

# Nova Scotia Air Zone Report

2018

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## Acronyms

<b>AQHI</b>	Air Quality Health Index
<b>AQMS</b>	Air Quality Management System
<b>AQU</b>	Nova Scotia Environment's Air Quality Unit
<b>BLIERS</b>	Base Level Industrial Emissions Requirements
<b>CAAQS</b>	Canadian Ambient Air Quality Standards
<b>CCME</b>	Canadian Council of Ministers of the Environment
<b>CMA</b>	Canadian Medical Association
<b>ECCE</b>	Environment and Climate Change Canada
<b>GLO</b>	Ground Level Ozone
<b>IISD</b>	International Institute for Sustainable Development
<b>NAPS</b>	National Air Pollution Surveillance Program
<b>NO</b>	Nitric oxide
<b>NO<sub>2</sub></b>	Nitrogen dioxide
<b>NO<sub>x</sub></b>	Nitrogen oxides (NO + NO <sub>2</sub> = NO <sub>x</sub> )
<b>NPRI</b>	National Pollutant Release Inventory
<b>NSE</b>	Nova Scotia Environment
<b>PM<sub>2.5</sub></b>	Fine particulate matter
<b>ppb</b>	Parts per billion
<b>QA/QC</b>	Quality Assurance/Quality Control
<b>SO<sub>2</sub></b>	Sulphur Dioxide
<b>µ/m<sup>3</sup></b>	Micrograms per cubic metre
<b>VOC</b>	Volatile Organic Compounds
<b>WHO</b>	World Health Organization

# Introduction

Nova Scotia Environment (NSE) 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 the results, and doing public outreach. This work is supported through a cooperative agreement between NSE and Environment and Climate Change Canada (ECCC) to collect essential ambient air quality data.<sup>1</sup> The terms of the National Air Pollution Surveillance (NAPS) Program agreement are that ECCC provides instruments and technical support for monitoring ambient air and maintains the Canada-wide Air Quality Database, while NSE's Air Quality Unit (AQU) sets up and maintains the stations that monitor air pollution and provides QA/QC'd monitoring data to ECCC.

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 NSE's air quality website.<sup>2</sup> Environment and Climate Change Canada uses the hourly measurements of nitrogen dioxide (NO<sub>2</sub>), ground-level ozone (GLO), and fine particulate matter (PM<sub>2.5</sub>) to calculate the Air Quality Health Index (AQHI). The AQHI is reported as a number from 1 to 10+, and as a risk category that ranges from "low" to "very-high". Each risk category has a health message to assist individuals in making daily decisions about adjusting their activities to limit exposure to air pollution.<sup>3</sup>

Following checks for quality assurance and quality control (QA/QC), the data are uploaded to the national air quality database.<sup>4</sup> 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 <http://airquality-qualitedelair.ccme.ca/en/>.

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<sup>1</sup> <https://www.canada.ca/en/environment-climate-change/services/air-pollution/monitoring-networks-data/national-air-pollution-program.html>

<sup>2</sup> <http://novascotia.ca/nse/airdata/>

<sup>3</sup> <https://www.canada.ca/en/environment-climate-change/services/air-quality-health-index/understanding-messages.html>

<sup>4</sup> <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<sup>5</sup> 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

### The Whole AQMS System

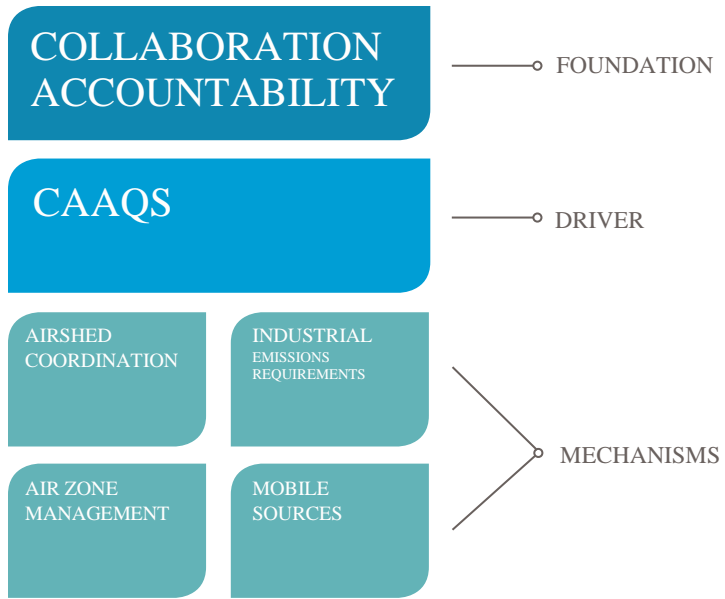


Figure 1. The Air Quality Management Framework

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.”<sup>6</sup> An electronic copy of this report and previous reports can be accessed at <https://novascotia.ca/nse/air/air-zone-reports.asp>.

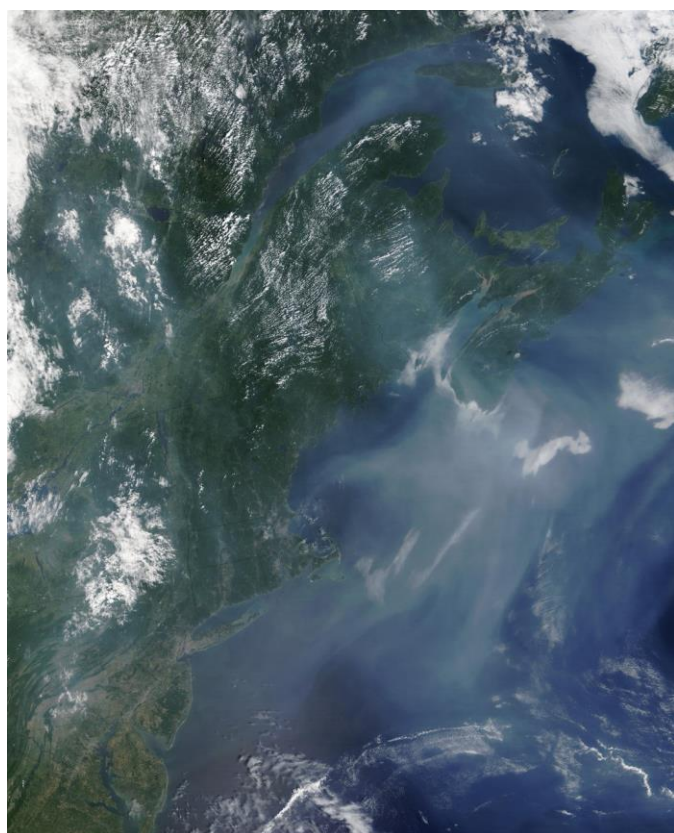
<sup>5</sup> <http://www.ccme.ca/en/resources/air/aqms.html>

<sup>6</sup> [https://www.ccme.ca/files/Resources/air/pn\\_1475\\_roles\\_and\\_respn\\_final\\_e.pdf](https://www.ccme.ca/files/Resources/air/pn_1475_roles_and_respn_final_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, the Eastern seaboard of the U.S., and the Québec/Ontario corridor. Emissions from these areas contribute to the formation of GLO, PM<sub>2.5</sub> and other pollutants that affect Nova Scotia's air quality (Figure 2). Canada and the United States have agreed<sup>7</sup> 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<sup>8</sup> is particulate air pollution over the Maritimes that originated in the Eastern United States.

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<sup>7</sup> <https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/transboundary/canada-united-states-air-quality-agreement-overview.html>.

<sup>8</sup> <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.

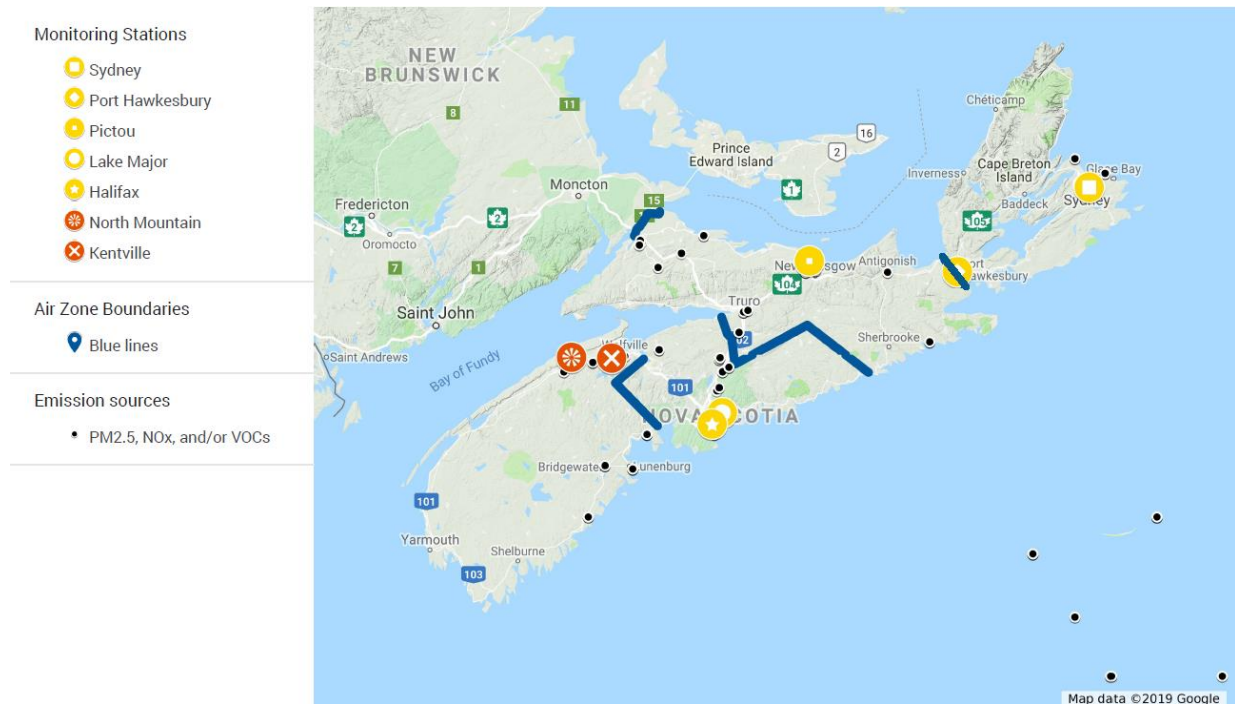


Figure 3. Nova Scotia’s four air zones and the locations of ambient air monitoring stations. The station colour corresponds to the management level achieved in 2018.

## 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<sub>2.5</sub> have been in place since 2015 and will become more stringent in 2020. In addition, CAAQS for sulphur dioxide (SO<sub>2</sub>) and NO<sub>2</sub> will be implemented beginning in 2020.

Pollutant	Averaging time	Standards (numerical values)			Metric
		2015	2020	2025	
PM <sub>2.5</sub>	24-hour (calendar day)	<b>28</b> µg/m <sup>3</sup>	27 µg/m <sup>3</sup>		The 3-year average of the annual 98 <sup>th</sup> percentile of the daily 24-hour average concentrations.
	Annual (calendar year)	<b>10.0</b> µg/m <sup>3</sup>	8.8 µg/m <sup>3</sup>		The 3-year average of the annual average concentrations.
Ground-level Ozone	8-hour	<b>63</b> ppb	62 ppb	60 ppb	The 3-year average of the annual 4 <sup>th</sup> -highest daily maximum 8-hour average concentrations.
Sulphur Dioxide	1-hour	N/A	70 ppb	65 ppb	The 3-year average of the annual 99 <sup>th</sup> percentile of the SO <sub>2</sub> 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 <sub>2</sub> 1-hour average concentrations in the year.
Nitrogen Dioxide	1-hour	N/A	60 ppb	42 ppb	The 3-year average of the annual 98 <sup>th</sup> percentile of the NO <sub>2</sub> 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 <sub>2</sub> 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 Nova Scotia's air zones in 2018. However, an air zone management framework is used to work towards continuous improvement even when CAAQS are achieved because the health for some portion of the population continues to be affected when ambient concentrations of GLO and PM<sub>2.5</sub> are very low.<sup>9, 10</sup> For example, in 2008 the World Health Organization (WHO) ranked Canada to have the third best air quality in the world,<sup>11</sup> but the Canadian Medical Association (CMA) estimated that in 2008 there were 2,682 premature deaths in Canada from air pollution (69 in Nova Scotia) and total economic damages of about \$8 billion (\$200 million in Nova Scotia).<sup>12</sup> More recently, the International Institute for Sustainable Development (IISD) estimated that “7,712 deaths were attributable to PM<sub>2.5</sub> and ground-level ozone in Canada in 2015”<sup>13</sup> and “direct welfare cost of [GLO and PM<sub>2.5</sub>] is estimated to have been \$36 billion in 2015”.<sup>14</sup> The majority of these cumulative effects occur on days that are normally regraded as having good air quality.<sup>15</sup>

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<sub>2.5</sub> 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.

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<sup>9</sup> 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>.

<sup>10</sup> 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.

<sup>11</sup> World Health Organization (2011). Urban outdoor air pollution database. [http://www.who.int/phe/health\\_topics/outdoorair/databases/OAP\\_database\\_8\\_2\\_011.xls](http://www.who.int/phe/health_topics/outdoorair/databases/OAP_database_8_2_011.xls). Accessed from, CBC News. *Canada's air quality 3rd best in world*, <http://www.cbc.ca/news/health/canada-s-air-quality-3rd-best-in-world-1.980695>.

<sup>12</sup> Canadian Medical Association (2008). No breathing room: National illness costs of air pollution.

<sup>13</sup> International Institute for Sustainable Development (2017). *Costs of pollution in Canada: Measuring the impacts on families, businesses and governments*. Page 26.

<sup>14</sup> Ibid. Page viii.

<sup>15</sup> Government of Canada (2012). <http://publications.gc.ca/site/eng/9.694820/publication.html>, pp. 4-5.





Management Level	Management Actions	Air Management Threshold Values (2015-2019)		
		Ozone 8-hour (ppb)	PM <sub>2.5</sub> 24-hour (µg/m <sup>3</sup> )	PM <sub>2.5</sub> Annual (µg/m <sup>3</sup> )
 <b>Red</b> <sup>††</sup>	Actions for <b>Achieving</b> Air Zone CAAQS	63	28	10
 <b>Orange</b>	Actions for <b>Preventing</b> CAAQS Exceedance	56	19	6.4
 <b>Yellow</b> <sup>*</sup>	Actions for <b>Preventing</b> air quality <b>Deterioration</b>	50	10	4
 <b>Green</b>	Actions for <b>Keeping Clean</b> Areas Clean	0	0	0

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

<sup>††</sup> The threshold values for the “red” management level are equal to the numerical values of the CAAQS.

<sup>\*</sup> The CAAQS thresholds between the green and yellow management levels are based on estimated baseline concentrations in ambient air.<sup>16</sup>

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<sup>16</sup> CCME (2012). *Guidance document on air zone management*, pp 12-14. [https://www.ccme.ca/files/Resources/air/aqms/pn\\_1481\\_gdazm\\_e.pdf](https://www.ccme.ca/files/Resources/air/aqms/pn_1481_gdazm_e.pdf).

## Nova Scotia Air Zone Results, 2018

In 2018 the CAAQS were achieved in all four of Nova Scotia's air zones. The management level in the central, eastern, and northern air zones was yellow and the management level for the western air zone was orange (Table 3).

















Air Zone	Management Level	Management Actions	2018 CAAQS Results		
			Ozone 8-hour (ppb)	PM <sub>2.5</sub> 24-hour (µg/m <sup>3</sup> )	PM <sub>2.5</sub> Annual (µg/m <sup>3</sup> )
Central	 Yellow	Actions for Preventing AQ Deterioration	 51	 12	 5.6
Eastern	 Yellow	Actions for Preventing AQ Deterioration	 48	 11	 5.4
Northern	 Yellow	Actions for Preventing AQ Deterioration	 49	 10	 5.1
Western	 Orange	Actions for Preventing CAAQS Exceedance	 61	 12	 6.5

Table 3. CAAQS achievement and management level results for air zone monitoring in Nova Scotia for the 2018 reporting year.

A year-to-year comparison shows that the management levels for the Central and Eastern air zones have been consistently yellow, there has been an improvement in the air zone management level for the Northern air zone, moving from an orange to a yellow level, and the Western air zone level has been consistently orange (Table 4).

























Air Zone Management Levels				
	Central	Eastern	Northern	Western
2013	Yellow 	Yellow 	Orange 	Orange 
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 

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



## Central Air Zone

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<sup>17</sup> from Downtown Halifax, in an area with less population, traffic, and commercial density. The PM<sub>2.5</sub> measurements in the central air zone in 2018, as in previous years, fall in the yellow management level. GLO in downtown Halifax is green, and yellow in Lake Major (Table 5).

### Central air zone CAAQS achievement and management levels

Reporting Year	CAAQS					
	Ozone 8-hour (ppb)		PM <sub>2.5</sub> 24-hour (µg/m <sup>3</sup> )		PM <sub>2.5</sub> Annual (µg/m <sup>3</sup> )	
	Lake Major	Downtown Halifax	Lake Major	Downtown Halifax	Lake Major	Downtown Halifax
2013	52	42	15	*	6.0	*
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 <sup>¥</sup>	12	4.8 <sup>¥</sup>	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 [http://www.ccme.ca/files/Resources/air/aqms/pn\\_1483\\_gdad\\_eng.pdf](http://www.ccme.ca/files/Resources/air/aqms/pn_1483_gdad_eng.pdf).

<sup>¥</sup>Value is calculated from two-years of data, not three.

<sup>17</sup> Based on the most frequent annual wind direction.

## Eastern Air Zone

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

Measurements of GLO at both monitoring stations in the eastern air zone in 2018, as in previous years, are within the green management level. Measurements of PM<sub>2.5</sub> are within the yellow management level (Table 6). Both the 24-hour and annual PM<sub>2.5</sub> CAAQS measured at the Port Hawkesbury monitoring station show a decreasing trend.

### Eastern air zone CAAQS achievement and management levels





































Reporting Year	CAAQS					
	Ozone 8-hour (ppb)		PM <sub>2.5</sub> 24-hour (µg/m <sup>3</sup> )		PM <sub>2.5</sub> Annual (µg/m <sup>3</sup> )	
	Port Hawkesbury	Sydney	Port Hawkesbury	Sydney	Port Hawkesbury	Sydney
2013	 47	 49	 16	 13	 6.3	 5.0
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

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

## Western Air Zone

There are two monitoring stations in the western air zone used for calculating CAAQS. One is located on the North Mountain, and the second in the town of Kentville.

The Annual PM<sub>2.5</sub> measurements in the Western air zone show an increasing trend, and in 2018 increased from the yellow to the orange management level. The western air zone's ground level ozone measurements also fall in the orange management level (Table 7) and are the highest in Nova Scotia.

### Western air zone CAAQS achievement and management levels

























Reporting Year	CAAQS					
	Ozone 8-hour (ppb)		PM <sub>2.5</sub> 24-hour (µg/m <sup>3</sup> )		PM <sub>2.5</sub> Annual (µg/m <sup>3</sup> )	
	North Mountain	Kentville	North Mountain	Kentville	North Mountain	Kentville
2013	 60	n/a	 12	n/a	 4.4	n/a
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 <sup>‡</sup>	 61	 60	 12	 11	 6.2	 5.5
2018 <sup>¥</sup>	 61	 59	 12	 12	 6.5	 6.1

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

<sup>‡</sup> Results for Kentville are based on two-years of data.

<sup>¥</sup> 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 increasing trend in annual PM<sub>2.5</sub> or high levels of 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 4) and transportation to the south-west are significant sources of transboundary pollution for the western air zone.

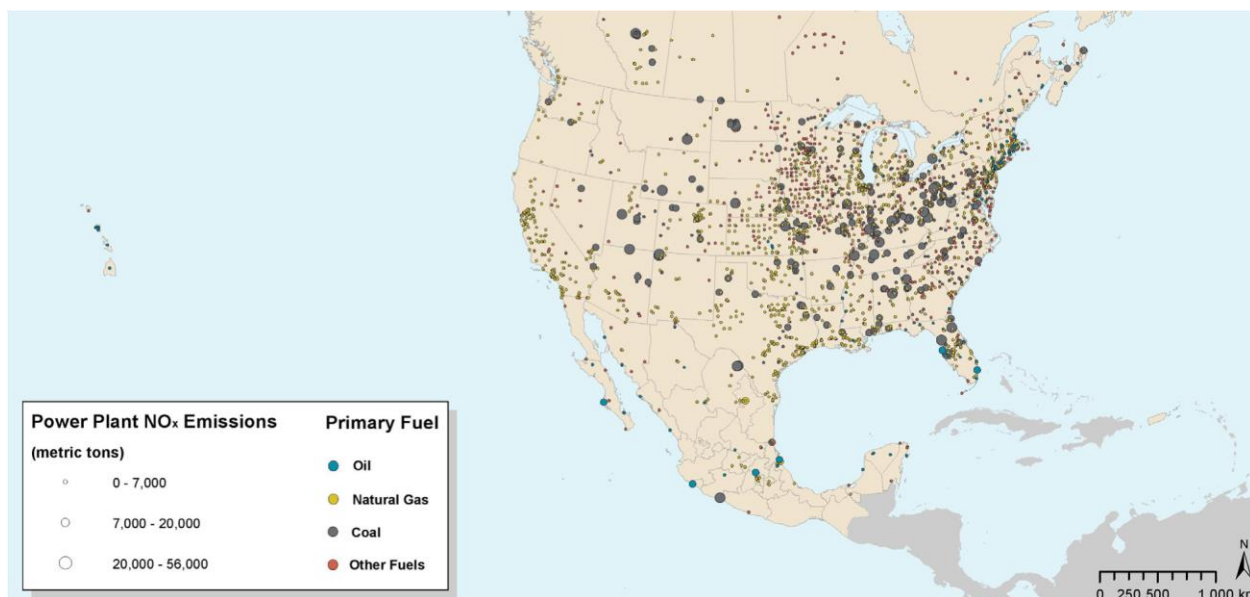


Figure 4. This map identifies the locations of North American coal-fired power plants and the relative size of their NO<sub>x</sub> emissions.<sup>18</sup> Emissions from sources Southwest of Nova Scotia can affect the province’s ambient air quality.<sup>19</sup>

Ground level ozone is formed when sunlight reacts with ‘precursor’ pollutants, such as NO<sub>x</sub> 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 NO<sub>x</sub>. Rural environments, like that of the Western air zone, tend to be limited in NO<sub>x</sub> so that an increase in NO<sub>x</sub> generally correlates with increased concentrations of GLO. Urban environments that are saturated with NO<sub>x</sub>, like downtown Halifax, generally experience an increase in GLO concentrations when NO<sub>x</sub> is decreased.

<sup>18</sup> Data are taken from the Commission for Environmental Cooperation of North America (CEC) power plant emissions project <http://www.cec.org/sites/default/napp/en/north-american-emissions/north-american-emissions.php>.

<sup>19</sup> 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

There is one monitoring station in the northern air zone, located in the Town of Pictou. There has been an improvement in the 24-hr PM<sub>2.5</sub> CAAQS, moving from an orange to a green management level, and the annual PM<sub>2.5</sub> CAAQS, moving from orange to yellow. As in previous years, the management level for GLO in 2018 was green, (Table 8).

#### Northern air zone CAAQS achievement and management levels



















Reporting Year	CAAQS		
	Ozone 8-hour (ppb)	PM <sub>2.5</sub> 24-hour (µg/m <sup>3</sup> )	PM <sub>2.5</sub> Annual (µg/m <sup>3</sup> )
2013	 46	 18	 6.9
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

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 us at <https://novascotia.ca/nse/air/> or contact us at **902-424-3600, ext. 3.**