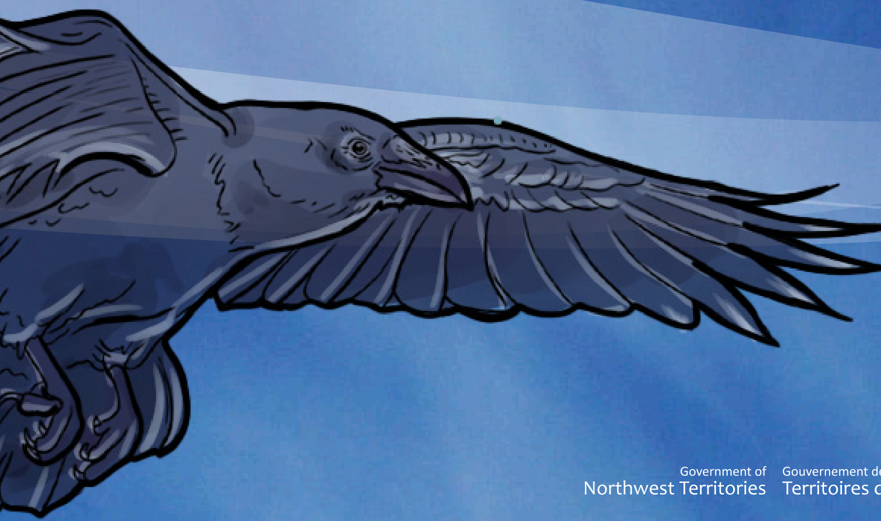

Government of Northwest Territories
Gouvernement des Territoires du Nord-Ouest

NORTHWEST TERRITORIES **AIR QUALITY REPORT 2017**

RAPPORT DE 2017 SUR LA QUALITÉ DE L'AIR AUX TERRITOIRES DU NORD-OUEST

LE PRÉSENT DOCUMENT CONTIENT UN SOMMAIRE EN FRANÇAIS

If you would like this information in another official language, contact us.
English

Si vous voulez ces informations dans une autre langue officielle, contactez-nous.
French

Kīspin ki nitawihtīn ē nīhīyawihk ōma ācimōwin, tipwāsinān.
Cree

Tłı̨chǫ yatı k'ę̀ę̀. Dı wegodı newǫ dè, gots'o gonede.
Tłı̨chǫ

ʔerıhtł'ís Dëne Sųłıné yatı t'a huts'elkër xa beyáyatı theʔą ʔat'e, nuwe ts'ën yółtı.
Chipewyan

Edı gondı dehgáh got'ı̨e zhatıé k'ę́ę́ edatł'éh enahddhę nıde naxets'ę́ edahłí.
South Slavey

K'áhshó got'ı̨ne xədə k'é hederı ʔedı̨htl'é yerınıwę nídé dúle.
North Slavey

Jii gwandak izhii ginjìk vat'atr'ijąhch'uu zhit yinohthan jì', diits'àt ginohkhìi.
Gwich'in

Uvanittuaq ilitchurisukupku Inuvialuktun, ququaqluta.
Inuvialuktun

ᑖᒃᑯᐊ ᑎᑎᕐᒃᑲᐃᑦ ᐱᔪᒪᒍᕕᒋᑦ ᐃᓄᒃᑎᑐᓕᕐᒃᓯᒪᓗᑎᒃ, ᐅᕙᑦᑎᓐᓄᑦ ᐅᕝᑲᓕᐊᓐᓇᕐᒃᑐᑎᑦ.
Inuktitut

Hapkua titiqqat pijumagupkit Inuinnaqtun, uvaptinnut hivajarlutit.
Inuinnaqtun

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EXECUTIVE SUMMARY

The Government of the Northwest Territories (GNWT) Department of Environment and Natural Resources (ENR) monitors air quality in the Northwest Territories (NWT). ENR maintains and operates the NWT Ambient Air Quality Monitoring Network, which consists of four monitoring stations located in Yellowknife, Inuvik, Fort Smith, and Norman Wells. Each station continuously collects information on any pollutants in the air as well as temperature, wind speed and wind direction. The Yellowknife, Inuvik and Fort Smith stations are operated in partnership with the National Air Pollution Surveillance (NAPS) program – a joint federal/provincial/territorial monitoring network that tracks regional air quality trends across Canada. Rainwater and snow quantities are monitored at Snare Rapids and Wood Buffalo National Park as part of the Canadian Air and Precipitation Monitoring Network (CAPMoN).

The Pollutants we monitor and why

The air surrounding us on the land and in our communities is called "ambient air." It contains nitrogen, oxygen, a small amount of carbon dioxide and water vapour. It also contains small amounts of particulate matter and other chemicals. The NWT Ambient Air Quality Standards (AAQS) for the Northwest Territories describe the amount of chemicals and particulate matter allowable in the ambient air. The naturally occurring levels of particulate matter and chemicals in the air are called "background levels." Human activities and natural events, such as wildfires, can cause the amount of particulate matter and chemicals in the ambient air to increase. By tracking background levels of particulate matter and chemicals we can better assess the impacts of human activities and natural events on air quality.

Particulate Matter ($PM_{2.5}$ and PM_{10})

Particulate matter comes in different sizes. Fine particulate matter ($PM_{2.5}$) is about 30 times smaller than the width of a human hair. Coarse particulate matter (PM_{10}) is slightly larger than $PM_{2.5}$. Both types of particulate matter can be inhaled and can aggravate existing pulmonary and cardiovascular disease. $PM_{2.5}$ is more dangerous because the particles are so small that they pass easily through our nose and throat defenses and can get deep into our lungs.

Particles in the $PM_{2.5}$ range are primarily the result of industrial activities, commercial and residential heating, vehicle emissions and wildfire smoke. Particles in the PM_{10} range include road dust and wind-blown soil.

Sulphur Dioxide (SO_2)

SO_2 is a colourless gas which can have negative effects on human and environmental health. Certain types of vegetation (especially lichens) are very sensitive to SO_2. SO_2 also contributes to the formation of other pollutants in the air. Emissions of SO_2 are created during the burning of fossil fuels containing sulphur. Sources of SO_2 in the north include power generating plants, commercial and residential heating, and wildfires.

Nitrogen Dioxide (NO_2)

The sources of NO_2 are the same as SO_2 as well as vehicle exhaust. High levels can cause serious breathing problems that can become chronic. High levels of NO_2 can also lead to formation of other pollutants.

Ground Level Ozone (O_3)

This is the same gas that is found higher up in the atmosphere, 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 and plants. High levels of ozone can be created in the lower atmosphere by sunlight and heat causing gases, usually NO_2 and substances called volatile organic compounds (VOCs) to undergo chemical reactions with each other. High ozone levels can lead to chest tightness, coughing, wheezing and other heart and lung problems. The effect of ozone on plants can be seen as discoloured leaves and general poor vegetation growth.

Carbon Monoxide (CO)

CO comes from a number of sources, including home heating, vehicle exhaust and wildfires. Extremely high levels of CO in our air can be poisonous and can cause headaches, shortness of breath and nausea.

Our network

ENR's monitoring stations are small trailers holding highly specialized instruments that are continuously measuring particulate matter and chemicals in the air. All four stations monitor levels of $PM_{2.5}$, PM_{10}, SO_2, NO_2 and O_3. At the Yellowknife, Inuvik, and Fort Smith stations, we also monitor for CO.

NWT air quality in 2017

Fine Particulate Matter ($PM_{2.5}$)

One of the main sources of $PM_{2.5}$ within the NWT is smoke from wildfires. The Yellowknife, Norman Wells, and Fort Smith stations recorded their highest levels of $PM_{2.5}$ in the month of August. This was directly attributed to wildfire smoke in the NWT. The Inuvik area did not experience any significant wildfire events during the summer of 2017 and as a result $PM_{2.5}$ levels remained fairly consistent throughout the year. In 2017, there were a total of nine instances where $PM_{2.5}$ levels exceeded the 24-hour average Ambient Air Quality Standard (AAQS) – all attributed to wildfire smoke.

Coarse Particulate Matter (PM_{10})

The greatest source of coarse particulate matter is typically dust from roads, especially in the spring when the snow cover disappears and exposes winter sand and gravel on roads. Once the sand and gravel is exposed, wind and vehicle activity can cause the dust to become suspended in the air. This is the cause of the elevated PM_{10} levels observed in April in Yellowknife. The other three stations experience fluctuating levels throughout the spring and summer months. This is due to these three regions having more gravel roads where wind-blown dust is present during the spring and summer months. PM_{10} concentrations can also be elevated due to wildfire smoke, especially in cases where the wildfire is nearby, resulting in larger ash particles falling out near the location of the station. There were a total of 28 instances of PM_{10} readings that exceeded the adopted standard of 50µg/m^3.

Ground Level Ozone (O_3)

Detectable concentrations of ozone exist even in remote areas due to naturally occurring processes. In large urban areas (and areas downwind), ozone concentrations can be much higher due to human activities. Slightly elevated levels of ozone occurred in the months of March, April and May at all stations, which is common at remote monitoring stations in the north. These levels are still well below the AAQS.

Nitrogen Dioxide (NO_2)

Slightly more elevated levels of NO_2 at all stations occurred during the winter months, but these levels were still well below the AAQS. This is likely due to increased emissions from fuel combustion for residential and commercial heating and idling vehicles, as well as short-term “rush hour” traffic influences.

Carbon Monoxide (CO)

CO is monitored at three stations (Yellowknife, Inuvik and Fort Smith). Since wildfire smoke consists of a mixture of carbon dioxide, volatile organic carbon and fine particles, CO levels are directly influenced during wildfire events. Both the Yellowknife and Fort Smith stations experienced higher CO levels in the month of August due to wildfire smoke impacting both these stations. These levels were still below the AAQS.

Sulphur Dioxide (SO_2)

The 2017 levels of SO_2 continued to be very low at all four monitoring stations. Levels did not exceed the AAQS.

Air quality and your health

The Air Quality Health Index (AQHI) is a health risk communication tool developed by Environment and Climate Change Canada (ECCC) and Health Canada. The AQHI, available in Yellowknife, Inuvik and Fort Smith, forecasts health risks related to air quality for the current and next day. It translates air quality monitoring data into a health scale from 1 to 10, and provides associated health-based information for the public, such as suggestions for adjusting activity level when air quality is poor.

Contact Information

If you have questions about ENR's air quality monitoring program or would like more information please contact us or visit ENR's air quality web site at:

www.enr.gov.nt.ca/en/services/air-quality

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SOMMAIRE

Le ministère de l'Environnement et des Ressources naturelles (MERN) du gouvernement des Territoires du Nord-Ouest (GTNO) surveille la qualité de l'air aux Territoires du Nord-Ouest (TNO). Le MERN maintient et gère le Réseau de surveillance de la qualité de l'air des TNO, composé de quatre stations de surveillance situées à Yellowknife, à Inuvik, à Fort Smith et à Norman Wells. Chacune de ces stations recueille en continu des données sur les polluants atmosphériques présents, la température, ainsi que la vitesse et la direction du vent. Les stations de Yellowknife, d'Inuvik et de Fort Smith sont exploitées en collaboration avec le Réseau national de surveillance de la pollution atmosphérique (Réseau NSPA), un programme fédéral-provincial-territorial visant à observer les tendances régionales de la qualité de l'air au Canada. Les quantités d'eau de pluie et de neige et leur composition chimique sont surveillées à la centrale hydroélectrique Snare Rapids et au parc national Wood Buffalo, dans le cadre du Réseau canadien d'échantillonnage des précipitations et de l'air (RCEPA).

QUELS POLLUANTS SURVEILLONS-NOUS, ET POURQUOI?

L'air qui nous entoure sur les terres et dans les collectivités est appelé l'air ambiant. Il contient de l'azote, de l'oxygène, une petite quantité de dioxyde de carbone et de la vapeur d'eau. Il contient également de petites quantités de matières particulaires et d'autres produits chimiques. Les Normes sur la qualité de l'air ambiant (NQAA) aux TNO établissent la quantité de produits chimiques et de matières particulaires permise dans l'air ambiant. Les concentrations naturelles de particules et de produits chimiques dans l'air sont appelées niveaux de fond. Les activités humaines et les événements naturels, comme les feux de forêt, peuvent faire augmenter la quantité de particules et de produits chimiques dans l'air ambiant. Le suivi du niveau naturel nous aide à mieux évaluer les répercussions des activités humaines et des phénomènes naturels sur la qualité de l'air.

Matières particulaires ($MP_{2,5}$ et MP_{10})

Les matières particulaires sont de tailles différentes. Les matières particulaires fines ($MP_{2,5}$) sont environ 30 fois plus petites que la largeur d'un cheveu humain. Les particules grossières (MP_{10}) sont un peu plus grosses que les $MP_{2,5}$. Les deux types peuvent être inhalés et aggraver les maladies pulmonaires ou cardiovasculaires. Les $MP_{2,5}$ sont plus dangereuses, car elles sont si petites qu'elles contournent facilement les moyens de défense du nez et de la gorge et peuvent pénétrer profondément dans les poumons.

Les particules de la catégorie des $MP_{2,5}$ proviennent principalement des activités industrielles, du chauffage commercial et résidentiel, des émissions des véhicules et de la fumée des feux de forêt. Les MP_{10} comprennent la poussière des routes et la terre portée par le vent.

Dioxyde de soufre (SO_2)

Le SO_2 est un gaz incolore qui peut avoir des effets négatifs sur la santé humaine et l'environnement. Certains types de végétation (en particulier le lichen) y sont très sensibles. Le SO_2 contribue aussi à la formation d'autres polluants atmosphériques. Les émissions de SO_2 proviennent de l'utilisation de combustibles fossiles qui contiennent du soufre. Les sources de SO_2 dans le Nord comprennent les centrales électriques, le chauffage commercial et résidentiel et les feux de forêt.

Dioxyde d'azote (NO_2)

Les sources de NO_2 sont les mêmes que celles du SO_2, en plus des gaz d'échappement des véhicules. Des concentrations élevées peuvent causer de graves problèmes respiratoires qui peuvent devenir chroniques. Des concentrations élevées de NO_2 peuvent également entraîner la formation d'autres polluants.

Ozone troposphérique (O_3)

C'est le même gaz que l'on trouve en haute atmosphère, soit l'ozone stratosphérique. En haute atmosphère, l'ozone est une bonne chose – il protège la planète des rayons ultraviolets nocifs du soleil. Par contre, l'ozone qu'on retrouve au niveau du sol peut être nocif pour les êtres humains et la végétation. De fortes concentrations d'ozone peuvent être créées dans la basse atmosphère par la lumière du soleil et la chaleur, provoquant des réactions chimiques entre les gaz, généralement du NO_2 et des substances appelées composés organiques volatils (COV). Une forte concentration d'ozone peut causer une gêne respiratoire, une toux, une respiration sifflante et d'autres problèmes cardiaques ou pulmonaires. Les effets de l'ozone sur les plantes se traduisent par une décoloration des feuilles et une faible croissance.

Monoxyde de carbone (CO)

Le CO provient de plusieurs sources, dont le chauffage domestique, les gaz d'échappement des véhicules et les feux de forêt. Une concentration très élevée de CO dans l'air peut être toxique et causer des maux de tête, un essoufflement et des nausées.

Notre réseau

Les stations de surveillance du MERN sont des petites remorques contenant des instruments hautement spécialisés qui mesurent en continu la quantité de particules et de substances chimiques dans l'air. Les quatre stations surveillent les concentrations de $MP_{2,5}$, de MP_{10}, de SO_2, de NO_2 et d'O_3. Les stations de Yellowknife, d'Inuvik et de Fort Smith surveillent aussi le CO.

LA QUALITÉ DE L'AIR DES TNO EN 2017

Particules fines ($MP_{2,5}$)

L'une des principales sources de $MP_{2,5}$ aux TNO est la fumée des feux de forêt. Les stations de Yellowknife, Norman Wells et Fort Smith ont enregistré leurs concentrations les plus élevées de $MP_{2,5}$ en août. Cette situation est directement attribuable à la fumée des feux de forêt aux TNO. La région d'Inuvik n'a pas été touchée par d'importants feux de forêt au cours de l'été 2017 et, par conséquent, les niveaux de $MP_{2,5}$ sont demeurés relativement constants tout au long de l'année. En 2017, des concentrations de $MP_{2,5}$ supérieures aux concentrations moyennes sur 24 heures des normes de qualité de l'air ambiant (NQAA) ont été observées à neuf occasions au total, toutes attribués à la fumée de feux de forêt.

Grosses particules (MP_{10})

La plus importante source de grosses particules est habituellement la poussière des routes, particulièrement au printemps, quand la neige fond et expose le sable et le gravier déposés sur la route pendant l'hiver. Le vent et les véhicules soulèvent ensuite ces particules, qui restent suspendues dans l'air. C'est ce qui explique les concentrations élevées de MP_{10} observées en avril à Yellowknife. Les concentrations aux trois autres stations fluctuent tout au long du printemps et de l'été. Cela s'explique par le fait que ces trois régions ont davantage de routes en gravier où il y a de la poussière soufflée par le vent au printemps et en été. Les concentrations de MP_{10} peuvent également être élevées en raison de la fumée des feux de forêt, surtout dans les cas où l'incendie est à proximité, ce qui entraîne la chute de particules de cendres plus grosses près de l'emplacement de la station. Au total, des concentrations de MP_{10} supérieures à la norme adoptée de 50 $\mu g/m^3$ ont été observées à 28 occasions.

Ozone troposphérique (O_3)

En raison de processus naturels, des concentrations détectables d'ozone existent même dans les régions éloignées. Dans les grands centres urbains (ou les régions dans la direction du vent), les activités humaines peuvent faire augmenter considérablement la concentration d'ozone. Les concentrations d'ozone ont été légèrement élevées en mars, en avril et en mai à toutes les stations, ce qui est courant dans les stations de surveillance dans les régions éloignées du Nord. Ces concertations sont encore bien inférieures aux NQAA.

Dioxyde d'azote (NO_2)

Des concentrations légèrement plus élevées de NO_2 ont été observées à toutes les stations pendant les mois d'hiver, mais ces concentrations étaient encore bien inférieures aux NQAA. Cela est probablement attribuable à l'augmentation des émissions provenant de l'utilisation de combustible pour le chauffage résidentiel et commercial et des véhicules tournant au ralenti, ainsi qu'aux influences à court terme de la circulation aux heures de pointe.

Monoxyde de carbone (CO)

Le CO est surveillé à trois stations (Yellowknife, Inuvik et Fort Smith). Comme la fumée de feux de forêt est composée d'un mélange de dioxyde de carbone, de carbone organique volatil et de particules fines, les concentrations de CO sont directement influencées par les feux de forêt. Aux stations de Yellowknife et de Fort Smith, les concentrations de CO ont été plus élevées en août en raison de la fumée de feux de forêt qui a touché ces deux stations. Ces concentrations sont encore bien inférieures aux NQAA.

Dioxyde de soufre (SO_2)

Les concentrations de SO_2 observées en 2017 sont demeurées très faibles aux quatre stations de surveillance. Les niveaux n'ont pas dépassé les NQAA.

La qualité de l'air et votre santé

La cote air santé (CAS) est un outil de communication des risques pour la santé mis au point par Environnement et Changement climatique Canada (ECCC) et Santé Canada. La CAS, appliquée à Yellowknife, Inuvik et Fort Smith, prévoit les risques pour la santé liés à la qualité de l'air pour la journée en cours et le lendemain. Elle convertit les données de surveillance de la qualité de l'air en une échelle de santé de 1 à 10 et fournit au public des renseignements connexes axés sur la santé, comme des suggestions pour ajuster le niveau d'activité lorsque la qualité de l'air est mauvaise.

Coordonnées

Si vous avez des questions au sujet du programme de surveillance de la qualité de l'air du MERN ou si vous souhaitez obtenir de plus amples renseignements, veuillez communiquer avec nous ou visiter le site Web du MERN consacré à la qualité de l'air :

https://www.enr.gov.nt.ca/fr/services/air-quality

Division de la gérance environnementale et du changement climatique

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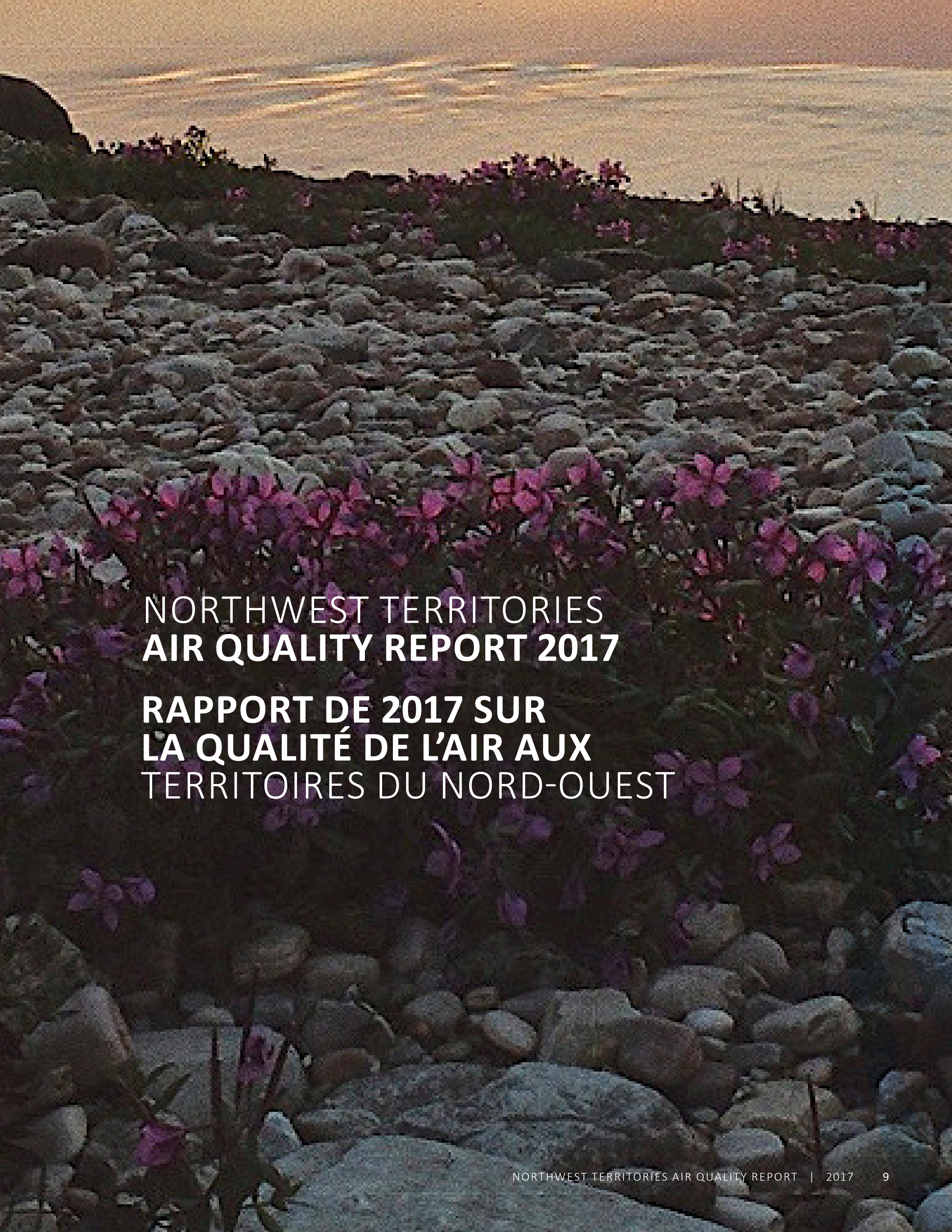


NORTHWEST TERRITORIES **AIR QUALITY REPORT 2017**

RAPPORT DE 2017 SUR LA QUALITÉ DE L’AIR AUX TERRITOIRES DU NORD-OUEST

GLOSSARY

Ambient air

Atmospheric *air* in its natural state. It is what we breathe in when the atmosphere is not contaminated by *air*-borne pollutants.

Anthropogenic

Emissions resulting from human activities, such as those from vehicles or manufacturing.

Black carbon (BC)

A gas that is produced both naturally and by human activities as a result of the incomplete combustion of fossil fuels, biofuels, and biomass. Primary sources include emissions from diesel engines, cook stoves, wood burning and wildfires.

Carbon monoxide (CO)

A gas formed from the incomplete combustion of substances that contain carbon (such as gasoline and wood).

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 pollutants such as acid rain, smog, particulate matter and mercury, in both air and precipitation.

Chemiluminescence

The emission of light during a chemical reaction that does not produce significant quantities of heat.

Exceedance

The amount by which something, especially a pollutant, exceeds a standard or permissible measurement.

Meteorological

The science that deals with the phenomena of the atmosphere, especially weather and weather conditions.

Micrograms per cubic metre ($\mu g/m^3$)

A measure of pollutant concentration. Micrograms of pollutant per cubic metre of air.

National Air Pollution Surveillance (NAPS)

The NAPS network was established in 1969 as a joint program of the federal and provincial governments to monitor and assess ambient air in Canadian urban centres.

Oxides of nitrogen (NO_x)

Gases that form when nitrogen and oxygen in the atmosphere are burned with fossil fuels at high temperatures. NO_x is a precursor to ozone formation.

Nitrogen dioxide (NO_2)

NO_2 is one of the two most significantly toxicologically significant compounds found in NO_x. It forms primarily from emissions from vehicles, power plants and off-road equipment. High concentrations can irritate airways in the human respiratory system.

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 as a result of complex chemical reactions when VOCs and NO_x react in the presence of sunlight.

Particulate matter (PM)

PM_{10} (Coarse Particulate Matter) – Solid or liquid particles with an aerodynamic particle size less than or equal to 10 micrometres, such as dust and aerosols, which may settle to the ground or stay suspended in air.

$PM_{2.5}$ (Fine Particulate Matter) – Small particles or liquid droplets measuring less than or equal to 2.5 micrometres in diameter. Due to their smaller size, these particles can be more harmful to human health than PM coarse particles.

Parts per billion (ppb)

A measure of pollutant concentration. Parts of pollutant per billion parts of air.

Parts per million (ppm)

A measure of pollutant concentration. Parts of pollutant per million parts of air.

Precursor: a compound that participates in a chemical reaction that produces another *compound.*

Sulfur dioxide (SO_2)

A heavy, pungent, colorless air pollutant formed primarily by the combustion of fossil fuels. It is a respiratory irritant, especially for asthmatics.

Transboundary pollution

Pollution that originates in one province or country but, by crossing the border through pathways of water or air, can impact the environment and human health in another province or country.

Volatile organic compounds (VOCs)

Compounds that contain carbon, oxygen, hydrogen, chlorine and other atoms that can evaporate easily into the atmosphere. They are found in nature as well as in some glues, solvents and paints. They combine with NO_x to form O_3 near the ground.

ACRONYMS

AAQS	Ambient Air Quality Standards
AQHI	Air Quality Health Index
ARI	Aurora Research Institute
CAAQS	Canadian Ambient Air Quality Standards
CAPMoN	Canadian Air and Precipitation Monitoring Network
ECCC	Environment and Climate Change Canada
ENR	Department of Environment and Natural Resources
FS	Fort Smith
IN	Inuvik
NAPS	National Air Pollution Surveillance Program
NTPC	Northwest Territories Power Corporation
NW	Norman Wells
NWT	Northwest Territories
PM	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
PM_{10}	Course Particulate Matter
ppb	Parts per Billion
ppb_v	Parts per Billion by Volume
ppm	Parts per Million
UV	Ultraviolet Light
VOCs	Volatile Organic Compounds
YK	Yellowknife
$\mu g/m^3$	Micrograms per Cubic Metre

INTRODUCTION

The Government of the Northwest Territories (GNWT) Department of Environment and Natural Resources (ENR) monitors air quality in the Northwest Territories (NWT). ENR maintains and operates the NWT Ambient Air Quality Monitoring Network, consisting of four monitoring stations located in Yellowknife (YK), Inuvik (IN), Fort Smith (FS) and Norman Wells (NW). Each station is capable of continuously monitoring a variety of air pollutants and meteorological conditions. The Yellowknife, Inuvik, and Fort Smith stations are operated in partnership with the National Air Pollution Surveillance (NAPS) program – a joint federal/provincial/territorial monitoring network. The goal of the NAPS program is to provide accurate and long-term air quality data of a uniform standard across Canada. ENR uses data collected from the stations to establish baseline levels of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3) and particulate matter ($PM_{2.5}$ and PM_{10}) ahead of development as well as to track the trends and cumulative impacts from source emissions should they occur.

Deposition monitoring of rainwater and snow quantities is also conducted in the NWT, in cooperation with Canadian Air and Precipitation Monitoring Network (CAPMoN). Precipitation samples are collected daily and sent to a lab for analyses. The results provide information about regional patterns and trends of atmospheric pollutants such as acid rain. One station is located in Wood Buffalo National Park and the other at the Snare Rapids Hydro Facility. The latter is operated in partnership with the Northwest Territories Power Corporation (NTPC).

The 2017 Annual Air Quality Report summarizes the air quality information collected in 2017, along with some discussion of trends. Data capture and select statistical information can be found in Appendix A. The report provides information on network operations, the air pollutants that were monitored and the air quality standards used in assessing the monitoring results. Additional information, including 'near real-time' air pollutant readings, can be found on the NWT Air Quality Monitoring Network web site at *aqm.enr.gov.nt.ca*.

NWT AIR QUALITY MONITORING NETWORK – OPERATIONS

The NWT Air Quality Monitoring Network consists of four permanent monitoring stations located in Yellowknife, Inuvik, Fort Smith and Norman Wells. The stations are climate controlled structures and include state of the art monitoring equipment capable of continuously sampling and analyzing a variety of air pollutants and meteorological conditions. Pollutants monitored vary by station but include sulphur dioxide (SO_2), fine particulate matter ($PM_{2.5}$), coarse particulate matter (PM_{10}), ground level ozone (O_3), carbon monoxide (CO), and nitrogen dioxide (NO_2). Wind speed, wind direction and temperature are also monitored. For additional information on air pollutants see Appendix B.

Figure 1: Map of the NWT Air Quality Monitoring Network

Table 1: Parameters Monitored by Station

Stations	Particulate Matter		Gaseous				Precipitation	Meteorological Monitoring	
	$PM_{2.5}$ – Fine Particulate	PM_{10} – Coarse Particulate	SO_2 – Sulphur Dioxide	NO_2 – Nitrogen Dioxide	O_3 – Ground Level Ozone	CO – Carbon Monoxide	Deposition	Wind Speed and Direction	Air Temperature
Yellowknife	√	√	√	√	√	√		√	√
Inuvik	√	√	√	√	√	√		√	√
Norman Wells	√	√	√	√	√			√	√
Fort Smith	√	√	√	√	√	√		√	√
Snare Rapids					√		√		
Wood Buffalo					√		√		

Table 1 shows the breakdown of the NWT Air Quality Monitoring Network by substances and meteorological parameters monitored at each station.

Data from each station is automatically transmitted every hour to ENR headquarters in Yellowknife using a sophisticated data acquisition system (DAS) and communications software. This allows for review of community air quality on a near real-time basis. The data also undergoes a series of real time validity checks before being archived by the data management, analysis and reporting system.

The Yellowknife, Inuvik and Fort Smith stations are part of National Air Pollution Surveillance (NAPS) program, a larger national network monitoring sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3) fine particulate matter ($PM_{2.5}$) and carbon monoxide (CO) in communities across Canada. The NAPS program is a joint federal/provincial/ territorial initiative, incorporating 286 stations in 203 communities across the country. ENR operates the Inuvik station in partnership with the Aurora Research Institute (ARI), which provides on-the-ground technical operations of the station. Data from the three stations, along with data from other cities, is summarized and assessed, with results published in the NAPS annual data reports. ENR expects the Norman Wells station will also become a part of the NAPS program in the future. The NAPS program has a stringent quality assurance/quality control (QA/QC) component, ensuring Canada-wide data is comparable. ENR follows these QA/QC procedures at all four of its stations.

More information on the NAPS program along with links to the data can be found at: *www.canada.ca/en/environment-climate-change/services/air-pollution/monitoring-networks-data/national-air-pollution-program.html.*

CANADIAN AIR AND PRECIPITATION MONITORING NETWORK (CAPMoN)

ENR also participates in the Canadian Air and Presipitation Monitoring Network (CAPMoN) program. CAPMoN is a non-urban monitoring network with 35 measurement sites in Canada and one in the United States designed to study the regional patterns and trends of atmospheric pollutants such as acid rain, smog, particulate matter and mercury, in both air and precipitation. Unlike NAPS, CAPMoN locates sites to limit the effect of anthropogenic sources. Most sites are remote and data is considered representative of background values.

Two CAPMoN stations are operated in the NWT, one at the Wood Buffalo National Park approximately 80 kilometres northwest of Fort Smith and the other at the Snare Rapids Hydro Facility approximately 150 kilometres northwest of Yellowknife. ENR, with assistance from the NTPC staff, operates the Snare Rapids station which consists of an acid precipitation collector and an ozone analyzer. The Wood Buffalo station uses an automated precipitation collector and monitors continuous ozone. Daily rain and snow samples from both stations are collected and forwarded to the CAPMoN laboratory for analysis. The data from these sites is available through Environment and Climate Change Canada (ECCC).

Table 2: NWT Air Quality Monitoring Network

	PARTNERSHIP/ CONTACT	STATIONS	NETWORK
Government of Northwest Territories GOVERNMENT OF THE NORTHWEST TERRITORIES		YELLOWKNIFE AND FORT SMITH	NAPS NATIONAL AIR POLLUTION SURVEILLANCE
	COLLÈGE AURORA COLLEGE Research Institute Institut de recherche	INUVIK	NAPS NATIONAL AIR POLLUTION SURVEILLANCE
		NORMAN WELLS	NORTHWEST TERRITORIES STATIONS
	NORTHWEST TERRITORIES POWER CORPORATION	SNARE RAPIDS	Environment and Climate Change Canada CANADIAN AIR AND PRECIPITATION MONITORING
		WOOD BUFFALO	

DEVELOPMENTS IN 2017

The NWT Air Quality Monitoring Network has been in operation since the 1990s beginning with a single particulate monitor in Yellowknife in 1974. Currently, the network consists of four stations located in Yellowknife, Norman Wells, Inuvik and Fort Smith. Appendix C traces the history of air quality monitoring in the NWT.

FUTURE PLANS

In 2017, ENR had two portable Met One Environmental Beta Attenuation Mass (EBAM) monitors available for deployment during wildfire events to communities without a permanent air quality station. The portable monitors measure fine particulate matter ($PM_{2.5}$) which is a component of wildfire smoke.

To ensure the NWT Air Quality Monitoring Network is current with technological advancements and serving the needs of the NWT, continuous improvement of the monitoring network is required. Improvements in 2017 included:

- The installation of a number of trace level instruments throughout the network to replace aging and in some cases outdated gas analyzers.
- The installation of a new calibration system for the Norman Wells station in order to provide consistency with the other three stations on the calibration instrumentation used.

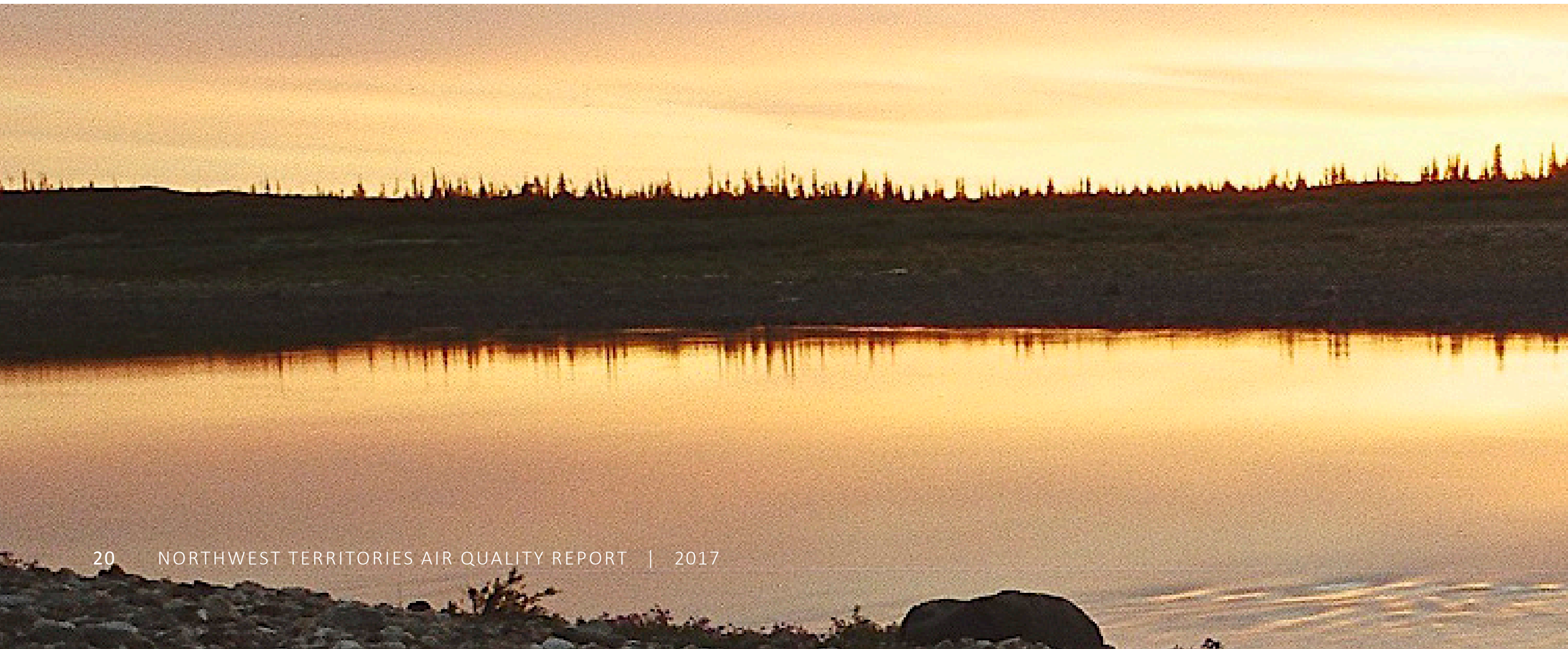
NWT Air Quality Standards

The GNWT has adopted a number of concentration limits for the protection of ambient (outdoor) air quality in the NWT. These standards apply to select pollutants and are documented in the "Guideline for Ambient Air Quality Standards in the Northwest Territories," established under the NWT *Environmental Protection Act*. They are summarized in **Table 3** below.

These NWT Ambient Air Quality Standards (AAQS) are used in the assessment of air quality monitoring data as well as in determining the acceptability of emissions from proposed and existing developments. Where NWT standards are not available for a particular pollutant, the Canadian National Ambient Air Quality Objectives (national standards) or standards established in other jurisdictions are used for comparison purposes.

Table 3: NWT Ambient Air Quality Standards (NWT AAQS)

Parameter and Standard	Concentration
Sulphur Dioxide (SO_2) 1-hour average 24-hour average	172 ppb 57 ppb
Ground Level Ozone (O_3) 8-hour running average	63 ppb
Fine Particulate Matter ($PM_{2.5}$) 24-hour average	28 $\mu g/m^3$
Nitrogen Dioxide (NO_2) 1-hour average 24-hour average	213 ppb 106 ppb
Carbon Monoxide (CO) 1-hour average 8-hour average	13 ppm 5 ppm



The “Guideline for Ambient Air Quality Standards in the Northwest Territories” provides additional information on the application of the NWT standards and the pollutants of concern.

Additional criteria from other jurisdictions used in this report are presented in **Table 4**.

Table 4: Additional Ambient Air Quality Standards (AAQS)

Parameter and Standard	Concentration	Source
Coarse Particulate Matter (PM_{10}) 24-hour average	50 ug/m^3	Ontario Ambient Air Quality Criteria, 2012 B.C. Ambient Air Quality Objectives, 2014

NWT AIR QUALITY IN 2017

Fine Particulate Matter ($PM_{2.5}$)

Fine Particulate Matter ($PM_{2.5}$) is monitored at all four stations with Met One Beta Attenuation Monitors (BAM). The BAM $PM_{2.5}$ monitor measures fine particles in the range of 0.1 to 2.5μm in diameter providing continuous, near real-time (hourly) analysis of particulate concentrations. Non-continuous particulate monitoring is also conducted at the Yellowknife station using a Partisol 2000i-D filter-based sampler. These smaller particles include combustion particles, organic compounds, and metals. One of the main sources of $PM_{2.5}$ within the NWT is smoke from wildfires. Note that wildfire events are observed and documented by regional ENR staff as they occur (i.e. visible smoke and olfactory indications of smoke), and this qualitative data serves as a validation to the conclusions drawn from measured $PM_{2.5}$ readings. In addition, smoke forecasts can be monitored with the use of sophisticated modeling programs developed by ECCC.

Figure 2: 2017 Fine Particulate Matter ($PM_{2.5}$) Monthly Averages

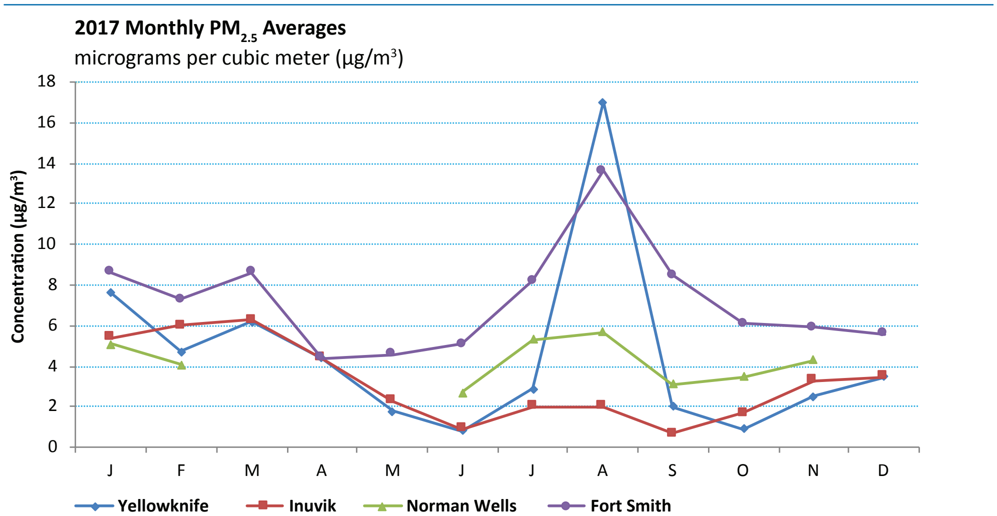


Figure 2 shows the monthly averages measured at the four air monitoring stations in 2017. The Yellowknife and Fort Smith stations both saw elevated levels in August. This was directly attributed to regional wildfire smoke. Inuvik and Norman Wells did not experience any significant wildfire events during the summer of 2017 and as a result, $PM_{2.5}$ levels remained fairly consistent throughout the year. The Norman Wells $PM_{2.5}$ BAM did not operate during the months of March through to May due to an instrument malfunction.

Figure 3: 2017 Fine Particulate Matter ($PM_{2.5}$) Maximum Daily Average per Month

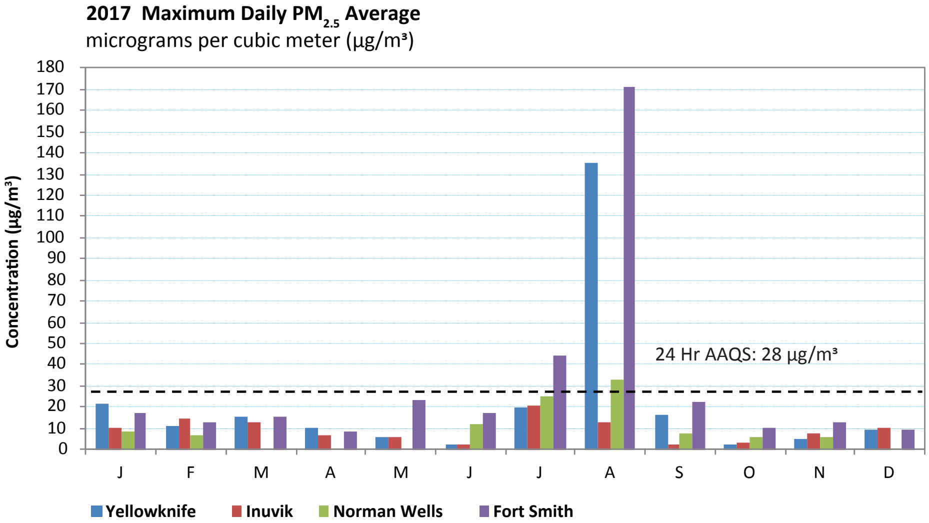


Figure 3 shows the maximum daily average for each month at each station. There were a total of nine episodes where $PM_{2.5}$ levels exceeded the 24-hour average AAQS of 28µg/m^3. The Yellowknife, Norman Wells and Fort Smith stations all recorded $PM_{2.5}$ levels above the AAQS in August and the Fort Smith station recorded an additional peak occurrence in July. The elevated levels of $PM_{2.5}$ recorded in August at the three stations were attributed to regional wildfire smoke. The elevated $PM_{2.5}$ level recorded at the Fort Smith station in July was attributed to wildfire smoke from fires burning in the South Slave region.

Table 5: $PM_{2.5}$ Averages and AAQS - 2017

Station	Max 24 Hour Avg. (µg/m³)	24 Hour Avg. AAQS (µg/m³)	# Exceedances Days >28 µg/m³
Yellowknife	135.7	28	5
Inuvik	20.3		0
Norman Wells	33.0		1
Fort Smith	171.3		3

Coarse Particulate Matter (PM_{10})

Coarse Particulate Matter (PM_{10}) is monitored at all four stations with Met One Beta Attenuation Monitors (BAM). The BAM PM_{10} monitor measures coarse particles in the range of 2.5 to 10µm in diameter. The greatest source of coarse particulate matter is dust from roads, especially in the spring when the snow cover disappears and exposes winter sand and gravel on roads. Once the sand and gravel is exposed, wind and vehicle activity can cause the dust to become suspended in the air. This is the cause of the peak PM_{10} levels we see in April in Yellowknife. The other three stations also experience springtime peaks but are also susceptible to elevated levels during late spring and into the summer months. This is due to the fact that these three regions have more gravel roads where wind-blown dust is present during the spring and summer months. PM_{10} concentrations can also be elevated due to wildfire smoke especially in cases where a wildfire is nearby resulting in larger ash particles falling out near the location of the station.

The NWT does not have an AAQS for PM_{10}. Instead, it adopts a 24-hour average standard of 50µg/m^3. This level is used in several Canadian jurisdictions, including British Columbia and Ontario.

Figure 4: 2017 Coarse Particulate Matter (PM_{10}) Monthly Averages

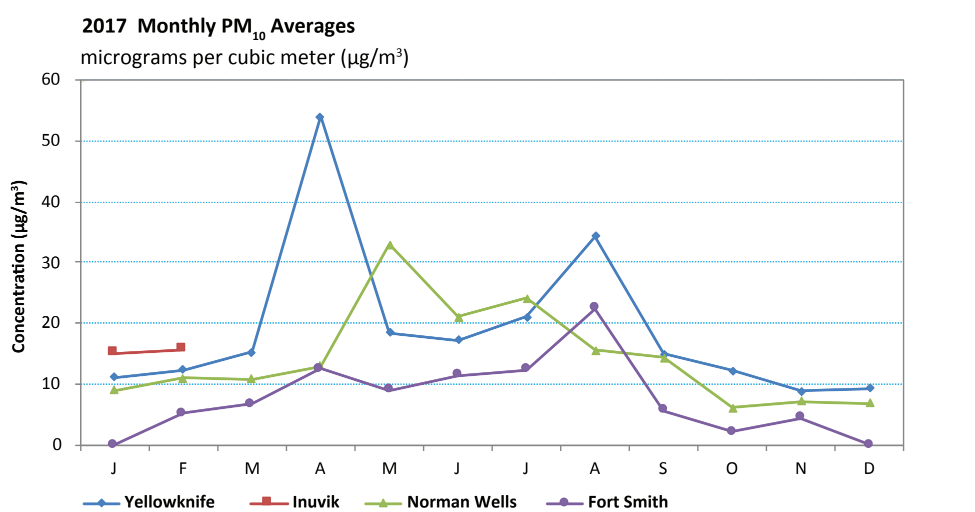


Figure 4 shows the monthly averages measured at the four air monitoring stations in 2017. The Yellowknife station had its highest month in April which can be attributed to spring melt and road dust. Unfortunately only two months of valid PM_{10} data were available for the Inuvik station due to a malfunction. Norman Wells experienced a peak spring dust event in the month of May. The highest Fort Smith monthly average occurred in August and was attributed to smoke from wildfires burning in the South Slave region.

Figure 5: 2017 Coarse Particulate Matter (PM_{10}) Maximum Daily Averages Per Month

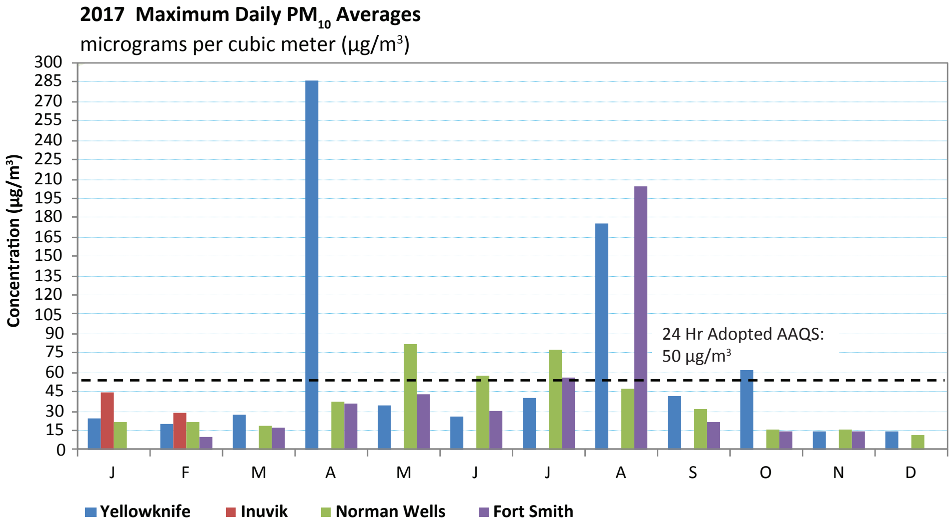


Figure 5 shows the maximum daily average for each month at each station. In 2017, there were a total of 28 instances of PM_{10} readings that exceeded the adopted standard of 50µg/m^3. Yellowknife had the most exceedances with 17; eleven of these occurred in April due to the spring melt and associated wind-blown dust. Five exceedances occurred in August and were caused by wildfire smoke. The October exceedance was a result of construction near the station. Norman Wells had eight exceedances, all occurring in the months of May to July. The five spring exceedances were associated with the springtime melt. The three July exceedances were caused by wildfire smoke from fires burning in the Sahtu region. Due to the Inuvik PM_{10} BAM malfunction, no statistics are available for 2017. Fort Smith had three exceedances: one in July and two in August. All of these exceedances were the result of wildfires burning in the South Slave region.

Table 6: PM_{10} Averages and AAQS - 2017

Station	Max 24 Hour Avg. (µg/m^3)	24 Hour Avg. Adopted Std (µg/m^3)	# Exceedances Days >50 µg/m^3
Yellowknife	286.4	50	17
Inuvik	44.5		0
Norman Wells	82.0		8
Fort Smith	204.6		3

Ground Level Ozone (O_3)

Ozone is monitored at all four stations with API 400 series UV absorption analyzers. Detectable concentrations of ozone exist even in remote areas due to naturally occurring sources of the precursor gases, such as VOC emissions from trees, and the introduction of stratospheric ozone to lower elevations that can occur due to atmospheric mixing processes. These background concentrations are typically in the range of 20 to 40 ppb. In large urban areas (and areas downwind), ozone concentrations can be much higher due to the additional emissions of precursor gases that form as a result of human activities.

Figure 6: 2017 Monthly Ozone (O_3) Averages

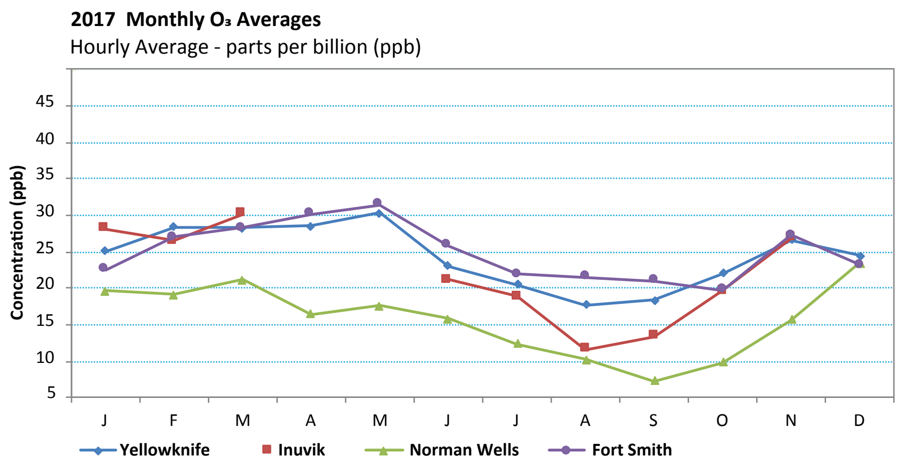


Figure 6 shows the monthly averages recorded in 2017. Ozone levels were highest in the spring, which coincides with the increased sunlight and natural and anthropogenic sources of precursor compounds. Generally, the most elevated monthly averages at all stations occurred within the spring months (March to May), which is common at remote monitoring stations located in mid to high latitudes in the northern hemisphere. Norman Wells had the highest monthly average occur in December, which is unusual. The highest December hourly concentrations coincided with unseasonably mild temperatures (0-1). This likely had an impact on the increase of ozone concentrations. Typical monthly ozone concentrations at remote sites in Canada range between 20 and 45 ppb.[1] The recorded ozone concentrations were within this range.

[1.] Vingarza, R. "A review of surface ozone background levels and trends". Atmospheric Environment, Vol 38, Issue 21, pp 3431-3442 (2004).

Figure 7: 2017 Monthly Ozone (O_3) Maximum 8-Hour Ozone (O_3) Averages

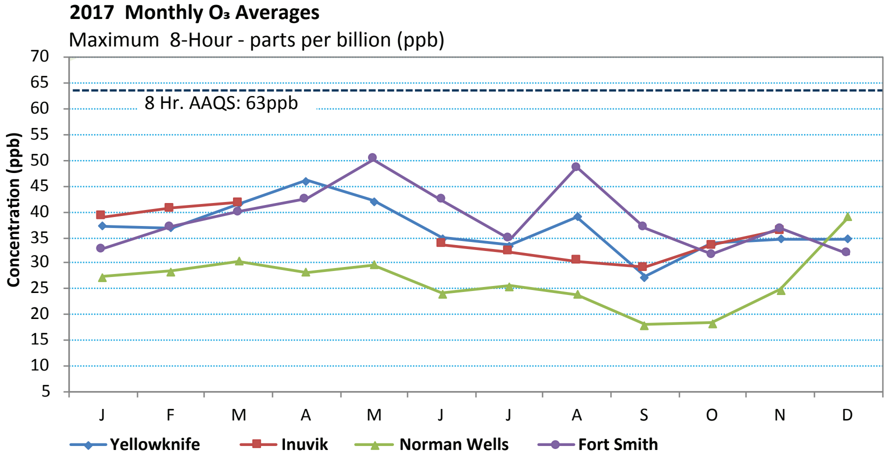


Figure 7 shows the maximum 8-hour averages per month recorded in 2017. The concentrations for all of the stations were well below the 8-hour NWT AAQS of 63 ppb and within typical remote site concentrations.

Table 7: Ozone (O_3) Averages and AAQS - 2017

Station	Max 8 Hour Avg. (ppb)	8 Hour Avg. AAQS (ppb)
Yellowknife	46.9	63
Inuvik	42.3	
Norman Wells	39.2	
Fort Smith	57.7	

Nitrogen Dioxide (NO_2)

NO_2 is monitored at all four stations with API 200 series chemiluminescence NO_x analyzers. The NO_x gas analyzers provide continuous information on oxides of nitrogen (NO, NO_2 and NO_x). However, the focus is on NO_2 due to the health concerns associated with this pollutant and the availability of national air quality standards for comparison. Exposure to elevated levels of NO_2 increases the likelihood of respiratory problems. It has the ability to inflame the lining of the lungs which can increase the risk of lung infection.

Figure 8: 2017 Nitrogen Dioxide (NO_2) Monthly Averages

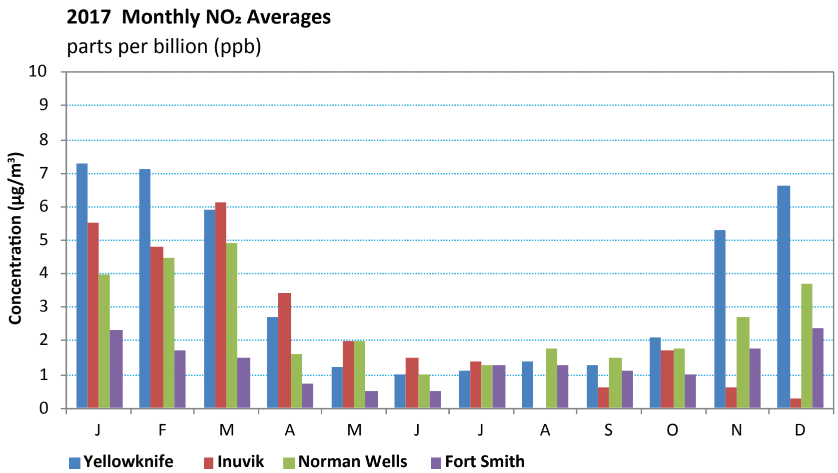


Figure 9: 2017 Nitrogen Dioxide (NO_2) 1-Hour Maximums

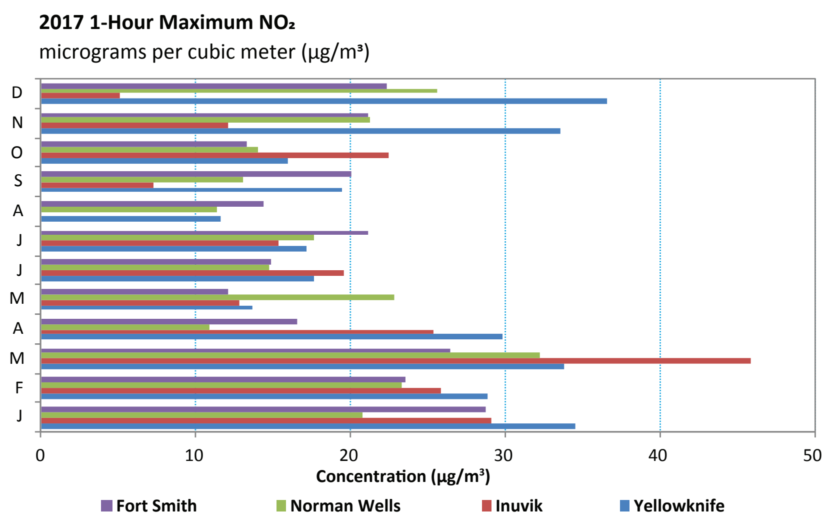
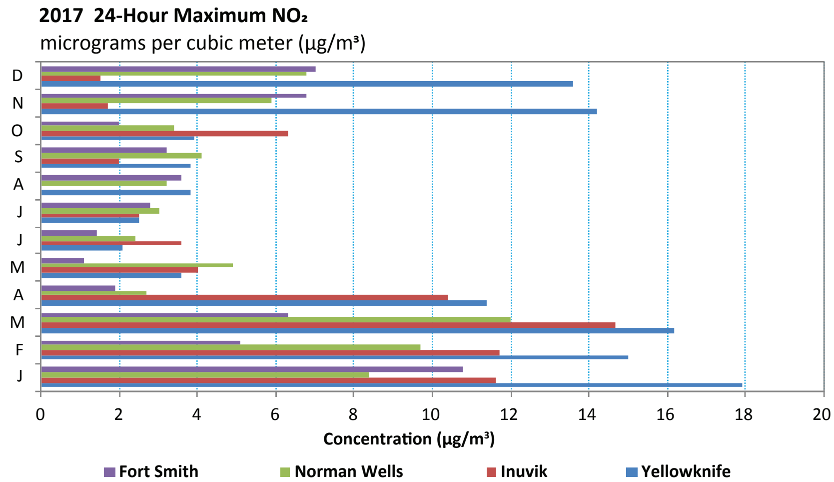


Figure 10: 2017 Nitrogen Dioxide (NO_2) 24-Hour Maximums



Figures 8, 9 and 10 show the monthly average, 1-hour maximum and 24-hour maximum concentrations of NO_2 at each station. Generally, the highest monthly averages and the highest hourly concentrations occurred during the winter months but continue to be well below AAQS standards. This is likely due to increased emissions from fuel combustion for residential and commercial heating and idling vehicles, as well as short-term "rush hour" traffic influences. The effects of these combustion emissions on wintertime air quality can increase when combined with stagnant meteorological conditions. Cold, calm days can result in an atmospheric situation where the normal decrease in air temperature with elevation is reversed and a zone of colder air is present at ground level. This zone of colder air and the lack of wind act to restrict dispersion and trap pollutants close to the ground. This is also known as an inversion. Neither the 1-hour (213 ppb) nor the 24-hour (106 ppb) AAQS for NO_2 were exceeded.

Table 8: Nitrogen Dioxide (NO_2) Averages and AAQS - 2017

Station	Max 1 Hour Avg. (ppb)	1 Hour Avg. AAQS (ppb)	Max 24 Hour Avg. (ppb)	24 Hour Avg. AAQS (ppb)
Yellowknife	36.6	213	17.9	106
Inuvik	45.9		14.7	
Norman Wells	32.2		12.0	
Fort Smith	28.8		10.8	

Carbon Monoxide (CO)

Carbon Monoxide (CO) is monitored at three stations (Yellowknife, Inuvik and Fort Smith), using API 300 series gas filter correlation analyzers. The 2017 data continued the pattern of low CO readings measured in 2016, with some exceptions. There were elevated concentrations that occurred during the winter months at all three stations; these levels were associated with high NO_x emissions from combustion sources in close proximity to the stations. The Fort Smith and Yellowknife spikes shown in Figure 11 that occurred in August and were directly associated with wildfire smoke.

Figure 11: 2017 Carbon Monoxide (CO) Monthly Averages

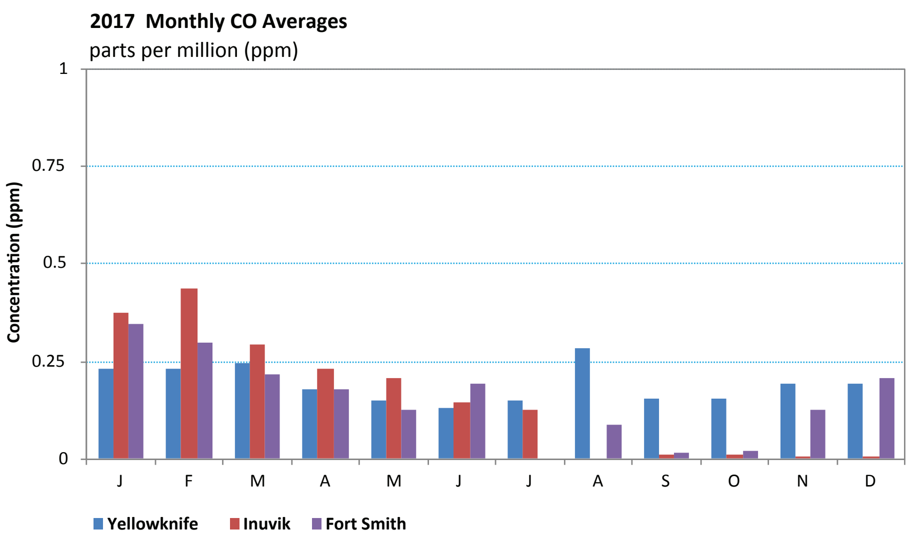


Figure 11 shows the overall concentrations at all three stations were well below the NWT 1-hr and 8-hr average AAQS of 13 ppm and 5 ppm, respectively. In 2017, the maximum 1-hour average was 3.529 ppm and coincided with the highest hourly $PM_{2.5}$ concentration; both of which were caused by wildfire smoke. The maximum 8-hr average for CO was 1.111 ppm.

Figure 12: 2017 Carbon Monoxide (CO) 1-Hour Maximum and Maximum 8-Hour Averages

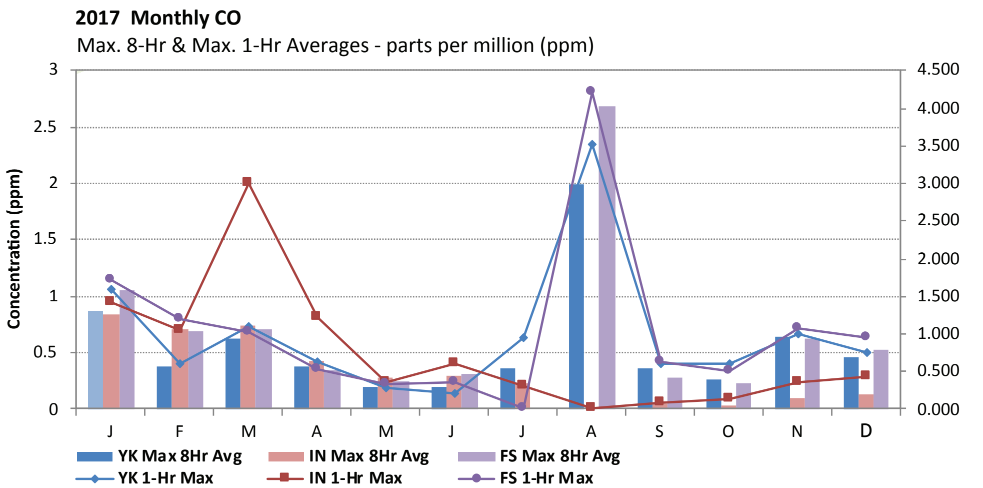


Figure 12 shows that even the 1-hour maximum and maximum 8-hour averages concentrations were below the AAQS standards

Table 9: Carbon Monoxide (CO) Averages and AAQS - 2017

Station	Max 1 Hour Avg. (ppm)	1 Hour Avg. AAQS (ppm)	Max 8 Hour Avg. (ppm)	8 Hour Avg. AAQS (ppm)
Yellowknife	3.5	13	2.0	5
Inuvik	3.0		0.8	
Fort Smith	4.2		2.7	

Sulphur Dioxide (SO_2)

Sulphur Dioxide (SO_2) is monitored at all four stations with API 100 series UV fluorescence analyzers. The 2017 levels continued to be extremely low at all four monitoring stations. Levels did not exceed the 24-hour average AAQS of 57 ppb or the annual average AAQS of 11 ppb.

Table 10: Sulphur Dioxide (SO_2) Averages and AAQS - 2017

Station	Annual Average (ppb)	Annual Average AAQS (ppb)	Max 24 Hour Avg. (ppb)	24 Hour Average AAQS (ppb)
Yellowknife	0.1	11	0.5	57
Inuvik	0.2		0.5	
Norman Wells	0.2		0.9	
Fort Smith	0.2		1.0	

LONG-TERM TRENDS

The NWT Ambient Air Quality Monitoring Network has been in operation for over a decade, and there is sufficient data to conduct longer term trend analyses. Comparisons of the annual averages of select parameters are presented below. In cases where no NWT AAQS exists, standards from other jurisdictions have been adopted for reference.

Figure 13: 2006 to 2017 $PM_{2.5}$ Trends

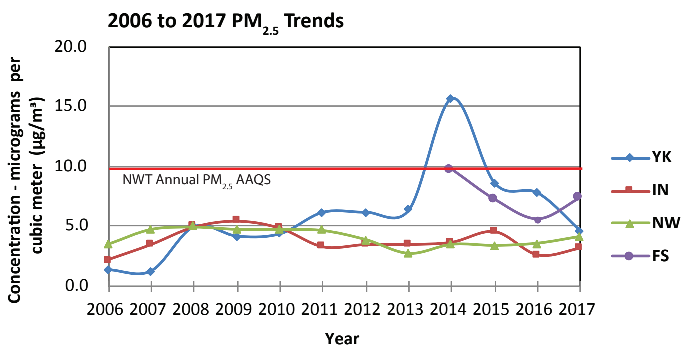


Figure 13 compares the annual $PM_{2.5}$ average concentrations from the Yellowknife, Norman Wells and Inuvik stations from 2006 to 2017. Fort Smith has only four years of data. The results demonstrate that the $PM_{2.5}$ levels in the NWT fluctuate annually, which could be due to the major influence of seasonal wildfires. These effects vary annually. The noticeable 2014 Yellowknife peak was directly caused by one of the worst wildfire events in the NWT. The wildfire smoke that surrounded Yellowknife in 2014 caused the highest $PM_{2.5}$ readings ever recorded at the Yellowknife station, exceeding the NWT annual $PM_{2.5}$ AAQS. In order to assess the data without the natural and variable/fluctuating influences from fires, the following figure presents the $PM_{2.5}$ averages for the years 2006 to 2017, excluding the May to August time frames.

Figure 14: 2006 to 2017 – $PM_{2.5}$ Trends, Excluding May to August

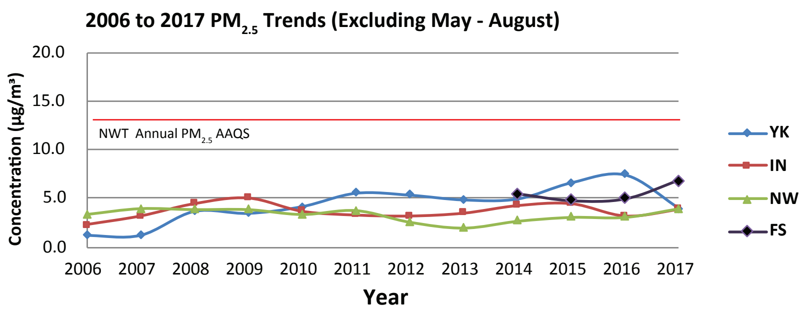


Figure 14 demonstrates that when seasonal influences from wildfire smoke are eliminated, the $PM_{2.5}$ levels in each of the NWT communities are generally consistent from year to year and below the AAQS, with the exception of Yellowknife, which shows a gradual increase. Data collection over a longer time period will be required to properly assess whether this is truly a continuing increasing trend or if future concentrations will level out.

Figure 15: 2006 to 2017 – Annual NO_2 Averages

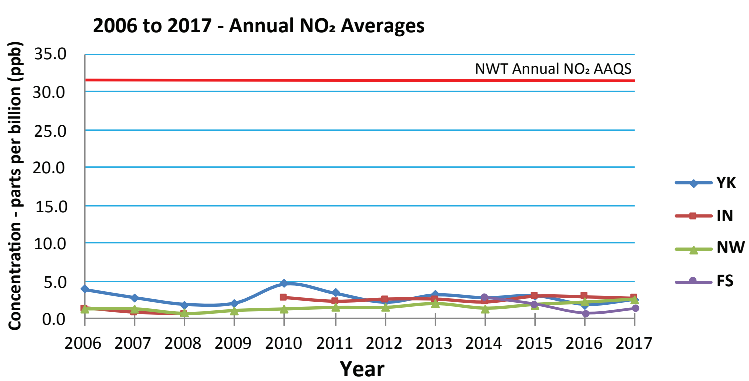


Figure 15 compares the annual NO_2 average concentrations from the Yellowknife, Norman Wells and Inuvik stations from 2006 to 2017. The Fort Smith data only includes four years. Results indicate that generally Yellowknife has slightly higher NO_2 levels than the other communities, which is to be expected given the larger population size and resulting combustion sources. All results are below the AAQS of 32 ppb. The trend over this time period for each monitoring station is relatively stable, which is to be expected given the absence of any major changes to emission sources or population growth in these communities.

Figure 16: 2005 to 2017 – 8-hr Ozone (0_3)

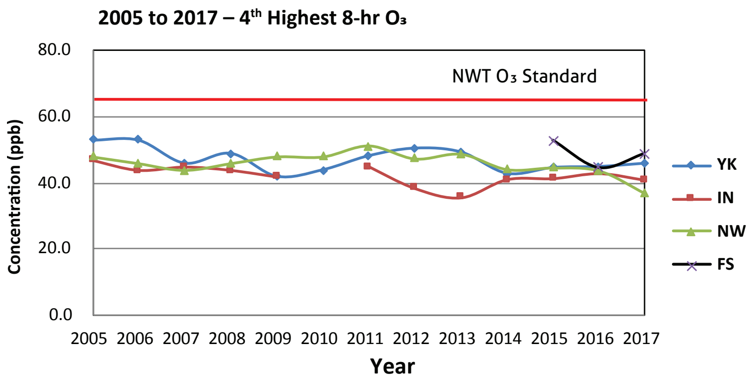


Figure 16 shows the O_3 8-hour average concentrations from the Yellowknife, Norman Wells and Inuvik stations from 2005 to 2017. The Fort Smith data only includes three years. The concentrations are consistently below the AAQS of 63 ppb. The results indicate that O_3 levels are fairly consistent from year to year and between the communities.

NATIONAL COMPARISONS

In addition to comparing our air quality data within the NWT, this report compares NWT air quality data against other cities in Canada. When looking at ambient air data from other locations, it is important to note that there are many influences to local air quality, including geographic considerations, population size and density, local industrial sources, transboundary considerations, and others. For comparison purposes, ENR has presented Yellowknife air quality against select jurisdictional capitals (Figure 17), followed by a comparison to cities of similar population (Figure 18), regardless of the types and sources of their air emissions.

Figure 17: 2017 National Comparisons – Jurisdictional Capitals

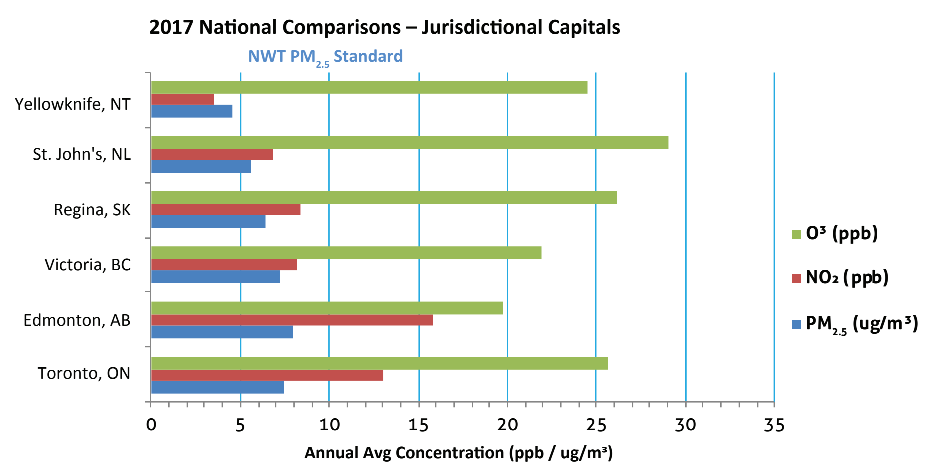


Figure 17 compares the 2017 annual average concentrations of O_3, NO_2 and $PM_{2.5}$ between select capital cities across Canada. The values are measured against the AAQS for $PM_{2.5}$ and NO_2; no standards are available for annual O_3.

The data shows that Yellowknife O_3 levels in 2017 ranked in the middle among the comparison cities. Yellowknife NO_2 levels were significantly lower than all the comparison cities, presumably as a result of a much smaller size city with fewer combustion emission sources. The reverse relationship between Yellowknife's O_3 and NO_2 concentrations is generally to be expected, in part since localized NO_x levels contribute to ozone reduction through a chemical process known as scavenging. Therefore, higher O_3 levels may be expected in areas with lower NO_2 concentrations. NO_2 levels for all comparison cities were below the AAQS. The $PM_{2.5}$ levels in Yellowknife were the lowest in the group of comparison cities and fell well below the AAQS.

Figure 18: 2017 National Comparisons – Similar Population Size

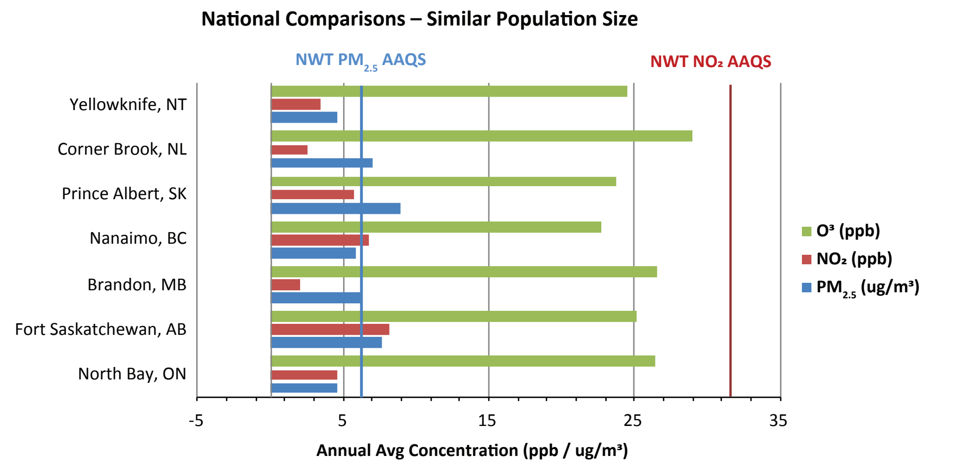


Figure 18 compares Yellowknife's annual average concentrations of O_3, NO_2 and $PM_{2.5}$ to select cities across Canada of a similar population size (<100,000). The results show that Yellowknife O_3 and NO_2 levels are in the middle relative to the comparison cities. All the NO_2 levels were below the AAQS. The Yellowknife O_3 levels are typical of rural sites. Yellowknife $PM_{2.5}$ levels tied with North Bay for the lowest levels in 2017. All of the $PM_{2.5}$ levels measured at all of the comparison cities were below the AAQS.

CAPMoN STATIONS

Since 1989, ENR has operated a Canadian Air and Precipitation Monitoring Network (CAPMoN) station at the NTPC Snare Rapids hydro-electric generating site. The CAPMoN Network, federally operated by ECCC, is designed to study the regional patterns and trends of atmospheric pollutants such as acid rain, smog, particulate matter and mercury, in both air and precipitation. This site is located approximately 150 kilometres northwest of Yellowknife. Rain and snow samples are collected on a daily basis and sent to ECCC CAPMoN laboratory in Toronto for analysis of precipitation chemistry. Select results are presented below.

Figure 19: Snare Rapids Acid Deposition

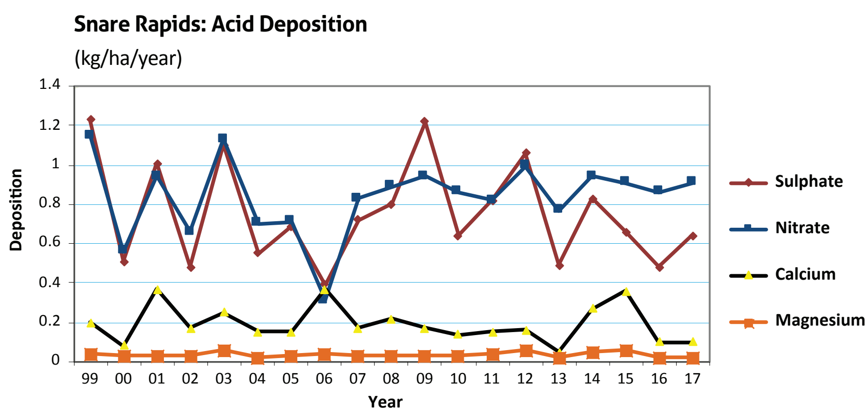


Figure 19 shows the deposition rates for sulphate, calcium, nitrate and magnesium from 1999 to 2017.

The geology of the NWT is mostly characterized by non-carbonate bedrock resistant to weathering, and/or shallow, coarse-textured soils with low cation exchange capacity, low sulphate adsorption capacity and low pH. The sulphate level of deposition that is considered to be protective of sensitive ecosystems in the NWT is 7 kg/ha/yr. In areas of eastern Canada where acid rain is a more serious environmental problem, sulphate deposition has been measured by CAPMoN in excess of 20 kg/ha/yr. Nitrate deposition at Snare Rapids is also low relative to eastern Canada.

Sulphate and nitrate deposition rates measured at Snare Rapids remain below levels expected to cause a significant environmental effect in sensitive ecosystems.

In 2014, a second CAPMoN station was opened in the NWT, in the Wood Buffalo National Park, approximately 80 kilometres northwest of Fort Smith. The area was of interest to CAPMoN due to the remote nature of the park and its location relative to the oil sands operations in Alberta. The site uses a state-of-the-art, automated daily collection sampler for precipitation chemistry and a continuous ambient analyzer for ozone monitoring. The first complete set of precipitation raw data was captured at the site in 2015, therefore annual comparisons cannot yet be made.

NWT 2017 WILDFIRE SEASON

The 2017 wildfire season was active in the Fort Smith and Yellowknife regions primarily in the month of August. There were 262 recorded wildfires in the NWT in 2017, which burned a total of 860,770 hectares. Yellowknife and Fort Smith experienced smoky conditions in August due to regional wildfires.

Figure 20: Summer 2017 - 24-Hour Average $PM_{2.5}$ Concentrations for Yellowknife, Fort Smith, Norman Wells and Inuvik

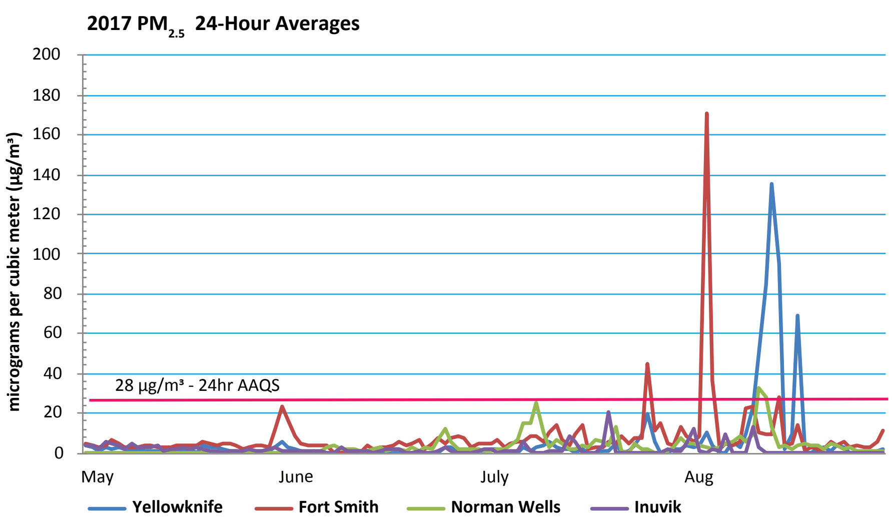
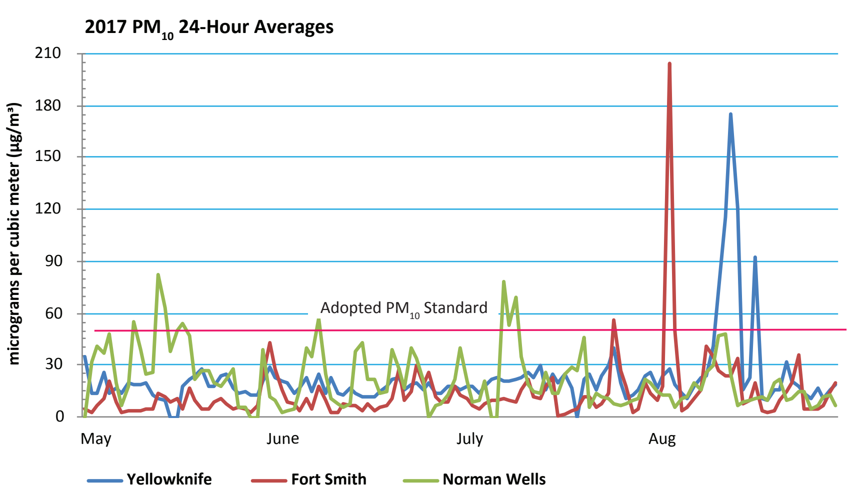


Figure 21: Summer 2017 – 24-Hour Average PM_{10} Concentrations for Yellowknife, Fort Smith and Norman Wells



Figures 20 and 21 illustrate the elevated particulate ($PM_{2.5}$ and PM_{10}) concentrations from May through to August. As stated earlier, Inuvik PM_{10} data was not available for most of the year due to a major malfunction. The elevated PM_{10} levels in Norman Wells recorded throughout the spring and summer were caused mainly by dusty conditions. The exception was part of July, which was affected by wildfire smoke. The highest PM_{10} levels occurred at the Fort Smith and Yellowknife stations in August. These were attributed to wildfire smoke and coincided with the elevated $PM_{2.5}$ levels that occurred during the same time. This illustrates that wildfire smoke was coming from fires burning within the NWT. Generally, the larger PM_{10} particles fall out sooner and therefore they are not usually transported from wildfires burning long distances away.

Between all of the communities, there were 16 exceedances of the adopted PM_{10} 24-hr standard between May and August. Most of these were influenced by wildfire smoke which is expected during the wildfire season.

Health Messaging from Wildfires

The Air Quality Health Index (AQHI) is a health risk communication tool developed by ECCC and Health Canada. In 2017, it was available in Yellowknife, Inuvik, and Fort Smith.

The AQHI forecasts health risks related to air quality for the current and next day. It translates air quality monitoring data into a health scale from 1 to 10, and provides associated health-based messaging for the public, such as suggestions to adjust activity level when the air quality is poor.

Figure 22: Air Quality Health Index

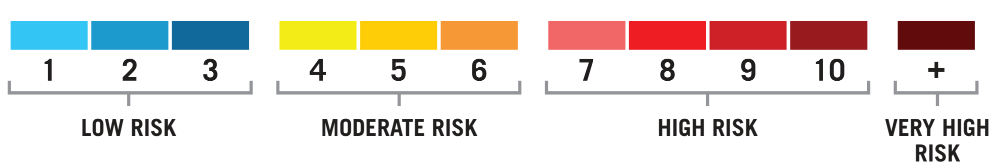


Figure 23: Summer 2017 Hourly AQHI for Yellowknife

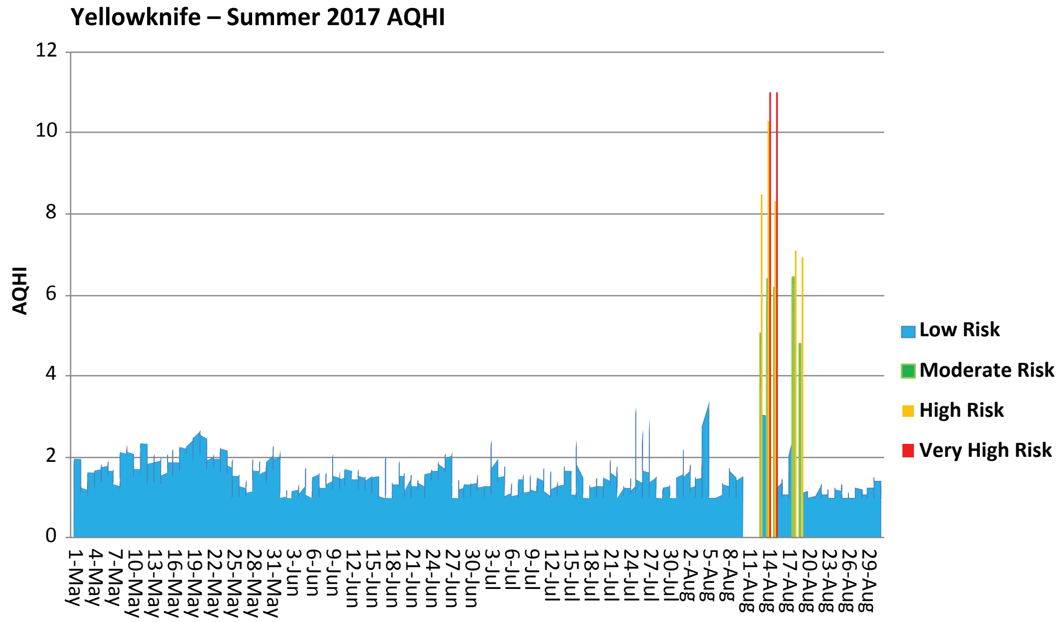


Figure 24: Summer 2017 Hourly AQHI for Inuvik

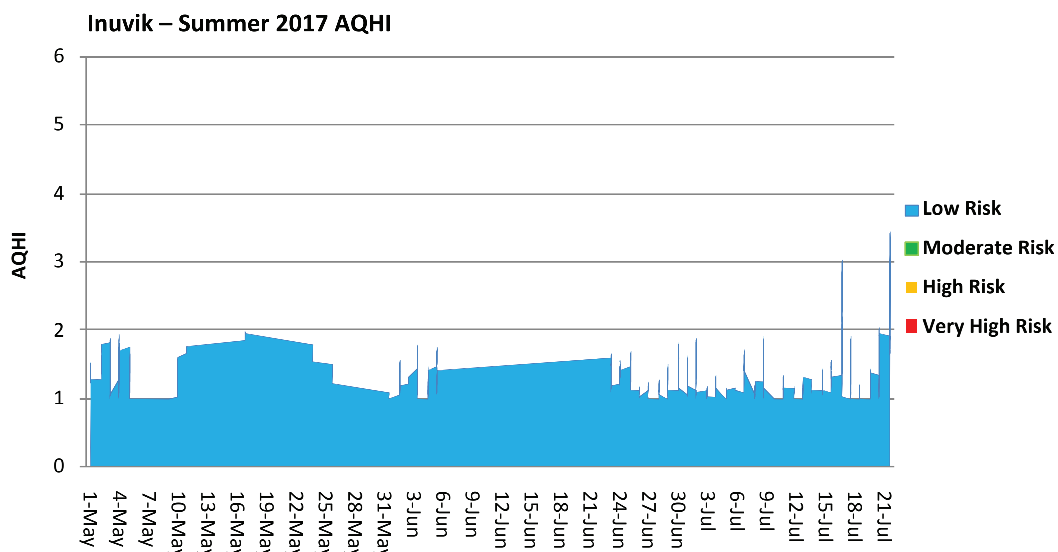
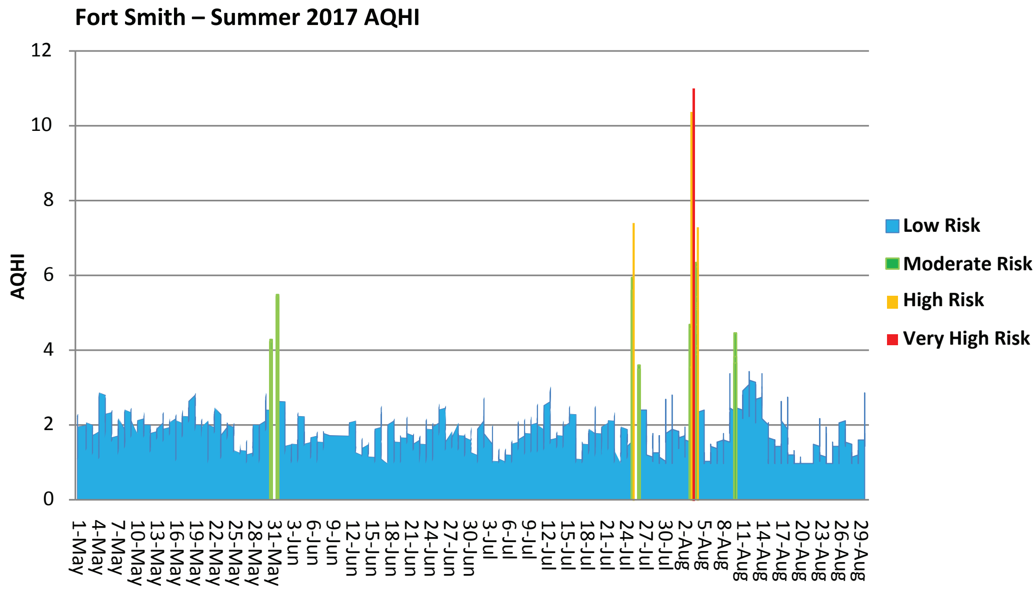


Figure 25: Summer 2017 Hourly AQHI for Fort Smith



Figures 23, 24, and 25 demonstrate the frequency that the AQHI reached the various levels of risk throughout the summer of 2017 in Yellowknife, Inuvik and Fort Smith. The AQHI system for Inuvik was out of service during the month of August due to a NO_x analyzer issue.

Since the AQHI is only available in Yellowknife, Inuvik and Fort Smith, there is a gap in health-related messaging for the rest of the territory. ECCC is continuing to develop tools to provide air quality-related information for regions across Canada, including all the regions of the NWT. These tools use meteorological information and smoke modeling software to predict and disseminate real-time and predicted conditions for a geographic area. They are a valuable complement to the Air Quality Monitoring Network, and can assist NWT residents in making health-related decisions based on air quality during wildfire seasons.

ENR collaborates closely with GNWT Health and Social Services, ECCC and Health Canada during wildfire events. GNWT Health and Social Services is responsible for providing information on health effects related to wildfire smoke and issues public health advisories during periods of poor air quality while ECCC issues special air quality statements and, along with Health Canada, provides additional expert advice and specialized technical support when required.

The 2017 wildfire season paled in comparison to the 2014 season when the City of Yellowknife often appeared to be enveloped in heavy fog from wildfire fire smoke. This photo was taken at approximately 7:00 PM on July 30, 2014.

Image – courtesy of John Mckay

SUMMARY

The results of the 2017 report show that the overall air quality of the NWT is very good. Major industries causing air pollution are extremely limited compared to larger Canadian centres. Regions that have major industrial influences, such as pulp and paper mills, steel plants, and oil and gas production are much more likely to experience poorer air quality at times. This is not to say that the NWT is not at risk. An increase in wildfires over the past several years has been observed in the NWT as well as in neighboring provinces. Smoke from wildfires as well as other pollutants can reach the NWT from a long distance away. It is very important that the GNWT continue to measure air quality across the NWT to ensure it is tracked now and for future generations.

APPENDIX A: 2017 DATA CAPTURE & SELECT STATISTICAL INFORMATION

$PM_{2.5}$ Data

								Percentile (24-hr)			>28 ug/m³	
Location	Valid Days	% Valid Days	Valid Hrs	% Valid Hrs	Mean	Max 1-hr	Max 24-hr	25	50	75	# days	% days
Yellowknife	355	97.3	8424	96.2	4.6	484.0	135.7	1.0	2.6	4.6	5	1.4
Inuvik	336	92.1	8121	92.7	3.2	112.0	20.3	0.9	2.6	4.6	0	0.0
Norman Wells	193	52.9	4666	53.3	4.2	95.0	33.0	2.4	3.5	4.8	1	0.3
Fort Smith	320	87.7	7761	88.6	7.4	447.0	171.3	4.1	5.7	8.0	3	0.8

PM_{10} Data

								Percentile (24-hr)			>50 ug/m³	
Location	Valid Days	% Valid Days	Valid Hrs	% Valid Hrs	Mean	Max 1-hr	Max 24-hr	25	50	75	# days	% days
Yellowknife	356	97.5	8574	97.9	19.2	822.0	286.4	10	13.6	19.6	17	4.7
Inuvik	336	17.3	1543	17.6	15.9	141.0	44.5	11.6	14.7	18.9	0	0.0
Norman Wells	193	92.3	8167	93.2	14.3	316.0	82.0	6.4	9.5	15.4	8	2.2
Fort Smith	320	75.1	6547	74.7	9.5	504.0	204.6	3.3	6.6	11.1	3	0.8

O_3

								Percentile (8-hr)			>63 ppb	
Location	Valid Days	% Valid Days	Valid Hrs	% Valid Hrs	Mean	Max 1-hr	Max 8-hr	25	50	75	# 8-hrs	% 8-hrs
Yellowknife	358	98.1	8607	98.3	24.5	54.8	46.9	19.3	24.6	30.1	0	0.0
Inuvik	235	64.4	5660	64.6	21.1	43.0	42.3	15..0	20.5	27.4	0	0.0
Norman Wells	361	98.9	8702	99.3	15.7	39.6	39.2	10.5	15.6	20.5	0	0.0
Fort Smith	359	98.4	8653	98.8	24.9	71.0	57.7	19.5	25.5	30.2	0	0.0

NO_2

							Percentile (1-hr)				>213 ppb	
Location	Valid Days	% Valid Days	Valid Hrs	% Valid Hrs	Mean	Max 1-hr	25	50	75	# 1-hrs	% 1-hrs	% days
Yellowknife	363	99.5	8712	99.5	3.5	36.6	0.6	1.8	4.7	0	0.0	4.7
Inuvik	302	82.7	7251	82.8	2.7	45.9	0.5	1.4	3.1	0	0.0	0.0
Norman Wells	361	98.9	8695	99.3	2.6	32.2	0.7	1.4	3.3	0	0.0	2.2
Fort Smith	361	98.9	8674	99.0	1.3	28.8	0.0	0.1	0.9	0	0.0	0.8

NO_2

		Percentile (24-hr)			>106 ppb	
Location	Max 24-hr	25	50	75	# days	% days
Yellowknife	17.9	1.0	2.2	4.8	0	0.0
Inuvik	14.7	0.9	1.8	3.5	0	0.0
Norman Wells	12.0	1.2	1.9	3.3	0	0.0
Fort Smith	10.8	0.5	0.9	1.5	0	0.0

SO_2

							Percentile (1-hr)			>172 PPB		
Location	Valid Days	% Valid Days	Valid Hrs	% Valid Hrs	Mean	Max 1-hr	25	50	75	# 1-hrs	% 1-hrs	% days
Yellowknife	347	95.1	8359	95.4	0.14	1.83	0.00	0.14	0.09	0.19	0.0	4.7
Inuvik	362	99.2	8638	98.6	0.20	1.80	0.10	0.10	0.20	0.20	0.0	0.0
Norman Wells	361	98.9	8691	99.2	0.20	1.20	0.00	0.10	0.50	0	0.0	2.2
Fort Smith	307	84.1	7407	84.6	0.20	2.10	0.00	0.00	0.40	0	0.0	0.8

SO_2

		Percentile (24-hr)			>57 PPB	
Location	Max 24-hr	25	50	75	# days	% days
Yellowknife	0.55	0.06	0.12	0.20	0	0.0
Inuvik	0.50	0.10	0.20	0.20	0.00	0.00
Norman Wells	0.90	0.00	0.20	0.40	0	0.0
Fort Smith	1.20	0.00	0.10	0.40	0	0.0

CO

								Percentile (1-hr)			>13 PPM	
Location	Valid Days	% Valid Days	Valid Hrs	% Valid Hrs	Mean	Max 1-hr	Max 24-hr	25	50	75	# 1-hrs	% 1-hrs
Yellowknife	363	99.5	8712	99.5	0.191	3.529	1.360	0.140	0.165	0.200	0	0.0
Inuvik	304	83.3	7292	83.2	0.175	2.999	0.593	0.000	0.167	0.258	0	0.0
Fort Smith	323	88.5	7785	88.9	0.163	4.203	1.441	0.061	0.148	0.226	0	0.0

CO

		Percentile (8-hr)			>5 PPM	
Location	Max 8-hr	25	50	75	# 8-hrs	% 8-hrs
Yellowknife	1.994	0.142	0.168	0.205	0	0.0
Inuvik	0.837	0.000	0.165	0.264	0	0.0
Fort Smith	2.678	0.061	0.148	0.226	0	0.0

APPENDIX B: AIR POLLUTANTS

The NWT Air Quality Monitoring Network tracks a number of different air pollutants. These pollutants are known as Criteria Air Contaminants (CAC's). They represent the gases and compounds most often affecting community air quality and targeted by monitoring programs.

Total Suspended Particulate (TSP)

Total Suspended Particulate (TSP) is a general term for dust. TSP includes a wide variety of solid and liquid particles found floating in the air, with a size range of approximately 50 micrometers (µm) in diameter and smaller (a human hair is approximately 100 µm in diameter). While TSP can have environmental and aesthetic impacts, it is the smaller particles contained within TSP that are of concern from a human health perspective (see Particulate Matter ($PM_{2.5}$) and (PM_{10}) later in section). Road dust, wildfires, mining activities and combustion products from vehicles, heating and electricity generation contribute to TSP levels.

The NWT AAQS for TSP is 120µg/m^3 over a 24-hour period. The standard for the annual average is 60µg/m^3 (geometric mean).

TSP monitoring has not been conducted in the NWT network since 2005, since particulate monitoring has instead been focused on $PM_{2.5}$ and PM_{10} monitoring.

Particulate Matter ($PM_{2.5}$) and (PM_{10})

A sub-portion of TSP, these very small particulates are named for the diameter size of the particles contained within each group – PM_{10} contains particles with a diameter of 10 microns (1 millionth of a metre) or less, while $PM_{2.5}$ (a sub-portion of PM_{10}) contains particles with a diameter of 2.5 microns or less. The significance of these microscopic particles is that they can be inhaled and are associated with health effects including aggravation of existing pulmonary and cardiovascular disease. Generally, the smaller the particle, the greater the penetration into the lung and the greater the associated health risk.

Sources of particulates that can be inhaled include road dust and wind-blown soil, which make up the majority of the PM_{10} particles. Particles in the $PM_{2.5}$ size range primarily result from combustion of fossil fuels for industrial activities, commercial and residential heating, as well as vehicle emissions, wildfire smoke and chemical reactions between other gases emitted to the air.

The national Canadian Ambient Air Quality Standards (CAAQS) has set a limit for $PM_{2.5}$ but has not yet established a limit for PM_{10}. The CAAQS 24-hour average limit for $PM_{2.5}$ is 28µg/m^3 and this concentration has been adopted under the NWT *Environmental Protection Act* as the NWT AAQS for $PM_{2.5}$. Several Canadian jurisdictions (e.g. BC, Ontario, Newfoundland and Labrador) have adopted a PM_{10} concentration of 50µg/m^3 (24-hour average) as an acceptable limit.

Sulphur Dioxide (SO_2)

SO_2 is a colourless gas, with a pungent odour at elevated concentrations, which can have negative effects on human and environmental health. Certain types of vegetation (especially lichens) are very sensitive to SO_2 impacts. SO_2 also plays a role in acid deposition and formation of secondary fine particulate through chemical reactions with other pollutants in the air.

There are some natural sources of SO_2 in ambient air (wildfires, volcanoes) but human activity is the major source. Emissions of SO_2 primarily result from the burning of fossil fuels containing sulphur. Sources include natural gas processing plants, gas plant flares and oil refineries, metal ore smelting, power generating plants and commercial or residential heating.

The NWT AAQS for SO_2 are 172ppb (1-hour average), 57ppb (24-hour average) and 11ppb (annual average).

Nitrogen Oxides (NO_x)

Nitrogen oxides (NO_x) consist of a mixture of nitrogen based gases, primarily nitric oxide (NO) and nitrogen dioxide (NO_2). Emissions of both NO and NO_2 results from the high temperature combustion of fossil fuels. The predominant emission is NO, which then rapidly converts to NO_2 through chemical reaction in the atmosphere. NO is a colourless and odourless gas, whereas NO_2 is a reddish-brown colour with a pungent, irritating odour. NO_2 is considered the more toxic and irritating of the two gases and, at elevated concentrations, is associated with both acute and chronic respiratory effects. Both gases play a role in the atmospheric reactions resulting in acid deposition and secondary pollutant formation (i.e. O_3 and fine particulate).

Because of the greater health effects of NO_2, development of air quality standards has focused on this gas, rather than NO or total NO_x. The NWT AAQS are reflective of national maximum desirable levels of 213ppb (1-hour average), 106ppb (24-hour average) and 32ppb (annual average).

Ground Level Ozone (O_3)

Ground level ozone (O_3) should not be confused with stratospheric O_3, which occurs at much higher elevations and forms a shield that protects life on the planet from the sun's harmful ultraviolet radiation. The gas is the same but at ground level O_3 is regarded as undesirable due to its association with a variety of human health concerns, environmental impacts and property damage. O_3 is a highly reactive gas and is defined as a secondary pollutant. It is not emitted in large quantities from any source but is formed through a series of complex chemical reactions involving other pollutants called precursors (e.g. NO_x and volatile organic compounds or VOCs) in the presence of sunlight.

The national standards provide a Maximum Acceptable Level of 82ppb for O_3 based on a 1-hour average, and an annual Maximum Acceptable Level of 15ppb. The Canada-wide Standards (CWS) process has also set an acceptable limit of 63ppb based on an 8-hour average. The CWS 8-hour limit has been adopted under the NWT *Environmental Protection Act* as the NWT AAQS for O_3.

Carbon Monoxide (CO)

Carbon monoxide (CO) is a colourless, odourless and tasteless gas produced by the incomplete combustion of fuels containing carbon. The primary source is vehicle exhaust especially in cities with heavy traffic congestion. Other sources include industrial processes and fuel combustion for building heating. One natural source is wildfires.

CO affects humans and animals by interfering with the ability of the blood to transport oxygen around the body.

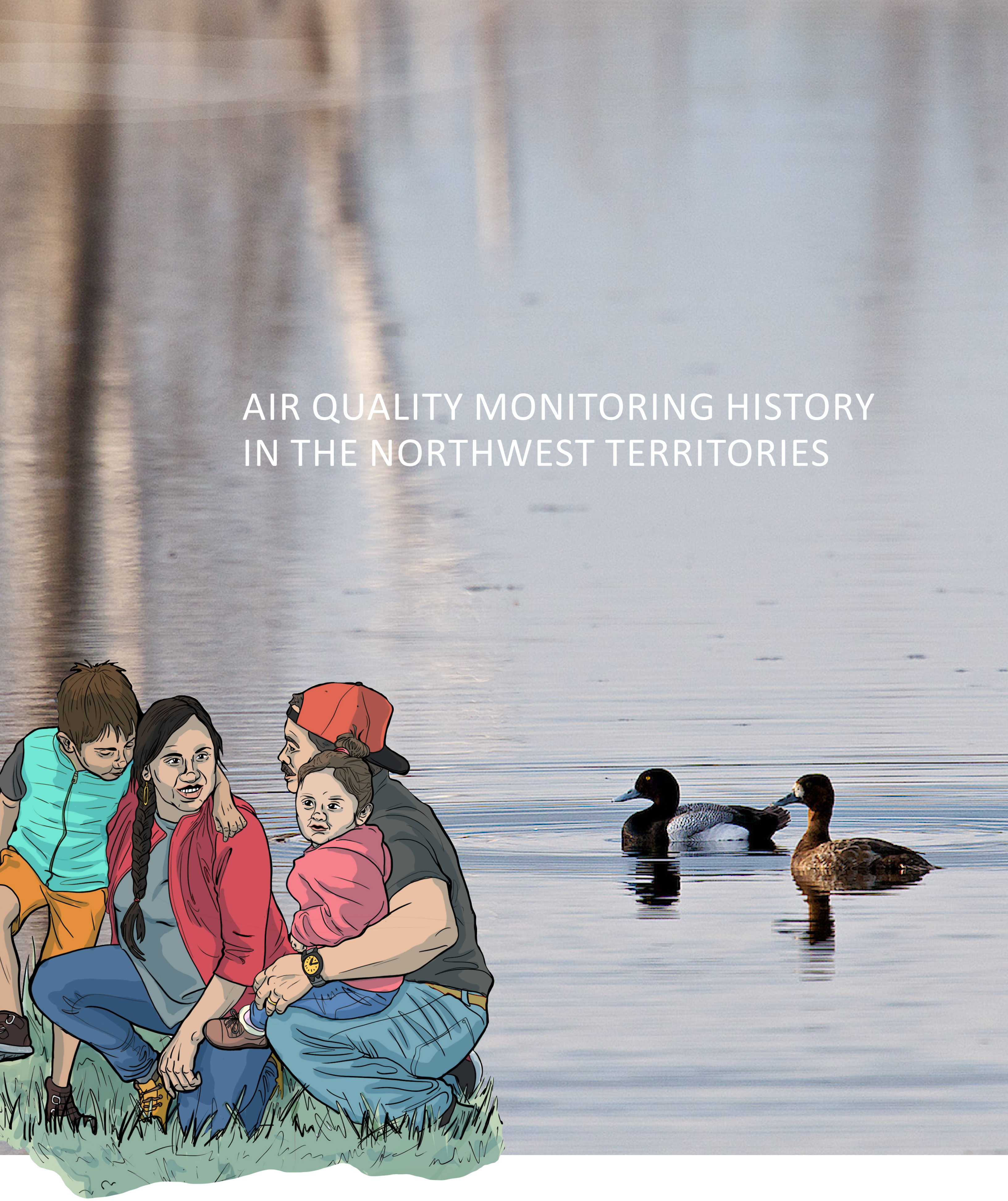
The NWT standards for CO reflect the national Maximum Desirable Levels of 13ppm (1-hour average) and 5ppm (8-hour average). CO values are reported in ppm as opposed to other gaseous pollutants, which are reported in ppb.

Acid Deposition

Acidity in precipitation is measured in pH units on a scale of 0 to 14. A value of seven indicates neutral, values less than seven indicate acidic conditions and values greater than seven indicate alkaline conditions. Even clean precipitation is slightly acidic—around pH5.6—due to the presence of naturally occurring concentrations of carbon dioxide, and minor amounts of sulphate and nitrate ions. The introduction of sulphur dioxide and nitrogen oxide emissions from combustion of fossil fuels for industrial, commercial and individual activities can result in an increase in acidic compounds in the atmosphere—often in areas far removed from the original emission sources. The removal of these sulphur and nitrogen compounds through atmospheric washout is reflected in the increased acidity (lower pH values) of precipitation. Calcium and magnesium ions—mostly from natural sources—act to neutralize acidity in precipitation.

Generally, precipitation with a pH value of 5.0 or less is termed 'acidic.' However, assessment of acid precipitation is usually based on deposition to an area over a specified time period (e.g. kilograms per hectare per year, kg/ha/yr) rather than review of specific precipitation event parameters. Also, the degree of impact to a particular environment is influenced by its 'buffering' capacity or ability to tolerate the acidic inputs. Therefore, determination of acceptable limits usually requires a range of values to reflect the differing tolerances of various areas.

AIR QUALITY MONITORING HISTORY IN THE NORTHWEST TERRITORIES



APPENDIX C: AIR QUALITY MONITORING HISTORY IN THE NORTHWEST TERRITORIES

1974	• GNWT begins monitoring air quality in Yellowknife with the installation of a high-volume air sampler at the Post Office site.
1989	• Monitoring of acid precipitation at the Snare Rapids hydro-electric site begins.
1992	• SO_2 analyzer installed at a second Yellowknife site at City Hall.
1997	• SO_2 monitoring in N'dilo begins and continues until 2000.
1998	• O_3 analyzer added in Yellowknife to the City Hall site.
2000	• A SO_2 analyzer was installed in the ENR building in Fort Liard in March followed by a H_2S analyzer in October.
2002	• Daring Lake summer sampling of PM_{10} begins. • Yellowknife City Hall SO_2 analyzer relocated to new air monitoring trailer located at École Sir John Franklin High School (current location).
2003	• Daring Lake summer sampling of $PM_{2.5}$ begins (the same sampler is used for PM_{10} and $PM_{2.5}$ monitoring). • Air monitoring trailers are installed in Inuvik, Norman Wells and Fort Liard. • CO and NO_x analyzers and continuous fine particulate sampler ($PM_{2.5}$) added to the Yellowknife station. • Norman Wells station now monitors SO_2 and H_2S. • Inuvik station now monitors SO_2, H_2S, NO_x and $PM_{2.5}$. • Fort Liard station now monitors SO_2 and H_2S. A $PM_{2.5}$ sampler is installed late in the year. • The O_3 analyzer that was operating at the Yellowknife City Hall location is relocated to the new École Sir John Franklin High School station. • ENR initiates the upgrade of the Data Acquisition System at all stations moving to a specialized air monitoring system, which will allow more efficient and quality controlled data collection. • Continuous $PM_{2.5}$ samplers are installed in Inuvik and Fort Liard. • A second high-volume sampler is installed at the École Sir John Franklin High School station in Yellowknife.
2004	• $PM_{2.5}$ sampler is installed in Norman Wells. • Data Acquisition System is significantly upgraded. New components are installed inside the stations and a new data management, analysis and reporting system is brought on-line.

2005	• NO_x analyzer is installed in March at the Fort Liard station. • O_3 and NO_x analyzers are installed at the Norman Wells station in April. • O_3 analyzer purchased by Environment Canada (Yellowknife office) is installed at the Inuvik station in April. • Due to years of significant data loss caused by extreme cold, the Partisol Dichotomous fine particulate sampler at the Yellowknife Post office station is relocated indoors at the Sir John Franklin station. • The Yellowknife Post Office station is officially closed after the last TSP sample ran on December 6th, 2005. • Development of an Air Quality web site to link with the data management, analysis and reporting system providing public access to air quality data, including archived data, for each monitoring location.
2006	• A BAM Particulate Matter (PM_{10}) monitor is installed and begins collecting data in April in Yellowknife. • A BAM Particulate Matter (PM_{10}) monitor is installed and begins collecting data in October in Inuvik. • The Air Quality Monitoring Network web site is officially released.
2007	• A BAM Particulate Matter (PM_{10}) monitor and an Ozone (O_3) analyzer are installed and begin collecting data in late August in Fort Liard. • The second phase of the Air Quality Monitoring Network web site is completed, which included database related modifications as well as web design improvements.
2008	• No significant changes to the network.
2009	• A BAM Particulate Matter (PM_{10}) monitor is installed in Norman Wells to complete particulate sampling throughout the network. • Hi-vol sampler discontinued in Yellowknife, to be replaced with a much improved type of sampler. • Daring Lake particulate monitoring temporarily discontinued due to malfunction.
2010	• The entire Inuvik station is relocated to a more representative location at ball diamond due to ongoing construction activities in the original location. • The $PM_{2.5}$ monitor is upgraded to BAM FEM (Federal Equivalency Method) in Yellowknife.

2011	• The $PM_{2.5}$ monitor upgraded to BAM FEM (Federal Equivalency Method) in Inuvik. • Data acquisition and management system upgraded in Yellowknife, Norman Wells and Inuvik, including Envista ARM software and PC-based Industrial data loggers. • Manual Partisol Dichotomous Sampler installed in Yellowknife. • BAMs at all stations begin reporting in actual conditions instead of STP, as per federal protocol.
2012	• Entered into partnership with Aurora Research Institute (ARI) to provide technical operations of the Inuvik station. • Installed CO monitoring in Inuvik (end of 2012). • Discontinued H_2S monitoring Inuvik (end of 2012). • Switched to trace level SO_2 monitoring in Yellowknife to capture background levels. • New air quality monitoring network website launched to provide current and historic data to users (*aqm.enr.gov.nt.ca*).
2013	• AQHI launched for Yellowknife. • $PM_{2.5}$ FEM installed in Norman Wells. • Fort Liard Station closed in November 2013 due to logistical issues. • New air quality station installed in Fort Smith in December 2013. • Yellowknife and Inuvik stations equipped with trace level CO analyzers. • Filter-based particulate sampler (Partisol 2000i-D) installed at the Yellowknife station.
2014	• H_2S monitoring discontinued at Norman Wells station. • Replaced Yellowknife station with a larger, 10’ x 25’ building. • AQHI launched in Inuvik.
2015	• New deployable units added to the inventory (two E-BAMs and two DustTraks). • Black Carbon Aetholometer added to Yellowknife station.
2016	• A number of trace level instruments installed throughout the network to replace aging and in some cases outdated gas analyzers • The Fort Smith station became an official NAPS designated site.
2017	• New trace level instrument installations continued where required. • A new calibration system for the Norman Wells station was installed in order to provide consistency on the calibration instrumentation used with the other three stations.

ENVIRONMENTAL STEWARDSHIP AND CLIMATE CHANGE DIVISION

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