Nova Scotia Air Zone Report

2019

NOVA SCOTIA

Contents

Nova Scotia Air Zone Report 2019
Department of Environment and Climate Change
May 2021
ISBN: 978-1-77448-204-9

Acronyms

AQHI	Air Quality Health Index
AQMS	Air Quality Management System
AQU	Nova Scotia Environment and Climate Change's Air Quality Unit
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CEC	Commission for Environmental Cooperation
CMA	Canadian Medical Association
ECCC	Environment and Climate Change Canada
GLO	Ground Level Ozone
IA	Industrial Approval
IISD	International Institute for Sustainable Development
NAPS	National Air Pollution Surveillance Program
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides ($NO + NO_2 = NO_x$)
ECC	Nova Scotia Department of Environment and Climate Change
$PM_{2.5}$	Fine particulate matter
ppb	Parts per billion
QA/QC	Quality Assurance/Quality Control
SO_2	Sulphur Dioxide
μ/m^3	Micrograms per cubic metre
VOC	Volatile Organic Compounds
WHO	World Health Organization

Introduction

Nova Scotia Department of Environment and Climate Change (ECC) protects, enhances, and promotes the sustainable use of Nova Scotia's ambient air resources by regulating designated activities that emit air pollutants, monitoring ambient air quality and reporting. This work is supported through cooperative agreement between ECC and Environment and Climate Change Canada (ECCC) to collect essential ambient data.[1] The terms of the National Air Pollution Surveillance (NAPS) Program agreement are that ECCC provides equipment and technical support for monitoring ambient air and maintains the Canada-wide Air Quality Database, while ECC's Air Quality Unit (AQU) sets up, operates and maintains the stations and equipment that monitor ambient air quality and provides quality assured and quality controlled (QA/QC) monitoring data to ECCC. ECC currently operates and maintains seven monitoring station across the province[2]

These data are used in several ways. First, average concentrations for continuously monitored pollutants are calculated each hour and the raw data are directly uploaded to ECC's air quality website.[3] ECCC also uses the hourly measurements of nitrogen dioxide (NO_2), ground-level ozone (GLO) and fine particulate matter ($PM_{2.5}$) to calculate the Air Quality Health Index (AQHI). The AQHI is reported as a number from 1 to 10+, and as a health risk category that ranges from "low" to "very-high". Each risk category has an associated health message to assist individuals in making daily decisions about adjusting their activities to limit exposure to air pollution.[4]

Following checks for QA/QC, data are uploaded to the national air quality database.[5] Data as far back as 1974 are maintained in the database and are used for compiling trend analyses and determining achievement of national air quality standards. A useful summary can be found on the Canadian Council of Ministers of the Environment's (CCME's) State of the Air website at https://www.ccme.ca/en/air-quality-report.

[1] https://www.canada.ca/en/environment-climate-change/services/air-pollution/monitoring-networks-data/national-air-pollution-program.html
[2] https://novascotia.ca/nse/air/docs/AirMonitoringNetworkMap.pdf
[3] https://novascotia.ca/nse/airdata/
[4] https://www.canada.ca/en/environment-climate-change/services/air-quality-health-index/understanding-messages.html
[5] http://data.ec.gc.ca/data/air/monitor/national-air-pollution-surveillance-naps-program/

The CCME is an important forum for collaboration on air quality. For example, the Air Quality Management System (AQMS) was put in place across Canada by the CCME [6] as a comprehensive approach with four 'mechanisms' that work together to achieve Canadian Ambient Air Quality Standards (CAAQS) that are designed to protect and improve ambient air quality. The four mechanisms are Base Level Industrial Emissions Requirements (BLIERS), mobile source emissions, airsheds, and air zones (Figure 1). Provinces and territories use air zones as geographic regions for monitoring, managing, and reporting on ambient concentrations of common air pollutants. This report is part of a commitment by provinces and territories to "report regularly to their publics on air quality, on the achievement of the ambient air quality standards, and on the actions undertaken in air zones within their boundaries." [7] An electronic copy of this report and previous reports can be accessed at https://novascotia.ca/nse/air/air-zone-reports.asp.

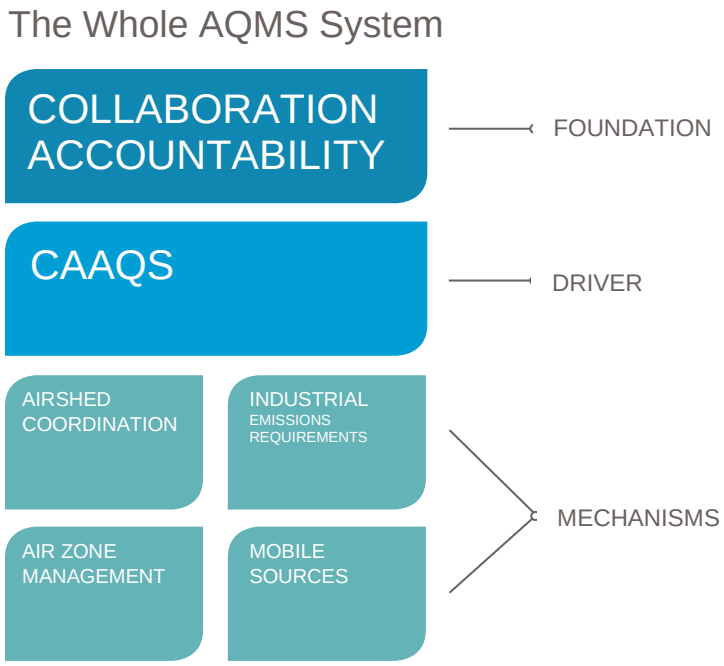


Figure 1. The Air Quality Management Framework

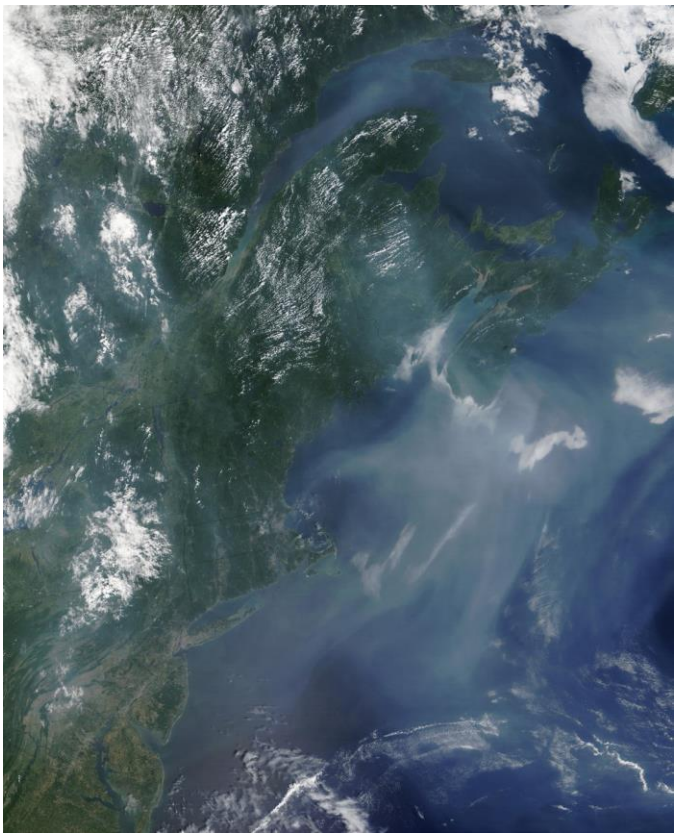
[6] https://www.ccme.ca/en/air-quality-report#slide-2

[7] https://ccme.ca/en/res/aqms_roles_and_resp_e.pdf

Airsheds and Air Zones

Airsheds

Airsheds are large areas that can include many jurisdictions. Emissions from vehicles, residential wood burning, industry, and other activities can remain in the atmosphere for extended periods of time and be carried across borders where they add to local, regional, and global air pollution far from where the emissions occurred. How far the pollution is carried depends on seasonal weather patterns and how long the pollutant is stable in the atmosphere. Air quality management in an airshed requires many jurisdictions to work together to minimise emissions that cause transboundary air pollution.



There are large cities, dense networks of roadways, and numerous industries upwind of Nova Scotia, in the Ohio River Valley, Eastern seaboard of the U.S., and the Québec/Ontario corridor. Emissions from these areas contribute to the formation of GLO, $PM_{2.5}$ and other pollutants that affect Nova Scotia's air quality (Figure 2). Canada and the United States have agreed[8] to reduce emissions in the airshed, and this has led significant improvements, but transboundary pollution still occurs.

Figure 2. The grey coloured haze in this satellite image[9] is particulate air pollution over the Maritimes that originated in the Eastern United States.

[8] https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/transboundary/canada-united-states-air-quality-agreement-overview.html.
[9] https://visibleearth.nasa.gov/view.php?id=61010

Air Zones

Air zones are geographically smaller than airsheds and are used to manage air quality inside provincial and territorial areas that have common terrain, meteorology, and other factors that interact with air pollutant emissions to influence ambient air quality in the air zone. Nova Scotia is divided into four air zones (Figure 3). The AQU collects data from ambient air monitoring stations in each air zone that are used to measure and calculate air quality compared to the CAAQS and help determine what management actions may be best suited to each air zone.

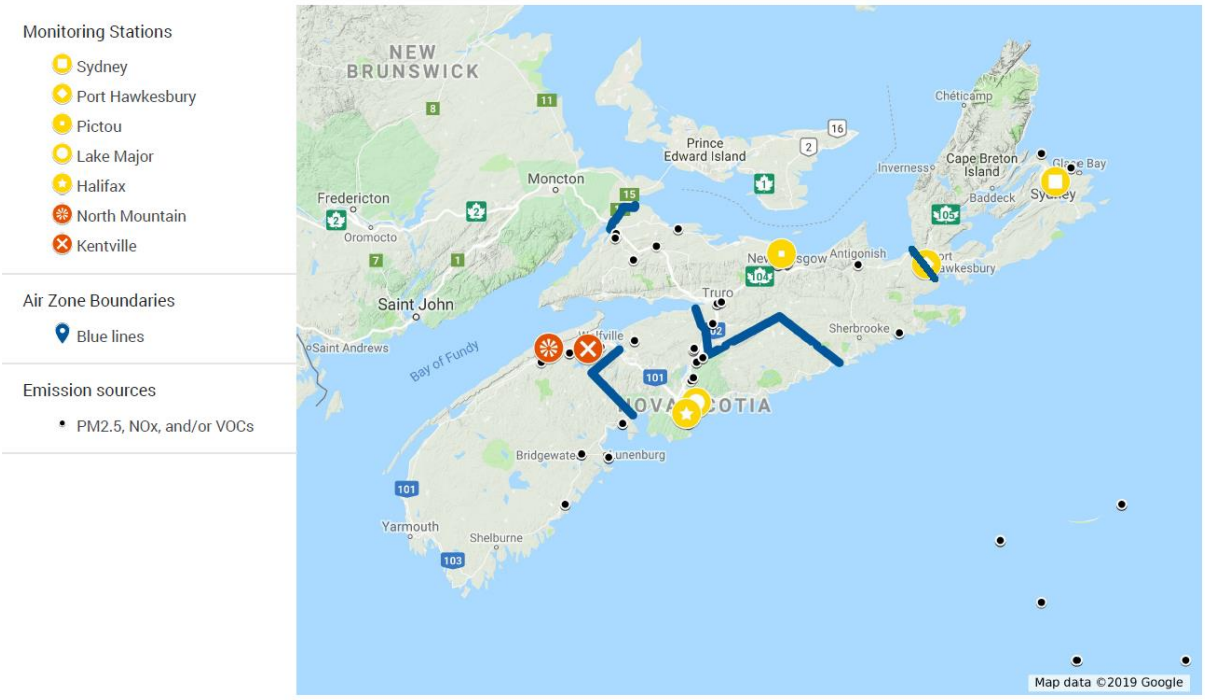


Figure 3. Nova Scotia's four air zones and the locations of ambient air monitoring stations indicated by large circles. The station colour corresponds to the management level achieved in 2019.

Canadian Ambient Air Quality Standards (CAAQS)

Canadian Ambient Air Quality Standards are designed to protect human health and the environment and are the drivers for air quality improvement in air zones across Canada. The CAAQS for GLO and $PM_{2.5}$ have been in place since 2015 and will become more stringent in 2020. In addition, CAAQS for sulphur dioxide (SO_2) and NO_2 will be implemented beginning in 2020.

Pollutant	Averaging time	Standards (numerical values)			Metric
		2015	2020	2025	
$PM_{2.5}$	24-hour (calendar day)	28 µg/m^3	27 µg/m^3	Under review	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.
	Annual (calendar year)	10.0 µg/m^3	8.8 µg/m^3	Under review	The 3-year average of the annual average concentrations.
Ground-level Ozone	8-hour	63 ppb	62 ppb	60 ppb	The 3-year average of the annual 4th-highest daily maximum 8-hour average concentrations.
Sulphur Dioxide	1-hour	N/A	70 ppb	65 ppb	The 3-year average of the annual 99th percentile of the SO_2 daily-maximum 1-hour average concentrations.
	1-year (annual)	N/A	5.0 ppb	4.0 ppb	The arithmetic average over a single calendar year of all SO_2 1-hour average concentrations in the year.
Nitrogen Dioxide	1-hour	N/A	60 ppb	42 ppb	The 3-year average of the annual 98th percentile of the NO_2 daily-maximum 1-hour average concentrations.
	1-year (annual)	N/A	17.0 ppb	12.0 ppb	The arithmetic average over a single calendar year of all NO_2 1-hour average concentrations in the year.

Table 1. The Canadian Ambient Air Quality Standards (CAAQS).

Air Zone Management Framework

The CAAQS were achieved in all of Nova Scotia's air zones in 2019. However, the intention of the air zone management framework is to work towards continuous improvement even when the CAAQS are achieved. This is important as we know that the health of some portion of the population continues to be affected, even when ambient concentrations of GLO and $PM_{2.5}$ are low. [10, 11] For example, based on latest data (2016 update) from the World Health Organization (WHO), Canada was ranked as having the 6th best air quality in the world.[12] However, based on 2016 population data and air pollutant concentrations from 2014 to 2017, Health Canada estimates the number of annual mortalities in Canada that can be attributed to air pollution from human sources in North America to be 15,300 and the economic cost associated with these health impacts to be $120 billion per year (2016 currency). [13]

The air zone management framework has four management levels, represented by four colours, and provides guidance on management actions for each level (Table 2). Numerical values of GLO and $PM_{2.5}$ in the form of the CAAQS are calculated from the data measured at each monitoring station. The values are compared to management level threshold values, and the highest CAAQS value in an air zone sets the air zone's management level. Management levels have continuous improvement as a priority and require more stringent management actions as the numerical form of the air pollutant measurements approach the CAAQS limits.

[10] For example, see: Bell, M. L., Peng, R. D., and Dominici, F. (2006). The Exposure-Response Curve for Ozone and Risk of Mortality and the Adequacy of Current Ozone Regulations. *Environmental Health Perspectives*. http://dx.doi.org/10.1289/ehp.8816.

[11] Government of Canada (2012). *Canadian smog assessment – Highlights and key messages*. Environment Canada. Retrieved from http://publications.gc.ca/site/eng/9.694820/publication.html, Page 4.

[12] World Heath Organization (2016). Urban outdoor air pollution database. https://www.who.int/data/gho/data/indicators/indicator-details/GHO/concentrations-of-fine-particulate-matter-(pm2-5)

[13] Health Canada, 2021. Health impacts of air pollution in Canada: Estimates of premature deaths and nonfatal outcomes. ISBN 978-0-660-37331-7. Retrieved from https://www.canada.ca/en/health-canada/services/publications/healthy-living/2021-health-effects-indoor-air-pollution.html, Page 4

Management Level	Management Actions	Air Management Threshold Values (2015-2019)		
		Ozone 8-hour (ppb)	**$PM_{2.5}$ 24-hour ($\mu g/m^3$)**	**$PM_{2.5}$ Annual ($\mu g/m^3$)**
Red††	Actions for **Achieving** Air Zone CAAQS	63	28	10
Orange	Actions for **Preventing** CAAQS **Exceedance**	56	19	6.4
Yellow*	Actions for **Preventing** air quality **Deterioration**	50	10	4
Green	Actions for **Keeping Clean Areas Clean**	0	0	0

Table 2. The Air Quality Management Framework and associated threshold values.

†† The threshold values for the "red" management level are equal to the numerical values of the Canadian Ambient Air Quality Standards (CAAQS).

* The CAAQS thresholds between the green and yellow management levels are based on estimated baseline concentrations in ambient air.[14]

[14] CCME (2012). *Guidance document on air zone management*, pages 10-12. https://ccme.ca/en/res/guidancedocumentonairzonemanagement_secured.pdf.

Air Zone Results, 2019

In 2019, the CAAQS were achieved in all four of Nova Scotia's air zones. The management level in the central, eastern, and northern air zones is 'yellow' and the management level for the western air zone is 'orange' (Table 3).

Air Zone	Management Level	Management Actions	2019 CAAQS Results		
			Ozone 8-hour (ppb)	$PM_{2.5}$ 24-hour ($\mu g/m^3$)	$PM_{2.5}$ Annual ($\mu g/m^3$)
Central	**Yellow**	Actions for Preventing AQ Deterioration	**52**	**12**	**5.6**
Eastern	**Yellow**	Actions for Preventing AQ Deterioration	**48**	**11**	**5.4**
Northern	**Yellow**	Actions for Preventing AQ Deterioration	**50**	**10**	**5.2**
Western	**Orange**	Actions for Preventing CAAQS Exceedance	**60**	**12**	**6.3**

Table 3. CAAQS achievement and management level results for air zone monitoring in Nova Scotia for the 2019 reporting year.

	Air Zone Management Levels			
	Central	Eastern	Northern	Western
2014	Yellow	Yellow	Orange	Orange
2015	Yellow	Yellow	Orange	Orange
2016	Yellow	Yellow	Orange	Orange
2017	Yellow	Yellow	Yellow	Orange
2018	Yellow	Yellow	Yellow	Orange
2019	Yellow	Yellow	Yellow	Orange

Table 4. Year-to-year comparison of the air zones' management levels.

Central Air Zone

Central air zone monitoring stations and emission sources

There are two ambient air monitoring stations in the central air zone. One is in Downtown Halifax and the other at Lake Major, which is downwind[15] from Downtown Halifax, in an area with less population, traffic, and commercial density (Figure 4).

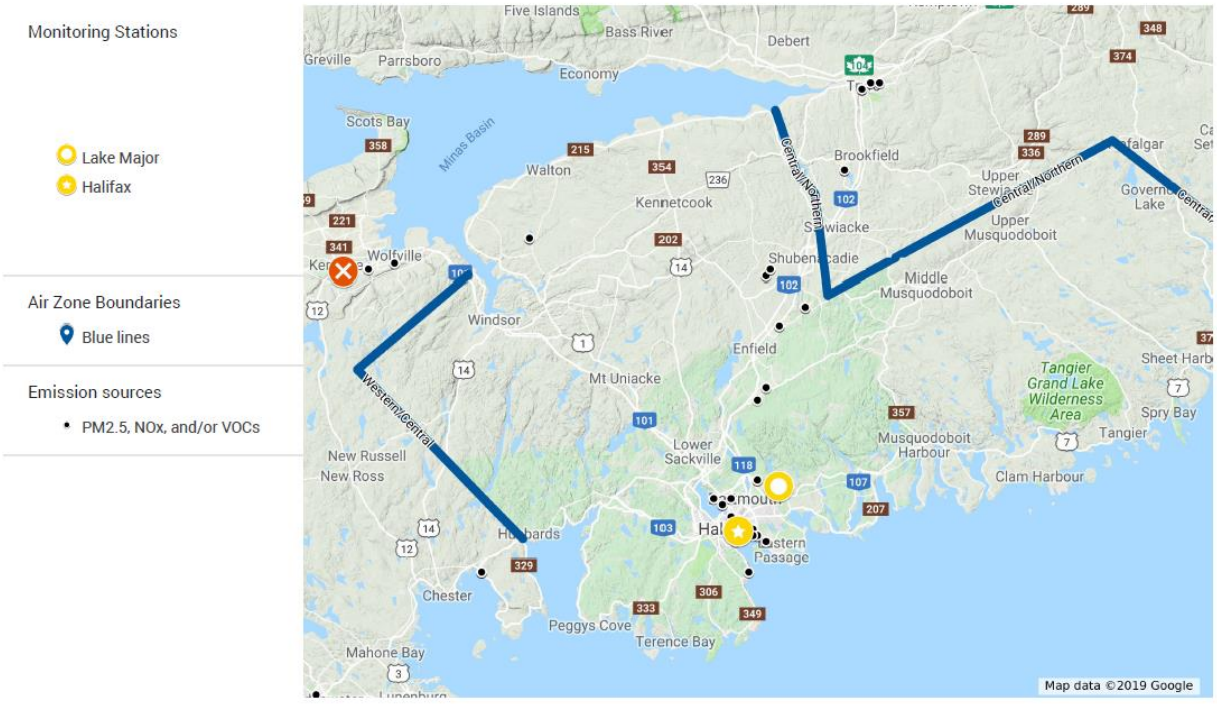


Figure 4. The location of ambient air monitoring stations in the central air zone.

[15] Based on the most frequent annual wind direction.

Central air zone CAAQS achievement and management levels

The $PM_{2.5}$ measurements in the central air zone in 2019, as in previous years, fall in the yellow management level. GLO in downtown Halifax is 'green,' and 'yellow' in Lake Major (Table 5).

	CAAQS					
	Ozone 8-hour (ppb)		$PM_{2.5}$ 24-hour (µg/m^3)		$PM_{2.5}$ Annual (µg/m^3)	
Reporting Year	Lake Major	Downtown Halifax	Lake Major	Downtown Halifax	Lake Major	Downtown Halifax
2014	52	41	14	*	6.0	*
2015	51	42	15	11	6.3	4.6
2016	51	41	*	11	*	4.6
2017	52	43	*	12	*	5.2
2018	51	46	9¥	12	4.8¥	5.6
2019	52	47	9	12	4.8	5.6

Table 5. Year-to-year comparison of the central air zone's air quality in the form of the CAAQS and management levels at each monitoring station.

* Station data did not pass quality assurance tests and are not used to calculate the CAAQS. More information on QA/QC testing for CAAQS can be found at https://ccme.ca/en/res/pn1483_gdad_eng-secured.pdf.

¥Value is calculated from two-years of data, not three.

Eastern Air Zone

Eastern air zone monitoring stations and emission sources

There are two monitoring stations in the Eastern air zone, located in the areas with the highest concentrations of population and industry (Figure 3). There are three coal-fired power plants, a biomass-fired power plant, a thermal mechanical pulping paper mill, and several commercial facilities and other smaller activities that report CAAQS-relevant air emissions to the National Pollutant Release Inventory (NPRI).

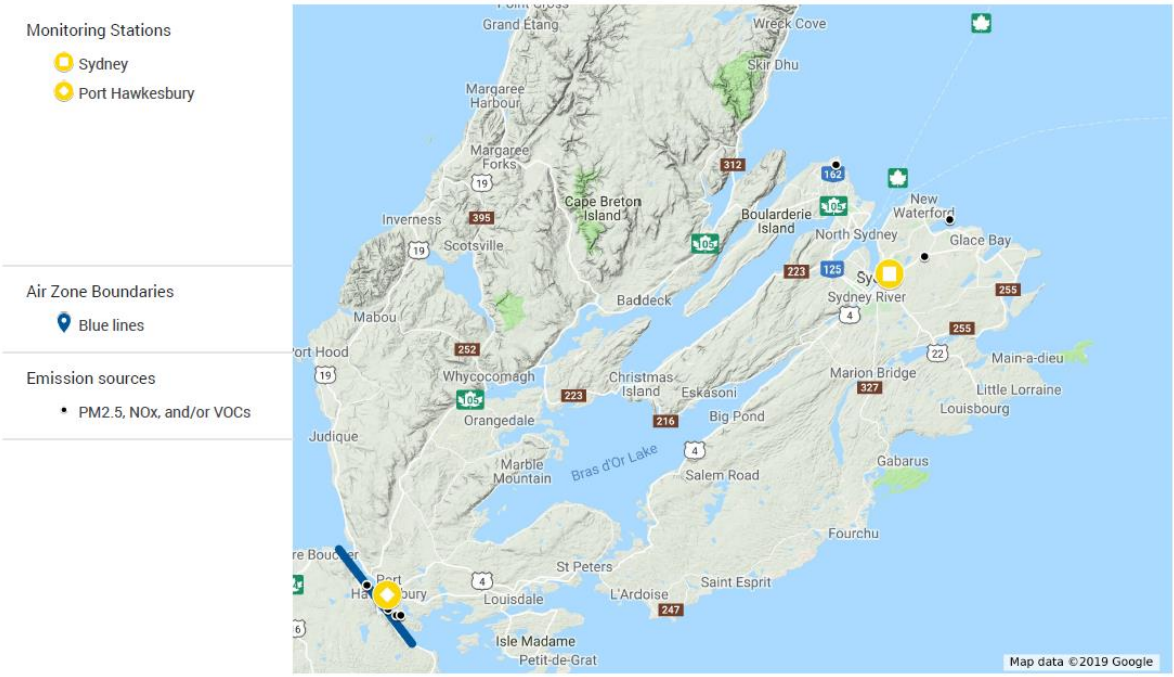


Figure 7. The location of ambient air monitoring stations in the eastern air zone.

Eastern air zone CAAQS achievement and management levels

Measurements of GLO at both monitoring stations in the eastern air zone in 2019, as in previous years, are within the green management level. Measurements of $PM_{2.5}$ are within the yellow management level (Table 6).

	CAAQS					
	Ozone 8-hour (ppb)		$PM_{2.5}$ 24-hour (µg/m³)		$PM_{2.5}$ Annual (µg/m³)	
Reporting Year	Port Hawkesbury	Sydney	Port Hawkesbury	Sydney	Port Hawkesbury	Sydney
2014	47	50	15	14	6.1	5.4
2015	46	49	15	14	6.1	5.9
2016	48	48	13	13	5.7	6.0
2017	48	48	11	12	5.5	5.8
2018	48	48	11	10	5.3	5.4
2019	48	48	11	10	5.4	5.1

Table 6. Year-to-year comparison of the eastern air zone's management levels and CAAQS measurements.

Western Air Zone

Western air zone monitoring stations and emission sources

There are two monitoring stations in the western air zone used for calculating CAAQS. One is located on North Mountain, and the second in the town of Kentville (Figure 4). Key geographic features include the North and South Mountains that border the Annapolis Valley. The Valley contains a high concentration of agricultural activity and some industrial air emissions sources that report to the NPRI, including an airport, food processing facilities, manufacturing plants, and other institutions.

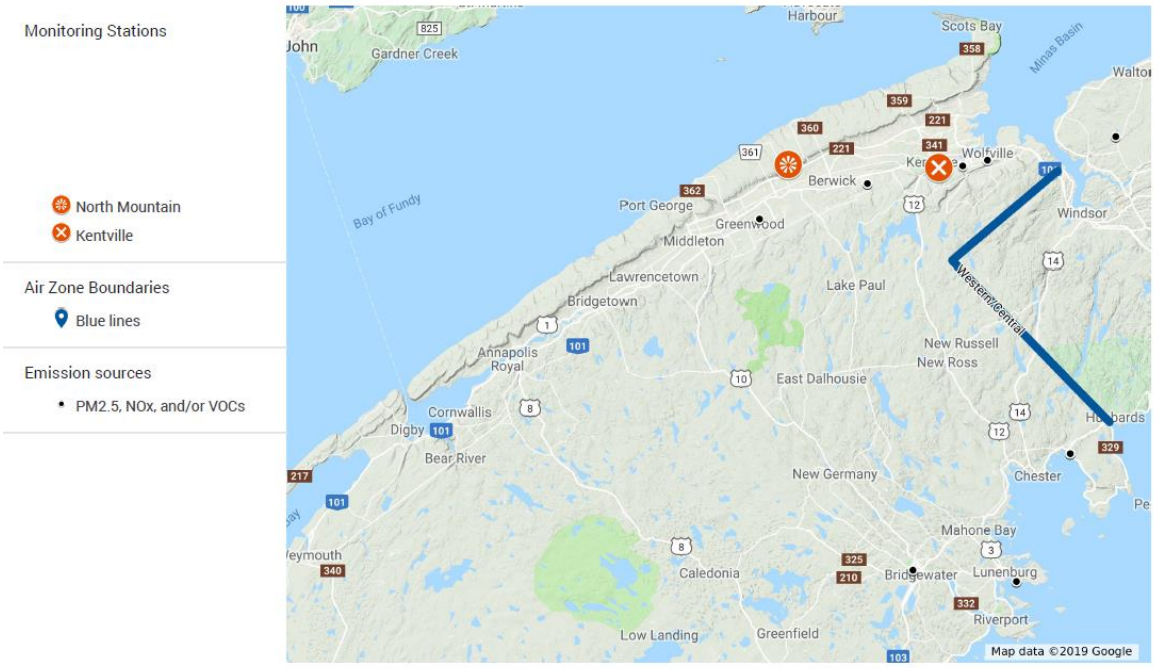


Figure 8. The location of ambient air monitoring stations in the western air zone.

Western air zone CAAQS achievement and management levels

The Annual $PM_{2.5}$ measurements in the Western air zone show a decrease from the previous year, and in 2019 decreased from the orange to the yellow management level (Table 7). The western air zone's ground level ozone measurements continue to be in the orange management level and are the highest in Nova Scotia.

	CAAQS					
	Ozone 8-hour (ppb)		$PM_{2.5}$ 24-hour (µg/m³)		$PM_{2.5}$ Annual (µg/m³)	
Reporting Year	**North Mountain**	**Kentville**	**North Mountain**	**Kentville**	**North Mountain**	**Kentville**
2014	59	n/a	12	n/a	4.8	n/a
2015	59	n/a	14	n/a	5.3	n/a
2016	57	n/a	12	n/a	5.7	n/a
2017‡	61	60	12	11	6.2	5.5
2018	61	59	12¥	12	6.5¥	6.1
2019	60	58	12¥	12	5.9¥	6.3

Table 7. Year-to-year comparison of the western air zone's management levels and CAAQS measurements at each monitoring station.

‡ Results for Kentville are based on two-years of data.

¥ $PM_{2.5}$ Results for North Mountain are based on two-years of data.

There is no obvious increasing trend in emissions from sources inside the Western air zone that might help explain the higher levels of annual $PM_{2.5}$ or GLO. One potential explanation being explored is increased transboundary pollution – air pollution that is created in one jurisdiction and travels across borders to another jurisdiction.

Weather patterns in eastern North America generally move from the west and south to the east and north. Because of its location, the Western air zone receives long-range air pollutants that originate in from the west, and the Eastern United States. Forest fires in western jurisdictions, and fossil fuel-fired power plants (Figure 9) and transportation to the south-west are significant sources of transboundary pollution for the western air zone.

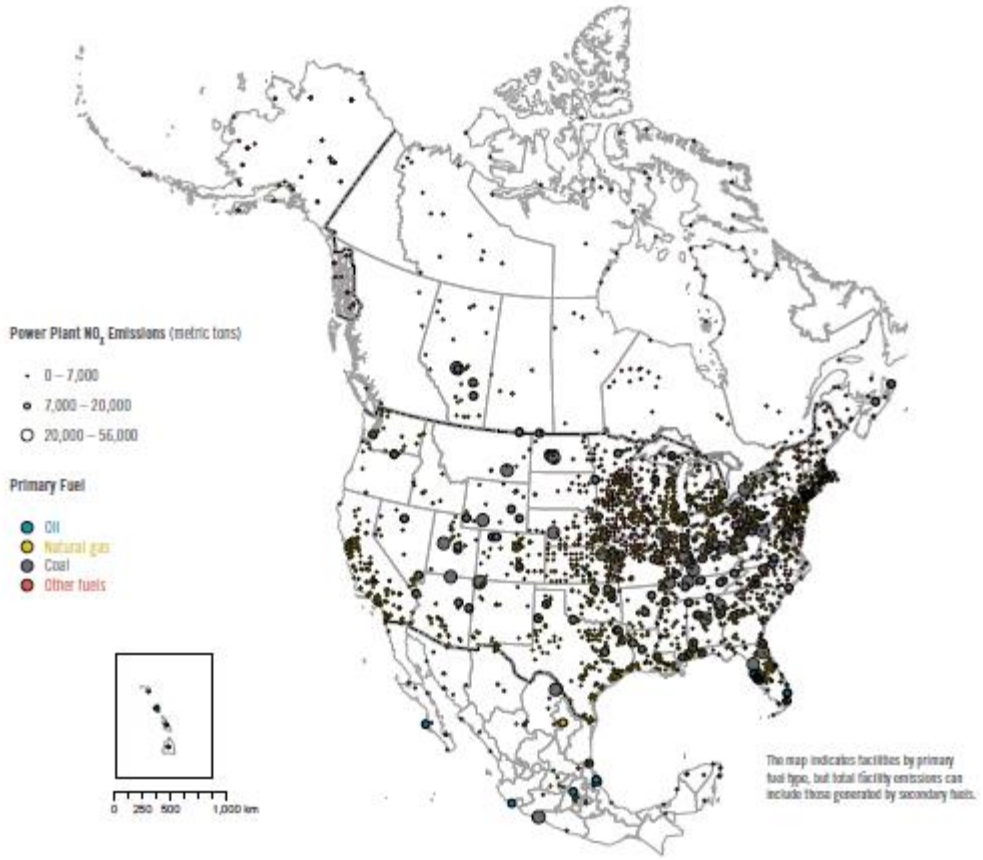


Figure 9. This map identifies the locations of North American power plants and the relative size of their NO_x emissions.[16] Emissions from sources Southwest of Nova Scotia can affect the province's ambient air quality.[17]

Ground level ozone is formed when sunlight reacts with 'precursor' pollutants, such as NOx and volatile organic compounds (VOCs), from sources such as forest fires, power plants, and transportation. The potential for ozone formation in an area depends on if the environment is saturated or limited in NOx. Rural environments, like that of the Western air zone, tend to be limited in NOx so that an increase in NOx generally correlates with increased concentrations of GLO. Urban environments that are saturated with NOx, like downtown Halifax, generally experience an increase in GLO concentrations when NOx is decreased.

[16] Data are taken from the Commission for Environmental Cooperation of North America (CEC) power plant emissions project. http://www3.cec.org/islandora/es/item/10236-north-american-power-plant-air-emissions-en.pdf

[17] For more information, see *Case study of a trans-boundary air pollution event in Nova Scotia* https://novascotia.ca/nse/air/docs/NovaScotiaTransboundaryEvent2004.pdf.

Northern Air Zone

Northern air zone monitoring stations and emission sources

There is one monitoring station in the northern air zone, located in the Town of Pictou. The Cobequid Mountain Range is a prominent geographical feature that runs west to east through the northern air zone, and the Maritime Lowlands ecoregion, to the north of the Cobequid Mountains, is characterised by having "the lowest precipitation levels in the Maritime provinces."[18] A coal-fired power plant, tire manufacturing plant, and pulp and paper plant are in this region, near the Town of Pictou (Figure 12).

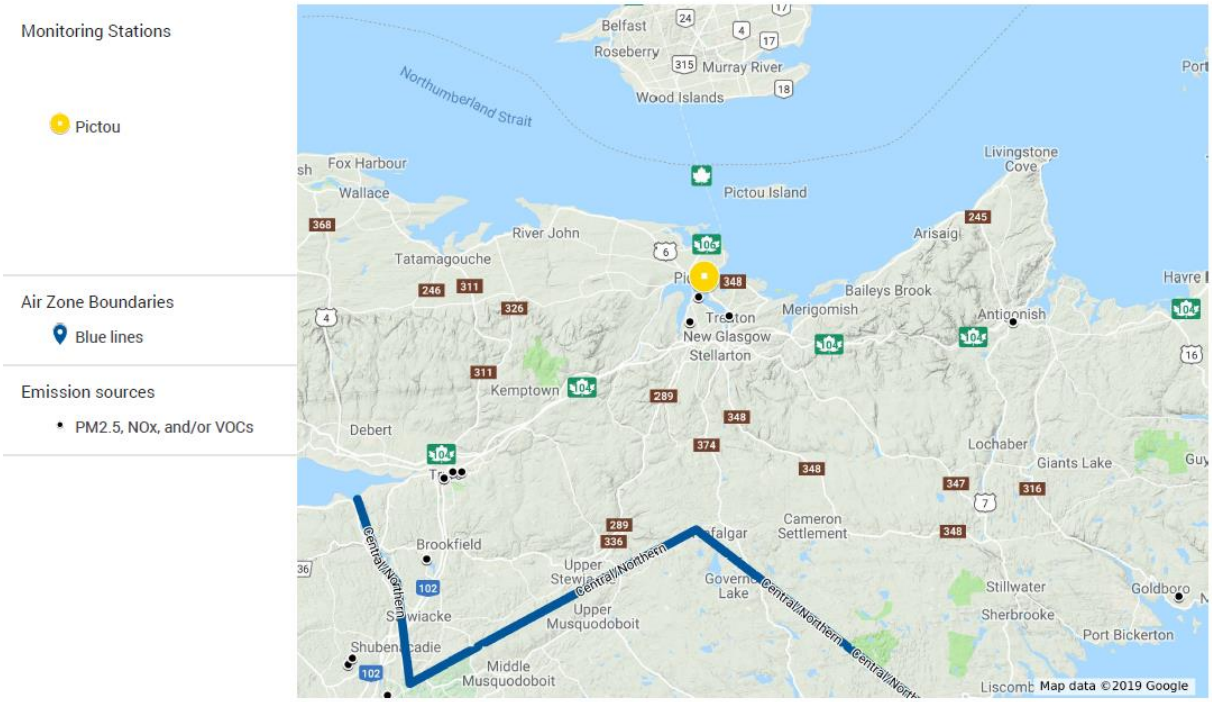


Figure 12. The location of the ambient air monitoring station in the northern air zone.

[18] Webb and Marshall (1999). *Ecoregions and ecodistricts of Nova Scotia*. Agriculture and Agri-Food Canada & Environment Canada. Accessed at http://sis.agr.gc.ca/cansis/publications/surveys/ns/nsee/nsee_report.pdf.

Northern air zone CAAQS achievement and management levels

In recent years, there has been an improvement in the 24-hr $PM_{2.5}$ CAAQS, moving from an orange to a green management level, and the annual $PM_{2.5}$ CAAQS, moving from orange to yellow. As in previous years, the management level for GLO in 2018 was green, (Table 8).

	CAAQS		
Reporting Year	**Ozone 8-hour (ppb)**	**$PM_{2.5}$ 24-hour (µg/m³)**	**$PM_{2.5}$ Annual (µg/m³)**
2014	45	21	7.5
2015	45	23	7.6
2016	45	18	6.6
2017	46	14	5.7
2018	49	10	5.1
2019	50	10	5.2

Table 8. Year-to-year comparison of the northern air zone's management levels and CAAQS measurements at the Pictou monitoring station.

Contact Us

For more information on ambient air quality monitoring, the AQMS, ambient air quality data or related products visit novascotia.ca/nse/air or contact us at **902-424-3600, ext. 3**.