NWT AIR QUALITY REPORT - 2020

Long-Term Trends 2006-2020
Canadian Ambient Air Quality Standards 2018-2020

RAPPORT DE 2020 SUR LA QUALITÉ DE L'AIR DES TNO

Tendances à long terme 2006-2020
Normes nationales de qualité de l'air ambiant 2018-2020

Government of | Gouvernement des
Northwest Territories
Territoires du Nord-Ouest

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Glossary

Air Quality Management System (AQMS): A comprehensive approach for protecting and improving air quality in Canada.

Air zone: A geographic area used to manage local air quality by the province or territory within its boundaries.

Canadian Air and Precipitation Monitoring Network (CAPMoN): A program operated by Environment and Climate Change Canada (ECCC), designed to study the regional patterns and trends of atmospheric parameters such as acid rain, smog, particulate matter and mercury, in both air and precipitation.

Canadian Ambient Air Quality Standards (CAAQS): Health and environmental-based air quality objectives to protect human health and the environment.

CAAQS metric value: The measured concentrations of an air parameter calculated in the statistical form of the CAAQS.

Exceedance: The amount by which a parameter exceeds a standard or permissible measurement.

Meteorological: Relating to the science that deals with the phenomena of the atmosphere, especially weather and weather conditions.

Micrograms per cubic meter ($\mu g/m^3$): A measure of parameter concentration. Micrograms of parameter per cubic meter of air.

National Air Pollution Surveillance (NAPS): A joint program of the federal, provincial, and territorial governments to monitor and assess ambient air in Canadian urban centers.

Nitrogen oxides (NO_x): Gases that form when nitrogen and oxygen in the atmosphere are burned with fossil fuels at high temperatures. NO_x contributes to ground-level ozone formation.

Nitrogen dioxide (NO_2): NO_2 is one of the two most toxicologically significant compounds found in NO_x. It forms primarily from emissions from burning fossil fuels, vehicles, power plants and off-road equipment.

Ozone (O_3): An invisible gas occurring naturally in the upper atmosphere but at ground levels it is a major component of smog. It is not emitted directly but formed because of complex chemical reactions when volatile organic compounds and NO_x react in the presence of sunlight.

Fine Particulate matter ($PM_{2.5}$): Airborne particulate matter that is less than or equal to 2.5 micrometers in diameter. These tiny particles can cause or worsen respiratory and cardiovascular problems. Forest fires, industry, heating, and transportation all produce $PM_{2.5}$.

Parts per billion (ppb): A measure of parameter concentration. Parts of parameter per billion parts of air.

Sulfur dioxide (SO_2): A heavy, pungent, colorless gas formed primarily by the combustion of fossil fuels. It is a respiratory irritant, especially for asthmatics.

Acronyms and Abbreviations

AQMS	Air Quality Management System
CAAQS	Canadian Ambient Air Quality Standards
CAPMoN	Canadian Air and Precipitation Monitoring Network
CCME	Canadian Council of Ministers of the Environment
ECC	Department of Environment and Climate Change
ECCC	Environment and Climate Change Canada
GNWT	Government of the Northwest Territories
NAPS	National Air Pollution Surveillance Program
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NWT	Northwest Territories
O_3	Ozone
$PM_{2.5}$	Fine Particulate Matter
ppb	parts per billion (by volume)
SO_2	Sulphur Dioxide
TF/EE	Transboundary Flows / Exceptional Events
$\mu g/m^3$	micrograms per cubic meter
%	percent

EXECUTIVE SUMMARY

Purpose

This report provides the Northwest Territories' 2018-2020 air quality monitoring results, including long-term trends observed from 2006-2020. The report includes a detailed technical explanation of these trends and comparison to standards. The release of this report has been delayed because of data collection and analysis processes, which were impacted by disruptions caused by the COVID-19 pandemic.

Who are we?

The Department of Environment and Climate Change (ECC, we, us) is a department of the Government of the Northwest Territories (GNWT) that is responsible for monitoring and managing air quality in the Northwest Territories. We have been monitoring air quality in the Northwest Territories since 1974 and generating annual air quality reports for the public since the mid 1990s.

We work closely with Environment and Climate Change Canada (ECCC) to monitor air quality. ECCC tracks air parameters across Canada. They have a program to supply us, and other provinces and territories, with the equipment we need to measure and share data. ECCC also has guidelines for us to conduct quality assurance and quality control to our air quality data. The GNWT in partnership with ECCC operates five monitoring stations in Yellowknife, Inuvik, Fort Smith, Fort Simpson, and Norman Wells. The Fort Simpson station was not established until 2022, so no data was used in this report.

What do we measure?

Each of our five stations tracks meteorological conditions and air quality parameters, including:

- **fine particulate matter ($PM_{2.5}$)**—small solid or liquid particles in the air that are harmful to breathe. Forest fires, industry, heating, and transportation all produce $PM_{2.5}$.
- **ground-level ozone (O_3)**—a gas that is harmful to breathe and can affect vegetation and reduce its productivity when too close to the earth. Ozone is essential in the upper atmosphere where it protects the earth from radiation.
- **nitrogen dioxide (NO_2)**—a gas that is harmful to breathe at certain levels. It is involved in the formation of fine particulate matter and acid rain. Most NO_2 comes from transportation, oil and gas industry, and burning fossil fuels for heat and electricity.
- **sulphur dioxide (SO_2)**—a gas that is harmful to breathe and can damage plants at certain levels. It is also involved in the formation of fine particulate matter and acid rain.

We also measure other parameters (coarse particulate matter, carbon monoxide) at select stations; however, we did not include these parameters in this report as national standards do not exist for them.

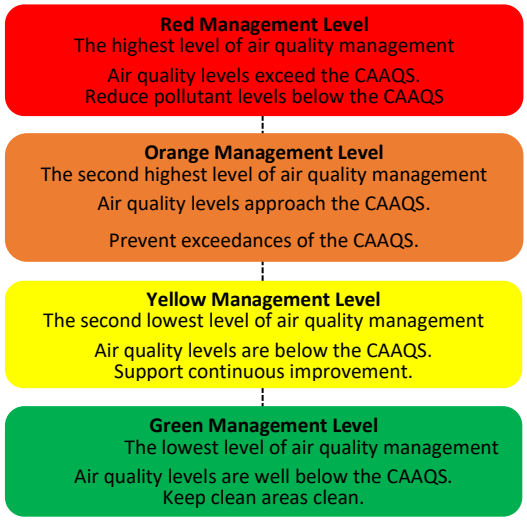
Why do we compare air quality to standards?

This report compares air quality in the territory to national standards—the Canadian Ambient Air Quality Standards (CAAQS) – which are developed by the Canadian Council of Ministers of the Environment (CCME). While our previous years' reports used territorial air quality standards, we now made the decision to transition our annual air quality reporting from territorial standards to the CAAQS for this report and future reports for the following reasons:

- Over the past decade, there have been no exceedances of territorial air quality standards, except for particulate matter during active wildfire events and from road dust in the spring when the snow cover disappears and exposes sand and gravel deposited in winter on roads;
- CAAQS are more stringent and protective of the environment and human health than the territorial standards, as CAAQS are based on recent science and health assessment research;
- This transition offers the benefit of harmonization in air quality reporting across the country, promoting data consistency and simplifying comparisons between provinces and territories;
- CAAQS were developed by provinces and territories to guide air zone management; and
- This fulfills GNWT's commitment to monitor and report on air quality as part of Canada's collaborative Air Quality Management System.

CAAQS are integrated into a framework of Air Zone Management Levels that is described below. Each colour represents a management level, which is related to how healthy the air is and how concerned we should be. Air quality in the red management level indicates exceedances of standards, whereas air quality in the green management level indicates air quality levels are well below the standards. We use the data from different air zones to score each zone to determine which management level applies to a particular zone. The resulting management level decides the level of concern and the next steps that should be taken.

Air Zone Management Framework



What did we find?

Our air is better than national standards

Overall, the 2018-2020 data shows our air quality is very good and is well below the national air quality standards for the four parameters. Our air quality is good because our population density is low, and we have limited industrial emission sources. However, wildfires and long-range pollutants can affect our air quality, and it is important that we continue to monitor.

The table below shows territorial air quality for each parameter at each station that represents an air zone. We have only green and yellow levels—the lowest and second lowest levels of air quality

management. We have no red or orange, which exceed or approach air quality standards, respectively and would set next management steps in motion.

Northwest Territories Air Zone Management Level Results 2018-2020

Air Zone	Fine Particulate ($PM_{2.5}$)	Ozone (O_3)	Nitrogen Dioxide (NO_2)	Sulphur Dioxide (SO_2)
North Slave	Yellowknife	Yellowknife	Yellowknife	Yellowknife
South Slave	Fort Smith	Fort Smith	Fort Smith	Fort Smith
Beaufort Delta	Inuvik	Inuvik	Inuvik	Inuvik
Sahtu	Norman Wells	Norman Wells *(insufficient data)*	Norman Wells	Norman Wells

How has air quality changed over the last 15 years?

$PM_{2.5}$ and NO_2 have increased while SO_2 and O_3 have decreased.

- The increase in $PM_{2.5}$ is mostly because of wildfire smoke.
- The slight increase in NO_2 is likely because of higher emissions from residential and commercial heating.
- The decrease in O_3 may be linked to a decrease in average background O_3.
- The decline in SO_2 can be related to lower emissions from combustion and mobile sources. This is a cross-country trend that is likely because of lower sulphur levels in fuel.

It is important to continue monitoring

Having clean air today is good news for the Northwest Territories, but we need to keep monitoring. Due to the changing climate, more wildfire events are likely to occur, with the potential for pollutants to reach our air from a long distance away. We must continue to measure air quality across the territory to understand current conditions and assess potential changes in the future.

SOMMAIRE

Objectif

Ce rapport présente les résultats de la surveillance de la qualité de l'air des Territoires du Nord-Ouest (TNO) pour la période 2018-2020, y compris les tendances à long terme observées entre 2006 et 2020. Il inclut une explication technique détaillée de ces tendances et une comparaison avec les normes. La publication de ce rapport a été retardée, car les processus de collecte et d'analyse des données ont été perturbés par la pandémie de COVID-19.

Qui sommes-nous?

Le ministère de l'Environnement et du Changement climatique (MECC) est un ministère du gouvernement des Territoires du Nord-Ouest (GTNO) chargé de la surveillance et de la gestion de la qualité de l'air aux TNO. Nous surveillons la qualité de l'air aux TNO depuis 1974 et produisons des rapports publics annuels à ce sujet depuis le milieu des années 1990.

Nous travaillons en étroite collaboration avec Environnement et Changement climatique Canada (ECCC) pour surveiller la qualité de l'air. ECCC surveille les paramètres de la qualité de l'air partout au Canada et a mis en place un programme pour nous fournir, ainsi qu'aux provinces et aux autres territoires, l'équipement dont nous avons besoin pour mesurer et partager les données. ECCC a également établi des lignes directrices pour l'assurance et le contrôle de la qualité de nos données sur la qualité de l'air. Le GTNO, en partenariat avec ECCC, exploite cinq stations de surveillance à Yellowknife, Inuvik, Fort Smith, Fort Simpson et Norman Wells. Comme la station de Fort Simpson n'a été mise en place qu'en 2022, aucune donnée du présent rapport ne provient de cette station.

Que mesurons-nous?

Chacune de nos cinq stations permet de surveiller les conditions météorologiques et les paramètres de la qualité de l'air, notamment :

- **Les particules fines ($PM_{2.5}$)**. Particules fines solides ou liquides présentes dans l'air et nocives pour la respiration. Les feux de forêt, l'industrie, le chauffage et les transports produisent tous des $PM_{2.5}$.
- **L'ozone troposphérique (O_3)**. Un gaz nocif pour la respiration qui peut affecter la végétation et réduire sa productivité lorsqu'il est trop près de la terre. L'ozone est essentiel dans la haute atmosphère, car il protège la Terre des radiations.
- **Le dioxyde d'azote (NO_2)**. Un gaz nocif pour la respiration à certaines concentrations. Il contribue à la formation de particules fines et de pluies acides. La plupart des émissions de NO_2 sont générées par les transports, l'industrie pétrolière et gazière et la combustion de combustibles fossiles pour la production de chaleur et d'électricité.
- **Le dioxyde de soufre (SO_2)**. Un gaz nocif pour la respiration et qui peut endommager les végétaux à certaines concentrations. Il contribue également à la formation de particules fines et de pluies acides.

Dans certaines stations, nous mesurons également d'autres paramètres (particules grossières, monoxyde de carbone) qui ne font pas l'objet de normes nationales. Les données recueillies pour ces paramètres ne sont donc pas incluses dans le présent rapport.

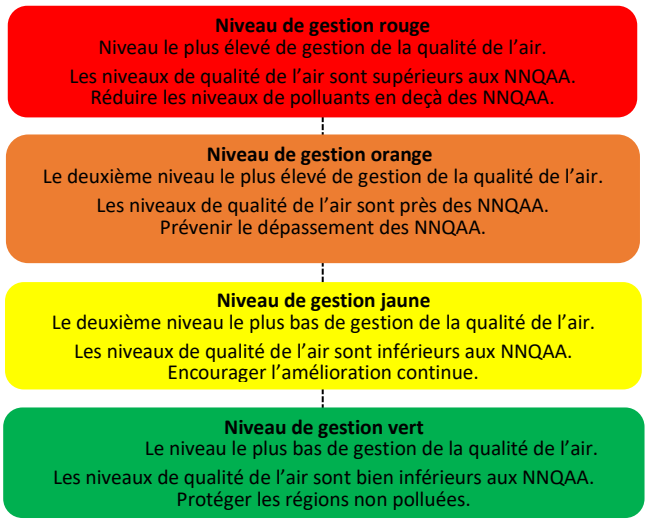
Pourquoi comparons-nous la qualité de l'air avec les normes nationales?

Ce rapport présente une comparaison entre les normes sur la qualité de l'air aux TNO et les normes nationales de qualité de l'air ambiant (NNQAA), qui sont établies par le Conseil canadien des ministres de l'Environnement (CCME). Bien que les normes sur la qualité de l'air aux TNO aient été utilisées dans les rapports des années précédentes, nous avons pris la décision d'utiliser les NNQAA pour le présent rapport et les rapports futurs. Voici les raisons qui ont motivé notre décision :

- Au cours de la dernière décennie, il n'y a pas eu de dépassement des normes sur la qualité de l'air aux TNO, à l'exception des particules lors des feux de forêt et de la poussière des routes au printemps, lorsque la couche neigeuse fond et que la poussière causée par l'épandage de sable et de gravier en hiver sur les routes est soulevée.
- Les NNQAA sont plus strictes quant à la protection de l'environnement et de la santé humaine que les normes territoriales, car elles sont basées sur des recherches scientifiques et des évaluations sanitaires récentes.
- Cette transition présente l'avantage d'harmoniser les rapports sur la qualité de l'air dans l'ensemble du pays, ce qui favorise la cohérence des données et simplifie les comparaisons entre les provinces et les territoires.
- Les NNQAA ont été créées par les provinces et les territoires afin d'orienter la gestion par zone atmosphérique.
- Le GTNO respecte ainsi son engagement de surveiller la qualité de l'air et d'en rendre compte dans le cadre du Système de gestion de la qualité de l'air du Canada.

Les NNQAA sont intégrées dans un cadre de gestion des zones atmosphériques qui comprend différents niveaux. Dans ce cadre, lequel est présenté plus bas, chaque couleur représente un niveau de gestion qui correspond à la qualité de l'air ambiant et au niveau de préoccupation lié. La qualité de l'air du niveau de gestion rouge indique le dépassement des normes, tandis que la qualité de l'air du niveau de gestion vert indique que les niveaux de la qualité de l'air sont bien inférieurs aux normes. Nous utilisons et évaluons les données de chaque zone atmosphérique afin de déterminer le niveau de gestion qui s'applique à une zone particulière. Le niveau de gestion qui en résulte détermine le niveau de préoccupation et les mesures à prendre, le cas échéant.

Cadre de gestion des zones atmosphériques



Qu'avons-nous constaté?

Notre qualité de l'air est meilleure que ce que prévoient les normes nationales

Dans l'ensemble, les données 2018-2020 montrent que notre qualité de l'air est très bonne et qu'elle est bien inférieure aux normes nationales de qualité de l'air pour les quatre paramètres. Notre faible densité de population et nos sources limitées d'émissions industrielles permettent d'expliquer pourquoi la qualité de l'air aux TNO est bonne. Toutefois, les feux de forêt et les polluants transportés sur de longues distances peuvent affecter notre qualité de l'air. Il est donc important de continuer à la surveiller.

Le tableau ci-dessous indique la qualité de l'air du territoire pour chaque paramètre à chaque station. Chacune d'entre elles représente une zone atmosphérique. Nous n'avons que des niveaux vert et jaune, soit les niveaux les plus bas et les deuxièmes plus bas de la gestion de la qualité de l'air. Nous n'avons pas de niveaux rouge (niveau de la qualité de l'air supérieur aux normes) ou orange (niveau de la qualité de l'air près des normes), ce qui aurait pour effet d'entraîner la mise en œuvre des prochaines mesures de gestion.

Résultats par zone atmosphérique de gestion aux Territoires du Nord-Ouest (2018-2020)

Zone atmosphérique	Particules fines ($PM_{2.5}$)	Ozone troposphérique (O_3)	Dioxyde d'azote (NO_2)	Dioxyde de soufre (SO_2)
Slave Nord	Yellowknife	Yellowknife	Yellowknife	Yellowknife
Slave Sud	Fort Smith	Fort Smith	Fort Smith	Fort Smith
Beaufort-Delta	Inuvik	Inuvik	Inuvik	Inuvik
Sahtu	Norman Wells	Norman Wells *(données insuffisantes)*	Norman Wells	Norman Wells

Comment la qualité de l'air a-t-elle évolué au cours des 15 dernières années?

- Les $PM_{2.5}$ et le NO_2 ont augmenté, tandis que le SO_2 et l'O_3 ont diminué.
- L'augmentation des $PM_{2.5}$ est principalement due à la fumée des feux de forêt.
- La légère augmentation du NO_2 est probablement due à l'augmentation des émissions provenant du chauffage résidentiel et commercial.
- La diminution de l'O_3 peut être liée à une diminution de la concentration de fond d'O_3 moyenne.
- La baisse du SO_2 peut être liée à la diminution des émissions provenant de la combustion et des sources d'émissions automobiles. Il s'agit d'une tendance nationale qui s'explique probablement par la diminution de la teneur en soufre des carburants.

Il est important de poursuivre la surveillance.

L'air est pur aujourd'hui, et il s'agit d'une bonne nouvelle pour les TNO. Malgré tout, nous devons continuer à en surveiller la qualité. En raison des changements climatiques, il est probable que les feux de forêt se multiplient et que les polluants transportés sur de grandes distances atteignent nos régions. Nous devons continuer à mesurer la qualité de l'air sur l'ensemble du territoire afin de comprendre les conditions actuelles et d'évaluer les changements possibles dans l'avenir.

1.0 INTRODUCTION

1.1 Air Quality Monitoring in the Northwest Territories

The Government of the Northwest Territories (GNWT) Department of Environment and Climate Change (ECC, we, us) monitors air quality in the Northwest Territories (NWT).

Air quality monitoring in the NWT began with a single particulate matter monitor in Yellowknife in 1974. Since the 1990s, the NWT Air Quality Monitoring Network has expanded to a network of five monitoring stations located in Yellowknife, Inuvik, Fort Smith, Norman Wells and Fort Simpson. Each station monitors a variety of air quality parameters and meteorological conditions. Data from the Fort Simpson station is not included in this report as the station opened in 2022.

While our previous years' reports used territorial air quality standards, we now made the decision to transition our annual air quality reporting from territorial standards to the CAAQS for this report and future reports for the following reasons:

- Over the past decade, there have been no exceedances of territorial air quality standards, except for particulate matter during active wildfire events and from road dust in the spring when the snow cover disappears and exposes sand and gravel deposited in winter on roads;
- CAAQS are more stringent and protective of the environment and human health than the territorial standards, as CAAQS are based on recent science and health assessment research;
- This transition offers the benefit of harmonization in air quality reporting across the country, promoting data consistency and simplifying comparisons between provinces and territories;
- CAAQS were developed by provinces and territories to guide air zone management; and
- This fulfills GNWT's commitment to monitor and report on air quality as part of Canada's collaborative Air Quality Management System.

The purpose of this report
This report presents long-term trends in air quality from 2006 to 2020 and monitoring results from 2018-2020 compared to Canadian Ambient Air Quality Standards (CAAQS). This report also serves as our first air zone report.

You can find additional information, including 'near real-time' air quality parameter readings, on the NWT Air Quality Monitoring Network website at http://aqm.enr.gov.nt.ca/.

Measuring air quality is coordinated across Canada
We work closely with other jurisdictions and are also involved with various programs to share data and knowledge. We participate in:

- the National Air Pollution Surveillance (NAPS) program—a joint federal, provincial and territorial monitoring network run by Environment and Climate Change Canada (ECCC). The goal of the NAPS program is to provide accurate and long-term air quality data in a uniform standard across Canada. We have five monitoring stations in the NWT - Yellowknife, Inuvik, Fort Smith, Norman Wells and Fort Simpson - as part of the NAPS program.

- the Canadian Air and Precipitation Monitoring Network (CAPMoN) program—a program that monitors rainwater and snow quantities for deposition and ozone levels at two stations in the NWT at the Wood Buffalo National Park and the Snare Rapids hydro facility (see **Figure 1**).
- CCME's Air Quality Management System (AQMS).

1.2 National Air Quality Management System

The CCME worked closely with Federal, provincial, and territorial governments; Indigenous governments and Indigenous organizations; industry; and environmental and health non-governmental organizations to establish the AQMS that launched in 2012. The AQMS is the country's comprehensive approach to air quality management and is built on a foundation of collaboration, accountability, and transparency. The CCME continues to monitor and improve how the AQMS is being implemented on the ground. You can find additional details regarding the AQMS on ccme.ca.

1.2.1 Canadian Ambient Air Quality Standards

The CAAQS are the national standards to assess air quality under the AQMS. They are designed to protect human health and the environment from air pollution. Federal, provincial, and territorial governments, Indigenous governments and Indigenous organizations, and stakeholders developed the standards together, led by the CCME. The CAAQS cover four parameters: $PM_{2.5}$, O_3, NO_2, and SO_2. The table below shows the current and future CAAQS. We used the 2020 CAAQS in this report. The 2025 CAAQS were announced in advance of their achievement date, allowing jurisdictions and industries sufficient time to make necessary adjustments and take appropriate actions to address emissions, if needed.

Table 1: Canadian Ambient Air Quality Standards

Parameter	Averaging Time	Standard		Statistical Form
		2020	2025	
Fine Particulate ($PM_{2.5}$)	24-hour	27 µg/m³	-	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
	Annual	8.8 µg/m³	-	The 3-year average of the annual average of the daily 24-hour average concentrations
Ozone (O_3)	8-hour	62 ppb	60 ppb	The 3-year average of the annual 4th highest daily maximum 8-hour average concentrations
Nitrogen Dioxide (NO_2)	1-Hour	60 ppb	42 ppb	The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations
	Annual	17.0 ppb	12.0 ppb	The average over a single calendar year of all 1-hour average concentrations
Sulphur Dioxide (SO_2)	1-hour	70 ppb	65 ppb	The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
	Annual	5.0 ppb	4.0 ppb	The average over a single calendar year of all 1-hour average SO_2 concentrations

- Future CAAQS for $PM_{2.5}$ are under review. µg/m³ - micrograms per cubic metres. ppb - parts per billion. (Source: ccme.ca)

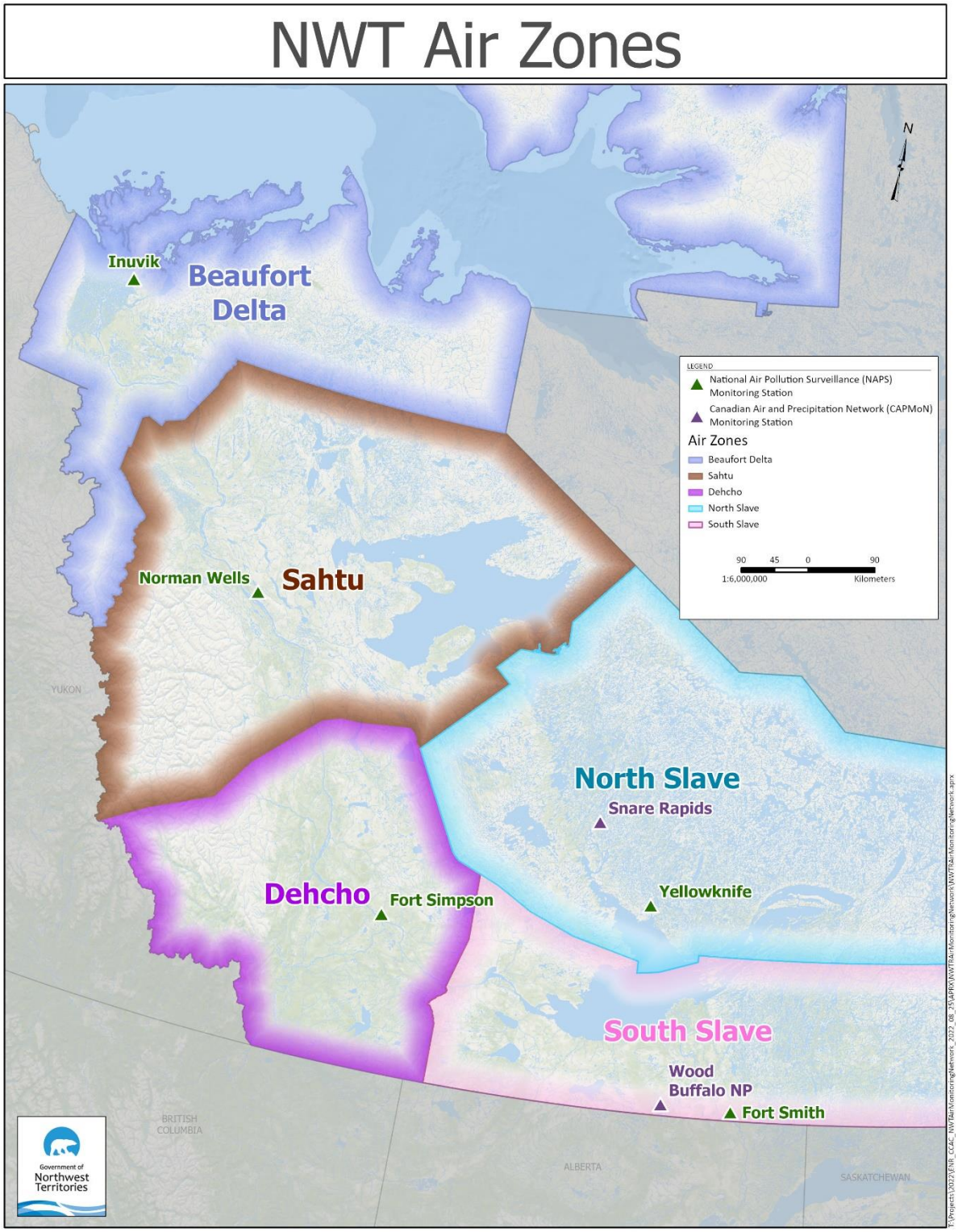
Note that when concentrations of air quality parameters measured at a monitoring station are converted into the statistical form of the CAAQS as shown in **Table 1** to enable comparison with the CAAQS, these concentrations are referred to as 'CAAQS metric values' or 'CAAQS metrics' or simply 'metric values'.

1.2.2 Air Zones

The AQMS requires territories and provinces to divide their jurisdictions into air zones—areas that show similar air quality characteristics, issues, and trends. These characteristics may include factors like pollutant sources, topography, meteorological patterns, population density, and other characteristics that influence air. Each jurisdiction must then measure, manage, and report on their air zones to show how air quality compares to the CAAQS.

We divided the NWT into five air zones which are aligned with the GNWT's five administrative regions—Beaufort Delta, Sahtu, Dehcho, North Slave, and South Slave (see **Figure 1**). The NWT consists of vast expanses of land, with relatively few intermittent and small populated areas, and few widely distributed industrial emission sources. The reason for currently using administrative regions as the basis for air zone delineation is that there are no specific air quality issues or trends that require us to delineate the territory differently and factors that typically affect air quality are not unique to any particular area. Also, this alignment provides administrative convenience for air monitoring and reporting. Additionally, each air zone has one NAPS air quality monitoring station. We used data from the monitoring stations to calculate how each air zone scored on the CAAQS air zone management levels.

Figure 1: Air Zones and Monitoring Stations in the Northwest Territories

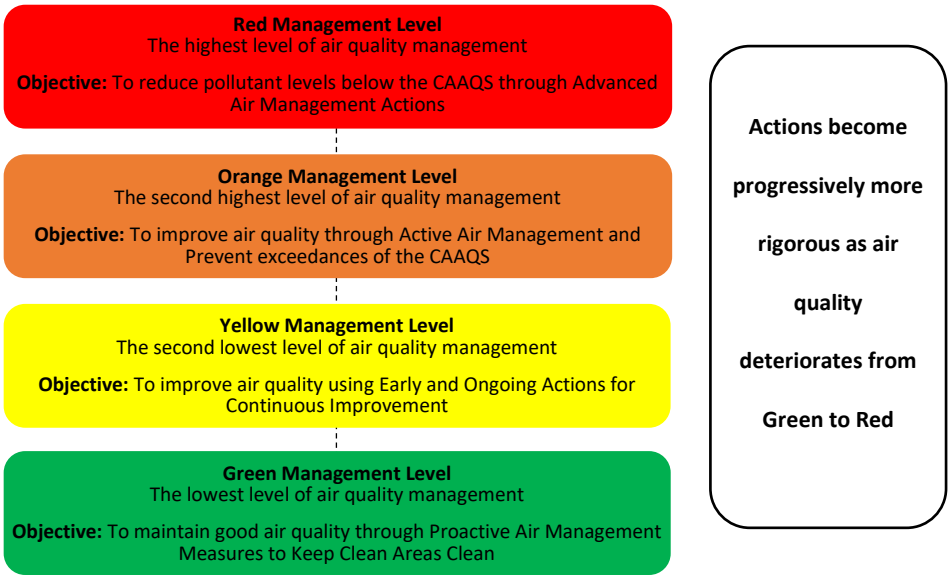


Note: Data from CAPMON stations was not used in this report

1.2.3 Air Zone Management Levels

A framework of air zone management levels helps to easily communicate air quality in an air zone and helps provinces and territories to set management objectives and take action, if needed. The CAAQS are supported by four management levels, each color-coded (see **Figure 2** and **Table 2**). Levels are separated by threshold values—if the concentration of a parameter exceeds a threshold value, then that air zone is assigned a new, stricter management level. A red management level means that air pollution exceeds the CAAQS. The green, yellow and orange management levels mean that air pollution achieves the CAAQS.

Figure 2: Air Zone Management Framework



(Source: CCME, 2019. Guidance Document on Air Zone Management)

Air zones are assigned management levels that correspond to their air quality. For a given year, we:

1. average parameter levels in the air zone over the previous three years, except for annual NO_2 and SO_2 levels that are averaged over a single year as shown in **Table 1**
2. compare the average to the threshold numbers in **Table 2**
3. assign the air zone the corresponding management level from **Table 2**

This report is dated 2020 and uses data collected over the previous three years from 2018 to 2020 to assign management levels.

Table 2: 2020 CAAQS Management Levels

Management Levels	$PM_{2.5}$		O_3	NO_2		SO_2	
	24-hour ($\mu g/m^3$)	Annual ($\mu g/m^3$)	8-hour (ppb)	1-hour (ppb)	Annual (ppb)	1-hour (ppb)	Annual (ppb)
Red	>27	>8.8	>62	>60	>17.0	>70	>5.0
Orange	20 to 27	6.5 to 8.8	57 to 62	32 to 60	7.1 to 17.0	51 to 70	3.1 to 5.0
Yellow	11 to 19	4.1 to 6.4	51 to 56	21 to 31	2.1 to 7.0	31 to 50	2.1 to 3.0
Green	≤10	≤4.0	≤50	≤20	≤2.0	≤30	≤2.0

(Source: ccme.ca)

1.2.4 Transboundary Flows and Exceptional Events

Air quality can be influenced by emissions that are uncontrollable or originate outside of the Northwest Territories boundaries:

- **transboundary flows (TF)**—when air pollutants originate in one province, territory, or country and are transported to another location through air flows.
- **exceptional events (EE)**— unusual or naturally occurring events that can affect air quality but are not reasonably controllable using techniques that provincial, territorial or local air agencies may implement to maintain the CAAQS.

How we handle data caused by transboundary flows and exceptional events

Jurisdictions have little to no control over TF or EE, such as wildfires. The AQMS allows provinces and territories to distinguish between pollution data caused by controllable and uncontrollable sources when determining the management levels in the air zones.

In this report, we use adjusted metric values (measured concentration) to determine management levels for air zones. These adjusted values (in **Table 3**) include $PM_{2.5}$ data influenced by smoke during the wildfire season (May 1 to September 30) that would put an air zone into the orange management level (over 19 µg/m^3).

1.2.5 Achievement Assessment

The *Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards* defines how to calculate levels of $PM_{2.5}$, O_3, NO_2, and SO_2, so they can be compared to the CAAQS levels shown in **Table 1**. We check data for completeness before using it in calculations.

An air zone achieves the CAAQS if the metric value is equal to or less than the standard. Otherwise, the air zone exceeds the CAAQS and is assigned the red management level.

2.0 RESULTS

2.1 Long-Term Air Quality Trends

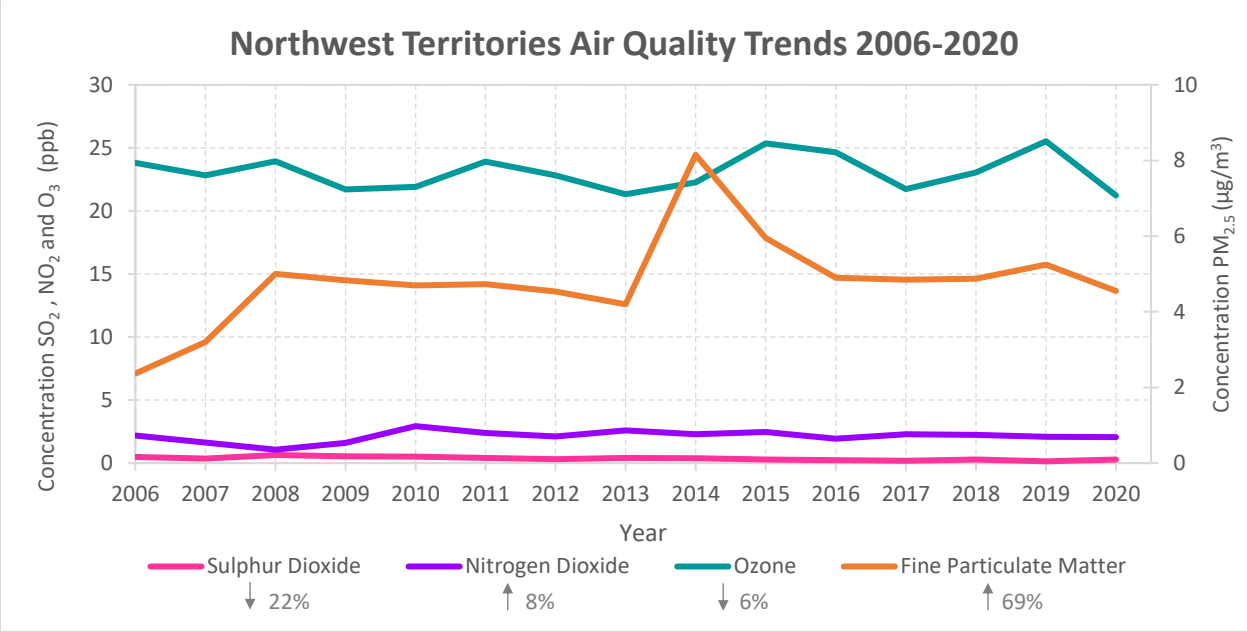
The NWT Ambient Air Quality Monitoring Network has been in operation for many years, providing enough data to analyze trends over a longer period. **Figures 3-7** show levels of $PM_{2.5}$, O_3, NO_2, and SO_2 from 2006 to 2020 for each station and parameter. Note that the long-term trends analyses presented below are based on all values including those influenced by wildfire smoke. **Appendix A** shows annual average concentrations and changes in concentrations since 2006 for the entire network.

2.1.1 Network-Wide Long-Term Trend

Generally, air quality in the NWT is very good. Since 2006, network-wide (**Figure 3**) concentrations of:

- **$PM_{2.5}$ increased**—this can be attributed to active wildfire seasons in recent years. The highest concentration was observed in 2014, due to a major wildfire season in the region.
- **NO_2 increased**—this slight increase is likely due to higher emissions from fuel combustion sources for residential and commercial heating and idling vehicles.
- **SO_2 dropped**— this can be related to lower emissions from combustion and mobile sources. This is a cross-country trend that is likely because of lower sulphur levels in fuel.
- **O_3 dropped**—this slight decrease may be linked to a decrease in average background O_3 levels. Natural sources contribute to background O_3, and the formation of O_3 is a complicated process that depends on a chemical reaction involving nitrogen oxides (NO_x) and hydrocarbons in the presence of sunlight. When there is more NO_x in the air, it can result in lower O_3 levels.

Figure 3: Network-wide Annual Concentrations and Percent Change in Concentrations Since 2006



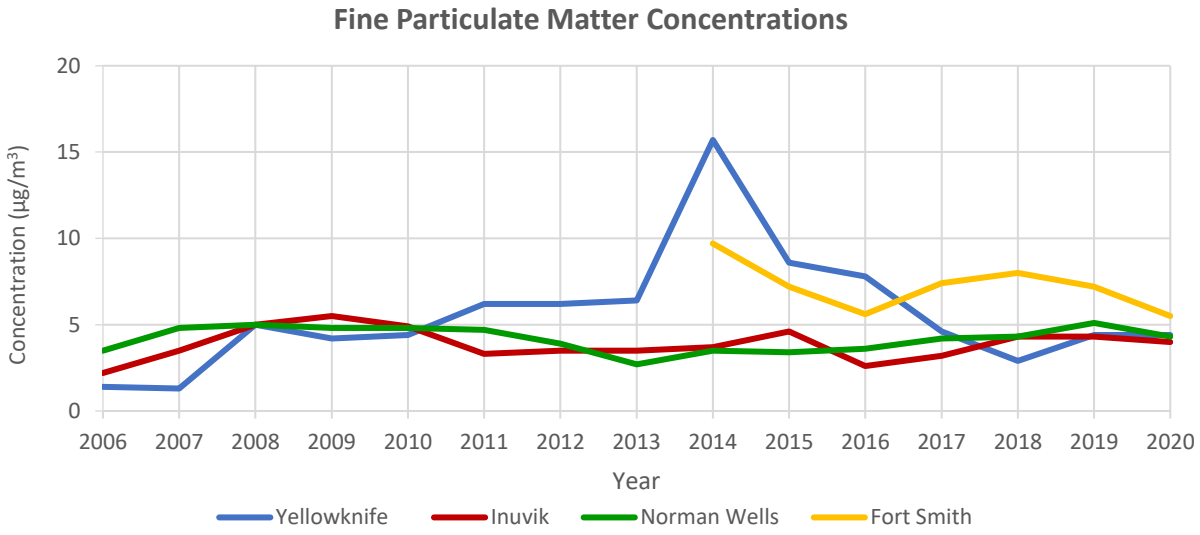
2.1.2 Fine Particulate Long-Term Trend

$PM_{2.5}$ refers to solid particles and liquid droplets suspended in air that are smaller than or equal to 2.5 micrometres (µm) in diameter. $PM_{2.5}$ is about 30 times smaller than the width of a human hair. $PM_{2.5}$ emissions come from natural events such as wildfires and human activities such as burning of fossil fuels, industry, mining, oil and gas operations, commercial and residential heating, and vehicle emissions. $PM_{2.5}$, depending on its chemical composition, can change chemistry of soil and water, leading to negative consequences for vegetation and organisms. $PM_{2.5}$ contributes to reduced visibility and is a major component of smog. These tiny particles, when inhaled, travel deep into the lungs and bloodstream where they can cause adverse health effects. $PM_{2.5}$ is considered a non-threshold pollutant, that is, there are no safe limits for exposure.

$PM_{2.5}$ levels in the NWT change annually

This is likely due to the significant influence of seasonal wildfires, which also change in amount and severity year-to-year. The noticeable peak in $PM_{2.5}$ levels recorded in Yellowknife in 2014 was a direct result of one of the most severe wildfire seasons experienced in the NWT. The wildfire smoke that year caused the highest $PM_{2.5}$ levels ever recorded at the Yellowknife monitoring station to date. Note that data started to be collected at the Fort Smith station in 2014.

Figure 4: $PM_{2.5}$ Annual Average Concentrations



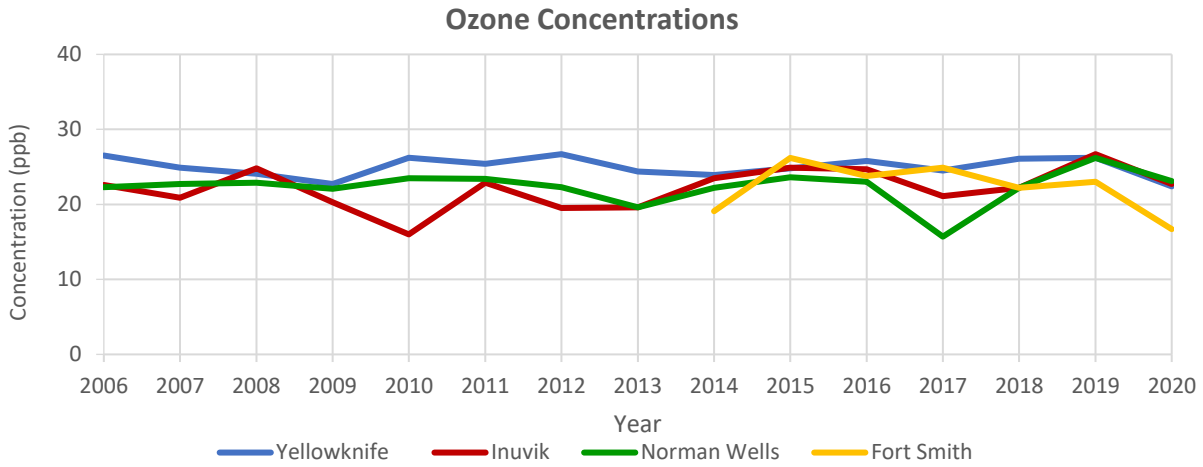
2.1.3 Ozone Long-Term Trend

O_3 is a colourless, odourless and irritating gaseous parameter. It is the same gas that is found higher up in the atmosphere, approximately 10 to 40 kilometers above the Earth's surface, where it is called stratospheric ozone. High in the atmosphere, ozone is a good thing—it protects the planet from the sun's harmful ultraviolet rays. However, at ground level, ozone can be harmful to humans, animals, and plants. High levels of ozone can be created in the lower atmosphere by sunlight and heat-causing gases, usually NO_x and substances called volatile organic compounds that undergo chemical reactions with each other. O_3 is a greenhouse gas that contributes to climate change and is a major component of smog.

O_3 levels have stayed relatively consistent from year-to-year

No significant trends were observed over the period of analysis. This indicates that O_3 levels in the NWT are largely influenced by regional factors, such as atmospheric transport. Overall, the O_3 levels in the NWT are within the range of natural levels of O_3 in other areas of Canada. Note that data started to be collected at the Fort Smith station in 2014.

Figure 5: O_3 Annual Average Concentrations



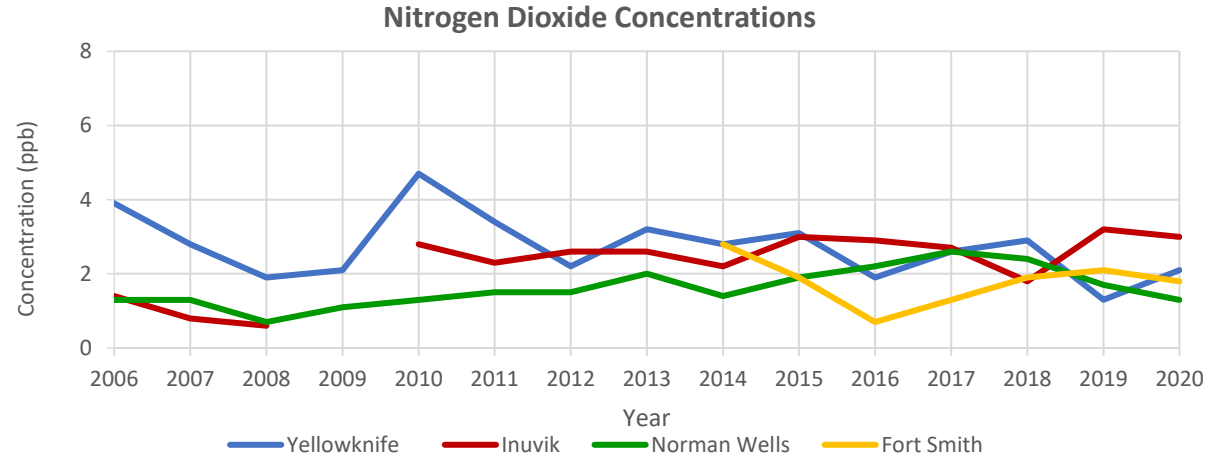
2.1.4 Nitrogen Dioxide Long-Term Trend

NO_2 is a gaseous parameter formed along with other nitrogen oxides (NO_x) during the high-temperature combustion of fossil fuels. NO_2 at higher levels has a strong and harsh odour and can be seen as a brownish haze. The sources of NO_2 are the same as for SO_2 as well as vehicle exhaust being one of the main contributors. High levels can cause serious breathing problems that can become chronic. NO_2 can affect the ecosystem and contribute to form $PM_{2.5}$, O_3, and acid rain.

Yellowknife and Inuvik generally have slightly higher NO_2 levels than other communities

This is expected considering their larger population sizes and higher number of combustion sources. Each stations' trend has remained relatively stable. This is also expected as there have been no major changes to emission sources or population growth in these communities. Note that data started to be collected at the Fort Smith station in 2014.

Figure 6: NO_2 Annual Average Concentrations



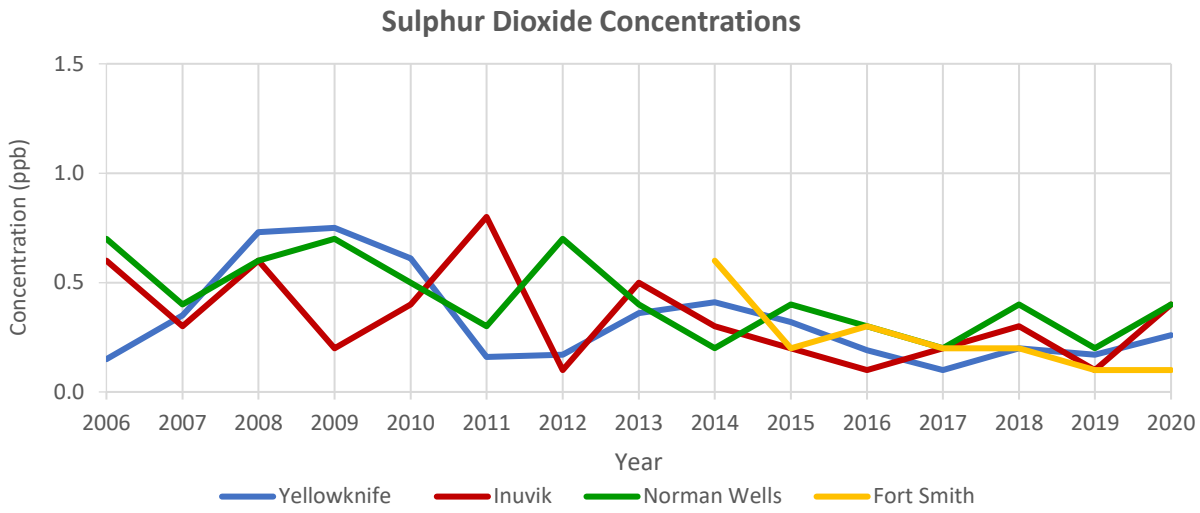
2.1.5 Sulphur Dioxide Long-Term Trend

SO_2 is a colourless gas that smells like burnt matches. Sources of SO_2 include burning of fossil fuels such as in power generation, industrial processes, transportation, and commercial and residential heating. SO_2 can have negative effects on human and ecosystem health. Certain types of vegetation (for example, lichens) are sensitive to SO_2. It also contributes to the formation of acid rain and smog.

SO_2 levels in the NWT have remained consistently low

Levels remain below 1 µg/m^3 across the monitoring stations. Low SO_2 levels indicate good air quality and absence of any major sources of SO_2 emissions. Note that data started to be collected at the Fort Smith station in 2014.

Figure 7: SO_2 Annual Average Concentrations



2.2 Canadian Ambient Air Quality Standards Achievement Status

2.2.1 Fine Particulate CAAQS Metric

$PM_{2.5}$ was measured at four air monitoring stations in the NWT during 2018-2020. All four stations achieved the $PM_{2.5}$ CAAQS for both the 24-hour standard and the annual standard.

Wildfire smoke was the largest contributor to $PM_{2.5}$ in the 2018-2020 reporting period. **Figure 8** compares $PM_{2.5}$ levels with and without wildfire smoke (that is, before and after removing the data influenced by transboundary flows and exceptional events) and illustrates the CAAQS achievement status by station. The data influenced by TF/EE is in **Appendix B.**

Figure 8: Fine Particulate Matter Concentrations during 2018-2020

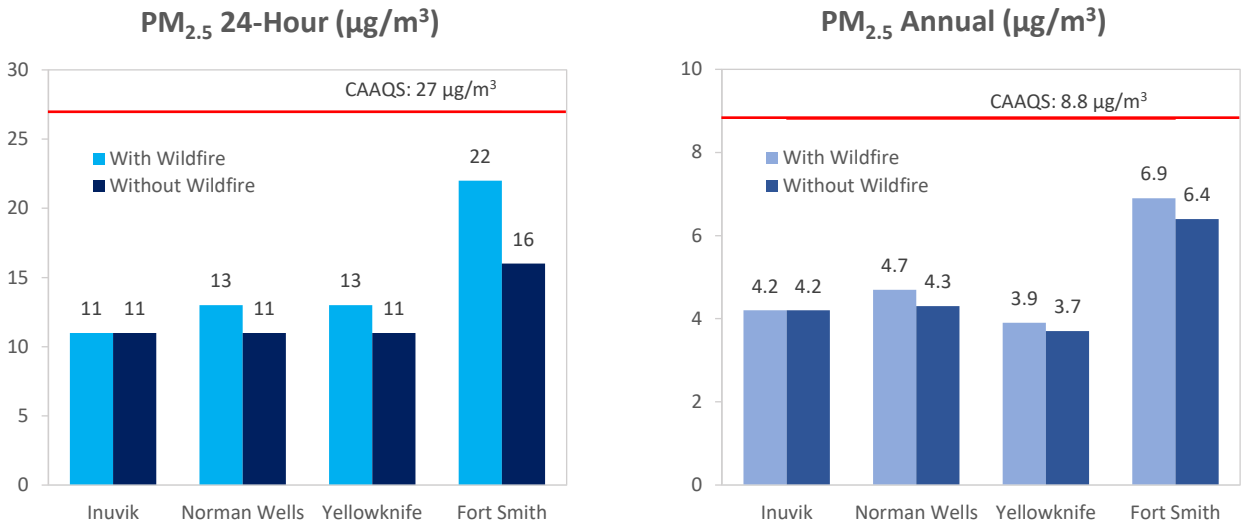


Table 3 shows each air zone's 2018-2020:

- actual $PM_{2.5}$ metric values
- adjusted metric values (excluding TE- and EE-influenced data)
- CAAQS achievement status
- $PM_{2.5}$ management level

Since there are two CAAQS averaging periods for $PM_{2.5}$ (24-hour and annual), the final management level is based on the stricter of the two adjusted management levels.

Table 3: Fine Particulate Matter CAAQS Results for 2018-2020

Air Zone	Station	$PM_{2.5}$ 24-hour			$PM_{2.5}$ Annual			$PM_{2.5}$ Air Zone Management Level
		Actual Metric Value[1] (µg/m³)	Adjusted Metric Value[2] (µg/m³)	CAAQS Achievement Status	Actual Metric Value[1] (µg/m³)	Adjusted Metric Value[2] (µg/m³)	CCAQS Achievement Status	
Beaufort Delta	Inuvik	11	11	Achieved	4.2	4.2	Achieved	Yellow
Sahtu	Norman Wells	13[3]	11[3]	Achieved	4.7[3]	4.3[3]	Achieved	Yellow
North Slave	Yellowknife	13	11	Achieved	3.9	3.7	Achieved	Yellow
South Slave	Fort Smith	22	16	Achieved	6.9	6.4	Achieved	Yellow
Dehcho[4]	Fort Simpson	-	-	-	-	-	-	-
CAAQS		**27**			**8.8**			

1. Actual CAAQS metric values are those calculated based on all measured concentrations.
2. Adjusted CAAQS metric values are those calculated after excluding concentrations influenced by TF/EE between May 1 and September 30.
3. The metric value is based on two years of data. One of the three years of the reporting period did not meet data completeness criteria.
4. No assessment is possible as no air monitoring station was available in the air zone for the reporting period.

2.2.2 Ozone CAAQS Metric

Ozone was measured at four air monitoring stations in the NWT during 2018-2020. **Figure 9** shows how all measured ozone concentrations were well below the CAAQS and typical of remote site concentrations. There was insufficient data for the Norman Wells air station to calculate the ozone metric value for the reporting period.

Figure 9: Ozone Concentrations during 2018-2020

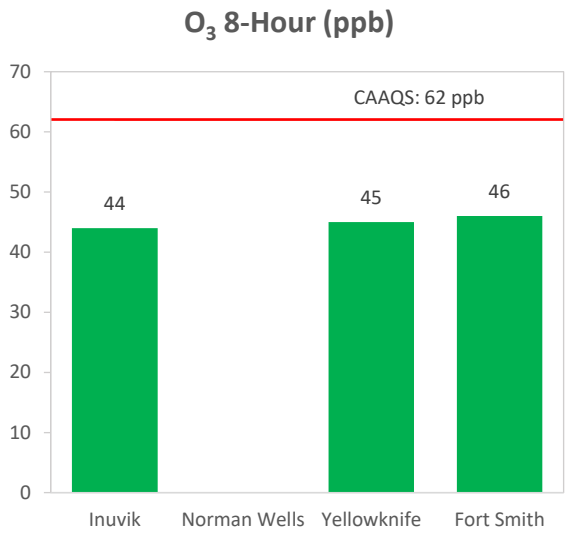


Table 4 shows each air zone's 2018-2020:

- O_3 levels
- CAAQS achievement status
- O_3 management level

Table 4: Ozone CAAQS Results for 2018-2020

Air Zone	Station	O_3 8-hour		O_3 Air Zone Management Level
		CAAQS Metric Value (ppb)	CAAQS Achievement Status	
Beaufort Delta	Inuvik	44[1]	Achieved	Green
Sahtu	Norman Wells	NA[2]	NA[2]	NA[2]
North Slave	Yellowknife	45	Achieved	Green
South Slave	Fort Smith	46[1]	Achieved	Green
Dehcho[3]	Fort Simpson	-	-	-
CAAQS		**62**		

1. The metric value is based on two years of data. One of the three years of the reporting period did not meet data completeness criteria.
2. Insufficient data to calculate the metric value and determine achievement status for this parameter.
3. No assessment is possible as no air monitoring station was available in the air zone for the reporting period.

2.2.3 Nitrogen Dioxide CAAQS Metric

NO_2 was measured at four air monitoring stations in the NWT during the 2018-2020 reporting period. All four stations achieved the NO_2 CAAQS for both the 1-hour standard and the annual standard (see **Figure 10**).

Figure 10: Nitrogen Dioxide Concentrations during 2018-2020

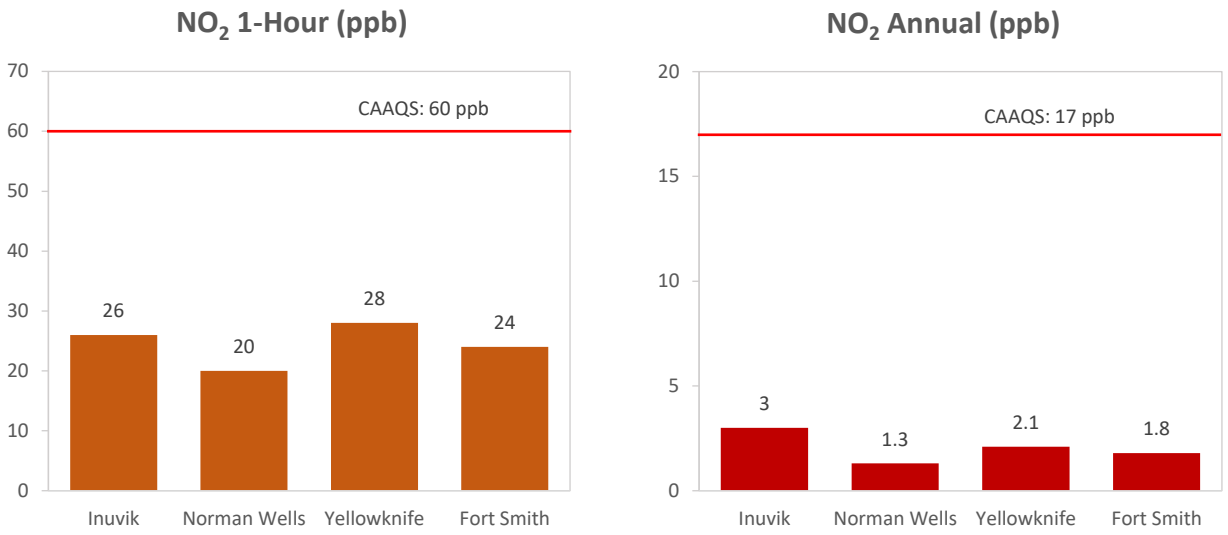


Table 5 shows each air zone's 2018-2020:

- NO_2 levels
- CAAQS achievement status
- NO_2 management level

Since there are two CAAQS averaging periods for NO_2 (1-hour and annual), the final management level is based on the stricter of the two management levels.

Table 5: Nitrogen Dioxide CAAQS Results for 2018-2020

Air Zone	Station	NO_2 1-hour		NO_2 Annual		NO_2 Air Zone Management Level
		CAAQS Metric Value (ppb)	CAAQS Achievement Status	CAAQS Metric Value (ppb)	CAAQS Achievement Status	
Beaufort Delta	Inuvik	26	Achieved	3.0	Achieved	Yellow
Sahtu	Norman Wells	20	Achieved	1.3	Achieved	Green
North Slave	Yellowknife	28	Achieved	2.1	Achieved	Yellow
South Slave	Fort Smith	24	Achieved	1.8	Achieved	Yellow
Dehcho[1]	Fort Simpson	-	-	-	-	-
CAAQS		**60**		**17.0**		

1. No assessment is possible as no air monitoring station was available in the air zone for the reporting period.

2.2.4 Sulphur Dioxide CAAQS Metric

SO_2 was measured at four air monitoring stations in the NWT during the 2018-2020 reporting period. All four stations achieved the SO_2 CAAQS for both the 1-hour standard and the annual standard (see **Figure 11**).

Figure 11: Sulphur Dioxide Concentrations during 2018-2020

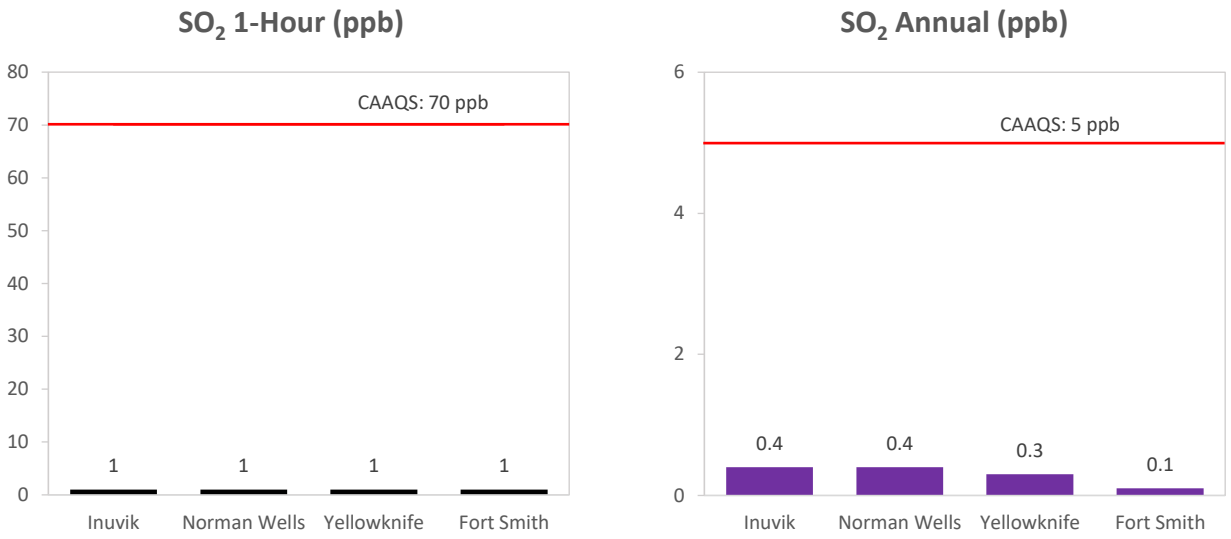


Table 6 shows each air zone's 2018-2020:

- SO_2 levels
- CAAQS achievement status
- SO_2 management level

Table 6: Sulphur Dioxide CAAQS Results for 2018-2020

Air Zone	Station	SO_2 1-hour		SO_2 Annual		SO_2 Air Zone Management Level
		CAAQS Metric Value (ppb)	CCAQS Achievement Status	CAAQS Metric Value (ppb)	CCAQS Achievement Status	
Beaufort Delta	Inuvik	1	Achieved	0.4	Achieved	Green
Sahtu	Norman Wells	1	Achieved	0.4	Achieved	Green
North Slave	Yellowknife	1	Achieved	0.3	Achieved	Green
South Slave	Fort Smith	1	Achieved	0.1	Achieved	Green
Dehcho[1]	Fort Simpson	-	-	-	-	-
CAAQS		**70**		**5.0**		

1. No assessment is possible as no air monitoring station was available in the air zone for the reporting period.

3.0 AIR ZONE MANAGEMENT

Table 7 shows the air zone management levels for each parameter during the 2018-2020 reporting period. All air zones are green or yellow, meaning that the NWT's air quality is very good.

Note that the Fort Simpson station was not established until 2022, so the Dehcho air zone was not assessed for this report. The Sahtu air zone did not have enough data to be assigned an O_3 management level.

Table 7: Air Zone Management Levels in the Northwest Territories for 2018-2020

Air Zone	Fine Particulate ($PM_{2.5}$)	Ozone (O_3)	Nitrogen Dioxide (NO_2)	Sulphur Dioxide (SO_2)
North Slave	Yellowknife	Yellowknife	Yellowknife	Yellowknife
South Slave	Fort Smith	Fort Smith	Fort Smith	Fort Smith
Beaufort Delta	Inuvik	Inuvik	Inuvik	Inuvik
Sahtu	Norman Wells	Norman Wells	Norman Wells	Norman Wells

Achieve CAAQS	Prevent CAAQS Exceedances	Prevent Air Quality Deterioration	Keep Clean Areas Clean

Red Level: The highest level of air quality management. Objective: To reduce pollutant levels below the CAAQS through Advanced Air Management Actions.

Orange Level: The second highest level of air quality management. Objective: To improve air quality through Active Air Management and Prevent Exceedances of the CAAQS.

Yellow Level: The second lowest level of air quality management. Objective: To improve air quality using Early and Ongoing Actions for Continuous Improvement.

Green Level: The lowest level of air quality management. Objective: To maintain good air quality through Proactive Air Management Measures to Keep Clean Areas Clean.

4.0 CONCLUSION

The data in this report indicates the overall air quality of the NWT is very good
Overall, the 2018-2020 data shows our air quality achieves national air quality standards, CAAQS, for the four air parameters. Major industries causing air pollution are extremely limited compared to larger Canadian centers. Regions that have major industrial influences such as pulp and paper mills, steel plants, and oil and gas production are more likely to experience poorer air quality at times.

Air quality has changed over the last 15 years
$PM_{2.5}$ and NO_2 have gone up while SO_2 and O_3 have gone down in 2020 compared to the 2006 levels.

- The increase in $PM_{2.5}$ is mostly because of wildfire smoke.
- The slight increase in NO_2 is likely because of emissions from heating.
- The decrease in O_3 may be linked to a decrease in average background O_3.
- The decline in SO_2 can be related to lower emissions from combustion and mobile sources. This is a cross-country trend that is likely because of lower sulphur levels in fuel.

It is very important to continue monitoring
Having good air quality today is good news for the NWT, but we need to keep monitoring. Given the shifting climate, more wildfire events are likely to occur, with the potential for pollutants to reach our air from a long distance away. We must continue to measure air quality across the NWT to understand current conditions and assess potential changes in the future.

If you have questions regarding ECC's air quality monitoring program or require further information, please contact us at this address:

Environmental Protection and Waste Management Division
Environmental Management, Monitoring and Climate Change Branch
Department of Environment and Climate Change
Government of the Northwest Territories
P.O. BOX 1320
Yellowknife, NT X1A 2L9
Telephone: (867) 767-9236 ext. 53176
Email: nwtairquality@gov.nt.ca

This report is also available on the Internet at:
www.ecc.gov.nt.ca/en/services/air-quality

Appendix A: Air Quality Data Summary

Table A-1: NWT Network-wide Annual Average Concentrations of $PM_{2.5}$, O_3, NO_2 and SO_2 from 2006-2020

Year	$PM_{2.5}$ ($\mu g/m^3$)	O_3 (ppb)	NO_2 (ppb)	SO_2 (ppb)
2006	2.4	24	2.2	0.5
2007	3.2	23	1.6	0.4
2008	5.0	24	1.1	0.6
2009	4.8	22	1.6	0.6
2010	4.7	22	2.9	0.5
2011	4.7	24	2.4	0.4
2012	4.5	23	2.1	0.3
2013	4.2	21	2.6	0.4
2014	8.2	22	2.3	0.4
2015	6.0	25	2.5	0.3
2016	4.9	25	1.9	0.2
2017	4.9	22	2.3	0.2
2018	4.9	23	2.3	0.3
2019	5.3	26	2.1	0.1
2020	4.6	21	2.1	0.3

Table A-2: Percent Change in $PM_{2.5}$, O_3, NO_2 and SO_2 Concentrations in NWT since 2006 to 2020

Air Monitoring Station	$PM_{2.5}$	O_3	NO_2	SO_2
Yellowknife	214%	-15%	-46%	73%
Inuvik	82%	0%	114%	-33%
Norman Wells	23%	4%	0%	-43%
Fort Smith*	-43%	-13%	-36%	-83%
Network-wide Average	**69%**	**-6%**	**8%**	**-22%**

* Monitoring began in 2014

Appendix B: Data Influenced by Wildfire Smoke

$PM_{2.5}$ 24-hour values that were influenced by TF/EE (i.e. wildfire smoke) between May 1 and September 30 and had values greater than 19 µg/m^3 (the orange management level threshold) were removed.

Table B-1: NWT $PM_{2.5}$ Data Influenced by Wildfire Smoke for the 2018-2020 Reporting Period

Beaufort Delta Air Zone	
Inuvik Air Station	
Date	**$PM_{2.5}$ 24-hour (µg/m^3)**
	*

* No data influenced by wildfire smoke.

Sahtu Air Zone	
Norman Wells Air Station	
Date	**$PM_{2.5}$ 24-hour (µg/m^3)**
7/15/2019	22.8
7/21/2019	23.5
7/22/2019	44.2
7/23/2019	30.3
7/30/2019	122.5
9/12/2019	22.5
8/1/2020	21.2

Dehcho Air Zone	
Fort Smith Air Station	
Date	**$PM_{2.5}$ 24-hour (µg/m^3)**
	N/A*

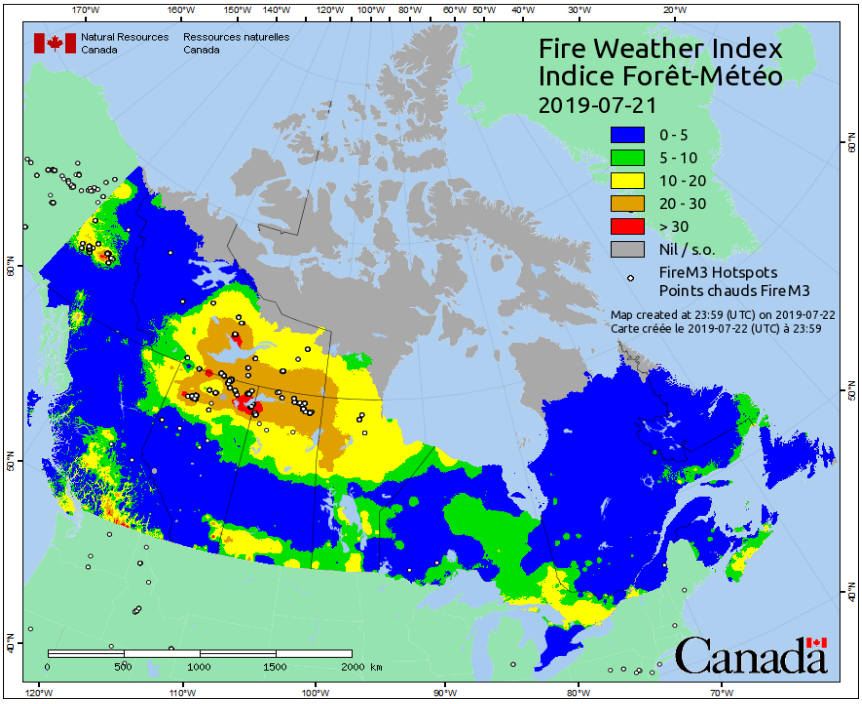
* No data available for the 2018-2020 period. Monitoring began in 2022.

North Slave Air Zone	
Yellowknife Air Station	
Date	**$PM_{2.5}$ 24-hour (µg/m^3)**
8/8/2018	22.0
5/19/2019	35.0
5/20/2019	54.0
6/17/2019	39.3
6/19/2019	29.8
7/21/2019	49.8
7/22/2019	24.6

South Slave Air Zone	
Fort Smith Air Station	
Date	**$PM_{2.5}$ 24-hour (µg/m^3)**
7/27/2018	20.3
8/8/2018	26.0
8/9/2018	20.8
8/13/2018	23.3
8/14/2018	20.8
8/16/2018	27.3
8/17/2018	50.8
8/21/2018	24.0
5/26/2019	22.4
6/12/2019	22.9
6/20/2019	23.8
7/21/2019	42.7
7/22/2019	51.1
7/23/2019	65.3
7/24/2019	32.6
7/26/2019	31.6
7/1/2020	22.5

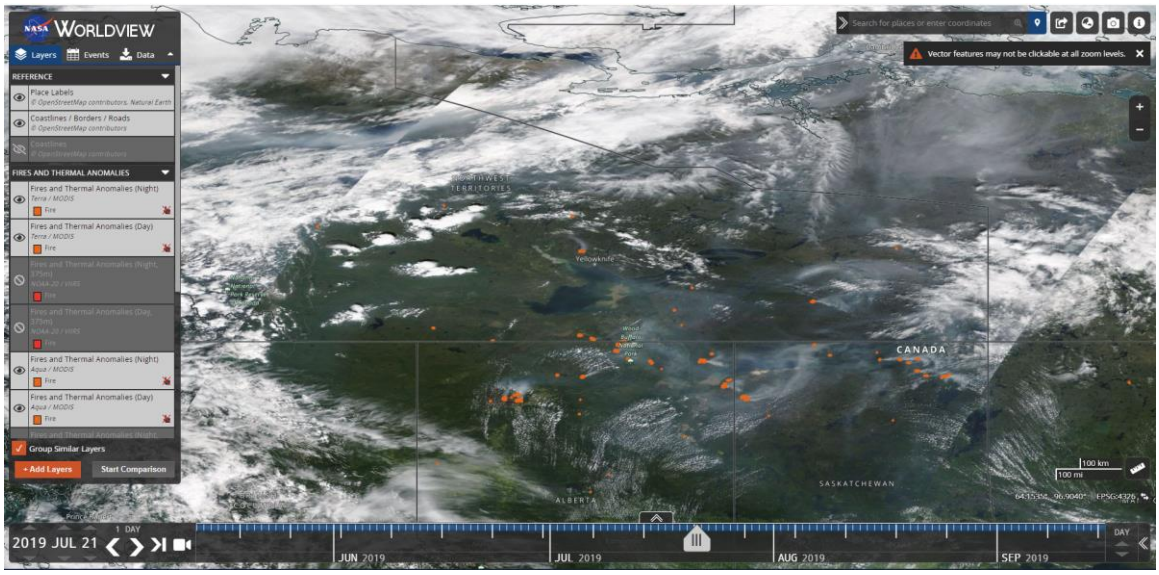
The evidence of wildfires is shown in images below as an example for July 21, 2019 when multiple monitoring stations in the Northwest Territories reported elevated levels of $PM_{2.5}$.

Figure B-1: Fire hot spots for July 21, 2019 over the Northwest Territories from the Canadian Wildland Fire Information System



(Source: https://cwfis.cfs.nrcan.gc.ca)

Figure B-2: Wildfire smoke (gray plume) and fire/thermal anomalies (red dots) image for July 21, 2019 over the Northwest Territories



(Source: https://worldview.earthdata.nasa.gov)