2021 Air Quality Monitoring Results

New Nouveau Brunswick

Contents

Air Quality Monitoring in New Brunswick

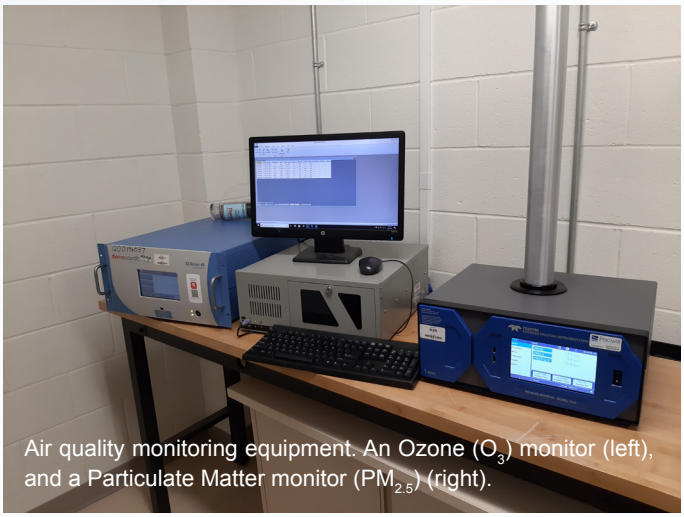
This report provides an overview of air quality in the province of New Brunswick for the year 2021. General information about air quality science and the province's monitoring networks is also provided.

Regular Monitoring

Air quality monitoring in New Brunswick is a partnership between the Federal Government (Environment and Climate Change Canada) and the Provincial Department of Environment and Local Government (DELG). This partnership has been formalized under a long-standing National Air Pollution Surveillance (NAPS) Agreement.

Through the NAPS agreement, Environment and Climate Change Canada provides the necessary monitoring equipment and a centralized national database for the air quality information collected. It is the Province's responsibility to deploy and maintain the equipment, operate the stations, perform necessary calibrations, and otherwise ensure that the data is accurate.

A typical air quality monitoring station (Bathurst).



Air quality monitoring equipment. An Ozone (O_3) monitor (left), and a Particulate Matter monitor ($PM_{2.5}$) (right).

In 2021 the provincial network included 10 air quality monitoring stations and 5 acid rain monitoring stations. There was a total of 47 instruments collecting data at these stations.

The stations and monitors have been established for a number of purposes:

- to detect and quantify impacts from regulated sources of pollution;
- to assess and track ambient background levels of various pollutants;
- to monitor transboundary migration of pollution into New Brunswick; and,
- to provide real-time data to public health reporting systems such as the Air Quality Health Index.

As a condition of regulatory approval under the *Clean Air Act*, the Province also requires the operators of large industrial facilities to participate in air quality monitoring. During the 2021 reporting year there were 29 industry-operated stations, with 49 instruments, dedicated to continuously monitoring the ambient concentrations of industry-specific contaminants in nearby communities.

Each air quality monitoring station is different, with monitors set up to target the pollution sources in that particular area. Site maps and monitor inventories are provided on pages 5 and 6.

Understanding Air Pollution

Air quality is constantly changing from season to season, and year to year. It is affected by a wide variety of factors, including the weather, long range movements of air from other parts of the world, natural events, industry cycles, and other human activities.

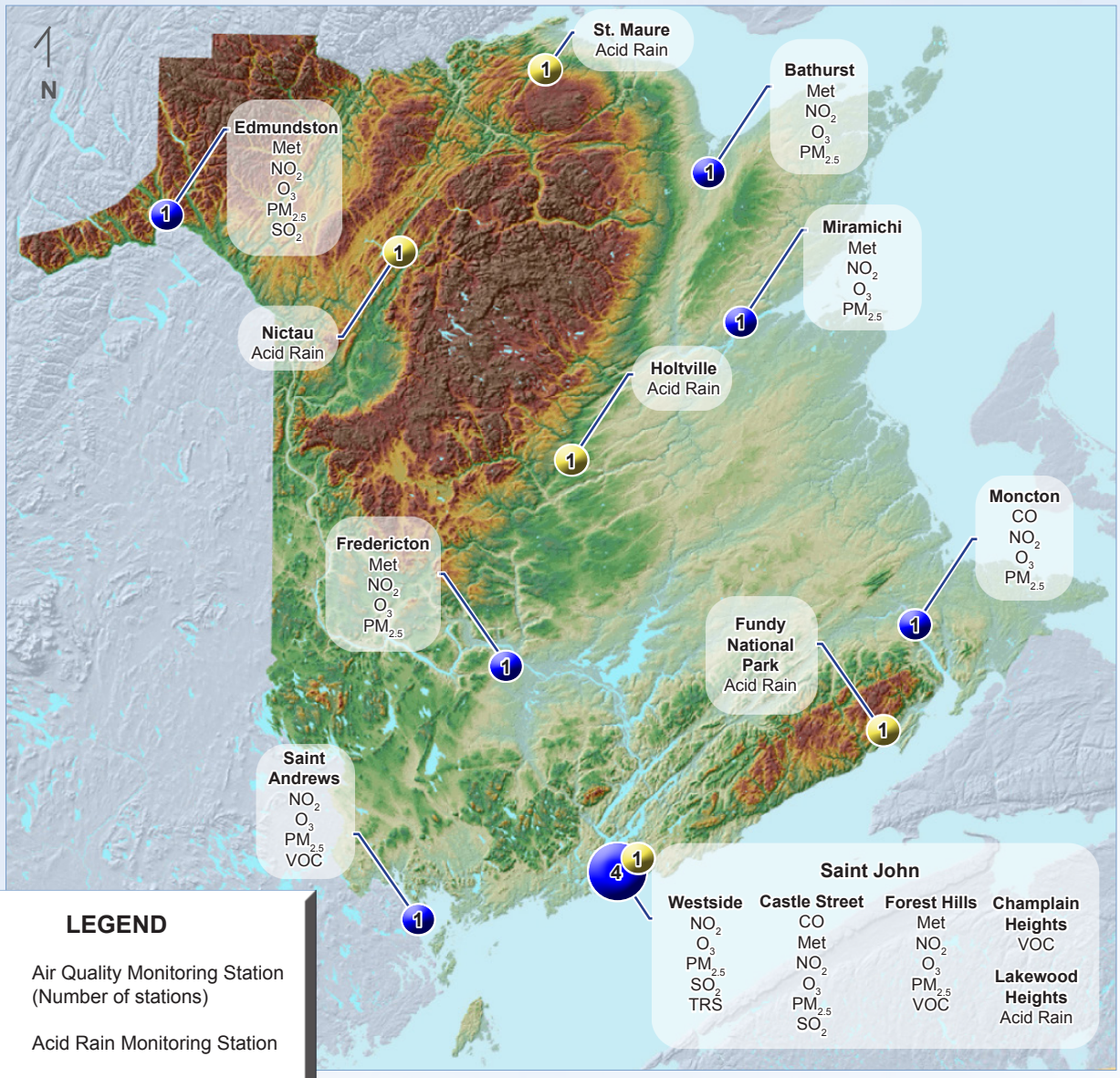
Below, we look at some of the more common air pollutants: what they are, where they come from, and how they can affect our environment and our health.

Overview of Key Air Pollutants - Sources and Effects		
Air Pollutant	**What is it?**	**What does it do?**
Sulphur Dioxide (SO_2)	A colourless gas with a sharp odour, like that of a struck match. It is produced by the burning of sulphur-bearing fuels such as oil and coal.	SO_2 can cause respiratory disease, tighten airways, and impair lung function. It can also irritate the eyes, throat, and lungs. It is a major contributor to acid rain, which impacts sensitive lakes and rivers. At very high concentrations it can also damage plants, and corrode metals.
Reduced Sulphur Compounds (Total Reduced Sulphur - TRS)	A group of gases with a characteristic "rotten egg" odour. These are produced by the natural decay of dead plants and animals (e.g. in marshes and tidal flats), and by certain industrial processes (e.g. kraft pulp mills, and oil refineries).	They cause a variety of nuisance odours, which can be very unpleasant, even at extremely low concentrations. At much higher levels they can cause respiratory irritation and related health concerns. They also contribute to acid rain.
Nitrogen Dioxide (NO_2)	A reddish-brown gas with a sharp odour. It is generated through combustion, especially motor vehicle exhaust and the burning of fossil fuels for electrical power generation.	Similar to SO_2, high concentrations can harm plants, corrode metals, and cause irritation to the eyes, throat, and lungs. It also decreases lung function. It contributes to acid rain, and can lend a reddish haze to smog. NO_2 also reacts with other pollutants to cause the formation of ground level ozone.
Carbon Monoxide (CO)	A colourless, odourless and flavourless gas. It is produced by the incomplete burning of carbon-containing materials such as coal, oil, gasoline, wood, or natural gas. Forest fires, industrial activity, and home heating systems also contribute significantly. Motor vehicles are also a source of CO.	CO interferes with the blood's ability to carry oxygen to vital organs and tissues. This causes decreased stamina and worsens certain symptoms of heart disease. Exposure to higher concentrations can impair vision and coordination, cause headaches, dizziness, confusion, nausea, and can be fatal.
Ground Level Ozone (O_3)	Ozone is invisible and odourless at typical ground level concentrations. It is formed through chemical reactions between a variety of "ozone precursor" pollutants, which are released by industrial facilities and motor vehicles. Most of New Brunswick's ground level ozone is carried here by air masses originating in the United States and central Canada.	Irritates the lungs, makes breathing difficult, and can also aggravate lung disease. Ground level ozone also damages plants, weakens rubber, and attacks metals and painted surfaces.

Overview of Key Air Pollutants - Sources and Effects			
Air Pollutant		**What is it?**	**What does it do?**
Volatile Organic Compounds (VOCs)		VOCs are a group of carbon-containing substances that can quickly evaporate at room temperature. They are produced through combustion and the evaporation of paint, solvents and other surface coatings. Also, some are naturally released from plants.	They can contribute to smog, the depletion of Earth's ozone layer, and toxic air pollution. These pollution issues are correlated with a broad range of adverse health and environmental effects.
Important VOC Subgroups	"Smog Forming" VOCs	A group of VOCs that when combined with nitrogen compounds can accelerate the formation of Ground Level Ozone and Smog. Smog formation is reliant on heat and sunlight so it can be of particular concern in the summer months.	Smog is a yellow/brown haze or a thick fog of air pollution. It reduces visibility and can cause numerous respiratory problems. It can also cause damage to crops and vegetation.
	"Air Toxic" VOCs	A class of organic compounds that are directly harmful to most living things, including humans. This group contains some well known VOCs such as Benzene and Formaldehyde.	Many compounds in this category can cause eye and respiratory irritation, dizziness, nervous system damage, and some are also known carcinogens.
	Ozone Depleting Substances	Ozone-depleting substances (ODS) generally contain chlorine, fluorine, bromine, carbon, and hydrogen in varying proportions. Although largely eliminated now, in the past they were widely used in refrigerators, air conditioners, fire extinguishers, cleaning solvents, and electronic equipment.	Although stable and non-toxic in the lower atmosphere, they are able to float up to the stratosphere and destroy ozone molecules, which make-up the protective ozone layer. This layer protects us from harmful ultraviolet radiation.
Particulate Matter (PM)		Particulate matter is made up of solid or liquid matter, including dust, ash, soot, smoke or tiny particles of pollutants.	Can cause a variety of respiratory problems, reduce visibility, damage vegetation, and creates nuisance dust.
Important PM Subgroups	Fine, 2.5 microns in diameter or less ($PM_{2.5}$)	Tiny (invisible) airborne specks of solid or liquid material (i.e. dust & soot). It is generated by natural sources (e.g. wind-blown dust and forest fires), and through fuel burning (especially fossil fuels and wood).	Causes and aggravates a variety of human cardiovascular and breathing ailments (e.g. asthma, lung disease, and bronchitis). It also contributes to haze.
	Total Suspended (TSP)	Tiny airborne particles suspended in the air with no defined size limit. All particle sizes are included. They can come from natural sources, such as pollen and spores, as well as particles from vehicles or smokestacks.	The health effects may include damage to the respiratory and cardiovascular systems (smaller particles). The key issue for larger particles is the nuisance of dust accumulation and reduced visibility.
In addition to the key pollutants described above, there are a variety of other air pollutants that can be monitored on a case-by-case basis, depending on local emission sources.			

The Provincial Air Quality Monitoring Network

Stations Operated by the Province



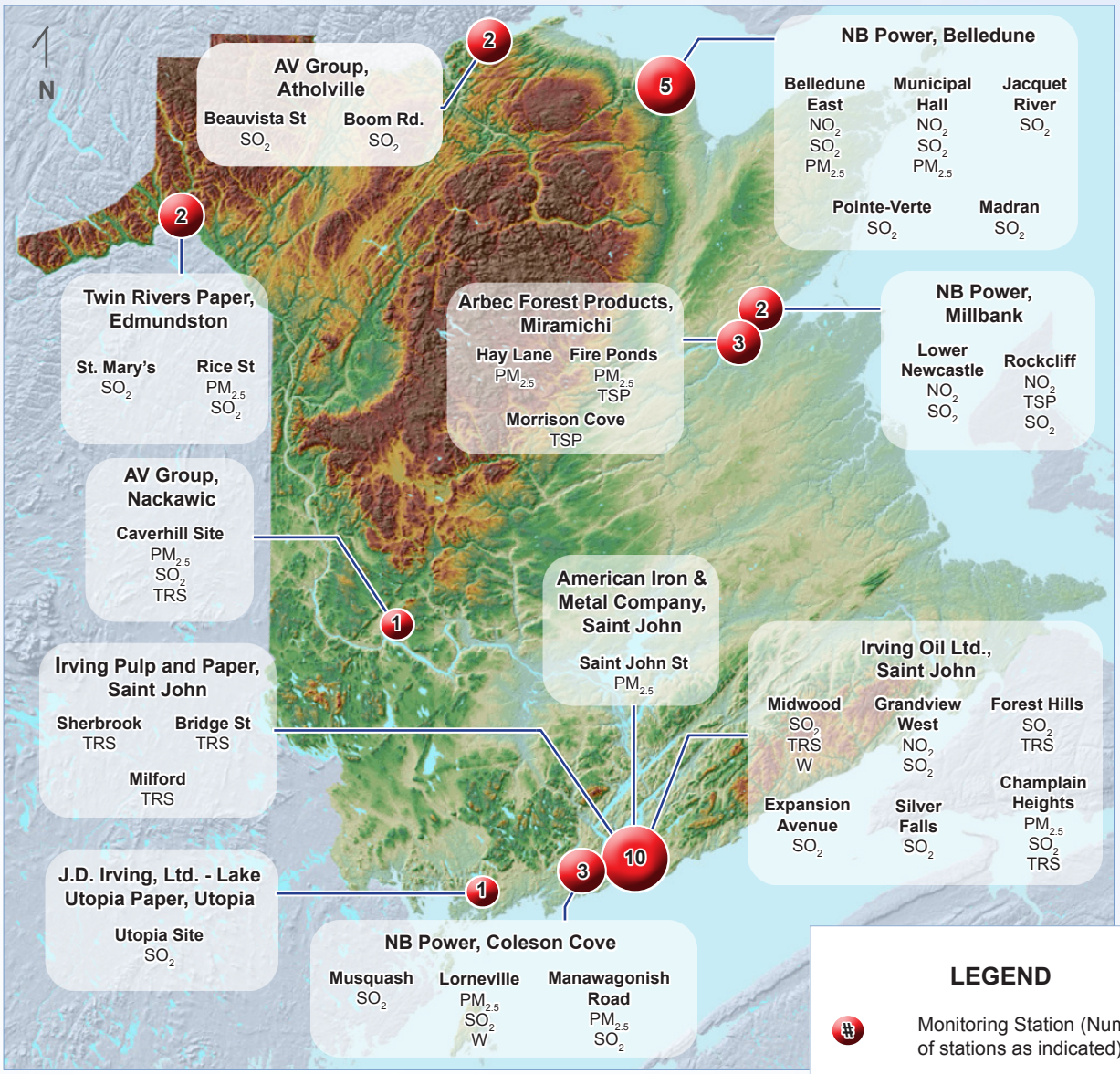
LEGEND

	Air Quality Monitoring Station (Number of stations)
	Acid Rain Monitoring Station
CO	Carbon Monoxide
Met	Meteorology (Wind Speed, Wind Direction, Temperature, Relative Humidity, Barometric Pressure)
NO_2	Nitrogen Dioxide
O_3	Ozone
$PM_{2.5}$	Fine Particulate Matter
SO_2	Sulphur Dioxide
TRS	Total Reduced Sulphur
VOC	Volatile Organic Compounds

New Brunswick's provincial air quality monitoring stations collect data continuously, year-round. For most monitors the collected data is transmitted to a central data management system in real time. The operation and oversight of the network and the associated data management system requires the constant attention of a team of dedicated air quality personnel.

Most of the stations are also audited by Environment and Climate Change Canada to ensure that monitors are appropriately maintained and data is accurate. Since the beginning of the program in the early 1970s these audits have consistently confirmed the high quality of the Province's reported data.

Stations Operated by Industry



As with provincial stations, New Brunswick's industry-operated stations are also operated continuously, year-round. Most of this data is submitted to DELG hourly via an automated system, but some is submitted at year-end.

Just as Environment and Climate Change Canada audits DELG stations, the industry-operated sites are audited by DELG to ensure accuracy of the reported data. Data quality problems are rare, but when issues do occur they are addressed immediately.

Provincial Air Quality Objectives

One of the main goals of this report is to describe the Province's success in achieving the provincial air quality objectives (listed below), which were established under the *Clean Air Act* in 1997.

The provincial air quality objectives apply to ambient air. That is, the normal outdoor air that is generally available for use by people and the environment. They are not meant to apply indoors, nor directly at the end of a chimney or smokestack.

The air quality objectives are described in units of "micrograms" (i.e. millionths of a gram) per cubic meter (µg/m^3). In the table below, most are also provided in the somewhat more common "parts per million" (ppm) or "parts per billion" (ppb) units.

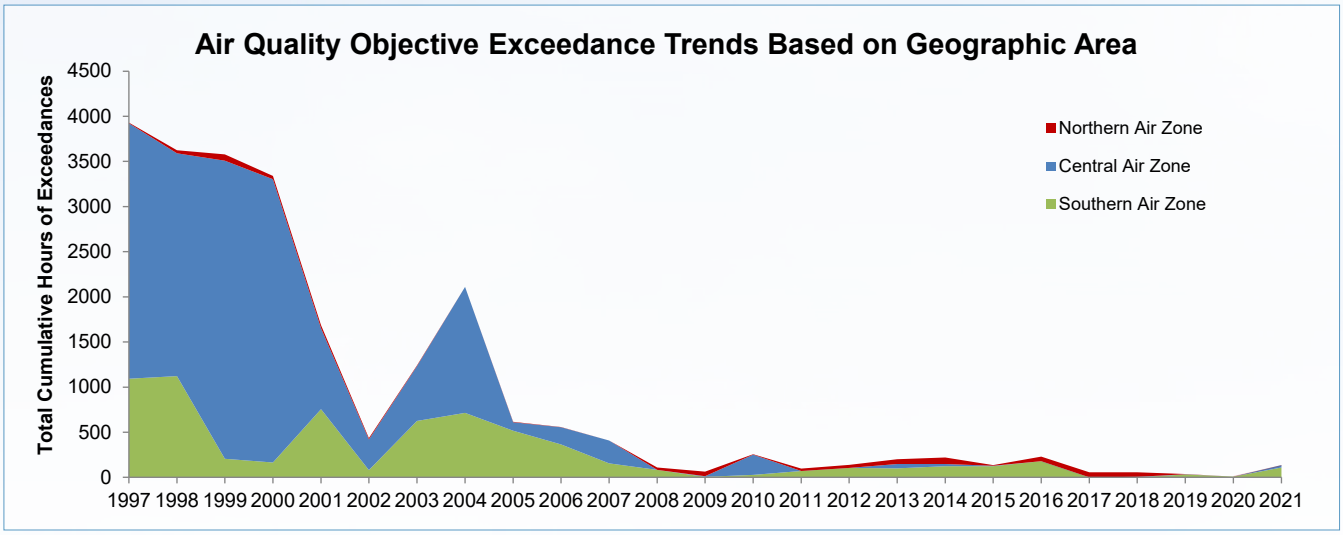
As reflected in the table, there are two or more objectives for each pollutant, each with an associated "averaging period". This is to ensure that the objectives properly address a variety of exposure scenarios, including short term peaks, long term exposure to lower levels, and potential combinations.

New Brunswick Air Quality Objectives				
Pollutant	Averaging Period			
	1 Hour	8 Hour	24 Hour	1 year
Carbon Monoxide	35,000 µg/m^3 (30 ppm)	15,000 µg/m^3 (13 ppm)	n/a	n/a
Hydrogen Sulphide	15 µg/m^3 (11 ppb)	n/a	5 µg/m^3 (3.5 ppb)	n/a
Nitrogen Dioxide	400 µg/m^3 (210 ppb)	n/a	200 µg/m^3 (105 ppb)	100 µg/m^3 (52 ppb)
Sulphur Dioxide*	900 µg/m^3 (339 ppb)	n/a	300 µg/m^3 (113 ppb)	60 µg/m^3 (23 ppb)
Total Suspended Particulate	n/a	n/a	120 µg/m^3	70 µg/m^3

* The objective for sulphur dioxide is 50% lower in Saint John, Charlotte, and Kings counties.

Long Term Trend

There have been tremendous improvements in accomplishing our air quality objectives since they were first established in 1997. As seen in the graphic below, the 136 cumulative hours of exceedances (across all stations) recorded in 2021 is down from the 3,931 hours recorded in 1997. This represents a 97% improvement on this metric since the creation of the *Clean Air Act.*



Accomplishing Our Air Quality Objectives

The table below summarizes the exceedances of the provincial air quality objectives that occurred in 2021. Province-wide, there were 15 exceedance events, which resulted in 136 cumulative hours of exceedances. Most of the events were short-lived.

Air Quality Objective Statistics for 2021			
Parameter	**Number of Exceedance Events**	**Location**	**Comments**
Hydrogen Sulphide (as Total Reduced Sulphur)	3	Saint John, East	The one hour objective was exceeded at the Midwood Avenue station (Irving Oil Ltd.) on September 20, October 13, and October 14. The 24 hour objective was also exceeded during the event on October 14. Further investigation indicated that refinery operations were normal. Emissions from a nearby wastewater treatment plant and/or adjacent tidal flats may have contributed.
	1	Nackawic	The one hour objective was exceeded at the Caverhill Site station (AV Nackawic) on July 10, 2021. The event lasted for one hour. Investigations suggest that local weather patterns resulting from heavy rainfall caused the emissions to be trapped under a low atmospheric ceiling, resulting in elevated readings. No follow-up was required.
	1	Utopia	The 1 hour and 24 hour objectives were each exceeded on December 17, 2021 at the special project site in Utopia, NB. There were no operational issues or malfunctions identified at the mill during the event. The mill has begun a program to investigate its TRS emissions and opportunities for reduction.
Sulphur Dioxide	7	Saint John, East	The one hour objective was exceeded on 5 occasions at the Grandview West station (Irving Oil Ltd.) on January 9 and 10, and September 19, 2021. The 24 hour objective was also exceeded on January 10 and September 19 at the same location. The events in January were due to operational issues in the sulphur recovery system and latter events due to operational issues following a temporary shutdown. The one hour objective was exceeded on June 24 at the Champlain Heights station. The event lasted 2 hours. Elevated SO_2 emissions were due to operational difficulties resulting from an unplanned shutdown in the refinery's gas system. The one hour and 24 hour objective were exceeded on July 16 at the Forest Hills station. Elevated emissions were a result of repair activities at the refinery.
	1	Utopia	The 24 hour objective was exceeded on January 18, 2021 for 3 hours at the Lake Utopia Paper station (J.D Irving Ltd.). The mill was operating under normal conditions at the time, but an excess of biogas was being combusted. The mill has since implemented an SO_2 response procedure.
	1	Edmundston	The one hour objective was exceeded on June 9, 2021 at the Rice Street station (Twin Rivers Paper). The event lasted 1 hour. Elevated emissions were the result of a chemical spill at the pulp mill. DELG was notified of the incident and remedial action was initiated immediately.
Total Suspended Particulate	1	Miramichi	The 24 hour objective was exceeded on June 27, 2021 at the Morrison Cove station (Arbec Forest Products). Further analysis from the dust filters suggests that the mill was not likely to be the source. The cause is undetermined.

Special Project Monitoring

In addition to its fixed network of permanent air quality monitoring stations, since 2001 DELG has also undertaken a variety of special air quality monitoring projects throughout New Brunswick. These projects are usually carried-out using DELG's mobile air quality monitoring unit.

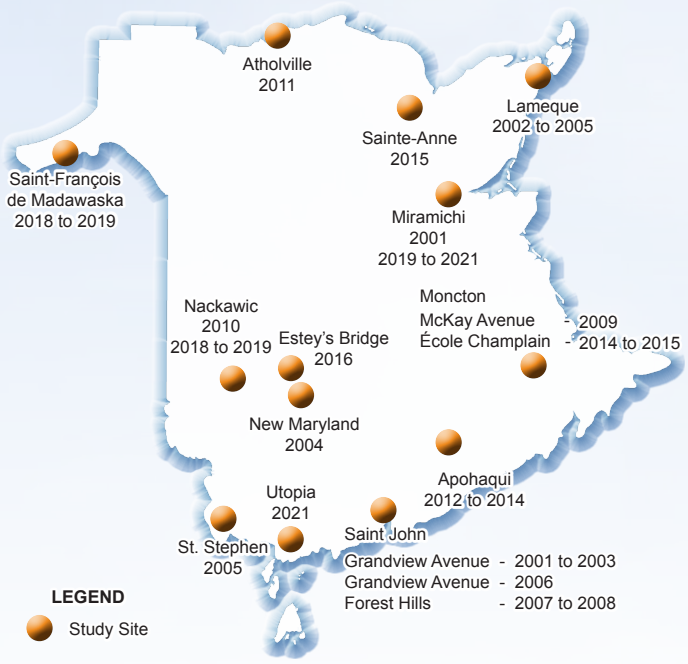
Special studies are typically used to:

- Assess air quality near pollution sources.
- Evaluate potential sites for permanent monitoring stations.
- Verify air quality modelling predictions.
- Measure background (baseline) air quality levels prior to a development.

Results from special studies may be included in the annual air quality monitoring results report for the year in question. Alternatively (or in addition), results may be reported in separate stand-alone reports. Stand-alone reports are available electronically via the DELG website, which can be accessed at:

www.gnb.ca/environment

Special Air Quality Study Sites (2001 - 2021)



DELG's mobile air quality monitoring unit.

Study Parameters

The DELG mobile air quality monitoring unit (pictured above) can be equipped with a wide variety of monitoring equipment, including all of the instrument types that are used in the regular monitoring network, but also specialized sampling equipment to address any site-specific issues that are being investigated.

Duration

Due to day-to-day and seasonal variations in weather patterns and pollution emissions, in order to capture the full variety of air quality conditions at a project site, special projects typically last between 6 months and 2 years.

Status

During the 2021 monitoring year the mobile air quality monitoring unit was in the Miramichi area until July (a summary regarding this completed study follows on page 10 and a full report is available online). In late 2021, the unit was deployed to Utopia for a special study, which remained ongoing into 2022.

Special Study: Miramichi

Background

In 2019 an air quality evaluation was initiated in Miramichi in response to ongoing citizen complaints related to odour and air pollution emissions from the Arbec Forest Products mill.

Key air quality contaminants related to the mill (fine particulate matter ($PM_{2.5}$) and Total Suspended Particulate (TSP)) are already monitored near the mill via permanent, facility-operated, air quality monitoring stations.

In addition to the permanent stations, a previous special study was carried out in 2001.

Results to date from both previous and ongoing monitoring have revealed no significant air quality issues.

The current project evaluated air quality at a different monitoring location, which was identified by local residents as being highly impacted.

Studied Parameters

The mobile unit was outfitted with continuous monitors for nitrogen dioxide (NO_2), ground level ozone (O_3), fine particulate matter ($PM_{2.5}$), respirable particulate (PM_{10}), and total suspended particulate (TSP).

Integrated sampling was also conducted for 17 aldehyde/carbonyl compounds and 11 Volatile Organic Compounds (VOC), via one of three methods (Passive absorption, DNPH Cartridge, or Summa Cannister).

In addition, meteorological conditions (wind speed and wind direction) were monitored.

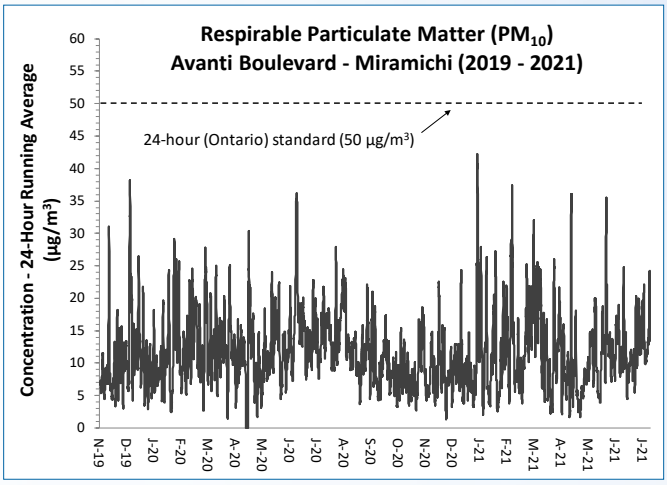
Study Period

Monitoring began at the study site on November 7, 2019 and concluded on July 28, 2021.

Results

A final report for this project has been published and is available online via the DELG website. The following is a brief summary of the key findings:

- For all pollutants monitored, concentrations were found to be within (better than) applicable standards and guidelines.
- The pollutant that reached the closest to a guideline value was PM_{10}, reaching 84% of the applicable 24-hour guideline.
- There were several short-lived, high value peaks of PM_{10} that may be noticeable by a human observer. However, these do not constitute exceedances as there is no applicable short term guideline.



Conclusion

Air quality monitoring did not identify a pollutant (or pollutants) that would explain citizen complaints of odour.

While brief peaks of poorer air quality are in agreement with citizen complaints that describe smoke impacts, it should be noted that the mill is not the only contributing source of PM_{10} in the area.

This study does not preclude the existence of odorous contaminants in the area, as the current work was not exhaustive in its attempt to identify or quantify aesthetic odour impacts.

Air Quality Management System Reporting

In 2012, the Canadian Council of Ministers of Environment (CCME) introduced a new Air Quality Management System (AQMS) for Canada. The AQMS provides a common approach for all Canadian jurisdictions to measure, manage, and report on air quality. The following sections (pages 11 through 28) provide New Brunswick's required annual reporting with respect to the CCME commitment.

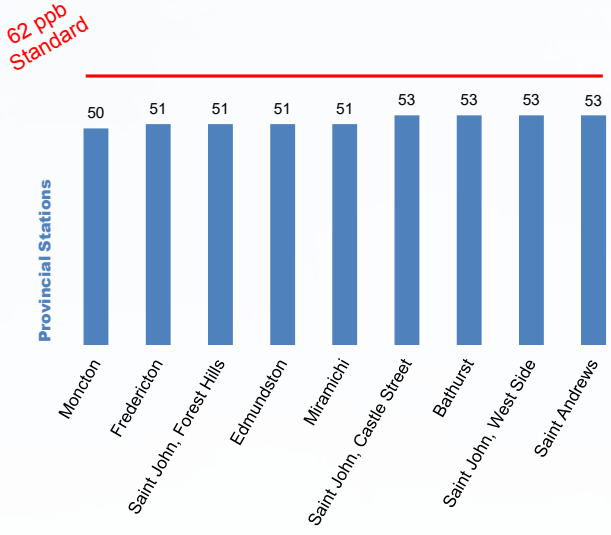
Canadian Ambient Air Quality Standards

The key "drivers" for air quality improvement in the AQMS are the Canadian Ambient Air Quality Standards (CAAQS). The adoption of CAAQS by the CCME provides a non-binding, common benchmark for air quality in all Canadian jurisdictions. At present, CAAQS have been adopted for four air pollutants: fine particulate matter ($PM_{2.5}$), ground level ozone (O_3), sulphur dioxide (SO_2), and nitrogen dioxide (NO_2).

2021 Achievement Status

New Brunswick's 2021 achievement status for the current CAAQS targets is illustrated below through page 15. Please note that each CAAQS is presented in the form of a simple concentration limit, which gives the appearance that they are similar to "traditional" air quality standards (e.g. hourly average concentration limits). However, this is not the case, as the CAAQS are more complex. The CAAQS require a large amount of data (1-3 years), and it must be sorted and analyzed in a variety of different ways. A brief overview of the purpose of each standard, and the calculations involved, is provided with each set of results.

Ground Level Ozone
8-Hour Metric



Understanding the Metric

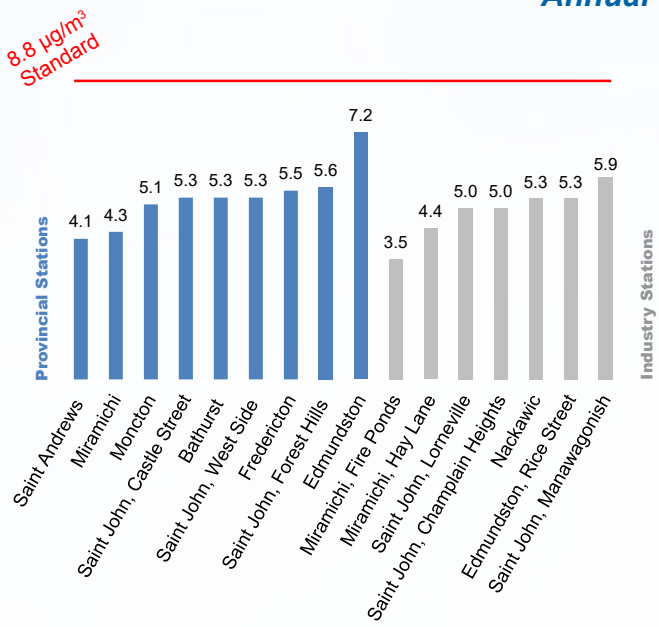
The ozone 8-hour metric provides a standard against which a location's poorer air quality days may be judged (i.e. how many "bad air quality days" does the area have, and how bad are they *usually*?)

The Calculation:
An ozone monitor records a 1-hour average concentration every hour for a year. From these values, 8-hour averages are calculated for every 8-hour period in the year.

The highest 8-hour average for each day of the year is then selected. These "daily 8-hour maximum" values are ranked from best to worst and the 4th worst value is selected for that year.

This is repeated for three years, and the three values averaged together. This three-year average is the value that is compared to the CAAQS target.

Fine Particulate Matter ($PM_{2.5}$)
Annual Metric



Understanding the Metric

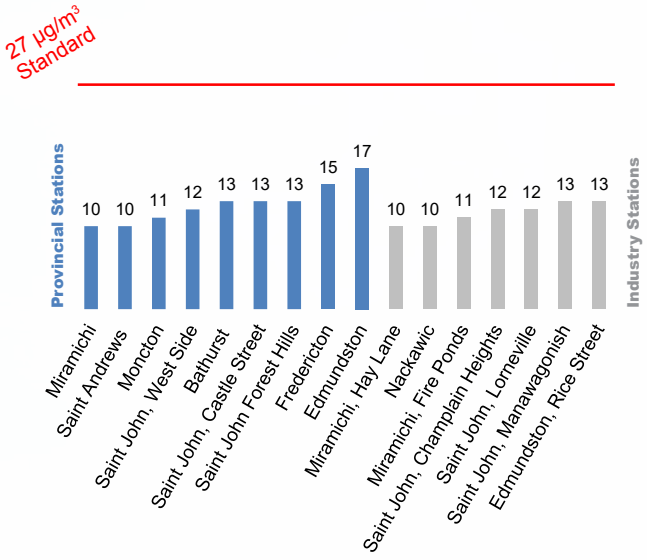
The fine particulate matter "annual metric" is one of the simpler CAAQS calculations, and provides a standard for truly average conditions over long time periods.

The Calculation:

A fine particulate matter monitor records a 1-hour average concentration every hour for a year. All of these values are then averaged together to create one annual average for that location.

This is repeated for three years, and the three values averaged together. This three-year average is the value that is compared to the CAAQS target.

Fine Particulate Matter ($PM_{2.5}$)
Daily Metric



Understanding the Metric

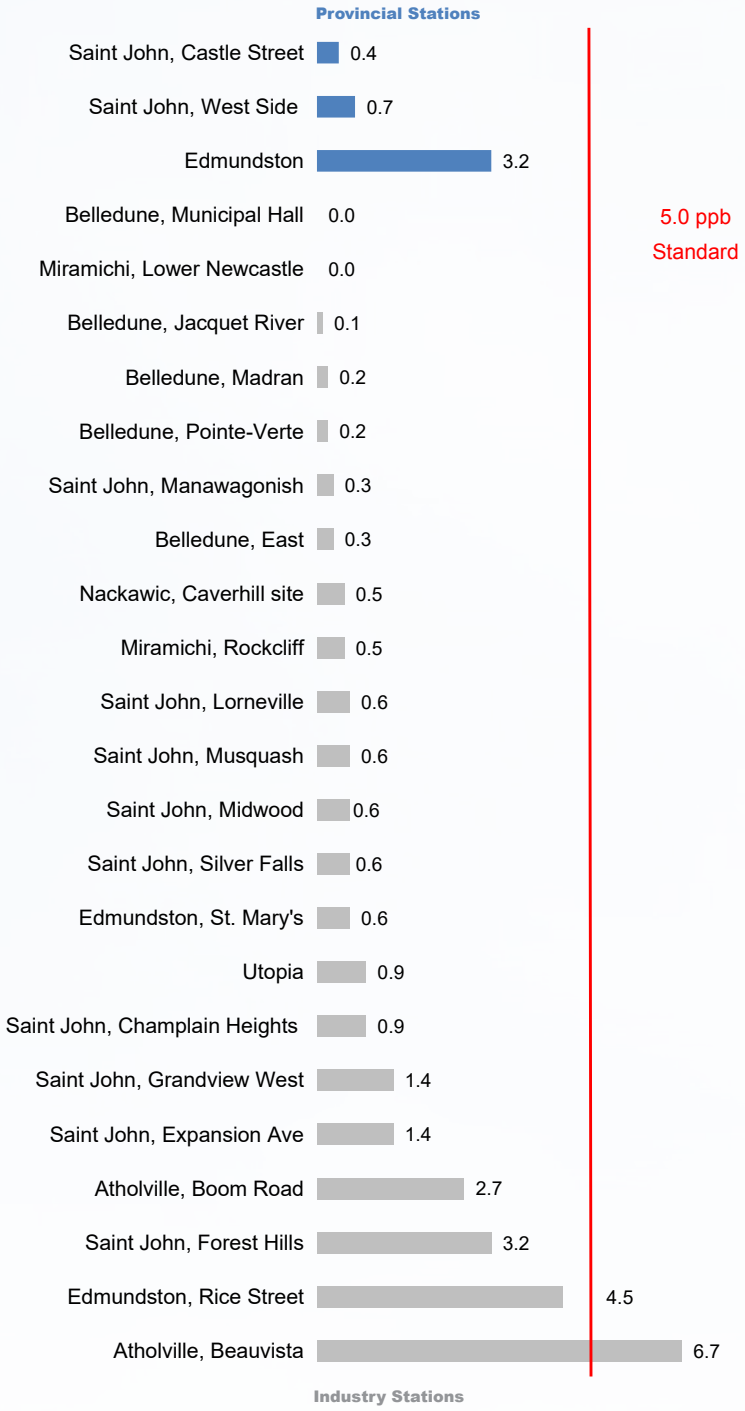
The fine particulate matter "daily metric" is similar to the ozone "8-hour metric" and serves a similar purpose.

The Calculation:

A fine particulate monitor records a 1-hour average concentration every hour for a year. From these, a daily average (24-hour average) is calculated for each day of the year. These daily averages are then ranked from best to worst and the 98th percentile (approximately the 7th or 8th worst) value is selected as the "daily value" for that year.

This is repeated for three years, and the three values averaged together. This three-year average is the value that is compared to the CAAQS target.

Sulphur Dioxide (SO_2)
Annual Metric

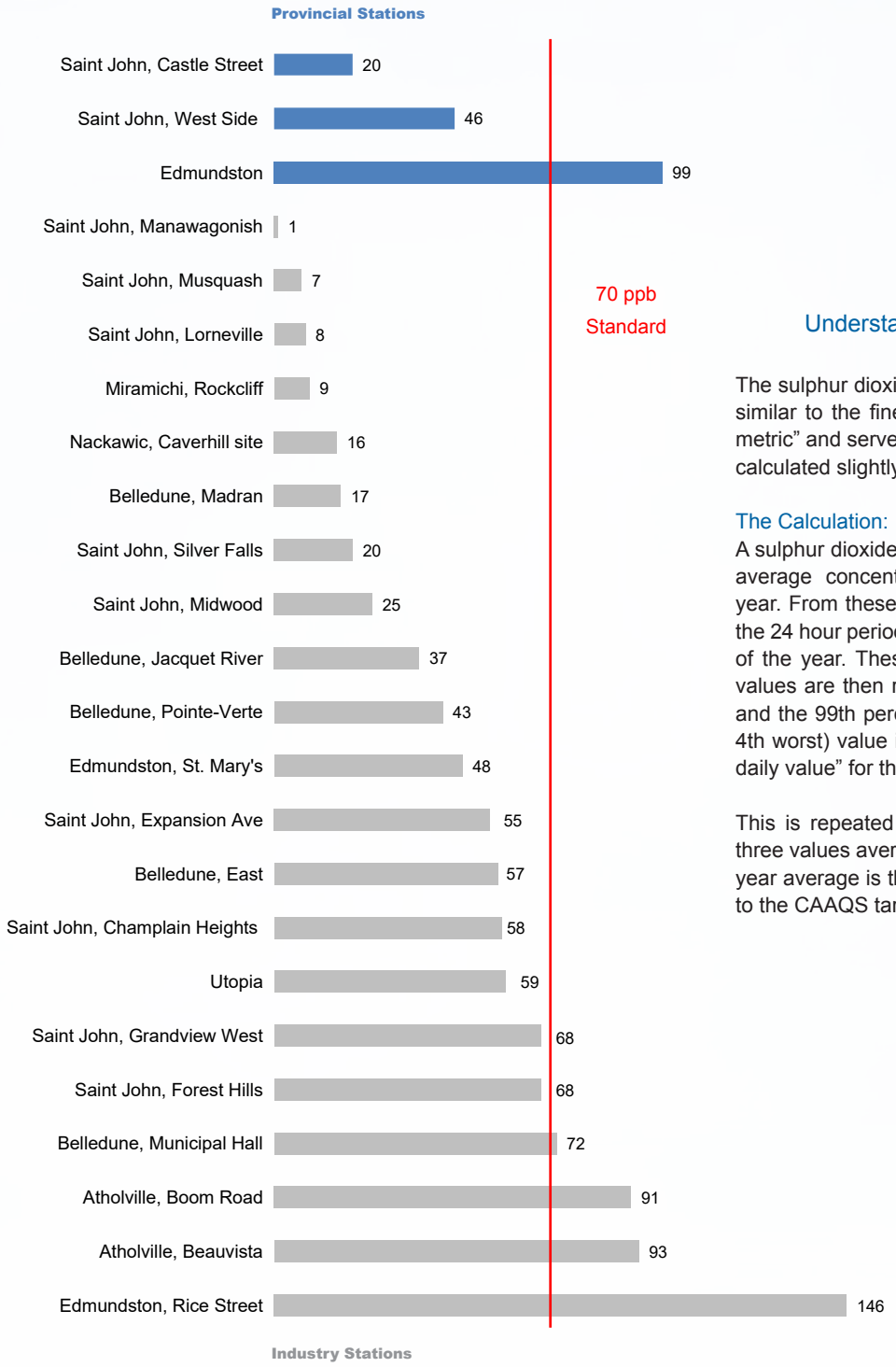


Understanding the Metric

The sulphur dioxide “annual metric” is the simplest type of CAAQS calculation, and provides a standard for average conditions over a 1-year timespan.

The Calculation:
A sulphur dioxide monitor records a 1-hour average concentration every hour for a year. All of these values are then averaged together to create one annual average for that location.

Sulphur Dioxide (SO_2)
1-Hour Daily Metric



Understanding the Metric

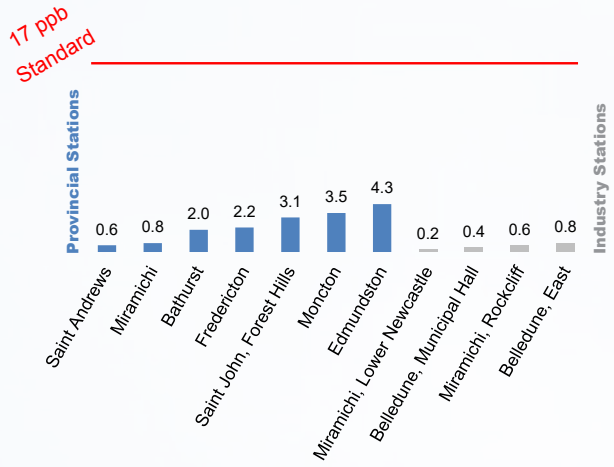
The sulphur dioxide “1-hour daily metric” is similar to the fine particulate matter “daily metric” and serves a similar purpose, but is calculated slightly differently.

The Calculation:

A sulphur dioxide monitor records a 1-hour average concentration every hour for a year. From these, the 1-hour maximum (in the 24 hour period) is selected for each day of the year. These daily maximum 1-hour values are then ranked from best to worst and the 99th percentile (approximately the 4th worst) value is selected as the “1-hour daily value” for that year.

This is repeated for three years, and the three values averaged together. This three-year average is the value that is compared to the CAAQS target.

Nitrogen Dioxide (NO_2)
Annual Metric



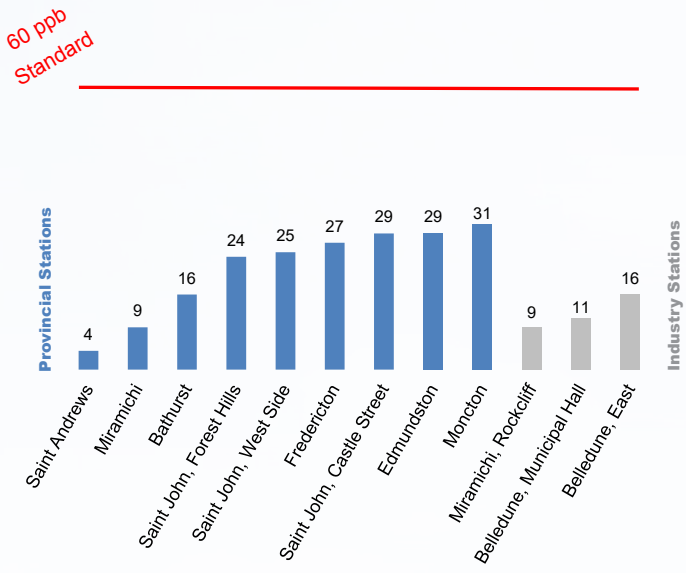
Understanding the Metric

The nitrogen dioxide “annual metric” is the same as the sulphur dioxide annual metric. It provides a standard for average conditions over a 1-year timespan.

The Calculation:

A nitrogen dioxide monitor records a 1-hour average concentration every hour for a year. All of these values are then averaged together to create one annual average for that location.

Nitrogen Dioxide (NO_2)
1-Hour Daily Metric



Understanding the Metric

The nitrogen dioxide “1-hour daily metric” is similar to the sulphur dioxide "1-hour daily metric” discussed previously.

The Calculation:

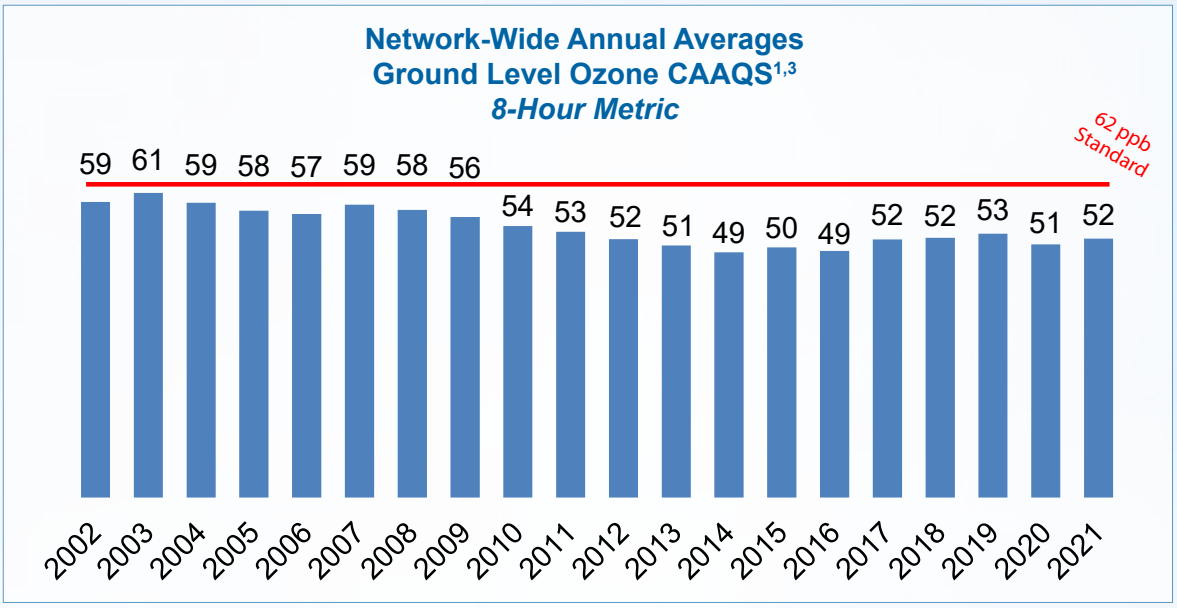
A nitrogen dioxide monitor records a 1-hour average concentration every hour for a year. From these, the 1-hour maximum (in the 24 hour period) is selected for each day of the year. These daily maximum 1-hour values are then ranked from best to worst and the 99th percentile (approximately the 4th worst) value is selected as the “1-hour daily value” for that year.

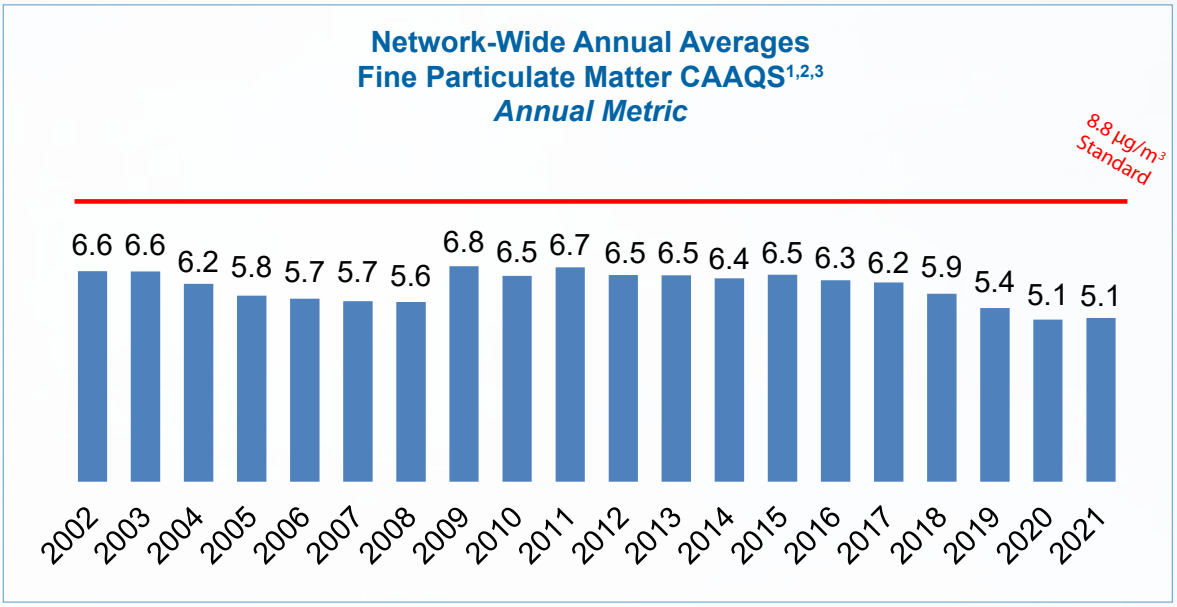
This is repeated for three years, and the three values averaged together. This three-year average is the value that is compared to the CAAQS target.

Particulate Matter and Ozone Trends

The previous illustrations provide a detailed, station-by-station view of CAAQS achievement status for a single year (2021) but do not describe longer term trends with respect to the levels of these contaminants in our air. The graphs below are included to provide this historical context for particulate matter and ozone acheivement (which has been tracked for many years). Similar trending will be available in future years for the newly adopted 2020 SO_2 and NO_2 CAAQS.

These graphs are based on the CAAQS calculations previously described (see pages 11 and 12), with the added step of averaging all of the CAAQS values from all sampling stations in New Brunswick for each year. In so doing, they reveal the 20-year network-wide trends for these contaminants.





[1] The number and location of sampling stations has varied throughout the period represented.
[2] Due to changing technologies, more recent values may not be directly comparable to those measured with older instruments.
[3] Historical values shown may differ from those previously reported due to changes in annual CAAQS calculation.

Provincial Air Zones

In addition to the CAAQS, the Air Quality Management System also includes guidance with respect to the management of air quality by the provinces. This is known as the Air Zone Management Framework (AZMF). Under the AZMF, each province is divided into a number of “Air Zones”, which are geographic areas that have similar air quality profiles and challenges. These divisions have no legal significance, but help to guide management actions by highlighting regional issues and opportunities. New Brunswick has established three provincial air zones, as illustrated and described below.

Northern Air Zone

The northern air zone is situated along New Brunswick’s northern coastline and includes most of the province’s border with Quebec. The area is largely rural, but contains a number of towns and villages. The largest community is Bathurst, with a population of approximately 12,000.

Because there are no major urban centers in the northern air zone, it does not experience many of the air quality issues associated with big cities (such as smog from heavy traffic).

The air zone is home to major industrial emitters in Atholville (AV Group Pulp Mill) and Belledune (NB Power Belledune Generating Station). These facilities emit a variety of air contaminants including sulphur dioxide, nitrogen dioxide, and fine particulate matter, which can impact air quality in nearby communities and the broader region. The NB Power Belledune Generating Station is currently New Brunswick's second largest sulphur dioxide emitter.

Central Air Zone

The central air zone is the largest of the three provincial air zones, and occupies New Brunswick’s middle latitudes. It encompasses five of New Brunswick’s major population centers: Moncton, Dieppe, Fredericton, Miramichi, and Edmundston. Although small by international standards, these cities can experience “big city” air quality issues (that is, the combined impact from many small pollution sources in close proximity - vehicles, homes, businesses, etc.).

There are also several major emitters in this area, including an AV Group pulp mill in Nackawic, the Twin Rivers Paper Company pulp mill in Edmundston, and the Arbec Forest Products oriented strand board mill in Miramichi. Emissions from these facilities can include sulphur dioxide, nitrogen dioxide, fine particulate matter, reduced sulphur compounds, and volatile organic compounds. These facilities can impact air quality at both the local and regional scale.

Southern Air Zone

The southern air zone includes a large portion of New Brunswick's southern coastline along the Bay of Fundy, and borders the State of Maine in the west. It is home to the City of Saint John, which is the province's second largest city (population 71,000).

The City of Saint John is a major industrial center for the province. It hosts a variety of industrial emitters, including Canada's largest oil refinery (Irving Oil Ltd.), the Irving Pulp and Paper Ltd. mill, and the Irving Paper Ltd. mill. The city also experiences air quality impacts from ship traffic via its active industrial port and its cruise ship terminal. Together, these sources emit fine particulates, sulphur dioxide, nitrogen dioxide, reduced sulphur compounds, and volatile organic compounds.

The air zone is also impacted by major emitters at Coleson Cove (NB Power Coleson Cove Generating Station), which is currently New Brunswick's largest sulphur dioxide emitter, and Utopia (J.D. Irving, Ltd. - Lake Utopia Paper mill).

Common Challenges

All New Brunswick air zones experience local (small) scale air quality impacts from various smaller industrial and commercial emitters (e.g. fish plants, commercial boilers, pits and quarries, paint shops, etc.).

New Brunswick's large forested areas can generate pollen events during warmer seasons, and are also vulnerable to forest fires. Both can impact air quality at the local and regional scale.

Wood burning for residential heat is popular throughout New Brunswick, which can result in wood smoke issues during the colder seasons. Also, outdoor burning (e.g. campfires) is popular in the summer months, and can similarly affect local air quality.

All New Brunswick air zones receive long range pollutants (such as fine particulate matter and ozone) from other parts of the World.

Air Zone Management

Each year, CAAQS values for each monitoring station are graded against a colour-coded system of “Management Levels”. Under the system, “green” is best, “yellow” and “orange” are progressively poorer, and “red” (CAAQS exceedance) is worst.

The purpose of the rating system is to guide government with respect to appropriate regulatory and management options for each air zone. For management purposes, each air zone is assigned an overall Management Level based on the "worst" station in that zone. Generally, poorer air quality is intended to trigger more aggressive action to improve air quality.

Management Levels are based on the CAAQS metric values, but may be adjusted to remove the influence of exceptional events (e.g. forest fires). No such adjustments were necessary for 2021.

Understanding the Management Levels

As previously mentioned, as of 2021 the CCME has adopted CAAQS metrics for a total of four parameters, some with two metrics each. Each CAAQS value, through the guidance of CCME, has a unique calculation method. As previously described, some of the calculated metrics require three years of data (2019, 2020 and 2021 for the current reporting period), while others are based on only a single year of data (2021 for the current reporting period).

The calculated metric values determine the colour-coded 'management level' and associated 'management goal' for each monitoring station, as per the table below. For those pollutants with more than one CAAQS metric (i.e. an annual and a daily metric), only one management level is determined, which is based on the poorer of the two calculated values. It is important to note that although air zones are assigned Management Levels based on their poorest results, this does not reflect the overall quality of the air throughout the zone. Rather, it suggests the types of actions needed to address the specific problem areas.

Worse ↑ ↓ Better

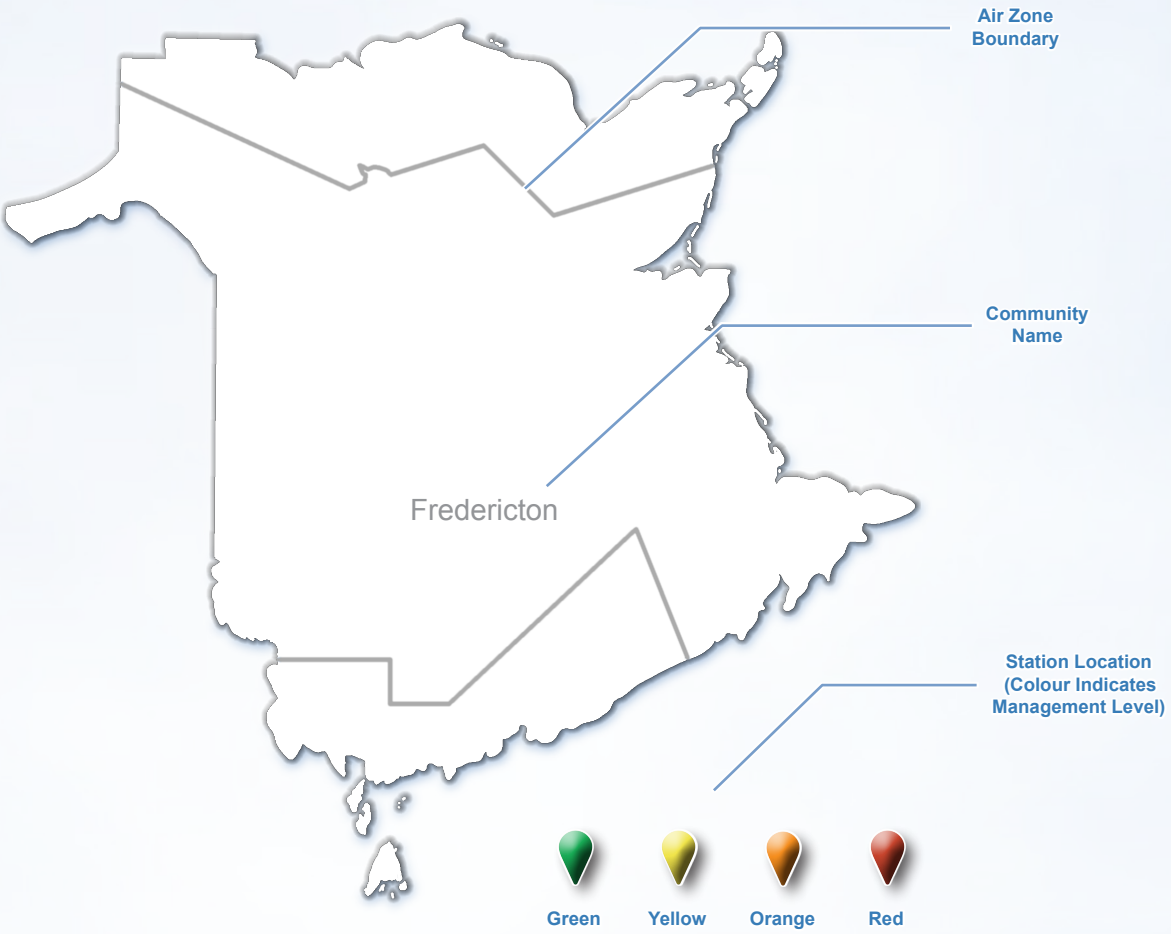
Management Level	Management Goal
Red	Achieve the CAAQS
Orange	Prevent CAAQS exceedance
Yellow	Prevent air quality deterioration
Green	Maintain: "keep clean areas clean"

The management levels for each CAAQS (for all applicable monitoring stations) are provided in the tables that follow, and have been colour-coded per the table above. In addition, the management level of each station is illustrated on an accompanying map. The map illustrations are explained further below.

Understanding the Management Level Maps

Each management level map illustrates the locations of all available stations that monitor for the pollutant in question via coloured markers. The colour of the marker indicates the management level associated with that location. New Brunswick's air zones are indicated by grey lines on each map. For management purposes, each air zone is assigned an overall management level based on the "worst" station in that zone.

Management Level Map Features



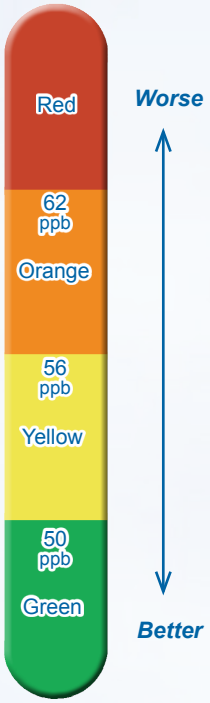
Current Management Levels

Management levels for the four adopted CAAQS pollutants are presented in the tables and maps that follow. The results indicating "red" management levels highlight areas that will require improvements in order to achieve the CAAQS targets.

Additional information about the CAAQS and AZMF are available via the CCME web site: *www.ccme.ca*

Ground Level Ozone CAAQS Air Zone Management Levels

	2021 CAAQS Value and Management Level Colour	
	Monitoring Station Location	**8-Hour**
Northern	Bathurst, Roughwaters Drive	53
Central	Moncton, Thanet Street	50
	Miramichi, Gretna Green School	51
	Fredericton, Needham Street	51
	Edmundston, Queen Street	51
Southern	Saint John, Forest Hills	51
	Saint John, Castle Street	53
	Saint John, West Side	53
	Saint Andrews, Route 127	53

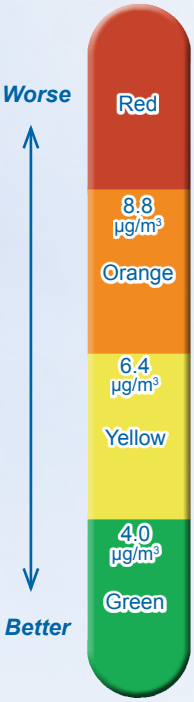


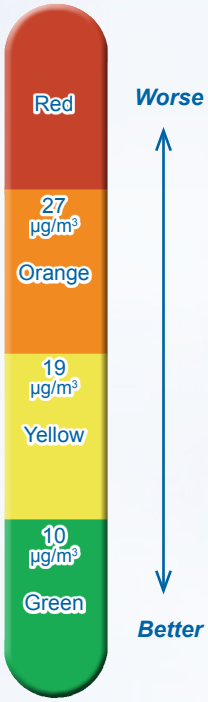
Ozone CAAQS Air Zone Management Level Map

New Brunswick's 2021 air zone management levels for ozone are illustrated above. Per CCME guidance, each air zone is assigned an overall management level based on the poorest level reported for any station within the zone. The northern, central, and southern air zones are therefore all assigned the yellow management level.

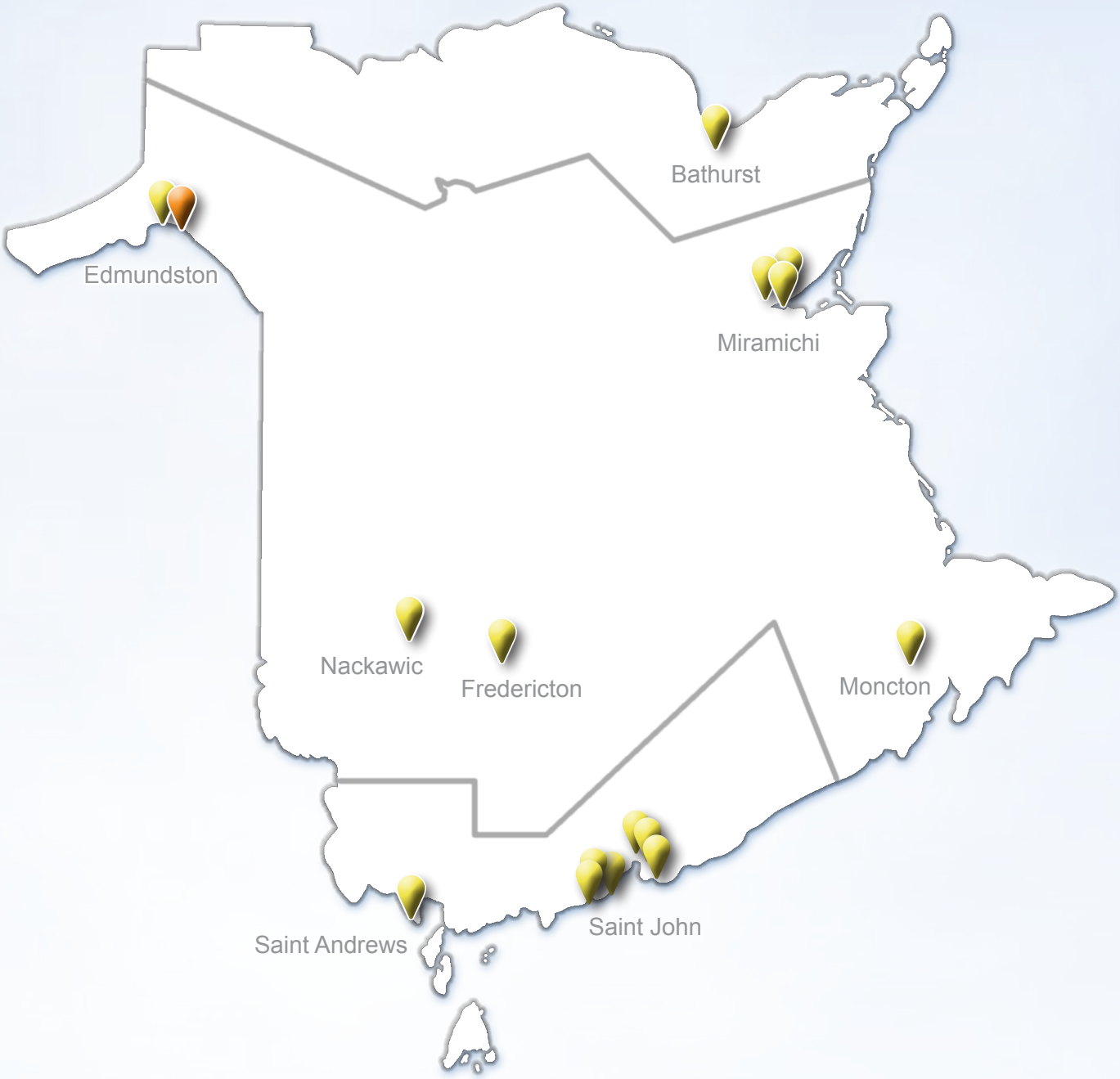
Fine Particulate Matter CAAQS Air Zone Management Levels

	2021 CAAQS Value and Management Level Colour			
	Annual	Monitoring Station Location	1-Hour Daily	
Northern	5.3	Bathurst, Roughwaters Drive	13	
	NA	Belledune, East	NA	
	NA	Belledune, Municipal Hall	NA	
Central	4.3	Miramichi, Gretna Green School	10	
	4.4	Miramichi, Hay Lane	10	
	5.3	Nackawic, Caverhill Site	10	
	3.5	Miramichi, Fire Ponds	11	
	5.1	Moncton, Thanet Street	11	
	5.3	Edmundston, Rice Street	13	
	5.5	Fredericton, Needham Street	15	
	7.2	Edmundston, Queen Street	17	
Southern	4.1	Saint Andrews, Route 127	10	
	5.0	Saint John, Lorneville	12	
	5.0	Saint John, Champlain Heights	12	
	5.3	Saint John, West Side	12	
	5.3	Saint John, Castle Street	13	
	5.6	Saint John, Forest Hills	13	
	5.9	Saint John, Manawagonish	13	





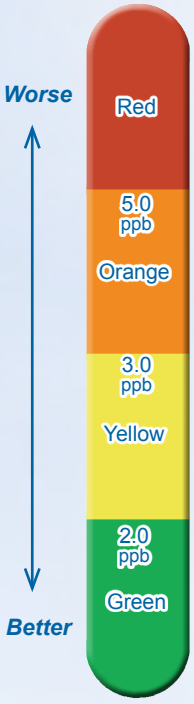
Fine Particulate Matter CAAQS Air Zone Management Level Map

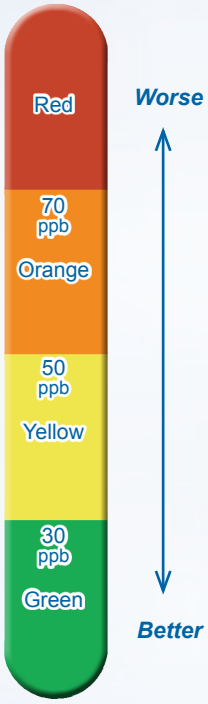


New Brunswick's 2021 air zone management levels for fine particulate matter are illustrated above. Per CCME guidance, each air zone is assigned an overall management level based on the poorest level reported for any station within the zone. The northern and southern air zones are therefore assigned the yellow management level and the central air zone is assigned the orange management level.

Sulphur Dioxide CAAQS Air Zone Management Levels

2021 CAAQS Value and Management Level Colour				
	Annual	Monitoring Station Location	1-Hour Daily	
Northern	0.2	Belledune, Madran	17	
	0.1	Belledune, Jacquet River	37	
	0.2	Belledune, Pointe-Verte	43	
	0.3	Belledune, East	57	
	0.0	Belledune, Municipal Hall	72	
	2.7	Atholville, Boom Road	91	
	6.7	Atholville, Beauvista	93	
Central	0.0	Miramichi, Lower Newcastle		NA
	0.5	Miramichi, Rockcliff	9	
	0.5	Nackawic, Caverhill Site	16	
	0.6	Edmundston, St. Mary's	48	
	3.2	Edmundston, Queen Street	99	
	4.5	Edmundston, Rice Street	146	
Southern	0.3	Saint John, Manawagonish	1	
	0.6	Saint John, Musquash	7	
	0.6	Saint John, Lorneville	8	
	0.4	Saint John, Castle Street	20	
	0.6	Saint John, Silver Falls	20	
	0.6	Saint John, Midwood	25	
	0.7	Saint John, West Side	46	
	1.4	Saint John, Expansion Avenue	55	
	0.9	Saint John, Champlain Heights	58	
	0.9	Utopia	59	
	1.4	Saint John, Grandview West	68	
	3.2	Saint John, Forest Hills	68	



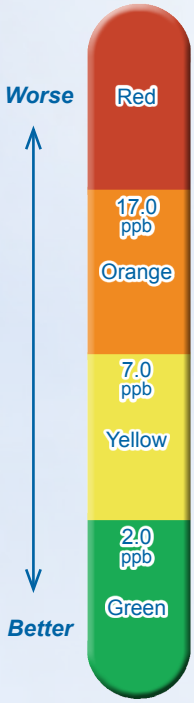


Sulphur Dioxide CAAQS Air Zone Management Level Map

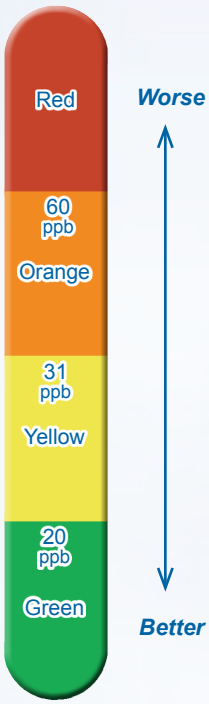
New Brunswick's 2021 air zone management levels for sulphur dioxide are illustrated above. Per CCME guidance, each air zone is assigned an overall managment level based on the poorest level reported for any station within the zone. The northern and central air zones are therefore assigned the red management level and the southern air zone is assigned the orange management level.

Note: While some stations in the Belledune area are assigned the red or orange Management Levels for 2021, this is due to the 3-year metric calculation which still includes data from before the closure of a major emitter in that area.

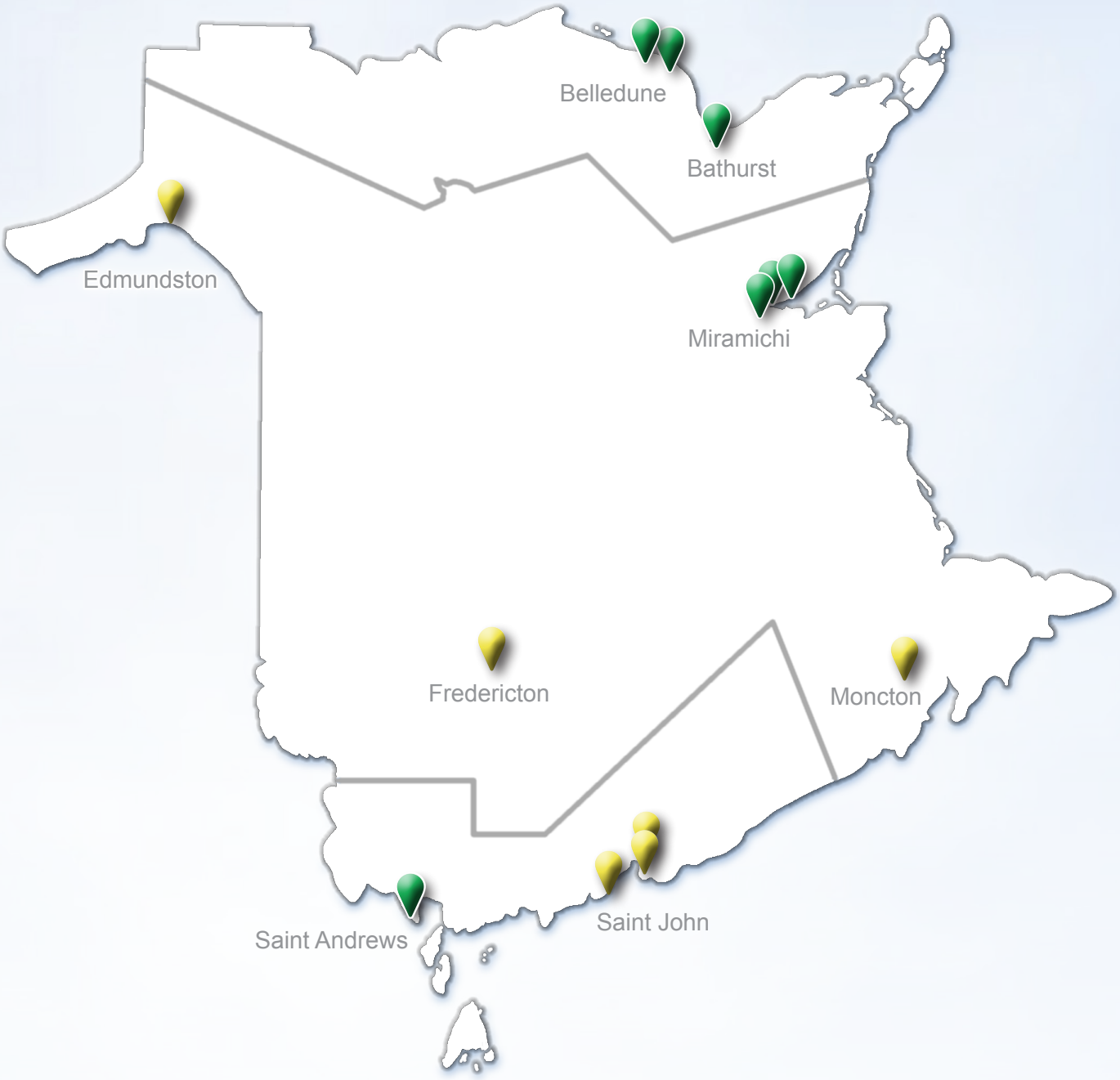
Nitrogen Dioxide CAAQS Air Zone Management Levels



2021 CAAQS Value and Management Level Colour				
	Annual	Monitoring Station Location	1-Hour Daily	
Northern	0.4	Belledune, Municipal Hall	11	
	0.8	Belledune, East	16	
	2.0	Bathurst, Roughwaters Drive	16	
Central	0.2	Miramichi, Lower Newcastle		NA
	0.6	Miramichi, Rockcliff	9	
	0.8	Miramichi, Gretna Green School	9	
	2.2	Fredericton, Needham Street	27	
	4.3	Edmundston, Queen Street	29	
	3.5	Moncton, Thanet Street	31	
Southern	0.6	Saint Andrews, Route 127	4	
	3.1	Saint John, Forest Hills	24	
	NA	Saint John, West Side	25	
	NA	Saint John, Castle Street	29	
	NA	Saint John, Grandview West		NA



Nitrogen Dioxide CAAQS Air Zone Management Level Map



New Brunswick's 2021 air zone management levels for nitrogen dioxide are illustrated above. Per CCME guidance, each air zone is assigned an overall managment level based on the poorest level reported for any station within the zone. The northern air zone is therefore assigned the green management level, and the central and southern air zones the yellow management level.

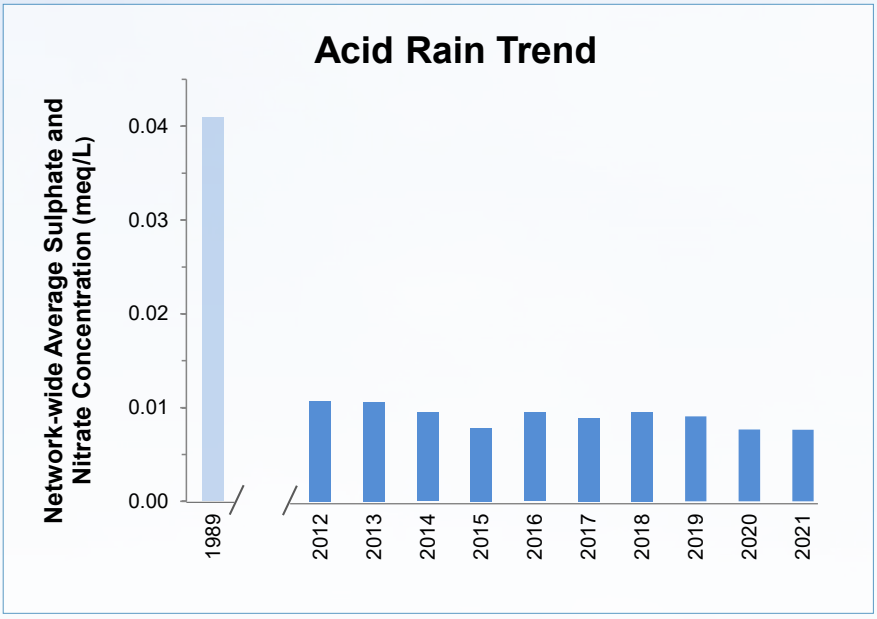
Acid Rain Monitoring

Some air pollutants can be transformed in the atmosphere into acidic particles that ultimately fall out as acid rain (or snow, hail, etc). The emissions that cause acid rain typically travel long distances, hundreds or even thousands of kilometers, before returning to the surface as rain or snow.

The adverse impacts of acid rain have been recognized since the early 1980s. Acid rain harms sensitive ecosystems by changing the chemistry of lakes, streams, and forest soils. It can also damage trees and agriculturally important plants. Infrastructure is also impacted by acid rain, as it can degrade paints and protective coatings, which accelerates corrosion.

Measures to reduce the emissions that contribute to acid rain have been undertaken in North America since the late 1980s. Most recently, this has included commitments to reduce emissions under the Canadian Council of Ministers of Environment's "Post-2000 Canada-wide Acid Rain Strategy". Over the past two decades emissions from major sources within New Brunswick have been reduced significantly.

DELG has operated an acid precipitation (rain and snow) monitoring network since the early 1980s. The map on page 5 shows the location of the 5 acid precipitation monitoring sites in New Brunswick. Samples are collected at each of these sites by a local site operator every day and sent to the provincial laboratory for analysis. DELG staff coordinate the monitoring program, perform data quality assurance, and maintain the official data archive.



The key indicators for acid rain are sulphate and nitrate concentration. Each of these parameters has a slightly different effect on acidity, but can be combined and expressed as "milliequivalents per litre" (meq/L). As reflected in the chart to the left, peak levels occurred in 1989. Emission reduction strategies have reduced sulphate and nitrate concentrations by approximately 81% since then.

Although levels have declined, acid rain monitoring remains important to ensure that our most sensitive lakes and rivers are provided with long-term protection from acid damage.

Volatile Organic Compounds in the Saint John Region

The City of Saint John is home to a variety of industries, including a large oil refinery with its supporting facilities such as the Marine Terminal located at Canaport as well as a marine loading and rail offloading terminal in east Saint John. The types of industrial activities at these facilities (fuel burning, petrochemical storage, refining, etc.) can result in the emission of a variety of Volatile Organic Compounds (VOCs). Consequently, VOCs are typically monitored by DELG in the Saint John region, and have been on an ongoing basis since 1992.

Within the city, VOC data is collected in Forest Hills and Champlain Heights. Background data is also being collected west of the city at Saint Andrews. All samples are analyzed for more than 100 VOC compounds.

For many of the VOC compounds monitored, the primary interest is their impact on the formation of ground level ozone. However, some carry other environmental and human health risks.

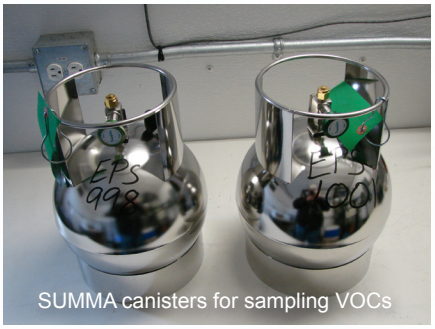
VOC sample collection was interrupted in 2020 due to logistical issues with the Covid-19 pandemic. Sampling resumed in late 2021, but insufficient samples were collected for meaningful analysis. Reporting of VOC results is expected to resume for the 2022 monitoring year.

Key Pollutant: Benzene

One particular VOC, benzene, receives special attention as it is recognized as cancer-causing by the World Health Organization and the United States Environmental Protection Agency. As such, it has been the target of emissions reduction efforts all over the world.

Major sources of benzene include evaporation from petroleum fuels and solvents, and combustion of petroleum products (especially gasoline), as well as other types of combustion. There are also natural sources (e.g. volcanoes and forest fires).

New Brunswick has not developed a provincial standard for benzene, but instead measures its progress against Ontario's provincial criterion for benzene, which is the most stringent currently available in the World.


SUMMA canisters for sampling VOCs

VOC Sampling Technology

Unlike most other parameters in the provincial network, VOCs are not monitored continuously. Rather, air samples are collected in stainless steel canisters, which are shipped to an Environment and Climate Change Canada laboratory for analysis. Results are returned at a later date. For this reason, VOC data is not available in real-time.

Local Air Quality Information
When You Need It

Although daily fluctuations in ambient pollution levels may pass unnoticed by many, for people with reduced lung function from respiratory disease and similar sensitivities, such changes can have significant impacts on their daily lives. Recognizing this, the following tools have been developed to provide timely information to the public about current and forecasted pollution levels in different areas of the province.

Air Quality Data Portal

New Brunswick operates an online Air Quality Data Portal to provide near real-time access to monitoring results at each of the provincially and industry operated monitoring stations (see maps on pages 5 and 6). This service is available at:

www.elgegl.gnb.ca/AirNB

Public Advisories

Air quality data and pollution forecasts are continually monitored by DELG, the Department of Health, and Environment and Climate Change Canada. Whenever air quality objectives are exceeded or are forecasted to be exceeded, advisories are issued to the media (via the Department of Health) to provide timely notice to the public. These notices include health-related messaging to advise at-risk groups about the level of risk and appropriate precautions that they should take. **Three air quality advisories** (in the form of "special air quality statements") were issued in 2021 for New Brunswick. The statements all warned of possible air quality impacts from wildfire smoke. On July 20th smoke was originating from central Canada with potential to affect most of the province. On August 5th and 7th smoke was originating from Ontario and Manitoba, potentially affecting northern NB.

Air Quality Health Index

The Air Quality Health Index (AQHI) is a numbered scale that was designed by Health Canada to help communicate air quality information. It converts air quality data for key air pollutants into a single, easy to understand, number.

Health Canada also provides health-related messaging to accompany the AQHI values to aid the public in understanding what the numbers mean in terms of health risks, and how best to respond to those risks to avoid health problems.

AQHI values and forecasts are reported through a variety of media outlets via television and the Internet. Current AQHI values and related information are available via the following national website:

www.weather.gc.ca

2021 AQHI Coverage

* Index values for this location are modelled

Conclusion

As reflected in this report, overall air quality in New Brunswick is good relative to provincial standards, but poor in some areas as measured against the SO_2 CAAQS specifically. The New Brunswick Department of Environment and Local Government acknowledges these poor air quality areas as now shown via the AQMS and is committed to working towards improvements.

There are areas of the province that are not represented by the provincial monitoring network. Should poor air quality conditions occur at these locations (e.g. due to localized effects of small emissions sources, such as wood stoves) this would not be detected or reflected in this reporting.

The province continues to benefit from key historic air quality policy initiatives. These include:

- The National Air Pollution Surveillance Program (1969) and its associated federal-provincial Memorandum of Understanding (2004), which establishes a cooperative, partnered, approach for ambient air quality monitoring across Canada.
- The Canada - US Air Quality Agreement (1991), which required both countries to reduce sulphur dioxide, and nitrogen dioxide emissions, and also to work together to address the transboundary air pollutants that cause ground-level ozone formation.
- The Canada-Wide Acid Rain Strategy for Post 2000 (1998), which provided an important policy road map for emissions reductions, data sharing, and public reporting of data across Canada.
- The Canadian Council of Ministers of Environment's Air Quality Management System (2012), which provides common goals for ambient air quality, a comprehensive public reporting framework, and regulated emissions limits for targeted industries across Canada.

The New Brunswick Department of Environment and Local Government remains committed to air quality surveillance throughout the province, and comprehensively reporting air quality information to New Brunswickers.

Further Explore the Data

In addition to this overview, complete site-specific monitoring results are available in the "Air Quality Monitoring Results - Supplementary Data 2021" companion document, which is available electronically via the DELG website, which can be accessed at:

www.gnb.ca/environment

Feedback...

We are interested in your feedback on this report. All suggestions will be considered, and if possible, incorporated in future reports. Please forward any comments to:

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