent has not been reported here as it may contain "outliers" (observations that are distant from the rest of the data that might be caused by extreme events from upsets to natural conditions such as wildfires).

Where shown, red lines on the graphs indicate the relevant threshold (acceptable provincial or levels) for the guideline or standard for the air pollutant.

This report highlights 2022 annual data compiled from 1-hour averages to provide context for the measured concentrations, which is presented as annual averages for each pollutant.
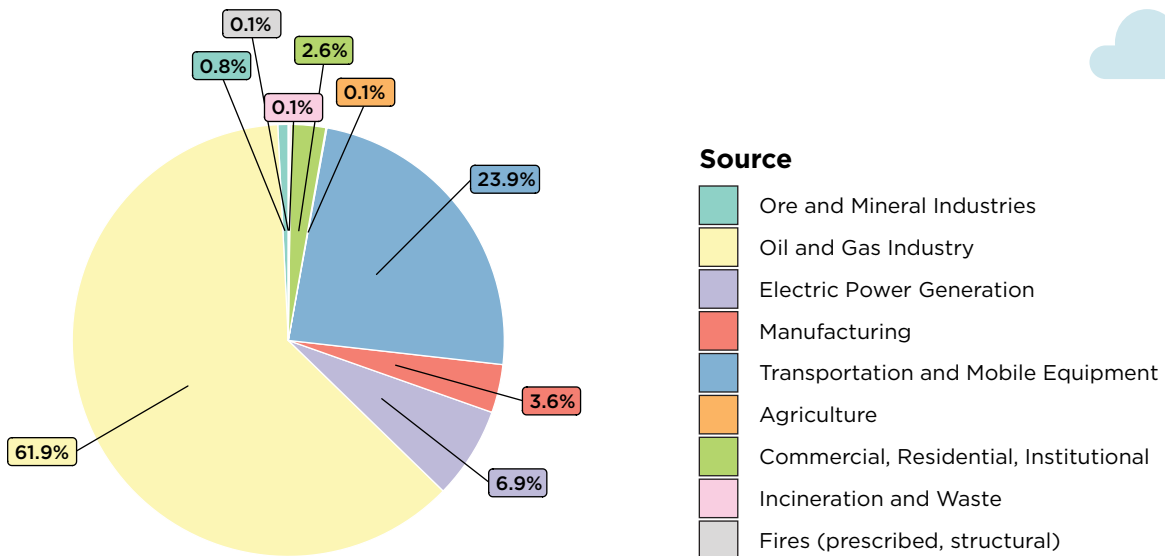
NO$_2$

NITROGEN DIOXIDE (NO$_2$)

IMPACT TO HUMAN HEALTH

Nitrogen dioxide is a reddish-brown gas with a pungent irritating odour. It has been linked to respiratory disease and contributes to acid rain. NO$_2$ plays a major role in atmospheric photochemical reactions and ground-level ozone formation and destruction. Short-term exposure to NO$_2$ can cause airway inflammation. Individuals with pre-existing conditions such as asthma, chronic obstructive pulmonary disorder (COPD) or chronic bronchitis can be more sensitive to exposure.[1]

SOURCES OF NO$_2$

Any combustion source will emit NO$_2$, including home and commercial heating and power generation. Wildfires, lightning and biological decay are natural sources of nitrogen emissions.

From the Alberta Air Pollution Emissions Inventory (2020), oil and gas activities and transportation account for approximately 85% of the nitrogen emissions in Alberta.

Source

- Ore and Mineral Industries
- Oil and Gas Industry
- Electric Power Generation
- Manufacturing
- Transportation and Mobile Equipment
- Agriculture
- Commercial, Residential, Institutional
- Incineration and Waste
- Fires (prescribed, structural)

Source: **Canada's Air Pollutant Emissions Inventory - Alberta**

Note: 2020 data set is most current available at time of production of this report; historical trends are consistent over time for these pollutant sources.

NO$_2$

2022 ALBERTA NO$_2$ DATA

In 2022, 579,535 hours of NO$_2$ data were collected from 80 stations. Of these 80 stations, 64 stations collected NO$_2$ data at least 75% of the total annual operating time.

Results from these 64 stations show an average annual range of NO$_2$ concentrations in 2022 from 1.0 to 13.2 ppb, all below the AAAQO annual limit (>24 ppb). There were no recorded exceedances of the 1-hour AAAQO (>159 ppb) for all the NO$_2$ monitoring conducted in 2022, with the highest reading recorded at 124.8 ppb.

Average NO$_2$ readings from the five monitoring stations reporting the highest annual averages from 2020 - 2022 (all urban stations) have shown a consistent annual average of 12.8, 12.2, and 12.6 ppb, respectively. The 95th percentiles decreased slightly from 40.0 ppb to 39.0 ppb.

2022 NO$_2$ Concentrations in Alberta

Annual Nitrogen Dioxide + 95th percentile (in ppb)
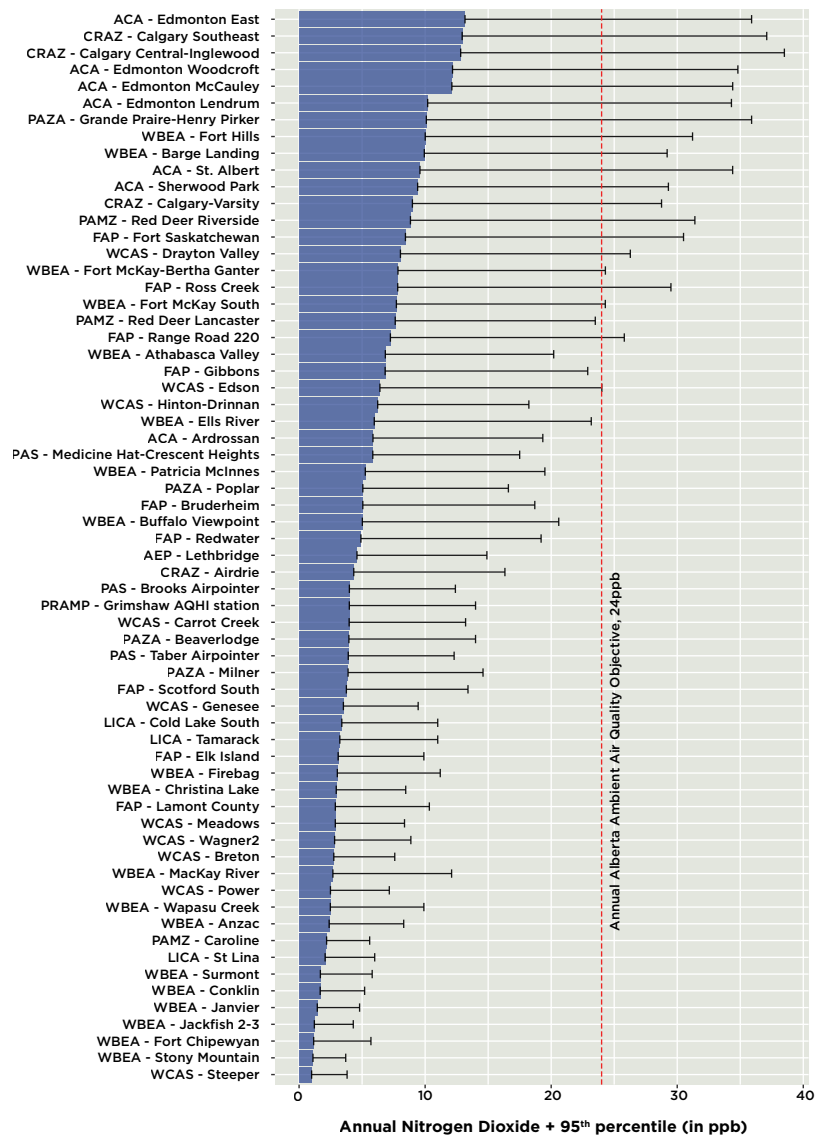
O₃

OZONE (O₃)

IMPACT TO HUMAN HEALTH

People most at risk from exposure to higher levels of O₃ include those with asthma, children, older adults, and those who are active outdoors, especially outdoor workers. Children are at greatest risk because their lungs are still developing.[4]

High levels of O₃ can cause the muscles in the airways to constrict, trapping air inside the tiny air sacks within the lungs (alveoli). This can lead to wheezing, shortness of breath, and can be serious in people with lung diseases such as asthma.

SOURCES OF O₃

Ozone in the upper atmosphere protects life on earth by filtering the sun's ultraviolet rays; however, O₃ on the ground is a pollutant and a component of smog. During hot weather, emissions of chemicals from automobiles, industry, and other non-natural sources can produce high O₃ levels through chemical reactions in the atmosphere. Non-natural sources can produce high O₃ levels through chemical reactions in the atmosphere. As a secondary pollutant which forms from these reactions, a source emission pie chart is not available because there are no direct emission sources for O₃.

Ozone can be transported long distances and can be responsible for large regional air pollution episodes.

O_3

2022 ALBERTA O_3 DATA

In 2022 there were 438,148 hours of O_3 data collected from 59 stations. Of these 59 stations, 49 stations collected O_3 data at least 75% of the total annual operating time.

Results from these stations show the range of annual average O_3 concentrations in 2022 from 18.5 ppb to 35.8 ppb. There were six readings above the 1-hour maximum AAAQO (>76 ppb), with the highest reading recorded at 82.6 ppb. In comparison, there were a total of 58, 2, and 66 readings above 76 ppb in 2019, 2020, and 2021 respectively.

2022 O_3 Concentrations in Alberta

Annual Ozone + 95th percentile (in ppb)
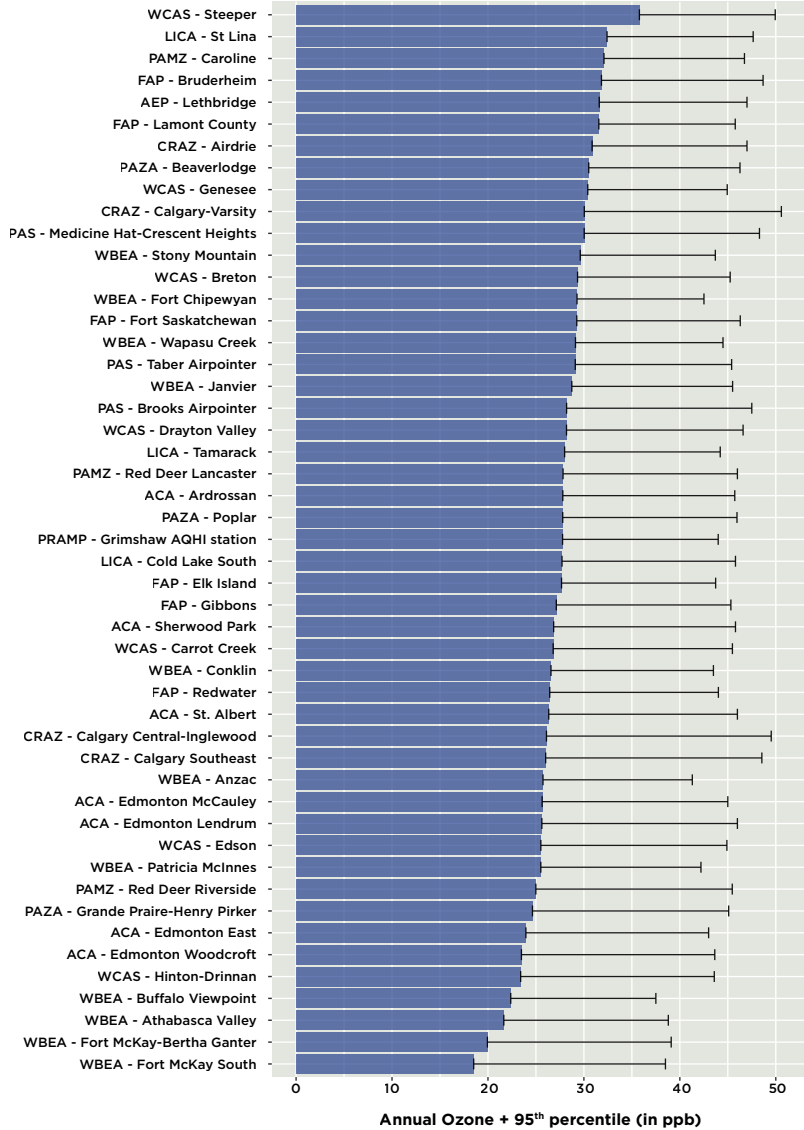
Note: There is no annual AAAQO for O_3.
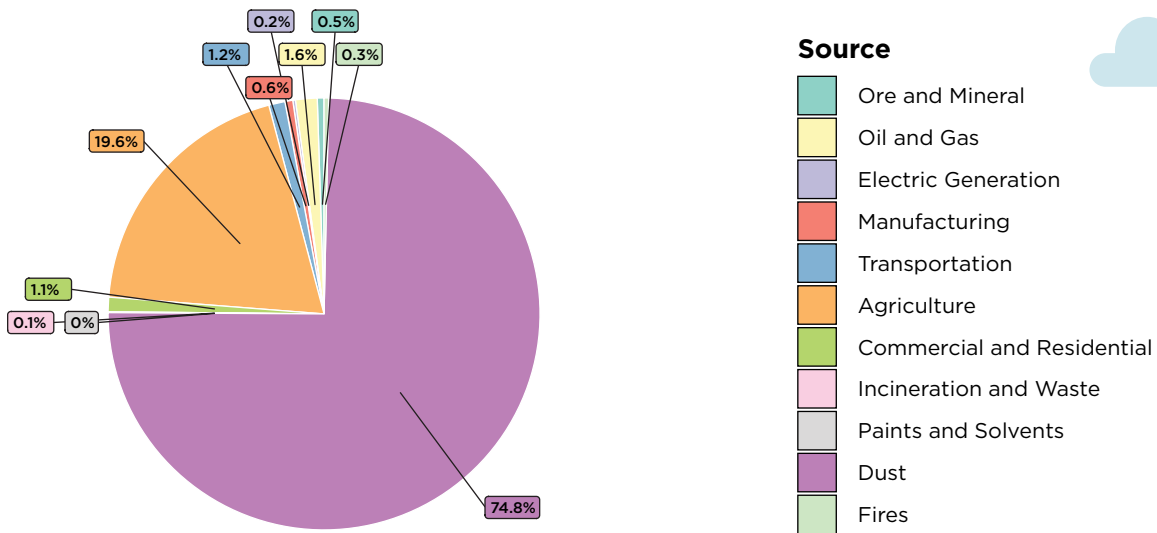
PARTICULATE MATTER (PM$_{2.5}$)

IMPACT TO HUMAN HEALTH

Particulate matter (PM$_{2.5}$) is less than 2.5 micrometres in diameter. In comparison, a human hair is about 70 micrometres in diameter. These fine particles are small enough to get into the lungs and can be a human health concern. PM$_{2.5}$ has been linked to many health issues; long-term exposure has been associated with increased lung and heart problems and even premature death.[2]

SOURCES OF PM$_{2.5}$

Particles which are less than 2.5 micrometers in diameter (PM$_{2.5}$) can reduce visibility and contribute to acidification of soils. PM$_{2.5}$ particles are formed from gases released to the atmosphere by combustion processes such as from motor vehicles, power plants, gas processing plants, compressor stations, household heating, and wildfires. Particulate matter can also be comprised of biological material such as mould, bacteria, and pollen fragments.

From the Alberta Air Pollution Emissions Inventory (2020), dust (from roads, construction, mine tailings) and agriculture account for approximately 94% of the particulate matter emissions in Alberta.

Pie chart data:
- 0.2%
- 0.5%
- 1.2%
- 1.6%
- 0.3%
- 0.6%
- 19.6%
- 1.1%
- 0.1%
- 0%
- 74.8%

Source
- Ore and Mineral
- Oil and Gas
- Electric Generation
- Manufacturing
- Transportation
- Agriculture
- Commercial and Residential
- Incineration and Waste
- Paints and Solvents
- Dust
- Fires

Source: **Canada's Air Pollutant Emissions Inventory - Alberta**

Note: 2020 data set is most current available at time of production of this report; historical trends are consistent over time for these pollutant sources.
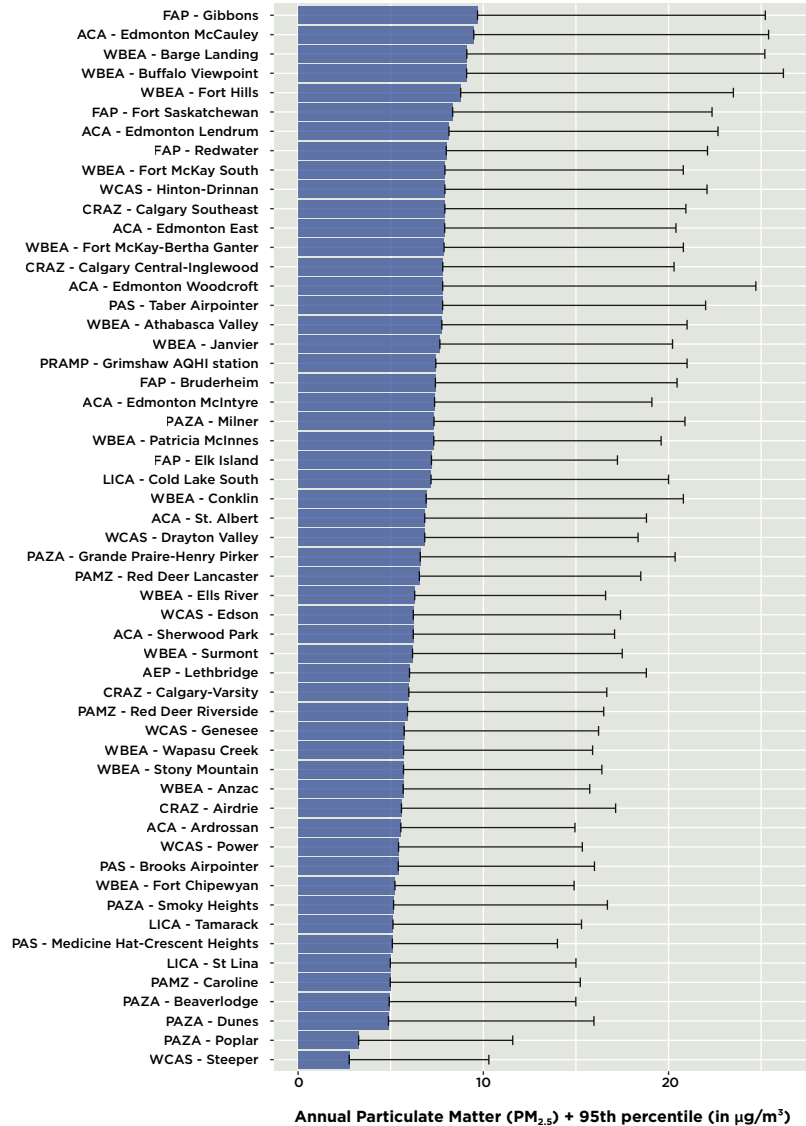
PM$_{2.5}$

2022 ALBERTA PM$_{2.5}$ DATA

In 2022 there were 531,651 hours of PM$_{2.5}$ data collected from 66 stations. Of the 66 stations, 55 stations collected PM$_{2.5}$ data at least 75% of the total annual operating time.

Results from these stations show an annual average range of PM$_{2.5}$ levels of 2.8 to 9.7 µg/m^3 in 2022. Based on these monitoring results, there was a total of 540 readings above the 1-hour AAAQO (>80 µg/m^3), with the maximum reading recorded at 1151 µg/m^3. There were 269 readings above the 24-hour AAAQO (>29 µg/m^3), with the maximum recorded reading at 199 µg/m^3.

Over the past four years (2019-2022) there has been a fluctuation of elevated PM$_{2.5}$ readings, often correlating to wildfire events throughout the province and when smoke is blown in from other regions.

2022 PM$_{2.5}$ Concentrations in Alberta

Annual Particulate Matter (PM$_{2.5}$) + 95th percentile (in µg/m^3)

Note: There is no annual AAAQO for PM$_{2.5}$
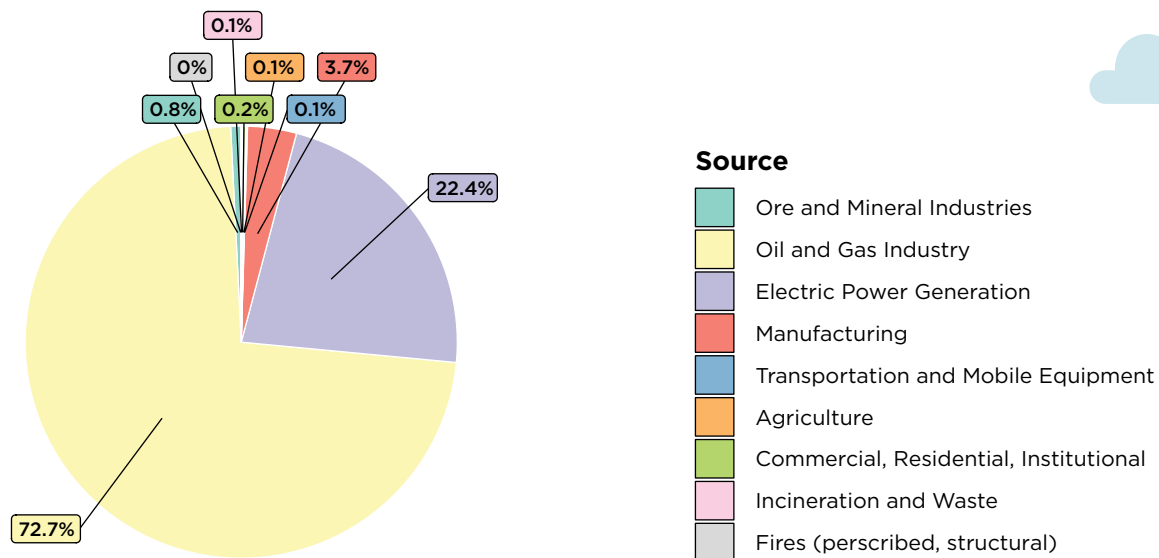
SO$_2$

SULPHUR DIOXIDE (SO$_2$)

IMPACT TO HUMAN HEALTH

Brief exposure to high concentrations of sulphur dioxide and its products can produce human health effects, irritating the upper respiratory tract and aggravating existing cardiac and respiratory disease. Long-term exposure may increase the risk of developing chronic respiratory disease. People with asthma may have increased symptoms such as chest tightness and difficulty breathing.[3]

SOURCES OF SO$_2$

Sulphur dioxide in Alberta is generated predominately through human activities, including the processing and combustion of fossil fuels containing sulphur. It is a colourless gas with a pungent odour (like a lit match) and can be detected by taste and odour at concentrations as low as 300 ppb. Sulphur dioxide reacts in the atmosphere to form sulphuric acid and acidic aerosols, which contribute to acid rain. Sulphur dioxide combines with other atmospheric gases to produce fine particles, which may reduce visibility.

From the Alberta Air Pollution Emissions Inventory (2020), oil and gas activities and electric power generation account for approximately 95% of the sulphur emissions in Alberta.

Pie chart values: 0.1%, 0%, 0.1%, 3.7%, 0.8%, 0.2%, 0.1%, 22.4%, 72.7%

Source
- Ore and Mineral Industries
- Oil and Gas Industry
- Electric Power Generation
- Manufacturing
- Transportation and Mobile Equipment
- Agriculture
- Commercial, Residential, Institutional
- Incineration and Waste
- Fires (perscribed, structural)

Source: **Canada's Air Pollutant Emissions Inventory - Alberta**

Note: 2020 data set is most current available at time of production of this report; historical trends are consistent over time for these pollutant sources.

SO$_2$

2022 ALBERTA SO$_2$ DATA

In 2022 there were 624,766 hours of SO$_2$ data collected from 83 stations. Of the 83 stations, 68 stations collected SO$_2$ data at least 75% of the total annual operating time.

2022 results from these stations show the range of SO$_2$ concentrations from <0.5 to 2.1 ppb, all below the annual AAAQO average for SO$_2$ (>8 ppb). There were no readings above the 30-day SO$_2$ AAAQO (>11 ppb), with a maximum monthly average of 3.6 ppb. There was one reading above the 1-hour AAAQO (>172 ppb), with the highest reading recorded at 237 ppb. There was one reading above the 24-hour SO$_2$ AAAQO (>48 ppb), with a maximum daily average of 49 ppb.

In comparing data over the last four years (2019-2022), the maximum annual SO$_2$ reading has been less than 3 ppb, with the 95th percentiles being less than 15 ppb for all four years.

2022 SO$_2$ Concentrations in Alberta

Annual Sulphur Dioxide + 95th percentile (in ppb)
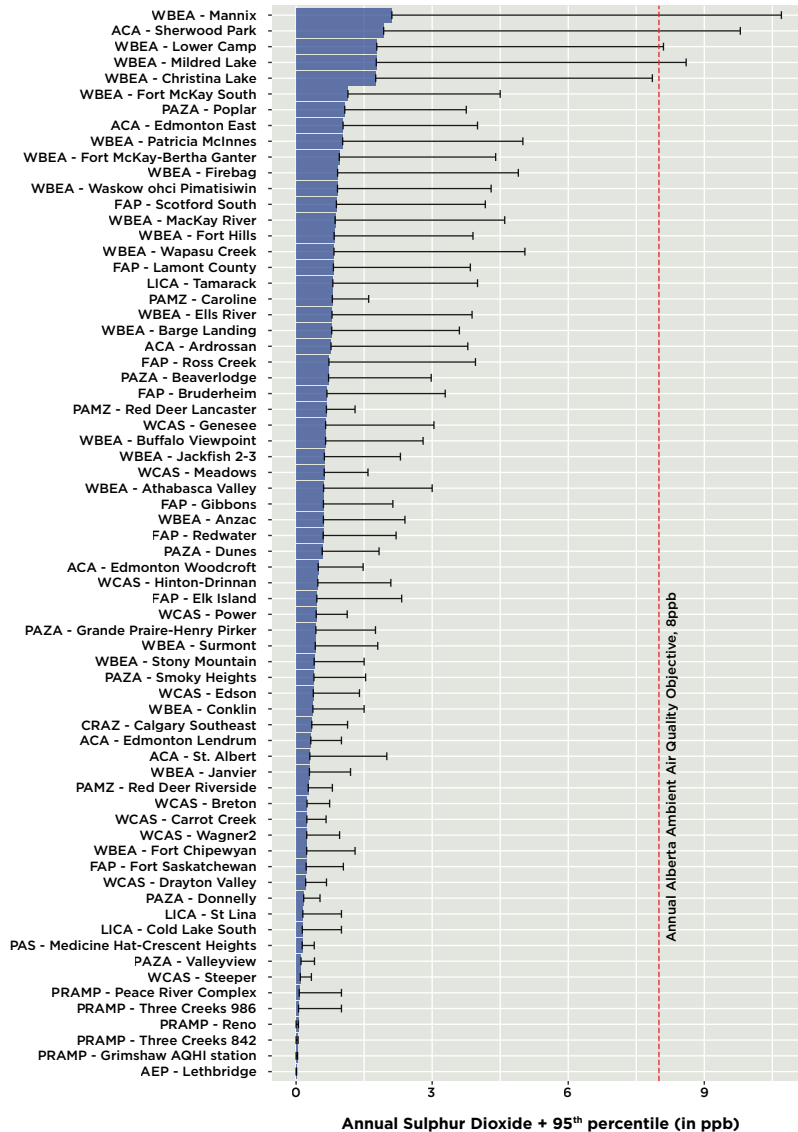
Air Quality Health Index (AQHI)

The AQHI represents the relative risk of a mixture of common air pollutants which are known to harm human health. Three pollutants (O_3, $PM_{2.5}$ and NO_2) were chosen as indicators of the overall outdoor air mixture and can pose a risk to human health even at low levels of exposure, especially among those with pre-existing health problems.

Data collected by Alberta's Airsheds is used to calculate the AQHI, a real-time air quality rating which is reported in over 35 Alberta communities.

The AQHI rating indicates the level of relative health risk associated with local air quality. The higher the number, the greater the health risk and the need to take precautions. Occasionally, during extreme pollution events such as a wildfire, AQHI levels may reach 10 or higher, indicating a very high health risk.

AQHIs can be found on your local Airshed's website, and on the WeatherCAN app for mobile devices.

| 1	2	3	4	5	6	7	8	9	10	+
Low Risk			Moderate Risk			High Risk				Very High Risk
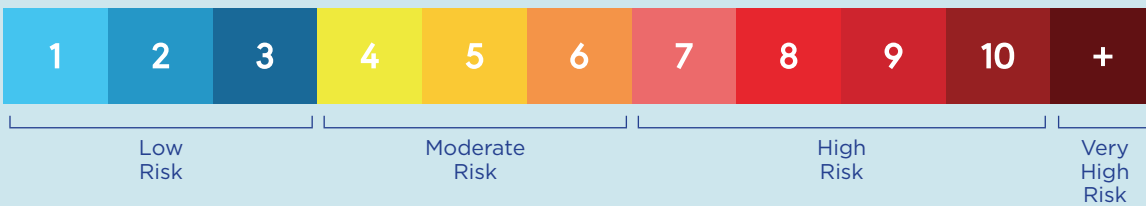
Health Canada estimates that above-background air pollution, including air pollution from human sources in North America, contributes to 15,300 premature deaths per year in Canada.[5]

2022 AQHI RATINGS IN ALBERTA

In Alberta, all monitoring stations saw AQHI ratings in the low risk range for 88% to 99.5% of the 2022 year, with a provincial average AQHI reading of 2.2 (based on 334,017 hours of data). From 2019 to 2022, the average AQHI for the province has been at 2.2 or lower.
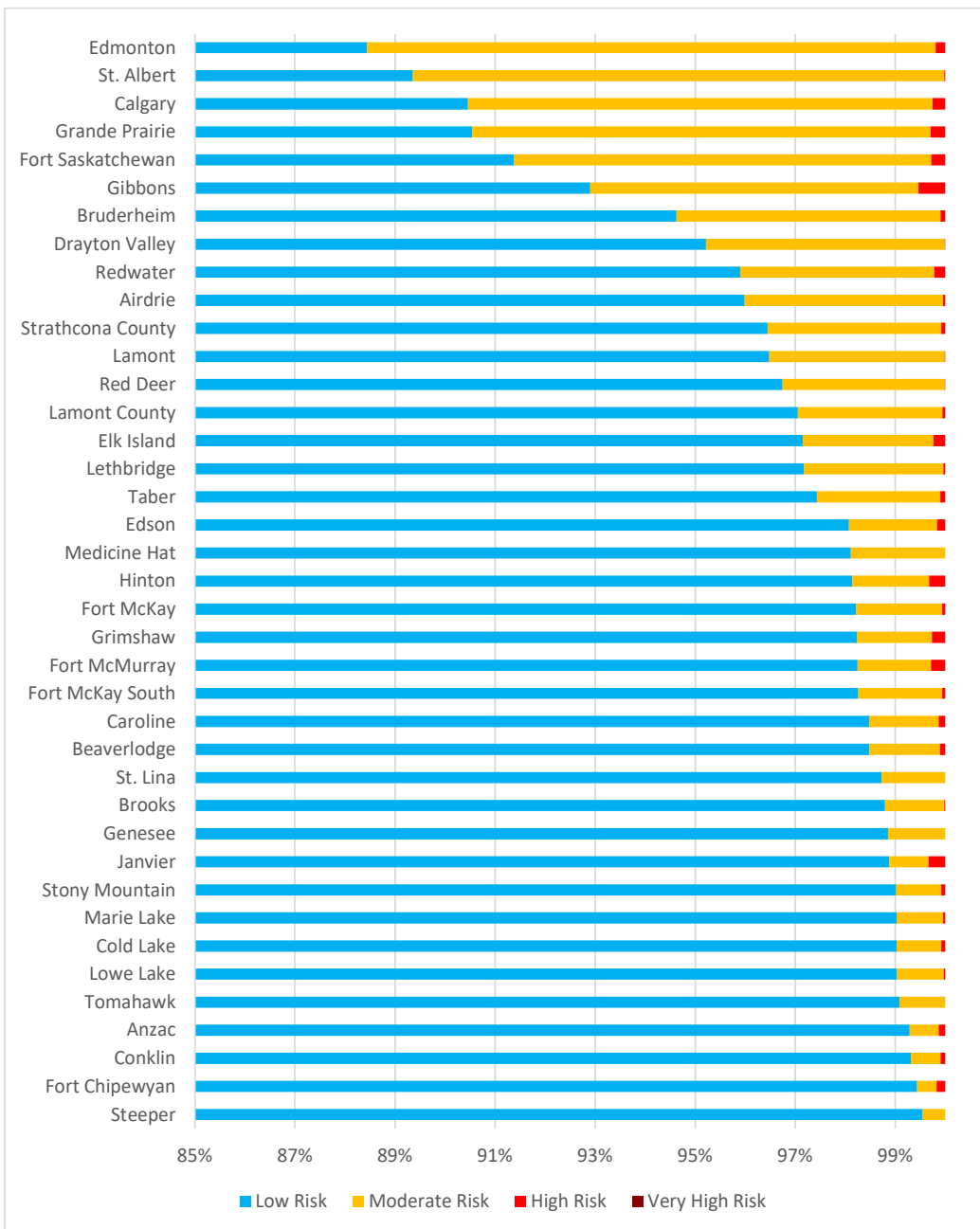
Exposure to air pollution may result in a variety of health effects ranging from slight discomfort to increased hospital admissions and emergency room visits, to increased risk of premature death. In particular, individuals with respiratory and cardiovascular conditions, children and the elderly may notice symptoms due to poor air quality conditions. Individuals should monitor their symptoms and take precautions recommended by their physicians.

Download the free WeatherCan app on your mobile device

Working Together for Clean Air

ALBERTA'S AIRSHEDS ARE VITAL CONTRIBUTORS TO MANAGING AIR QUALITY.

Alberta Airsheds Council (AAC) is a partnership of Alberta's Airsheds and provides leadership in support of healthy air quality for Albertans and the environment.

The efforts of each of Alberta's Airsheds ensures valuable community oversight and involvement in our collective goal of clean air.

Resources, including links to each of Alberta's Airsheds, can be found at: **AlbertaAirshedsCouncil.ca.**

For information on local air quality monitoring and programs in your community, contact your regional Airshed.

AlbertaAirshedsCouncil.ca | @albertaairsheds

References

[1] *Human Health Risk Assessment for Ambient Nitrogen Dioxide* (Government of Canada). https://www.canada.ca/en/health-canada/services/publications/healthy-living/human-health-risk-assessment-ambient-nitrogen-dioxide.html

[2] *Air Pollution: What is Particulate Matter* (Health Canada). https://www.canada.ca/en/health-canada/services/air-quality/indoor-air-contaminants/fine-particulate-matter.html#4

[3] *Human Health Risk Assessment for Sulphur Dioxide* (Government of Canada). https://www.canada.ca/en/health-canada/services/publications/healthy-living/human-health-risk-assessment-sulphur-dioxide-executive-summary.html

[4] *Health Effects of Ozone Pollution (United States Environmental Protection* Agency). https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution

[5] *Health Impacts of Air Pollution in Canada - 2021* (Government of Canada). https://www.canada.ca/en/health-canada/services/publications/healthy-living/2021-health-effects-indoor-air-pollution.html

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