WOOD BUFFALO
ENVIRONMENTAL ASSOCIATION
W B E A

# Wood Buffalo Environmental Association

2021 Annual Report

# Contents

Cliff Dimm

# Message from the President

**“Business as Usual”**

COVID-19 continued to influence all aspects of our work this past year. While ensuring technical and regulatory requirements were maintained to our high standards, WBEA leadership and staff faced the work and personal challenges presented by the pandemic head-on.

In 2021, “business as usual” was redefined as “usual business unusually”. The impacts of the pandemic were felt across the RMWB and Alberta regardless of work or location. To that end, myself, and all members of the Governance Committee (GC) worked closely with the WBEA’s Executive Director, Sanjay Prasad, to ensure effective adaptation to changing protocols, safety standards, and the needs of the WBEA staff.

Through it all, the resilience and resolve of our stakeholders and community partners as well as the WBEA team was demonstrated daily. The GC is heartened and grateful for the excellent work from each member of the team, whose efforts came together to drive exciting momentum for the WBEA.

Being nimble and creative in finding new, out-of-the-box ways to get work done has been a challenge to all, and I’d like to extend my personal thanks to Sanjay and his team for delivering on the WBEA’s scopes and work plans, as well as development of our dynamic new five-year strategic plan.

The GC also supported Sanjay’s request to re-introduce an Operations Manager role to the WBEA’s organizational structure. We were able to look internally to find the best, most qualified candidate for the job, which serves as a testament to the calibre and competency of the entire WBEA team.

Our organization continues to be recognized as a leader and pacesetter in the work that we do. This will only become more outwardly apparent as COVID-19 restrictions continue to ease, and “business as usual” resumes in the next year and beyond.

Cliff Dimm, WBEA President

Sanjay Prasad

## Message from the

# Executive Director

**“Optimism”**

As the COVID-19 pandemic marked a second full year of operational and business disruptions, there was a notable undercurrent of optimism felt by the WBEA in 2021 about the future.

In the face of continued uncertainty, the WBEA benefited from strategic, tactical, operational, and contingency plans developed following the 2016 Horse River wildfire and in the early days of the pandemic.

We recognize there truly is no “one-size-fits-all” approach to the work we do. From top to bottom it is understood that in order to thrive, the WBEA must hear from multiple voices as part of a large, meaningful, and ongoing conversation.

As we refine and improve upon our ambient air, deposition, and community odour monitoring initiatives, the needs of our stakeholders remain paramount. To that end, three strategic priorities were identified for 2021 and beyond; continued accountability, improved transparency, and a concerted effort to protect our strong reputation.

The WBEA continues to be defined by its pace-setting adaptability. The ramping up of work scope this past year meant bolstering our organizational structure with the creation of new procurement, communications, and operational positions, as well as the inclusion of additional field and laboratory technicians into the fold. Our growth affords us the resources to effectively manage project plans and deliverables, while communicating these successes with transparency. In this way, the WBEA demonstrates its core values to stakeholders, community partners, and the public.

It is our intention to carry the optimism felt this past year into the future. Our path forward will embrace a mandate of delivering world-class environmental monitoring programs, a commitment to purposeful collaboration, credibility, and social acceptance, and enhanced financial stability and program security. I’m pleased to say that, because of the hard work and commitment of each WBEA team member, these objectives are very much within our reach.

Our 2021 Annual Report is a tangible example of the cohesion and support enjoyed by the WBEA from its General Members Board, Governance Committee, Technical Committees, and staff. Through the uncertainty of the past year, the dutiful participation of every individual associated with the WBEA has been uniquely felt, and deeply appreciated.

On behalf of myself and my team, thank you for your engagement with the Wood Buffalo Environmental Association.

Sanjay Prasad, WBEA Executive Director

# The WBEA Today

## Our Focus

From our earliest days the WBEA's operational objective has focused on a simple vision; the monitoring, collection, and dissemination of high quality, transparent ambient air data as broadly as possible.

It is our intention that the information found within our 2021 Annual Report will empower our stakeholders and partners—including industry and government, Indigenious communities, and the public at large—to affect positive change, make informed decisions, and ensure a safe and healthy environment today, and in the years to come.

The WBEA believes in empowering user groups to make informed decisions through the provision of transparent, accurate, and timely data. This report aims to provide our partners, and stakeholders with the complete picture of our work, our values and our continued mission and priorities for the region we serve.

# Who we are

Scientifically independent and consensus-driven, the WBEA relies on careful implementation of the best available scientific practices and technology. This commitment—along with the respectful application of Traditional Knowledge and teaching—provides regional stakeholders, community partners, and the public with the most transparent, accurate, and timely ambient air data possible.

## Vision

People are empowered to make informed decisions to ensure a safe and healthy environment.

## Mission

The Wood Buffalo Environmental Association is a multi-stakeholder, consensus-based organization that leads in state-of-the-art environmental montioring to enable informed decision-making.

## Core Values

Our values are as diverse as the region we serve and include:

- We are scientifically independent.
- We recognize, respect, and use Traditional Knowledge.
- We are transparent and timely in communicating accurate and accessible data.
- We are dedicated to using best available practices and technology.
- We support diverse stakeholder participation to achieve consensus-based decisions.

## Your independent air quality reporter.

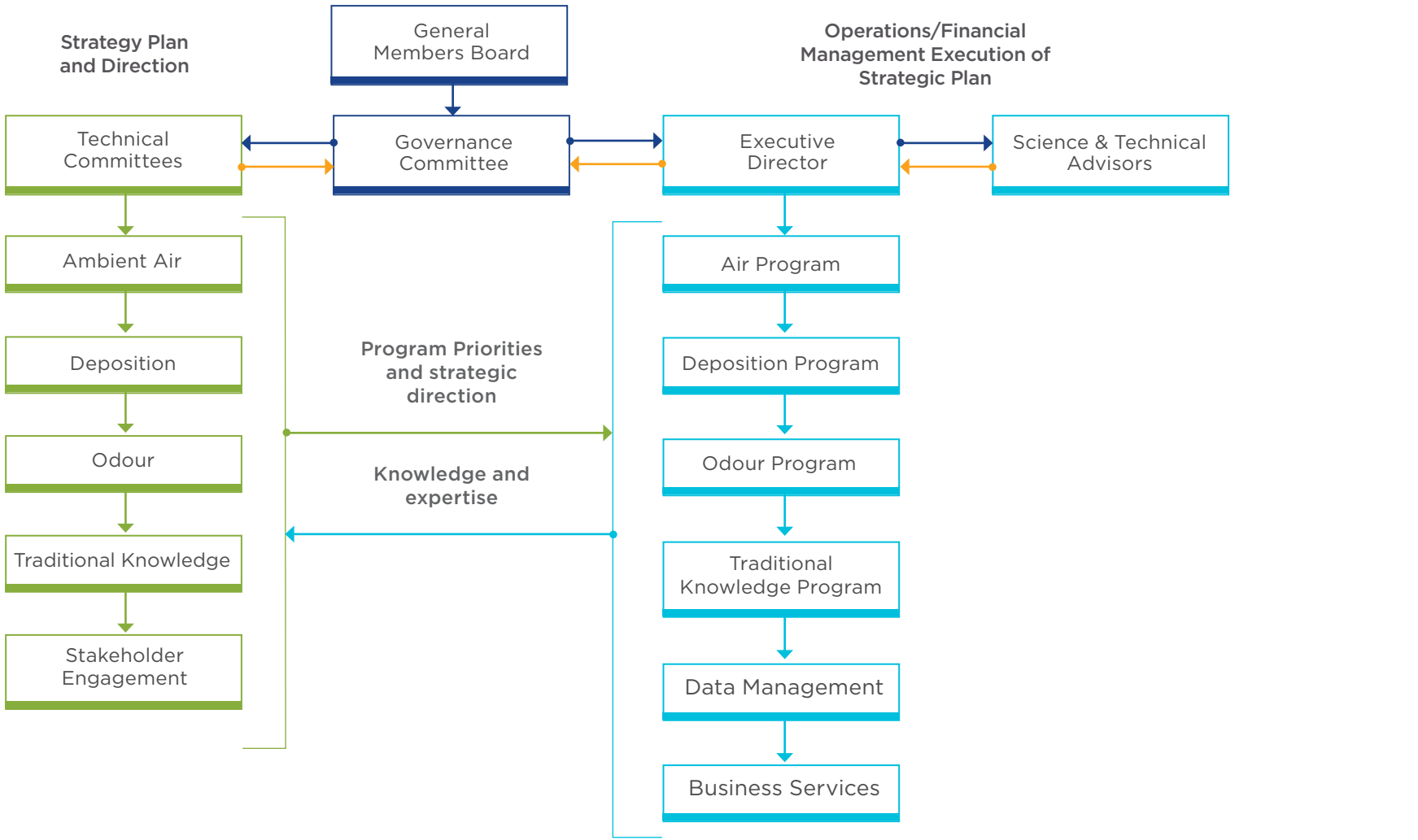
The Wood Buffalo Environmental Association (WBEA) is your independent air quality reporter. Now in our 25th year, the WBEA continues to serve the Regional Municipality of Wood Buffalo (RMWB) with a complete picture of regional air quality

**24** hours/day

**365** days/year

# Organizational Structure

The General Members Board and Governance Committee provide strategic direction and oversight for the organization. The Technical Committees determine the strategic plans and direction for each of the WBEA's monitoring programs. The Executive Director provides operational direction for the WBEA staff, engaging science and technical advisors as required, to ensure stewardship to the overarching direction set by the General Members Board and Governance Committee.



# Partners in Air Quality Reporting

## Alberta Environment & Parks (AEP)

Alberta Environment and Parks (AEP) is responsible for monitoring, evaluating, and reporting on key air, water, land, and biodiversity indicators. The mandate within the ministry is to provide open and transparent access to scientific data and information on the condition of Alberta's environment, including specific indicators as well as cumulative effects, both provincially and in specific locations. The Oil Sands Monitoring (OSM) Program is a joint federal and provincial initiative between the Government of Alberta and Environment and Climate Change Canada. The mandate of the program is to implement an ambient environmental monitoring program in the oil sands region that integrates air, water, land, and biodiversity. The OSM Program strives to improve characterization of the state of the environment and enhance understanding of the cumulative effects of oil sands development.

The WBEA has entered into a contractual agreement with AEP. As a working partner, the WBEA is one of the agencies helping to ensure that the OSM Program is delivered with the best expertise possible.

For more information, visit **www.alberta.ca/environmental-monitoring.aspx.**

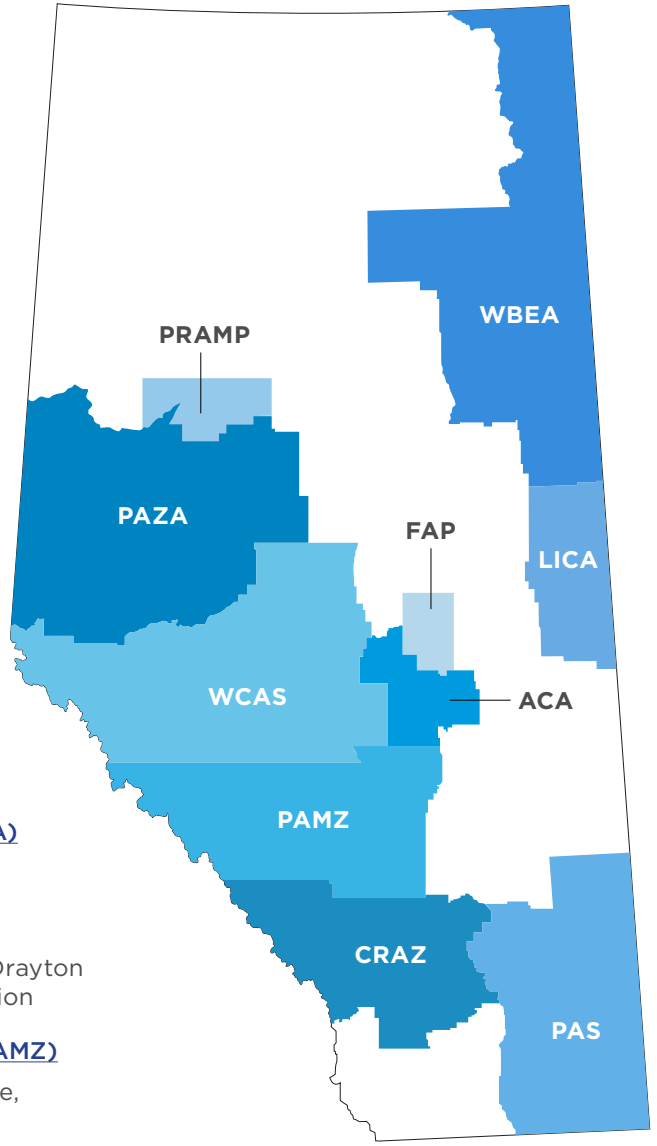
# WBEA within Alberta Airsheds

## Alberta's Airsheds Council

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

Initiated in 2006, the AAC includes membership from all ten Airsheds in Alberta and was formed to represent the collective interests of this collaborative group.

The AAC provides a forum for Airsheds to work and learn together, to continue to advance effective and efficient air monitoring, reporting and outreach, and to address regional matters.




**Wood Buffalo Environmental Association (WBEA)**

Fort McMurray and the Wood Buffalo region

**Lakeland Industry and Community Association (LICA)**

Bonnyville, Cold Lake, St. Paul and region

**Fort Air Partnership (FAP)**

Fort Saskatchewan region

**Alberta Capital Airshed (ACA)**

Edmonton region

**Palliser Airshed Society (PAS)**

Medicine Hat, Redcliffe and surrounding region

**Peace River Area Monitoring Program Committee (PRAMP)**

Peace River region

**Peace Airshed Zone Associations (PAZA)**

Grande Prairie and region

**West Central Airshed Society (WCAS)**

Jasper, Hinton, Edson, Lake Wabamun, Drayton Valley, Pigeon Lake and surrounding region

**Parkland Airshed Management Zone (PAMZ)**

Red Deer, Rocky Mountain House, Sundre, Banff and surrounding region

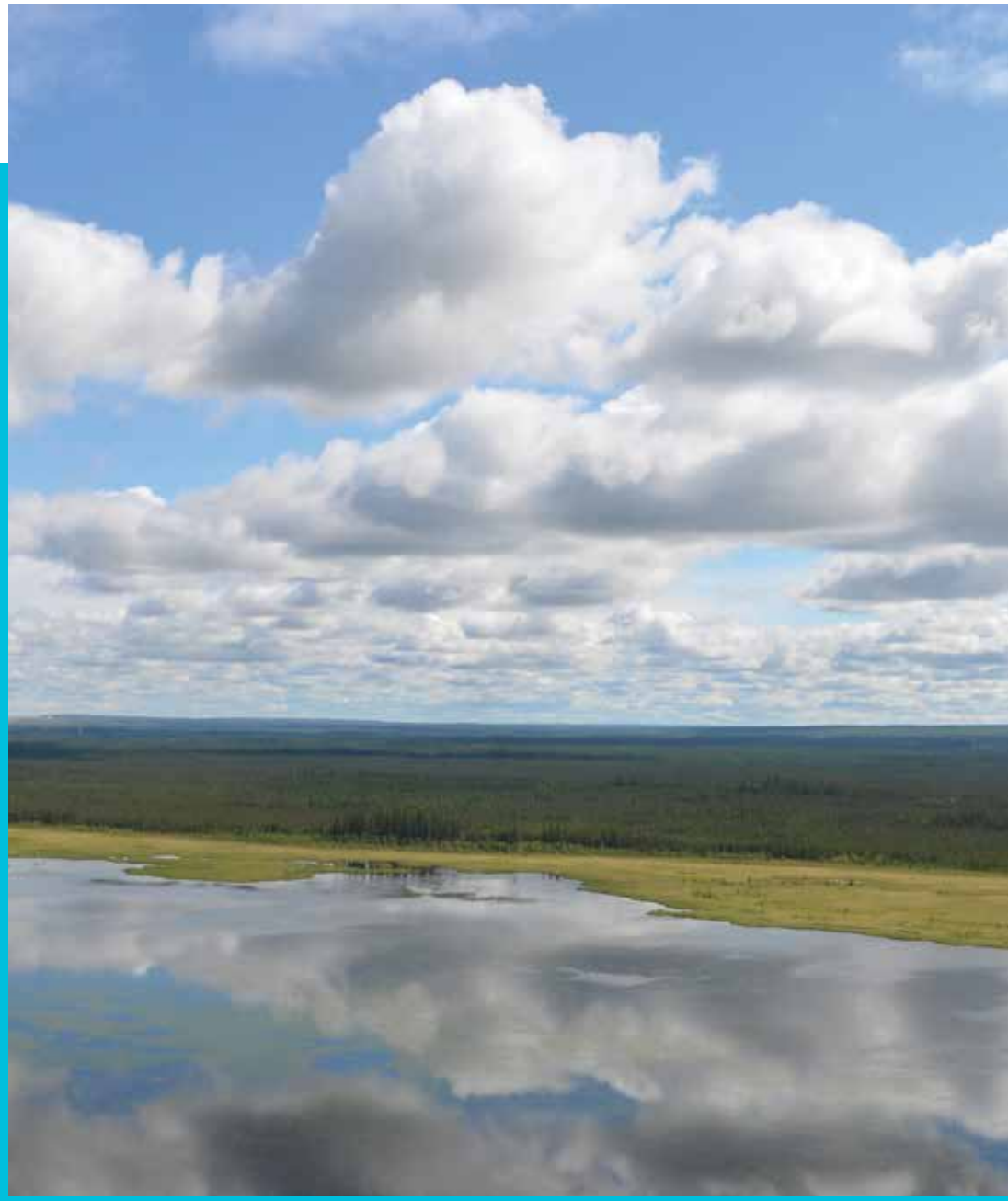
**Calgary Region Airshed Zone (CRAZ)**

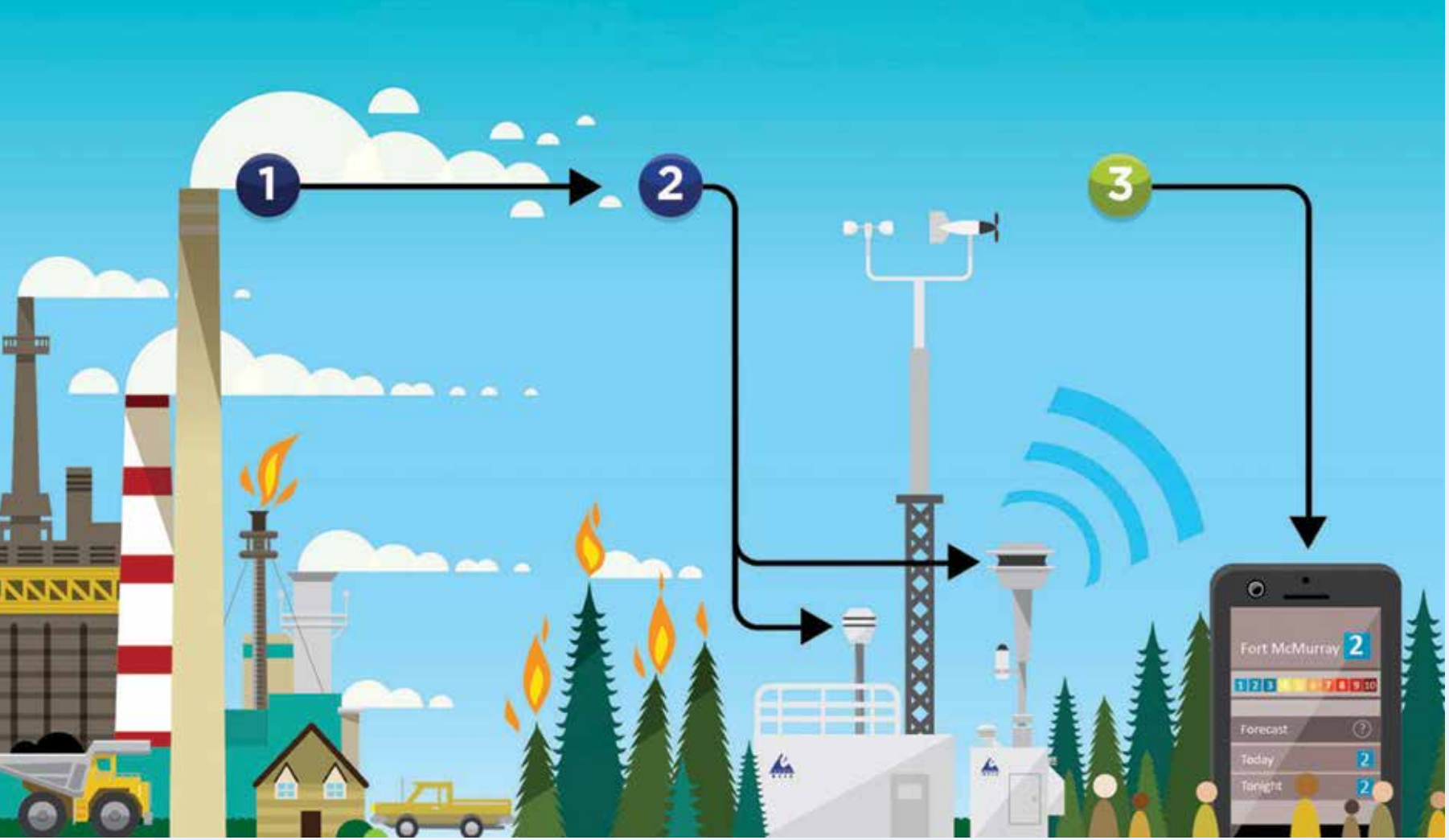
Calgary and region

# Ambient Air Monitoring

The WBEA operated 29 ambient air monitoring stations in 2021 throughout the RMWB. These included industrial, attribution, community, background, and meteorological stations. The image below demonstrates how the WBEA collects ambient air data through continuous analyzers and time-integrated samplers to ensure residents and stakeholders have the information they need to make informed environmental decisions.

- All WBEA air monitoring data are fully quality-assured and then sent by the end of the following month to **airdata.alberta.ca**, an AEP on-line database for all of Alberta's ambient air quality data.
- All of the WBEA's data can also be found on our website at **wbea.org**.
- The **WBEA's Ambient Air Annual Report 2021** contains detailed information related to the data collected in the WBEA's monitoring network.
- To see various ambient air monitoring trends within the WBEA's network, visit **annualtrends.wbea.org**.






## 1 Source

Pollution is emitted into the air from a variety of sources

## 2 Measure

The WBEA ambient air monitoring stations measures the concentrations of pollutants in the air

## 3 Share

The information the WBEA collects is available to view on **wbea.org** and is used to calculate the air quality health index (AQHI)

# Air Quality Health Index

Alberta's Air Quality Health Index—AQHI—is a scale created to help individuals better understand the impact of air quality on their health by providing important ambient air data at a glance. AQHI helps the public make informed decisions to protect their health by limiting short-term exposure to air pollution and adjusting activity levels during increased levels of air pollution. The WBEA reports AQHI ratings from nine of its continuous monitoring stations in the Wood Buffalo region.

Primary compounds measured and used to calculate the AQHI are nitrogen dioxide (NO2), fine particulate matter (PM2.5), and ground-level ozone (O3)—all of which can negatively impact an individual's respiratory system.

As an additional precaution, AQHI hourly pollutant concentrations are also compared against Alberta's Ambient Air Quality Objectives (AAAQOs). If an exceedance is detected by the province, the AQHI will report a HIGH or VERY HIGH ambient air risk value.

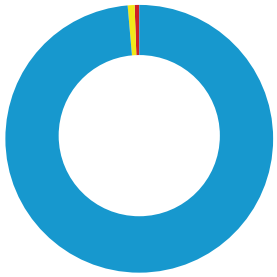
While the AQHI network relies on WBEA ambient air data, odour causing compounds measured in the network are not considered, therefore index data does not describe the potential for odour events.

The community of Fort McKay has also developed its own Fort McKay Air Quality Index (FMAQI), based on the data collected by the WBEA at its Bertha Ganter-Fort McKay air monitoring station. The FMAQI is independent of the provincial AQHI, and includes compounds that can indicate odours, such as Total Reduced Sulphur (TRS), total hydrocarbons (THC), and sulphur dioxide (SO2). For more information on the FMAQI, visit **wbea.org/air/fort-mckay-air-qualityindex-aqi/**.

To find out more, visit **wbea.org/air/airquality-health-index**.

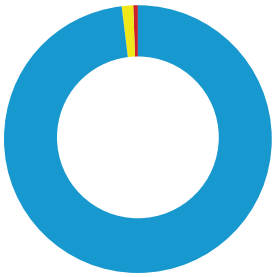
# 2021 Hourly AQHI by Station

LOW RISK 1 2 3 | MODERATE RISK 4 5 6 | HIGH RISK 7 8 9 | VERY HIGH RISK 10+



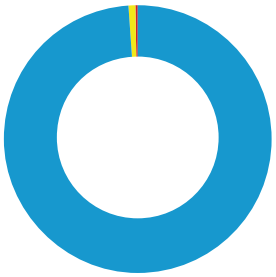
### Anzac

98.71% Low Risk
1.00% Moderate Risk
0.29% High Risk
0.00% Very High Risk



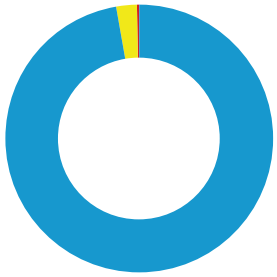
### Conklin

98.26% Low Risk
1.30% Moderate Risk
0.44% High Risk
0.00% Very High Risk



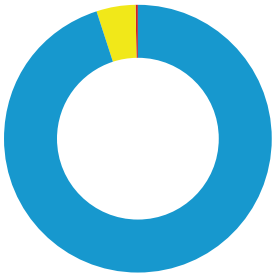
### Fort Chipewyan

99.05% Low Risk
0.90% Moderate Risk
0.05% High Risk
0.00% Very High Risk



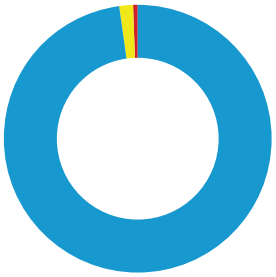
### Athabasca Valley (Fort McMurray)

97.23% Low Risk
2.57% Moderate Risk
0.20% High Risk
0.00% Very High Risk



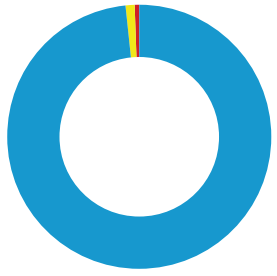
### Patricia McInnes (Fort McMurray)

95.02% Low Risk
4.78% Moderate Risk
0.20% High Risk
0.00% Very High Risk



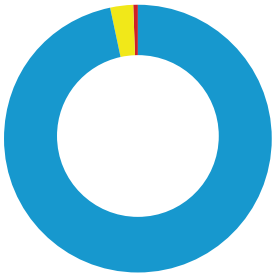
### Janvier

97.94% Low Risk
1.54% Moderate Risk
0.52% High Risk
0.00% Very High Risk



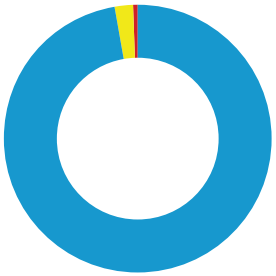
### Stony Mountain

98.49% Low Risk
1.11% Moderate Risk
0.39% High Risk
0.00% Very High Risk



### Bertha Ganter - Fort McKay

96.85% Low Risk
2.83% Moderate Risk
0.33% High Risk
0.00% Very High Risk

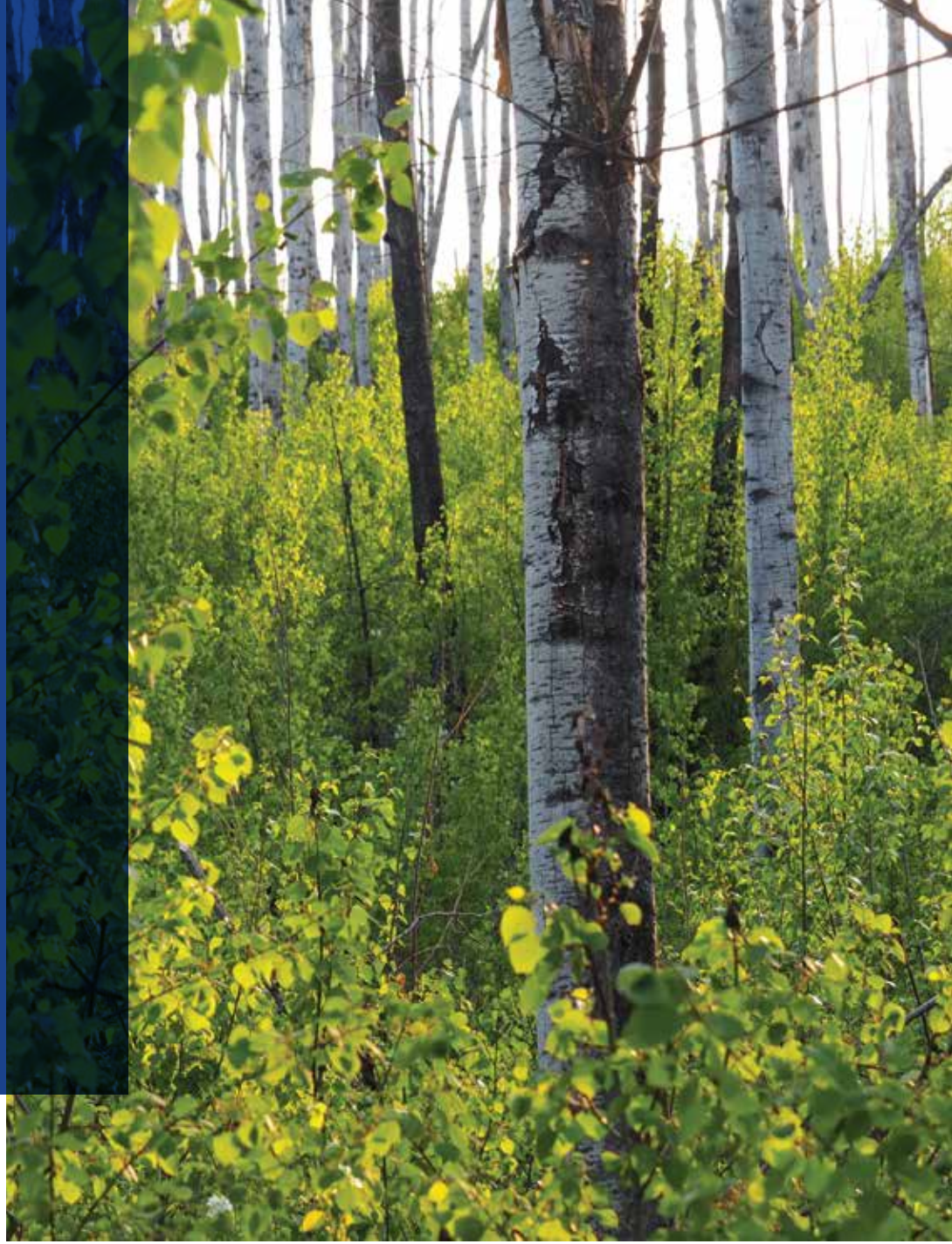


### Fort McKay South

97.39% Low Risk
2.31% Moderate Risk
0.29% High Risk
0.00% Very High Risk

# Ambient Air Quality Standards

The WBEA's ambient air quality data is compared to several established air quality thresholds, triggers, and limits, including the World Health Organization Air Quality Guidelines, the Canadian Ambient Air Quality Standards, Alberta's Ambient Air Quality Objectives and Guidelines, and the Lower Athabasca Regional Plan's trigger levels and limits.



# World Health Organization Air Quality Guidelines

The World Health Organization (WHO) Air Quality Guidelines offer guidance on threshold limits for key air pollutants that pose health risks and provide a reference for setting air pollution targets at regional and national levels to improve air quality. The WHO provides additional details in their **guideline publication**.

The table below provides a summary of the WHO Air Quality Guidelines.

| Parameter | Averaging Period | Objective or Guideline Value | Units |
|---|---|---|---|
| Fine Particulate Matter ($PM_{2.5}$) | 24-hour 99th percentile | 25 | µg/m³ |
| | Annual | 10 | |
| Nitrogen Dioxide ($NO_2$) | 1-hour | 105 | ppb |
| | Annual | 21 | |
| Ozone ($O_3$) | 8-hour daily maximum | 100 | ppb |
| Sulphur Dioxide ($SO_2$) | 24-hour | 48 | ppb |
| | Annual | 20 | |

# Canadian Ambient Air Quality Standards

The Canadian Ambient Air Quality Standards (CAAQS) are national air quality standards that are designed to protect human health and the environment. The CAAQS inform the development of management plans and appropriate management actions required to improve air quality. The CAAQS, which are based on three years of data, are targeted to assess air quality issues that can be controlled locally through management actions (such as emissions reductions). The Government of Alberta provides additional information about CAAQS on their **website**.

The table below provides a summary of the CAAQS for 2020 and 2025.

| Contaminant | Average Time | Numerical Value Effective | | Statistical Form of the Standard (Metric) |
|---|---|---|---|---|
| | | 2020 | 2025 | |
| $NO_2$ (ppb) | Annual | 17 | 12 | Arithmetic average over a single calendar year of all $NO_2$ 1-hour average concentrations in the year |
| | 1-hour | 60 | 42 | 3-year average of the annual 98th percentile of the $NO_2$ daily maximum 1-hour average concentrations |
| $SO_2$ (ppb) | Annual | 5 | 4 | Arithmetic average over a single calendar year of all $SO_2$ 1-hour average concentrations in the year |
| | 1-hour | 70 | 65 | 3-year average of the annual 99th percentile of the $SO_2$ daily maximum 1-hour average concentrations |
| $O_3$ (ppb) | 8-hour | 62 | 60 | 3-year average of the annual 4th highest of the daily maximum 8-hour average ozone concentrations |
| $PM_{2.5}$ ($\mu g/m^3$) | Annual | 10 | 8.8 | 3-year average of the annual average of all 1-hour concentrations |
| | 24-hour | 28 | 27 | 3-year average of the annual 98th percentile of the daily 24-hour average concentrations |

# Alberta Ambient Air Quality Objectives & Guidelines

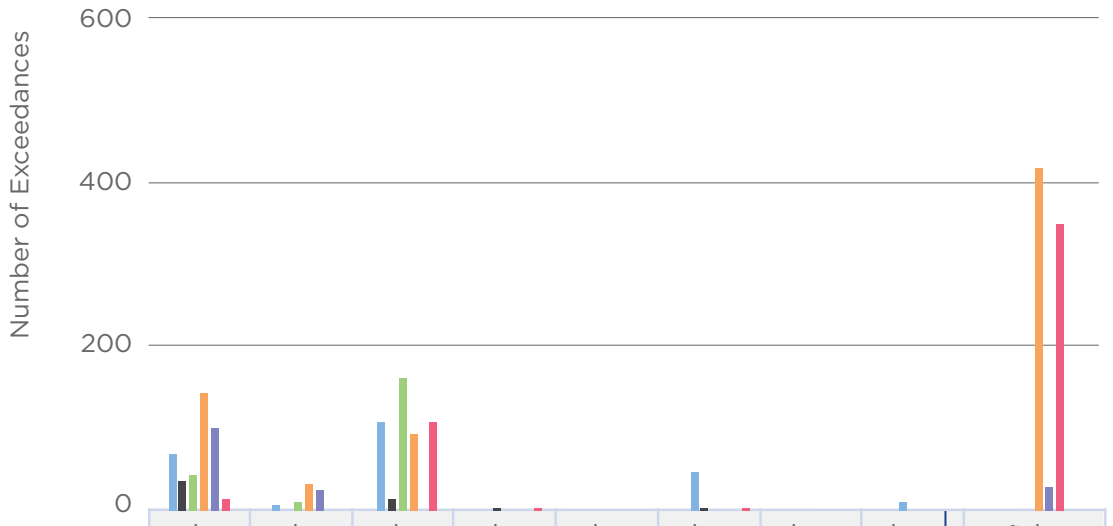
Alberta's Ambient Air Quality Objectives (AAAQOs) and Ambient Air Quality Guidelines (AAAQGs) were developed under the Alberta Environmental Protection and Enhancement Act (EPEA) to protect Alberta's air quality. AAAQOs help assess industry compliance and evaluate facility performance, and AAAQGs are a general performance indicator used to help with airshed planning and management. Both are established for a variety of averaging periods depending on the characteristics of the pollutant.

The first graph on the following page presents a total count of air quality event exceedances at all WBEA ambient air monitoring stations over a five-year period for AAAQOs from 2016-2021. Since the PM2.5 1-hour AAAQG was established in 2019, exceedance data available from 2019 and 2021 are included in the graph. The second graph, on page 17, shows the exceedances for 2021 based on station locations.

| Parameter | 1-hour Average | 8-hour Average | 24-hour Average | 30-day Average | Annual Average |
|---|---|---|---|---|---|
| **AAAQOs** | | | | | |
| Sulphur Dioxide ($SO_2$) | 172 ppb | - | 48 ppb | 11 ppb | 8 ppb |
| Nitrogen Dioxide ($NO_2$) | 159 ppb | - | - | - | 24 ppb |
| Ozone ($O_3$) | 76 ppb | - | - | - | - |
| Total Reduced Sulphurs (TRS)/ Hydrogen Sulphide ($H_2S$)* | 10 ppb | - | 3 ppb | - | - |
| Particulate Matter 2.5 ($PM_{2.5}$) | - | - | 29 µg/m$^3$ | - | - |
| Carbon Monoxide (CO) | 13 ppm | 5 ppm | - | - | - |
| Ammonia ($NH_3$) | 2 ppm | - | - | - | - |
| **AAAQG** | | | | | |
| $PM_{2.5}$ | 80 µg/m$^3$ | - | - | - | - |

**In the WBEA network TRS concentrations are reported using the $H_2S$ AAAQOs.*

# Air Quality Events in Excess of AAAQOs and AAAQGs (2016-2021)

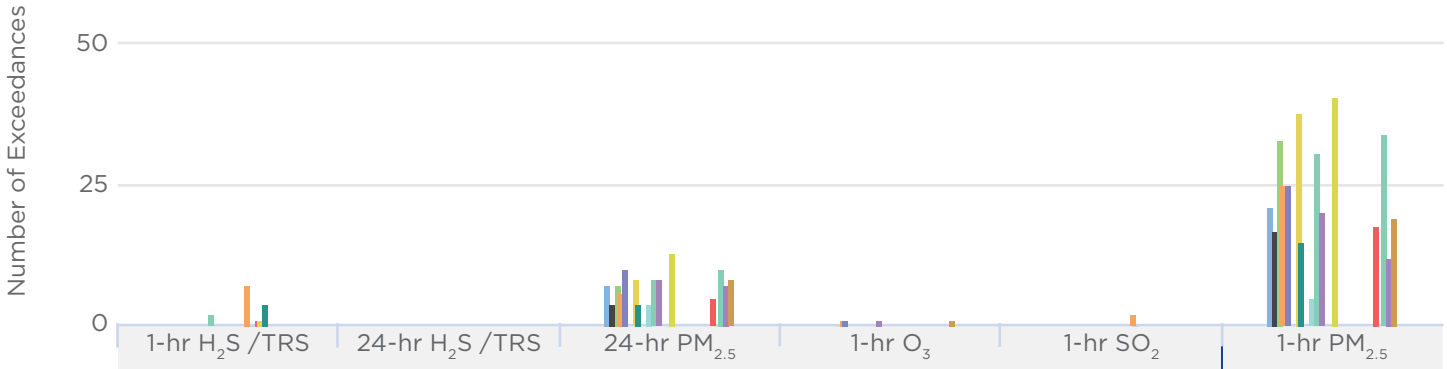



| | AAAQO | | | | | | | | AAAQG |
|---|---|---|---|---|---|---|---|---|---|
| 2016 | 68 | 9 | 109 | 1 | 0 | 49 | 1 | 10 | - |
| 2017 | 36 | 4 | 16 | 2 | 0 | 3 | 0 | 0 | - |
| 2018 | 44 | 10 | 163 | 1 | 0 | 0 | 0 | 0 | - |
| 2019 | 146 | 31 | 95 | 0 | 0 | 0 | 0 | 0 | 420 |
| 2020 | 103 | 27 | 0 | 1 | 0 | 1 | 0 | 0 | 30 |
| 2021 | 15 | 0 | 109 | 2 | 0 | 3 | 0 | 0 | 354 |

*Note: Forest fire season was considered to be from March 1 – October 31, 2020. There were no $PM_{2.5}$ AAAQO exceedances in 2020; however, there were 14 $PM_{2.5}$ AAAQG exceedances outside the forest fire season.*

*Note: The WBEA began reporting $PM_{2.5}$ AAAQG exceedances in 2019 as per the Alberta Air Monitoring Directive (AMD) requirements; the graph shows exceedance data for only 2019 and 2020.*

# 2021 Exceedances by Station




| | 1-hr $H_2S$ /TRS | 24-hr $H_2S$ /TRS | 24-hr $PM_{2.5}$ | 1-hr $O_3$ | 1-hr $SO_2$ | 1-hr $PM_{2.5}$ |
|---|---|---|---|---|---|---|
| | | | AAAQO | | | AAAQG |
| Anzac | | | 7 | | | 21 |
| Athabasca Valley | | | 4 | | | 17 |
| Barge Landing | | | 7 | | | 33 |
| Bartha Ganter - Fort Mckay | | | 6 | 1 | | 25 |
| Buffalo Viewpoint | | | 10 | 1 | | 25 |
| Christina Lake | | | | | | |
| Conklin | | | 8 | | | 38 |
| Ellis River | | | 4 | | | 15 |
| Firebag | | | | | | |
| Fort Chipewyan | | | 4 | | | 5 |
| Fort Hills | 2 | | 8 | | | 31 |
| Fort McKay South | | | 8 | 1 | | 20 |
| Jackfish 1 | | | | | | |
| Jackfish 2/3 | | | | | | |
| Janvier | | | 13 | | | 41 |
| Kirby North | | | | | | |
| Kirby South | | | | | | |
| Leismer | | | | | | |
| Lower Camp | 7 | | | | 2 | |
| Lower Camp Met Tower | | | | | | |
| Mackay River | 1 | | | | | |
| Mannix | 1 | | | | | |
| Mildred Lake | 4 | | | | | |
| Patricia McInnes | | | 5 | | | 18 |
| Sawbones Bay | | | | | | |
| Stony Mountain | | | 10 | | | 34 |
| Surmont 2 | | | 7 | | | 12 |
| Wapasu | | | 8 | 1 | | 19 |
| Waskōw ohci Pimâtisiwin | | | | | | |

*Note: Forest fire season was considered to be from March 1 – October 31, 2021.*

# Reporting Air Quality Events

When ambient concentrations of any air pollutant the WBEA measures exceed the AAAQOs and AAAQGs, the WBEA has an Immediate Reporting Protocol that is put into action. WBEA analyzers continuously monitor ambient air, and in the event of an exceedance, the following steps are taken:

1. The data collection system automatically sends out alarm notifications to WBEA personnel and an independent third-party alarm monitoring company.

2. If an AAAQO is exceeded, the alarm company acknowledges the incoming alarm and reports the data and supporting information such as wind conditions, locations, time, etc. to Alberta Environment and Parks (AEP) in real time. AEP uses the data and information from the WBEA to follow up appropriately.

3. If an AAAQG is exceeded, the WBEA reports the data and supporting information such as wind conditions, locations, time, etc. to AEP during business hours. AEP uses the data and information from the WBEA to follow up appropriately.

4. If the exceedance occurs at an industry station, the owner is informed that they have exceeded an AAAQO or AAAQG, and they are provided with the same information that was given to AEP. They follow up with AEP and/or the Alberta Energy Regulator (AER), as required. Exceedances at community stations are followed up by the WBEA.

## WBEA's Air Quality Events (AQE) App

The WBEA has developed an Air Quality Events (AQE) app as another way to notify interested stakeholders and partners of air quality events related to AAAQOs and AAAQGs. The AQE app provides near-real time notifications when an exceedance occurs in the network and allows users to subscribe to the air monitoring stations of interest. In addition, the AQE app stores all the historical and near real-time air quality events information on the Air Quality **Events page** of the WBEA website. The app is available for download on **Apple** and **Android** platforms.

# LARP Triggers & Limits

The Lower Athabasca Regional Plan (LARP) has existed as an extension of the Alberta Land-Use Framework since September 2012.

The LARP air quality objective is to manage releases from multiple sources so they do not collectively result in unacceptable air quality. LARP sets out trigger levels and limits for $NO_2$ and $SO_2$ as described in the table below. The WBEA provides AEP with the air quality data that is used to calculate the annual LARP triggers and limits. When a trigger is exceeded, AEP is required to create a regional management response.

The following graphs show the annual average and hourly 99th percentile concentrations of $NO_2$ and $SO_2$ at each station location compared to the respective triggers and limit for each parameter. The use of the hourly 99th percentile data is a statistical measure to indicate upper limits of the data. Increases in the 99th percentile beyond the LARP triggers can be an early warning to help inform appropriate management actions to prevent future exceedances.

Learn more about LARP by visiting **https://landuse.alberta.ca/RegionalPlans/LowerAthabascaRegion/**.

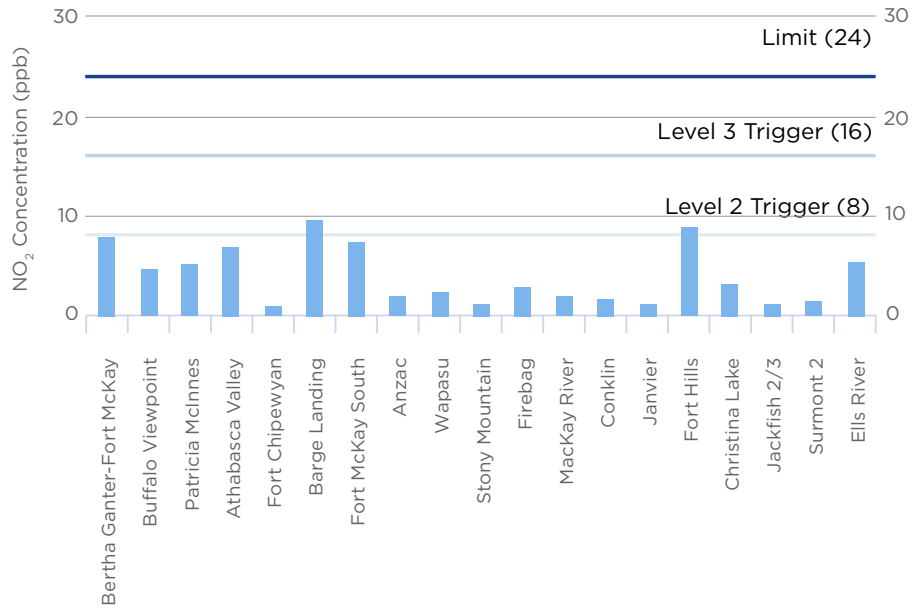
## Larp Trigger Levels & Limits for Air Quality

| Description | Management Intent |
|---|---|
| **Level 4** | |
| Ambient air quality exceeding air quality limits | Improve ambient air quality to below limits |
| **Limit** | |
| **Level 3** | |
| Ambient air quality below but approaching air quality limits | Proactively maintain air quality below limits |
| **Trigger** | |
| **Level 2** | |
| Ambient air quality below air quality limits | Improve knowledge and understanding, and plan |
| **Trigger** | |
| **Level 1** | |
| Ambient air quality well below air quality limits | Apply standard regulatory and non-regulatory approaches |

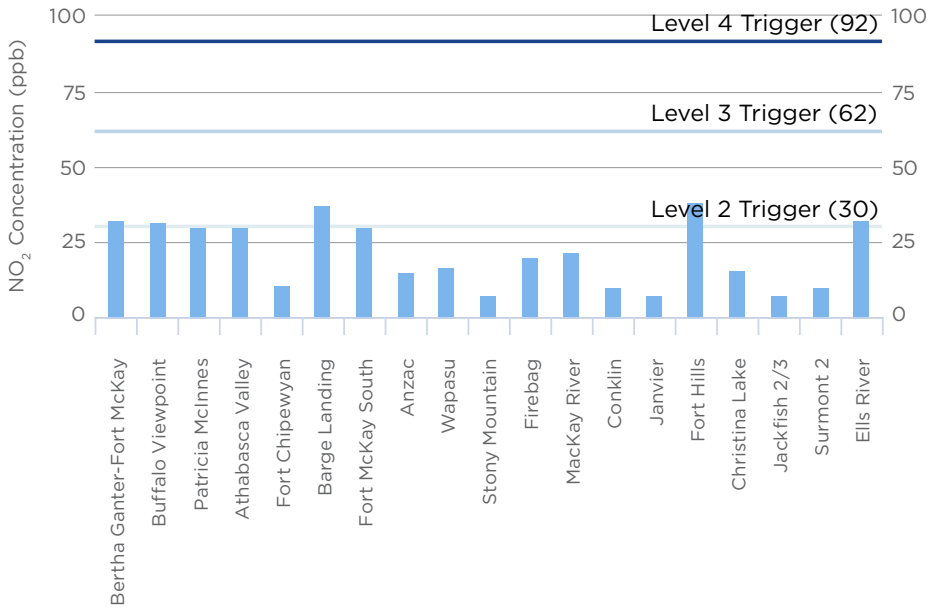
Note: The ambient air quality values based on the 99th percentile of hourly data are all established as triggers in the management framework

Stations

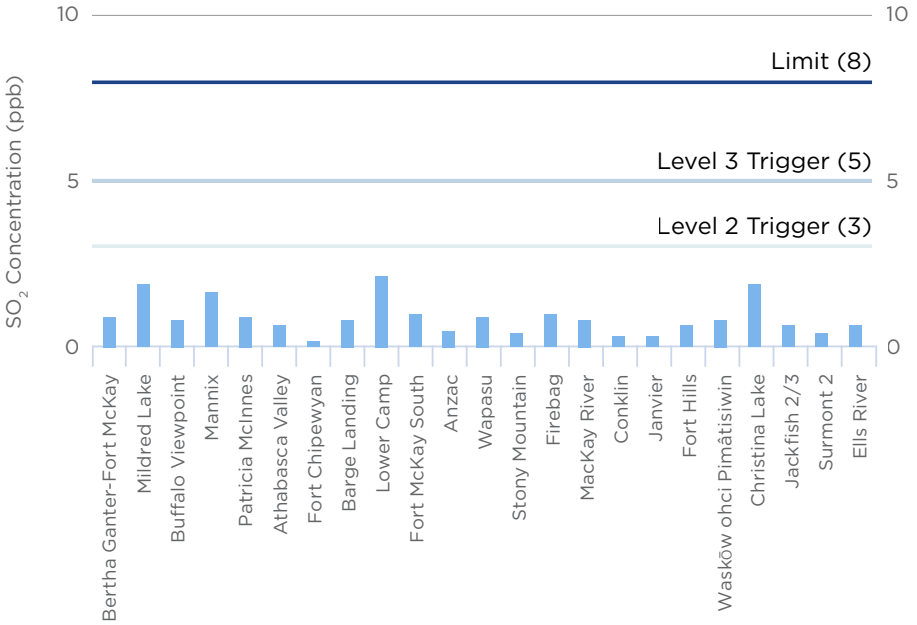
## LARP $NO_2$ Annual Average



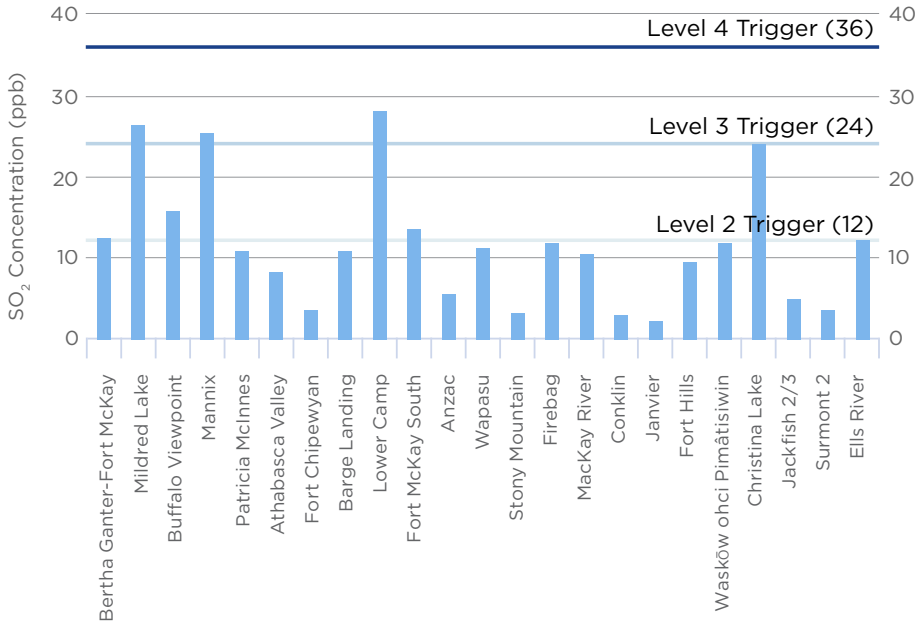

## LARP $NO_2$ Hourly 99th Percentile




## LARP $SO_2$ Annual Average




## LARP $SO_2$ Hourly 99th Percentile



# Regional Wind Profiles

Meteorological parameters, including wind speed and direction, humidity, precipitation, atmospheric pressure, solar radiation, and the vertical temperature structure of the atmosphere, all impact the dispersion, deposition, and transformation of common air pollutants.

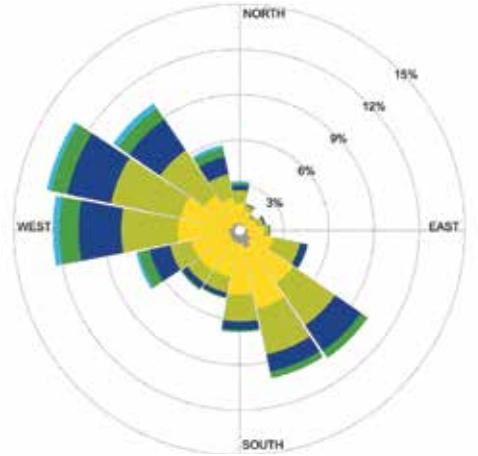
Wind rose plots provide visual context for the speed, direction, and frequency of winds, and are shown below for each WBEA community station in the network. The colours within each wind rose triangle denote the frequency of the wind speed (shown in the legend below). Calms are shown for each community as a percentage of time that wind speeds are below 0.5 km/h.

For example, the largest triangle in Fort Chipewyan wind rose shows the wind comes from the east, about 17% of the time in 2021. The olive green colour in this triangle shows the wind was between 10 and 15 kilometers per hour (km/h) 4% of the time. Wind speeds were less than 0.5 km/h in Fort Chipewyan 0.06% of the time (calms).

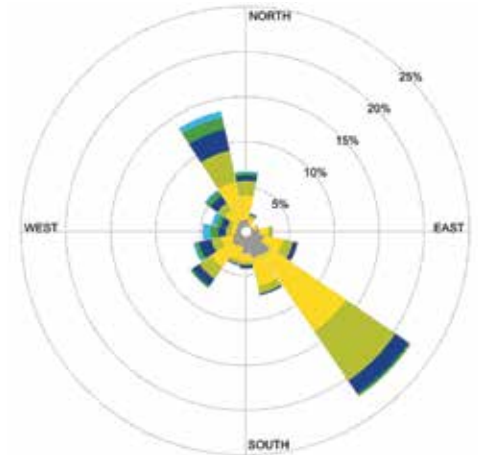
**WIND SPEED (km/h)**

| 0.5 - 5 | 5 - 10 | 10 - 15 | 15 - 20 | 20 - 25 | > = 25 |
|---|---|---|---|---|---|

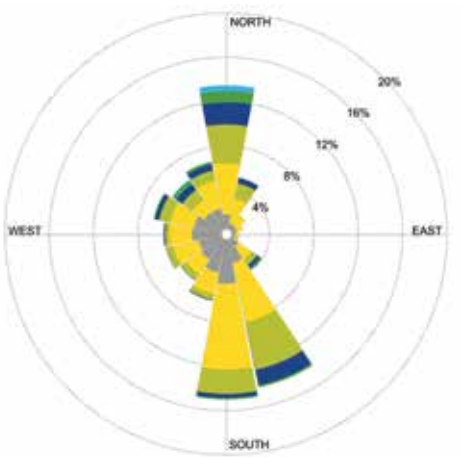
Anzac
Calms: 0.07% | Tower Height: 20m



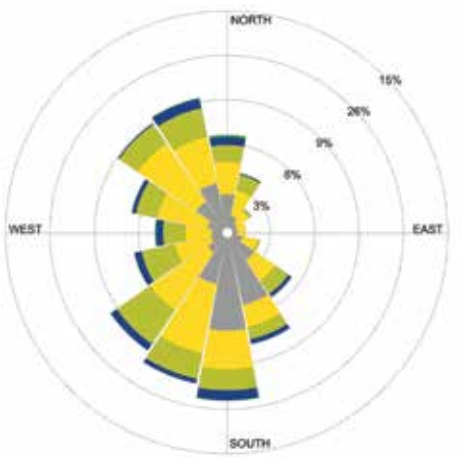

Athabasca Valley (Fort McMurray)
Calms: 0.38% | Tower Height: 10m



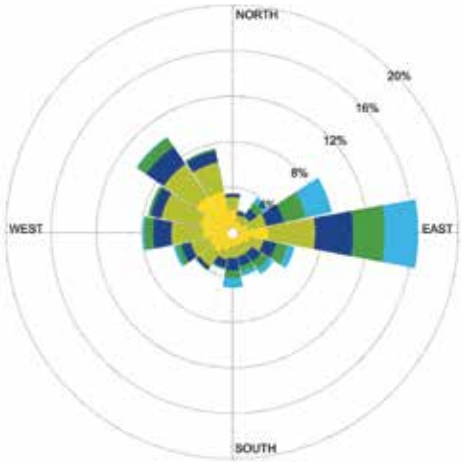
Bertha Ganter - Fort McKay
Calms: 0.24% | Tower Height: 10m



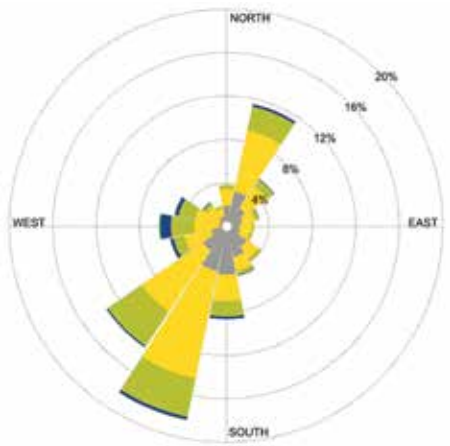

Conklin
Calms: 1.54% | Tower Height: 10m



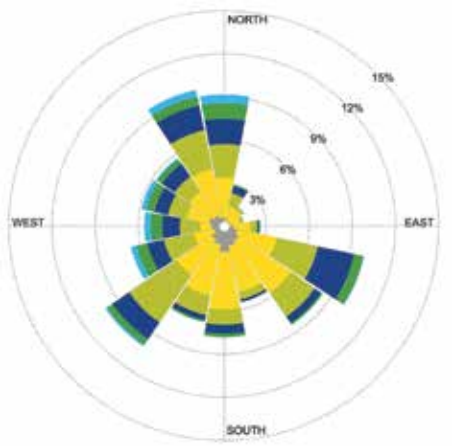

Fort Chipewyan
Calms: 0.06% | Tower Height: 10m




Janvier
Calms: 0.78% | Tower Height: 10m



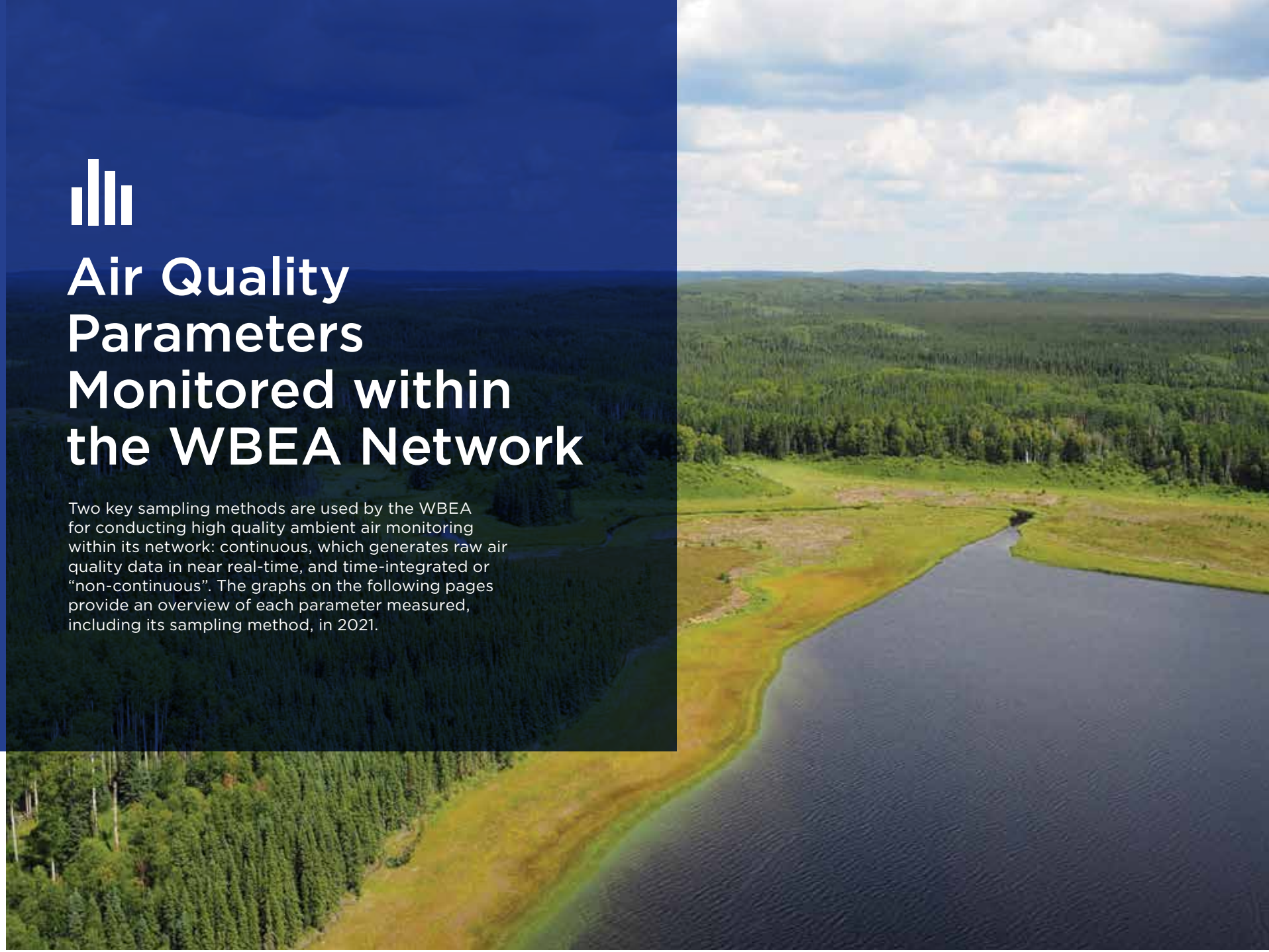

Patricia McInnes (Fort McMurray)
Calms: 0.13% | Tower Height: 10m




Waskōw ohci Pimâtisiwin
Calms: 0.96% | Tower Height: 10m

# Air Quality Parameters Monitored within the WBEA Network

Two key sampling methods are used by the WBEA for conducting high quality ambient air monitoring within its network: continuous, which generates raw air quality data in near real-time, and time-integrated or “non-continuous”. The graphs on the following pages provide an overview of each parameter measured, including its sampling method, in 2021.



# Summary of stations and parameters measured continuously at WBEA sites.

| WBEA ID | Type | Station Name | $SO_2$ | $NO/NO_2/NO_x$ | $O_3$ | $PM_{2.5}$ | TRS | $H_2S$ | THC | Methane NMHC | CO | $CO_2$ | $NH_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Community | Bertha Ganter-Fort Mckay | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2 | Compliance | Mildred Lake | ✓ | | | | | ✓ | ✓ | ✓ | | | |
| 3 | Meteorological | Lower Camp Met Tower | | | | | | | | | | | |
| 4 | Compliance | Buffalo Viewpoint | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | | |
| 5 | Compliance/Meteorological | Mannix | ✓ | | | | | ✓ | ✓ | ✓ | | | |
| 6 | Community | Patricia Mcinnes | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | ✓ |
| 7 | Community | Athabasca Valley | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | |
| 8 | Community/Compliance | Fort Chipewyan | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | |
| 9 | Attribution | Barge Landing | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | | |
| 11 | Compliance | Lower Camp | ✓ | | | | | ✓ | ✓ | ✓ | | | |
| 13 | Compliance/Attribution | Fort Mckay South | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | |
| 14 | Compliance/Community | Anzac | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | |
| 17 | Compliance | Wapasu | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | |
| 18 | Background | Stony Mountain | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | |
| 19 | Compliance | Firebag | ✓ | ✓ | | | | ✓ | ✓ | | | | |
| 20 | Compliance | Mackay River | ✓ | ✓ | | | | ✓ | ✓ | | | | |
| 21 | Community | Conklin | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | |
| 22 | Community | Janvier | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | |
| 23 | Compliance | Fort Hills | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | | |
| 25 | Emergency Response | Waskōw ohci Pimâtisiwin | ✓ | | | | | ✓ | | | | | |
| 26 | Compliance | Christina Lake | ✓ | ✓ | | | | ✓ | | | | | |
| 27 | Compliance | Jackfish 2/3 | ✓ | ✓ | | | | ✓ | | | | | |
| 29 | Compliance | Surmont 2 | ✓ | ✓ | | ✓ | | ✓ | ✓ | | | | |
| 30 | Compliance | Ells River | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | | |
| 501 | Compliance | Leismer | ✓ | ✓ | | | | ✓ | | | | | |
| 505 | Compliance | Sawbones Bay | ✓ | ✓ | | | | ✓ | | | | | |
| 506 | Compliance | Jackfish 1 | ✓ | ✓ | | | | ✓ | | | | | |
| 507 | Compliance | Kirby South | ✓ | ✓ | | | | ✓ | ✓ | | | | |
| 508 | Compliance | Kirby North | ✓ | ✓ | | | | ✓ | ✓ | | | | |

# Summary of stations and meteorological parameters measured continuously at WBEA sites.

| WBEA ID | Type | Station Name | Temperature | RH | BP | Wind Speed | Wind Direction | Vertical Wind Speed | Solar Radiation | Precip | Leaf Wetness |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Community | Bertha Ganter-Fort Mckay | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 2 | Compliance | Mildred Lake | ✓ | ✓ | | ✓ | ✓ | | | | |
| 3 | Meteorological | Lower Camp Met Tower | ✓ | ✓ | | ✓ | ✓ | ✓ | | | |
| 4 | Compliance | Buffalo Viewpoint | ✓ | ✓ | | ✓ | ✓ | | | | |
| 5 | Compliance/Meteorological | Mannix | ✓ | ✓ | | ✓ | ✓ | ✓ | | | |
| 6 | Community | Patricia Mcinnes | ✓ | ✓ | | ✓ | ✓ | | | | |
| 7 | Community | Athabasca Valley | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| 8 | Community/Compliance | Fort Chipewyan | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ |
| 9 | Attribution | Barge Landing | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| 11 | Compliance | Lower Camp | ✓ | ✓ | | ✓ | ✓ | | | | |
| 13 | Compliance/Attribution | Fort Mckay South | ✓ | ✓ | | ✓ | ✓ | | | | |
| 14 | Compliance/Community | Anzac | ✓ | ✓ | | ✓ | ✓ | | | | ✓ |
| 17 | Compliance | Wapasu | ✓ | ✓ | | ✓ | ✓ | | | ✓ | |
| 18 | Background | Stony Mountain | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 19 | Compliance | Firebag | ✓ | ✓ | | ✓ | ✓ | | | | |
| 20 | Compliance | Mackay River | ✓ | ✓ | | ✓ | ✓ | | | ✓ | |
| 21 | Community | Conklin | ✓ | ✓ | | ✓ | ✓ | | | | |
| 22 | Community | Janvier | ✓ | ✓ | | ✓ | ✓ | | | | |
| 23 | Compliance | Fort Hills | ✓ | ✓ | | ✓ | ✓ | | | | |
| 25 | Emergency Response | Waskōw ohci Pimâtisiwin | ✓ | ✓ | | ✓ | ✓ | | | | |
| 26 | Compliance | Christina Lake | ✓ | ✓ | | ✓ | ✓ | | | | |
| 27 | Compliance | Jackfish 2/3 | ✓ | ✓ | | ✓ | ✓ | | | | |
| 29 | Compliance | Surmont 2 | ✓ | ✓ | | ✓ | ✓ | | | | |
| 30 | Compliance | Ells River | ✓ | ✓ | | ✓ | ✓ | | ✓ | | |
| 501 | Compliance | Leismer | ✓ | ✓ | | ✓ | ✓ | | | | |
| 505 | Compliance | Sawbones Bay | ✓ | ✓ | | ✓ | ✓ | | | | |
| 506 | Compliance | Jackfish 1 | ✓ | ✓ | | ✓ | ✓ | | | | |
| 505 | Compliance | Kirby South | ✓ | ✓ | | ✓ | ✓ | | | | |
| 508 | Compliance | Kirby North | ✓ | ✓ | | ✓ | ✓ | | | | |

## Summary of parameters measured using integrated methods at WBEA sites.

| WBEA ID | Type | Station Name | VOC | $PM_{2.5}$ Mass, Metals and Ions | $PM_{2.5}$ Mass, ECOC | $MP_{10}$ Mass, Metals and Ions | PAH | Precip |
|---|---|---|---|---|---|---|---|---|
| 1 | Community | Bertha Ganter-Fort Mckay | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 6 | Community | Patricia Mcinnes | ✓ | ✓ | | ✓ | ✓ | |
| 7 | Community | Athabasca Valley | ✓ | ✓ | | ✓ | ✓ | |
| 9 | Attribution | Barge Landing | ✓ | | | | | |
| 13 | Compliance/Attribution | Fort Mckay South | ✓ | | | ✓ | | |
| 14 | Compliance/Community | Anzac | ✓ | ✓ | | ✓ | ✓ | |
| 17 | Compliance | Wapasu | | | ✓ | | | ✓ |
| 18 | Enhanced Deposition/Background | Stony Mountain | | | ✓ | | | ✓ |
| 21 | Community | Conklin | ✓ | ✓ | | ✓ | ✓ | |
| 22 | Community | Janvier | ✓ | ✓ | | ✓ | ✓ | |
| 30 | Compliance | Ells River | ✓ | | | ✓ | | |

# Continuous Monitoring

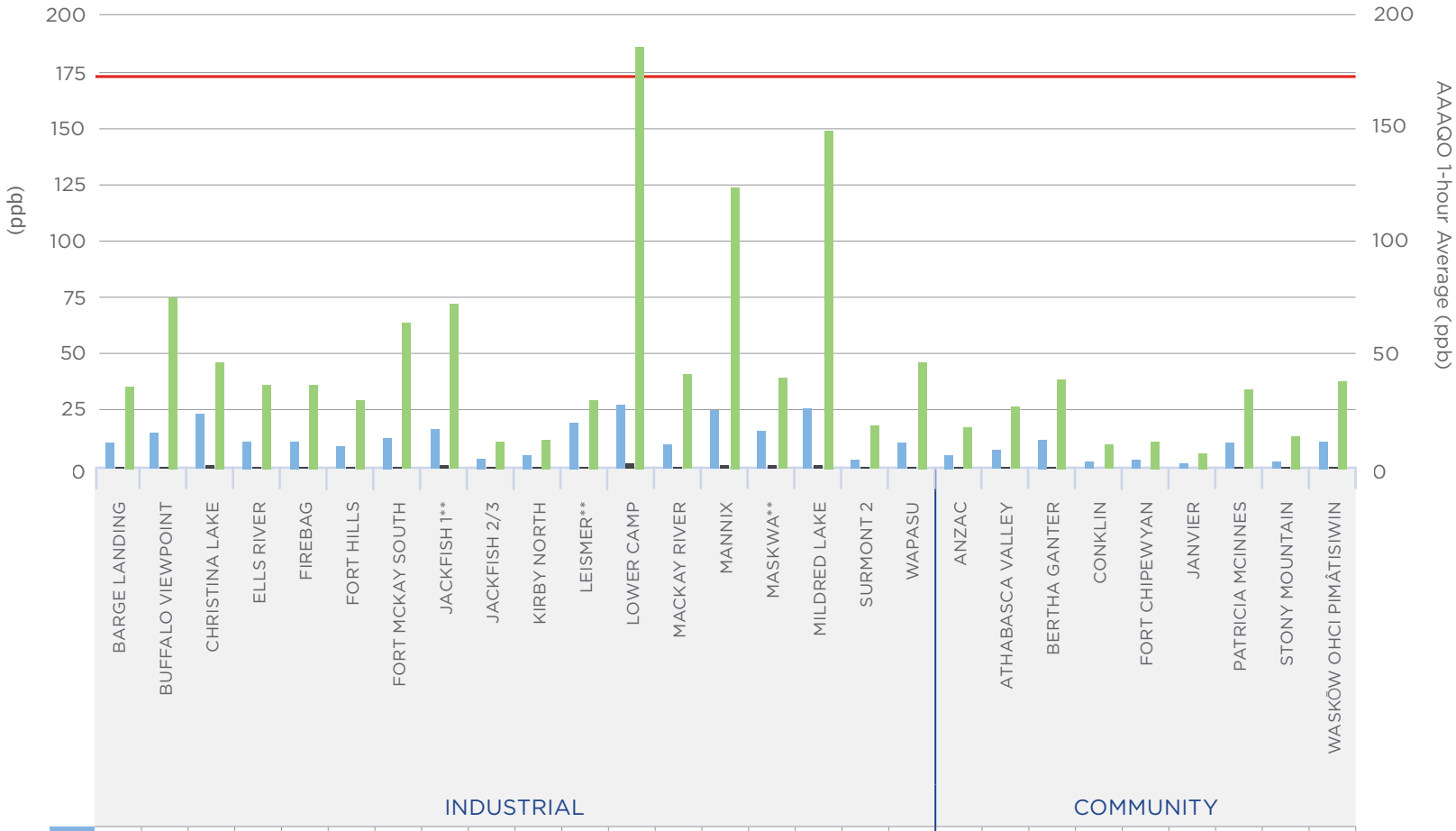
As its title suggests, the WBEA's continuous ambient air monitoring uses analyzers that continually measure concentrations of pollutants in the air. This data is readily available to anyone in near real-time on our website, **wbea.org**.

In addition to specific compounds, all stations continuously measure temperature, relative humidity, and wind speed and direction.

The data for continuous monitoring is presented in the following graphs as the annual hourly average (mean) concentrations of each parameter, along with the annual hourly 99th percentile and maximum concentrations. Please note, the averages may be too small to be visible on some graphs. The annual hourly 99th percentile is used to show the high end of concentrations measured at the WBEA air monitoring stations, after removing the highest 1% of events which may be outliers.

# Sulphur Dioxide ($SO_2$)

Sulphur dioxide is produced from the combustion of sulphur-containing fossil fuels. Sulphur dioxide in the air at high concentrations can make breathing difficult, particularly for children, the elderly, and people with asthma. Sulphur dioxide reacts in the atmosphere to form sulphuric acid and acidic aerosols, which contribute to acid deposition and acid rain.

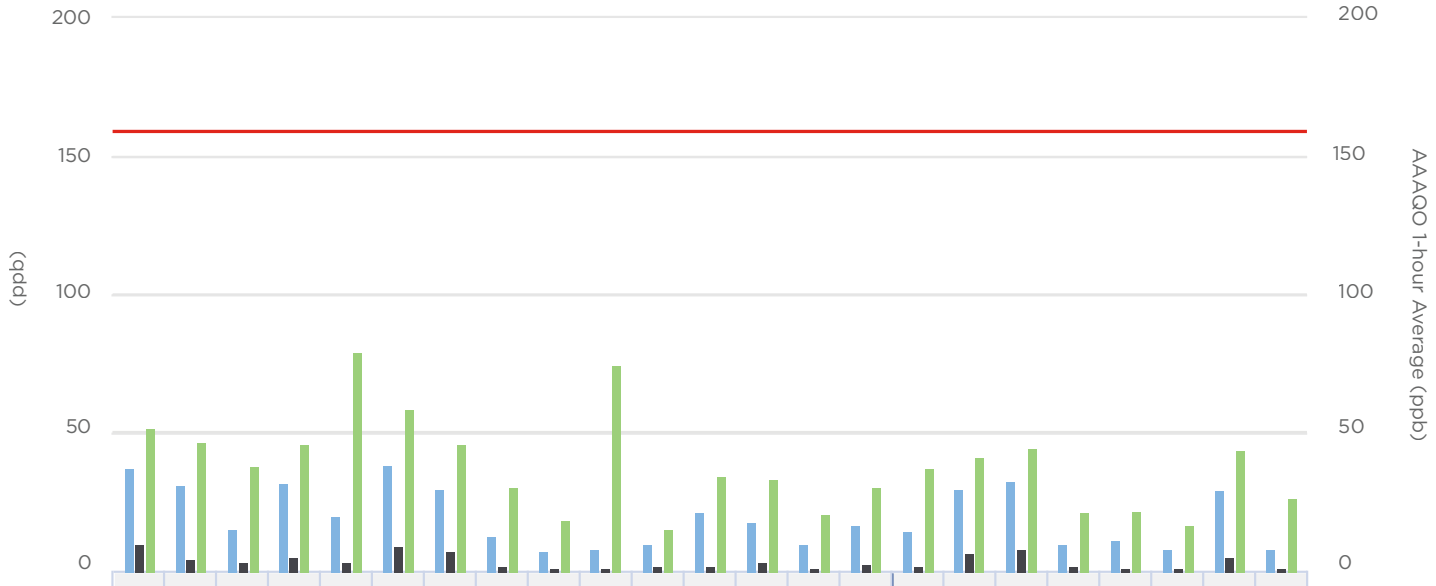



| | BARGE LANDING | BUFFALO VIEWPOINT | CHRISTINA LAKE | ELLS RIVER | FIREBAG | FORT HILLS | FORT MCKAY SOUTH | JACKFISH 1** | JACKFISH 2/3 | KIRBY NORTH | LEISMER** | LOWER CAMP | MACKAY RIVER | MANNIX | MASKWA** | MILDRED LAKE | SURMONT 2 | WAPASU | ANZAC | ATHABASCA VALLEY | BERTHA GANTER | CONKLIN | FORT CHIPEWYAN | JANVIER | PATRICIA MCINNES | STONY MOUNTAIN | WASKÓW OHCI PIMÂTISIWIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99th Percentile | 11.1 | 16.0 | 24.4 | 12.3 | 11.9 | 9.6 | 13.7 | 17.3 | 4.9 | 6.0 | 20.6 | 28.4 | 10.8 | 25.8 | 16.5 | 26.6 | 3.8 | 11.5 | 5.8 | 8.5 | 12.8 | 3.0 | 3.6 | 2.4 | 11.1 | 3.3 | 12.1 |
| Average | 0.8 | 0.8 | 1.9 | 0.7 | 1.0 | 0.7 | 1.0 | 1.4 | 0.7 | 0.7 | 1.1 | 2.2 | 0.8 | 1.7 | 1.6 | 1.9 | 0.4 | 0.9 | 0.5 | 0.7 | 0.9 | 0.3 | 0.2 | 0.3 | 0.9 | 0.4 | 0.8 |
| Max | 36.7 | 76.2 | 47.5 | 37.2 | 37.3 | 30.5 | 64.5 | 72.8 | 12.4 | 13.3 | 30.4 | 186.8 | 42.0 | 124.9 | 40.3 | 150.1 | 18.9 | 47.3 | 18.6 | 27.4 | 39.6 | 10.4 | 12.1 | 6.8 | 35.3 | 14.8 | 39.1 |
| AAAQO 1-hour avg. | 172 | | | | | | | | | | | | | | | | | | | | | | | | | | |

** Station operational less than 75% of the time in 2021.

# Nitrogen Dioxide ($NO_2$)

Nitrogen dioxide is a reddish-brown gas with a pungent, irritating odour that is produced by combustion of fossil fuels. It plays a major role in atmospheric photo-chemical reactions, ground level ozone formation and destruction, and can also interact with water to form acid rain.

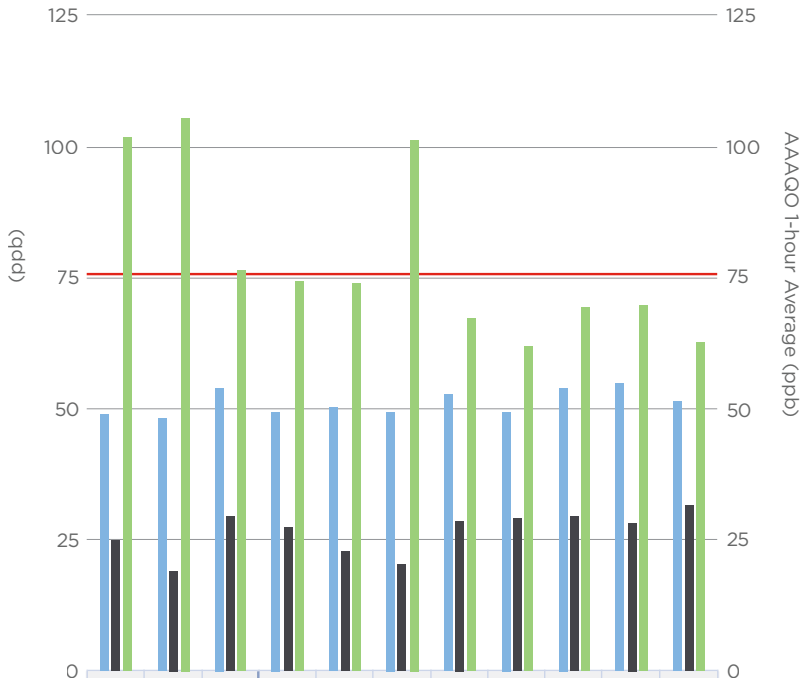



| | BARGE LANDING | BUFFALO VIEWPOINT | CHRISTINA LAKE | ELLS RIVER | FIREBAG | FORT HILLS | FORT MCKAY SOUTH | JACKFISH 1** | JACKFISH 2/3 | KIRBY NORTH** | LEISMER** | MACKAY RIVER | MASKWA** | SURMONT 2 | WAPASU | ANZAC | ATHABASCA VALLEY | BERTHA GANTER | CONKLIN | FORT CHIPEWYAN | JANVIER | PATRICIA MCINNES | STONY MOUNTAIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99th Percentile | 37.1 | 31.5 | 15.6 | 32.2 | 20.1 | 38.7 | 30.2 | 12.4 | 7.2 | 7.8 | 10.0 | 21.6 | 18.1 | 9.8 | 17.0 | 14.7 | 29.9 | 32.7 | 9.9 | 11.1 | 7.9 | 29.6 | 7.9 |
| Average | 9.7 | 4.8 | 3.2 | 5.6 | 3.1 | 9.1 | 7.5 | 2.2 | 1.3 | 1.4 | 1.8 | 1.9 | 3.1 | 1.4 | 2.6 | 2.1 | 7.0 | 8.1 | 1.7 | 1.1 | 1.3 | 5.2 | 1.2 |
| Max | 51.7 | 46.9 | 38.3 | 46.0 | 79.1 | 58.5 | 46.0 | 30.5 | 18.7 | 74.4 | 15.1 | 35.0 | 33.3 | 20.6 | 30.4 | 37.3 | 41.2 | 44.7 | 21.5 | 22.2 | 16.9 | 44.1 | 26.5 |
| AAAQO 1-hour avg. | 159 | | | | | | | | | | | | | | | | | | | | | | |

*** Station operational less than 75% of the time in 2021.*

# Ozone ($O_3$)

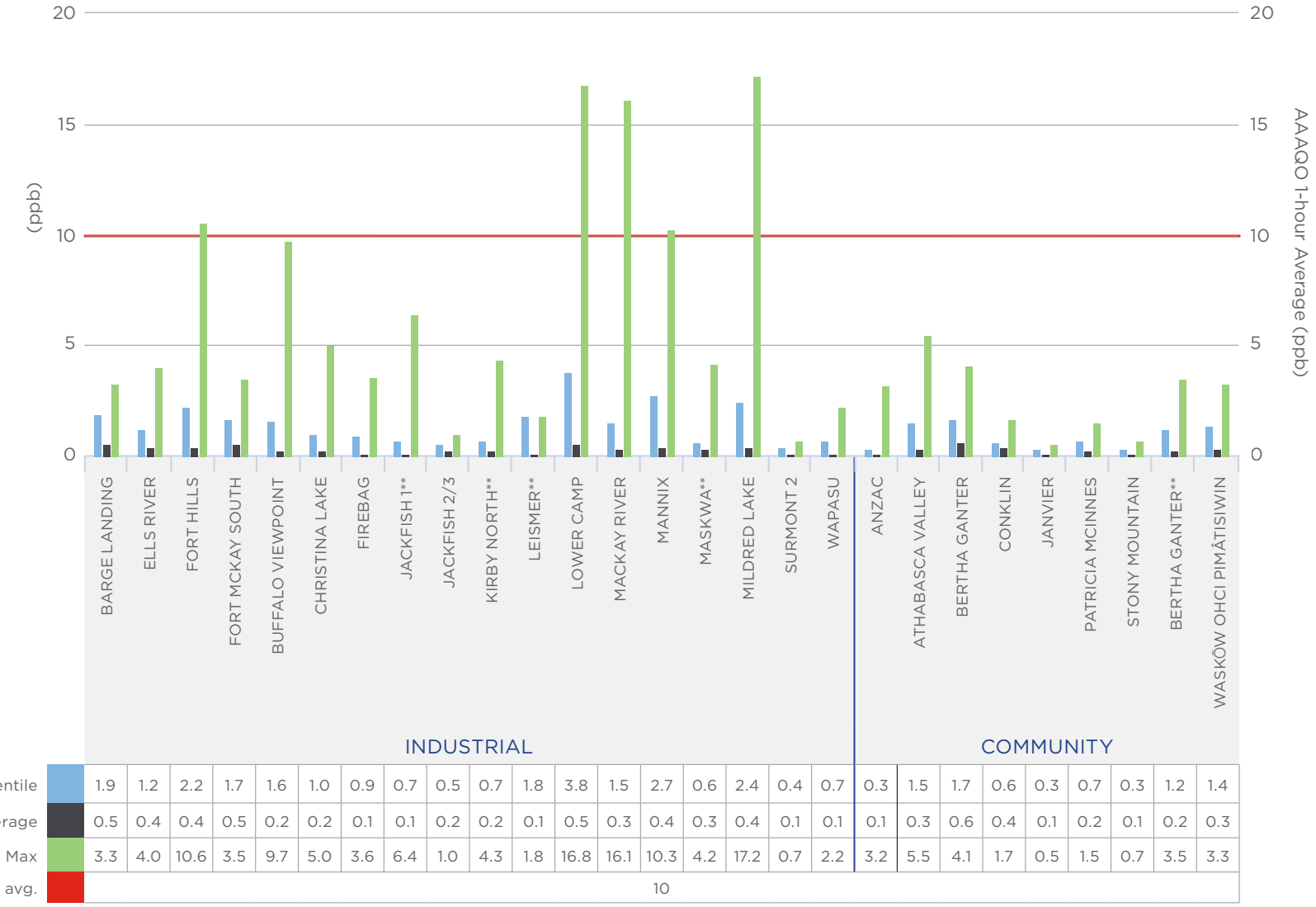
Ozone at ground-level is not emitted directly into the air but formed by chemical reactions of $NO_x$ and volatile organic compounds (VOCs), from vehicular and industrial emissions. At high concentrations, breathing ozone can affect respiratory function, and cause coughing, throat irritation, and airway inflammation. Children, the elderly, and people with asthma are the most susceptible. Ozone can affect sensitive vegetation, by slowing plant growth and making them more susceptible to disease.




| | BUFFALO VIEWPOINT | FORT MCKAY SOUTH | WAPASU | ANZAC | ATHABASCA VALLEY | BERTHA GANTER | CONKLIN | FORT CHIPEWYAN | JANVIER | PATRICIA MCINNES | STONY MOUNTAIN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 99th Percentile | 49.0 | 48.4 | 54.2 | 49.7 | 50.4 | 49.7 | 52.9 | 49.5 | 54.0 | 55.1 | 51.5 |
| Average | 25.1 | 19.1 | 29.7 | 27.3 | 23.0 | 20.4 | 28.6 | 29.2 | 29.6 | 28.2 | 31.5 |
| Max | 101.9 | 106.0 | 76.5 | 74.5 | 74.3 | 101.7 | 67.3 | 62.2 | 69.4 | 70.0 | 62.8 |
| AAAQO 1-hour avg. | 76 | | | | | | | | | | |

# Total Reduced Sulphur/Hydrogen Sulphide (TRS/$H_2S$)

Hydrogen sulphide is a colourless gas with a rotten egg odour. It is produced through industrial processes. The term "Total Reduced Sulphur" covers a larger group of sulphur-containing compounds, including $H_2S$, carbonyl sulphide, mercaptans, etc. These substances have the potential to cause odours in the region. In the WBEA airshed most industrial TRS and $H_2S$ emissions are from upgraders and tailings ponds, though there is a natural background ambient air concentration of the reduced sulphur compound carbonyl sulphide of approximately 0.5 ppb.



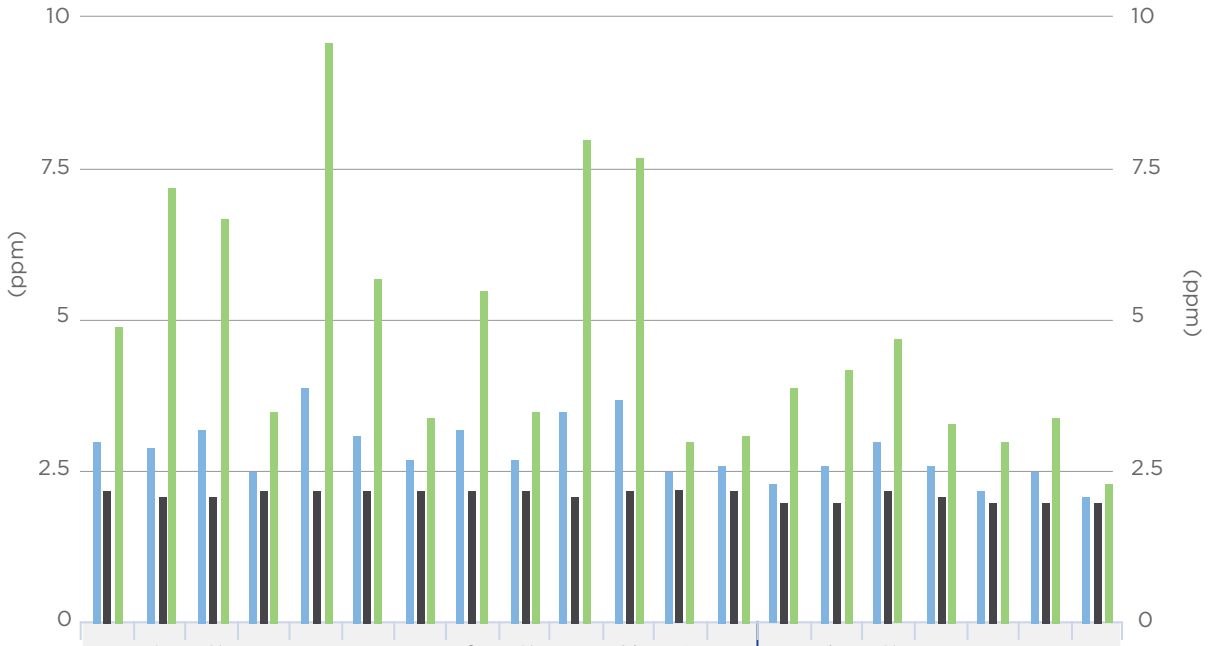

| | BARGE LANDING | ELLS RIVER | FORT HILLS | FORT MCKAY SOUTH | BUFFALO VIEWPOINT | CHRISTINA LAKE | FIREBAG | JACKFISH 1** | JACKFISH 2/3 | KIRBY NORTH** | LEISMER** | LOWER CAMP | MACKAY RIVER | MANNIX | MASKWA** | MILDRED LAKE | SURMONT 2 | WAPASU | ANZAC | ATHABASCA VALLEY | BERTHA GANTER | CONKLIN | JANVIER | PATRICIA MCINNES | STONY MOUNTAIN | BERTHA GANTER** | WASKÓW OHCI PIMÂTISIWIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99th Percentile | 1.9 | 1.2 | 2.2 | 1.7 | 1.6 | 1.0 | 0.9 | 0.7 | 0.5 | 0.7 | 1.8 | 3.8 | 1.5 | 2.7 | 0.6 | 2.4 | 0.4 | 0.7 | 0.3 | 1.5 | 1.7 | 0.6 | 0.3 | 0.7 | 0.3 | 1.2 | 1.4 |
| Average | 0.5 | 0.4 | 0.4 | 0.5 | 0.2 | 0.2 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.5 | 0.3 | 0.4 | 0.3 | 0.4 | 0.1 | 0.1 | 0.1 | 0.3 | 0.6 | 0.4 | 0.1 | 0.2 | 0.1 | 0.2 | 0.3 |
| Max | 3.3 | 4.0 | 10.6 | 3.5 | 9.7 | 5.0 | 3.6 | 6.4 | 1.0 | 4.3 | 1.8 | 16.8 | 16.1 | 10.3 | 4.2 | 17.2 | 0.7 | 2.2 | 3.2 | 5.5 | 4.1 | 1.7 | 0.5 | 1.5 | 0.7 | 3.5 | 3.3 |
| AAAQO 1-hour avg. | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | |

*** Station operational less than 75% of the time in 2021.*

# Total Hydrocarbons (THC)

Methane ($CH_4$) is the most abundant hydrocarbon on earth, while reactive non-methane hydrocarbons (NMHCs) can react with other compounds in atmosphere to form ozone. Total hydrocarbons (THC) are the combined concentrations on both methane and non-methane hydrocarbons. Some stations in the WBEA network only measure THCs, while certain stations measure $CH_4$, NMHC, and THC. Many hydrocarbons are emitted from natural sources, while others can come from industrial and vehicular emissions. The natural background level of THC, composed mainly of $CH_4$, is generally around 1.8 ppm.

*Note: THC does not currently have an AAAQO.*



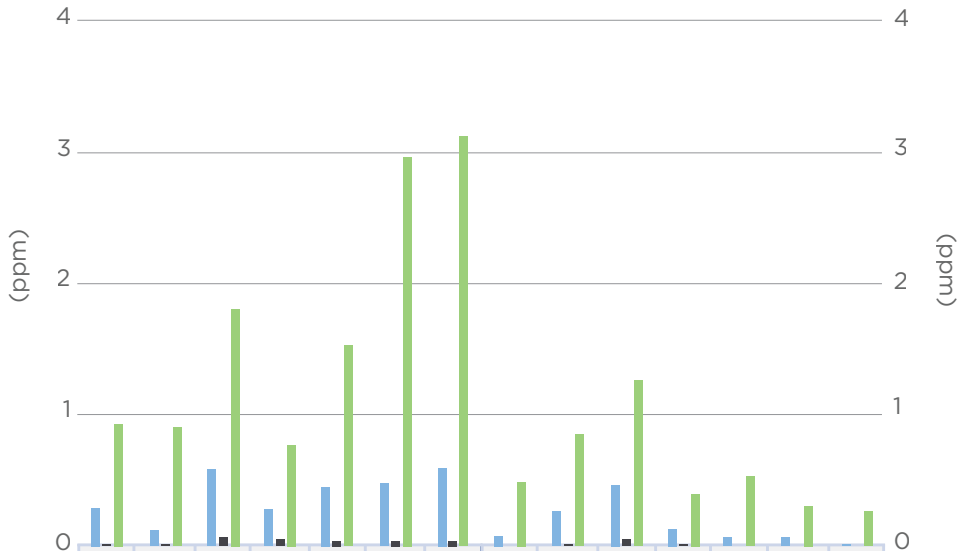

| | BARGE LANDING | BUFFALO VIEWPOINT | ELLS RIVER | FIREBAG | FORT HILLS | FORT MCKAY SOUTH | KIRBY NORTH** | LOWER CAMP | MACKAY RIVER | MANNIX | MILDRED LAKE | SURMONT 2 | WAPASU | ANZAC | ATHABASCA VALLEY | BERTHA GANTER | CONKLIN | JANVIER | PATRICIA MCINNES | STONY MOUNTAIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99th Percentile | 3.0 | 2.9 | 3.2 | 2.5 | 3.9 | 3.1 | 2.7 | 3.2 | 2.7 | 3.5 | 3.7 | 2.5 | 2.6 | 2.3 | 2.6 | 3.0 | 2.6 | 2.2 | 2.5 | 2.1 |
| Average | 2.2 | 2.1 | 2.1 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.1 | 2.2 | 2.2 | 2.2 | 2.0 | 2.0 | 2.2 | 2.1 | 2.0 | 2.0 | 2.0 |
| Max | 4.9 | 7.2 | 6.7 | 3.5 | 9.6 | 5.7 | 3.4 | 5.5 | 3.5 | 8.0 | 7.7 | 3.0 | 3.1 | 3.9 | 4.2 | 4.7 | 3.3 | 3.0 | 3.4 | 2.3 |

*** Station operational less than 75% of the time in 2021.*

# Non-Methane Hydrocarbons (NMHC)

Methane ($CH_4$) is the most abundant hydrocarbon on earth, while reactive non-methane hydrocarbons (NMHCs) can react with other compounds in atmosphere to form ozone. Total hydrocarbons (THC) are the combined concentrations on both methane and non-methane hydrocarbons. Some stations in the WBEA network only measure THCs, while certain stations measure $CH_4$, NMHC, and THC. Many hydrocarbons are emitted from natural sources, while others can come from industrial and vehicular emissions. The natural background level of THC, composed mainly of $CH_4$, is generally around 1.8 ppm.

*Note: NMHC does not currently have an AAAQO.*

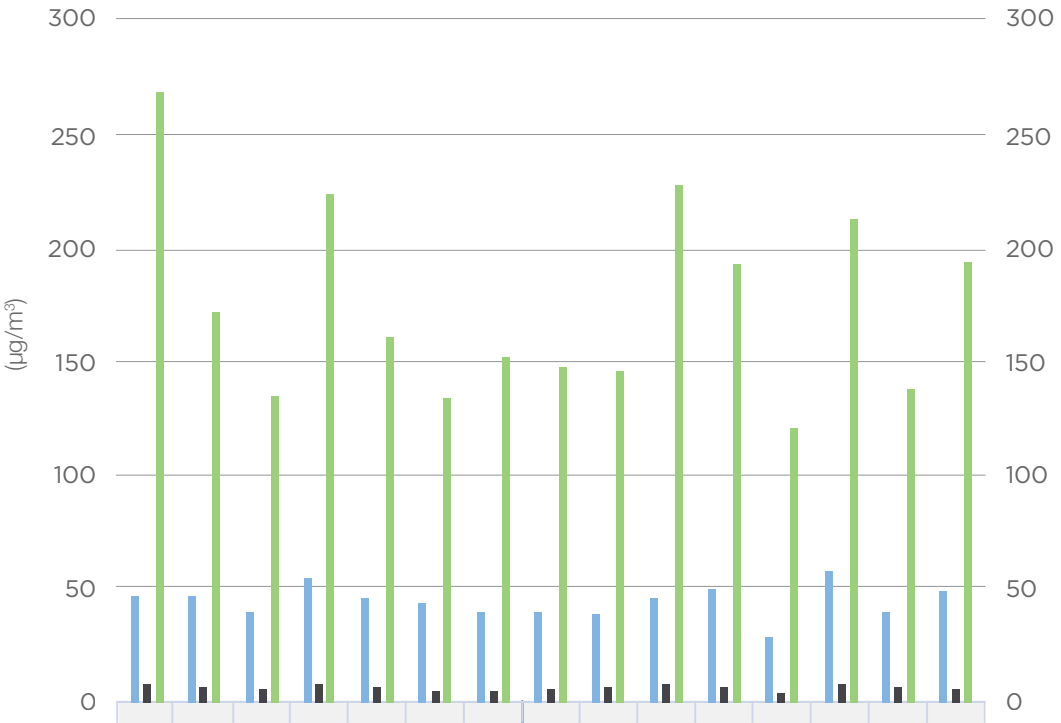



| | BARGE LANDING | BUFFALO VIEWPOINT | FORT HILLS | FORT MCKAY SOUTH | LOWER CAMP | MANNIX | MILDRED LAKE | ANZAC | ATHABASCA VALLEY | BERTHA GANTER | CONKLIN | JANVIER | PATRICIA MCINNES | STONY MOUNTAIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99th Percentile | 0.3 | 0.1 | 0.6 | 0.3 | 0.5 | 0.5 | 0.6 | 0.1 | 0.3 | 0.5 | 0.1 | 0.1 | 0.1 | 0.0 |
| Average | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Max | 0.9 | 0.9 | 1.8 | 0.8 | 1.5 | 3.0 | 3.1 | 0.5 | 0.9 | 1.3 | 0.4 | 0.5 | 0.3 | 0.3 |

# Fine Particulate Matter ($PM_{2.5}$)

Particulate matter consists of a mixture of solid particles and liquid droplets found in the air. Fine particulate matter is 2.5 µm in diameter or less, and is produced mainly by combustion processes, including forest fires. In 2019, all exceedances of the $PM_{2.5}$ AAAQO in the WBEA network were a result of forest fires. Fine particles are composed primarily of sulphate, nitrate, ammonium, inorganic and organic carbon compounds, and heavy metals. Fine particulate matter poses a health risk as the particles can be inhaled deep into the lungs.

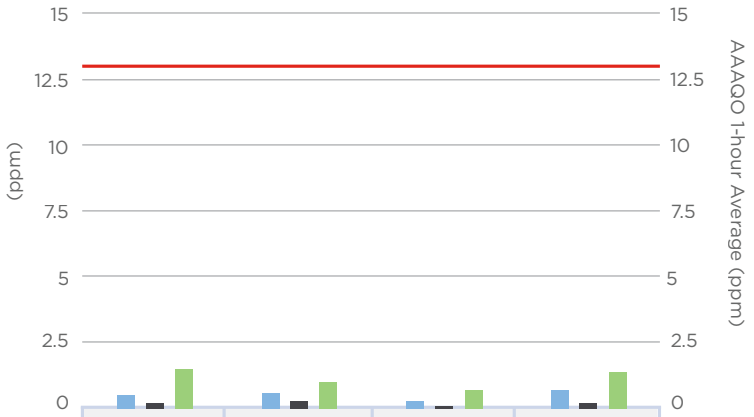
*Note: The data in the graph is presented using 1-hour concentration averages. Fine Particulate Matter ($PM_{2.5}$) does not currently have a 1-hour average AAAQO.*




| | BARGE LANDING | BUFFALO VIEWPOINT | ELLS RIVER | FORT HILLS | FORT MCKAY SOUTH | SURMONT 2 | WAPASU | ANZAC | ATHABASCA VALLEY | BERTHA GANTER | CONKLIN | FORT CHIPEWYAN | JANVIER | PATRICIA MCINNES | STONY MOUNTAIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99th Percentile | 47.2 | 46.9 | 40.3 | 54.7 | 46.0 | 43.7 | 40.4 | 40.5 | 39.0 | 46.4 | 49.9 | 29.5 | 58.5 | 39.8 | 49.0 |
| Average | 8.5 | 7.4 | 5.7 | 8.2 | 7.4 | 5.4 | 5.5 | 5.6 | 7.3 | 7.9 | 6.9 | 4.2 | 8.0 | 6.6 | 5.7 |
| Max | 269.1 | 172.1 | 135.4 | 224.4 | 161.3 | 133.8 | 152.4 | 148.2 | 146.3 | 228.4 | 193.3 | 121.1 | 213.4 | 138.0 | 194.0 |

# Carbon Monoxide (CO)

Carbon monoxide is formed from the incomplete combustion of carbon in fossil fuels. Transportation and vehicle emissions are the major source of carbon monoxide with elevated concentrations during the morning and evening rush hours. Breathing carbon monoxide decreases the amount of oxygen carried by the blood stream.

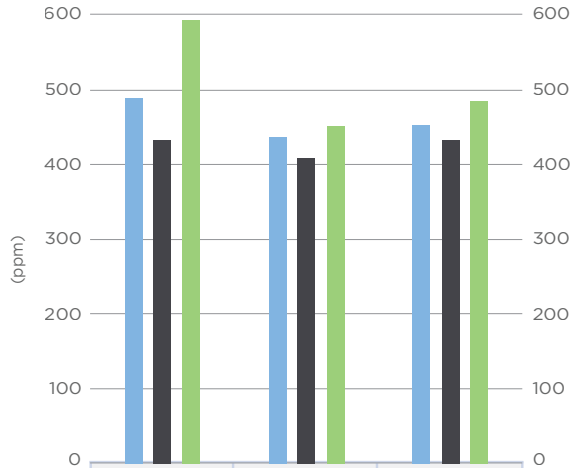



| | ATHABASCA VALLEY | BERTHA GANTER | FORT CHIPEWYAN | STONY MOUNTAIN |
|---|---|---|---|---|
| 99th Percentile | 0.5 | 0.6 | 0.3 | 0.7 |
| Average | 0.2 | 0.3 | 0.1 | 0.2 |
| Max | 1.5 | 1.0 | 0.7 | 1.4 |
| AAAQO 1-hour avg. | 13 | | | |

# Carbon Dioxide ($CO_2$)

Carbon dioxide is a natural component of the air we breath. It is a colorless, odourless gas produced by respiration of plants and animals, and through combustion of fossil fuels. Ambient carbon dioxide is generally not a human health concern and is monitored in the network to help differentiate between origins of emissions such as forest fires and anthropogenic sources.

*Note: $CO_2$ does not currently have an AAAQO.*

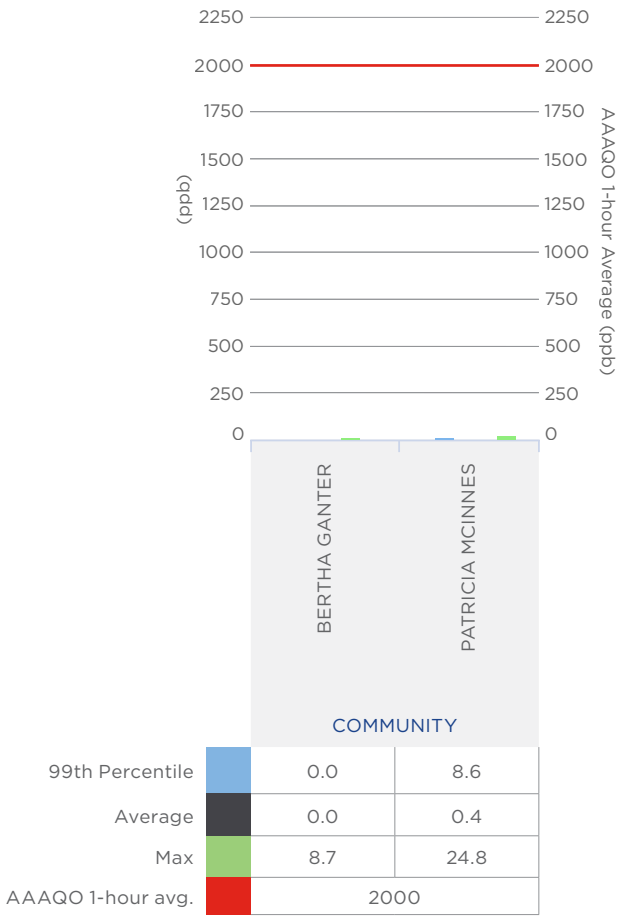



| | BERTHA GANTER | FORT CHIPEWYAN | STONY MOUNTAIN |
|---|---|---|---|
| 99th Percentile | 490.0 | 438.0 | 454.0 |
| Average | 433.0 | 409.0 | 433.0 |
| Max | 594.0 | 452.0 | 486.0 |

*** Station operational less than 75% of the time in 2021.*

# Ammonia ($NH_3$)

Ammonia is a natural compound found in the environment as part of the nitrogen cycle and can also come from human activity. Ammonia is monitored by the WBEA because it is used by one industry member to help reduce $SO_2$ emissions. Exposure to elevated concentrations of ammonia can cause irritation of the nose, throat, and respiratory tract.




| | | BERTHA GANTER | PATRICIA MCINNES |
|---|---|---|---|
| 99th Percentile | | 0.0 | 8.6 |
| Average | | 0.0 | 0.4 |
| Max | | 8.7 | 24.8 |
| AAAQO 1-hour avg. | | 2000 | |

*** Station operational less than 75% of the time in 2021.*
*Note: Averages may be too small to be visible on some graphs.*

# Time-Integrated monitoring

Time-integrated sampling provides more detailed analysis of species present in ambient air, and supplements continuous monitoring which reports a total concentration in real-time. Time-integrated monitoring methods consist of exposing sample media to the atmosphere for a period of time, and then the media is sent to a laboratory for analysis.

The WBEA's time-integrated sampling data is available to everyone at **wbea.org/network-and-data/integrated-data**. The data for time-integrated monitoring methods is presented in the graphs below as the annual average (mean) of 24-hour sample concentrations, along with the 95th percentile to show readings on the high-end of the data collected, after removing the highest 5% which may be outliers. There are numerous species collected, however, the graphs show the nine (9) or ten (10) parameters with the highest concentrations in 2021.

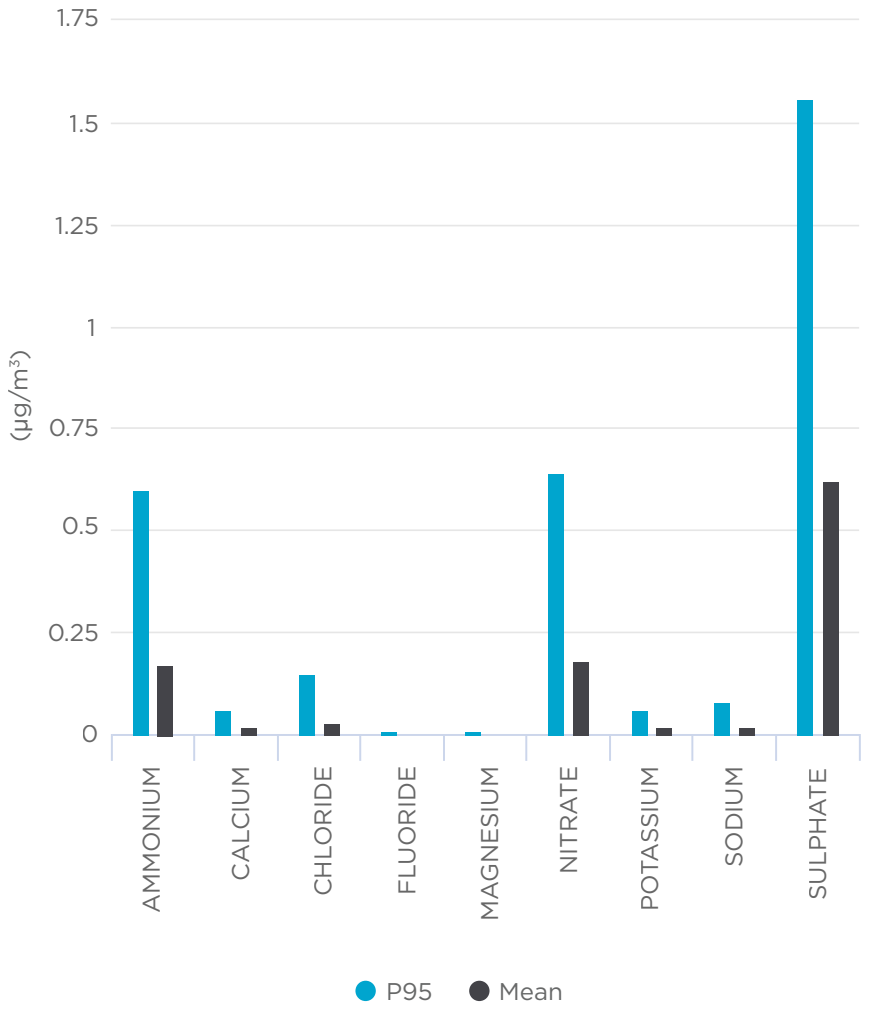
# Particulate Matter 2.5 ($PM_{2.5}$) Ions

$PM_{2.5}$ refers to particles in the fine fraction (2.5 µm in diameter or less) that are produced mainly by combustion processes and by atmospheric reactions between precursor gases such as sulphur dioxide, nitrogen oxides, ammonia and some volatile organic compounds. In the coarse fraction (between 2.5 and 10 µm in diameter), particles are mainly from re-suspended road dust, windblown dust, and material handling, grinding and crushing operations. $PM_{10}$ includes both the fine and coarse fractions and is sometimes referred to as inhalable particulate matter. Particulate matter consists of a mixture of solid particles and liquid droplets found in the air. Fine particulate matter ($PM_{2.5}$) is 2.5µm in diameter or less, while coarse particulate matter ($PM_{10}$) is 10µm in diameter or less.

In the time-integrated sampling program, particulate matter (both $PM_{2.5}$ & $PM_{10}$) is collected on a filter for a 24-hour period, every six days. $PM_{2.5}$ samples were collected at six community stations (Bertha Ganter-Fort McKay, Patricia McInnes, Athabasca Valley, Anzac, Janvier, and Conklin) and one industrial location (Horizon). $PM_{10}$ samples were taken at the same six community stations and three industrial stations (Fort McKay South, Horizon, and Muskeg River). These filters are then sent to the lab for sample analysis to learn the chemical compositions including ionic and metal species. Ions are electrically-charged, water-soluble particles, while metals are neutral species.

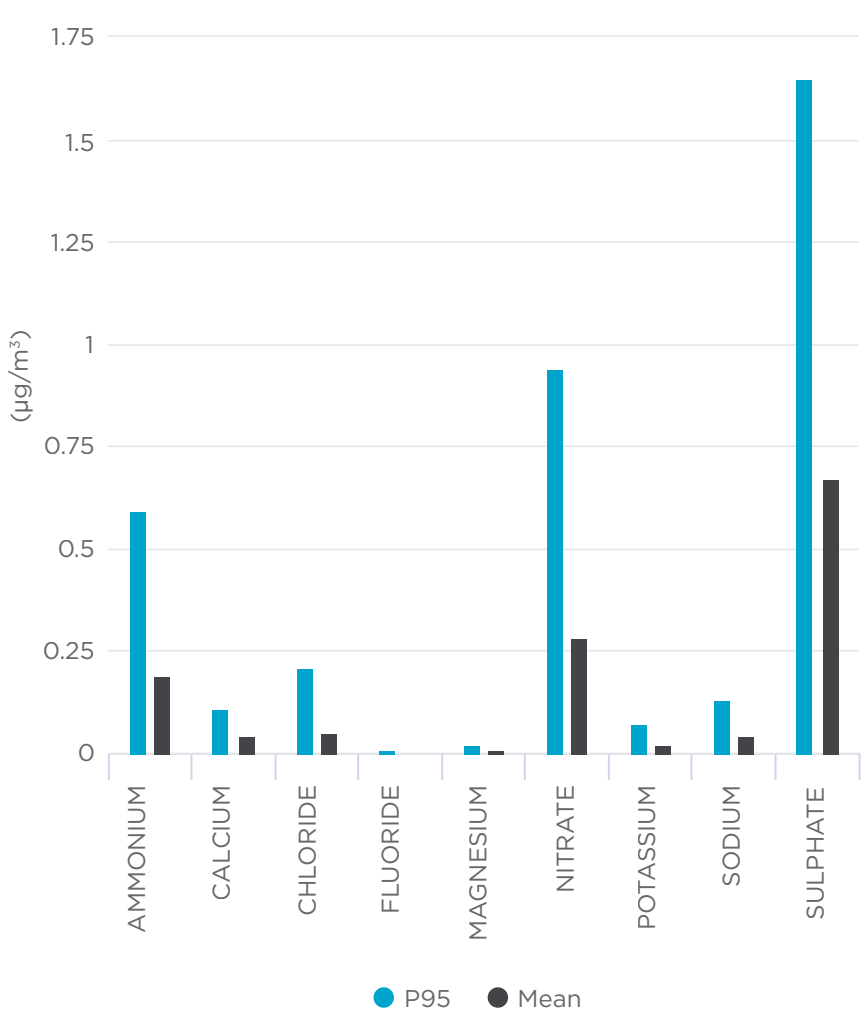
The continuous analyzer can tell us the concentration of particulate matter in the air at any given time, while a time-integrated sample can tell us what is making up the composition of the particulate matter in the air.

## Anzac

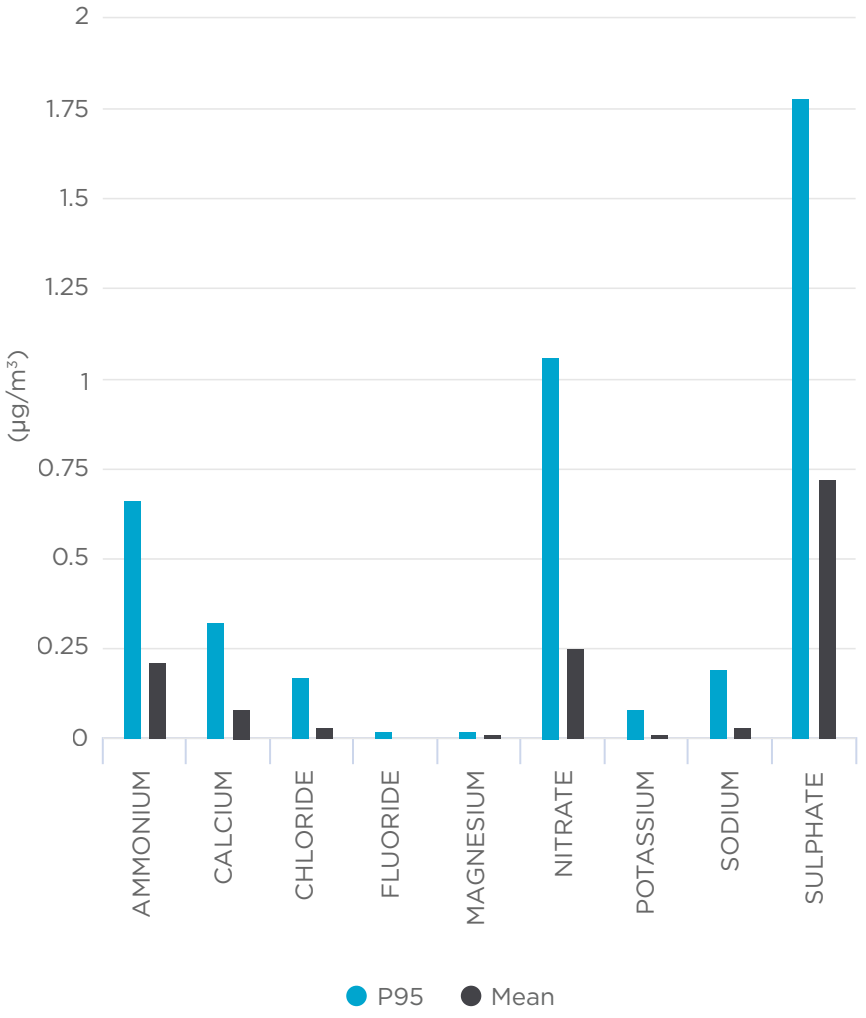



*Note: Averages may be too small to be visible on some graphs.*

## Athabasca Valley

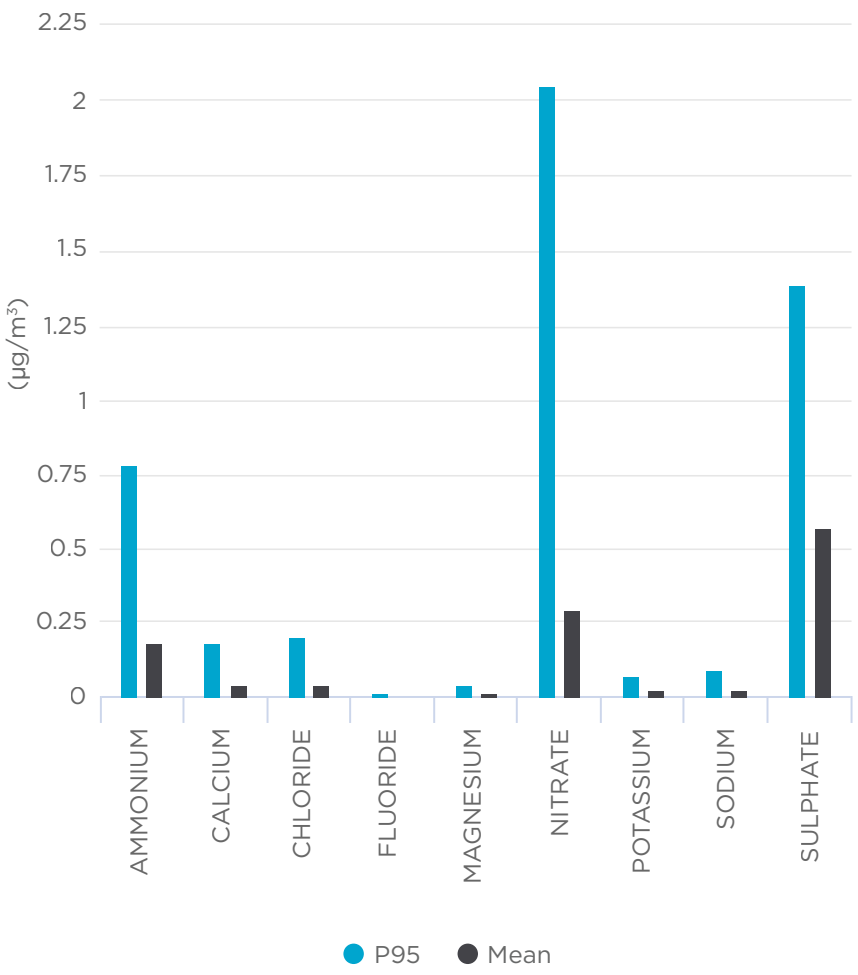



## Bertha Ganter - Fort McKay

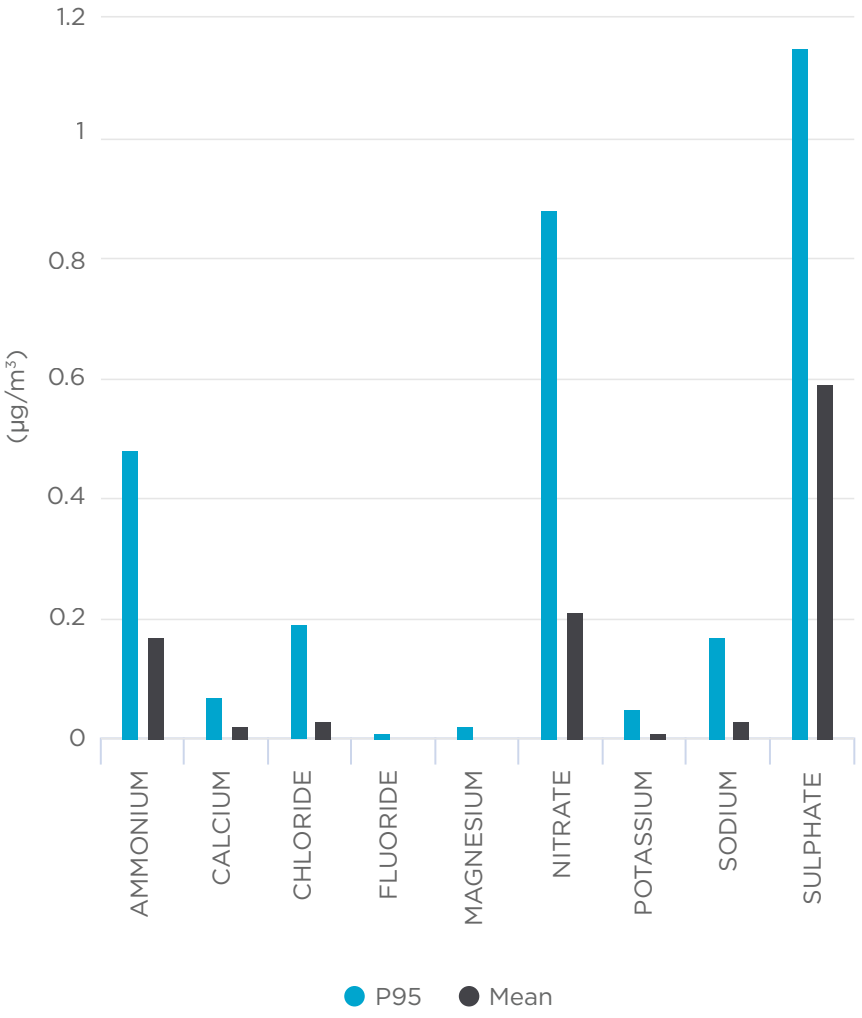



*Note: Averages may be too small to be visible on some graphs.*

## Conklin

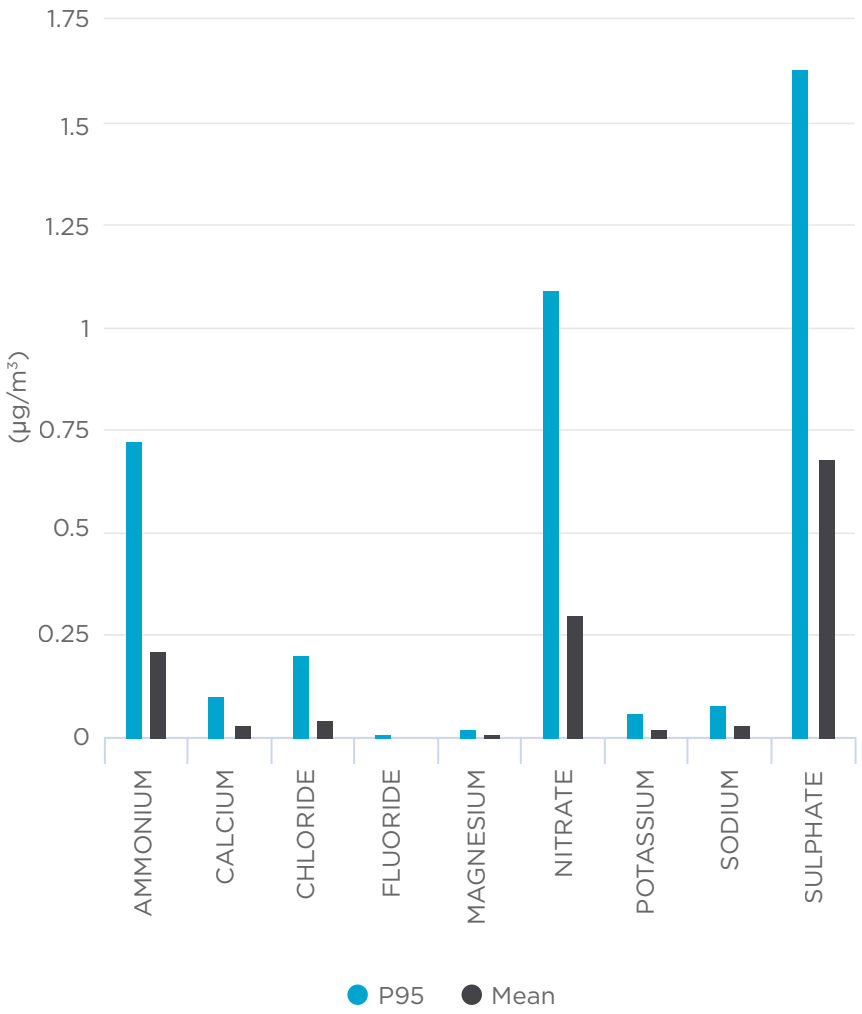



## Janvier



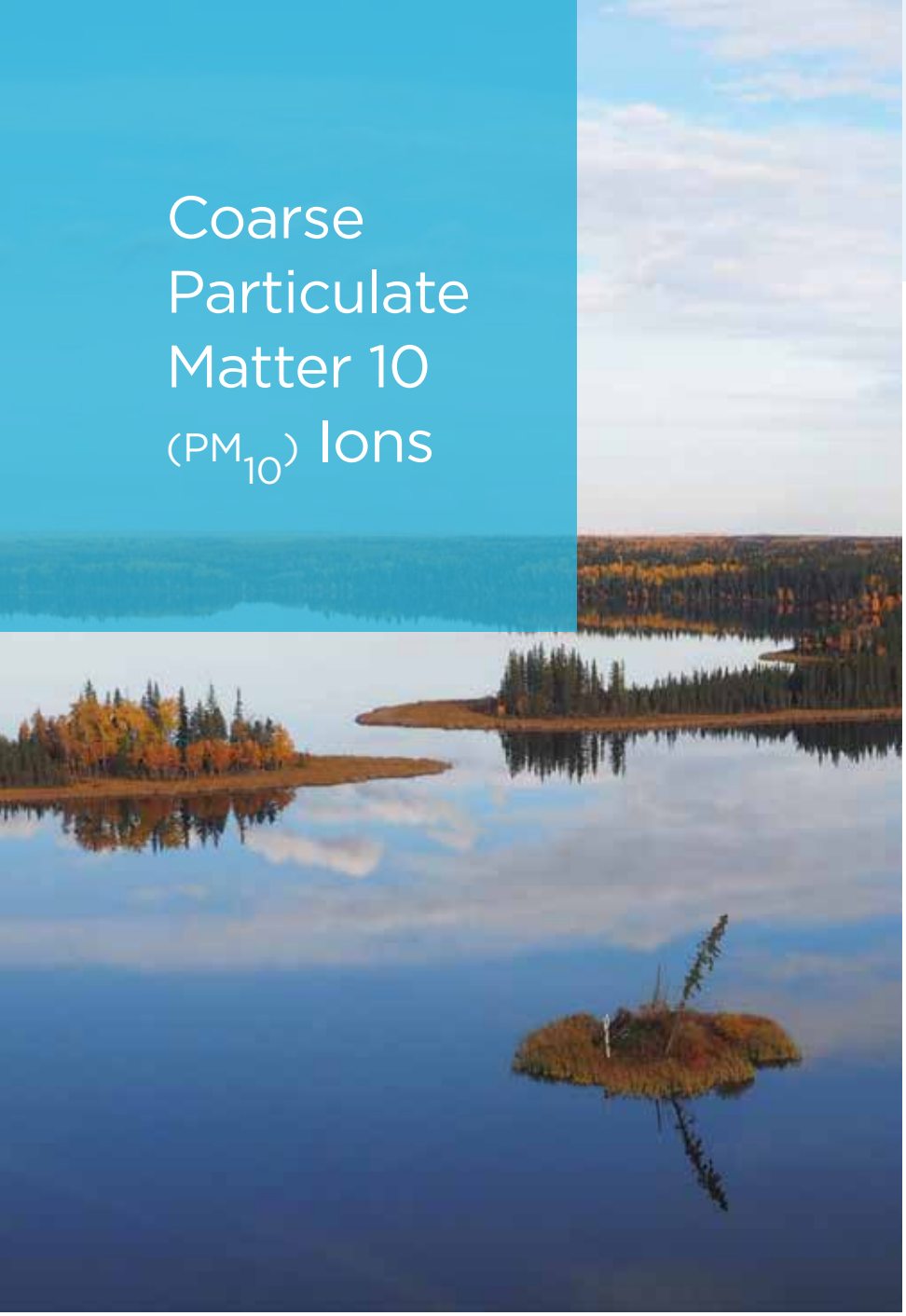

*Note: Averages may be too small to be visible on some graphs.*

## Patricia McInnes

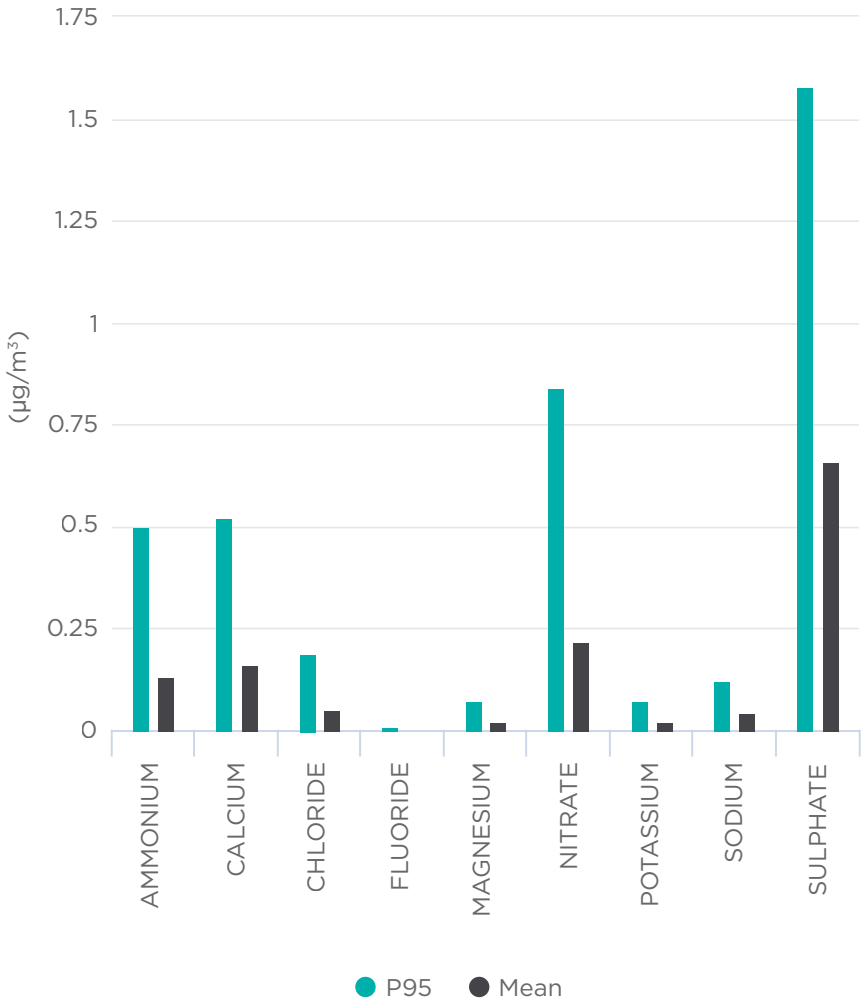



*Note: Averages may be too small to be visible on some graphs.*

# Coarse Particulate Matter 10 ($PM_{10}$) Ions

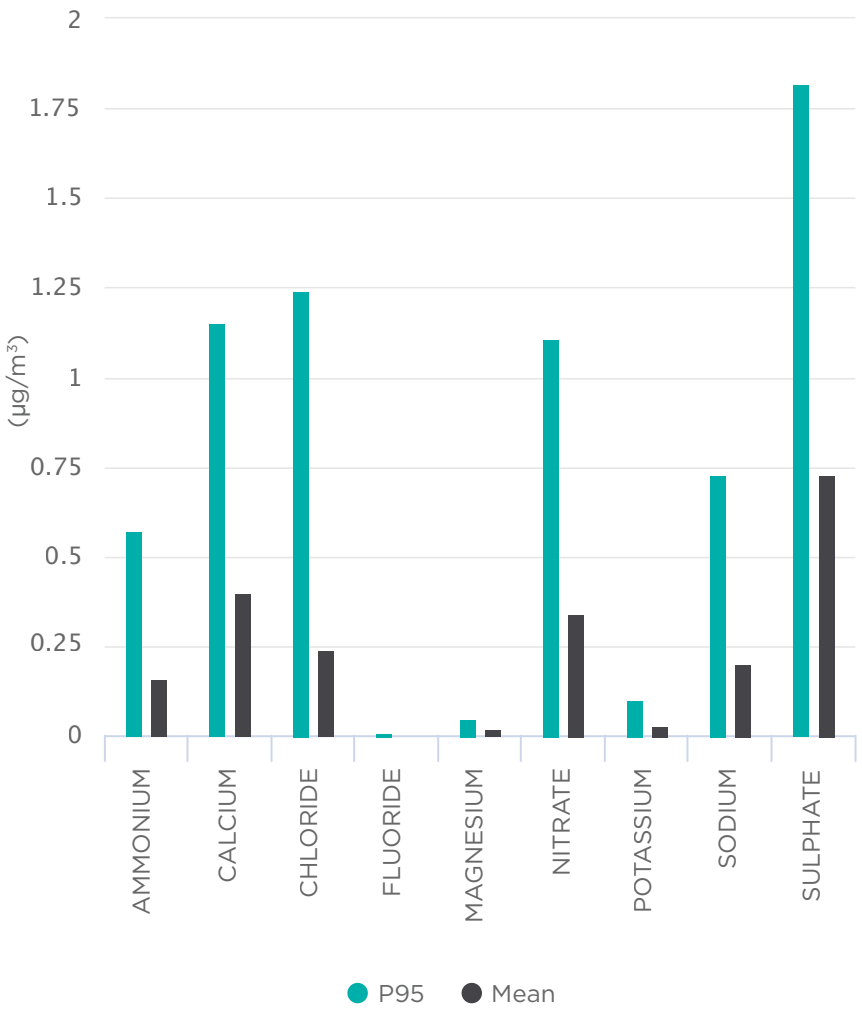


## Anzac

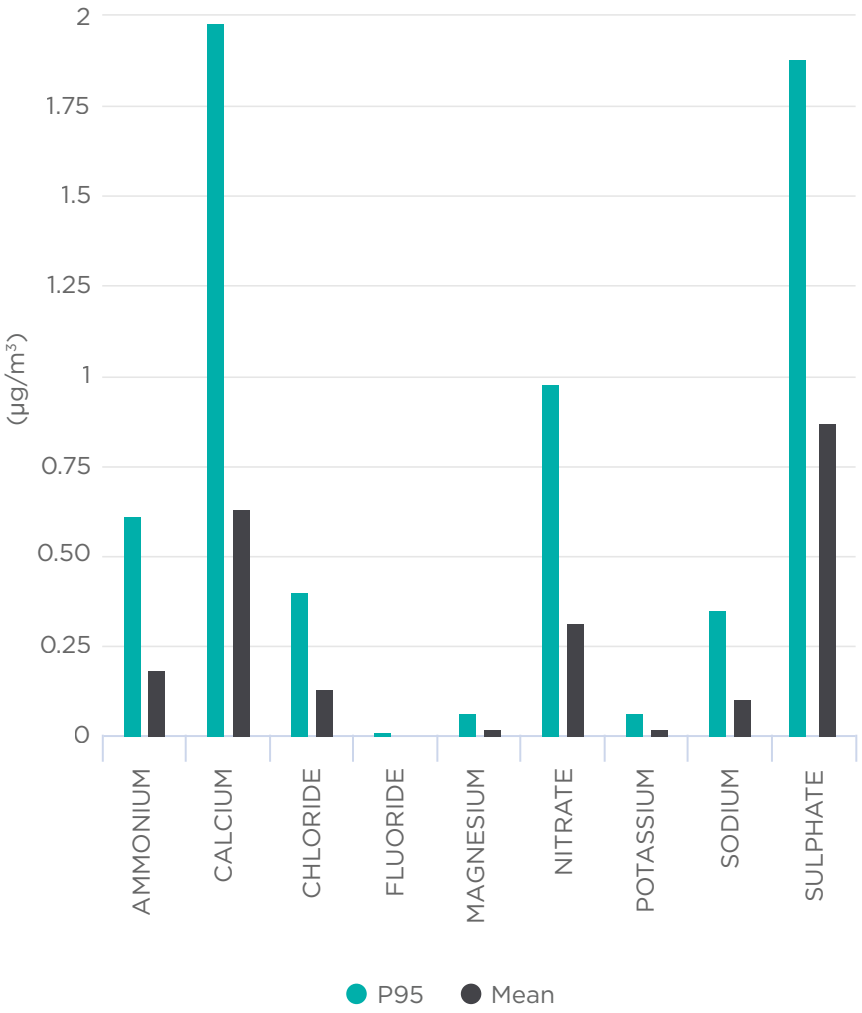



*Note: Averages may be too small to be visible on some graphs.*

## Athabasca Valley

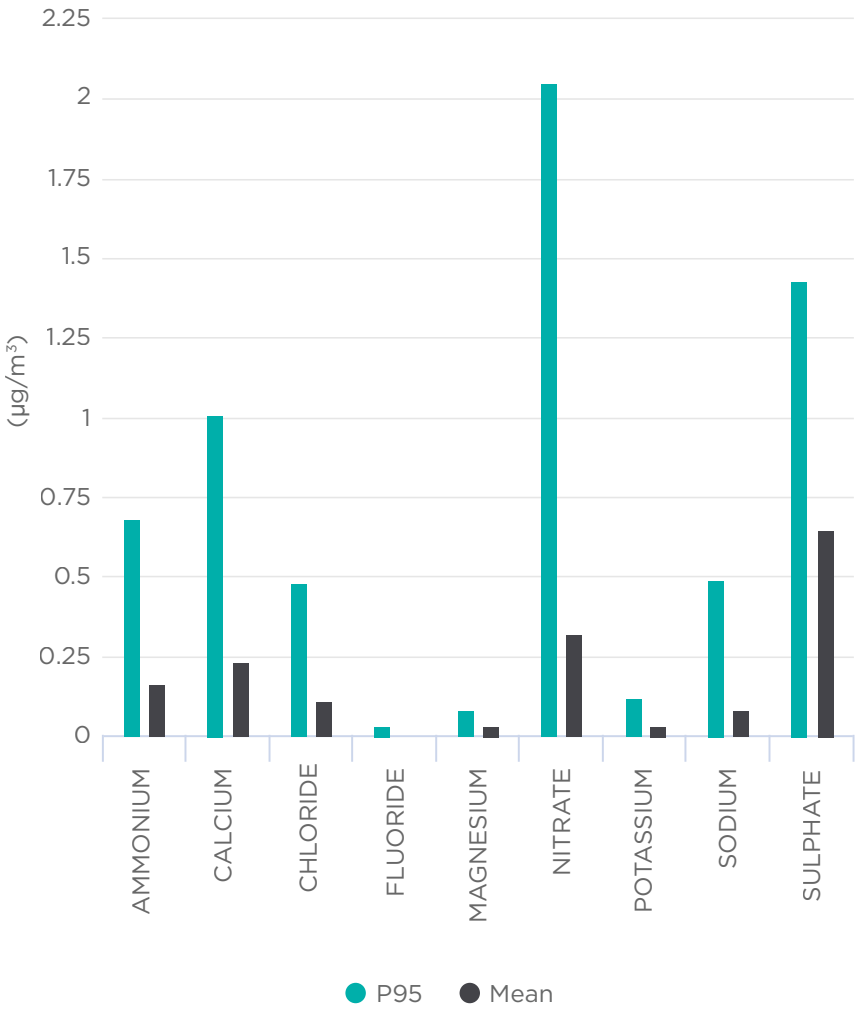



## Bertha Ganter - Fort McKay

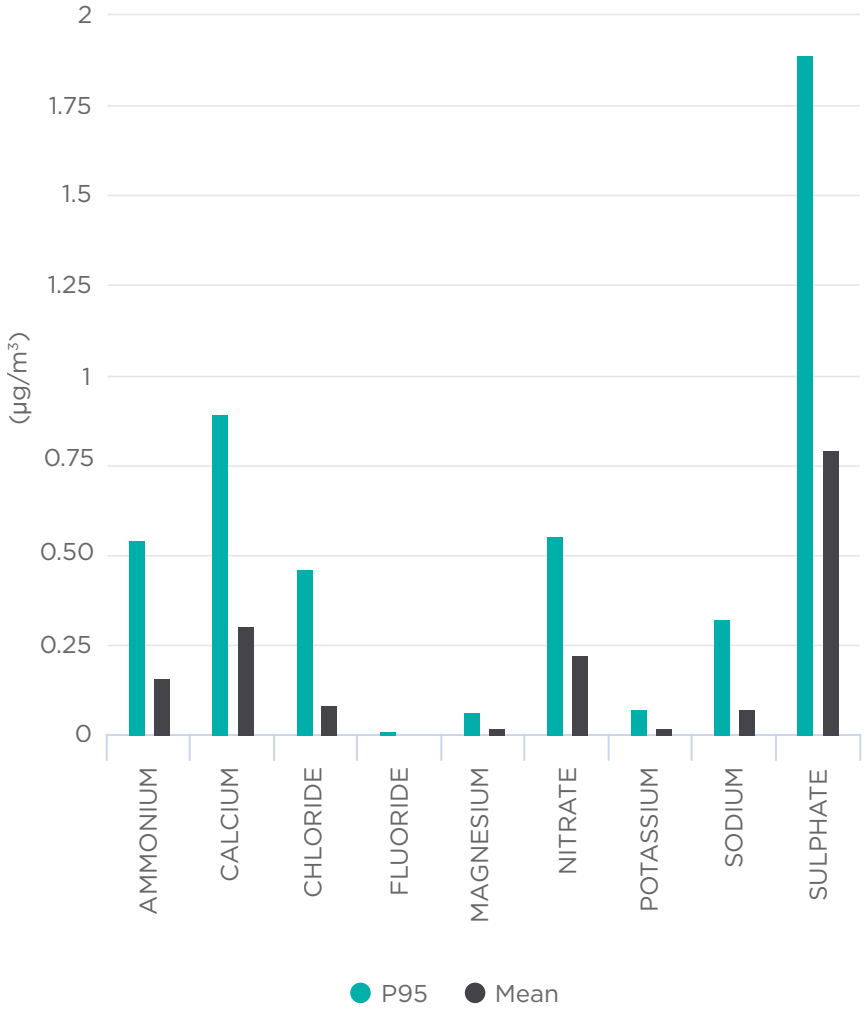



*Note: Averages may be too small to be visible on some graphs.*

## Conklin

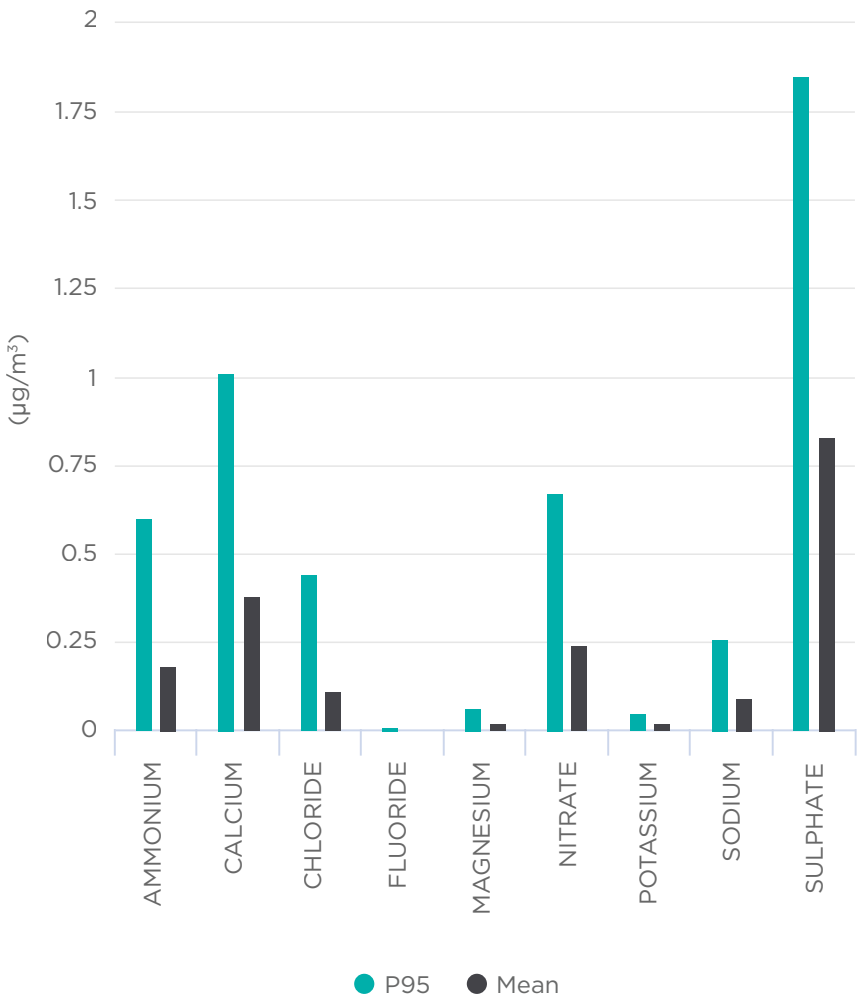



## Ells River

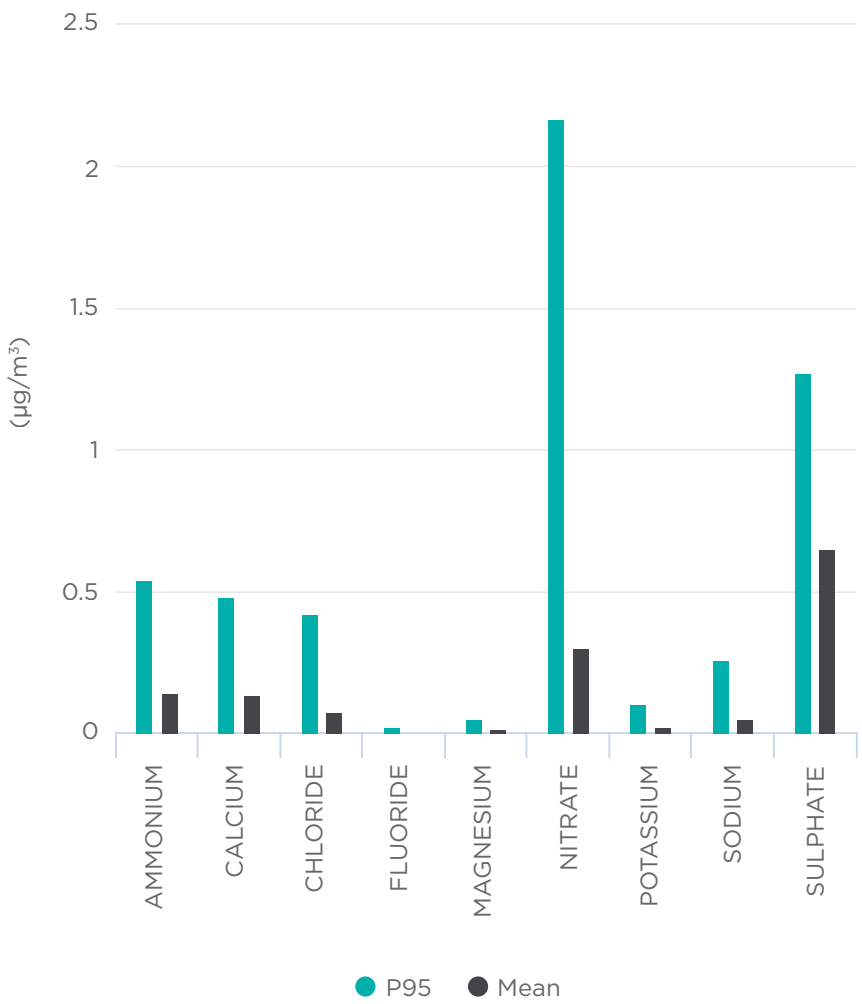



*Note: Averages may be too small to be visible on some graphs.*

## Fort McKay South

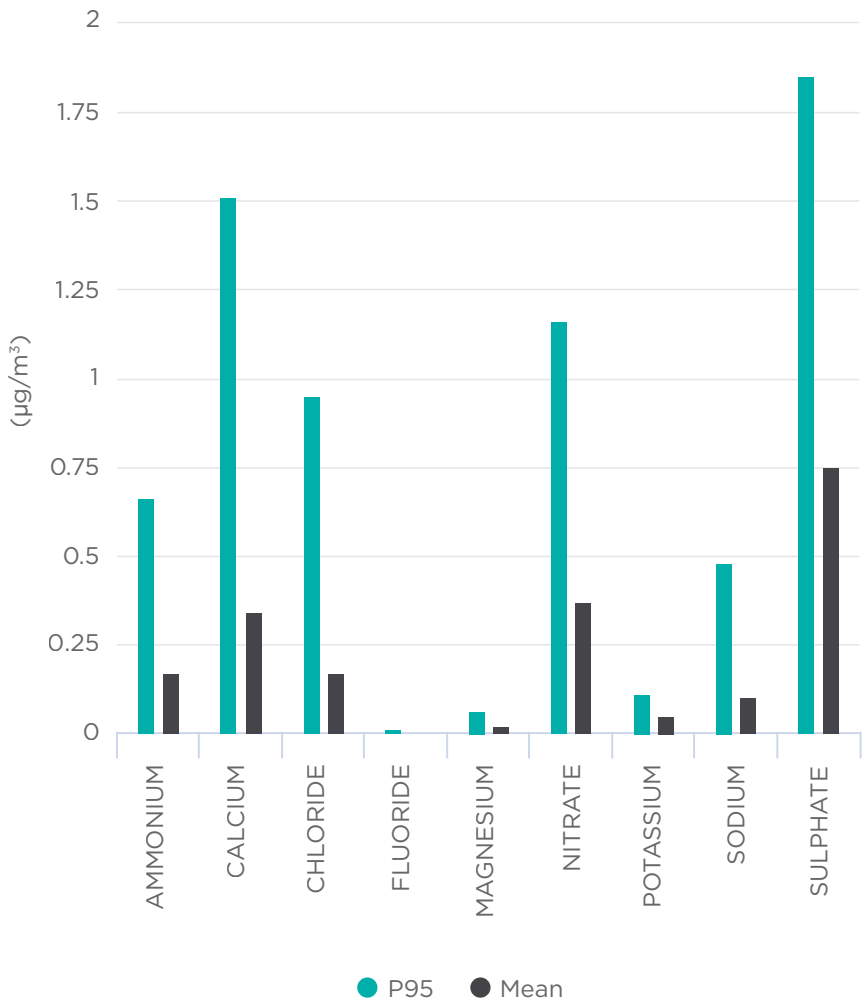



## Janvier



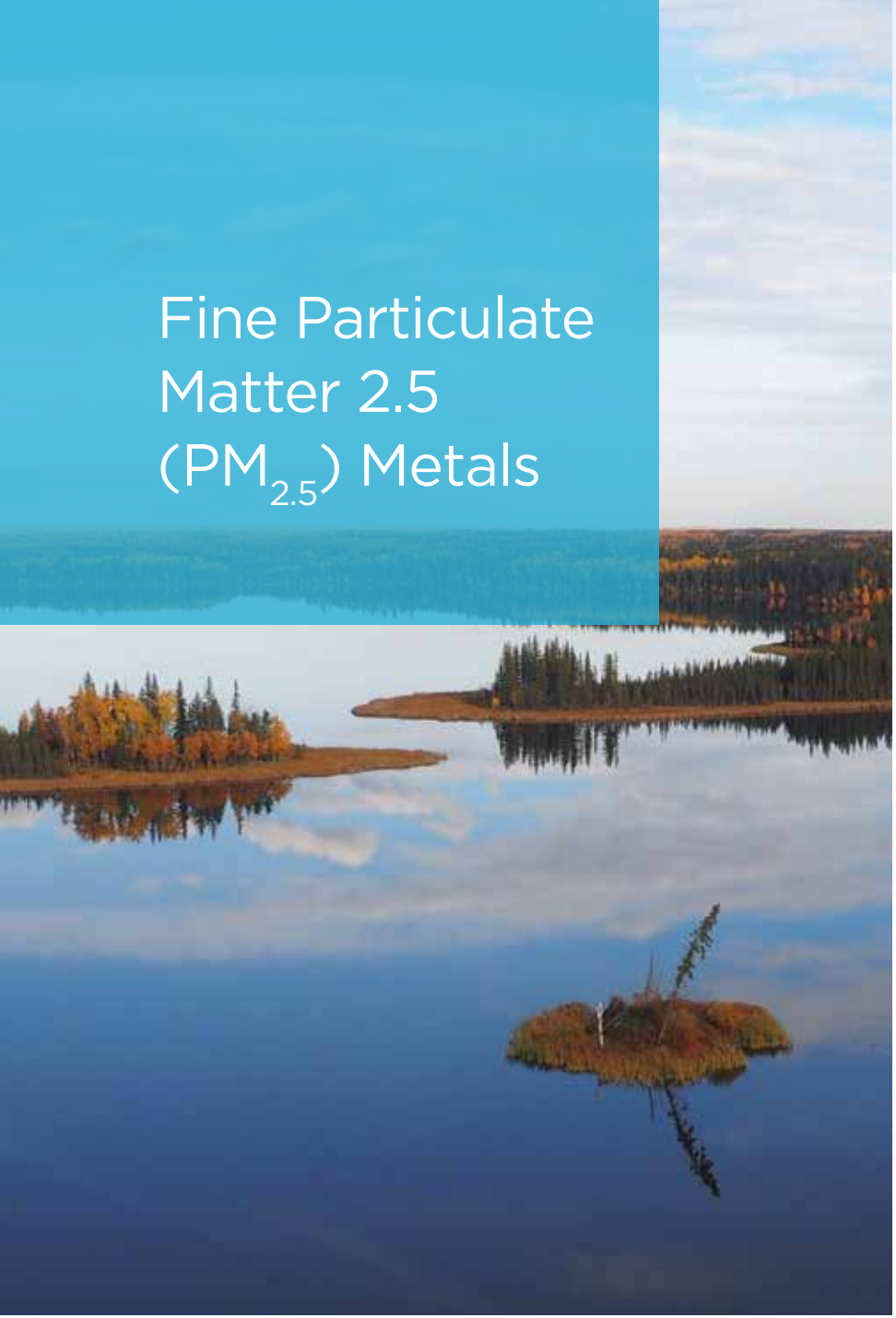

*Note: Averages may be too small to be visible on some graphs..*

## Patricia McInnes

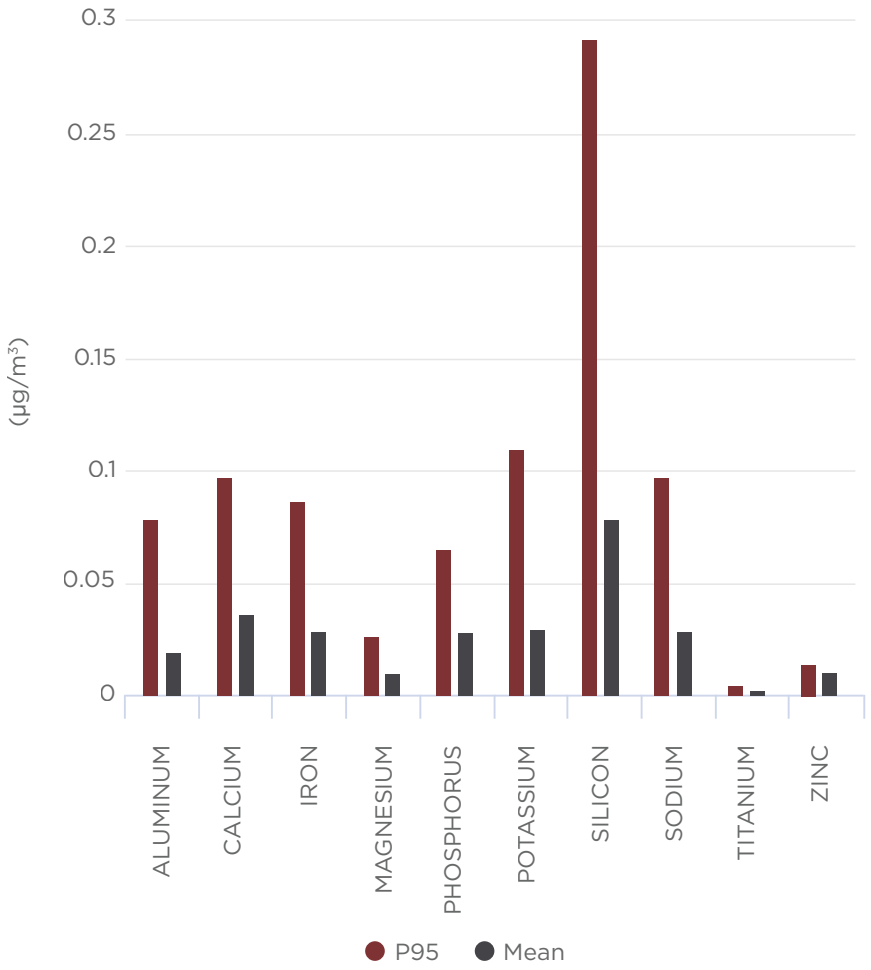



*Note: Averages may be too small to be visible on some graphs..*

# Fine Particulate Matter 2.5 ($PM_{2.5}$) Metals

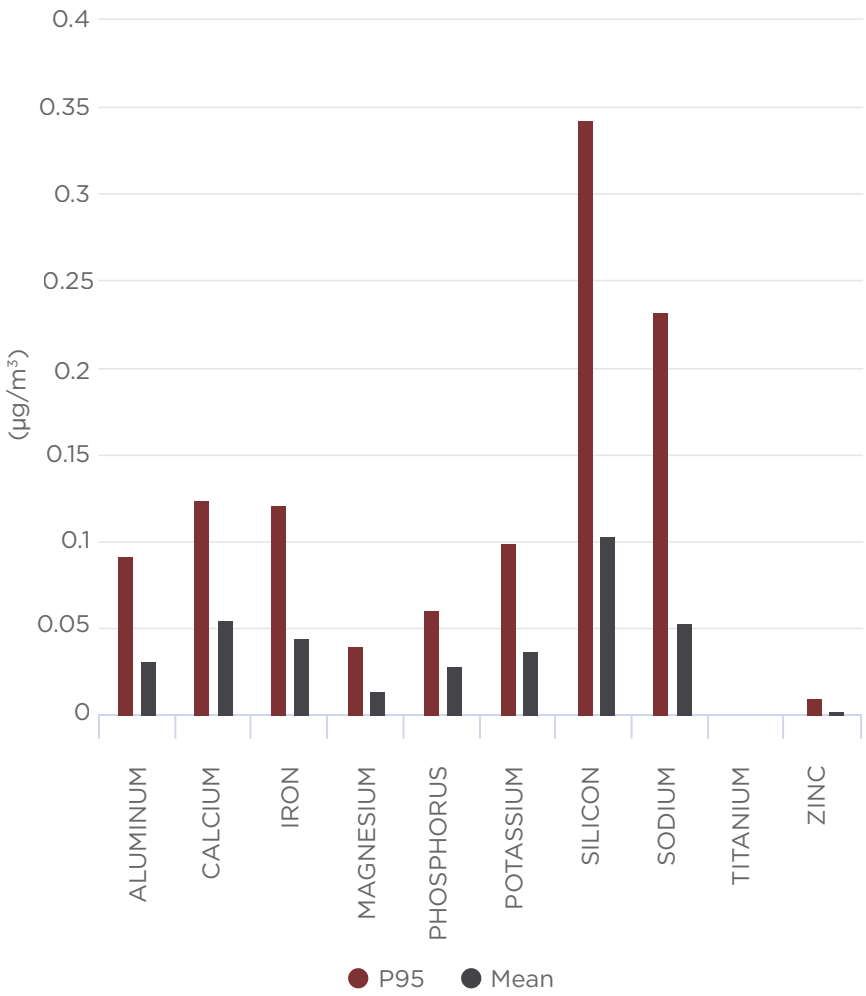


## Anzac

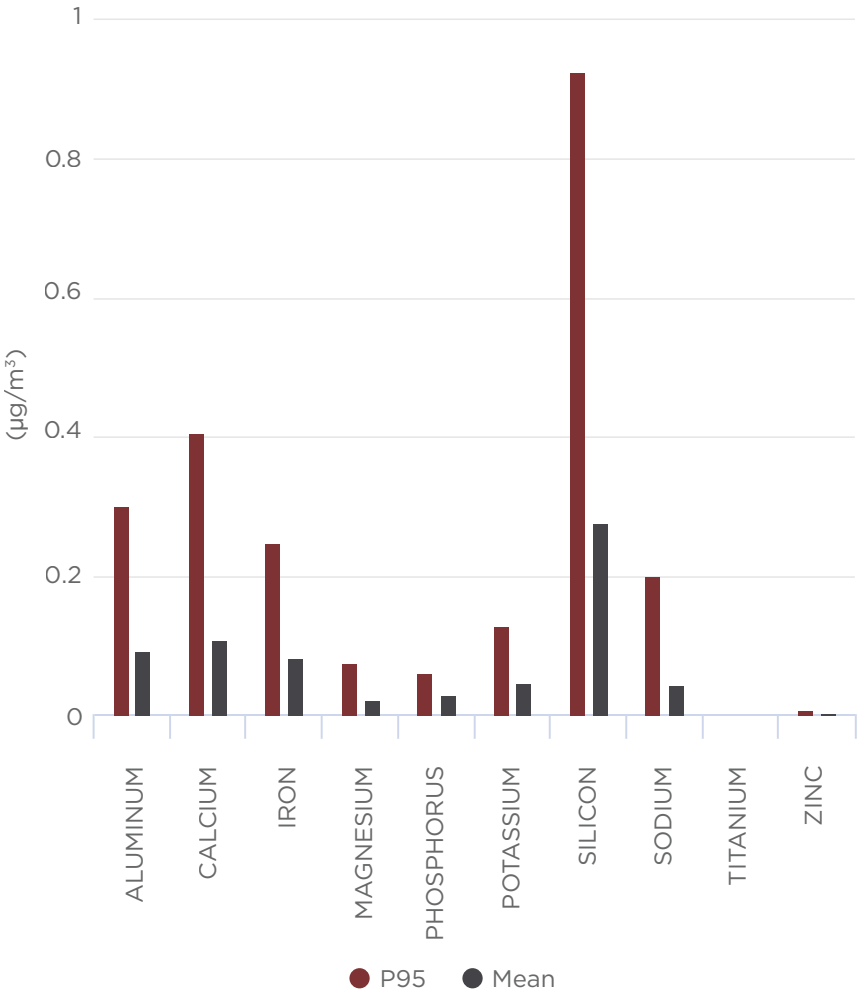



*Note: Averages may be too small to be visible on some graphs.*

## Athabasca Valley

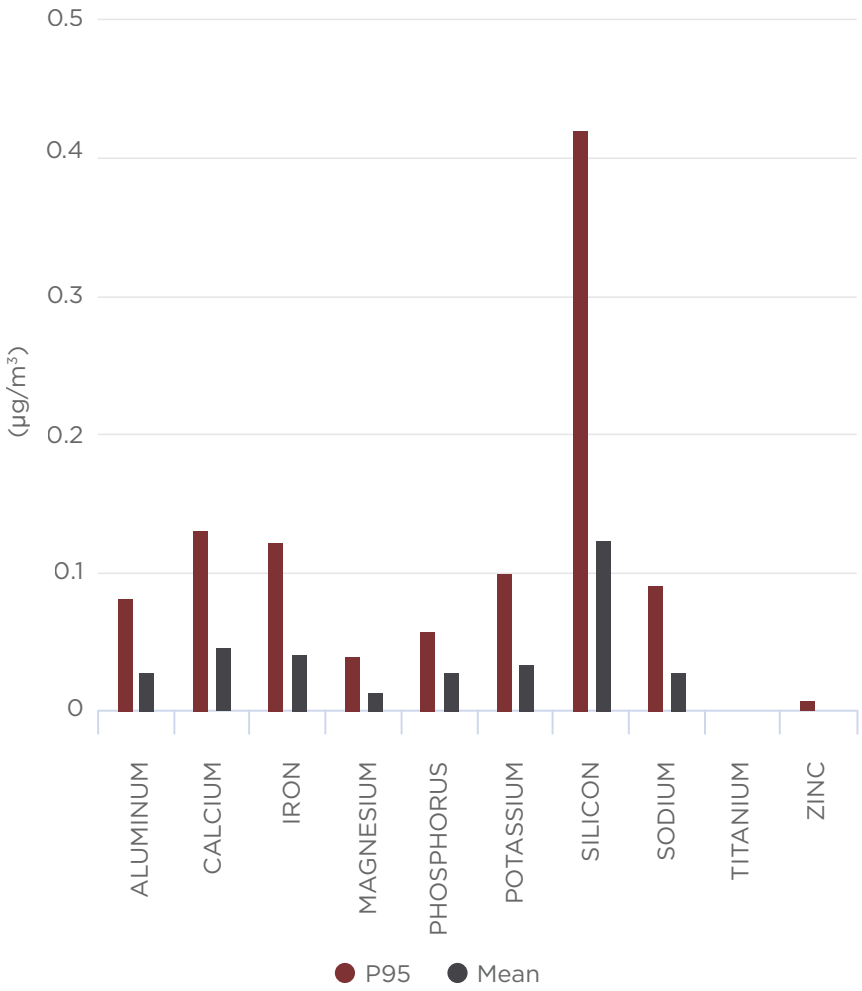



## Bertha Ganter - Fort McKay

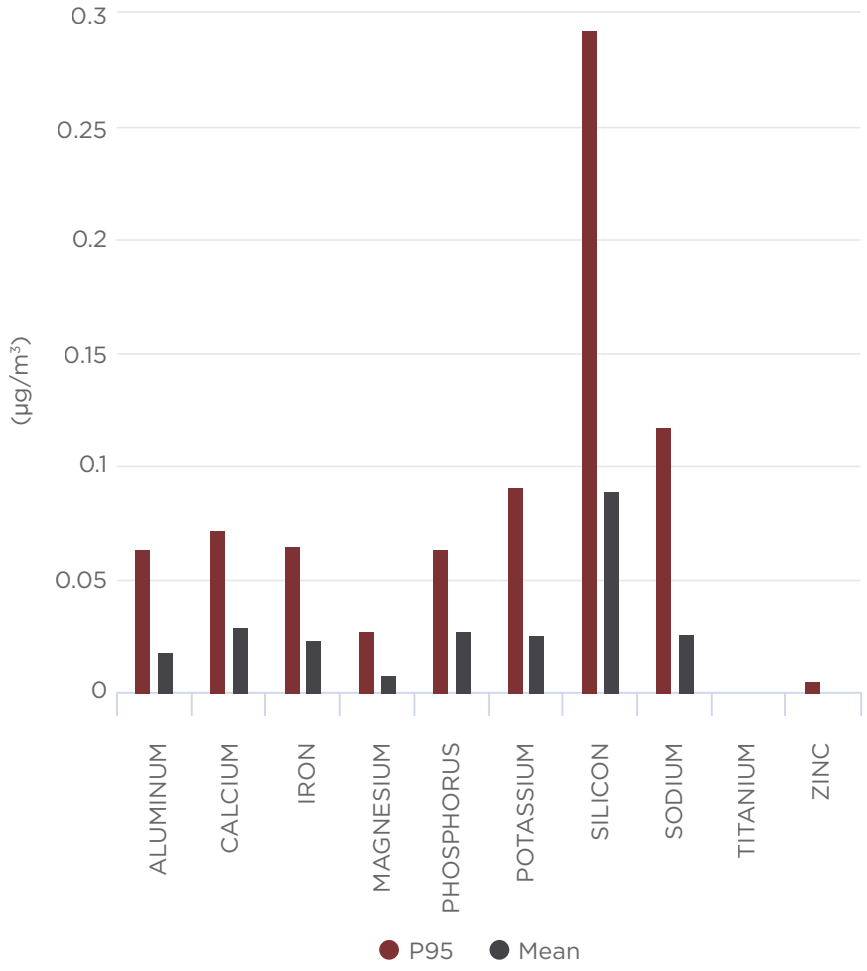



*Note: Averages may be too small to be visible on some graphs.*

## Conklin

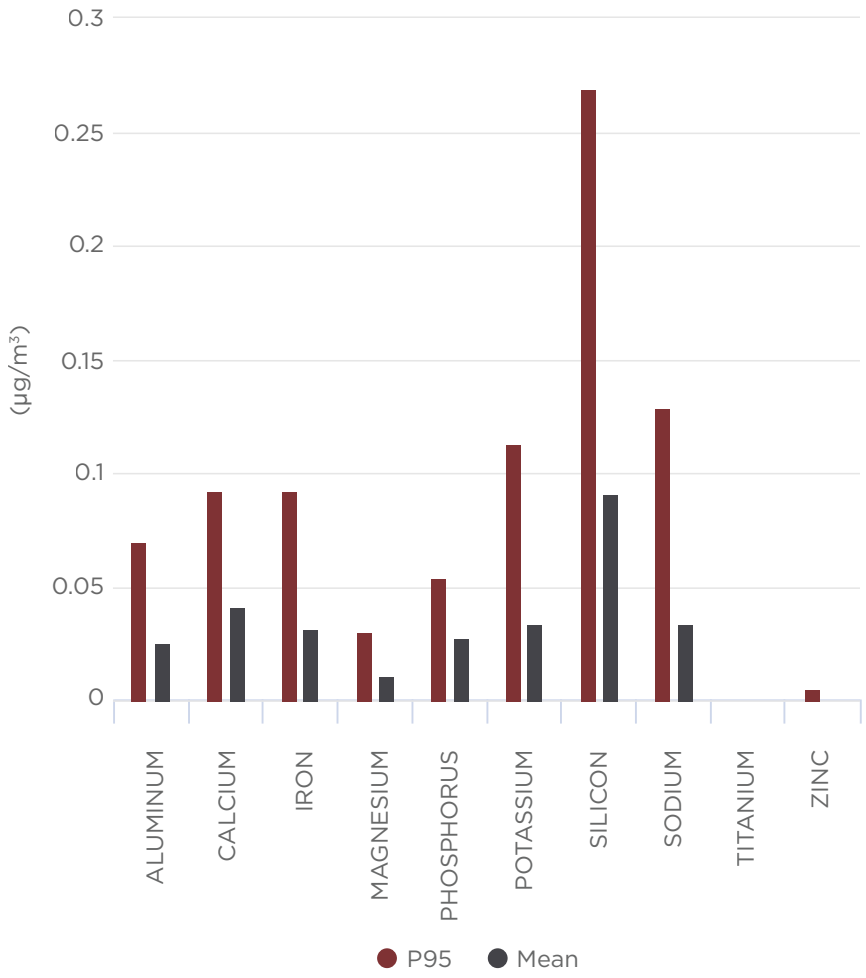



## Janvier



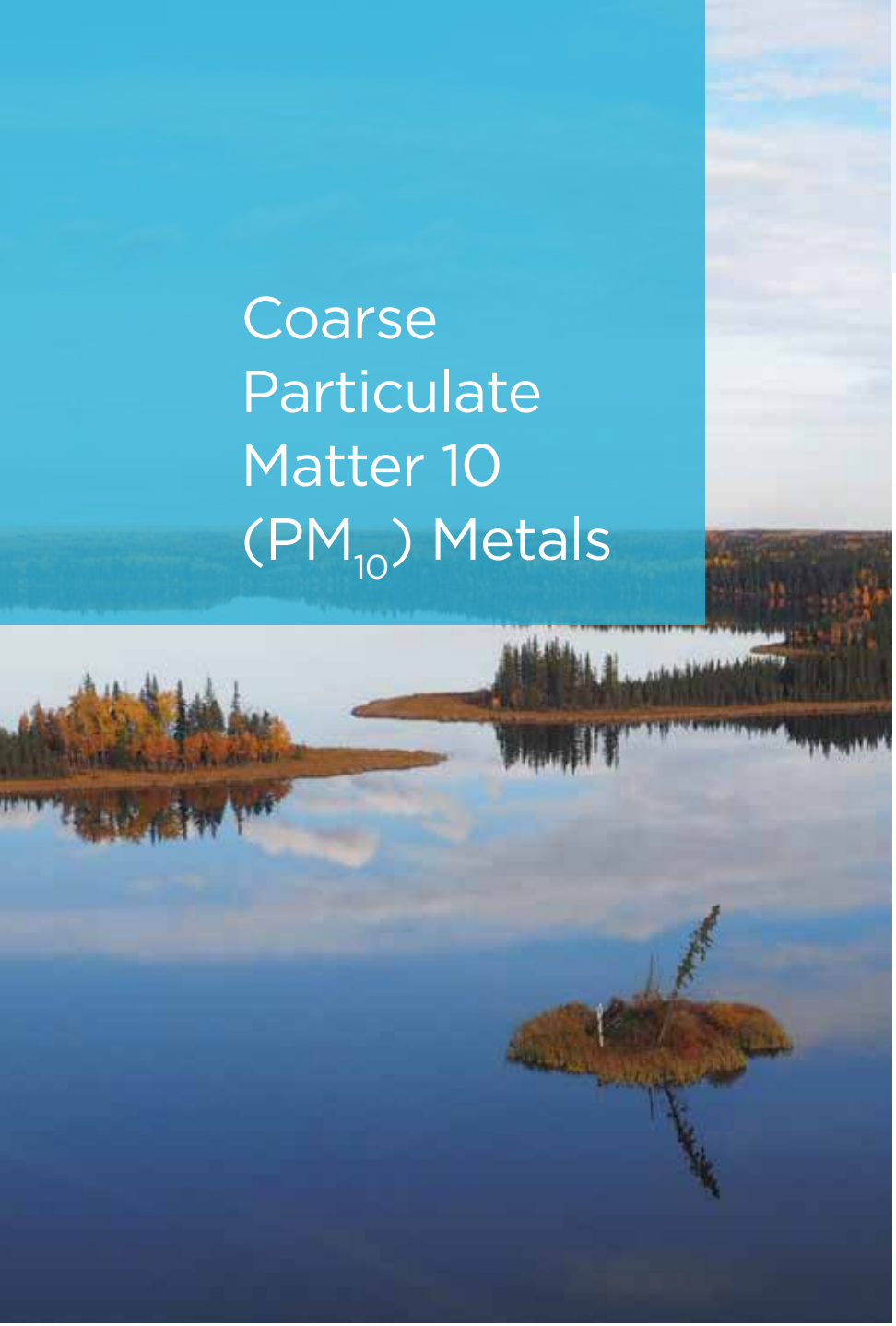

*Note: Averages may be too small to be visible on some graphs.*

## Patricia McInnes

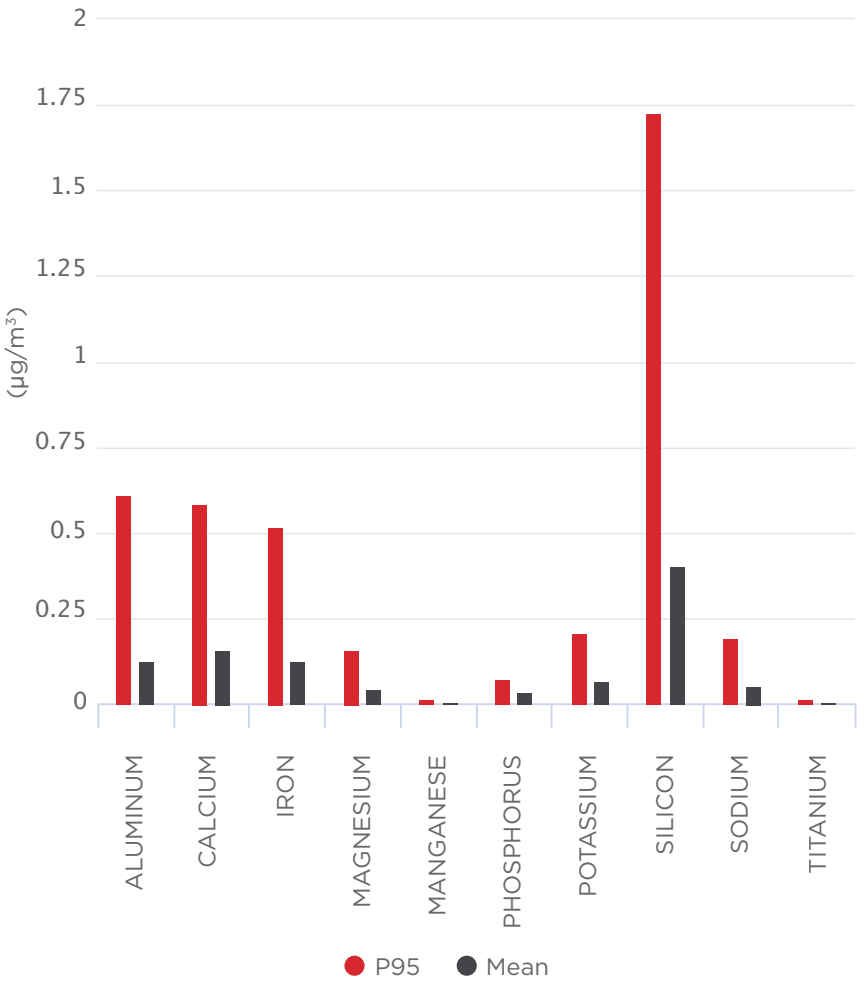



*Note: Averages may be too small to be visible on some graphs.*

# Coarse Particulate Matter 10 ($PM_{10}$) Metals

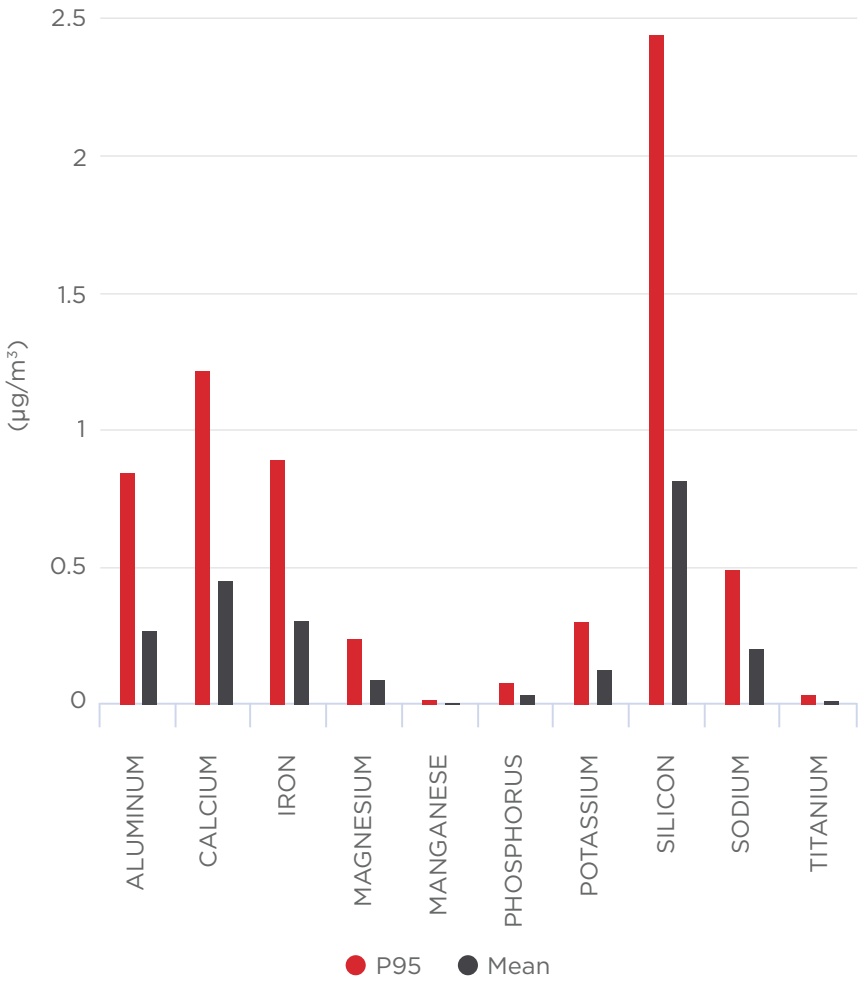


## Anzac

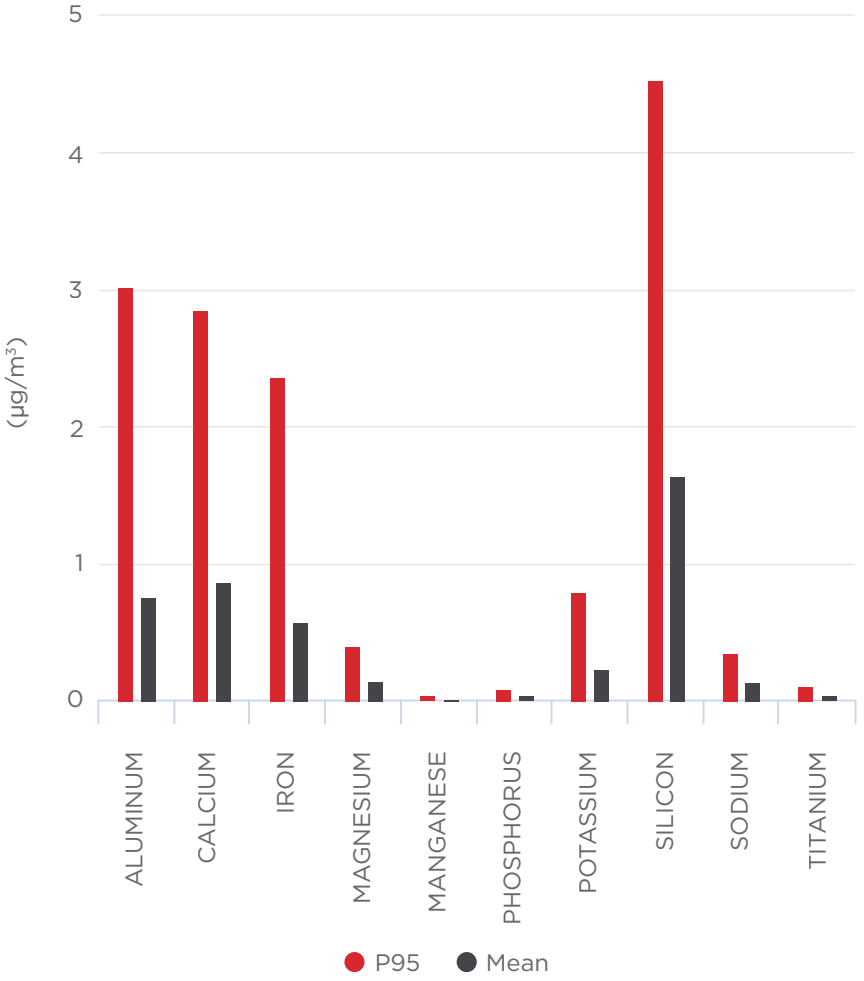



*Note: Averages may be too small to be visible on some graphs.*

## Athabasca Valley

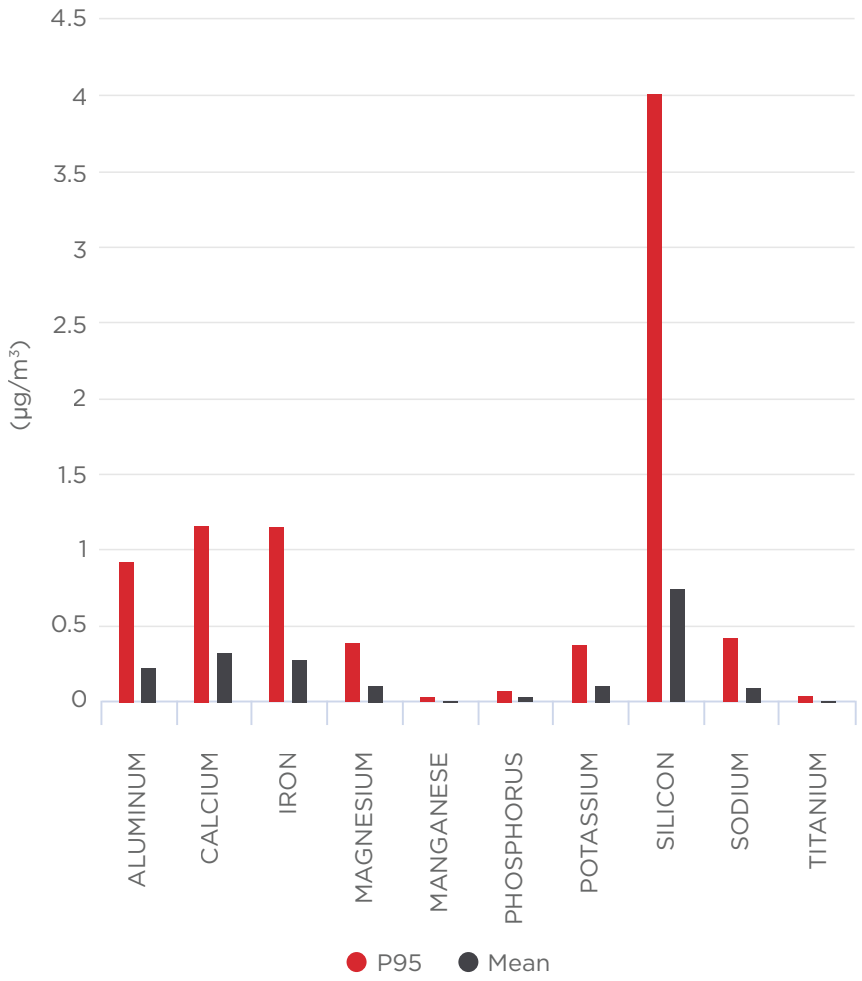



## Bertha Ganter - Fort McKay

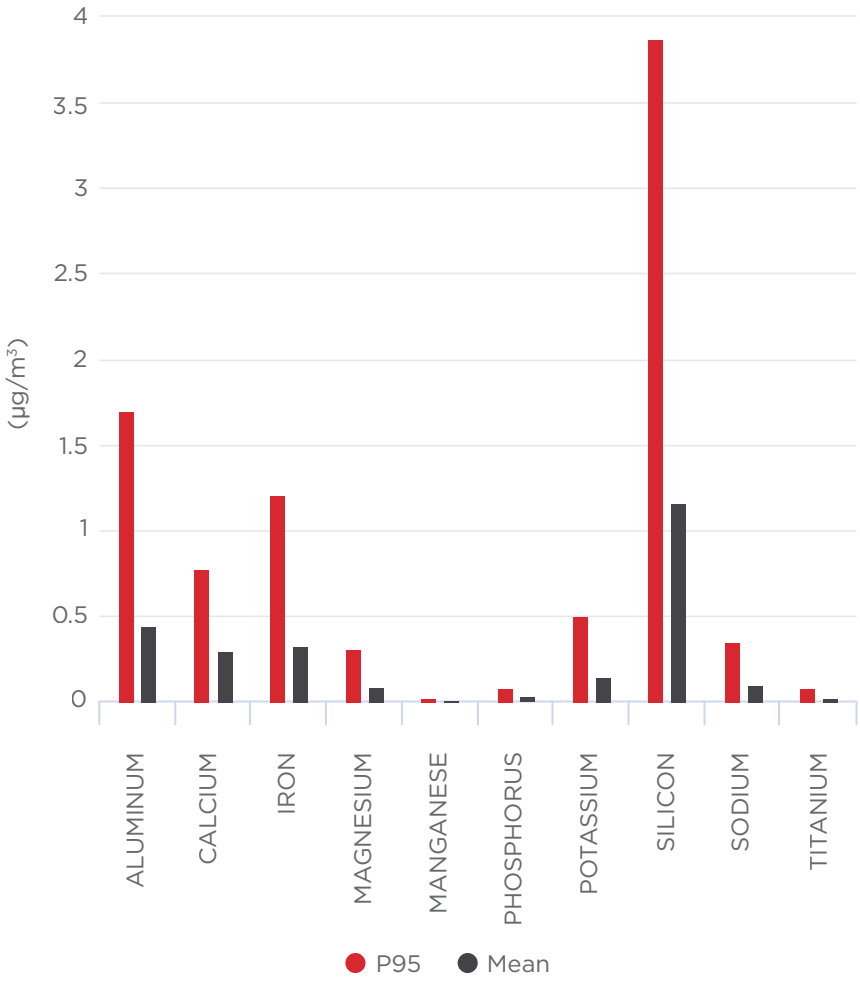



*Note: Averages may be too small to be visible on some graphs.*

## Conklin

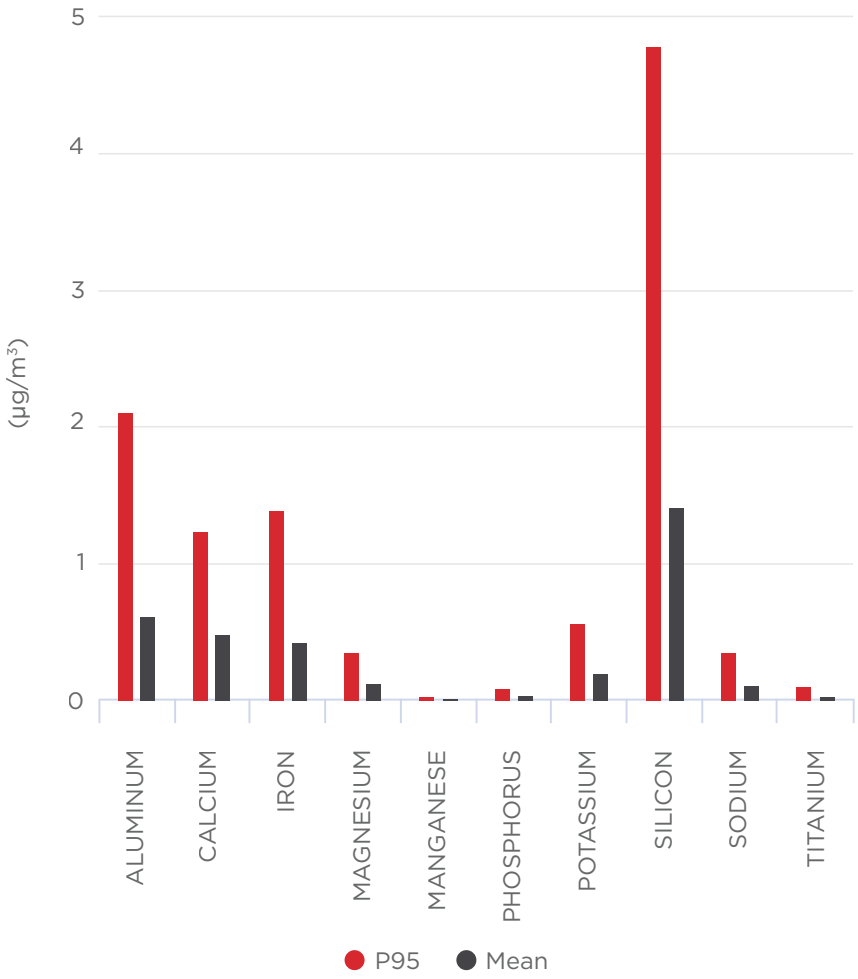



## Ells River

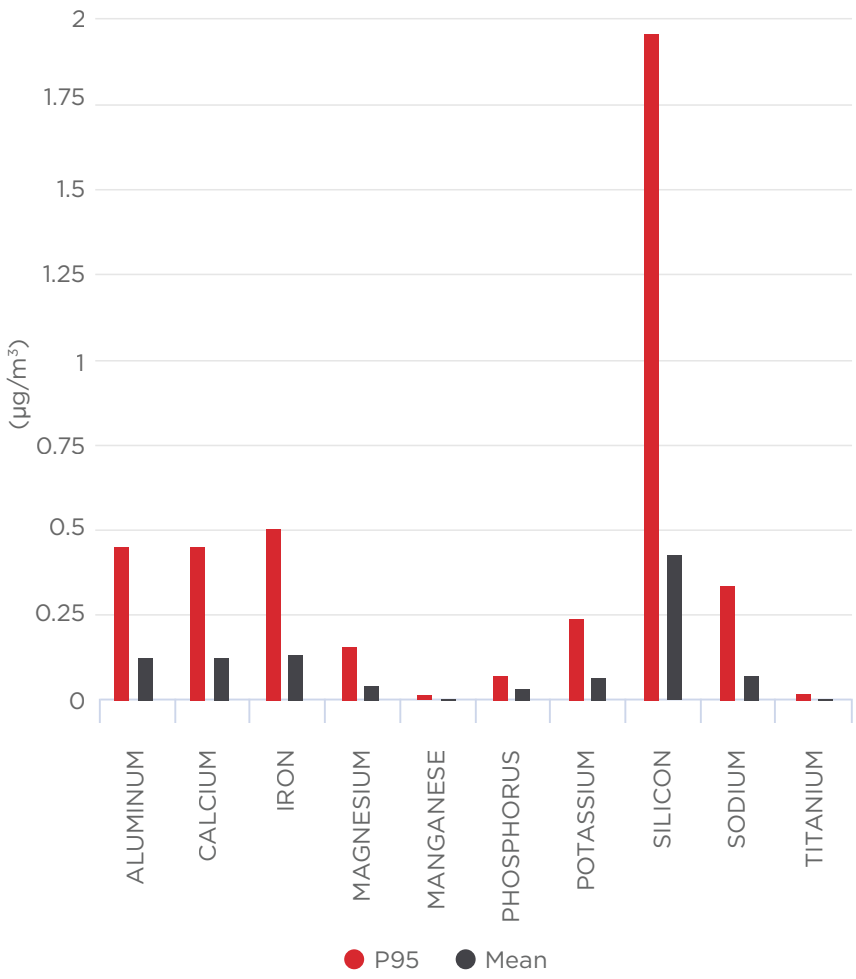



*Note: Averages may be too small to be visible on some graphs.*

## Fort McKay South

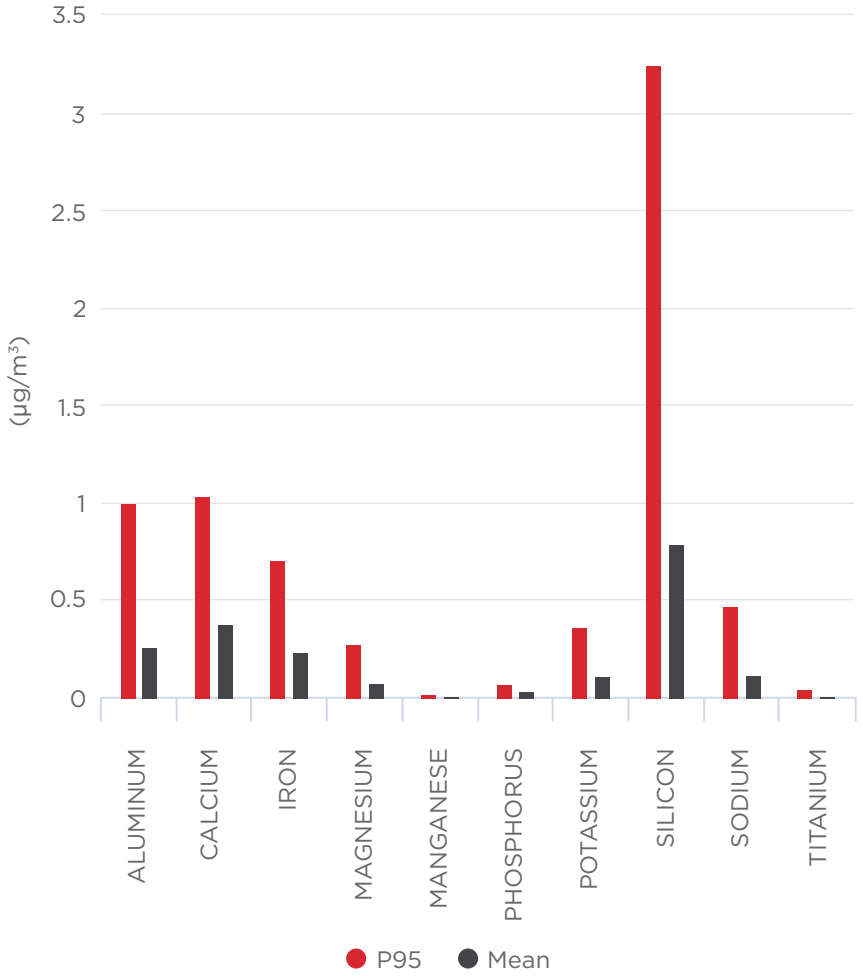



## Janvier




*Note: Averages may be too small to be visible on some graphs.*

## Patricia McInnes

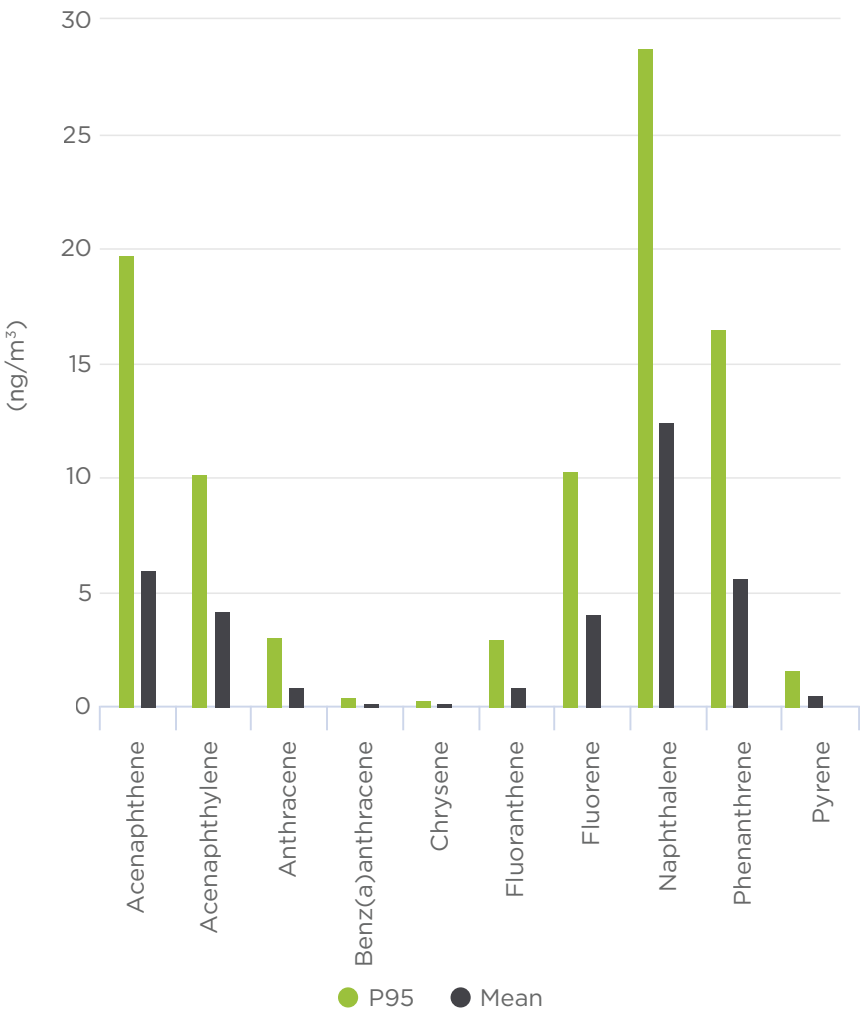



*Note: Averages may be too small to be visible on some graphs.*

# Polycyclic Aromatic Hydracarbons (PAHs)

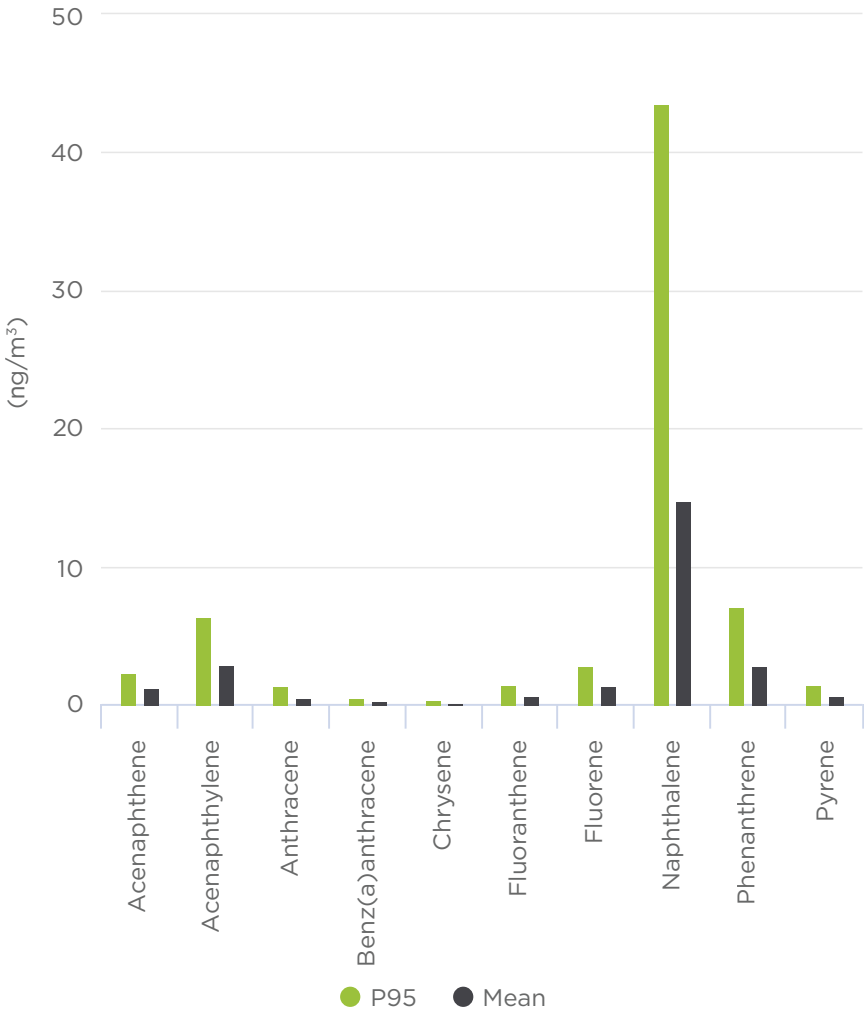
Polycyclic aromatic hydrocarbons (PAHs) are a class of chemicals that occur naturally in coal, crude oil, gasoline and oil sand deposits. They also are produced when coal, oil, gas, wood or garbage are burned. PAHs generated from these sources can bind to or form small particles in the air. There are hundreds of different PAHs – some of which can be detrimental to human health and the environment.

## Anzac

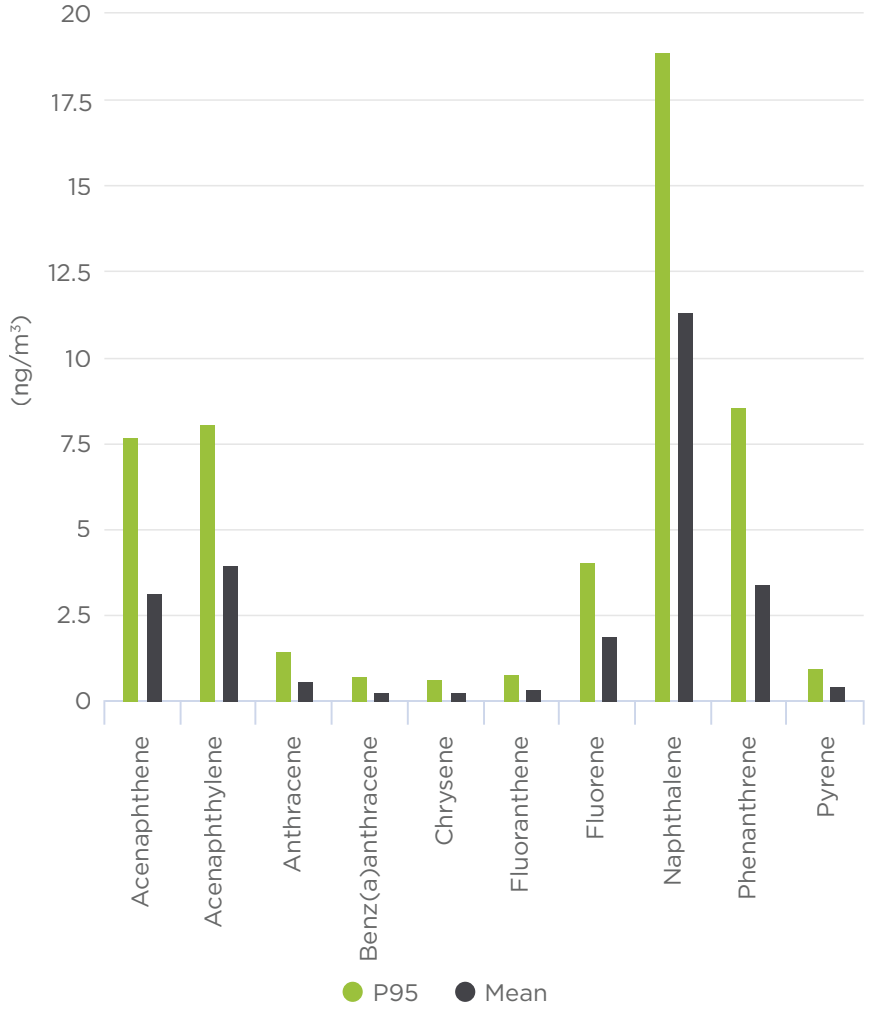



*Note: Averages may be too small to be visible on some graphs.*

## Athabasca Valley

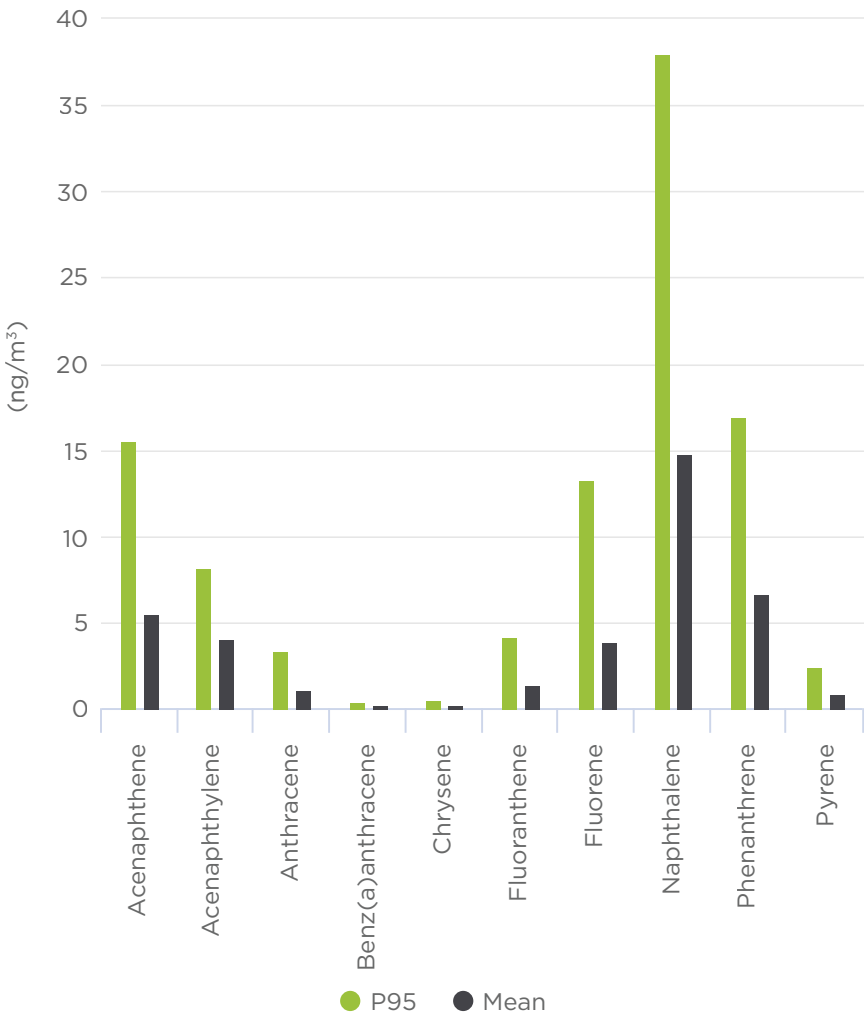



## Bertha Ganter - Fort McKay

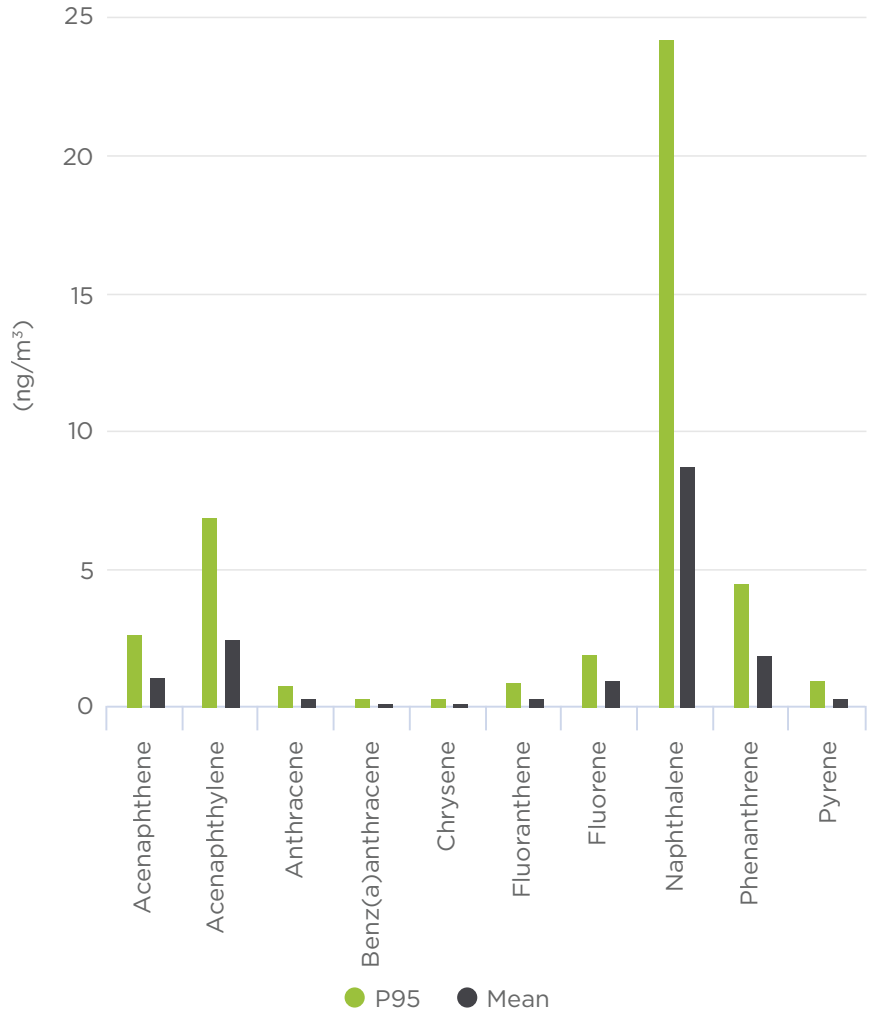



*Note: Averages may be too small to be visible on some graphs.*

## Conklin

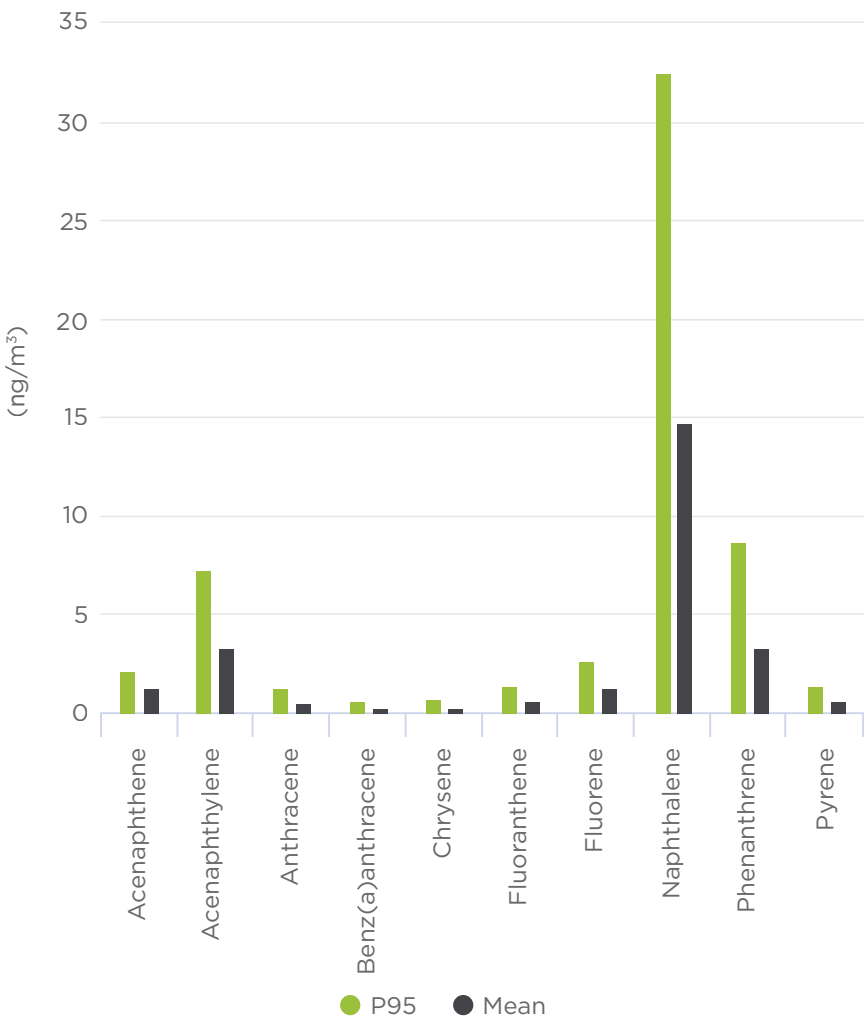



## Janvier




*Note: Averages may be too small to be visible on some graphs.*

## Patricia McInnes

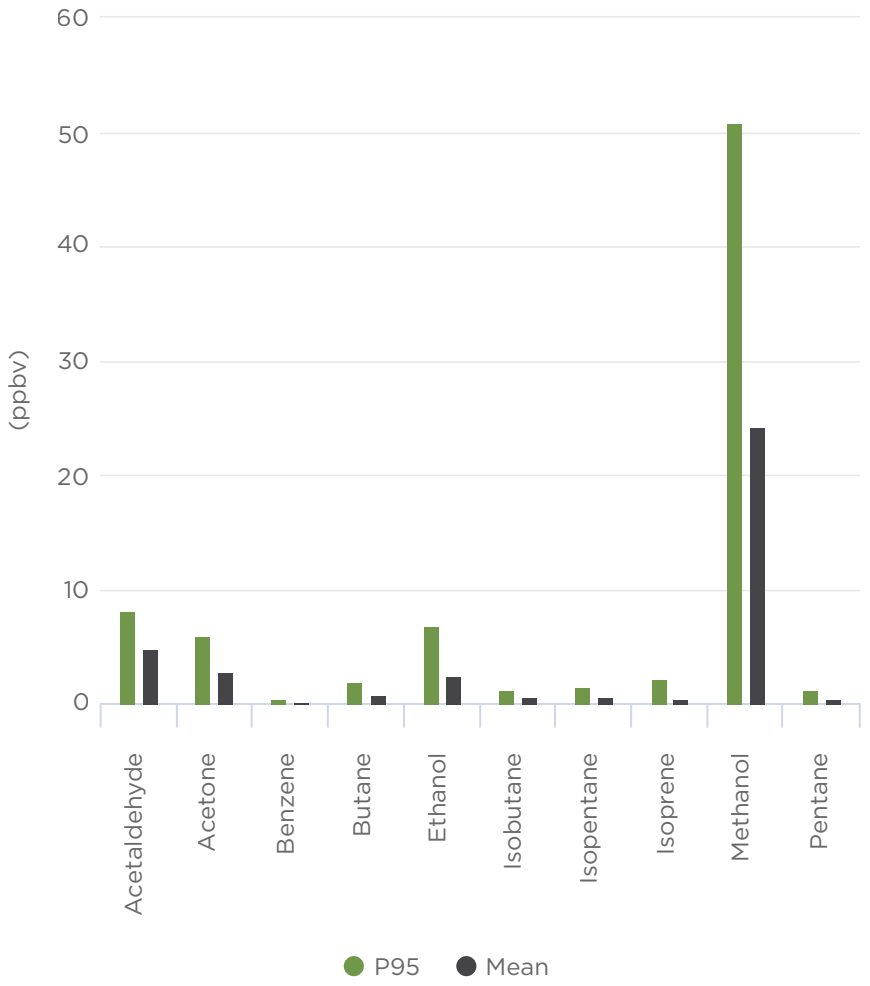



*Note: Averages may be too small to be visible on some graphs.*

# Volatile Organic Compounds (VOCs)

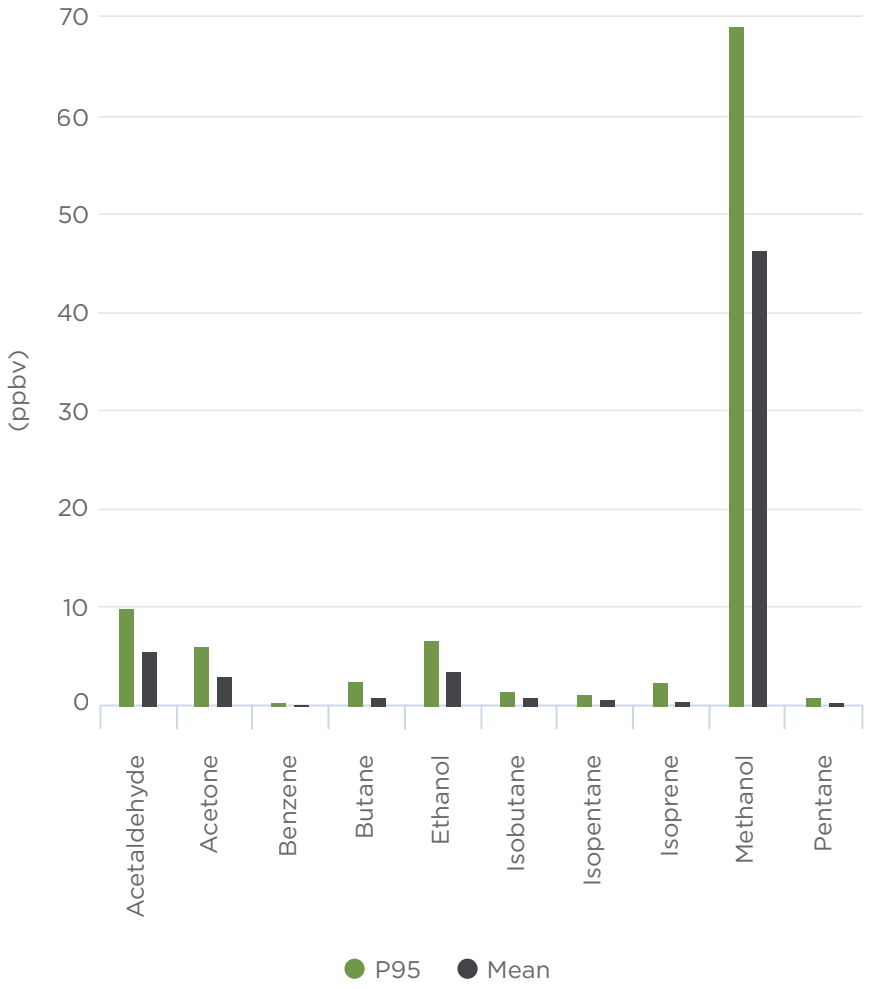
Volatile organic compounds (VOCs) are a group of chemical species that contain carbon, and whose composition makes it possible for them to evaporate under normal atmospheric conditions of temperature and pressure. They may contain additional elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulphur, or nitrogen. VOCs are numerous, and come from both natural and human sources, and certain VOCs may contribute to ozone formation, odours, and long-term health-effects.

## Anzac

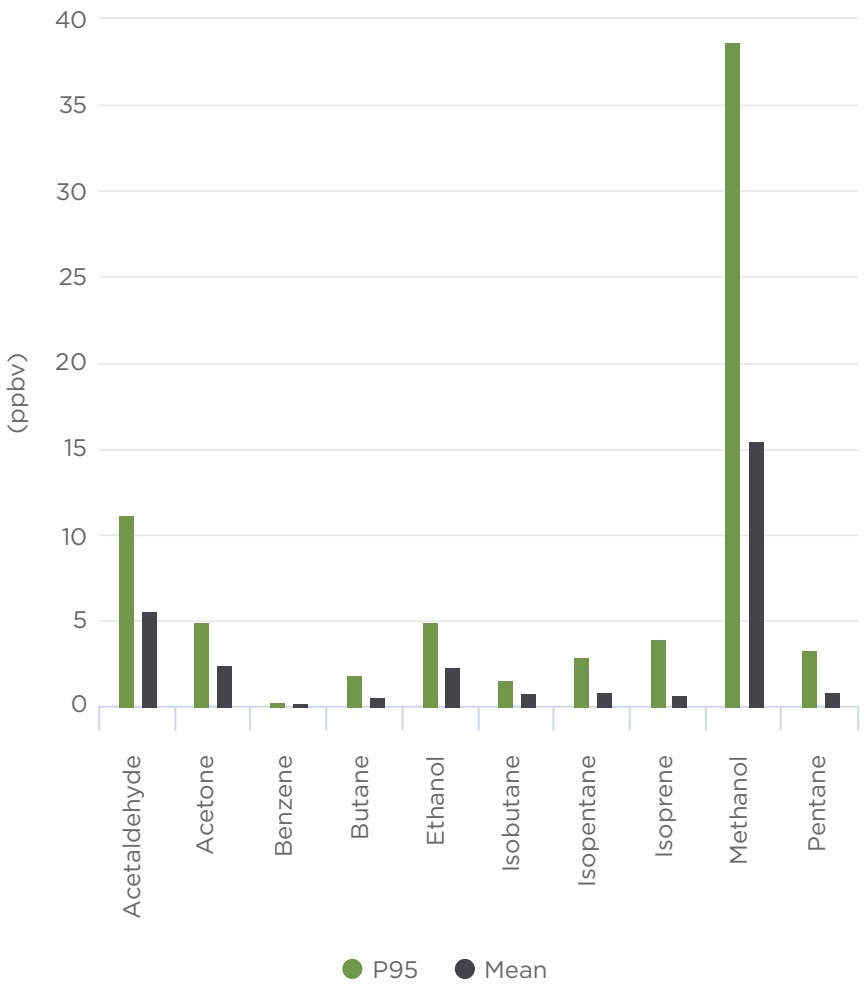



*Note: Averages may be too small to be visible on some graphs.*

## Athabasca Valley

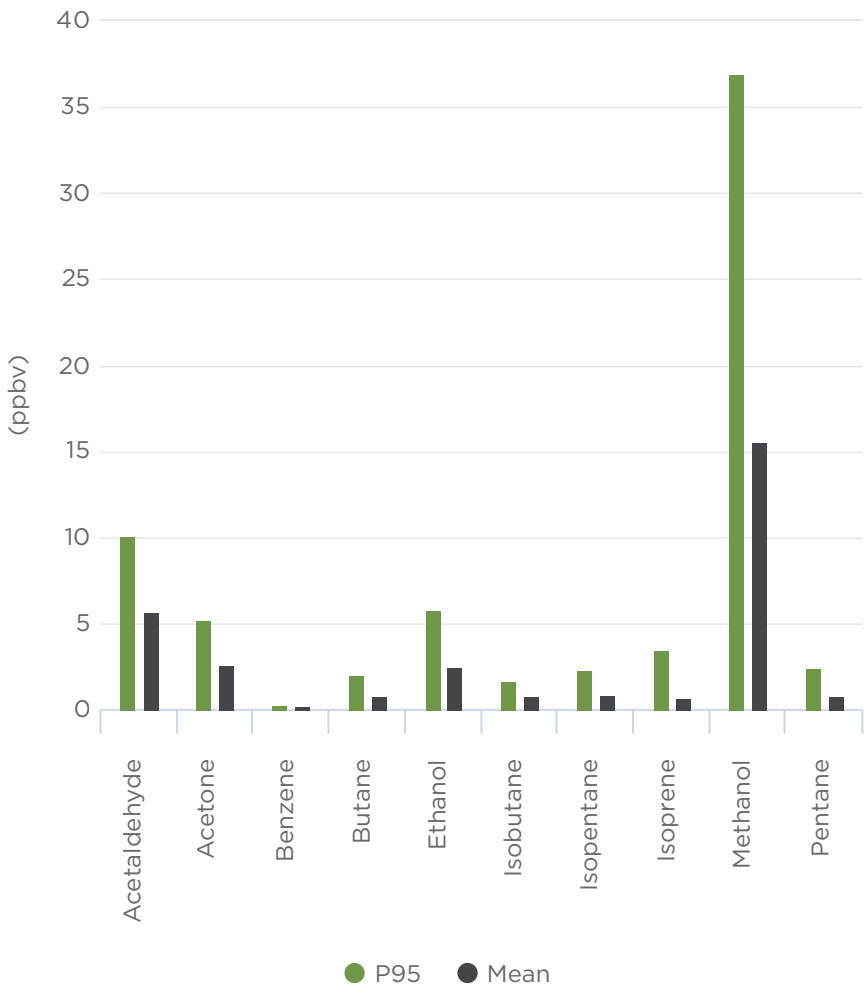



## Barge Landing

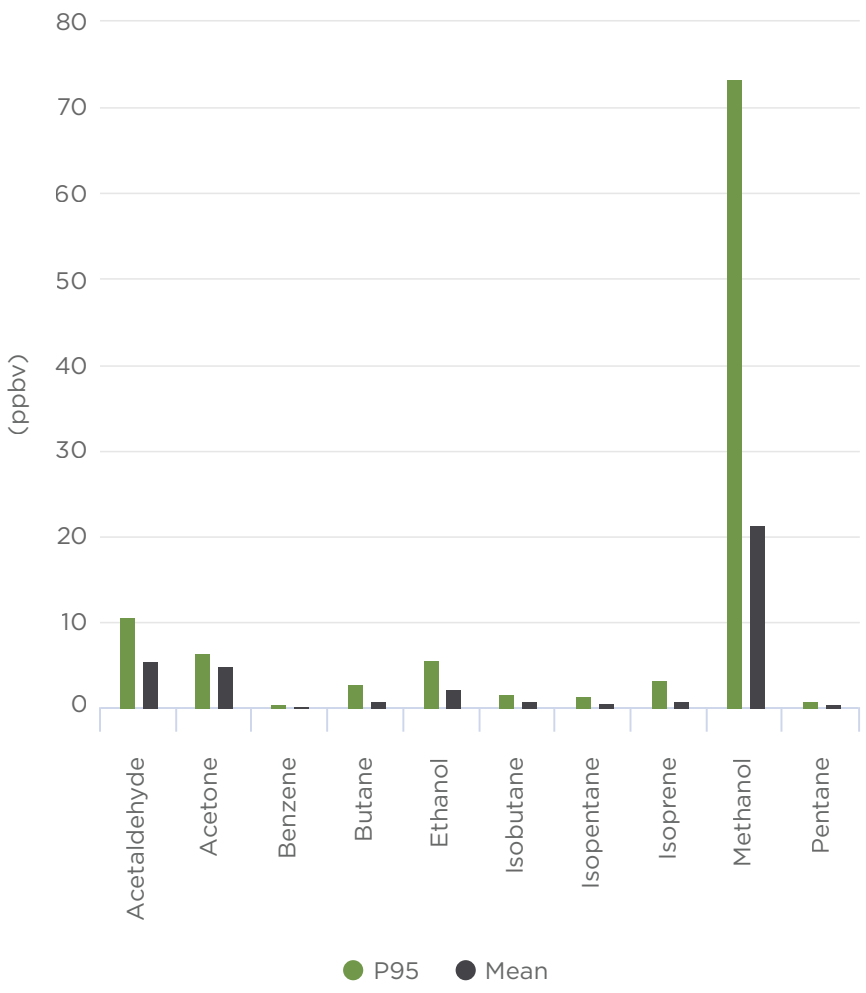



*Note: Averages may be too small to be visible on some graphs.*

## Bertha Ganter - Fort McKay

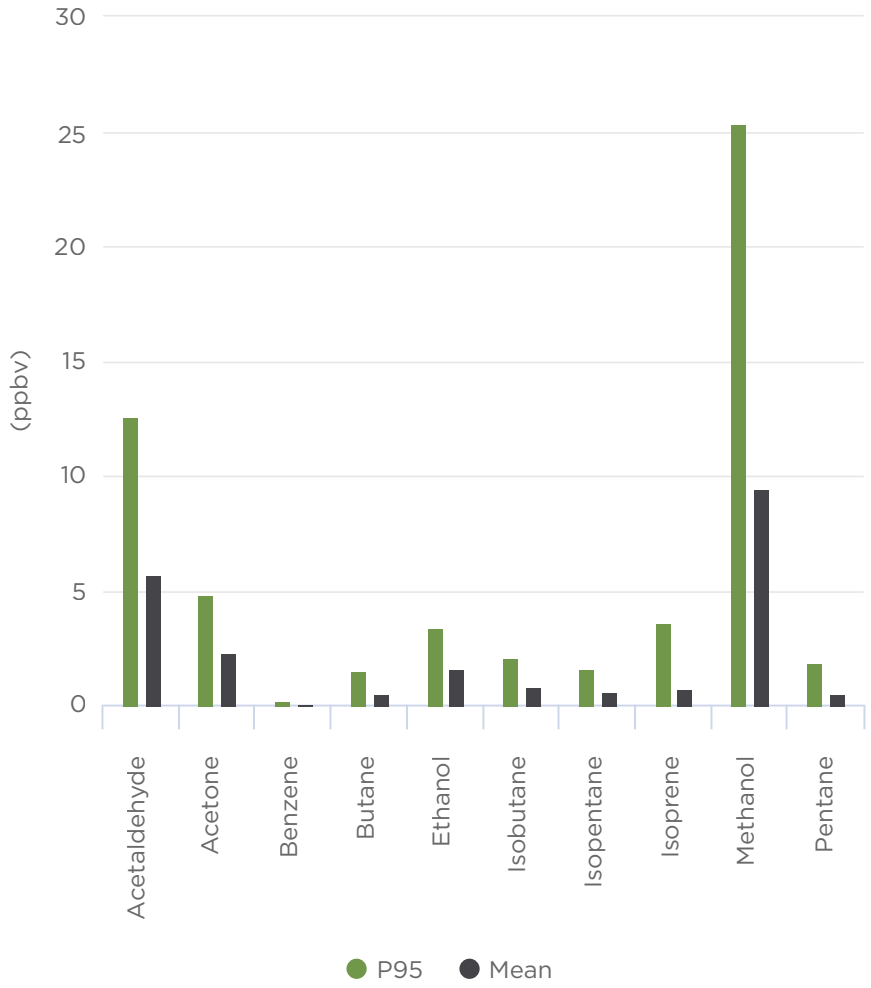



## Conklin

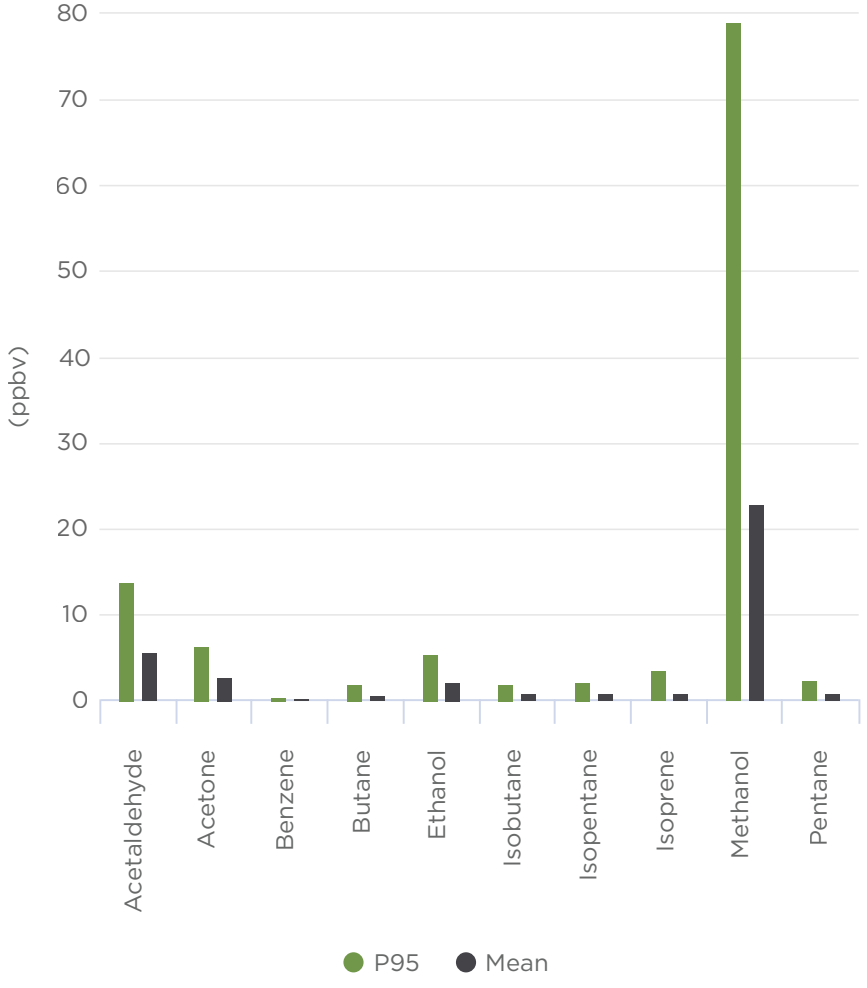



*Note: Averages may be too small to be visible on some graphs.*

## Ells River

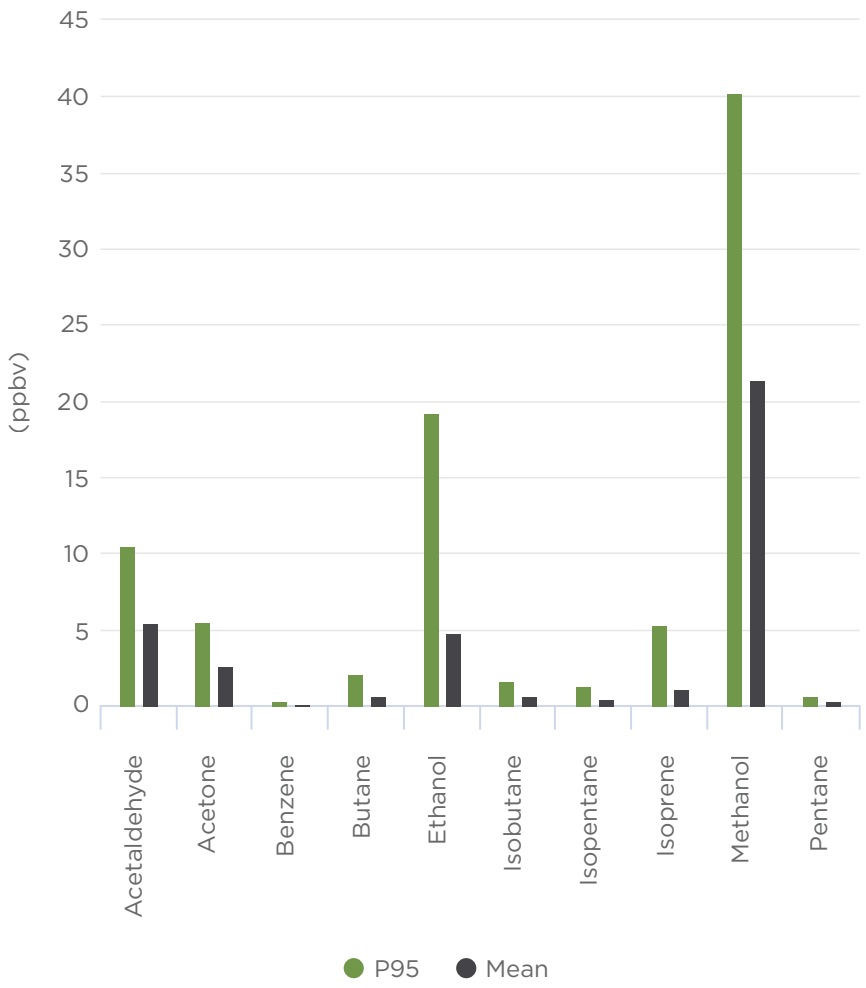



## Fort McKay - South

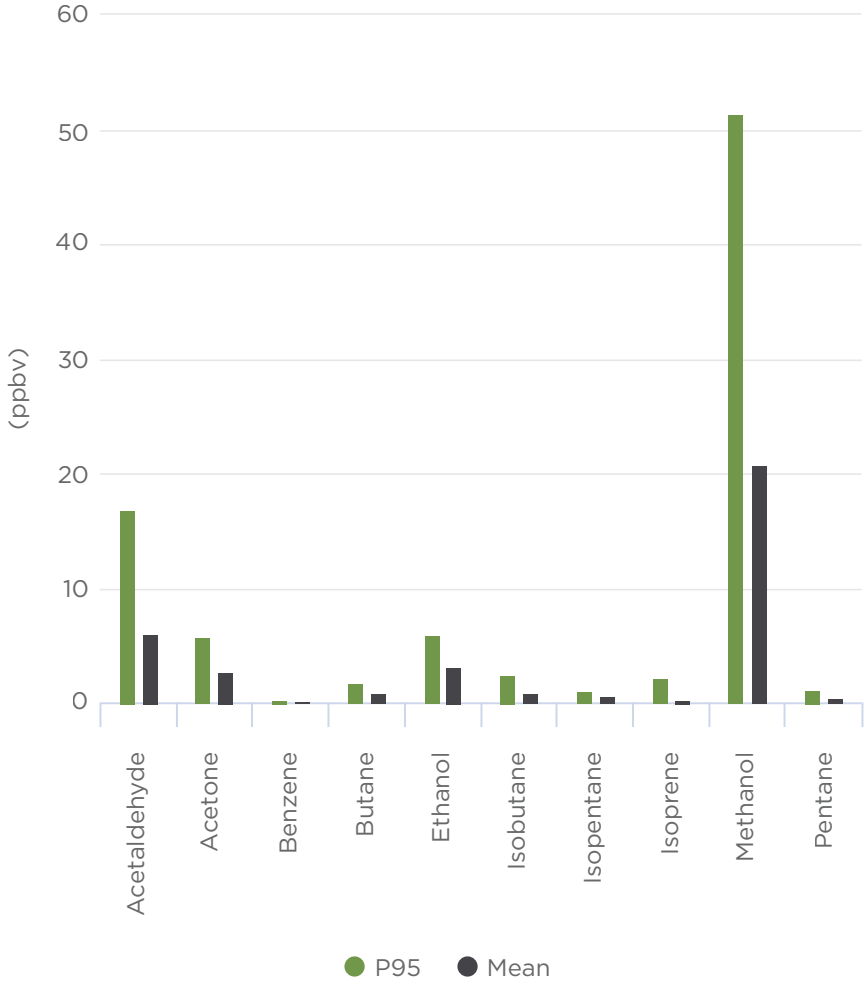



*Note: Averages may be too small to be visible on some graphs.*

## Janvier




## Patricia McInnes




*Note: Averages may be too small to be visible on some graphs.*

# Ambient Air Monitoring Trends

The WBEA's monitoring trends website was created to provide a visual overview of key annual data metrics. This data empowers stakeholders, partners, and the public to compare overall ambient air data trends over time.

There are currently three primary sections to view data trends: continuous and time-integrated data for specific air quality parameters, ground-level concentration exceedances, and analyzer average operational time.

View the WBEA's Annual Trends Website by visiting: **https://annualtrends.wbea.org/**

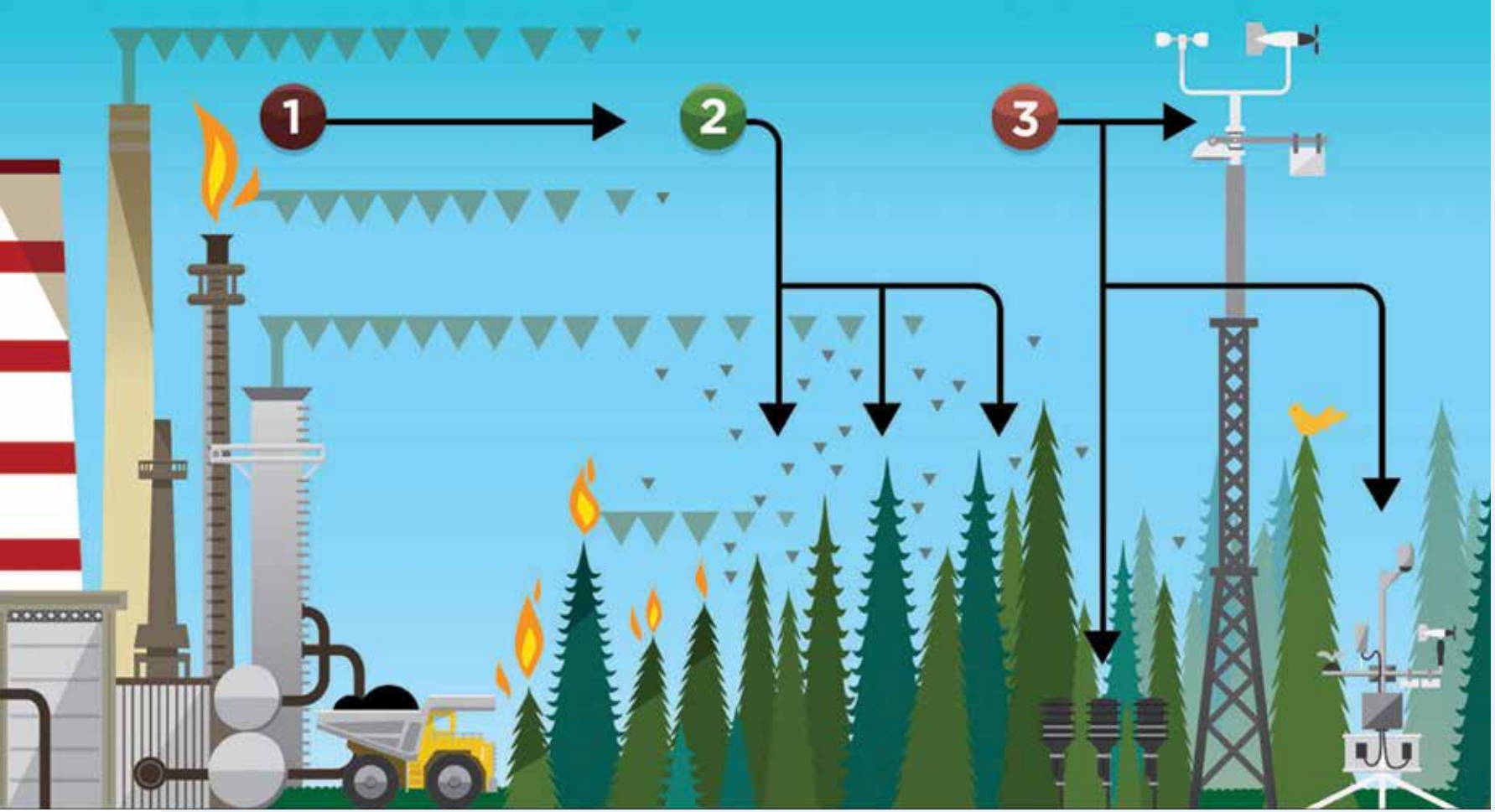
# Deposition Monitoring

The Deposition Monitoring program, also referred to as the Terrestrial Environmental Effects Monitoring (TEEM) program, was established to address community, industry, and government concerns about impacts to regional forests from industrial development.

The objective of the program is to determine cause-effect relationships between air pollutants and forest ecosystem health in the region. To meet this objective the WBEA operates both a long-term Forest Health Monitoring Program and an Atmospheric Pollutant Deposition Monitoring Program which monitor stressors (acidification/ eutrophication) along the pathway (atmospheric transport) from source (industrial emissions) to the receiving environment (jack pine forests).

To understand changes in regional deposition over time, data derived from the program must be integrated and analyzed every several years. The most recent comprehensive analysis of historical data was completed in 2019. At that time, the WBEA developed 75 recommendations for program improvements and also published nine open access manuscripts in a Virtual Special Issue of the journal Science of the Total Environment. The issue, entitled "Relationships Between Air Pollutants and Forest Ecosystem Health in the Oil Sands Region, AB, Canada", is available online by visiting **https://www.sciencedirect.com/journal/science-of-the-total-environment/special-issue/10LW6CG6CPT.**

In 2021, the WBEA initiated the next data analysis exercise, using data collected more recently, that will supplement the previous findings and continue to explore changes in deposition over time. In addition, the WBEA continued to evaluate the program recommendations and, using these lessons learned, adapt its activities to better meet the program objectives.




## 1 Source

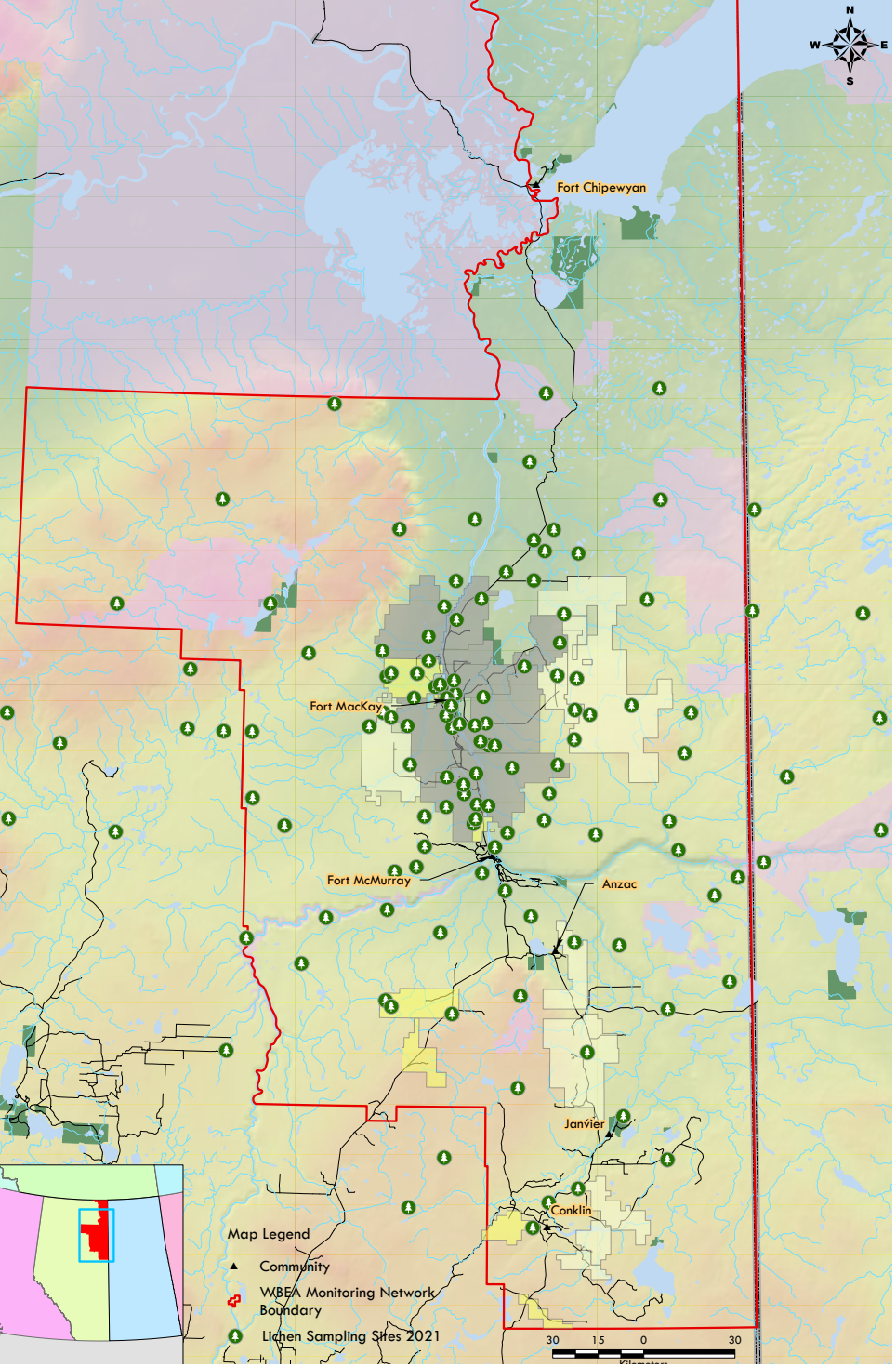
Pollution is emitted into the air from a variety of sources

## 2 Deposit

The pollution may be deposited onto the surrounding forest

## 3 Measure

The WBEA collects samples and information to measure the effects of pollution on the enviroment

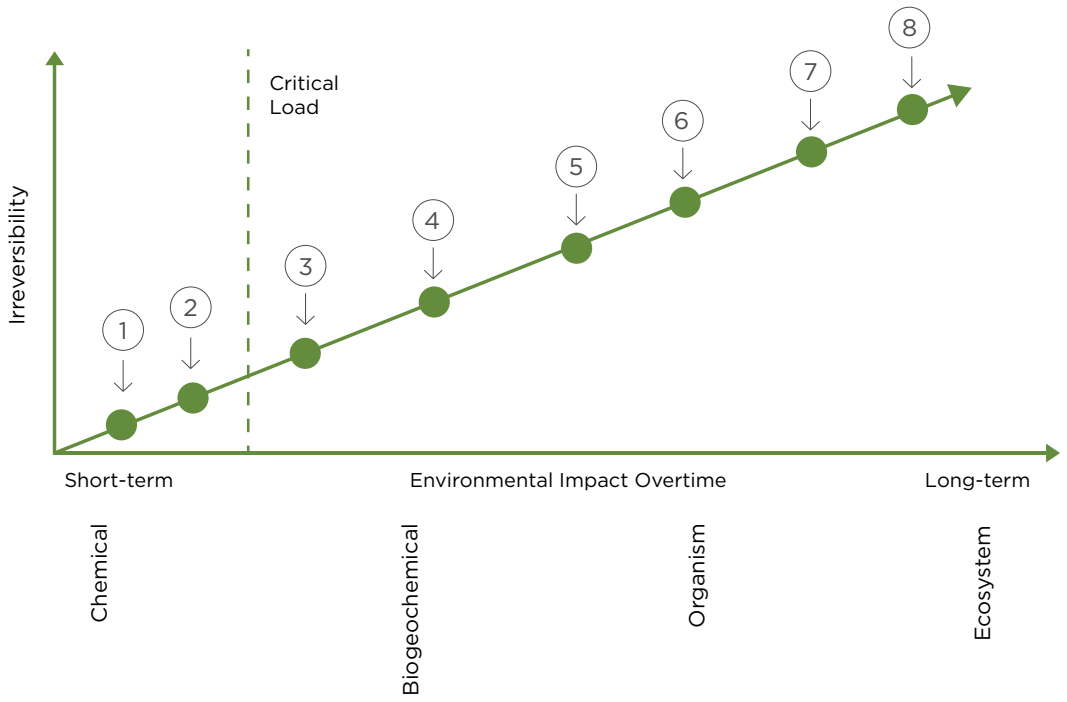



# Forest Health Monitoring

The Forest Health Monitoring program monitors jack pine forest sites to assess whether there are changes to biological, physical, and chemical indicators through a sampling campaign of soils and vegetation every 6-years, as well as lichen sampling at varying intervals. During initial program development, the upland jack pine (Pinus banksiana) ecosystem was identified as the most sensitive receptor to acidification due to their characteristically dry, nutrient poor soils with limited buffering capacity. In these ecosystems, the effects of acid deposition are expected to be observed in a cascading manner from soils to vegetation, first impacting individual organisms, then the stand, and onward to landscape level impacts. This concept is depicted in the critical load graph on the following page.

In 2021, two new forest health sites were established in the southern portion of the WBEA region to meet new *Environmental Protection and Enhancement Act* compliance conditions and to address a gap in the current network. Site establishment followed the 2018 Forest Health Monitoring Program Procedures and included soil, foliage, and lichen sampling, and tree coring.

Also in 2021, the WBEA executed the regional lichen monitoring program and collected approximately 150 lichen samples, of the species *Hypogymnia* physodes, from all over the region as shown on the adjacent map. This species of lichen receives its nutrients from the air and rain making it a very effective natural tool for monitoring air pollution. Data obtained from these samples is critical to the program and is used to determine changes in atmospheric deposition over time and across the regional landscape.

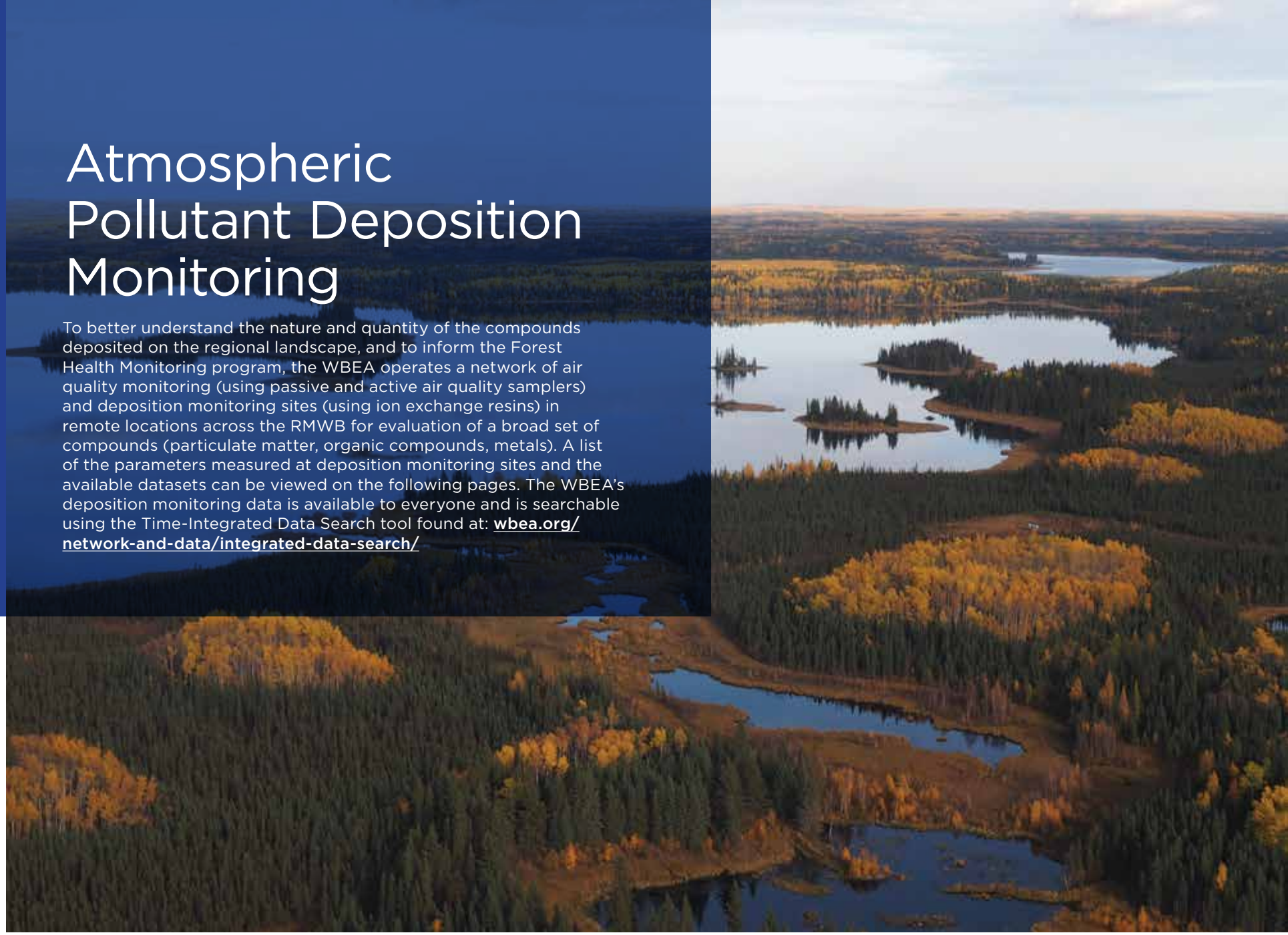



1. Emissions (stack, fleet)
2. Deposition (wet, dry) below CL & no effect
3. Altered jack pine soil chemestry (BC:Al, BS% C:N, nutrients)
4. Altered jack pine growth
5. Altered jack pine understory community composition
6. Altered aspen soil chemistry (BC:Al, BS% C:N, nutrients)
7. Altered aspen growth
8. Altered aspen understory community composition

**Critical Load** = the highest load that will not cause chemical changes leading to long-term harmful effects on the most sensitive ecological systems.

# Atmospheric Pollutant Deposition Monitoring

To better understand the nature and quantity of the compounds deposited on the regional landscape, and to inform the Forest Health Monitoring program, the WBEA operates a network of air quality monitoring (using passive and active air quality samplers) and deposition monitoring sites (using ion exchange resins) in remote locations across the RMWB for evaluation of a broad set of compounds (particulate matter, organic compounds, metals). A list of the parameters measured at deposition monitoring sites and the available datasets can be viewed on the following pages. The WBEA's deposition monitoring data is available to everyone and is searchable using the Time-Integrated Data Search tool found at: **wbea.org/network-and-data/integrated-data-search/**



# Passive Air Sampling – Passive Samplers

Passive air sampling, specifically using passive samplers, is a cost-effective method for coverage of a broad spatial range, including remote locations, because they have no moving parts and require no power. The WBEA uses passive samplers to monitor sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), nitric acid ($HNO_3$), ammonia ($NH_3$), and ozone ($O_3$) across the Athabasca Oil Sands Region and this data, along with meteorological data, is used to model deposition trends. In 2021, data collection was paused to allow for the validation of laboratory analytical results and a program evaluation.

| Site Name | $HNO_3$ | $NH_3$ | $NO_2$ | $SO_2$ | $O_3$ |
|---|---|---|---|---|---|
| 1001 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1002 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1004 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1007 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1008 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1023 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1027 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1947 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1991 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1992 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1993 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1994 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1995 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1996 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1997 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1998 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2001 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2005 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2010 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2013 | ✓ | ✓ | ✓ | ✓ | ✓ |

| Site Name | $HNO_3$ | $NH_3$ | $NO_2$ | $SO_2$ | $O_3$ |
|---|---|---|---|---|---|
| 2054 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3009 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3011 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3016 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3083 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3086 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3088 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3092 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3096 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3212 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4000 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4001 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4002 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4003 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4004 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4014 | ✓ | ✓ | ✓ | ✓ | ✓ |
| ATHV | ✓ | ✓ | ✓ | ✓ | ✓ |
| BGFM | ✓ | ✓ | ✓ | ✓ | ✓ |
| MILD | ✓ | ✓ | ✓ | ✓ | ✓ |

# Active Air Sampling – Denuders and Remote Ozone Analyzers

Active air sampling uses a pump to provide a known volume of air to a continuous analyzer or sample media. For this reason, in addition to a low detection limit, active air sampling provides higher quality data than passive air sampling, however, because they require power, they can be more costly and less versatile. In 2021, ammonia ($NH_3$), nitric acid ($HNO_3$), and particulate matter ($PM_{2.5}$) were monitored year-round at eights sites by active sampling using a solar-powered denuder system. Ground-level ozone ($O_3$) was monitored during the summer season at three sites with solar-powered continuous analyzers. The WBEA's deposition monitoring data is available to everyone using the Time-Integrated Data Search tool found at: [wbea.org/network-and-data/integrated-data-search/](wbea.org/network-and-data/integrated-data-search/).

| | Low-Power Denuder | | | | | | | Portable Ozone Monitor |
|---|---|---|---|---|---|---|---|---|
| **Site Name** | **$HNO_3$** | **$NH_3$** | **$PM_{2.5}$** | **Trace Elements** | **$NH_4^+$** | **$NO_3^-$** | **$SO_4^{2-}$** | **$O_3$** |
| 1004 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 1007 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 2001 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 2013 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 3502 | | | | | | | | ✓ |
| 3501 | | | | | | | | ✓ |
| 3513 | | | | | | | | ✓ |

# Passive Deposition Sampling - Ion Exchange Resin

Ion exchange resin technology (IER) are a passive sampling technology, comprised of a column of resin beads that capture anions [ammonium ($NH_4^+$), nitrate ($NO_3^-$), phosphate ($PO_4^{3-}$), sulfate(SO42-)] and base cations [calcium ($Ca^+$), potassium($K^+$), magnesium($Mg^+$), and sodium($Na^+$)]. IERs are critical to the deposition program as they provide actual measurements of deposition which are required to validate the critical loads mapping and modeling exercises. In 2021, the WBEA collected IERs from 47 sites in the spring and fall.

| Site Name | $NH_4$ | $NO_3$ | $PO_4$ | $SO_4$ | Base Cation |
|---|---|---|---|---|---|
| 2054 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2513 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3083 | ✓ | ✓ | ✓ | ✓ | |
| 3092 | ✓ | ✓ | ✓ | ✓ | |
| 3102 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3111 | ✓ | ✓ | ✓ | ✓ | |
| 3116 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3153 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3172 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3207 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3210 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3211 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3212 | ✓ | ✓ | ✓ | ✓ | |
| 3308 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3309 | ✓ | ✓ | ✓ | ✓ | |
| 3311 | ✓ | ✓ | ✓ | ✓ | |
| 3398 | ✓ | ✓ | ✓ | ✓ | |
| 3550 | ✓ | ✓ | ✓ | ✓ | |
| ANZC | ✓ | ✓ | ✓ | ✓ | |
| BGFM | ✓ | ✓ | ✓ | ✓ | |
| 1001 | ✓ | ✓ | ✓ | ✓ | |
| 1004 | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1006 | ✓ | ✓ | ✓ | ✓ | |

| Site Name | $NH_4$ | $NO_3$ | $PO_4$ | $SO_4$ | Base Cation |
|---|---|---|---|---|---|
| 2001 | ✓ | ✓ | ✓ | ✓ | |
| 2010 | ✓ | ✓ | ✓ | ✓ | |
| 2012 | ✓ | ✓ | ✓ | ✓ | |
| 2013 | ✓ | ✓ | ✓ | ✓ | |
| 2050 | ✓ | ✓ | ✓ | ✓ | |
| 2554 | ✓ | ✓ | ✓ | ✓ | |
| 3003 | ✓ | ✓ | ✓ | ✓ | |
| 3008 | ✓ | ✓ | ✓ | ✓ | |
| 3009 | ✓ | ✓ | ✓ | ✓ | |
| 3011 | ✓ | ✓ | ✓ | ✓ | |
| 3052 | ✓ | ✓ | ✓ | ✓ | |
| 3072 | ✓ | ✓ | ✓ | ✓ | |
| 3098 | ✓ | ✓ | ✓ | ✓ | |
| 3107 | ✓ | ✓ | ✓ | ✓ | |
| 3202 | ✓ | ✓ | ✓ | ✓ | |
| 3253 | ✓ | ✓ | ✓ | ✓ | |
| 4000 | ✓ | ✓ | ✓ | ✓ | |
| 4001 | ✓ | ✓ | ✓ | ✓ | |
| 4002 | ✓ | ✓ | ✓ | ✓ | |
| 4003 | ✓ | ✓ | ✓ | ✓ | |
| 4004 | ✓ | ✓ | ✓ | ✓ | |
| 4014 | ✓ | ✓ | ✓ | ✓ | |

# Instrumented Regional Meteorological Network

The WBEA's regional meteorological network provides key data for calculating deposition rates, modeling dry deposition, and evaluating the performance of deterministic models. The network is comprised of six 30-meter instrumented towers ("met towers") and six instrumented tripods ("met tripods") that provide continuous, hourly data on climatic conditions throughout the Wood Buffalo region. Each met tower is co-located with a Forest Health Monitoring (FHM) site and monitors air temperature, relative humidity, wind speed, wind direction, and solar radiation at four levels within and above the jack pine canopy, as well as temperature and volumetric water content within forest soil. Each met tripod is positioned in natural peatland clearing adjacent to a FHM site and monitors air temperature, relative humidity, wind speed, wind direction, and solar radiation.

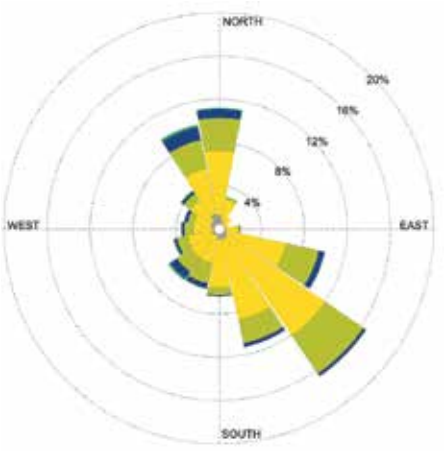
The adjacent map shows where each of the six 30-meter meteorological towers are located within the WBEA's network. The wind data collected from these towers, measured above the tree canopy, are used to characterize wind flow in a wider geographical area, calculate emission deposition, and evaluate ecological data. The corresponding seasonal wind roses for each tower are in the following section.


Access tower data online by visiting:
https://wbea.org/historical-monitoring-data/

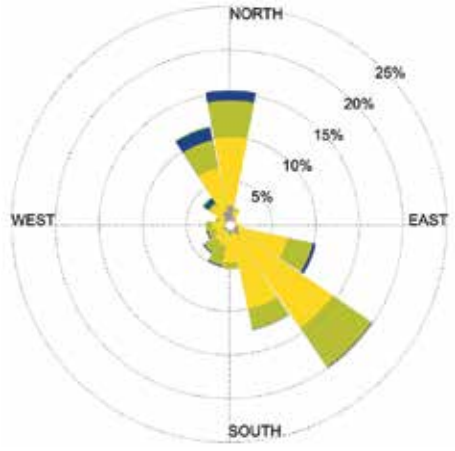
# 2021 Meteorological Tower Wind Roses

## Meteorological Tower 1004

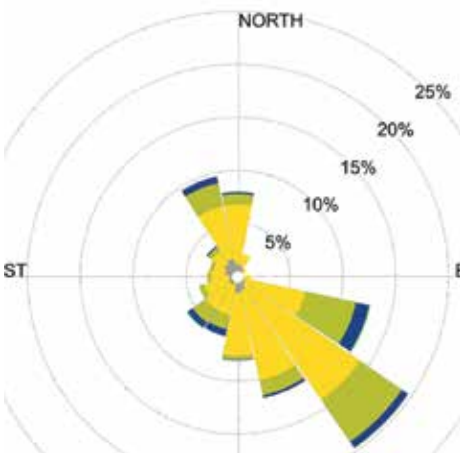
**Annual Average**




**Spring**



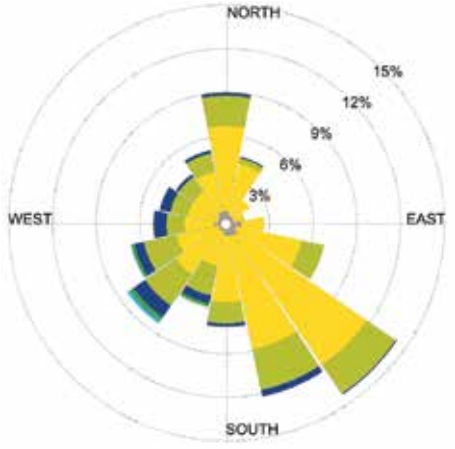

**Summer**



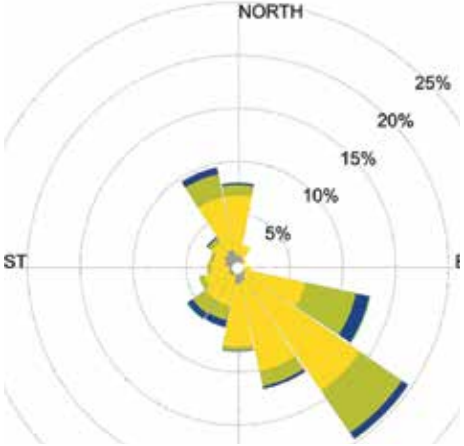

WIND SPEED (km/h)
Tower Height: 29m

- 0.5 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- > = 25

**Fall**

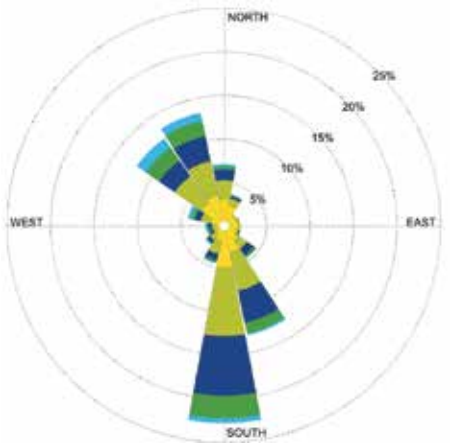



**Winter**

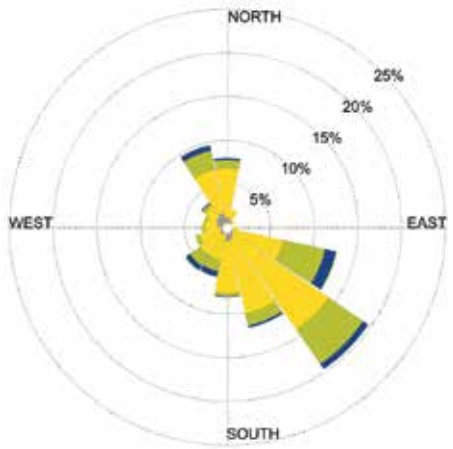


# Meteorological Tower 1007

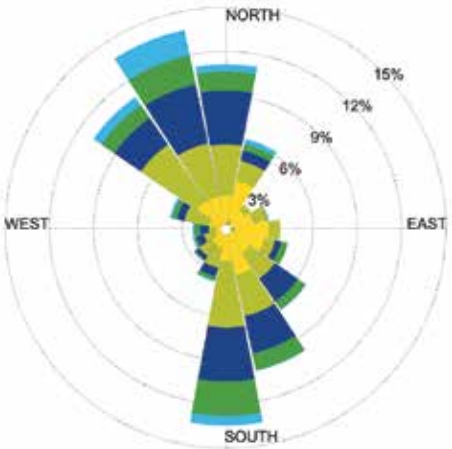
**Annual Average**



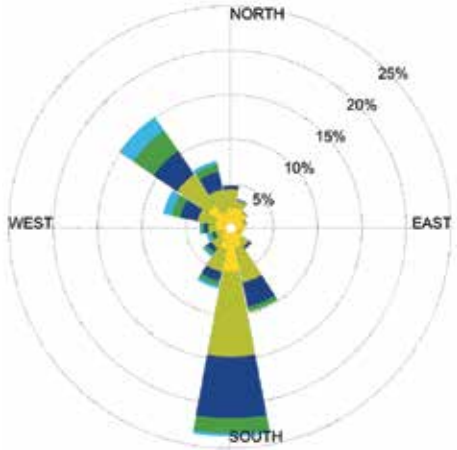

**Spring**



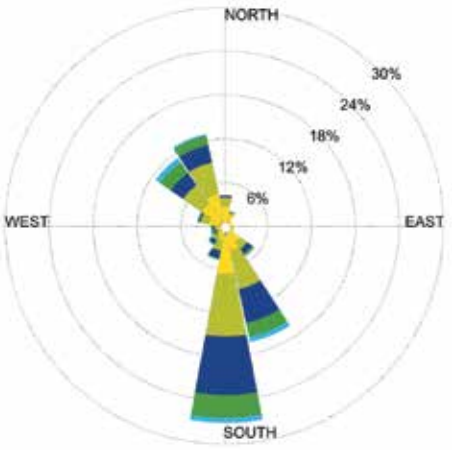

**Summer**




**Fall**




**Winter**

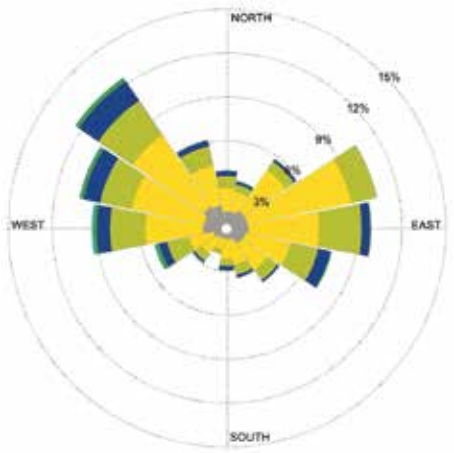



WIND SPEED (km/h)
Tower Height: 29m

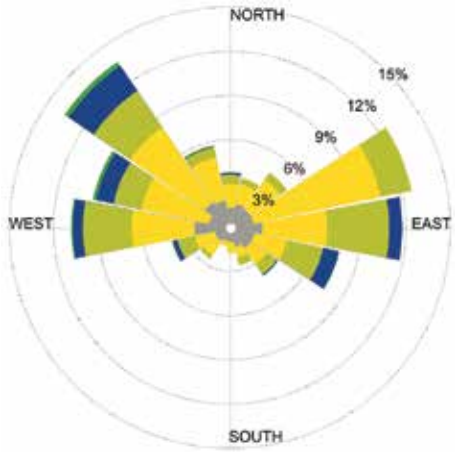
- 0.5 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- > = 25

# Meteorological Tower 2001

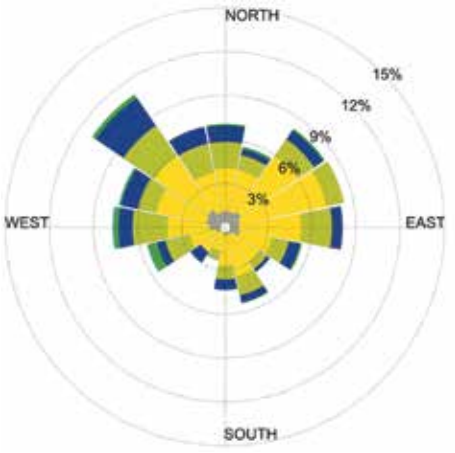
**Annual Average**



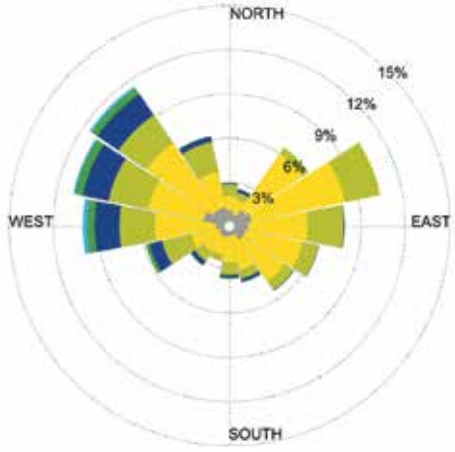

**Spring**



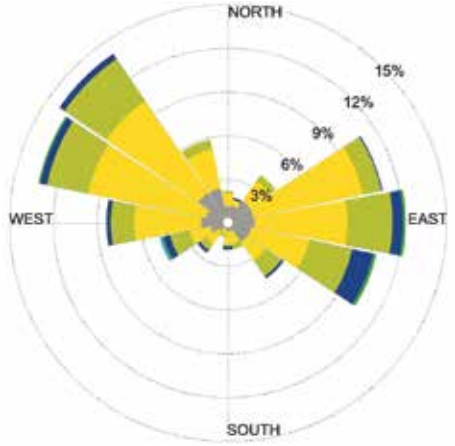

**Summer**




**Fall**




**Winter**

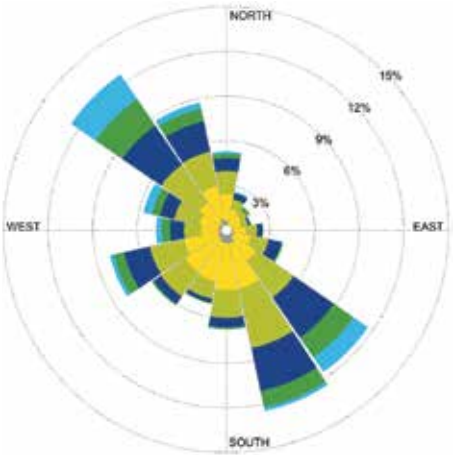



WIND SPEED (km/h)
Tower Height: 29m

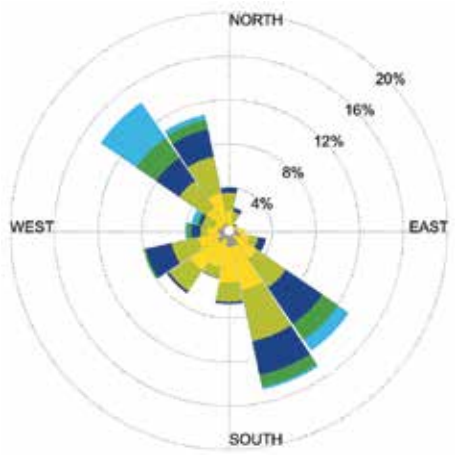
- 0.5 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- > = 25

# Meteorological Tower 2013

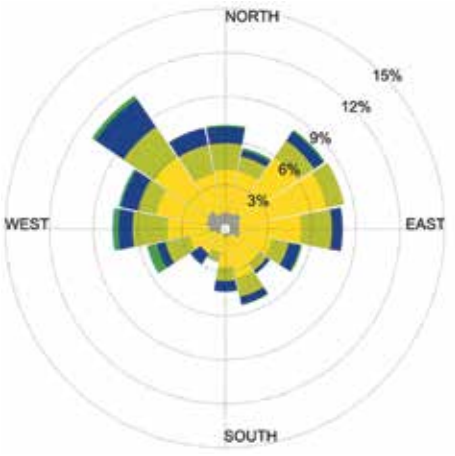
**Annual Average**



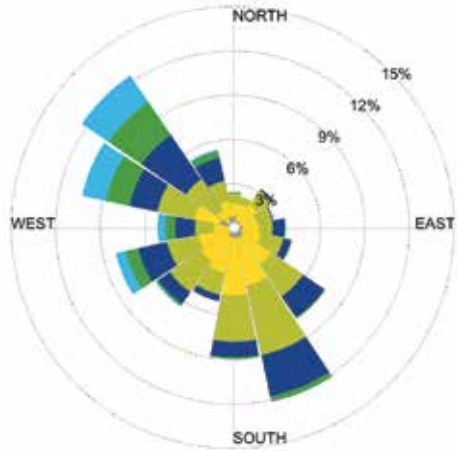

**Spring**




**Summer**




**Fall**



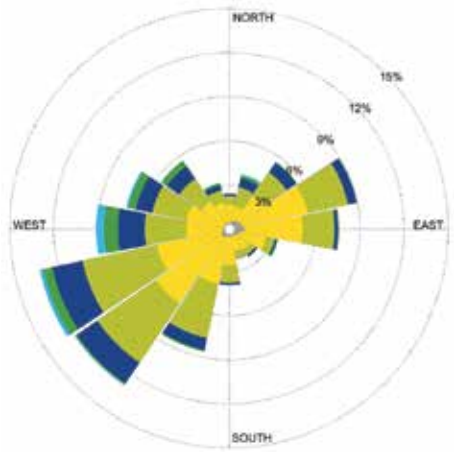

**Winter**


WIND SPEED (km/h)
Tower Height: 29m

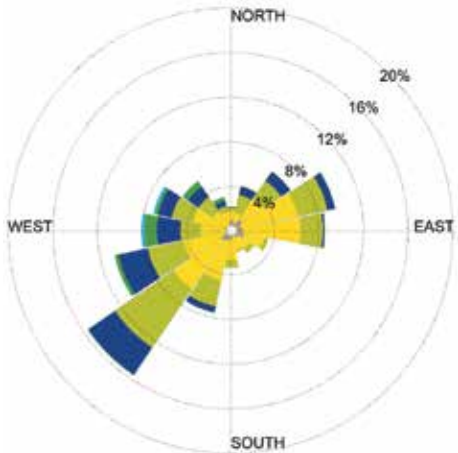
- 0.5 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- > = 25

# Meteorological Tower 3011

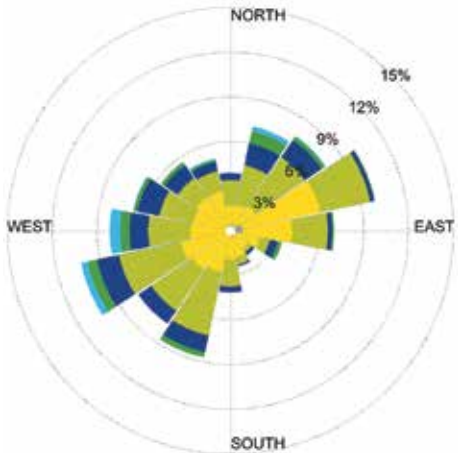
**Annual Average**



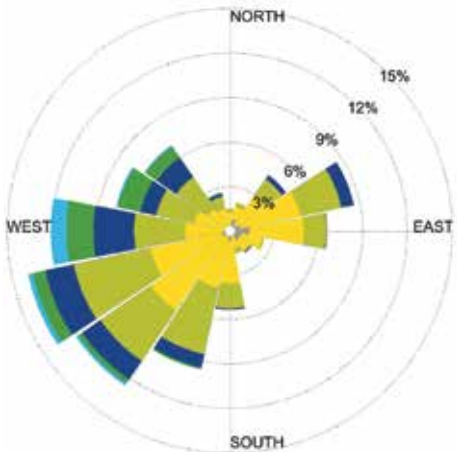

**Spring**



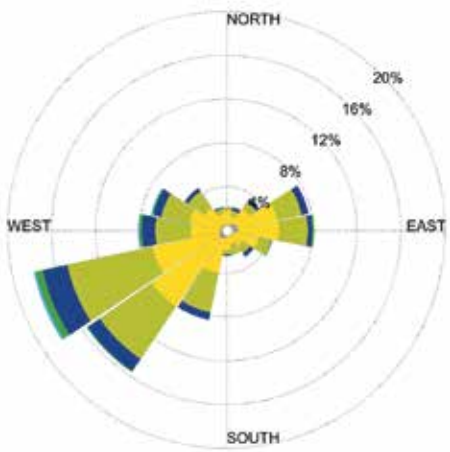

**Summer**




**Fall**




**Winter**

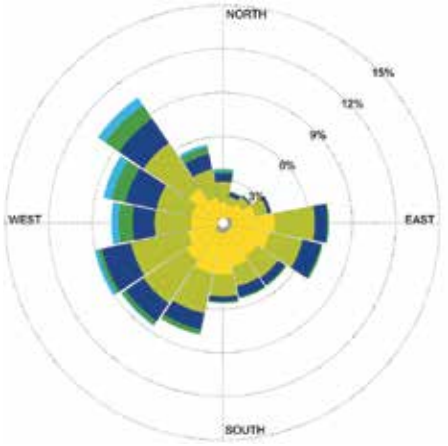



WIND SPEED (km/h)
Tower Height: 29m

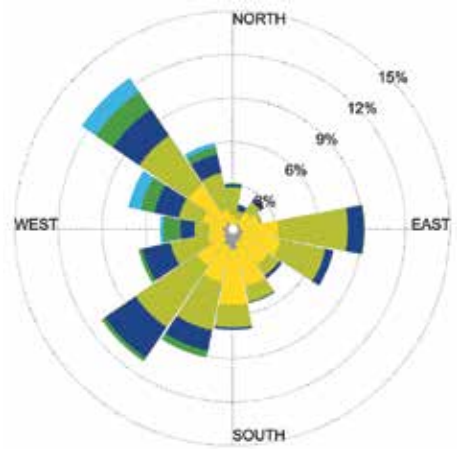
- 0.5 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- > = 25

# Meteorological Tower 3016

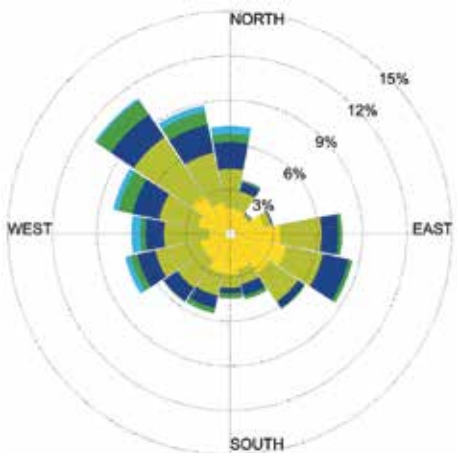
**Annual Average**



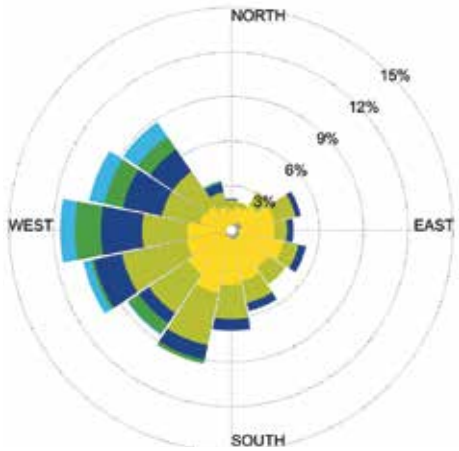

**Spring**



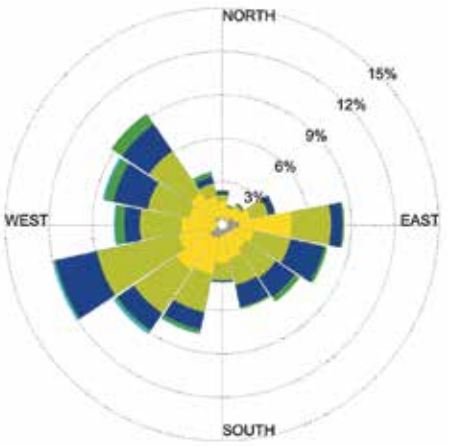

**Summer**




**Fall**




**Winter**

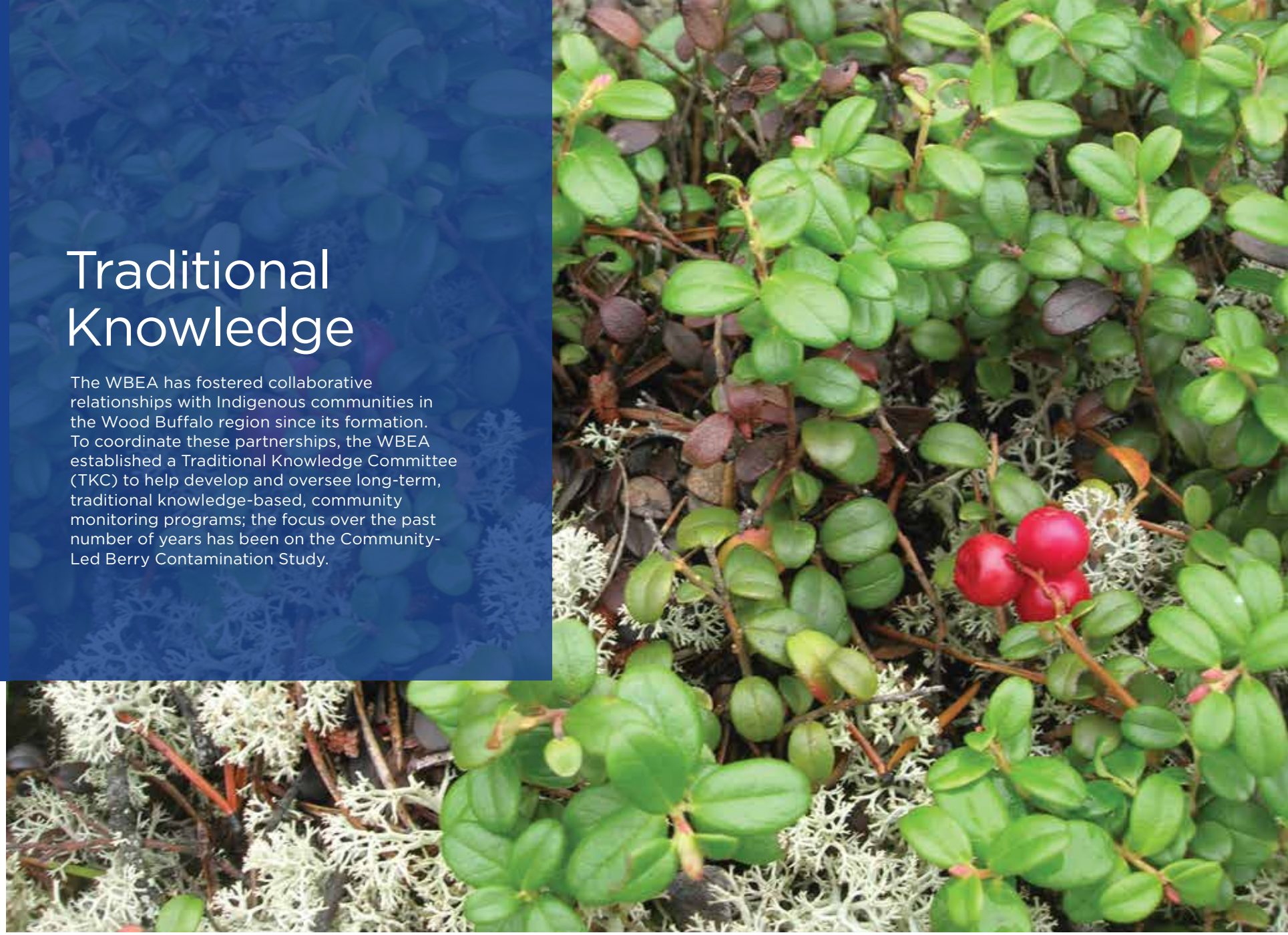



WIND SPEED (km/h)
Tower Height: 29m

- 0.5 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- > = 25

# Traditional Knowledge

The WBEA has fostered collaborative relationships with Indigenous communities in the Wood Buffalo region since its formation. To coordinate these partnerships, the WBEA established a Traditional Knowledge Committee (TKC) to help develop and oversee long-term, traditional knowledge-based, community monitoring programs; the focus over the past number of years has been on the Community-Led Berry Contamination Study.



The Community Led Berry Contamination Study is a multi-year community-based monitoring project that builds upon work initiated by Fort McKay First Nation, with support from the Wood Buffalo Environmental Association, since 2010. The project has grown to include Conklin Métis, Fort McKay Métis, Fort McMurray Métis, and Fort McMurray First Nation 468.

The study objective is to monitor berries from culturally significant patches to inform the community questions, including “are the berries safe to eat?” and is driven by the concerns of the participating community members about changes to berry quality and health due to oil sands-related development. The cultural identity of Indigenous peoples is intertwined with their food sovereignty and food security, therefore, the continued access to cultural keystone species of berries is paramount for community health and well-being.

In 2021, the study focused on the assessment of laboratory analytical data and lessons learned from previous monitoring years, resulting in the documentation of project design and standard operating procedures in a comprehensive Project Framework and the development of community-specific technical reports summarizing results. Gatherings were held by each participating community where these results were shared.

The study has produced qualitative and quantitative data for each community that has provided meaningful insight on their berry condition. While the WBEA provides support to the communities, the WBEA does not share the data on the communities’ behalf; however, there is some indication from this project that levels of contaminants of concern are elevated in berries from patches considered unclean by Indigenous members, which are located closer to oil sands development, versus berries from patches considered clean or sacred by Indigenous members, which are located farther away from development.

Going forward, the study will continue to use best practice methodologies that appropriately braid Indigenous and Western knowledge systems to build trusted relationships between participating Indigenous communities, academic researchers, and provincial and federal government scientists.

# Odour Monitoring

## Community Odour Monitoring Program

The WBEA created the Community Odour Monitoring Program (COMP) app as an opportunity for people to provide information about the odours they experience throughout the RMWB, as outlined in the image below. Currently, analyzers can measure the concentration of specific pollutants or groups of pollutants, but they cannot measure if an odour is present or how strong the odour would be. Therefore, the app allows the WBEA to compare the information people provide about odours to the ambient air data collected at WBEA air monitoring stations. The intent is to find whether there are trends in the ambient data when odours are present—such as elevated concentrations of odour-causing compounds.

View near-real time observations, access the COMP 2021 Annual Report, and find links to download the app to your iOS or Android Device on the COMP website: **comp.wbea.org**.


## 1 Source

Pollution is emitted into the air from a variety of sources

## 2 Smell

The pollution may cause odours - anyone who experiences an odour in the RMWB can submit their observations via the WBEA's COMP app

## 3 Share

Users can learn about odours and view all observations submitted at [comp.wbea.org](comp.wbea.org)

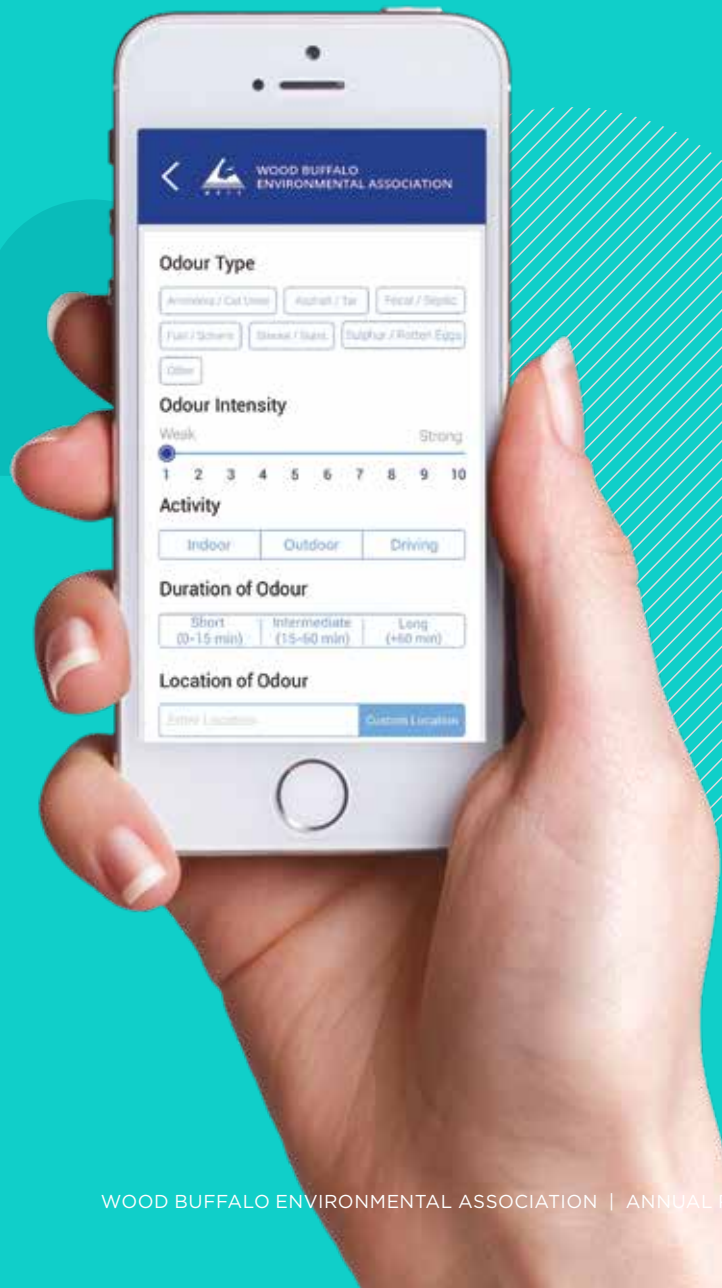
# COMP Needs You!

The Community Odour Monitoring Program is still going on. To participate and provide information on the odours you experience in the Regional Municipality of Wood Buffalo:

1. Download the COMP App for iPhone or for Android devices
2. When you smell an odour in the air, submit an observation in the App

Access links to download the app to your iOS or Android Device on the COMP website: **comp.wbea.org**.

*The information collected is anonymous and will be used for research purposes only.*



# WBEA 2021 Membership

## INDIGENOUS MEMBERS

Athabasca Chipewyan First Nation
Chipewyan Prairie Dene First Nation
Christina River Dene Nation Council
Conklin Resource Development Advisory Committee
Fort McKay First Nation
Fort McMurray #468 First Nation
Fort McKay Métis Nation
Lakeland Métis Community Association
McMurray Métis
Mikisew Cree First Nation

## NON-GOVERNMENT ORGANIZATION MEMBERS

Pembina Institute
Keyano College

## GOVERNMENT MEMBERS

Alberta Energy Regulator
Alberta Environment and Parks
Alberta Health
Alberta Health Services
Environment and Climate Change Canada
Health Canada
Parks Canada
Regional Municipality of Wood Buffalo

## INDUSTRY MEMBERS

Athabasca Oil Corporation
Canadian Natural
Cenovus Energy Inc.
CNOOC International
Connacher Oil and Gas Ltd
ConocoPhillips Canada
Hammerstone Infrastructure Materials Ltd.
H.J. Baker Sulphur Canada ULC
Husky Oil Operations Ltd.
Imperial Oil Limited
Inter Pipeline Limited
MEG Energy Corp.
Parsons Creek Aggregates
PetroChina Canada Ltd.
Suncor Energy Inc.
Sunshine Oilsands Ltd.
Surmont Energy
Syncrude Canada Ltd.
Teck Resources Ltd.
Titan Tire Reclamation Corporation

WOOD BUFFALO
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