

# Nova Scotia Air Zone Report

Nova Scotia Air Quality Unit, 2015

# 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>CAAQS</b>	Canadian Ambient Air Quality Standards
<b>CCME</b>	Canadian Council of Ministers of the Environment
<b>ECCC</b>	Environment and Climate Change Canada
<b>GLO</b>	Ground Level Ozone
<b>IA</b>	Industrial Approval
<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>NSE</b>	Nova Scotia Environment
<b>PM<sub>2.5</sub></b>	Fine particulate matter
<b>VOCs</b>	Volatile Organic Compounds

# Air Quality Monitoring

Air contains gases essential for life but may also contain unhealthy air pollutants. Nova Scotia Environment's Air Quality Unit (AQU) collaborates with Environment and Climate Change Canada's (ECCC) National Air Pollution Surveillance Program (NAPS) to set up and maintain air monitoring stations in Nova Scotia that collect and share data about air pollution concentrations in outdoor air, known as ambient air<sup>1</sup>.

- AQU measures concentrations each hour

The ambient air monitoring network measures average concentrations of pollutants each hour. These hourly measurements are made available to the public, researchers, media, and other interested parties on our website: [novascotia.ca/nse/airdata/](http://novascotia.ca/nse/airdata/).

- AQU submits averages to national database

After passing quality assurance and quality control, the 1-hour averages are provided to NAPS as part of a national database [ec.gc.ca/rnsps-naps/default.asp?lang=En&n=8BA86647-1](http://ec.gc.ca/rnsps-naps/default.asp?lang=En&n=8BA86647-1).

- AQU calculates AQHI

Measurements of nitrogen dioxide (NO<sub>2</sub>), ground-level ozone (GLO), and fine particulate matter (PM<sub>2.5</sub>) are used to calculate the Air Quality Health Index (AQHI). The AQHI is a communication tool that assists individuals in making daily decisions about adjusting their activities to limit exposure to air pollution. The AQHI is reported as a number from 1 to 10+ and as a risk category, from low to very-high, with an associated health message: [weather.gc.ca/airquality/healthmessage\\_e.html](http://weather.gc.ca/airquality/healthmessage_e.html)

<sup>1</sup> In the remainder of the report, outdoor air will be referred to as referred to as "ambient air."



- AQU works to protect and improve air quality

Ambient air data are also used to determine the state of air quality over longer periods of time and to support actions for protecting and improving air quality. For example, the Air Quality Management System (AQMS), put in place across Canada through the Canadian Council of Ministers of the Environment's (CCME)<sup>2</sup>, is a comprehensive approach with four "mechanisms" that work together to protect and improve ambient air quality: base level industrial emissions requirements, mobile source emissions, airsheds, and air zones (Figure 1).

This document is Nova Scotia Environment's (NSE) second annual air zone report.<sup>3</sup>

Provinces and territories use air zones as geographic regions for monitoring, managing, and reporting on ambient concentrations of GLO and PM<sub>2.5</sub>.

While the NSE ambient air monitoring network is not used to monitor industrial emitters or demonstrate their compliance with Industrial Approvals (IA), the Nova Scotia Air Quality Regulations<sup>4</sup> do have maximum permissible ground level concentrations for a number of pollutants that some IA holders must measure for. The results of an IA holder's monitoring network must be reported to NSE and demonstrate compliance with limits in their approvals.

## The Whole AQMS System

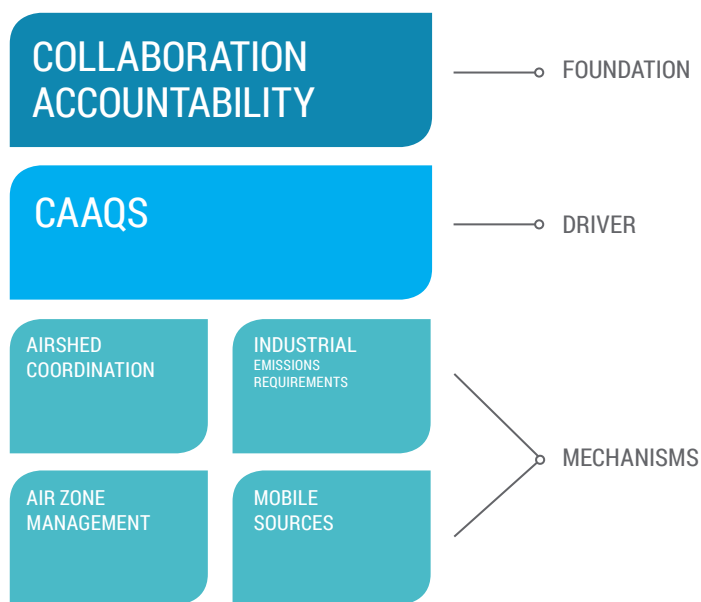


Figure 1. Elements of the Air Quality Management System (AQMS).

<sup>2</sup> <http://www.ccme.ca/en/resources/air/aqms.html>

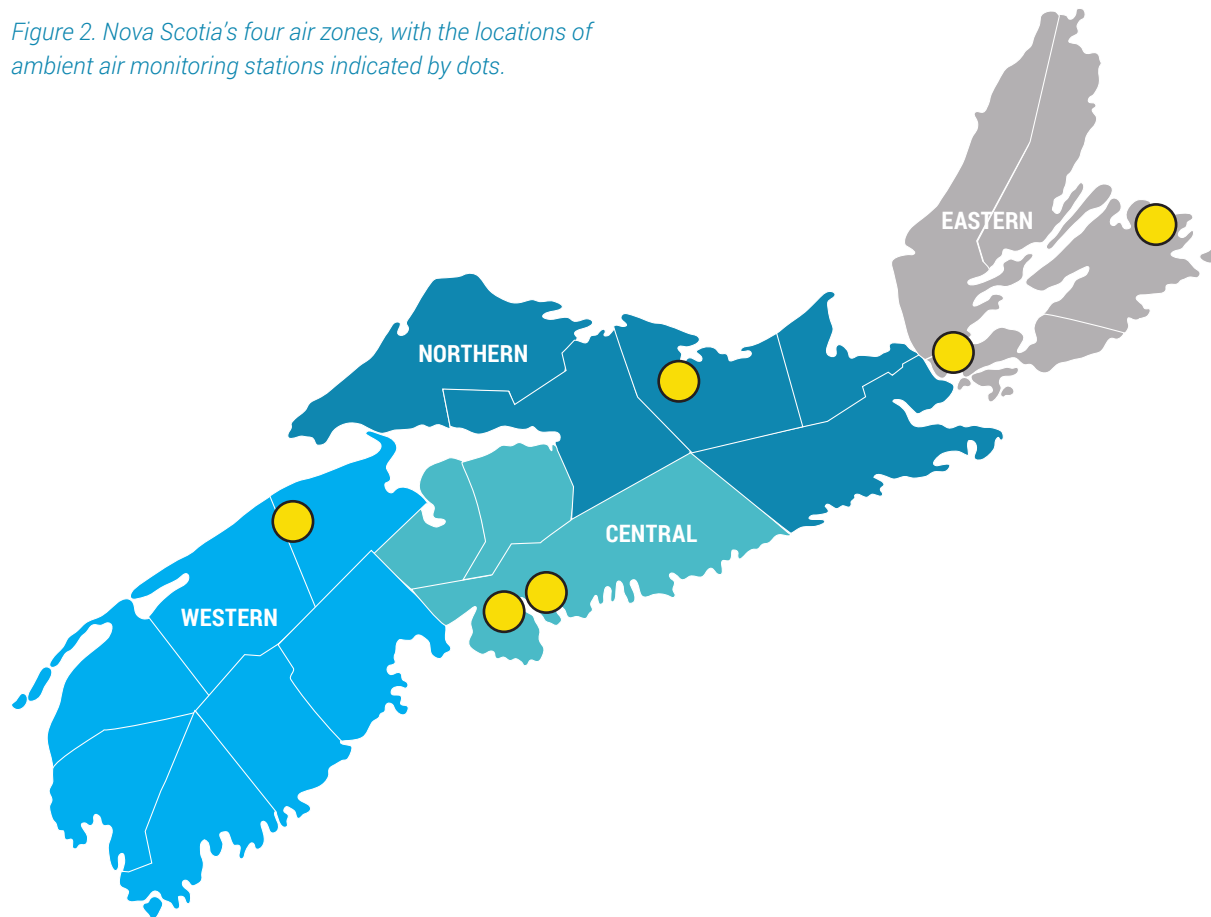
<sup>3</sup> NSE's first annual report, for 2014, can be accessed at <http://novascotia.ca/nse/air/docs/15-43405%20AirZone%20V3.pdf>.

<sup>4</sup> <http://novascotia.ca/just/regulations/regs/envairqt.htm>

## Nova Scotia's Air Zones and Monitoring Stations

Nova Scotia's four air management areas, called air zones, share terrain, meteorology, and other natural factors that interact with air pollutant emissions to influence ambient air quality in the area (Figure 2). Data are collected from ambient air monitoring stations in each air zone. NSE's air quality program administrators use an air zone management framework to help determine what management actions may be best suited to each air zone.

*Figure 2. Nova Scotia's four air zones, with the locations of ambient air monitoring stations indicated by dots.*



## Canadian Ambient Air Quality Standards (CAAQS)

Data from ambient air monitoring stations in each air zone are used to determine achievement of Canadian Ambient Air Quality Objectives (CAAQS) for ground-level ozone (GLO) and fine particulate matter (PM<sub>2.5</sub>) (Table 1).

Pollutant	Averaging time	Standards (numerical values)		Metric
		2015	2020	
PM <sub>2.5</sub>	24-hour (calendar day)	28 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.
PM <sub>2.5</sub>	Annual (calendar year)	10.0 µg/m <sup>3</sup>	8.8 µg/m <sup>3</sup>	The 3-year average of the annual average concentrations.
GLO	8-hour	63 ppb	62 ppb	The 3-year average of the annual 4 <sup>th</sup> -highest daily maximum 8-hour average concentrations.

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

## Air Zone Management Framework

The numerical values of GLO and PM<sub>2.5</sub> in the form of the CAAQS are compared to threshold values of an air zone management framework (Table 2) and the highest CAAQS value in an air zone sets the air zone's management level. The framework has four levels of management actions, represented by colour. Three management levels keep clean areas clean or prevent degradation of air quality when the CAAQS are achieved – green, yellow, orange. One management level requires actions to achieve CAAQS if the CAAQS are exceeded – red.





Management Level	Management Actions	Air Management Threshold Values		
		Ozone (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<sup>††</sup></b>	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>	Actions for <b>Preventing</b> air quality <b>Deterioration</b>	50	10	4
 <b>Green</b>	Actions for <b>Keeping Clean Areas Clean</b>	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).



# Air Zone Results for Nova Scotia at a Glance

In 2015 the CAAQS were achieved in all four of Nova Scotia's air zones: "yellow" in the Central and Eastern air zones, and "orange" in the Northern and Western air zones (Table 3).

NOVA SCOTIA AIR ZONE MANAGEMENT LEVELS AND CAAQS ACHIEVEMENT RESULTS FOR 2015 (2013–2015 AVERAGE)

















Air Zone	Management Level*	Management Actions	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	 15 <sup>†</sup>	 6.3 <sup>†</sup>
Eastern	 Yellow	Actions for Preventing AQ Deterioration	 49	 14	 5.9
Northern	 Orange	Actions for Preventing CAAQS Exceedance	 45	 23 <sup>†</sup>	 7.6 <sup>†</sup>
Western	 Orange	Actions for Preventing CAAQS Exceedance	 59	 14	 5.3

Table 3. CAAQS achievement and management level results for air zone monitoring in Nova Scotia for the 2015 reporting year.

\* Management levels for each air zone are determined by the highest air pollutant measurement in the numerical form of the CAAQS relative to the threshold values in the Air Quality Management Framework. 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.

† Result is based on two-years of data. Data must pass quality assurance/quality control and completeness tests to be acceptable for calculating CAAQS. More information can be found at [http://www.come.ca/files/Resources/air/aqms/pn\\_1483\\_gdad\\_eng.pdf](http://www.come.ca/files/Resources/air/aqms/pn_1483_gdad_eng.pdf).









	Air Zone (AZ) Management Level			
	Central AZ	Eastern AZ	Northern AZ	Western AZ
2014	 Yellow	 Yellow <sup>†</sup>	 Orange	 Orange
2015	 Yellow	 Yellow	 Orange	 Orange

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

† The management level for the Eastern Air Zone was reported as "orange" in the 2014 Air Zone Report. It was later discovered that an instrument used for measuring PM<sub>2.5</sub> had a technical issue to cause the readings to be incorrect. The data have been adjusted to account for the issue, and the air zone management level has been revised to "yellow."





## What do these results mean?

Ozone that is formed higher up in the atmosphere through natural processes makes up a region called the ozone layer. The ozone layer prevents harmful ultraviolet rays from reaching the Earth's surface and is beneficial to human health and the environment. Actions have been taken in Nova Scotia, Canada, and around the world to prohibit the manufacture and release of gases that deplete ozone in the ozone layer. While ozone found high in the atmosphere is beneficial, ozone found at ground-level (GLO) can be harmful to human health and the environment. GLO is not directly emitted; rather, nitrogen oxides ( $\text{NO}_x$ ) and volatile organic compounds (VOCs) that are emitted from activities such as electric power generation, the natural gas industry, wood burning, manufacturing and transportation<sup>5</sup> react with sunlight to form GLO.

The Central Air Zone, which includes Halifax, has the greatest population and population density of Nova Scotia's four air zones and includes many of the activities that emit  $\text{NO}_x$  and VOCs. GLO in the Central Air Zone has a "yellow" management level.

Nova Scotia also receives GLO that was carried long distances from where it was formed outside of the province. In Nova Scotia, this is most evident in the Western Air Zone. The Western Air Zone includes Annapolis, Digby, Kings, Lunenburg, Queens, Shelburne, and Yarmouth counties and is mostly rural. However, because of its location it is generally the first region of Nova Scotia to receive long-range air pollutants that originate in the Eastern United States. Analysis of the long-term GLO monitoring data from the Western Air Zone show that reductions of  $\text{NO}_2$  emissions from coal-fired power plants in the Ohio River Valley beginning in 1999 are correlated with reduced summertime GLO concentrations in Nova Scotia (Figure 3).

### WESTERN AIR ZONE GLO AND THE OHIO RIVER VALLEY'S AMBIENT $\text{NO}_2$ AND $\text{NO}_2$ EMISSIONS

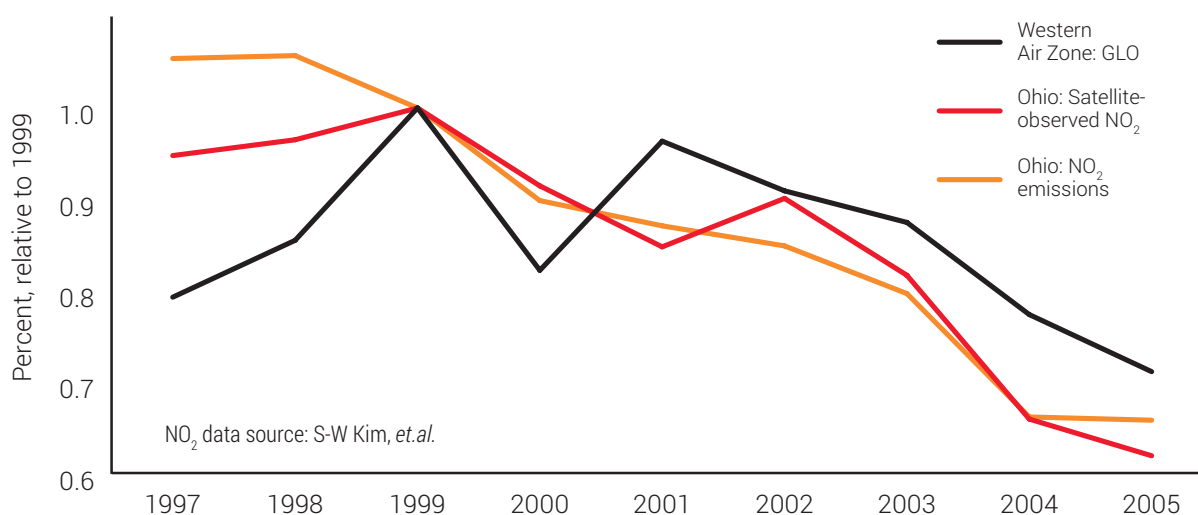


Figure 3. Reduced summertime ambient  $\text{NO}_2$  concentrations in the Ohio River Valley were correlated with strategies to reduce  $\text{NO}_2$  emissions from coal-fired power plants in the region<sup>6</sup>. The summertime GLO concentrations measured in NS's Western Air Zone were also correlated with the reduced ambient  $\text{NO}_2$ .

<sup>5</sup> <http://www.ec.gc.ca/inrp-npri/donnees-data/ap/index.cfm?lang=En>

<sup>6</sup> S-W Kim, et al. 2006. Satellite-observed U.S. power plant  $\text{NO}_x$  emission reductions and their impact on air quality. Geophysical Research Letters, VOL. 33, L22812.

By converting the long-term ozone data from the Western Air Zone to the numeric form of the CAAQS for comparison purposes, it is shown that the CAAQS for GLO may not have been achieved without the emission reduction strategies implemented in the United States (Figure 4). Although the CAAQS have been achieved in the Western Air Zone, the results are in the “orange” management level that requires action for preventing CAAQS exceedance. In addition to GLO that comes from the Ohio River Valley, GLO in the Western Air Zone also arrives from the eastern seaboard of the United States where transportation produces the majority of emissions that contribute to its formation. Strategies to reduce transportation emissions in the eastern United States and Nova Scotia would likely result in further reductions in ambient GLO concentrations in both the Western and Central air zones.

#### WESTERN AIR ZONE: REPRESENTATION OF CAAQS FOR GLO, 2000–2015

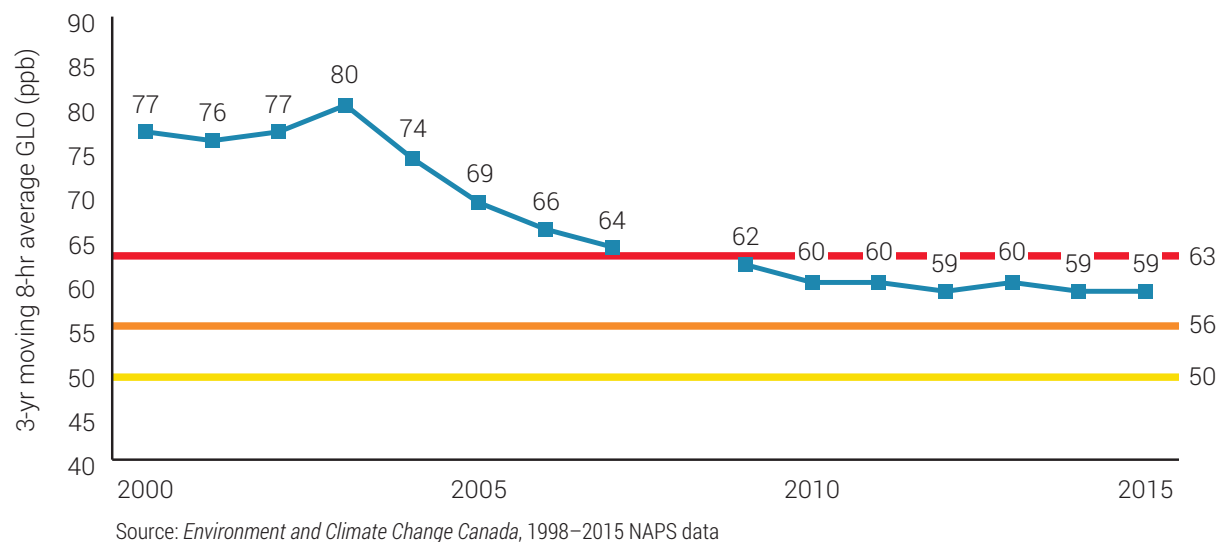


Figure 4. The CAAQS for GLO only came into force in 2015, but the GLO measurements from the Western Air Zone were converted to the numeric form of the CAAQS for comparison with the standard and management level thresholds. The results show that the values prior to 2009 were greater than the CAAQS threshold for achievement. There is evidence that a component of GLO measured in the Western Air Zone were transported from the Eastern United States and that reduction strategies there have had beneficial results for Nova Scotia.

Fine particulate matter ( $PM_{2.5}$ ) are very small solid or liquid particles that can originate from natural sources such as forest fires, wind-blown dust, and sea salt and also from activities such as wood burning, transportation, agriculture, power plants, and factories.<sup>7</sup> Long-term  $PM_{2.5}$  data in all of Nova Scotia’s air zones exhibit patterns of local, distant, natural, and human-caused sources of  $PM_{2.5}$  pollution. However, a local source of human-caused  $PM_{2.5}$  pollution significantly influenced ambient readings in the Northern Air Zone and the air zone’s management level is “orange.” Actions have been taken to reduce emissions from this source, and beginning in mid-2015 a significant reduction in the ambient concentrations of  $PM_{2.5}$  has been observed (Figure 5 and Figure 6). However, because the CAAQS are based on a 3-year average of the 98<sup>th</sup> percentile of 24-hour averages and the 3-year average of the annual average, there is not an immediate reduction in the numeric form of the CAAQS but one is expected in the future.

<sup>7</sup> <http://www.ec.gc.ca/inrp-npri/donnees-data/ap/index.cfm?lang=En>

### NORTHERN AIR ZONE 2015: 24-HOUR DAILY AVERAGE PM<sub>2.5</sub>

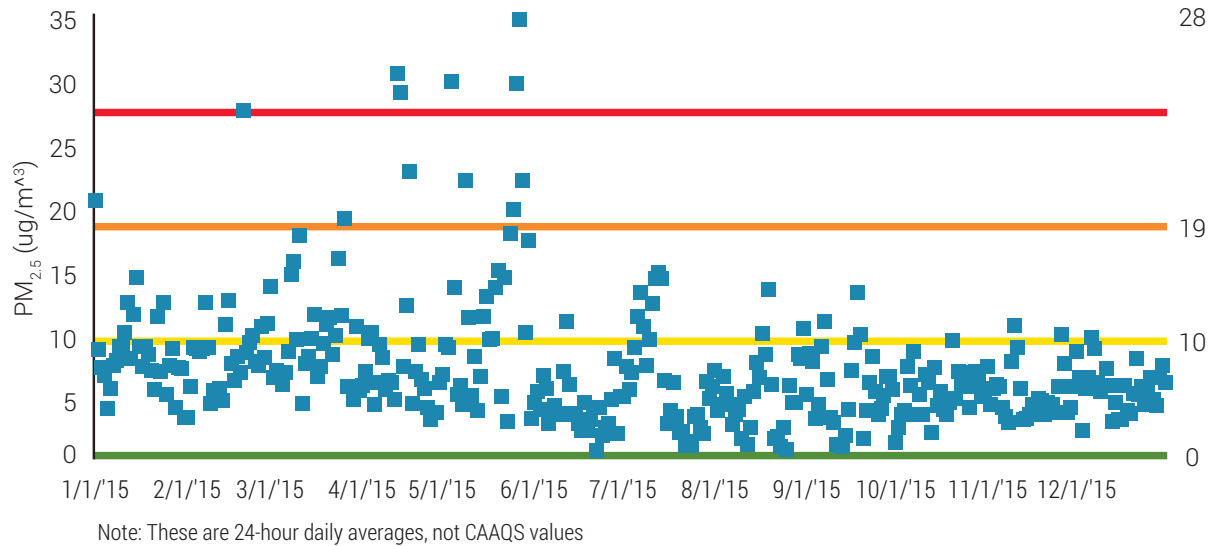


Figure 5. For comparison purposes, peak values of 24-hour average ambient PM<sub>2.5</sub> in the Northern Air Zone did not exceed the air quality management framework threshold of 19 µg/m<sup>3</sup> during the second half of 2015. This corresponds with the period during which a kraft paper mill in the air zone shutdown for repairs and resumed operations with new pollution control equipment to reduce PM<sub>2.5</sub> emissions.

### NORTHERN AIR ZONE: ANNUAL AVERAGE PM<sub>2.5</sub>

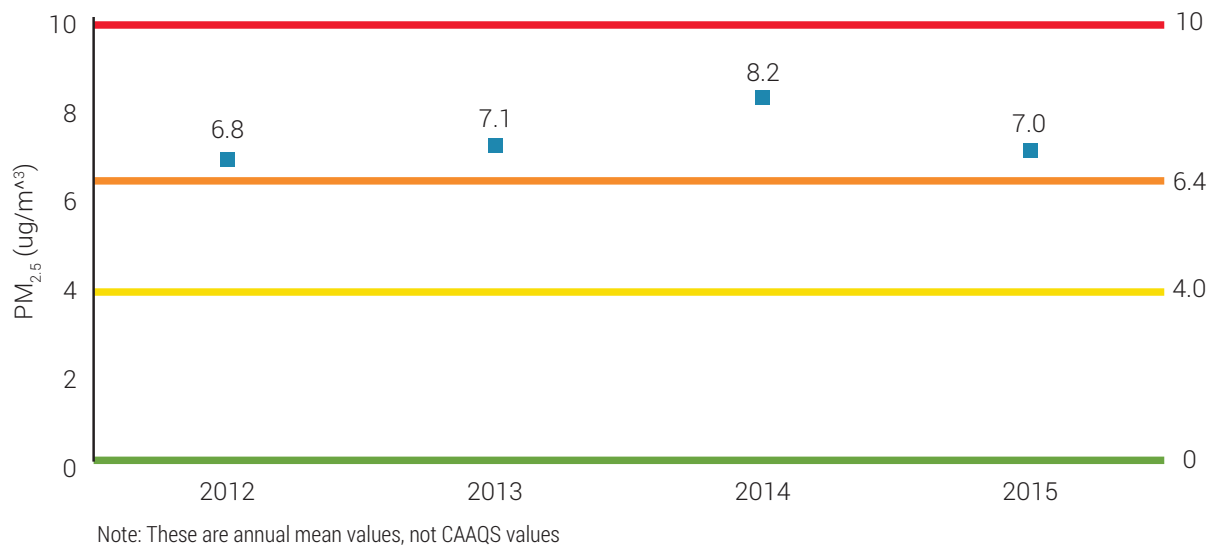


Figure 6. The annual average PM<sub>2.5</sub> in the Northern Air Zone for 2015 showed a reduction from the previous two years. It is expected that future annual averages will be lower because a local kraft paper mill installed emissions control equipment in mid-2015 and continues to operate with significantly reduced emissions.

# Contact Us

For more information on ambient air quality monitoring, the AQMS, ambient air quality data or related products visit [novascotia.ca/nse/air/](http://novascotia.ca/nse/air/) or contact us at **902-424-3600**.

