Air Quality in Ontario

2015 Report

MINISTRY OF THE ENVIRONMENT
AND CLIMATE CHANGE

Ontario

Acknowledgements

This report has been prepared by the staff of the Environmental Monitoring and Reporting Branch of the Ontario Ministry of the Environment and Climate Change. Environment and Climate Change Canada's National Air Pollution Surveillance program is acknowledged for providing air monitoring instrumentation and air toxics data, and assisting data quality assurance/quality control of criteria pollutants to the province of Ontario.

Air Quality in Ontario Report 2015

The Air Quality in Ontario Report, the 45th in a series, summarizes the state of ambient air quality in 2015 and 10-year trends for key airborne pollutants affecting Ontario's air quality.

2015 Highlights

Overall, air quality in Ontario has improved significantly over the past 10 years due to substantial decrease in harmful pollutants such as nitrogen dioxide, sulphur dioxide and carbon monoxide that are emitted by vehicles and industry.

There has also been a significant decrease in fine particulate matter which is emitted directly into the atmosphere as a by-product of fuel combustion or formed indirectly in the atmosphere through a series of complex chemical reactions. Fine particulate matter includes aerosols, smoke, fumes, dust, fly ash and pollen, and can have various negative health effects, especially on the respiratory system.

The continued decrease in these pollutants is due in part to Ontario's air quality initiatives such as:

- The phase-out of coal-fired generating stations
- Emissions trading regulations, (O. Reg. 397/01 and O. Reg. 194/05)
- Emissions controls at Ontario smelters
- Drive Clean testing of vehicle emissions

The following table shows the decreasing trend for airborne pollutant concentrations from 2006-2015 and emissions from 2006-2015:

Pollutant	Concentrations
Nitrogen dioxide	↓ 32%
Sulphur dioxide	↓ 48%
Carbon monoxide	↓ 53%
Fine particulate matter	↓ 25%

Pollutant	Emissions
Nitrogen oxides	↓ 38%
Sulphur dioxide	↓ 44%
Carbon monoxide	↓ 32%
Fine particulate matter	↓ 11%

Ozone Trends

Ozone is a pollutant formed when nitrogen oxides and volatile organic compounds (a group of pollutants from sources such as transportation, industrial activities, and use of solvents) react in the presence of sunlight. This means that formation and transport of ozone is very dependent on weather conditions and air pollutant concentrations.

Overall, annual ozone concentrations have increased three per cent over the past 10 years. Ozone concentrations can vary due to the season: winter ozone concentrations have increased by nine per cent while summer ozone concentrations have decreased by four per cent.

The winter increases are due mainly to rising global background concentrations of ozone. The summer increases are a result of reductions in emissions of pollutants such as nitrogen oxides and volatile organic compounds within Ontario and the U.S.

The following table shows a decreasing trend for six volatile organic compounds from 2005-2014, based on data collected at eight ambient air monitoring stations:

VOC	Concentrations
1,3 Butadiene	↓ 62%
Benzene	↓ 42%
Toluene	↓ 64%
Ethylbenzene	↓ 79%
m-, p-xylene	↓ 85%
o-xylene	↓ 84%

Rapport sur la qualité de l'air en Ontario de 2015

Le Rapport sur la qualité de l'air en Ontario, 45e de la série, résume l'état de la qualité de l'air ambiant en 2015 et les tendances sur 10 ans relatives aux principaux polluants atmosphériques qui affectent la qualité de l'air en Ontario.

Faits saillants de 2015

En général, la qualité de l'air en Ontario s'est nettement améliorée ces 10 dernières années grâce à la réduction substantielle des polluants nocifs, comme le dioxyde d'azote, le dioxyde de soufre et le monoxyde de carbone qui sont rejetés par les véhicules et l'industrie.

Il y a aussi eu une baisse importante des particules fines qui sont rejetées dans l'air directement, comme sous-produit du brûlage de combustibles, ou indirectement, par une série de réactions chimiques complexes. Les particules fines, qui incluent les aérosols, la fumée, les vapeurs, la poussière, les cendres volantes et le pollen, peuvent affecter la santé de diverses façons, notamment le système respiratoire.

Ces polluants continuent de baisser, en partie grâce aux mesures prises par l'Ontario pour améliorer la qualité de l'air, dont :

- la fermeture des centrales électriques alimentées au charbon;
- les règlements sur l'échange des droits d'émission (Règl. de l'Ont. 397/01 et Règl. de l'Ont. 194/05);
- la lutte contre les émissions des fonderies;
- l'analyse des émissions des véhicules dans le cadre d'Air pur Ontario.

Le tableau ci-dessous montre la tendance à la baisse des concentrations de polluants atmosphériques de 2006 à 2015 et des émissions de 2006 à 2015 :

Polluant	Concentrations
dioxyde d'azote	↓ 32 %
dioxyde de soufre	↓ 48 %
monoxyde de carbone	↓ 53 %
particules fines	↓ 25 %

Polluant	Émissions
oxydes d'azote	↓ 38 %
dioxyde de soufre	↓ 44 %
monoxyde de carbone	↓ 32 %
particules fines	↓ 11 %

Tendances liées à l'ozone

L'ozone est un polluant qui se forme quand les oxydes d'azote et les composés organiques volatils (groupe de polluants issus du secteur des transports, des industries et de l'utilisation de solvants) réagissent entre eux sous le rayonnement solaire. Ainsi, la formation et le déplacement de l'ozone dépendent beaucoup des conditions climatiques et des concentrations de polluants dans l'air.

En général, les concentrations annuelles d'ozone ont augmenté de trois pour cent en 10 ans. Les concentrations d'ozone varient selon la saison : elles ont augmenté de neuf pour cent en hiver, tandis qu'elles ont baissé de quatre pour cent en été.

L'ozone a augmenté en hiver principalement à cause de la hausse des concentrations de fonds d'ozone à l'échelle mondiale. L'ozone a baissé en été grâce à la réduction des émissions de polluants, comme les oxydes d'azote et les composés organiques volatils en Ontario et aux États-Unis.

Le tableau ci-dessous montre une tendance à la baisse pour six composés organiques volatils (COV) de 2005 à 2014, selon les données recueillies par huit stations de surveillance de l'air ambiant :

COV	Concentrations
1,3 butadiène	↓ 62%
benzène	↓ 42%
toluène	↓ 64%
éthylbenzène	↓ 79%
m-, p-xylène	↓ 85%
o-xylène	↓ 84%

Contents

1.0 Introduction

This annual report, the 45th in a series, summarizes the state of ambient air quality in Ontario during 2015 and examines 10-year trends.

It reports on the measured levels of six common air pollutants: ground-level ozone (O_3), fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), sulphur dioxide (SO_2) and total reduced sulphur (TRS) compounds, and how Ontario is performing compared to the province's Ambient Air Quality Criteria (AAQC). This report also provides an overview and implementation of the new Air Quality Health Index (AQHI) and Air Quality Alert programs in Ontario, plus the monitoring of select volatile organic compounds (VOCs) in the province. Annual statistics, as well as 10-year trends of ambient air quality data are provided in the attached Appendix.

An AAQC is a desirable concentration of a contaminant in air, based on protection against adverse effects on health or the environment. The term "ambient" is used to reflect general air quality independent of location or source of a contaminant. AAQCs are most commonly used in environmental assessments, special studies using ambient air monitoring data, assessment of general air quality in a community and annual reporting on air quality across the province. AAQCs are set with different averaging times appropriate for the effect they are intended to protect against.

Contaminant	1-hour AAQC	8-hour AAQC	24-hour AAQC	Annual AAQC
O_3	80 ppb	-	-	-
$PM_{2.5}$	-	-	28 µg/m^3(1)	-
NO_2	200 ppb	-	100 ppb	-
SO_2	250 ppb	-	100 ppb	20 ppb
CO	30 ppm	13 ppm	-	-

(1) Reference level based on Canadian Ambient Air Quality Standard (CAAQS).

Ontario continues to benefit from one of the most comprehensive air monitoring systems in North America, comprised of 39 monitoring sites across the province that undergo regularly scheduled maintenance and strict data quality assurance and quality control (QA/QC) procedures to ensure a high standard of data quality and data completeness. The data, which are collected continuously at these sites, are used to determine the current state of ambient air quality and are reported every hour on the ministry's web site, www.airqualityontario.com.

2.0 Ground-Level Ozone

Ground-level ozone is a gas formed when nitrogen oxides (NO_x) and VOCs react in the presence of sunlight. While ozone at ground level is a significant environmental and health concern, the naturally occurring ozone in the stratosphere, 10 to 40 kilometres above the earth's surface, is beneficial as it shields the earth from harmful ultraviolet radiation.

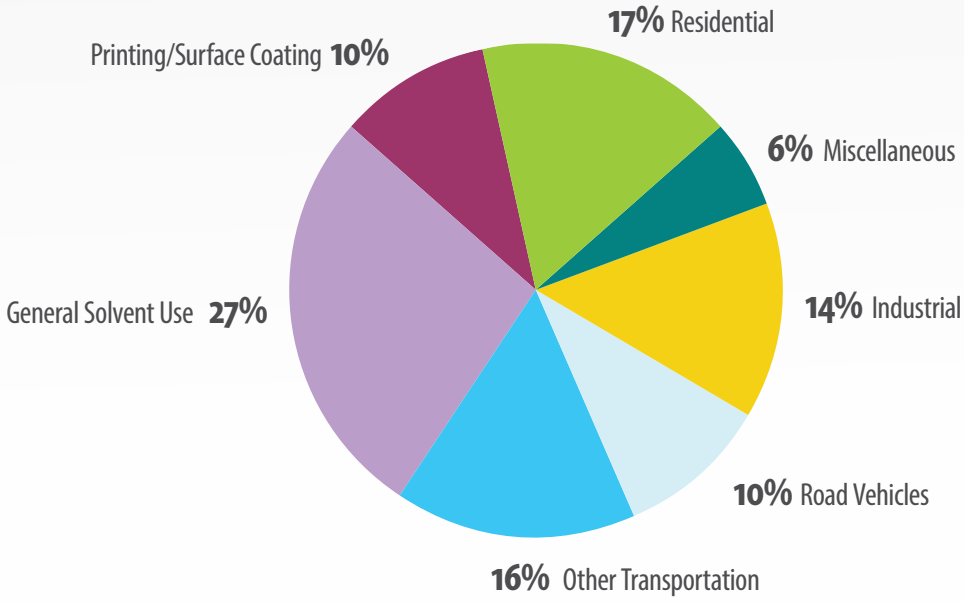
Ozone is a colourless, odourless gas at typical ambient concentrations, and is a major component of smog. Ozone is not generally emitted directly into the atmosphere; the formation and transport of ozone is strongly dependent on meteorological conditions and emissions of chemical precursors, particularly NO_x and VOCs. Changing weather patterns contribute to differences in ozone concentrations hour-to-hour, day-to-day, season-to-season, and year-to-year. In Ontario, the highest concentrations of ground-level ozone are typically recorded on hot and sunny days mainly from May to September, between noon and early evening.

Ozone irritates the respiratory tract and eyes. Exposure to ozone in sensitive people can result in chest tightness, coughing and wheezing. Children who are active outdoors during the summer, when ozone levels are highest, are particularly at risk. Individuals with pre-existing respiratory disorders, such as asthma and chronic obstructive pulmonary disease (COPD), are also at risk. Ozone is associated with increased hospital admissions and premature deaths. Ozone may cause losses in agricultural crops each year in Ontario, with visible leaf damage in many crops, garden plants and trees, especially during the summer months.

Figure 1 shows the estimates of Ontario's VOCs emissions from point, area and transportation sources. General solvent use accounted for approximately 27 per cent of VOCs emissions and the second largest source was the transportation sectors accounting for approximately 26 per cent. **Figure 2** shows the estimates for Ontario's NO_x emissions from point, area and transportation sources. The transportation sectors accounted for approximately 68 per cent of NO_x emissions (2015 APEI).

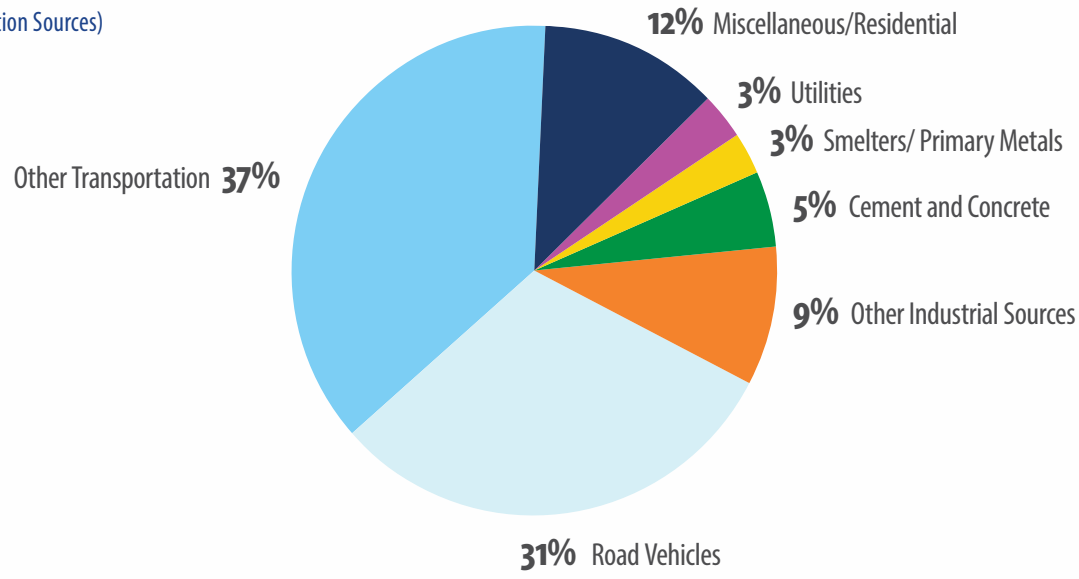
In 2015, ozone was monitored at the ministry's 39 AQHI sites. The highest annual mean was 32.8 parts per billion (ppb), measured at Port Stanley, a transboundary-influenced site on the northern shore of Lake Erie. The lowest annual mean, 21.3 ppb, was measured at Toronto West, an urban site located near a major transportation corridor, Highway 401, and directly impacted by local nitric oxide (NO) emissions from vehicles. Generally, ozone concentrations are lower in urban areas because ozone is depleted by reacting with NO emitted by vehicles and other local combustion sources.

Figure 1:
Ontario VOCs Emissions by Sector (2015 Estimates for Point/Area/ Transportation Sources)



Note: Excludes emissions from open and natural sources.

Figure 2:
Ontario Nitrogen Oxides Emissions by Sector (2015 Estimates for Point/Area/ Transportation Sources)

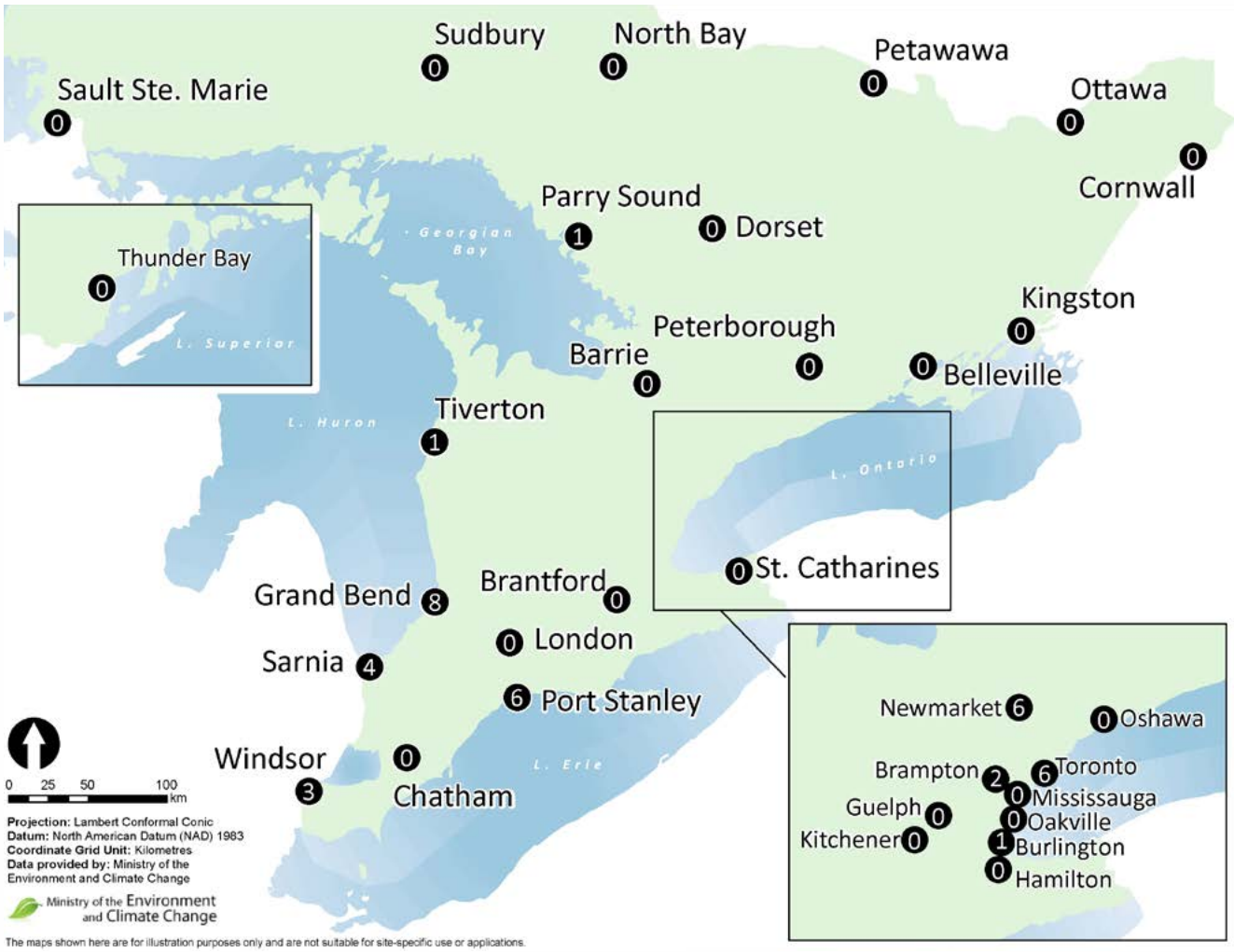


Note: Excludes emissions from open and natural sources.

Ground-level ozone was monitored at 39 AQHI sites in 2015. The maximum one-hour ozone concentrations ranged from 62 ppb recorded in Thunder Bay, to 92 ppb recorded in Newmarket. In 2015, thirteen sites in 10 locations across the province measured ozone levels above Ontario's one-hour AAQC of 80 ppb for at least one hour as shown in **Figure 3**. Ontario's one-hour AAQC for ozone was exceeded the most often at Grand Bend on eight occasions.

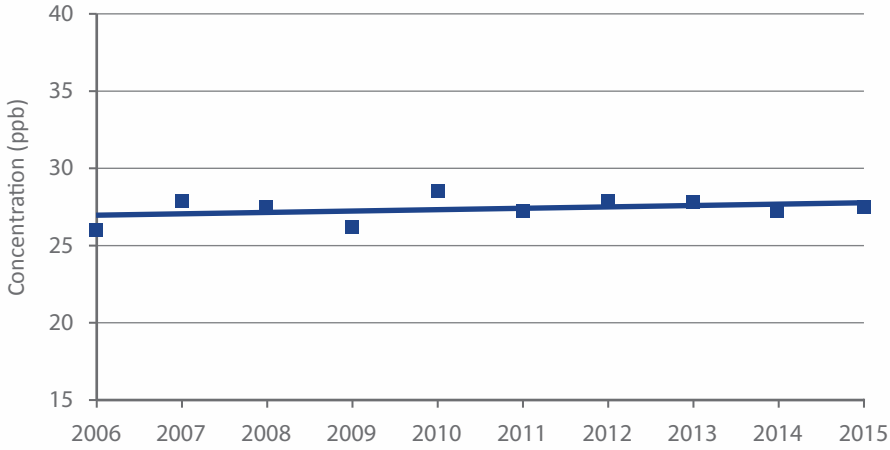
The ozone exceedances reported in southwestern Ontario, on the eastern shore of Lake Huron and on the northern shore of Lake Erie, are typically resulting from transboundary flow of pollutants. As stated in the *Transboundary Air Pollution in Ontario* report, elevated ozone levels in southwestern Ontario are generally attributed to the long-range transport of pollutants from the United States (Yap et al, 2005).

Figure 3: Geographical Distribution of the Number of Hours Above the 1-Hour Ozone AAQC Across Ontario in 2015



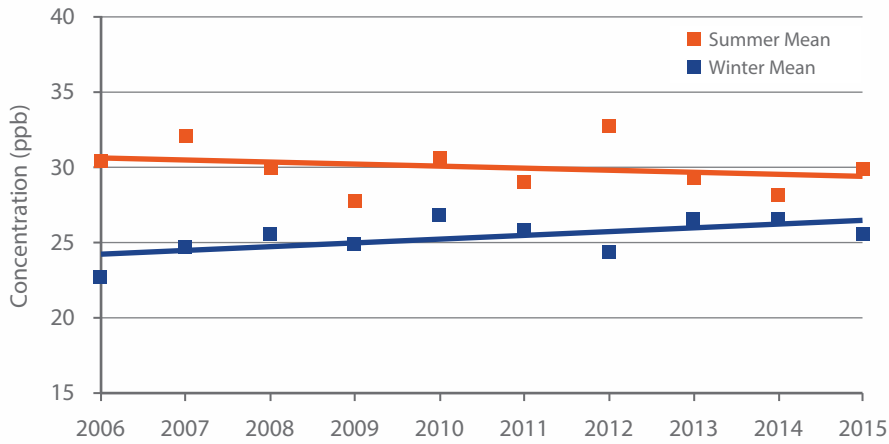
The ozone annual means in **Figure 4** display an increasing trend of 3 per cent for the 10-year period from 2006 to 2015. The trend for ozone summer means and ozone winter means are shown in **Figure 5**. The ozone summer means trend decreased by 4 per cent from 2006 to 2015, whereas the ozone winter means have increased by 9 per cent over the same 10-year period. The decrease in summer means over the past 10 years is largely due to the progressive reductions of NO_x emissions in Ontario and the U.S. resulting in the decrease in local ozone formation and transboundary influences especially during the summer months. Summer ozone, however, continues to exceed the Ontario AAQC during the warmer months and remains a challenge in areas of the province. The increase in the ozone winter means are mainly attributed to the rising global background concentrations which in turn drives the increasing trend of ozone annual means (Reid et al, 2008). In general, even with the increase in ozone winter means, ozone concentrations during the winter months continue to remain well below the Ontario AAQC of 80 ppb.

Figure 4:
Trend of Ozone Annual Means Across Ontario (2006-2015)



Note: 10-year trend is a composite annual mean based on data from 39 monitoring sites.

Figure 5:
Trend of Ozone Summer and Winter Means Across Ontario (2006-2015)



Note: 10-year trends are composite means for the summer and winter months based on data from 39 monitoring sites. Summer: May -September; Winter: January -April, October -December.

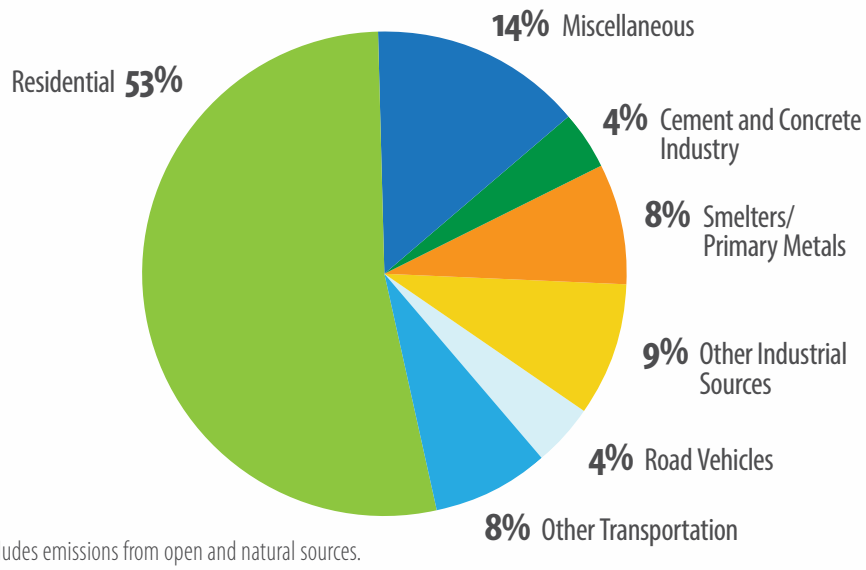
3.0 Fine Particulate Matter

Airborne particulate is the general term used to describe a mixture of microscopic solid particles and liquid droplets suspended in air. Particulate matter (PM) is classified according to its aerodynamic size, mainly due to the different health effects associated with particles of different diameters. Fine particulate matter, denoted as $PM_{2.5}$, refers to respirable particles that are less than 2.5 micrometres in diameter, approximately 30 times smaller than the average diameter of a human hair. Due to their small size, they can penetrate deep into the lungs.

Particulate matter includes aerosols, smoke, fumes, dust, fly ash and pollen. Its composition is complex and varies with origin, residence time in the atmosphere, time of year and environmental conditions. Major components of $PM_{2.5}$ in Ontario are typically nitrates, sulphates, organic matter and particle-bound water. Higher nitrate levels are common in the cooler months whereas sulphates are more elevated during warm temperatures. Fine particulate matter may be emitted directly into the atmosphere as a by-product of fuel combustion or it may be formed indirectly in the atmosphere through a series of complex chemical reactions. Major sources of $PM_{2.5}$ include motor vehicles, smelters, power plants, industrial facilities, residential fireplaces and wood stoves, agricultural burning and forest fires.

The 2015 estimates for Ontario's $PM_{2.5}$ emissions from point, area and transportation sources (excluding emissions from open and natural sources) indicate residential fuel combustion accounted for 53 per cent, as shown in **Figure 6**. The major contributor to residential emissions is fuel wood combustion in fireplaces and wood stoves. Industrial processes and transportation sectors accounted for 21 per cent and 12 per cent, respectively (2015 APEI).

Figure 6:
Ontario $PM_{2.5}$ Emissions by Sector (2015 Estimates for Point/Area/Transportation Sources)

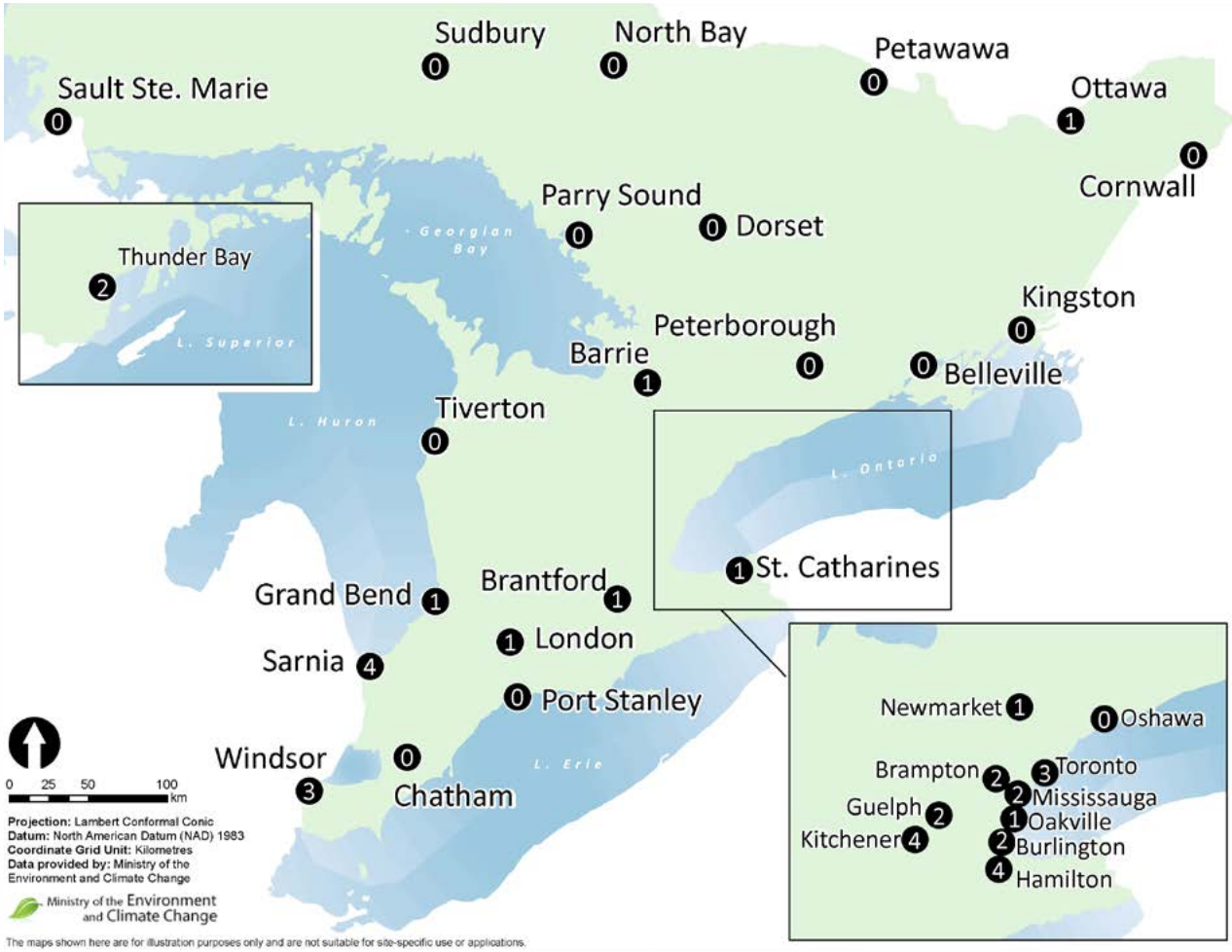


Note: Excludes emissions from open and natural sources.

In 2013, as part of a national initiative funded by Environment and Climate Change Canada (ECCC), Ontario upgraded all $PM_{2.5}$ monitors across its ambient air monitoring network and started reporting with this new technology. While annual means and maximums are reported for 2015, 10-year trends for the entire ambient air monitoring network cannot be determined since the 2013 to 2015 $PM_{2.5}$ data set is not directly comparable to data collected using the older technology. Ontario's new $PM_{2.5}$ measurement technology and 10-year trends are discussed further in **Section 3.1**: Technical Discussion - New $PM_{2.5}$ Measurement Technology in Ontario.

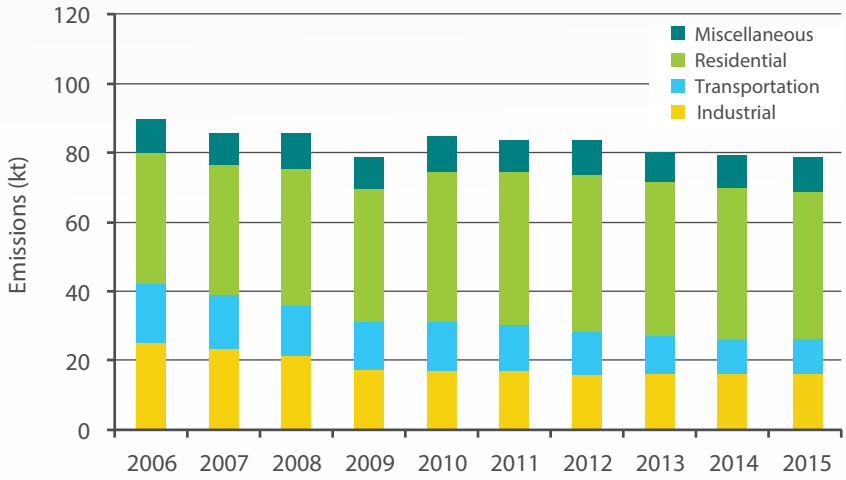
In 2015, 39 AQHI sites measured $PM_{2.5}$; annual mean concentrations ranged from 4.8 µg/m³ in Petawawa to 10.2 µg/m³ in downtown Hamilton. The $PM_{2.5}$ 24-hour maximum concentrations ranged from 15 µg/m³ in Petawawa to 42 µg/m³ recorded at Windsor West. Twenty-five air monitoring sites in 18 locations across the province measured daily averages above Ontario's 24-hour $PM_{2.5}$ reference level of 28 µg/m³ on at least one occasion as shown in **Figure 7**.

Figure 7:
Geographical Distribution of the Number of Days Above the 24-Hour $PM_{2.5}$ Reference Level Across Ontario in 2015



Provincial $PM_{2.5}$ emissions have decreased approximately 11 per cent from 2006 to 2015 as shown in **Figure 8**. Fine particulate matter emissions from electric utilities and industrial processes have been reduced approximately 35 per cent during this period. Emissions from the transportation sector decreased 44 per cent with the phase-in of new vehicles/engines having more stringent emission standards over the same period.

Figure 8:
Ontario $PM_{2.5}$ Emission Trend (2006-2015)



Note: Excludes emissions from open and natural sources.

3.1 Technical Discussion

New $PM_{2.5}$ Measurement Technology in Ontario

In 2002 Ontario became the first province in Canada to report hourly $PM_{2.5}$ concentrations to the public under the Air Quality Index (AQI) program utilizing Tapered Element Oscillating Microbalance (TEOM) instruments that provided continuous PM monitoring. Continuous PM monitoring is essential for reporting hourly ambient concentrations. The TEOM was the most innovative method at the time for continuous real-time $PM_{2.5}$ monitoring (Patashnick and Rupprecht, 1991), and continues to be used by many jurisdictions across North America.

Over the last decade, continuous $PM_{2.5}$ monitoring technologies have evolved dramatically to address the technical issues associated with cold weather $PM_{2.5}$ measurements. After extensive evaluation of four new $PM_{2.5}$ monitors, it was determined that Ontario's TEOM instruments did not perform as well as these new $PM_{2.5}$ monitors, particularly during the winter. Ontario selected the Synchronized Hybrid Ambient Real-time Particulate (SHARP) 5030 to replace the aging TEOM monitors deployed in the AQI network. As part of a national initiative funded by ECCC, Ontario deployed the SHARP 5030 monitors in 2012 across the ambient air monitoring network for testing. In January 2013, Ontario commenced public reporting with the new SHARP 5030 instruments. The SHARP 5030 reports higher $PM_{2.5}$ concentrations than the TEOM analyzer during cold weather due to the improved performance of the SHARP 5030

(Sofowote et al, 2014). This has resulted in an increase in Ontario's $PM_{2.5}$ annual mean from 2013 to 2015, however this is not an indication that the air quality has changed; only that the measurement is more accurate.

A network-wide trend using historical TEOM and 2013-2015 SHARP data cannot be determined as the two datasets are not directly comparable. In anticipation of this, TEOM and SHARP monitors were collocated at a sub-set of air monitoring stations to continue reporting annual trends and work towards making the new $PM_{2.5}$ measurements comparable to historical data. Seven sites including Sarnia, Port Stanley, Hamilton Downtown, Toronto West, Ottawa Downtown, Cornwall and North Bay, were selected to be representative of Ontario's $PM_{2.5}$ network, taking into consideration the differences in air quality across the province. The 10-year $PM_{2.5}$ trend for these sites, using TEOM technology, continues to show a decrease of $PM_{2.5}$ levels. For the period of 2006 to 2015 a decrease of 25 per cent was observed **(Figure 9)**. Additionally, Ontario developed corrections for historical TEOM measurements, for the fall and winter seasons, for the purpose of making them more comparable to SHARP measurements through a multiple linear regression analysis. This analysis, using collocated TEOM and SHARP instruments, showed that on average, annual SHARP measurements were 25 per cent higher than TEOM measurements (Sofowote et al, 2014). Using this as an approximate correction factor, **Figure 9** displays an estimated SHARP-like 10-year trend that parallels the TEOM trend, and illustrates that Ontario's air quality is still improving based on measurements using the new technology. With more accurate, but higher, reported $PM_{2.5}$ values resulting from the implementation of SHARP instruments, achievement of $PM_{2.5}$ reference levels and standards may be more challenging.

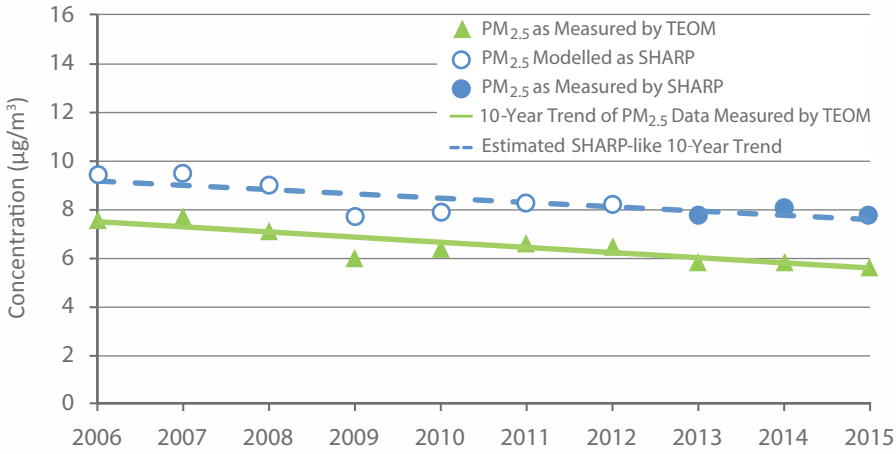


Figure 9:
Trend of $PM_{2.5}$ Annual Means at Select Sites Across Ontario (2006-2015)

Note: The trend is a composite mean based on data from Sarnia, Port Stanley, Hamilton Downtown, Toronto West, Ottawa Downtown, Cornwall and North Bay. $PM_{2.5}$ concentrations as measured by TEOM operated at 30°C with Sample Equilibration System (2006-2015) and by SHARP 5030 (2013-2015).

4.0 Other Air Pollutants

Nitrogen Dioxide

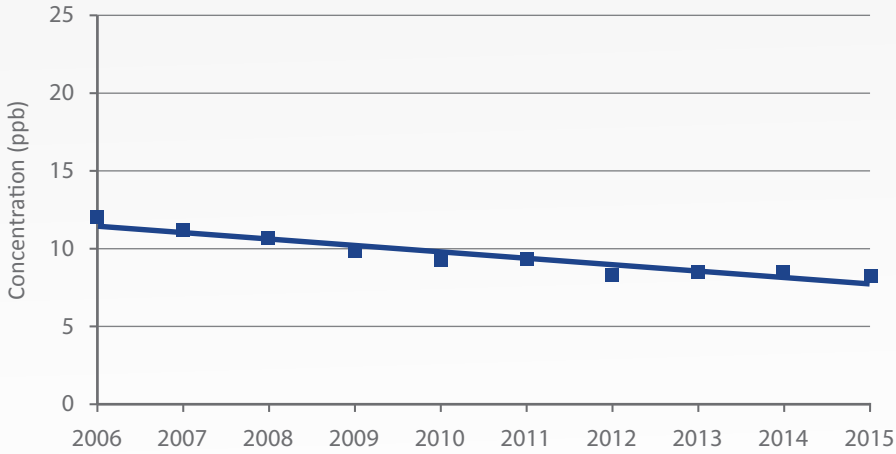
Nitrogen dioxide is a reddish-brown gas with a pungent odour, which transforms in the atmosphere to form gaseous nitric acid and nitrates. It plays a major role in atmospheric reactions that produce ground-level ozone, a major component of smog. Nitrogen dioxide also reacts in the air and contributes to the formation of $PM_{2.5}$ (Seinfeld and Pandis, 2006). All combustion in air produces NO_x, of which NO_2 is a component. Major sources of NO_x emissions include the transportation sector, industrial processes and utilities.

Nitrogen dioxide can irritate the lungs and lower their resistance to respiratory infection. People with asthma and bronchitis have increased sensitivity to NO_2. Nitrogen dioxide chemically transforms into nitric acid in the atmosphere and, when deposited, contributes to the acidification of lakes and soils in Ontario. Nitric acid can also corrode metals, fade fabrics, degrade rubber, and damage trees and crops.

There were no exceedances of the provincial one-hour and 24-hour AAQC for NO_2, 200 ppb and 100 ppb, respectively, at any of the monitoring locations in Ontario during 2015. The Toronto West air monitoring station, located in an area of Toronto influenced by significant vehicular traffic, recorded the highest NO_2 annual mean (16.6 ppb) during 2015; whereas Tiverton, a rural site, recorded the lowest NO_2 annual mean (2.4 ppb). The highest NO_2 means were recorded in large urbanized areas, such as the Greater Toronto Area of southern Ontario. The Toronto East station recorded the highest one-hour NO_2 concentration (69 ppb), and both Toronto West and Sudbury recorded the highest 24-hour NO_2 concentration (42 ppb).

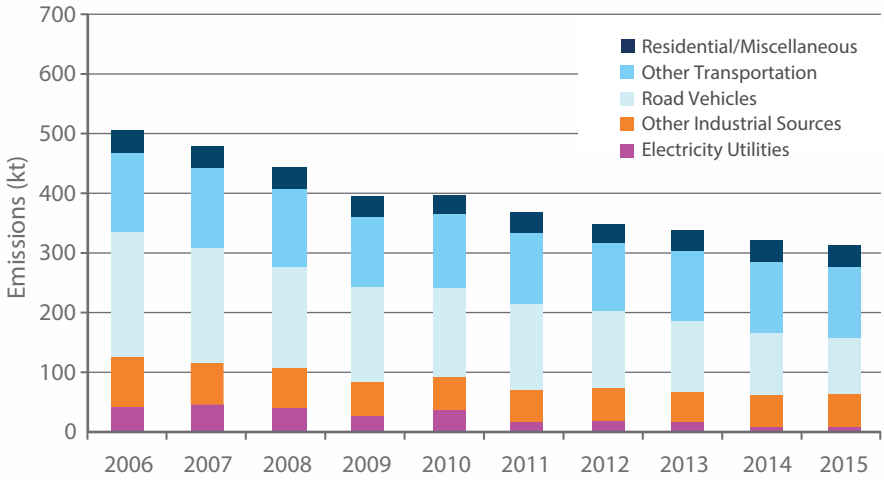
The NO_2 annual mean concentrations across Ontario have decreased 32 per cent from 2006 to 2015, as displayed in **Figure 10**. The NO_x emission trend from 2006 to 2015 indicates a decrease of approximately 38 per cent as shown in **Figure 11** (2015 APEI). Ontario's emissions trading regulations on sulphur dioxide and nitrogen oxides (O. Reg. 397/01 and O. Reg. 194/05) have contributed to the reduction in nitrogen oxides emissions in recent years. Nitrogen oxides emissions from on-road vehicles have also decreased due to the phase-in of new vehicles having more stringent emission standards. The implementation of the Ontario Drive Clean program in southern Ontario in 1999 has also helped further reduce the NO_x emissions from light duty gasoline vehicles.

Figure 10:
Trend of NO_2 Annual Means Across Ontario (2006-2015)



Note: 10-year trend is a composite mean based on data from 31 monitoring sites.

Figure 11:
Ontario NO_X Emission Trend (2006-2015)



Note: Excludes emissions from open and natural sources.

Sulphur Dioxide

Sulphur dioxide is a colourless gas that smells like burnt matches. It can also be oxidized in the atmosphere to form sulphuric acid aerosols. In addition, sulphur dioxide is a precursor to sulphates, one of the main components of airborne secondary $PM_{2.5}$. Major sources of SO_2 include smelters, industrial processes and electric utilities.

Health effects caused by exposure to high levels of SO_2 include breathing problems, respiratory illness, and the exacerbation of respiratory and cardiovascular disease. People with asthma, chronic lung disease or heart disease are the most sensitive to SO_2. Sulphur dioxide damages trees and crops. Similar to NO_2, SO_2 leads to the formation of $PM_{2.5}$ and is also a precursor to acid rain, which contributes to the acidification of soils, lakes and streams, accelerated corrosion of buildings, and reduced visibility.

Smelters in central Ontario are the major sources of SO_2 emissions in Ontario, accounting for approximately 71 per cent of the provincial SO_2 emissions according to 2015 estimates for point, area and transportation sources (excluding emissions from open and natural sources). Industrial processes (e.g. petroleum refining, cement and concrete manufacturing) accounted for an additional 26 per cent. The transportation sector and miscellaneous sources accounted for the remaining 3 per cent of all SO_2 emissions in the province (2015 APEI).

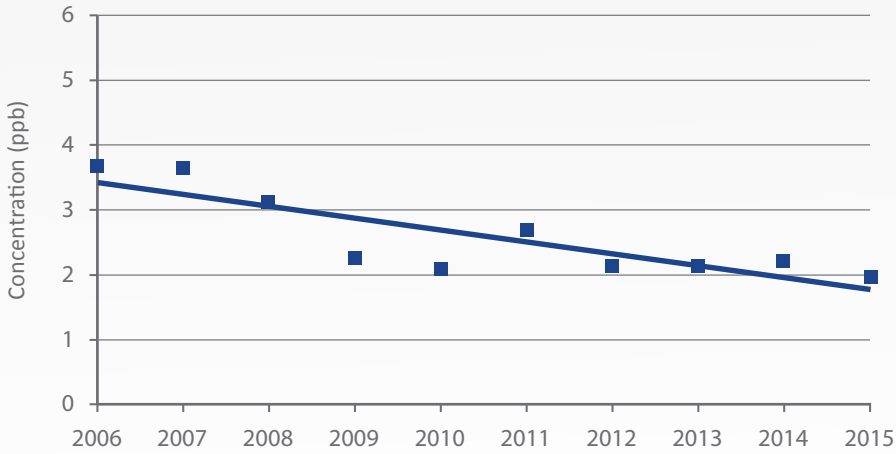
There were no exceedances of the provincial one-hour, 24-hour and annual AAQC for SO_2 of 250 ppb, 100 ppb and 20 ppb, respectively, at any of the ambient air monitoring locations in Ontario during 2015. Hamilton Downtown recorded the highest SO_2 annual mean (4.3 ppb) during 2015, and the highest 24-hour maximum concentration (39 ppb) was recorded at Sarnia. Sudbury recorded the highest one-hour maximum concentration (221 ppb) during 2015.

The SO_2 annual mean concentrations from 2006 to 2015 show a decreasing trend of 48 per cent across Ontario in **Figure 12**. Overall, provincial SO_2 emissions have decreased by approximately 44 per cent from 2006 to 2015 as shown in **Figure 13** (2015 APEI). The reduction of SO_2 emissions over the years is the result of various initiatives, which include, but are not limited to,

i. Control orders for Ontario smelters;
ii. Countdown Acid Rain program and Canada-wide Acid Rain Strategy;
iii. Ontario emissions trading regulations on sulphur dioxide and nitrogen oxides (O. Reg. 397/01 and O. Reg. 194/05);
iv. Cessation of coal use in electricity generation; and
v. Low sulphur content in transportation fuels.

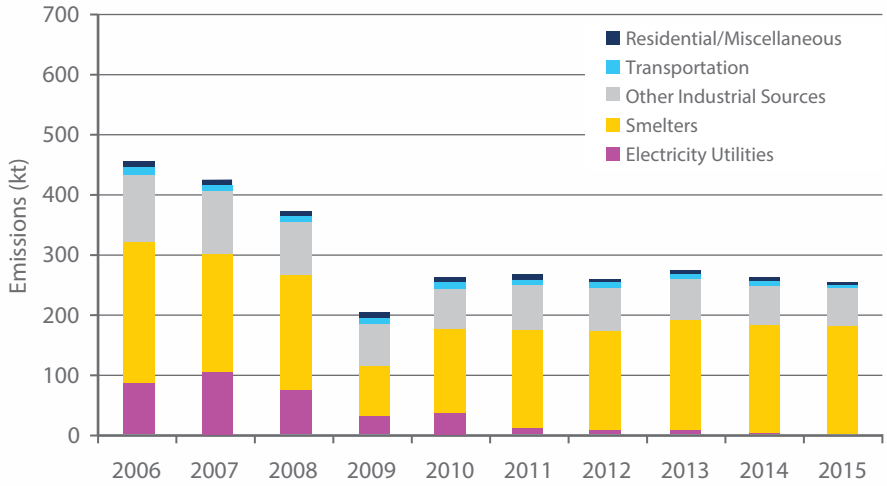
FACT: NO_X and SO_2 electricity sector emissions trading regulation (O. Reg. 397/01) placed limits on Ontario Power Generation's (OPG) fossil fuel-fired generating stations starting 2002. Effective January 1, 2004 the program also applied to independent power producers (IPPs). The trading program was expanded in 2006 to include thirty facilities from seven industrial sectors. NO_X and SO_2 emissions for electricity generators covered under the trading program have fallen by approximately 78% and 98% respectively between 2006 and 2015, largely because of coal closure. NO_X and SO_2 emissions for the industrial facilities regulated under the program (O.Reg. 194/05) have fallen by approximately 26% and 27% between 2006 and 2015. This decline is the result of a combination of factors including emissions reduction initiatives undertaken by facilities covered by the program and industry restructuring.

Figure 12:
Trend of SO_2 Annual Means Across Ontario (2006-2015)



Note: 10-year trend is a composite mean based on 10 ambient air monitoring sites.

Figure 13:
Ontario SO_2 Emission Trend (2006-2015)



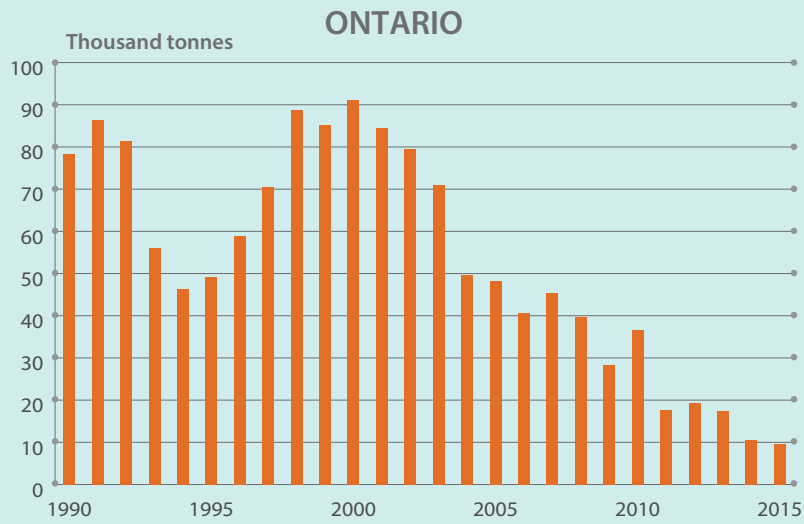
Note: Excludes emissions from open and natural sources.

Ontario Coal Closure

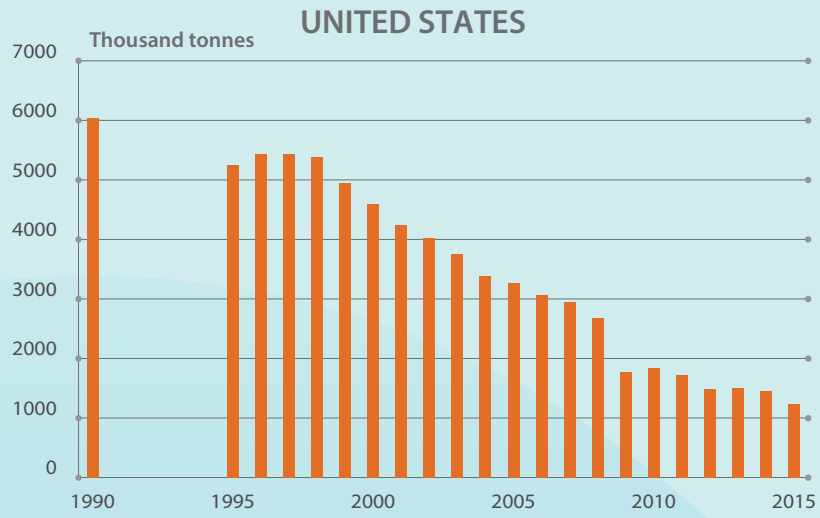
Ontario was the first jurisdiction in North America to eliminate coal as a source of electricity production, resulting in significant decreases in emissions of NO_x, SO_2 and mercury.

As a result of the introduction of the Cessation of Coal Use Regulation in August 2007, coal went from 25% of Ontario's energy supply mix in 2003 to zero in 2014 when the last plant ceased coal use. Improvements in SO_2 and NO_x pollution control technologies at operating fossil fuel generating stations also contributed to reductions during the 1990's to mid-2000's. Between the mid-1990's and 2000's, SO_2 and NO_x emissions increased because coal-fired power generation capacity was increased to compensate for the lost capacity while the nuclear generating units were refurbished. The coal generating capacity has since been replaced with a mix of emission-free energy sources including nuclear, hydro and renewables beginning in the early to mid-1990's, along with lower-emission energy sources such as natural gas and biomass beginning in the late 2000's. More than 90% of the power generated in Ontario now comes from clean energy.

NO_x Emission Trend from Electric Utilities

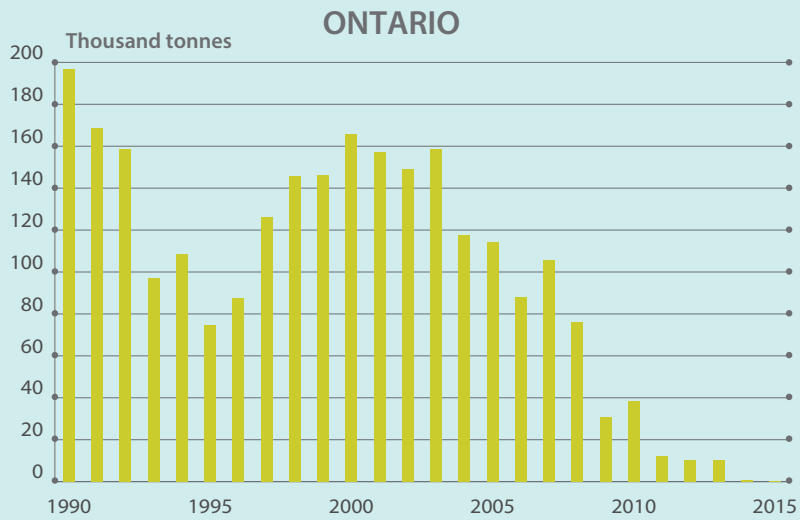


Source of Data: 2015 APEI

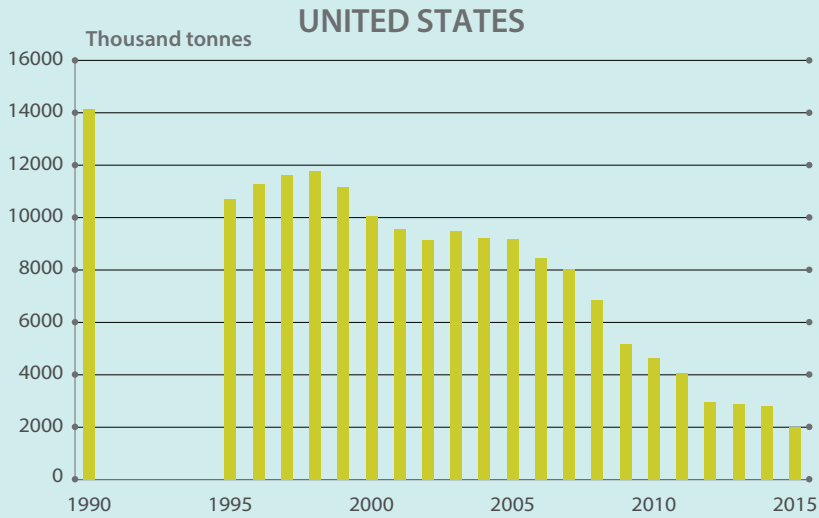


Source of Data: 2015 AMPD and 1990 APETD

SO_2 Emission Trend from Electric Utilities



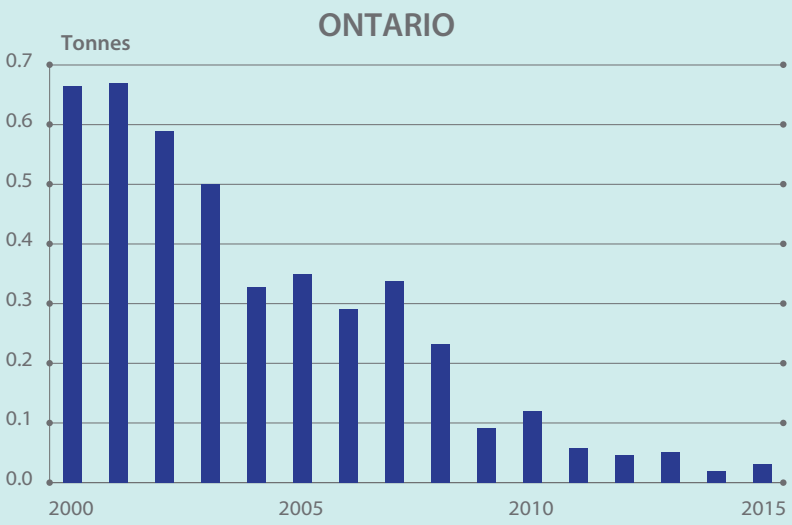
Source of Data: 2015 APEI



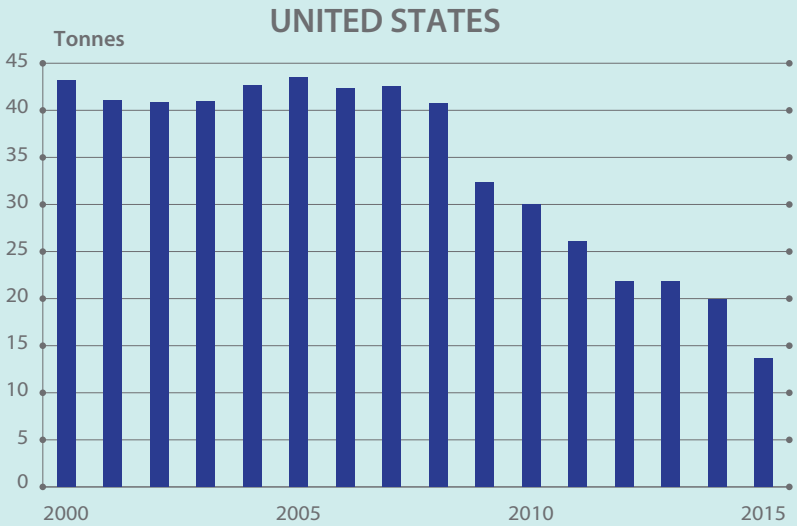
Source of Data: 2015 AMPD and 1990 APETD

The U.S. has also reduced emissions from power plants and industrial units over the same period as a result of introducing its Clean Air Markets Programs which targeted SO_2, NO_x and other contaminants by either placing caps on emissions or imposing reduction targets. The first nationwide program was the Acid Rain Program, which was first phased in 1995 and was fully implemented by 2010, followed by the NO_x Budget Trading Program (2003-2008) which was subsequently replaced by the Clean Air Interstate Rule (CAIR) beginning in 2009.

Mercury Emission Trend
Electric Utilities



Source of Data: 2015 APEI



Source of Data: 2015 TRI

Between 1990 and 2015 NO_x emissions from Ontario's electricity sector (including coal, natural gas, fuel oil, diesel and biomass generating stations) decreased by 87.8% and SO_2 emissions decreased by 99.8%, and mercury emissions decreased by 95.3% between 2000 and 2015; due in part to the elimination of coal. By comparison, for the same periods, NO_x emission from the electricity sector in the U.S. decreased by 79.5%, SO_2 by 85.9% and mercury by 68.2%.

Further, a comparison of the emission reductions attributable to coal elimination as compared to overall provincial emission reductions, illustrates the significance of coal cessation – coal plant NO_x emission reductions were 24% of provincial total, SO_2 was 22% and mercury was 29%.

Pollutant	Emission Reductions		Coal Plant Emission Reductions relative to Ontario
	Ontario	Coal Plant	
SO_2	↓ 878 kt	↓ 193 kt	22%
NO_x	↓ 313kt	↓ 75 kt	24%
Mercury	↓ 1897 kg	↓ 549 kg	29%

Notes: Excludes emissions from open and natural sources.
NO_x and SO_2 emission reductions are based on 1990-2015 data.
Mercury emission reductions are based on 2000-2015 data.

Carbon Monoxide

Carbon monoxide is a colourless, odourless, tasteless and, at high concentrations, poisonous gas. This gas can enter the bloodstream and reduce oxygen delivery to the organs and tissues. People with heart disease are particularly sensitive to CO. Exposure to high CO levels is associated with the impairment of vision, work capacity, learning ability and performance of complex tasks. Carbon monoxide is produced primarily by the incomplete combustion of fossil fuels. The 2015 estimates for point, area and transportation sources (excluding emissions from open and natural sources) indicate that the transportation sector accounted for 66 per cent of all CO emissions (2015 APEI).

In 2015 there were no exceedances of the provincial one-hour and eight-hour AAQC of 30 parts per million (ppm) and 13 ppm, respectively, at any of the ambient air monitoring locations in Ontario. Windsor Downtown recorded the highest one-hour CO maximum of 1.91 ppm and the highest eight-hour maximum of 1.20 ppm. Typically, higher CO concentrations recorded in urban centres are attributable to vehicle emissions.

The composite means of the one-hour and eight-hour CO maximums have decreased 53 per cent and 41 per cent, respectively, across the province from 2006 to 2015. Carbon monoxide emissions have been reduced by approximately 32 per cent from 2006 to 2015 (2015 APEI).

5.0 Canadian Ambient Air Quality Standards

In May of 2013 the federal government published the Canadian Ambient Air Quality Standards (CAAQS) as non-binding objectives under the *Canadian Environmental Protection Act*. The CAAQS were developed under the auspices of the Canadian Council of Ministers of the Environment (CCME) as outdoor air quality targets that "set the bar" for air quality actions across the country.

The CAAQS replaced the existing Canada-wide Standards (CWS) for ozone and $PM_{2.5}$ in 2013 by setting stricter targets, and introducing an annual standard for $PM_{2.5}$. An annual standard helps protect human health from long-term or chronic exposure to fine particles. The purpose of the CAAQS is to drive continuous improvement in air quality. In 2015, provinces and territories were formally required to report ambient air quality measurements against the CAAQS. **Table 1** shows the 2015 standards for achieving the CAAQS.

Table 1:
CAAQS Standards

Ozone 8h	$PM_{2.5}$ 24h	$PM_{2.5}$ Annual
63 ppb(1)	28 µg/m^3 (2)	10 µg/m^3 (3)

(1) based on the annual 4th highest daily maximum eight-hour running average, averaged over three consecutive years.
(2) based on the 98th percentile measurement annually, averaged over three consecutive years.
(3) based on the annual mean averaged over three consecutive years.

The Influence of Transboundary Flow - Weight of Evidence Analysis

Outdoor concentrations of ozone and $PM_{2.5}$ can be influenced by emission sources that are outside the control of provinces and territories, such as transboundary flows and exceptional events including forest fires. The CCME *Guidance Document on Achievement Determination for the Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (2012)* guides provinces and territories in the consideration of transboundary flows and exceptional events when implementing management actions, and in conveying to the public that a CAAQS was not achieved as a result of these influences.

Transboundary influences, mainly from the U.S., account for a significant portion of Ontario's smog when their levels are higher. Emission reductions in Ontario and the U.S. have contributed to decreases in $PM_{2.5}$ and ozone concentrations. However, while ambient concentrations have improved, the province continues to experience high levels of ozone due to both transboundary air pollution and increasing global background levels, which has contributed to exceedances of the ozone standard. It is therefore important to consider the influence of transboundary flows using WOE for CAAQS designated air monitoring stations when reporting on achievement of the CAAQS.

Meeting Ozone CAAQS in Ontario

The ozone CAAQS metric values for CAAQS designated Ontario ambient air monitoring sites for 2015 is based on a three-year average, 2013-2015. The 2015 ozone CAAQS metric values ranged from 52 ppb, reported for Thunder Bay, to 69 ppb, reported for Windsor Downtown. Five of the 21 designated sites originally met the CAAQS of 63 ppb for ozone in 2015. A weight of evidence (WOE) analysis was thus conducted to demonstrate the influence of transboundary flows for CAAQS designated air monitoring sites where the ozone CAAQS was exceeded in 2015 – the first year that achievement has been assessed relative to the CAAQS. The WOE approach consists of performing, evaluating and documenting a series of technical analyses that collectively support the conclusion that exceedances of the standard on a given day were influenced by, in this case, transboundary flows. **Figure 14** shows the 2015 ozone CAAQS metric values for designated CAAQS sites across Ontario, in addition to the amended CAAQS metrics which exclude transboundary flow days, only for those locations where the ozone CAAQS was originally exceeded. The WOE analysis confirms that these Ontario cities displayed in **Figure 14** would have met the ozone CAAQS if they had not been influenced by days with transboundary flow. **Figure 15** displays the number of transboundary flow days that were removed for each of the exceeding CAAQS sites using WOE. The WOE approach is applied if the three-year ozone metric value and the corresponding annual 4^{th} highest daily maximum eight-hour running average(s) exceed the ozone CAAQS. For more details on the CAAQS metrics for ozone and the WOE approach, refer to **Tables A19-A21** of the Appendix.

Figure 14: Ozone CAAQS Metric Values for Designated Sites Across Ontario, 2015

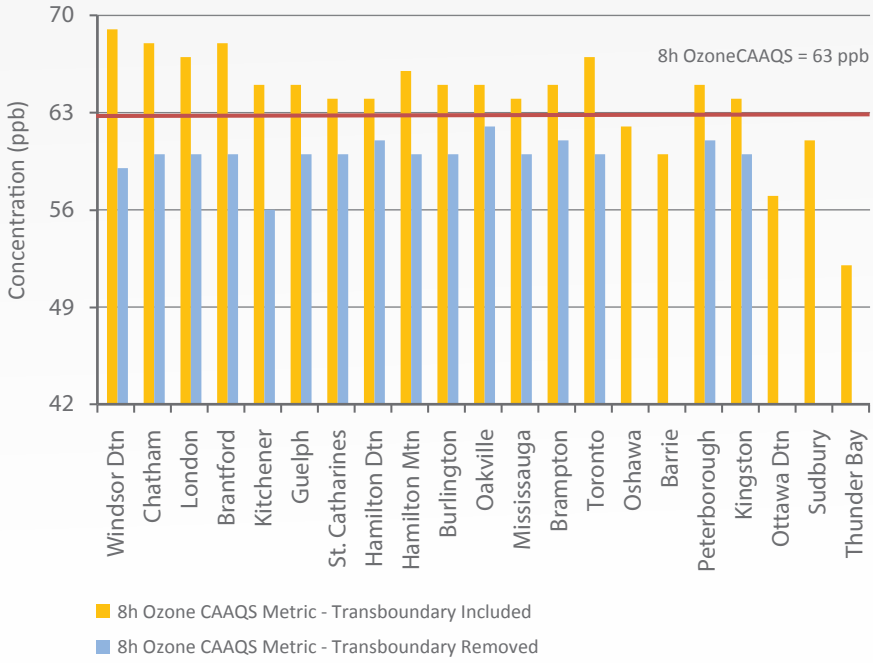
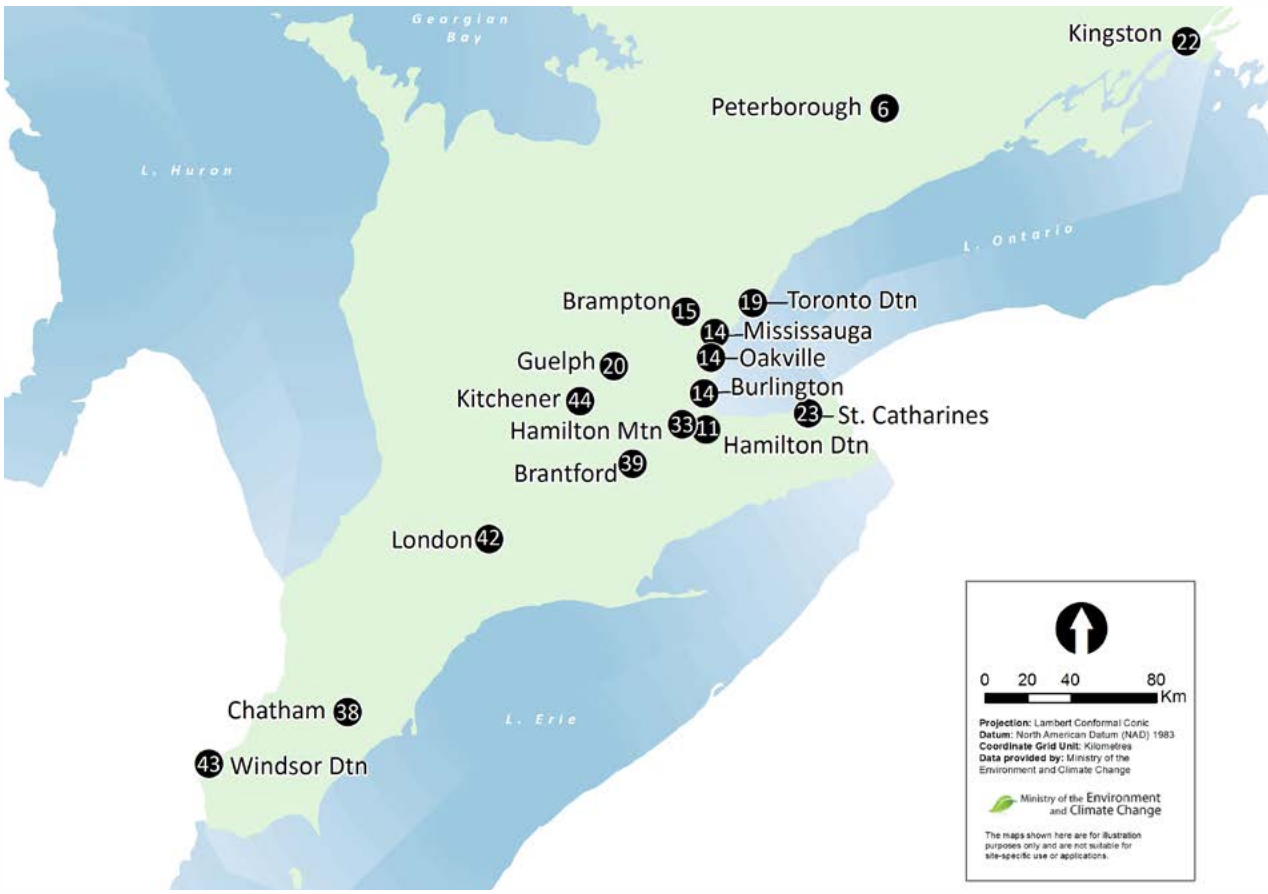


Figure 15: Total Number of Transboundary Days Removed (2013-2015)

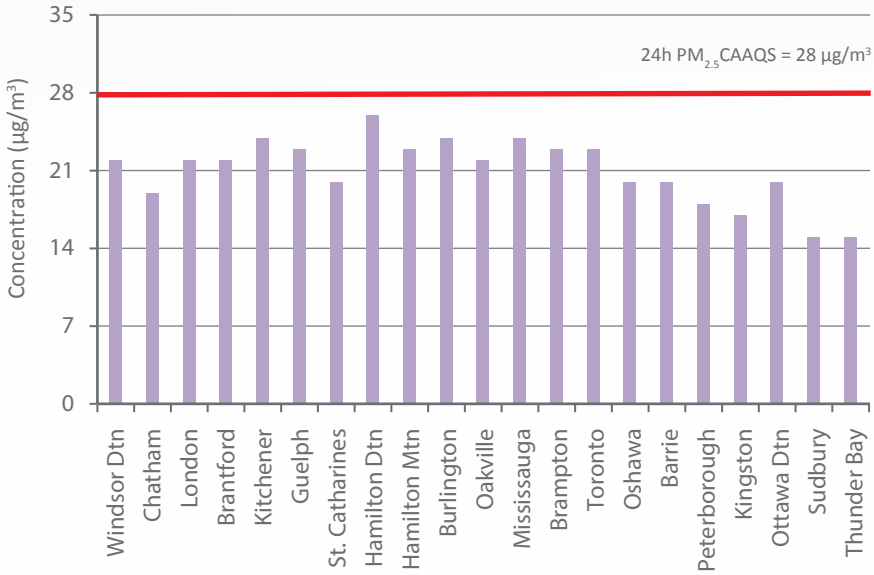
Note: The CAAQS for ozone (63 ppb) is based on the consecutive three-year average of the annual 4th highest daily maximum eight-hour running average. The weight of evidence analysis was applied to those sites which exceeded the CAAQS for ozone; as such, the ozone metric values were amended after removing transboundary-influenced days accordingly.



Meeting $PM_{2.5}$ CAAQS in Ontario

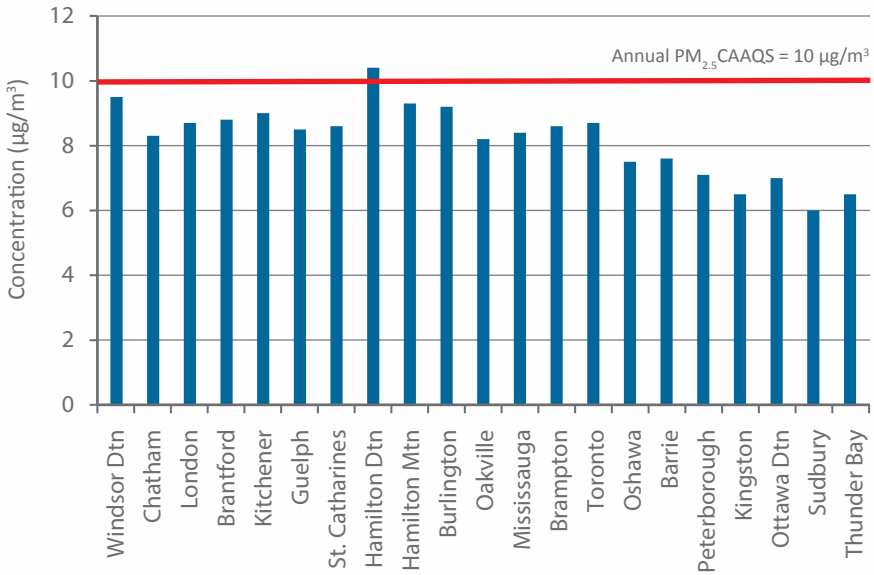
The 2015 24-hour $PM_{2.5}$ CAAQS metric values ranged from 15 µg/m³, reported for both Sudbury and Thunder Bay, to 26 µg/m³, reported for Hamilton Downtown. The 2015 annual $PM_{2.5}$ CAAQS metric concentrations ranged from 6.0 µg/m³, reported for Sudbury, to 10.4 µg/m³, reported for Hamilton Downtown which is the only site to exceed the $PM_{2.5}$ CAAQS of 10 µg/m³ in 2015. The CAAQS metric values for the 24h and annual $PM_{2.5}$ are displayed in **Figures 16** and **17**, respectively, and in **Table A19** of the Appendix.

Figure 16: 24h $PM_{2.5}$ CAAQS Metric Values for Designated Sites Across Ontario, 2015



Note: The CAAQS for 24h $PM_{2.5}$ (28 µg/m³) is based on the 98th percentile measurement annually, averaged over three consecutive years.

Figure 17: Annual $PM_{2.5}$ CAAQS Metric Values for Designated Sites Across Ontario, 2015



Note: The CAAQS for annual $PM_{2.5}$ (10 µg/m³) is based on the annual mean averaged over three consecutive years.

6.0 Air Quality Health Index and Air Quality Alerts

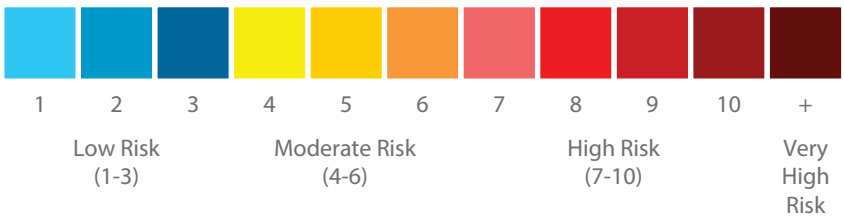
Progressing Forward: Moving From the Air Quality Index to the Air Quality Health Index

The Environmental Monitoring and Reporting Branch at the Ministry of the Environment and Climate Change (MOECC) continuously collects near real-time data for up to six criteria pollutants (ozone, $PM_{2.5}$, NO_2, SO_2, CO and TRS compounds) from 39 ambient air monitoring sites as displayed in **Map A1** of the Appendix.

On June 24, 2015, in partnership with ECCC, the ministry introduced the new AQHI to replace the previous AQI. Ontario's AAQC for the common criteria pollutants was the foundation of the AQI. The AQI reported air quality based on the pollutant recording the highest sub-index for a single pollutant at each site. The purpose of the AQI was to inform the public about air quality and the potential of smog to influence public/industry behaviour and protect public health.

The AQHI derives a value based on the cumulative health effects of three pollutants – ozone, $PM_{2.5}$ and NO_2. The AQHI was developed and implemented by Health Canada with the assistance of ECCC and all provinces. Ontario's AQHI combines the best features of the federal AQHI and the previous AQI by incorporating Ontario's AAQC for the common criteria pollutants with the health risks associated with ozone, $PM_{2.5}$ and NO_2. It provides real-time air quality measurements using a scale of one through 10 or greater, with lower numbers representing better air quality, as depicted in **Figure 18**. Index values between one and three are considered low risk, four to six are moderate risk, seven to 10 are high risk and greater than 10 are very high risk. **Table 2** outlines the health messages associated with the AQHI. The ministry website, www.airqualityontario.com, provides index values and corresponding categories and health messages.

Figure 18: AQHI Scale



Source: Environment & Climate Change Canada.

Table 2: Air Quality Health Index Categories and Health Messages

Health Risk	Air Quality Health Index	Health Messages	
		At Risk Population [1]	General Population
Low	1 - 3	Enjoy your usual outdoor activities.	Ideal air quality for outdoor activities.
Moderate	4 - 6	Consider reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	No need to modify your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High	7 - 10	Reduce or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High	Above 10	Avoid strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

* People with heart or breathing problems are at greater risk. Follow your doctor's usual advice about exercising and managing your condition.

Source: Environment & Climate Change Canada

Based on the AQHI categories, in 2015, Ontario reported low risk air quality 89.79 per cent of the time, moderate risk 10.17 per cent of the time, and high risk only 0.04 per cent of the time; there were no very high risk hours reported. **Table A22** of the Appendix provides the percentage distribution of hourly AQHI readings for each of the 39 monitoring sites by AQHI value and the number of high risk AQHI days.

Air Quality Alerts

In 2015, with the introduction of the AQHI, Ontario began issuing air quality alerts that include a two-level alert system, issued in partnership with ECCC. The first level is a Special Air Quality Statement (SAQS), which informs the public of the potential for degrading air quality and is issued if an AQHI of 7 or greater is expected to last for 1 or 2 hours (i.e., "pop-up"). A SAQS is also issued for areas where forest fire smoke is expected to cause deteriorating air quality. The second level is a Smog and Air Health Advisory (SAHA), issued when "high risk" AQHI levels (AQHI of 7 or greater) are expected to be persistent and continue for 3 hours or more. The SAQS does not constitute a SAHA, but serves as a notification for Ontarians, especially those at risk, to pay attention to air quality and adjust their activities if adverse health effects are observed.

Air quality alerts are issued via the ministry's web site, ECCC's website, and through email air quality alert notifications. To subscribe for air quality alert notifications, please visit the ministry web site, www.airqualityontario.com/alerts/signup.php.

Ontario did not issue a SAHA in 2015, however, there were seven SAQS issued for regions across the province. Three SAQS were issued for parts of northwestern Ontario due to forest fire smoke originating from Manitoba and/or Saskatchewan. The remaining SAQS were all issued as a result of elevated ozone concentrations in southern Ontario. **Table A23** of the Appendix summarizes the number of SAQS and SAHA issued for Ontario in 2015.

Access to Air Quality Information

Near real-time and historic pollutant concentration data and AQHI values are available to the public (24 hours per day, 7 days a week) from across the province on the ministry's web site , www.airqualityontario.com . The public can also access index values via the Interactive Voice Response (IVR) system. (To access a recording in English or French, call 1.800.387.7768, or in Toronto, call 416.246.0411). The ministry's web site also provides air quality forecasts throughout the day, based on regional meteorological conditions and current pollution levels in Ontario and bordering American states.

7.0 Air Toxics – Select VOCs

VOCs are precursors of ground-level ozone and $PM_{2.5}$. VOCs are emitted into the atmosphere from a variety of anthropogenic sources, including vehicles, fossil fuel combustion, steel-making, petroleum refining, fuel-refilling, industrial and residential solvent use, paint application, manufacturing of synthetic materials (e.g. plastics, carpets), food processing, agricultural activities and wood processing and burning. As stated in Section 2.0, general solvent use accounted for approximately 27 per cent of VOCs emissions in Ontario; the second largest source was the transportation sectors accounting for approximately 26 per cent. (Refer to **Figure 1** for the estimates of Ontario's VOCs emissions from point, area and transportation sources).

VOC Monitoring

Specialized, non-routine monitoring and analytical techniques are required to measure VOCs because they are usually present in the atmosphere in a gaseous form at ultra-trace concentrations. VOC samples are collected by automatically drawing ambient air into empty stainless steel canisters over a 24-hour period (midnight to midnight), following the National Air Pollution Surveillance (NAPS) sampling schedule (typically every sixth day) for urban sites. Concentrations for up to 161 selected VOCs are reported for each sample. For the purposes of this report, select VOCs (benzene, toluene, ethylbenzene, xylene, and 1,3-butadiene) data collected from eight ambient air monitoring stations (Windsor West, Sarnia, London, Kitchener, Hamilton Downtown, Brampton, Newmarket and Ottawa) between 2005 and 2014 are included in this discussion. Data from these sites are provided by ECCC as part of a co-operative federal-provincial program under NAPS and are available online at http://maps-cartes.ec.gc.ca/rnspa-naps/data.aspx. Annual 2014 statistics for the six select VOCs are presented in the Appendix.

Benzene, Toluene, Ethylbenzene, Xylene (BTEX)

Benzene is a volatile aromatic hydrocarbon, which is primarily used in the production of plastics and other chemical products. Large quantities of benzene are obtained from petroleum, either by direct extraction from certain types of crude oils or by chemical treatment of gasoline. Benzene is classified as a human carcinogen (USEPA, 2016).

In 2014, benzene annual means ranged from 0.41 µg/m³ at Ottawa Downtown to 1.01 µg/m³ in Sarnia. Ontario's 24h AAQC for benzene of 2.3 µg/m³ was exceeded on four occasions at both Sarnia and Hamilton Downtown, as displayed in **Table 3**. These measurements are reflective of all sources of benzene at the community level (for example, industrial activity and transportation) and are not specific to any one source and/or a specific point source. The 24-hour maximum benzene concentration reported at Sarnia was 17.37 µg/m³ capturing an episodic condition; Hamilton Downtown reported a 24-hour maximum of 4.01 µg/m³.

Table 3: 24h Benzene Concentrations > 2.3 µg/m³ in 2014

Sarnia	Hamilton Downtown
17.4 µg/m³ (Feb-04-2014)	4.0 µg/m³ (May-29-2014)
3.8 µg/m³ (Jul-22-2014)	3.7 µg/m³ (Jun-16-2014)
2.5 µg/m³ (Aug-03-2014)	2.7 µg/m³ (Apr-29-2014)
2.4 µg/m³ (Jan-11-2014)	2.6 µg/m³ (Jun-22-2014)

Note: Ontario's 24-hour AAQC for benzene is 2.3 µg/m³.

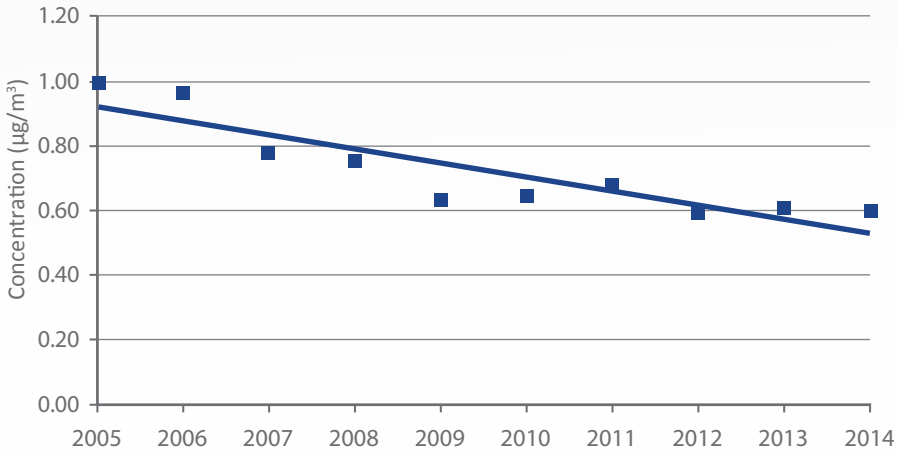
Of the eight monitoring locations, the Ontario annual AAQC for benzene of 0.45 µg/m³ was exceeded at five sites – Windsor West, Sarnia, Kitchener, Hamilton Downtown and Brampton. London, Newmarket and Ottawa Downtown reported benzene annual means of 0.45 µg/m³, 0.42 µg/m³ and 0.41 µg/m³, respectively, merely meeting the annual AAQC. Over the 10-year period from 2005 to 2014, benzene concentrations have decreased 42 per cent as shown in **Figure 19**.

Toluene is an aromatic hydrocarbon used to make chemicals, explosives, dyes and many other compounds. It is used as a solvent for inks, paints, lacquers, resins, cleaners, glues and adhesives. Toluene is found in gasoline and aviation fuel. Studies reveal that toluene affects the central nervous system of humans and animals; however, there is little evidence to classify it as a carcinogen (USEPA, 2016).

In 2014, toluene annual means ranged from 0.73 µg/m³ in Newmarket to 1.91 µg/m³ in Sarnia. **Figure 20** shows a 64 per cent decrease in toluene annual mean concentrations from 2005 to 2014.

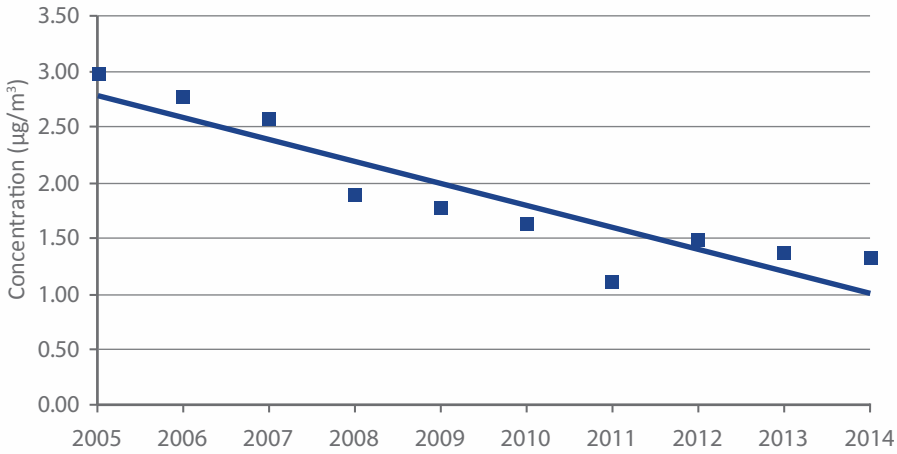
Ethylbenzene is a colourless liquid that smells like gasoline and is mainly used in the manufacture of styrene. Exposure to ethylbenzene occurs from the use of consumer products, fuel, pesticides, solvents, carpet glues, varnishes, paints and tobacco smoke. In humans, acute exposure results in respiratory effects; limited information is available on the carcinogenic effects of ethylbenzene (USEPA, 2016).

Figure 19: Trend of Benzene Annual Means Across Ontario (2005-2014)



Note: 10-year trend is a composite mean based on 8 sites.

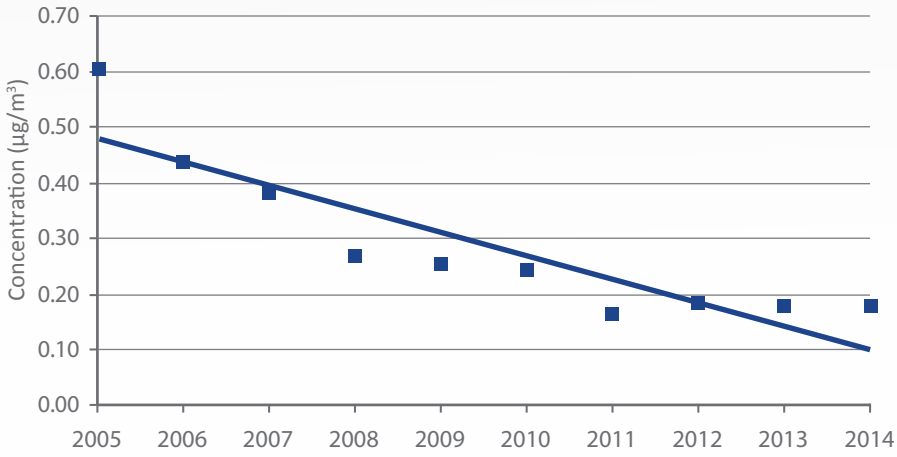
Figure 20: Trend of Toluene Annual Means Across Ontario (2005-2014)



Note: 10-year trend is a composite mean based on 8 sites.

In 2014, ethylbenzene annual means ranged from 0.10 µg/m³ at Ottawa Downtown to 0.27 µg/m³ at Windsor West. There has been a 79 per cent decrease in ethylbenzene annual mean concentrations from 2005 to 2014 as shown in **Figure 21**.

Figure 21: Trend of Ethylbenzene Annual Means Across Ontario (2005-2014)

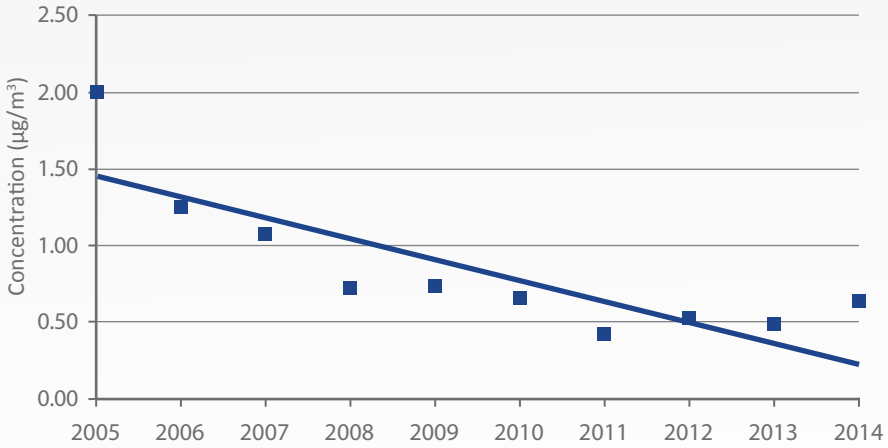


Note: 10-year trend is a composite mean based on 8 sites.

Xylene is a colourless, sweet-smelling liquid or gas occurring naturally in petroleum, coal and wood tar; it is also used as a solvent in the printing, rubber, paint and leather industries. Xylene, also referred to as mixed xylenes, is a mixture of three isomers: *ortho*-, *meta*-, and *para*-xylene, commonly known as *o*-, *m*-, and *p*-xylene, which have the same molecular formula but different chemical structure, meaning the arrangement of their atoms are different. There is no information on the carcinogenic effects of mixed xylenes on humans (USEPA, 2016).

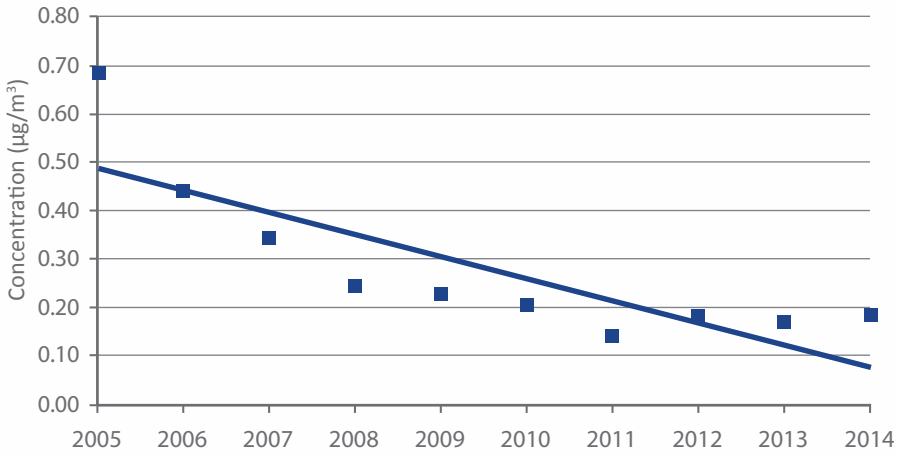
In 2014, m-, and p-xylene annual means ranged from 0.32 µg/m³ at Ottawa Downtown and London to 0.83 µg/m³ at Windsor West. The annual mean concentrations of o-xylene ranged from 0.12 µg/m³ at Ottawa Downtown to 0.29 µg/m³ at Windsor West. As shown in **Figure 22**, there has been an 85 per cent decrease in m-, and p-xylene annual mean concentrations from 2005 to 2014. Similarly, in **Figure 23**, o-xylene annual mean concentrations decreased 84 per cent over the same 10-year period.

Figure 22: Trend of m-, and p-xylene Annual Means Across Ontario (2005-2014)



Note: 10-year trend is a composite mean based on 8 sites.

Figure 23: Trend of o-xylene Annual Means Across Ontario (2005-2014)



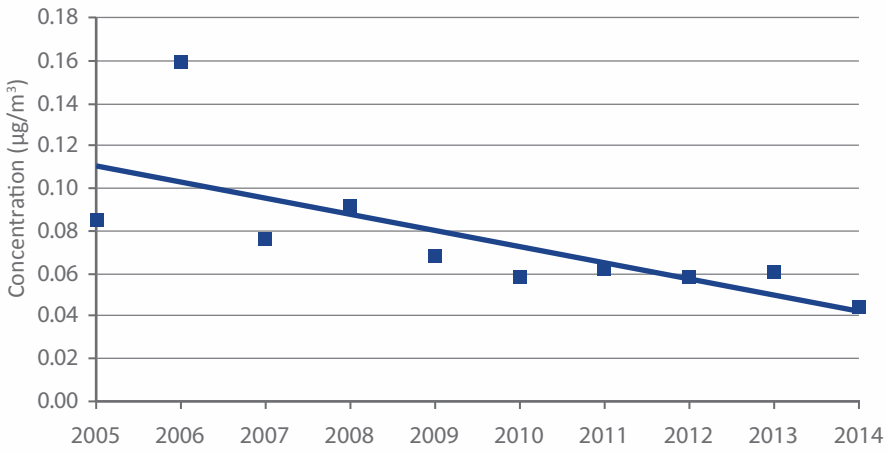
Note: 10-year trend is a composite mean based on 8 sites.

1,3-Butadiene

1,3-Butadiene is a colourless gas with a mild gasoline-like odour. It is released into the air through motor vehicle exhaust, manufacturing and processing facilities, forest fires or other combustion, and cigarette smoke. Acute exposure to 1,3-butadiene by inhalation in humans results in irritation of the eyes, nasal passages, throat and lung; in addition, 1,3-butadiene is carcinogenic in humans by inhalation (USEPA, 2016).

In 2014, 1,3-butadiene annual means ranged from 0.02 µg/m³ in Newmarket to 0.12 µg/m³ in Sarnia. The Ontario annual AAQC for 1,3-butadiene of 2 µg/m³ was met at each of the eight sites. Over the 10-year period, 2005 to 2014, 1,3-butadiene concentrations have decreased 62 per cent as shown in **Figure 24**.

Figure 24: Trend of 1,3-Butadiene Annual Means Across Ontario (2005-2014)



Note: 10-year trend is a composite mean based on 8 sites.

Acronyms

AAQC	Ambient Air Quality Criterion (Ontario)
AQHI	Air Quality Health Index
AQI	Air Quality Index
CAAQS	Canadian Ambient Air Quality Standard
CCME	Canadian Council of Ministers of the Environment
CO	carbon monoxide
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
PM	particulate matter
$PM_{2.5}$	fine particulate matter
SAHA	Smog and Air Health Advisory
SAQS	Special Air Quality Statement
SHARP	Synchronized Hybrid Ambient Real-time Particulate
SO_2	sulphur dioxide
TEOM	Tapered Element Oscillating Microbalance
TRS	total reduced sulphur
U.S.	United States (of America)
VOCs	volatile organic compounds
WOE	weight of evidence
kt	kilotonnes
µg/m³	micrograms (of contaminant) per cubic metre (of air) – by weight
ppb	parts (of contaminant) per billion (parts of air) – by volume
ppm	parts (of contaminant) per million (parts of air) – by volume

Glossary

Aerodynamic size — the size of a particle as it moves in the air.

Air Quality Health Index — real-time information system that provides the public with an indication of air quality in cities, towns and in rural areas across Ontario. The AQHI derives a value based on the cumulative health effects of three pollutants – O_3, $PM_{2.5}$ and NO_2.

AQHI station — continuous monitoring station used to inform the public of general ambient air quality levels over an entire region (not a localized area) on a real-time basis; station reports on criteria pollutant levels that are not unduly influenced by a single emission source, but rather are the result of emissions from multiple sources, including those in neighbouring provinces and states.

Ambient air — outdoor or open air.

Annual mean — the average value of hourly data for a given year.

Anthropogenic — derived from human activities.

Carbon monoxide — a colourless, odourless, tasteless, and at high concentrations, poisonous gas.

Continuous pollutants — pollutants for which a continuous measurement record exists; effectively, pollutants that have hourly data (maximum 8,760 values per year except leap year – e.g. 2004 where maximum values for the year are 8,784).

Continuous station — where pollutants are measured on a real-time basis and data determined hourly (for example ozone, sulphur dioxide).

Criterion — maximum concentration or level (based on potential effects) of pollutant that is desirable or considered acceptable in ambient air.

Exceedance — above the air pollutant concentration levels established by environmental protection criteria or other environmental standards.

Fine Particulate Matter — also referred as respirable particles: particles smaller than 2.5 micrometres in aerodynamic diameter, which arise mainly from fuel combustion, condensation of hot vapours and chemically-driven gas-to-particle conversion processes; also referred to as $PM_{2.5}$ or respirable particles. These are fine enough to penetrate deep into the lungs.

Fossil fuels — natural gas, petroleum, coal and any form of solid, liquid or gaseous fuel derived from organic materials for the purpose of generating heat.

Fly ash — generated as a by-product of coal combustion and is used as a replacement for cement in concrete, among other uses.

Ground-level ozone — colourless gas formed from chemical reactions between nitrogen oxides and volatile organic compounds (VOCs) in the presence of sunlight near the Earth's surface.

Micrometre — a millionth of a metre.

Nitrogen dioxide	a reddish-brown gas with a pungent and irritating odour.
Oxidation	a chemical reaction where a substance gains an oxygen; for example, in the atmosphere, sulphur dioxide is oxidized by hydroxyl radicals to form sulphate.
Particulate matter	the general term used to describe a mixture of microscopic solid particles and liquid droplets suspended in air.
Point sources	sources that have a fixed location and are identified individually by name and location.
Primary pollutant	pollutant emitted directly to the atmosphere.
Residence time	the average length of time during which a particle is in a given location or condition.
Respirable particles	see definition for fine particulate matter.
Secondary pollutant	pollutant formed from other pollutants in the atmosphere.
Smog	a contraction of smoke and fog; colloquial term used for photochemical smog, which includes ozone, fine particulate matter and other contaminants; tends to be a brownish haze.
Stratosphere	atmosphere 10 to 40 kilometres above the Earth's surface.
Stratospheric ozone	ozone formed in the stratosphere from the conversion of oxygen molecules by solar radiation; ozone found there absorbs some of the sun's ultraviolet radiation and prevents it from reaching the Earth.
Styrene	primarily a synthetic chemical that is used extensively in the manufacture of plastics, rubber, and resins. It is also known as vinylbenzene, ethenylbenzene, cinnamene, or phenylethylene.
Sulphur dioxide	a colourless gas that smells like burnt matches.
Troposphere	atmospheric layer extending from the surface up to about 10 kilometres above the Earth's surface.

References

1. 1990 APETD. *Air Pollutant Emissions Trends Data*. United States Environmental Protection Agency. April 2017. www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data.

2. 2015 AMPD. *Air Market Program Data, Acid Rain Program*. United States Environmental Protection Agency. April 2017. https://ampd.epa.gov/ampd/.

3. 2015 APEI. *Air Pollutant Emission Inventory (APEI) Report 1990-2015*. Environment and Climate Change Canada. February 2017. http://ec.gc.ca/pollution/default.asp?lang=En&n=E96450C4-1.

4. 2015 TRI. *Toxic Release Inventory*. United States Environmental Protection Agency. April 2017. https://www.epa.gov/toxics-release-inventory-tri-program.

5. Canadian Council of Ministers of the Environment, 2012. *Guidance Document on Achievement Determination: Canadian Ambient Air Quality Standards for Particulate Matter and Ozone*.

6. Federal Register. 2006. *40 CFR Parts 53 and 58: Revisions to Ambient Air Monitoring Regulations; Final Rule*. 71 (200), 61236-61328. October 17, 2006.

7. Ontario Ministry of the Environment and Climate Change. 2016. *Air Quality in Ontario 2014 Report*.

8. Patashnick, H. and E.G. Rupprecht. 1991. *Continuous PM-10 Measurements Using the Tapered Element Oscillating Microbalance*. Journal of the Air & Waste Management Association, Vol. 41, pp. 1079-1083.

9. Seinfeld, J.H. and S.N. Pandis. 2006. *Atmospheric chemistry and physics: From air pollution to climate change*. (2nd ed.) New Jersey: John Wiley & Sons Inc.

10. Sofowote, U., Su, Y., Bitzos, M.M., and Munoz, A. 2014. *Improving the Correlations of Ambient TEOM $PM_{2.5}$ Data and SHARP 5030 FEM in Ontario: a Multiple Linear Regression Analysis*. Journal of the Air & Waste Management Association, 64:1, 104-114.

11. United States Environmental Protection Agency (USEPA). 2011. *List of Designated Reference and Equivalent Methods*. Issue Date: October 12, 2011.

12. United States Environmental Protection Agency (USEPA). Health Effects Notebook for Hazardous Air Pollutants. November 4, 2016. www.epa.gov/haps/health-effects-notebook-hazardous-air-pollutants.

13. Yap, D., Reid, N., De Brou, G. and R. Bloxam. 2005. *Transboundary Air Pollution in Ontario*. Ontario Ministry of the Environment.

Resources

1. Brook, J.R., Dann, T. and R.T. Burnett. 1997. *The Relationship among TSP, PM_{10}, $PM_{2.5}$ and Inorganic Constituents of Atmospheric Particulate Matter at Multiple Canadian Locations*. Journal of Air and Waste Management Association, Vol 46, pp. 2-18.

2. Burnett, R.T., Dales, R.E., Krewski, D., Vincent, R., Dann, T., and J.R. Brook. 1995. *Associations between Ambient Particulate Sulphate and Admissions to Ontario Hospitals for Cardiac and Respiratory Diseases*. American Journal of Epidemiology, Vol 142, pp. 15-22.

3. Fraser, D., Yap, D., Kiely, P. and D. Mignacca. 1991. *Analysis of Persistent Ozone Episodes in Southern Ontario 1980-1991*. Technology Transfer Conference, Toronto, 1991. Proceedings AP14, pp. 222-227.

4. Geddes, J.A., Murphy, J.G. and D.K.Wang. 2009. *Long term changes in nitrogen oxides and volatile organic compounds in Toronto and the challenges facing local ozone control*. Atmospheric Environment, Vol. 43, pp. 3407-3415.

5. Itano, Y., Bandow, H., Takenaka, N., Saitoh, Y., Asayama, A. and J. Fukuyama. 2007. *Impact of NO_X reduction on long-term ozone trends in an urban atmosphere*. Science of the Total Environment, Vol. 379, pp. 46-55.

6. Lin, C.C.-Y., Jacob, D.J., Munger, J.W., and A.M. Fiore. 2000. *Increasing Background Ozone in Surface Air Over the United States*. Geophysical Research Letters, Vol. 27 (21), pp. 3465-3468.

7. Lioy, P., 1991. *Assessing Human Exposure to Airborne Pollutants*. Environmental Science and Technology, Vol. 25, pp. 1360.

8. Lipfert, F.W. and T. Hammerstrom. 1992. *Temporal Patterns in Air Pollution and Hospital Admissions*. Environmental Research, Vol. 59, pp. 374-399.

9. Lippmann, M. 1991. *Health Effects of Tropospheric Ozone*. Environmental Science and Technology, Vol. 25, No. 12, pp. 1954-1962.

10. Logan, J. A., Staehelin, J., Megretskaia, I. A., Cammas, J.-P., Thouret, V., Claude, H., Backer, H. D., Steinbacher, M., Scheel, H.-E., Stubi, R., Frohlich, M., and R. G. Derwent. 2012. *Changes in ozone over Europe: Analysis of ozone measurements from sondes, regular aircraft (MOZAIC) and alpine surface sites*. Journal of Geophysical Research, 117, D09301, doi:10.1029/2011JD016952.

11. Ontario Ministry of the Environment, 2011. Publications. Ontario Ministry of the Environment. http://www.airqualityontario.com/press/publications.php.

12. Pengelly, L.D., Silverman, F. and C.H. Goldsmith. 1992. *Health Effects of Air Pollution Assessed Using Ontario Health Survey Data*. Urban Air Group, McMaster University.

13. Reid, N., Yap, D. and R. Bloxam. 2008. The potential role of background ozone on current and emerging air issues: An overview. *Air Quality, Atmosphere & Health*, Vol. 1, pp. 19-29.

14. *Rethinking the Ozone Problem in Urban and Regional Air Pollution*. National Academy Press, Washington, D.C., 1991.

15. Sofowote, U. and F. Dempsey. 2015. *Impacts of Forest Fires on Ambient near Real-Time $PM_{2.5}$ in Ontario, Canada: Meteorological Analyses and Source Apportionment of the July 2011-2013 Episodes*. Atmospheric Pollution Research, doi: 10.5094/APR.2015.001.

16. United States Environmental Protection Agency. 2003. *Latest Findings on National Air Quality, 2002 Status and Trends*.

17. United States Environmental Protection Agency. 2003. *National Air Quality and Emission Trends, 2003 Special Studies Edition*.

18. United States Environmental Protection Agency. 2004. *Particle Pollution Report, Current Understanding of Air Quality and Emissions through 2003*.

19. Vingarzan, R. 2004. *A review of surface ozone background levels and trends*. Atmospheric Environment, Vol. 38, pp. 3431-42.

20. Wolff, G.T., Kelley, N.A. and M.A. Ferman. 1982. *Source Regions of Summertime Ozone and Haze Episodes in the Eastern U.S.* Water, Air and Soil Pollution, 18: pp. 65-81.

21. Yap, D., Ning, D.T. and W. Dong. 1988. *An Assessment of Source Contribution to the Ozone Concentrations in Southern Ontario*. Atmospheric Environment, Vol. 22, No. 6, pp. 1161-1168.

Air Quality in Ontario

2015 Report

2015 Appendix

The Appendix is intended for use in conjunction with the 2015 Annual Air Quality in Ontario Report. The Appendix briefly describes the provincial Air Quality Health Index (AQHI) network, quality assurance and quality control procedures, and the Ministry of the Environment and Climate Change's air quality database. It also includes a series of tables displaying station locations and a listing of the summary statistics including means, maximums, percentile values and the number of exceedances of the Ontario Ambient Air Quality Criteria (AAQC) for each pollutant. In addition, trends for select pollutants are displayed for a 10-year period.

Monitoring Network Operations

Network Description

In 2015, the Environmental Monitoring and Reporting Branch (EMRB) operated 39 ambient air monitoring sites across Ontario as part of the AQHI network. Monitoring site locations for the AQHI network are illustrated in **Map A1**. The AQHI network was comprised of 133 continuous monitoring instruments at 39 sites. These instruments have the capability of recording minute data (approximately 70 million data points per year) that are used to scan and validate the continuous hourly data.

Quality Assurance and Quality Control

Day-to-day maintenance and support of the instruments are administered by EMRB staff. Instrumentation precision is verified by daily automatic internal zero and span checks. Data analysts and station operators review span control charts to confirm instrument precision using a telemetry system. A quarterly quality assurance and quality control (QA/QC) review is performed on the ambient data set in order to highlight anomalies and administer corrective action in a timely manner.

The air monitoring station operators routinely inspect and maintain monitoring equipment and stations with mandatory bi-monthly on-site visits where secondary transfer standards are used to calibrate instrumentation. Station maintenance activities are recorded using FieldWorker Inc. software, an electronic documentation solution; this information is transferred directly to the ministry's database. The instrumentation used throughout the provincial air monitoring network has been standardized to Thermo Electron Corporation analyzers in an effort to streamline parts inventory and leverage common hardware used within each analyzer. The following is a summary of the instrumentation deployed within the network and are all US EPA designated equivalent methods:

- Ozone – TE49C/I
- Fine Particulate Matter – SHARP 5030
- Nitrogen Oxides – TE42C/I
- Carbon Monoxide – TE48C/I
- Total Reduced Sulphur – TE43C/CDN101
- Sulphur Dioxide – TE43C/I

EMRB operates a laboratory with gas reference standards that adhere to those of the U.S. National Institute of Standards and Technology (NIST) and the Air Quality Research Division of Environment Canada and Climate Change. The secondary transfer standards used by station operators are referenced and certified to EMRB's NIST primary standards on a quarterly basis.

The Ontario ambient air quality monitoring network undergoes constant maintenance to ensure a high standard of quality control. Continuous real-time data are consistently reviewed, assessed and validated by EMRB staff. Immediate actions are taken to correct any inconsistencies that may affect the validity of the data. These measures ensure ambient air monitoring data are valid, complete, comparable, representative and accurate. As a result, the 2015 ambient air quality monitoring network had greater than 97 per cent valid data from over one million hourly data points.

Data Base

The ambient air quality data used in this report are stored in the ministry's air quality information system (AQUIS) and are made available through the Air Quality Ontario web site, http://www.airqualityontario.com/history/ and the ministry's Open Data Catalogue web page, https://www.ontario.ca/search/data-catalogue?sort=asc. A statistical pattern test is used to identify data anomalies, such as unusual pollutant concentrations. Each pollutant has a predetermined concentration range based on historical data. Values outside this range are flagged for further investigation.

Data are obtained from automated ambient air monitoring instruments that operate continuously to produce an average measurement for every hour for a possible total of 8,760 measurements in a given year. Hourly parameters measured include O_3, $PM_{2.5}$, $NO/NO_2/NO_x$, CO, SO_2 and TRS compounds. A valid annual mean requires at least 6,570 hourly readings. In addition, the 2nd and 3rd quarters of the year should have 75 per cent valid data for ozone, whereas for $PM_{2.5}$, each quarter of the year should have 75 per cent valid data.

Network Descriptive Table

The AQHI network for 2015 is summarized in **Table A1**. The table displays the station name, numerical identifier and pollutants measured. The numerical identifier is the station (ID) number, the first digit of which identifies the geographic region in which the station is located. Air monitoring stations within the AQHI network can measure up to six common pollutants (ozone, $PM_{2.5}$, NO_2, SO_2, CO and TRS compounds) based on the pollutant(s) of concern for the regional area it represents.

Table A1 also identifies the *type* of air monitoring site: ambient, road-side, Canadian Ambient Air Quality Standard (CAAQS), and/or National Air Pollution Surveillance (NAPS). Ambient sites represent the general air quality of an area without any direct influence of local industrial sources. Road-side sites are within approximately 100 m of a major roadway with daily traffic volumes greater than 10,000 vehicles per day.

Annual Statistics and 10-Year Trends

The 2015 statistical data and 10-year trends for various continuous pollutants are provided in **Tables A2-A9**, and **Tables A10-A18**, respectively. The annual averages, maximums and percentiles are displayed in the annual statistics tables. (A percentile value is the percentage of the data set that is equal to or below the stated value; for example, if the 70 percentile value is 0.10 ppm, then 70 percent of the data are equal to or below 0.10 ppm). To be included in the 10-year trend analysis, a site must have valid annual means for a minimum of 8 years over the 10-year period from 2006-2015.

Other Informative Tables

The calculated CAAQS metrics for ozone and $PM_{2.5}$ are presented for 2015 (based on a three-year average, 2013-2015) in **Table A19**. In addition, **Tables A20** and **A21** focus on WOE analysis and the influence of transboundary flow days when calculating the ozone CAAQS metric. The percentage distribution of hourly AQHI readings within the various health risk categories for each of the 39 monitoring sites are displayed in **Table A22**. **Table A23** summarizes the number of air quality alerts issued in Ontario during 2015. The 2014 statistical data for selected toxics are provided in **Tables A24-A29**.

Map A1: Air Quality Health Index (AQHI) Monitoring Sites Across Ontario in 2015

Table A1: 2015 Ontario Continuous Ambient Air Monitoring Network

ID	STATION NAME	STATION LOCATION	YEAR	LATITUDE (D:M:S)	LONGITUDE (D:M:S)	AIR INTAKE (AGL)	TYPE	AQHI	O_3	$PM_{2.5}$	NO_2	SO_2	CO	TRS
12008	Windsor Downtown	467 University Ave. W.	1969	42°18'56.8"	-83°02'37.2"	8	A/RS/C/N	Y	T	T	T	T	T	.
12016	Windsor West	College Ave./South St.	1975	42°17'34.4"	-83°04'23.3"	4	A/N	Y	T	T	T	T	.	T
13001	Chatham	435 Grand Ave. W.	2005	42°24'13.3"	-82°12'29.9"	15	A/C/N	Y	T	T	T	.	.	.
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	1978	42°58'56.2"	-82°24'18.3"	3	A/N	Y	T	T	T	T	.	T
15020	Grand Bend	Point Blake Conservation Area	1991	43°19'59.1"	-81°44'34.4"	5	A/N	Y	T	T	T	.	.	.
15026	London	42 St. Julien St.	2013	42°58'28.1"	-81°12'03.1"	5	A/C/N	Y	T	T	T	.	.	.
16015	Port Stanley	43665 Dexter Line, Elgin Water T. Plant	2002	42°40'19.5"	-81°09'46.4"	5	A/N	Y	T	T	T	.	.	.
18007	Tiverton	4th Concession/ Bruce Rd. 23	1979	44°18'52.1"	-81°32'59.0"	4	A/N	Y	T	T	T	.	.	.
21005	Brantford	324 Grand River Ave.	2004	43°08'19.0"	-80°17'33.5"	5	A/C/N	Y	T	T	T	.	.	.
26060	Kitchener	West Ave./Homewood Ave.	1990	43°26'37.8"	-80°30'13.7"	5	A/C/N	Y	T	T	T	.	.	.
27067	St. Catharines	Argyle Cres., Pump Stn.	1987	43°09'36.2"	-79°14'05.1"	4	A/C/N	Y	T	T	T	.	.	.
28028	Guelph	Exhibition St./Clark St. W.	2000	43°33'05.8"	-80°15'51.0"	4	A/C/N	Y	T	T	T	.	.	.
29000	Hamilton Downtown	Elgin St./Kelly St.	1987	43°15'28.0"	-79°51'42.0"	4	A/RS/C/N	Y	T	T	T	T	T	T
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	1985	43°13'45.9"	-79°51'46.0"	3	A/C/N	Y	T	T	T	T	.	.
29118	Hamilton West	Main St. W./Hwy 403	1985	43°15'26.8"	-79°54'27.9"	3	A/RS	Y	T	T	T	.	.	.
31103	Toronto Downtown	Bay St./Wellesley St. W.	2000	43°39'46.7"	-79°23'17.2"	10	A/RS/C/N	Y	T	T	T	.	.	.
33003	Toronto East	Kennedy Rd./ Lawrence Ave. E.	1970	43°44'52.5"	-79°16'26.6"	4	A/RS/C/N	Y	T	T	T	.	.	.
34020	Toronto North	Hendon Ave./Yonge St.	1988	43°46'53.8"	-79°25'03.8"	5	A/RS/C/N	Y	T	T	T	.	.	.
35125	Toronto West	125 Resources Rd.	2003	43°42'34.0"	-79°32'36.6"	8	A/RS/C/N	Y	T	T	T	T	T	.
44008	Burlington	North Shore Blvd. E./ Lakeshore Rd.	1979	43°18'54.4"	-79°48'09.5"	5	A/C/N	Y	T	T	T	.	.	.
44017	Oakville	Eighth Line/Glenashton Dr., Halton Reservoir	2003	43°29'12.9"	-79°42'08.2"	12	A/C/N	Y	T	T	T	.	.	.
45026	Oshawa	2000 Simcoe St. N., Durham College	2005	43°56'45.4"	-78°53'41.7"	7	A/RS/C/N	Y	T	T	T	.	.	.
46089	Brampton	525 Main St. N., Peel Manor	2000	43°41'55.5"	-79°46'51.3"	5	A/C/N	Y	T	T	T	.	.	.
46108	Mississauga	3359 Mississauga Rd. N., U of T Mississauga	2007	43°32'49.1"	-79°39'31.3"	5	A/C/N	Y	T	T	T	T	.	.

Table A1: 2015 Ontario Continuous Ambient Air Monitoring Network (continued)

ID	STATION NAME	STATION LOCATION	YEAR	LATITUDE (D:M:S)	LONGITUDE (D:M:S)	AIR INTAKE (AGL)	TYPE	AQHI	O_3	$PM_{2.5}$	NO_2	SO_2	CO	TRS
47045	Barrie	83 Perry St.	2001	44°22'56.5"	-79°42'08.3"	5	A/C/N	Y	T	T	T	.	.	.
48006	Newmarket	Eagle St. W./McCaffrey Rd.	2001	44°02'39.5"	-79°28'59.7"	5	A/N	Y	T	T	T	.	.	.
49005	Parry Sound	7 Bay St.	2001	45°20'16.3"	-80°02'17.4"	5	A/N	Y	T	T	T	.	.	.
49010	Dorset	1026 Bellwood Acres Rd.	1981	45°13'27.4"	-78°55'58.6"	3	A/N	Y	T	T	.	.	.	.
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	1971	45°26'03.6"	-75°40'33.6"	4	A/C/N	Y	T	T	T	T	T	.
51002	Ottawa Central	960 Carling Ave.	2007	45°22'57.1"	-75°42'51.1"	5	A/N	Y	T	T	T	.	.	.
51010	Petawawa	Petawawa Research Forest Facility	2007	45°59'48.2"	-77°26'28.3"	6	A/N	Y	T	T	.	.	.	.
52023	Kingston	23 Beechgrove Lane	2014	44°13'11.5"	-76°31'16.1"	5	A/C/N	Y	T	T	T	.	.	.
54012	Belleville	2 Sidney St., Water Treatment Plant	2002	44°09'01.9"	-77°23'43.8"	10	A/N	Y	T	T	T	.	.	.
56051	Cornwall	Bedford St./3rd St. W.	1970	45°01'04.7"	-74°44'06.8"	4	A/N	Y	T	T	T	.	.	.
59006	Peterborough	10 Hospital Dr.	1998	44°18'06.9"	-78°20'46.4"	10	A/C/N	Y	T	T	T	.	.	.
63203	Thunder Bay	421 James St. S.	2004	48°22'45.8"	-89°17'24.6"	15	A/RS/C/N	Y	T	T	T	.	.	.
71078	Sault Ste. Marie	Sault College	2004	46°31'59.5"	-84°18'35.7"	8	A/N	Y	T	T	T	T	.	T
75010	North Bay	Chippewa St. W., Dept. National Defence	1979	46°19'23.5"	-79°26'57.4"	4	A/RS/N	Y	T	T	T	.	.	.
77233	Sudbury	155 Elm St.	2013	46°29'31.0"	-81°00'11.2"	3	A/C/N	Y	T	T	T	T	.	.
TOTAL								**39**	**39**	**39**	**37**	**10**	**4**	**4**

Notes:

ID - station identfication number

Year - year station began monitoring

Air intake - height of air intake above ground (m)

Type - type of monitoring site: A = ambient, RS = road-side, C = CAAQS, N = NAPS

AQHI - Air Quality Health Index site

T - telemetry

O_3 - ground-level ozone

$PM_{2.5}$ - fine particulate matter

NO_2 - nitrogen dioxide

CO - carbon monoxide

SO_2 - sulphur dioxide

TRS - total reduced sulphur

Table A2: 2015 Ozone (O_3) Annual Statistics

Unit: parts per billion (ppb)
O_3 1h AAQC: 80 ppb

ID	City	Location	PERCENTILES								Maximum		No. of Times Above Criterion
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	24h	1h
12008	Windsor Downtown	467 University Ave. W.	8728	9	19	26	33	46	64	27.0	89	51	3
12016	Windsor West	College Ave./South St.	8680	8	19	26	33	45	63	26.5	87	50	2
13001	Chatham	435 Grand Ave. W.	8667	15	23	29	35	46	63	29.6	79	54	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8635	12	21	28	34	43	59	27.8	83	48	4
15020	Grand Bend	Point Blake Conservation Area	8705	16	24	30	36	45	66	30.4	87	53	8
15026	London	42 St. Julien St.	8658	8	21	28	35	46	62	27.9	77	58	0
16015	Port Stanley	43665 Dexter Line, Elgin Water T. Plt	8215	17	26	32	38	50	67	32.8	86	61	6
18007	Tiverton	4th Concession/Bruce Rd. 23	8699	19	27	32	37	45	63	32.5	83	62	1
21005	Brantford	324 Grand River Ave.	8665	9	22	29	36	47	63	28.9	79	55	0
26060	Kitchener	West Ave./Homewood Ave.	8582	11	22	28	34	44	60	27.9	76	58	0
27067	St. Catharines	Argyle Cres., Pump Stn.	8592	11	22	29	34	45	62	28.6	73	60	0
28028	Guelph	Exhibition St./Clark St. W.	8662	10	21	28	34	44	61	27.7	79	54	0
29000	Hamilton Downtown	Elgin St./Kelly St.	8681	9	19	25	32	43	60	25.9	74	59	0
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8573	13	23	29	35	47	63	29.4	79	63	0
29118	Hamilton West	Main St. W./Hwy 403	8712	5	17	24	31	41	56	23.9	71	53	0
31103	Toronto Downtown	Bay St./Wellesley St. W.	8706	9	18	25	31	43	63	25.7	80	55	0
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8689	6	17	23	29	40	61	23.5	91	52	3
34020	Toronto North	Hendon Ave./Yonge St.	8675	8	18	25	32	42	64	25.7	90	59	6
35125	Toronto West	125 Resources Rd.	8602	3	13	20	27	39	61	21.3	82	51	1
44008	Burlington	North Shore Blvd. E./ Lakeshore Rd.	8677	9	19	26	33	43	60	26.5	84	53	1
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8678	11	21	27	33	43	62	27.4	80	58	0
45026	Oshawa	2000 Simcoe St. N., Durham College	8706	10	20	26	32	41	61	26.2	73	45	0

Table A2: 2015 Ozone (O_3) Annual Statistics (continued)

Unit: parts per billion (ppb)
O_3 1h AAQC: 80 ppb

ID	City	Location	PERCENTILES								Maximum		No. of Times Above Criterion
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	24h	1h
46089	Brampton	525 Main St. N., Peel Manor	8657	8	19	27	33	44	62	26.5	84	58	2
46108	Mississauga	3359 Mississauga Rd. N., U of T Campus	8646	6	18	26	32	43	61	25.4	79	60	0
47045	Barrie	83 Perry St.	8731	9	19	26	31	40	56	25.4	80	52	0
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8693	12	22	29	35	44	63	28.5	92	61	6
49005	Parry Sound	7 Bay St.	8629	15	25	31	36	44	60	30.4	86	59	1
49010	Dorset	1026 Bellwood Acres Rd.	8690	9	21	28	34	42	56	27.0	78	49	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8681	10	19	25	31	40	56	25.6	69	53	0
51002	Ottawa Central	960 Carling Ave.	8678	10	21	27	33	42	57	27.0	71	53	0
51010	Petawawa	Petawawa Research Forest Facility	8723	11	20	27	33	42	55	26.7	70	55	0
52023	Kingston	23 Beechgrove Lane	8664	15	25	30	36	45	59	30.3	74	59	0
54012	Belleville	2 Sidney St., Water Treatment Plant	8631	14	23	29	35	46	64	29.6	77	61	0
56051	Cornwall	Bedford St./3rd St. W.	8668	12	22	28	34	43	57	27.9	69	58	0
59006	Peterborough	10 Hospital Dr.	8658	14	23	29	35	44	62	29.3	78	59	0
63203	Thunder Bay	421 James St. S.	8653	8	18	24	30	39	49	24.0	62	48	0
71078	Sault Ste. Marie	Sault College	8664	14	22	28	33	41	54	27.8	75	53	0
75010	North Bay	Chippewa St. W., Dept. National Defence	8645	10	21	28	33	43	58	27.0	70	52	0
77233	Sudbury	155 Elm St.	8677	11	20	26	31	40	57	25.7	67	58	0

Table A3: 2015 Fine Particulate Matter ($PM_{2.5}$) Annual Statistics

Unit: micrograms per cubic metre (µg/m^3)
$PM_{2.5}$ 24h Reference Level: 28 µg/m^3

ID	City	Location	PERCENTILES								Maximum		No. of Times Above Reference Level
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	24h	24h
12008	Windsor Downtown	467 University Ave. W.	8738	3	5	7	11	18	33	9.3	64	37	3
12016	Windsor West	College Ave./South St.	8619	3	5	8	12	20	34	9.9	68	42	3
13001	Chatham	435 Grand Ave. W.	8460	2	4	7	10	16	26	8.1	43	26	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8557	2	4	6	10	18	32	8.4	78	35	4
15020	Grand Bend	Point Blake Conservation Area	8580	2	4	6	9	16	28	7.7	45	29	1
15026	London	42 St. Julien St.	8714	2	5	7	10	17	29	8.3	57	30	1
16015	Port Stanley	43665 Dexter Line, Elgin Water T. Plt	8554	2	4	7	10	16	27	8.0	38	22	0
18007	Tiverton	4th Concession/Bruce Rd. 23	8598	2	3	5	7	14	27	6.4	39	26	0
21005	Brantford	324 Grand River Ave.	8673	3	5	7	10	18	32	8.7	57	30	1
26060	Kitchener	West Ave./Homewood Ave.	8505	2	4	7	10	19	35	8.8	68	36	4
27067	St. Catharines	Argyle Cres., Pump Stn.	8642	3	5	7	10	17	29	8.4	46	29	1
28028	Guelph	Exhibition St./Clark St. W.	8549	2	4	6	9	17	34	8.4	76	37	2
29000	Hamilton Downtown	Elgin St./Kelly St.	8728	3	5	8	12	21	37	10.2	66	35	4
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8617	3	5	7	10	18	35	9.0	79	31	1
29118	Hamilton West	Main St. W./Hwy 403	8658	3	5	7	11	20	35	9.9	54	31	3
31103	Toronto Downtown	Bay St./Wellesley St. W.	8737	3	5	7	9	17	31	8.4	54	34	2
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8712	3	4	6	10	17	33	8.5	60	39	3
34020	Toronto North	Hendon Ave./Yonge St.	8733	3	5	7	11	18	33	9.4	54	37	2
35125	Toronto West	125 Resources Rd.	8602	3	5	7	10	17	32	8.5	58	33	3
44008	Burlington	North Shore Blvd. E./ Lakeshore Rd.	8700	3	5	7	11	20	35	9.4	56	34	2
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8302	2	4	6	9	17	32	8.3	55	34	1
45026	Oshawa	2000 Simcoe St. N., Durham College	8618	2	4	6	9	16	29	7.5	50	26	0

Table A3: 2015 Fine Particulate Matter ($PM_{2.5}$) Annual Statistics (continued)

Unit: micrograms per cubic metre (µg/m^3)
$PM_{2.5}$ 24h Reference Level: 28 µg/m^3

ID	City	Location	PERCENTILES								Maximum		No. of Times Above Reference Level
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	24h	24h
46089	Brampton	525 Main St. N., Peel Manor	8711	2	4	6	9	18	35	8.4	75	36	2
46108	Mississauga	3359 Mississauga Rd. N., U of T Campus	8595	3	4	6	10	17	33	8.5	56	36	2
47045	Barrie	83 Perry St.	8710	2	4	6	9	16	29	7.6	58	31	1
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8714	1	3	5	8	16	30	7.1	48	33	1
49005	Parry Sound	7 Bay St.	8617	2	3	4	7	12	22	5.7	41	23	0
49010	Dorset	1026 Bellwood Acres Rd.	8586	2	3	4	7	11	20	5.6	38	21	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8706	2	4	5	8	13	29	6.9	65	33	1
51002	Ottawa Central	960 Carling Ave.	8621	2	4	5	8	13	25	6.9	46	33	1
51010	Petawawa	Petawawa Research Forest Facility	8525	2	3	4	6	9	16	4.8	28	15	0
52023	Kingston	23 Beechgrove Lane	8714	2	4	5	7	13	21	6.3	39	18	0
54012	Belleville	2 Sidney St., Water Treatment Plant	8367	2	3	5	8	14	23	6.6	41	22	0
56051	Cornwall	Bedford St./3rd St. W.	8607	2	4	6	8	13	26	6.9	63	27	0
59006	Peterborough	10 Hospital Dr.	8678	2	4	5	8	14	26	6.8	56	26	0
63203	Thunder Bay	421 James St. S.	8744	3	4	5	7	11	23	6.5	91	32	2
71078	Sault Ste. Marie	Sault College	8385	2	3	5	7	12	21	5.9	45	17	0
75010	North Bay	Chippewa St. W., Dept. National Defence	8613	2	3	4	6	11	19	5.3	46	17	0
77233	Sudbury	155 Elm St.	8730	2	3	5	7	13	23	6.3	47	17	0

Table A4: 2015 Nitric Oxide (NO) Annual Statistics

Unit: parts per billion (ppb)

ID	City	Location	PERCENTILES								Maximum	
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	24h
12008	Windsor Downtown	467 University Ave. W.	8745	0	1	1	3	8	37	3.5	181	52
12016	Windsor West	College Ave./South St.	8669	0	1	1	3	8	54	4.2	223	67
13001	Chatham	435 Grand Ave. W.	8511	0	0	1	1	4	16	1.7	81	14
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8067	0	1	1	2	5	26	2.4	108	31
15020	Grand Bend	Point Blake Conservation Area	8476	0	0	0	0	1	4	0.3	17	3
15026	London	42 St. Julien St.	8685	0	0	0	1	3	21	1.4	79	13
16015	Port Stanley	43665 Dexter Line, Elgin Water T. Plt	8064	0	0	0	0	1	4	0.3	23	2
18007	Tiverton	4th Concession/Bruce Rd. 23	8700	0	0	0	0	1	2	0.3	56	3
21005	Brantford	324 Grand River Ave.	8684	0	0	0	1	4	15	1.3	56	13
26060	Kitchener	West Ave./Homewood Ave.	8582	0	0	0	1	3	31	1.6	133	35
27067	St. Catharines	Argyle Cres., Pump Stn.	8633	0	1	1	1	3	28	2.1	129	22
28028	Guelph	Exhibition St./Clark St. W.	8598	0	0	0	1	2	26	1.3	93	27
29000	Hamilton Downtown	Elgin St./Kelly St.	8679	0	0	1	3	9	43	3.7	263	59
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8582	0	0	1	1	4	20	1.8	72	13
29118	Hamilton West	Main St. W./Hwy 403	8712	0	1	2	3	12	60	5.1	168	62
31103	Toronto Downtown	Bay St./Wellesley St. W.	8703	0	1	1	2	6	31	2.7	88	22
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8674	0	1	2	5	12	58	5.8	164	43
34020	Toronto North	Hendon Ave./Yonge St.	8705	0	1	1	3	9	40	3.9	111	37
35125	Toronto West	125 Resources Rd.	8599	0	1	4	8	23	88	9.2	221	67
44008	Burlington	North Shore Blvd. E./Lakeshore Rd.	8652	0	1	1	3	9	38	3.9	122	31
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8605	0	0	1	2	7	32	2.7	102	43
45026	Oshawa	2000 Simcoe St. N., Durham College	8654	0	1	1	2	5	21	2.3	78	16
46089	Brampton	525 Main St. N., Peel Manor	8665	0	1	1	2	7	53	3.8	184	62
46108	Mississauga	3359 Mississauga Rd. N., U of T Campus	8545	0	1	1	1	6	50	3.1	136	45
47045	Barrie	83 Perry St.	8675	1	1	2	2	5	43	3.5	160	37
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8693	0	0	1	1	3	23	1.7	91	19
49005	Parry Sound	7 Bay St.	8633	0	0	0	1	1	9	0.8	46	11
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8692	0	1	1	2	4	22	2.0	73	18
51002	Ottawa Central	960 Carling Ave.	8662	0	0	0	1	2	30	1.6	108	29
52023	Kingston	23 Beechgrove Lane	8664	0	0	0	1	2	13	0.9	93	22
54012	Belleville	2 Sidney St., Water Treatment Plant	8648	0	0	0	1	3	19	1.5	91	14
56051	Cornwall	Bedford St./3rd St. W.	8665	0	0	1	1	2	33	1.8	201	49
59006	Peterborough	10 Hospital Dr.	8619	0	0	1	1	3	17	1.5	77	16
63203	Thunder Bay	421 James St. S.	8694	1	2	2	3	12	45	5.2	116	33
71078	Sault Ste. Marie	Sault College	8675	0	1	1	2	4	13	1.7	110	10
75010	North Bay	Chippewa St. W., Dept. National Defence	8631	0	0	1	1	4	33	2.1	131	27
77233	Sudbury	155 Elm St.	8672	0	1	1	2	5	42	2.9	150	59

Table A5: 2015 Nitrogen Dioxide (NO_2) Annual Statistics

Unit: parts per billion (ppb)
NO_2 1h AAQC: 200 ppb
NO_2 24h AAQC: 100 ppb

ID	City	Location	PERCENTILES								Maximum		No. of Times Above Criteria	
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	24h	1h	24h
12008	Windsor Downtown	467 University Ave. W.	8745	4	7	10	15	25	41	12.7	56	32	0	0
12016	Windsor West	College Ave./South St.	8669	4	6	9	13	22	39	11.4	62	31	0	0
13001	Chatham	435 Grand Ave. W.	8511	2	4	5	8	13	28	6.8	50	26	0	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8067	3	4	7	11	19	33	9.3	50	29	0	0
15020	Grand Bend	Point Blake Conservation Area	8476	1	1	2	4	8	16	3.4	33	22	0	0
15026	London	42 St. Julien St.	8685	2	3	5	7	13	32	6.6	46	27	0	0
16015	Port Stanley	43665 Dexter Line, Elgin Water T. Plt	8064	1	2	2	3	6	12	3.0	27	11	0	0
18007	Tiverton	4th Concession/Bruce Rd. 23	8700	1	1	2	3	5	10	2.4	27	20	0	0
21005	Brantford	324 Grand River Ave.	8684	2	3	4	6	12	24	5.5	53	22	0	0
26060	Kitchener	West Ave./Homewood Ave.	8582	2	3	5	7	14	37	6.8	61	31	0	0
27067	St. Catharines	Argyle Cres., Pump Stn.	8633	2	4	5	8	15	31	7.3	51	25	0	0
28028	Guelph	Exhibition St./Clark St. W.	8598	1	3	4	7	14	33	6.3	50	29	0	0
29000	Hamilton Downtown	Elgin St./Kelly St.	8679	4	6	10	15	24	39	12.2	59	32	0	0
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8581	3	4	7	10	19	36	9.0	50	28	0	0
29118	Hamilton West	Main St. W./Hwy 403	8712	4	7	10	15	24	40	12.2	57	32	0	0
31103	Toronto Downtown	Bay St./Wellesley St. W.	8703	5	8	11	16	25	41	13.4	58	33	0	0
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8674	4	8	11	16	28	46	13.9	69	38	0	0
34020	Toronto North	Hendon Ave./Yonge St.	8705	3	6	10	16	26	43	12.9	60	40	0	0
35125	Toronto West	125 Resources Rd.	8599	6	10	14	20	31	49	16.6	63	42	0	0
44008	Burlington	North Shore Blvd. E./Lakeshore Rd.	8652	3	5	8	12	22	38	10.4	58	33	0	0
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8605	1	3	5	8	17	32	7.5	52	33	0	0
45026	Oshawa	2000 Simcoe St. N., Durham College	8654	1	3	5	8	14	30	6.6	46	26	0	0
46089	Brampton	525 Main St. N., Peel Manor	8665	2	4	7	11	23	44	9.9	60	34	0	0
46108	Mississauga	3359 Mississauga Rd. N., U of T Campus	8542	2	4	7	11	19	39	9.2	54	35	0	0
47045	Barrie	83 Perry St.	8675	2	3	5	8	16	37	7.4	52	31	0	0
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8693	2	3	4	7	15	37	6.8	57	26	0	0
49005	Parry Sound	7 Bay St.	8633	1	1	2	3	7	23	3.2	42	19	0	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8692	2	3	5	8	16	36	7.4	51	32	0	0
51002	Ottawa Central	960 Carling Ave.	8662	1	2	3	5	13	39	5.8	53	33	0	0
52023	Kingston	23 Beechgrove Lane	8664	1	2	3	4	9	29	4.4	48	23	0	0
54012	Belleville	2 Sidney St., Water Treatment Plant	8648	1	2	3	5	10	30	4.8	45	24	0	0
56051	Cornwall	Bedford St./3rd St. W.	8665	1	2	3	5	12	34	5.3	68	38	0	0
59006	Peterborough	10 Hospital Dr.	8619	1	2	3	5	11	32	5.1	44	23	0	0
63203	Thunder Bay	421 James St. S.	8694	2	3	5	8	16	33	7.5	50	27	0	0
71078	Sault Ste. Marie	Sault College	8675	1	2	3	5	10	23	4.8	47	16	0	0
75010	North Bay	Chippewa St. W., Dept. National Defence	8631	1	2	3	5	13	37	5.6	50	28	0	0
77233	Sudbury	155 Elm St.	8672	2	3	4	7	16	42	7.2	59	42	0	0

Table A6: 2015 Nitrogen Oxides (NO_x) Annual Statistics

Unit: parts per billion (ppb)

ID	City	Location	PERCENTILES								Maximum	
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	24h
12008	Windsor Downtown	467 University Ave. W.	8745	5	8	12	18	32	74	16.2	213	73
12016	Windsor West	College Ave./South St.	8669	4	8	11	16	30	85	15.5	257	87
13001	Chatham	435 Grand Ave. W.	8511	2	4	6	9	17	41	8.5	131	37
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8067	3	5	9	13	23	51	11.7	153	44
15020	Grand Bend	Point Blake Conservation Area	8476	1	2	3	4	9	19	3.8	33	24
15026	London	42 St. Julien St.	8685	2	4	5	8	16	45	8.0	117	37
16015	Port Stanley	43665 Dexter Line, Elgin Water T. Plt	8064	1	2	2	4	6	15	3.2	35	12
18007	Tiverton	4th Concession/Bruce Rd. 23	8700	1	2	2	3	5	11	2.9	73	22
21005	Brantford	324 Grand River Ave.	8684	2	3	5	7	14	37	6.8	108	35
26060	Kitchener	West Ave./Homewood Ave.	8582	2	3	5	8	17	60	8.4	194	62
27067	St. Catharines	Argyle Cres., Pump Stn.	8633	3	4	6	9	19	55	9.4	175	44
28028	Guelph	Exhibition St./Clark St. W.	8598	1	3	5	8	16	51	7.7	136	49
29000	Hamilton Downtown	Elgin St./Kelly St.	8679	4	7	11	17	33	75	15.9	312	88
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8582	3	5	8	12	23	52	10.9	108	39
29118	Hamilton West	Main St. W./Hwy 403	8712	5	8	11	18	36	90	17.3	204	87
31103	Toronto Downtown	Bay St./Wellesley St. W.	8703	6	9	13	18	30	64	16.1	129	50
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8674	5	10	14	21	40	100	19.7	209	67
34020	Toronto North	Hendon Ave./Yonge St.	8705	4	8	12	19	34	77	16.9	157	66
35125	Toronto West	125 Resources Rd.	8599	7	12	19	28	51	127	25.7	263	109
44008	Burlington	North Shore Blvd. E./Lakeshore Rd.	8652	3	6	10	15	31	72	14.3	153	62
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8605	2	4	6	10	23	56	10.1	135	64
45026	Oshawa	2000 Simcoe St. N., Durham College	8654	2	4	6	10	19	47	8.9	112	32
46089	Brampton	525 Main St. N., Peel Manor	8665	2	5	8	14	31	90	13.7	226	93
46108	Mississauga	3359 Mississauga Rd. N., U of T Campus	8542	3	5	8	12	27	79	12.3	175	79
47045	Barrie	83 Perry St.	8675	3	5	7	10	21	74	10.9	185	68
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8693	2	3	5	8	18	55	8.5	139	43
49005	Parry Sound	7 Bay St.	8633	1	2	2	4	8	29	4.0	80	29
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8692	2	4	6	10	20	56	9.5	103	50
51002	Ottawa Central	960 Carling Ave.	8662	2	3	4	6	16	64	7.5	161	63
52023	Kingston	23 Beechgrove Lane	8664	1	2	3	5	10	39	5.3	140	40
54012	Belleville	2 Sidney St., Water Treatment Plant	8648	1	2	4	6	13	47	6.2	132	38
56051	Cornwall	Bedford St./3rd St. W.	8665	2	3	4	6	14	60	7.1	269	86
59006	Peterborough	10 Hospital Dr.	8619	2	3	4	6	13	47	6.6	119	39
63203	Thunder Bay	421 James St. S.	8694	4	5	8	12	28	74	12.7	153	54
71078	Sault Ste. Marie	Sault College	8675	2	3	4	7	14	34	6.6	157	25
75010	North Bay	Chippewa St. W., Dept. National Defence	8631	1	2	4	6	17	67	7.8	179	55
77233	Sudbury	155 Elm St.	8672	2	4	6	9	21	79	10.2	199	101

Table A7: 2015 Sulphur Dioxide (SO_2) Annual Statistics

Unit: parts per billion (ppb)
SO_2 1h AAQC: 250 ppb
SO_2 24h AAQC: 100 ppb
SO_2 1y AAQC: 20 ppb

ID	City	Location	PERCENTILES								Maximum		No. of Times Above Criteria		
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	24h	1h	24h	1y
12008	Windsor Downtown	467 University Ave. W.	8745	0	0	1	1	5	19	1.9	40	16	0	0	0
12016	Windsor West	College Ave./South St.	8632	0	0	0	1	6	18	1.9	43	16	0	0	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8632	0	0	1	2	9	41	3.2	72	39	0	0	0
29000	Hamilton Downtown	Elgin St./Kelly St.	8681	0	0	1	2	13	49	4.3	86	35	0	0	0
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8478	0	0	1	2	7	27	2.6	74	31	0	0	0
35125	Toronto West	125 Resources Rd.	8606	0	1	1	1	2	5	1.0	15	4	0	0	0
46108	Mississauga	3359 Mississauga Rd. N., U of T Campus	8240	0	0	1	1	3	7	1.1	35	5	0	0	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8681	0	0	0	1	1	2	0.4	15	3	0	0	0
71078	Sault Ste. Marie	Sault College	8675	0	0	0	0	1	14	0.8	74	11	0	0	0
77233	Sudbury	155 Elm St.	8636	0	0	1	1	5	35	2.4	221	23	0	0	0

Table A8: 2015 Carbon Monoxide (CO) Annual Statistics

Unit: parts per million (ppm)
CO 1h AAQC: 30 ppm
CO 8h AAQC: 13 ppm

ID	City	Location	PERCENTILES								Maximum		No. of Times Above Criteria	
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	8h	1h	8h
12008	Windsor Downtown	467 University Ave. W.	8742	0.16	0.2	0.23	0.28	0.41	0.76	0.27	1.91	1.20	0	0
29000	Hamilton Downtown	Elgin St./Kelly St.	8063	0.16	0.19	0.22	0.27	0.39	0.68	0.25	1.34	1.12	0	0
35125	Toronto West	125 Resources Rd.	8240	0.16	0.19	0.22	0.26	0.36	0.66	0.25	1.30	0.82	0	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8705	0.14	0.16	0.19	0.22	0.28	0.50	0.20	0.78	0.60	0	0

Table A9: 2015 Total Reduced Sulphur (TRS) Compounds Annual Statistics

Unit: parts per billion (ppb)

ID	City	Location	PERCENTILES								Maximum	
			Valid h	10%	30%	50%	70%	90%	99%	Mean	1h	24h
12016	Windsor West	College Ave./South St.	8688	0	0	0	0	1	3	0.2	20	1
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	7810	0	1	1	1	1	2	0.8	4	2
29000	Hamilton Downtown	Elgin St./Kelly St.	8653	0	0	0	0	1	3	0.1	10	2
71078	Sault Ste. Marie	Sault College	8676	0	0	0	0	0	0	0.0	4	0

Table A10: 10y Trend for O_3 Annual Mean (ppb)

ID	City/Town	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change Over Time
12008	Windsor Downtown	24.6	27.0	26.9	24.8	28.0	27.2	28.0	26.9	26.0	27.0	↑ 5%
12016	Windsor West	24.3	25.3	25.9	24.9	26.7	26.4	28.0	26.7	27.2	26.5	↑ 10%
13001	Chatham	28.7	30.9	30.9	28.8	31.9	29.7	29.5	29.6	29.3	29.6	↓ 2%
14064	Sarnia	26.7	28.6	28.7	26.6	30.7	29.7	29.7	28.6	27.1	27.8	↑ 1%
15020	Grand Bend	29.7	31.7	31.3	29.6	35.0	32.8	33.2	32.3	31.0	30.4	↑ 3%
15026	London	25.1	27.2	27.0	25.1	28.2	26.8	27.7	28.7	28.1	27.9	↑ 10%
16015	Port Stanley	32.4	34.3	34.3	30.9	34.6	32.8	33.1	33.9	32.3	32.8	↓ 1%
18007	Tiverton	29.0	34.3	32.6	31.4	33.8	32.1	32.0	32.4	31.8	32.5	↑ 2%
21005	Brantford	27.0	28.9	28.4	26.5	29.4	28.7	28.8	29.0	29.4	28.9	↑ 6%
26060	Kitchener	26.6	28.6	28.1	27.0	29.4	27.6	28.0	28.0	27.3	27.9	↑ 1%
27067	St. Catharines	26.2	28.1	27.5	25.6	28.3	28.0	28.7	28.6	28.5	28.6	↑ 8%
28028	Guelph	26.8	28.1	27.9	27.3	30.7	28.9	28.8	29.0	27.8	27.7	↑ 3%
29000	Hamilton Downtown	23.2	24.8	25.1	24.3	26.9	25.4	25.7	25.0	25.3	25.9	↑ 7%
29114	Hamilton Mountain	27.5	29.2	29.0	27.2	29.7	28.8	30.2	29.5	29.1	29.4	↑ 5%
29118	Hamilton West	20.9	23.0	23.3	21.8	24.5	24.2	24.2	24.4	22.7	23.9	↑ 9%
31103	Toronto Downtown	22.6	25.7	26.0	24.6	26.1	25.4	26.6	26.2	25.7	25.7	↑ 8%
33003	Toronto East	22.0	23.2	21.6	22.1	23.0	23.3	24.6	24.1	23.4	23.5	↑ 9%
34020	Toronto North	23.3	24.5	22.7	22.1	24.8	23.6	25.7	25.3	25.3	25.7	↑ 12%
35125	Toronto West	19.0	21.1	20.7	19.5	20.6	20.1	21.5	21.5	21.1	21.3	↑ 8%
44008	Burlington	23.5	24.6	24.9	24.1	26.6	25.9	26.7	26.4	25.5	26.5	↑ 11%
44017	Oakville	26.1	27.5	27.0	25.5	28.0	26.8	27.7	28.3	27.2	27.4	↑ 4%
45026	Oshawa	25.1	28.0	27.0	25.5	28.0	26.6	27.0	27.2	27.2	26.2	↑ 2%
46089	Brampton	25.5	26.8	26.6	25.2	27.5	26.1	26.6	26.7	26.5	26.5	↑ 2%
46108	Mississauga	22.4	23.3	24.6	24.0	25.9	24.1	25.6	25.2	25.4	25.4	↑ 11%
47045	Barrie	24.1	25.9	26.5	24.3	26.8	25.3	26.3	25.5	25.6	25.4	↑ 2%
48006	Newmarket	28.8	31.7	29.5	28.6	31.5	27.8	29.4	28.7	28.6	28.5	↓ 5%
49005	Parry Sound	30.7	31.8	32.1	29.7	31.3	29.7	30.1	30.4	29.6	30.4	↓ 5%
49010	Dorset	28.9	29.9	29.3	27.7	28.6	27.0	28.0	28.1	27.7	27.0	↓ 7%
51001	Ottawa Downtown	23.6	24.7	23.3	23.4	25.7	24.2	26.0	25.6	24.8	25.6	↑ 8%
51002	Ottawa Central	INS	26.5	27.4	24.7	26.6	24.8	25.6	26.6	26.6	27.0	↑ 1%
51010	Petawawa	INS	28.3	27.6	27.3	27.9	26.7	27.7	27.6	26.8	26.7	↓ 4%
52023	Kingston	INS	33.9	32.7	30.3	32.6	30.3	32.7	30.3	31.4	30.3	↓ 7%
54012	Belleville	29.2	32.0	29.8	28.5	30.0	27.9	28.0	29.2	29.6	29.6	↓ 4%
56051	Cornwall	27.5	28.3	26.6	25.5	27.9	26.1	27.1	26.9	27.3	27.9	→ 0%
59006	Peterborough	24.9	27.6	28.2	27.7	30.5	27.9	29.1	28.6	29.2	29.3	↑ 11%
63203	Thunder Bay	23.5	24.2	23.0	24.2	25.7	25.2	25.0	26.3	23.4	24.0	↑ 4%
71078	Sault Ste. Marie	29.1	29.7	28.9	27.8	28.4	27.8	28.8	28.9	28.4	27.8	↓ 4%
75010	North Bay	26.7	27.1	27.7	26.1	28.0	26.7	26.1	27.4	26.7	27.0	→ 0%
77233	Sudbury	28.4	28.1	27.9	25.9	28.7	28.7	28.5	27.2	26.3	25.7	↓ 6%

Notes:

INS indicates there was insufficient data in the 2nd and/or 3rd quarter to calculate a valid annual mean.

Station 15026 replaced station 15025 as the London site in 2013.

Station 46108 replaced station 46109 as the Mississauga site in 2008.

Station 52023 replaced station 52022 as the Kingston site in 2014.

Station 77233 replaced station 77219 as the Sudbury site in 2013.

Table A11: 10y Trend for O_3 Summer Means (May-September) Summer Mean (ppb)

ID	City/Town	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change Over Time
12008	Windsor Downtown	32.6	36.3	34.1	30.4	34.6	33.8	36.8	32.5	30.9	33.3	↓ 3%
12016	Windsor West	31.9	33.5	32.1	29.5	31.8	31.9	35.7	30.9	30.9	31.8	↓ 1%
13001	Chatham	35.5	38.2	36.7	32.6	36.5	34.4	36.6	34.2	32.4	34.4	↓ 8%
14064	Sarnia	32.0	34.2	33.0	28.6	34.3	32.9	36.6	32.0	29.4	31.1	↓ 4%
15020	Grand Bend	33.5	34.9	32.4	29.7	37.8	33.9	38.9	33.1	31.5	32.3	↓ 1%
15026	London	31.2	33.2	31.6	28.4	32.5	30.7	34.4	30.9	29.5	31.0	↓ 3%
16015	Port Stanley	38.5	40.4	38.8	33.2	38.9	35.5	38.4	36.9	33.7	35.6	↓ 10%
18007	Tiverton	30.4	38.3	34.0	30.3	33.3	31.7	36.0	32.5	30.8	33.3	↓ 3%
21005	Brantford	31.8	33.6	31.0	27.5	31.6	31.1	33.5	30.1	29.9	31.2	↓ 3%
26060	Kitchener	32.0	34.2	31.0	28.8	31.6	30.2	33.5	29.8	28.5	30.2	↓ 8%
27067	St. Catharines	32.6	33.9	31.2	27.7	32.0	31.2	35.0	31.2	29.5	31.7	↓ 3%
28028	Guelph	31.5	33.1	30.4	28.7	32.5	31.3	34.5	30.4	28.9	30.2	↓ 4%
29000	Hamilton Downtown	29.2	30.8	29.8	28.2	31.6	28.7	32.4	28.4	27.5	29.5	↓ 3%
29114	Hamilton Mountain	33.7	36.1	33.6	31.0	34.4	32.3	37.4	32.5	31.6	33.9	↓ 3%
29118	Hamilton West	25.3	26.9	26.7	23.9	27.9	26.2	29.2	26.4	22.7	26.5	↓ 1%
31103	Toronto Downtown	28.7	33.2	30.9	27.9	31.1	29.5	33.3	30.1	28.9	30.8	→ 0%
33003	Toronto East	27.2	28.3	24.9	25.2	26.7	27.4	30.6	27.1	25.9	27.7	↑ 3%
34020	Toronto North	28.6	29.9	26.4	25.6	28.0	27.5	32.7	29.4	28.6	30.7	↑ 9%
35125	Toronto West	24.3	25.9	24.8	22.5	24.3	23.6	27.5	24.4	23.5	25.0	→ 0%
44008	Burlington	29.2	30.0	28.3	26.7	30.2	29.2	32.5	29.2	27.4	30.1	↑ 2%
44017	Oakville	31.7	32.8	30.8	28.2	31.5	29.9	34.2	30.6	28.3	30.2	↓ 5%
45026	Oshawa	28.0	31.5	28.3	26.4	29.5	28.5	31.1	28.3	27.9	28.9	↓ 1%
46089	Brampton	31.3	31.9	31.0	28.5	30.8	29.3	32.7	29.5	28.9	30.3	↓ 5%
46108	Mississauga	28.5	28.6	27.3	26.2	29.0	26.7	30.4	26.5	26.5	28.0	↓ 2%
47045	Barrie	28.1	28.6	30.0	25.0	27.9	26.2	29.7	25.6	25.4	26.8	↓ 8%
48006	Newmarket	33.7	36.0	32.1	30.9	34.4	30.5	34.2	30.3	29.4	31.2	↓ 11%
49005	Parry Sound	33.3	33.6	32.2	28.6	30.4	28.7	32.8	30.1	28.2	31.4	↓ 9%
49010	Dorset	29.2	30.0	27.2	25.0	25.2	23.8	28.3	25.3	24.4	24.6	↓ 16%
51001	Ottawa Downtown	26.5	28.2	24.9	24.6	26.1	25.1	29.3	26.5	24.6	27.8	↑ 2%
51002	Ottawa Central	INS	27.9	25.3	26.3	25.4	29.4	27.0	26.2	26.2	28.7	↑ 4%
51010	Petawawa	INS	26.7	24.7	24.4	23.8	22.8	28.1	24.5	22.9	24.4	↓ 5%
52023	Kingston	INS	39.3	35.4	32.5	35.9	32.0	38.5	32.4	32.7	32.2	↓ 12%
54012	Belleville	34.1	37.0	32.3	30.6	34.2	29.9	32.7	30.6	30.4	33.2	↓ 10%
56051	Cornwall	29.8	31.1	27.6	27.1	29.8	26.7	30.7	28.1	27.0	29.7	↓ 4%
59006	Peterborough	27.2	30.0	31.6	29.2	32.0	29.8	34.2	29.5	30.0	31.5	↑ 8%
63203	Thunder Bay	24.7	24.6	21.3	24.2	23.9	24.2	25.3	24.7	22.7	23.6	↓ 1%
71078	Sault Ste. Marie	31.4	31.5	28.4	27.5	27.2	26.4	30.3	28.2	27.4	28.1	↓ 9%
75010	North Bay	29.0	28.5	28.3	26.5	28.4	26.3	28.5	26.9	26.2	27.8	↓ 6%
77233	Sudbury	30.1	29.5	26.0	25.7	26.3	26.9	29.8	28.0	27.0	27.7	↓ 3%

Notes:

INS indicates there was insufficient data to calculate a valid summer mean.

Station 15026 replaced station 15025 as the London site in 2013.

Station 46108 replaced station 46109 as the Mississauga site in 2008.

Station 52023 replaced station 52022 as the Kingston site in 2014.

Station 77233 replaced station 77219 as the Sudbury site in 2013.

Table A12: 10y Trend for O_3 Winter Means (January-April, October-December) Winter Mean (ppb)

ID	City/Town	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change Over Time
12008	Windsor Downtown	18.8	20.3	21.7	20.8	23.2	22.5	21.7	22.8	22.8	22.4	↑ 16%
12016	Windsor West	18.8	19.4	21.5	21.6	22.8	22.5	22.3	23.4	24.5	22.7	↑ 23%
13001	Chatham	23.9	25.4	26.8	26.1	28.5	26.7	24.3	26.2	27.1	26.3	↑ 5%
14064	Sarnia	23.0	24.7	25.5	25.2	28.1	27.4	24.7	26.2	25.4	25.4	↑ 6%
15020	Grand Bend	26.8	29.4	30.5	29.5	33.0	32.1	29.1	31.8	30.6	29.1	↑ 6%
15026	London	20.7	22.8	23.7	22.8	25.0	24.2	22.9	26.9	27.1	25.8	↑ 23%
16015	Port Stanley	28.0	30.0	31.0	29.4	31.5	31.0	29.3	31.8	31.3	31.2	↑ 8%
18007	Tiverton	28.2	31.5	31.7	32.3	34.1	32.2	29.2	32.4	32.7	31.9	↑ 6%
21005	Brantford	23.6	25.5	26.6	25.8	27.8	27.1	25.4	28.3	28.8	27.2	↑ 14%
26060	Kitchener	22.7	24.6	26.0	25.9	27.8	25.7	24.0	26.7	26.5	26.1	↑ 9%
27067	St. Catharines	21.7	24.1	24.9	24.1	25.6	25.8	24.1	26.8	27.9	26.3	↑ 19%
28028	Guelph	23.4	24.8	26.1	26.4	29.3	27.2	24.8	28.0	27.0	26.0	↑ 9%
29000	Hamilton Downtown	18.9	20.5	21.7	21.5	23.5	23.1	20.9	22.5	23.7	23.3	↑ 17%
29114	Hamilton Mountain	23.0	24.2	25.7	24.5	26.3	26.3	25.0	27.3	27.3	26.3	↑ 14%
29118	Hamilton West	17.8	20.1	20.9	20.4	22.1	22.7	20.6	23.0	22.8	22.1	↑ 20%
31103	Toronto Downtown	18.2	20.4	22.2	22.4	22.4	22.6	21.8	23.5	23.5	22.0	↑ 16%
33003	Toronto East	18.2	19.5	19.3	19.9	20.4	20.4	20.3	22.0	21.6	20.5	↑ 15%
34020	Toronto North	19.4	20.7	20.1	19.5	22.5	20.8	20.7	22.3	22.8	22.1	↑ 14%
35125	Toronto West	15.1	17.7	17.7	17.4	18.0	17.7	17.2	19.5	19.4	18.6	↑ 17%
44008	Burlington	19.3	20.7	22.5	22.3	23.9	23.5	22.5	24.4	24.1	23.8	↑ 20%
44017	Oakville	22.0	23.7	24.4	23.6	25.5	24.7	23.1	26.6	26.5	25.3	↑ 14%
45026	Oshawa	23.0	25.6	25.7	24.9	26.9	25.2	24.1	26.4	26.7	24.3	↑ 4%
46089	Brampton	21.4	23.1	23.4	22.8	25.2	23.8	22.2	24.6	24.8	23.8	↑ 9%
46108	Mississauga	18.0	19.2	22.8	22.5	23.7	22.5	22.2	24.3	24.7	23.6	↑ 26%
47045	Barrie	21.3	24.0	24.2	23.8	26.0	24.7	23.9	25.5	25.8	24.4	↑ 11%
48006	Newmarket	25.3	28.6	27.6	27.1	29.4	25.8	26.0	27.5	28.1	26.6	→ 0%
49005	Parry Sound	28.9	30.6	32.0	30.5	31.9	30.4	28.1	30.6	30.6	29.8	↓ 1%
49010	Dorset	28.6	30.1	30.7	29.6	31.0	29.5	27.7	30.1	30.1	28.8	↓ 2%
51001	Ottawa Downtown	21.4	22.0	22.2	22.6	25.5	23.6	23.5	24.9	25.1	24.0	↑ 15%
51002	Ottawa Central	INS	25.6	27.0	24.1	26.8	24.5	22.9	26.3	26.9	25.8	↑ 1%
51010	Petawawa	INS	29.5	29.6	29.5	30.8	29.5	27.5	29.9	29.6	28.5	↓ 3%
52023	Kingston	INS	30.1	30.6	28.6	30.0	29.0	28.6	28.8	30.4	28.9	↓ 3%
54012	Belleville	25.8	28.4	28.0	26.9	27.0	26.4	24.6	28.2	29.1	27.0	↑ 2%
56051	Cornwall	25.9	26.3	26.0	24.5	26.5	25.7	24.2	25.7	27.6	26.6	↑ 3%
59006	Peterborough	23.3	25.9	26.0	26.7	29.5	26.6	25.5	28.0	28.6	27.7	↑ 14%
63203	Thunder Bay	22.6	23.9	24.3	24.2	27.1	26.1	24.7	27.4	23.8	24.2	↑ 7%
71078	Sault Ste. Marie	27.5	28.6	29.3	28.4	29.3	28.9	27.6	29.4	29.2	27.7	↑ 1%
75010	North Bay	25.0	26.2	27.2	25.8	27.7	27.0	24.4	27.8	27.1	26.4	↑ 3%
77233	Sudbury	27.2	27.2	29.3	26.0	30.5	30.0	27.6	26.6	25.8	24.3	↓ 9%

Notes:

INS indicates there was insufficient data to calculate a valid winter mean.

Station 15026 replaced station 15025 as the London site in 2013.

Station 46108 replaced station 46109 as the Mississauga site in 2008.

Station 52023 replaced station 52022 as the Kingston site in 2014.

Station 77233 replaced station 77219 as the Sudbury site in 2013.

Ontario's move to new measurement technology in 2013 has resulted in increased $PM_{2.5}$ annual means; the increases are not an indication that the air quality has changed, but that the measurements are more accurate. For more information see Section 3.1: Technical Discussion – New $PM_{2.5}$ Measurement Technology in Ontario.

Table A13: 10y Summary for $PM_{2.5}$ Annual Mean ($\mu g/m^3$)

ID	City/Town	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
12008	Windsor Downtown	8.2	9.5	8.3	7.2	7.7	7.6	7.4	**9.2**	**10.1**	**9.3**
12016	Windsor West	9.2	9.8	8.9	7.4	7.8	7.8	7.6	**10.0**	**10.7**	**9.9**
13001	Chatham	7.4	7.9	7.3	6.3	6.5	6.6	6.0	**8.1**	**8.6**	**8.1**
14064	Sarnia	11.3	12.2	11.4	9.8	10.4	10.5	10.2	**8.5 (7.0*)**	**9.0 (6.7*)**	**8.4 (7.1*)**
15020	Grand Bend	6.5	6.7	6.8	5.8	6.1	6.1	5.8	**7.3**	**8.1**	**7.7**
15026	London	6.9	6.5	6.8	5.7	INS	6.2	6.5	**9.1**	**8.8**	**8.3**
16015	Port Stanley	7.3	7.2	6.7	5.6	5.9	6.0	5.9	**7.4 (5.3*)**	**8.2 (5.6*)**	**8.0 (5.3*)**
18007	Tiverton	5.6	5.6	5.0	4.0	4.5	4.7	INS	**5.8**	**6.5**	**6.4**
21005	Brantford	7.6	7.7	6.8	5.8	6.5	6.6	6.2	**8.5**	**9.2**	**8.7**
26060	Kitchener	7.7	8.0	7.1	5.8	6.3	6.2	6.0	**8.7**	**9.3**	**8.8**
27067	St. Catharines	7.9	8.2	7.4	6.0	6.5	6.3	6.3	**8.5**	**8.8**	**8.4**
28028	Guelph	7.0	7.5	6.5	5.6	5.7	5.9	5.8	**8.1**	**8.9**	**8.4**
29000	Hamilton Downtown	9.1	8.9	8.3	6.8	7.7	8.1	8.3	**10.1 (7.8*)**	**10.8 (8.5)**	**10.2 (7.3*)**
29114	Hamilton Mountain	8.1	7.8	7.3	6.3	6.2	6.7	6.5	**9.2**	**9.4**	**9.0**
29118	Hamilton West	8.2	8.3	7.6	6.1	6.8	7.1	7.3	**9.6**	**9.9**	**9.9**
31103	Toronto Downtown	7.3	7.3	6.6	5.6	6.0	6.2	6.4	**8.3**	**8.7**	**8.4**
33003	Toronto East	7.6	7.8	6.7	5.9	6.7	6.2	6.3	**8.2**	**8.9**	**8.5**
34020	Toronto North	7.6	7.8	7.3	5.9	6.2	7.7	7.3	**8.3**	**9.2**	**9.4**
35125	Toronto West	8.2	8.4	7.5	6.1	6.5	6.9	7.1	**8.8 (6.6*)**	**9.1 (6.7*)**	**8.5 (6.8*)**
44008	Burlington	7.6	7.3	6.9	5.9	6.2	6.2	6.4	**8.7**	**9.6**	**9.4**
44017	Oakville	7.4	7.6	6.7	5.3	5.7	6.4	6.1	**8.0**	**8.5**	**8.3**
45026	Oshawa	6.8	6.8	6.3	5.2	5.6	5.5	5.5	**7.4**	**7.7**	**7.5**
46089	Brampton	7.2	7.4	6.8	5.6	5.8	6.0	5.7	**8.5**	**8.9**	**8.4**
46108	Mississauga	7.6	7.2	7.1	5.8	6.1	6.0	6.0	**7.9**	**8.7**	**8.5**
47045	Barrie	6.7	6.9	6.1	5.2	5.4	5.7	5.6	**7.5**	**7.6**	**7.6**
48006	Newmarket	6.4	6.6	6.0	5.1	5.6	5.5	5.6	**7.3**	**7.3**	**7.1**
49005	Parry Sound	5.3	5.5	4.7	3.9	4.4	4.7	4.8	**5.8**	**5.8**	**5.7**
49010	Dorset	4.5	5.0	4.5	3.6	4.0	4.1	4.1	**5.4**	**5.3**	**5.6**
51001	Ottawa Downtown	6.1	6.0	5.3	4.6	4.5	4.9	4.8	**7.0 (5.1*)**	**7.0 (4.8*)**	**6.9 (5.1*)**
51002	Ottawa Central	INS	5.8	5.1	4.4	4.3	4.5	5.0	**7.1**	**6.8**	**6.9**
51010	Petawawa	INS	4.0	3.9	3.1	3.2	3.4	3.6	**4.8**	**4.7**	**4.8**
52023	Kingston	INS	7.5	7.0	6.4	6.5	6.9	6.8	**6.5**	**6.8**	**6.3**
54012	Belleville	6.2	6.2	6.1	4.9	INS	4.8	5.1	**6.9**	**6.8**	**6.6**
56051	Cornwall	6.5	6.4	6.1	5.4	5.7	5.7	5.4	**7.7 (5.2*)**	**7.0 (5.1*)**	**6.9 (4.7*)**
59006	Peterborough	6.3	6.4	6.0	4.9	5.1	5.5	4.9	**7.4**	**6.9**	**6.8**
63203	Thunder Bay	4.8	4.4	4.2	3.8	4.1	4.8	4.1	**6.3**	**6.6**	**6.5**
71078	Sault Ste. Marie	5.2	5.3	4.4	4.0	4.1	4.4	4.4	**5.6**	**6.0**	**5.9**
75010	North Bay	4.9	5.0	4.6	3.8	3.8	4.2	4.1	**5.2 (3.8*)**	**5.3 (3.8*)**	**5.3 (4.0*)**
77233	Sudbury	4.6	4.9	4.1	3.4	3.6	4.0	4.0	**5.7**	**6.0**	**6.3**

Notes:

* For data comparison purposes, measurements were taken by Tapered Element Oscillating Microbalance (TEOM) sampler at selected sites.
From 2004-2012, measurements taken by TEOM sampler operated at 30°C with a Sample Equilibration System (SES).
As of 2013, measurements taken by Synchronized Hybrid Ambient Real-time Particulate (SHARP) 5030.
Due to change in the $PM_{2.5}$ monitoring method in 2013, it is inappropriate to calculate a change over time.
INS indicates there was insufficient data in any one quarter to calculate a valid annual mean.
Station 15026 replaced station 15025 as the London site in 2013.
Station 46108 replaced station 46109 as the Mississauga site in 2008.
Station 52023 replaced station 52022 as the Kingston site in 2014.
Station 77233 replaced station 77219 as the Sudbury site in 2013.

Table A14: 10y Trend for NO

Annual Mean (ppb)

ID	City/Town	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change Over Time
12008	Windsor Downtown	7.2	6.4	5.9	5.6	4.7	4.5	4.7	3.7	4.0	3.5	↓ 51%
12016	Windsor West	7.2	6.5	5.1	5.4	6.1	3.8	4.6	3.6	3.8	4.2	↓ 48%
13001	Chatham	2.6	2.4	3.1	3.5	2.6	1.9	1.8	1.6	1.5	1.7	↓ 50%
14064	Sarnia	3.7	3.2	3.2	2.8	2.2	3.1	2.1	1.7	1.9	2.4	↓ 45%
15026	London	4.4	3.6	3.1	2.8	2.9	3.3	4.2	1.4	1.3	1.4	↓ 63%
18007	Tiverton	INS	0.2	0.2	0.4	0.7	0.9	0.7	0.1	1.3	0.3	rb
21005	Brantford	2.5	1.8	1.3	1.7	1.3	1.2	1.1	1.2	0.9	1.3	↓ 54%
26060	Kitchener	3.5	2.7	2.5	2.1	2.5	2.0	2.1	1.6	1.6	1.6	↓ 53%
27067	St. Catharines	5.5	4.5	3.6	3.7	2.8	2.3	2.5	2.2	1.7	2.1	↓ 70%
29000	Hamilton Downtown	8.0	7.7	6.5	5.8	5.0	4.8	4.6	4.3	3.9	1.3	↓ 69%
29114	Hamilton Mountain	3.6	3.2	2.4	2.5	2.2	2.3	1.9	2.0	2.0	1.8	↓ 50%
31103	Toronto Downtown	7.0	5.9	5.0	5.1	4.1	3.4	2.8	2.7	2.5	2.7	↓ 70%
33003	Toronto East	12.5	10.8	9.2	7.8	7.8	7.6	6.6	5.7	6.2	5.8	↓ 56%
34020	Toronto North	10.0	8.3	7.7	7.1	5.7	6.2	5.0	4.1	4.3	3.9	↓ 63%
35125	Toronto West	20.1	17.5	16.2	13.5	13.4	12.4	11.3	8.6	9.5	9.2	↓ 59%
44008	Burlington	9.8	8.8	6.5	5.9	5.0	4.6	4.6	4.6	4.6	3.9	↓ 63%
44017	Oakville	4.3	3.9	4.0	3.5	3.6	2.7	3.4	2.1	3.4	2.7	↓ 37%
45026	Oshawa	3.8	3.2	3.2	3.0	2.3	2.3	2.1	1.5	2.0	2.3	↓ 52%
46089	Brampton	9.1	6.0	5.8	6.5	3.7	4.6	4.4	4.6	4.0	3.8	↓ 55%
46108	Mississauga	n/a	n/a	6.1	5.1	4.1	4.1	3.8	3.1	2.9	3.1	↓ 54%
47045	Barrie	8.0	5.5	5.5	5.1	4.3	3.8	3.2	3.2	3.7	3.5	↓ 59%
48006	Newmarket	3.0	2.2	2.6	3.2	2.3	2.2	2.0	1.5	1.4	1.7	↓ 48%
51001	Ottawa Downtown	3.0	3.4	2.7	2.4	1.6	1.8	2.4	2.1	1.9	2.0	↓ 40%
51002	Ottawa Central	INS	2.4	2.7	1.8	1.4	1.5	2.0	2.8	1.0	1.6	↓ 33%
52023	Kingston	INS	0.6	1.1	0.6	0.3	0.5	0.4	0.2	0.8	0.9	↓ 12%
54012	Belleville	3.0	3.2	3.0	1.9	2.3	2.3	1.6	1.7	1.2	1.5	↓ 62%
56051	Cornwall	3.1	3.5	3.6	3.2	2.0	1.9	2.2	1.9	1.5	1.8	↓ 59%
59006	Peterborough	2.5	2.3	3.0	1.9	1.7	2.2	1.8	1.7	1.8	1.5	↓ 41%
63203	Thunder Bay	6.1	5.4	5.1	5.7	4.6	5.9	5.1	4.7	4.2	5.2	↓ 19%
71078	Sault Ste. Marie	1.6	1.4	1.4	1.8	1.9	2.0	1.7	1.3	2.0	1.7	↑ 15%
75010	North Bay	4.4	3.5	3.8	4.2	3.4	4.0	2.9	2.5	2.6	2.1	↓ 46%

Notes:

INS indicates there was insufficient data to calculate a valid annual mean.

rb indicates regional background measurements near detection limit of analyzer; trend is statistically insignificant.

Station 15026 replaced station 15025 as the London site in 2013.

Station 52023 replaced station 52022 as the Kingston site in 2014.

Table A15: 10y Trend for NO_2 Annual Mean (ppb)

ID	City/Town	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change Over Time
12008	Windsor Downtown	17.2	17.2	15.2	14.4	15.6	14.5	13.2	12.4	14.0	12.7	↓ 26%
12016	Windsor West	15.7	16.1	16.2	13.2	14.5	12.9	11.4	11.5	11.8	11.4	↓ 33%
13001	Chatham	9.5	8.6	7.0	7.5	6.4	6.6	5.7	6.0	6.8	6.8	↓ 31%
14064	Sarnia	11.0	11.3	10.8	8.2	8.0	8.6	8.6	8.1	9.0	9.3	↓ 23%
15026	London	12.3	11.7	10.8	9.0	8.8	8.3	6.3	6.4	6.9	6.6	↓ 53%
18007	Tiverton	INS	2.9	3.0	2.3	1.9	2.5	2.5	1.9	2.7	2.4	↓ 16%
21005	Brantford	8.8	7.7	6.9	7.3	5.8	6.1	5.4	4.8	5.5	5.5	↓ 41%
26060	Kitchener	10.8	9.7	9.0	8.6	7.7	7.7	7.1	6.7	7.0	6.8	↓ 39%
27067	St. Catharines	11.7	12.0	10.4	9.9	9.1	8.5	8.1	7.7	7.3	7.3	↓ 43%
29000	Hamilton Downtown	17.0	17.0	14.7	13.6	12.7	13.5	11.9	12.4	12.4	12.2	↓ 31%
29114	Hamilton Mountain	11.6	11.9	10.5	9.9	8.9	9.9	8.6	9.0	9.3	9.0	↓ 25%
31103	Toronto Downtown	19.2	18.2	17.0	16.5	16.1	14.9	13.4	13.5	14.0	13.4	↓ 32%
33003	Toronto East	17.4	17.2	16.5	14.9	14.8	15.2	14.0	13.6	14.2	13.9	↓ 22%
34020	Toronto North	17.4	16.7	16.5	15.8	14.3	15.4	13.4	12.9	13.4	12.9	↓ 28%
35125	Toronto West	22.3	22.1	20.8	19.0	20.1	19.1	16.3	16.1	17.1	16.6	↓ 29%
44008	Burlington	16.2	16.0	13.6	12.5	12.2	11.8	11.0	11.0	10.9	10.4	↓ 37%
44017	Oakville	12.5	13.0	12.0	11.1	9.2	10.3	9.1	9.2	8.2	7.5	↓ 42%
45026	Oshawa	8.9	8.1	8.5	7.4	7.2	7.0	5.6	5.9	6.8	6.6	↓ 31%
46089	Brampton	15.2	13.9	13.1	13.3	10.7	11.3	10.4	9.1	10.6	9.9	↓ 37%
46108	Mississauga	n/a	n/a	12.3	12.2	10.4	10.6	9.6	9.5	9.2	9.2	↓ 28%
47045	Barrie	12.6	11.5	10.8	9.9	8.7	8.6	8.1	7.8	8.1	7.4	↓ 42%
48006	Newmarket	9.0	8.3	8.0	7.8	7.2	8.1	7.2	6.8	6.8	6.8	↓ 24%
51001	Ottawa Downtown	8.6	8.7	11.4	8.6	7.4	7.9	7.8	7.9	7.4	7.4	↓ 23%
51002	Ottawa Central	INS	7.9	8.1	6.6	6.2	6.6	6.6	6.6	6.0	5.8	↓ 24%
52023	Kingston	INS	5.5	5.5	5.0	4.3	4.6	4.0	3.6	3.9	4.4	↓ 31%
54012	Belleville	4.5	6.4	7.3	6.0	5.5	6.3	4.7	4.7	4.5	4.8	↓ 24%
56051	Cornwall	6.7	7.6	7.5	7.3	6.5	6.5	6.1	6.2	5.6	5.3	↓ 27%
59006	Peterborough	6.3	6.4	7.0	5.6	5.0	4.3	3.7	5.0	5.3	5.1	↓ 30%
63203	Thunder Bay	8.1	8.7	8.1	8.4	7.8	8.6	7.3	7.3	7.8	7.5	↓ 12%
71078	Sault Ste. Marie	5.2	5.0	5.5	5.1	5.5	5.3	4.8	5.0	5.3	4.8	↓ 5%
75010	North Bay	7.7	7.4	7.5	8.2	7.6	7.4	6.1	5.8	5.6	5.6	↓ 31%

Notes:

INS indicates there was insufficient data to calculate a valid annual mean.

n/a indicates data not available.

Station 15026 replaced station 15025 as the London site in 2013.

Station 52023 replaced station 52022 as the Kingston site in 2014.

Table A16: 10y Trend for NO_X

Annual Mean (ppb)

ID	City/Town	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change Over Time
12008	Windsor Downtown	24.4	23.6	21.1	20.0	20.2	18.9	17.8	16.2	18.0	16.2	↓ 34%
12016	Windsor West	22.8	22.6	21.3	18.6	20.6	16.7	16.0	15.2	15.7	15.5	↓ 38%
13001	Chatham	12.1	11.0	10.1	10.9	9.0	8.4	7.5	7.7	8.2	8.5	↓ 36%
14064	Sarnia	14.7	14.5	13.9	11.0	10.2	11.7	10.7	9.8	10.9	11.7	↓ 28%
15026	London	16.7	15.3	13.9	11.9	11.7	11.6	10.5	7.8	8.3	8.0	↓ 56%
18007	Tiverton	INS	3.0	3.3	2.7	2.6	3.4	3.1	2.1	4.0	2.9	↑ 4%
21005	Brantford	11.3	9.5	8.2	9.1	7.2	7.3	6.7	5.7	6.4	6.8	↓ 45%
26060	Kitchener	14.3	12.4	11.5	10.8	10.3	9.6	9.2	8.3	8.5	8.4	↓ 42%
27067	St. Catharines	17.2	16.5	14.0	13.7	11.8	10.9	10.6	9.9	9.1	9.4	↓ 50%
29000	Hamilton Downtown	24.9	24.7	21.2	19.5	17.8	18.3	16.6	16.8	16.3	7.7	↓ 53%
29114	Hamilton Mountain	15.3	15.1	12.9	12.4	11.2	12.2	10.5	11.0	11.3	10.9	↓ 30%
31103	Toronto Downtown	26.1	24.2	22.1	21.6	20.3	18.4	16.2	16.1	16.5	16.1	↓ 42%
33003	Toronto East	29.9	28.0	25.7	22.7	22.6	22.8	20.6	19.4	20.4	19.7	↓ 35%
34020	Toronto North	27.5	25.0	24.3	22.8	20.0	21.5	18.5	17.0	17.7	16.9	↓ 40%
35125	Toronto West	42.4	39.6	37.0	32.5	33.5	31.5	27.6	24.7	26.5	25.7	↓ 43%
44008	Burlington	26.0	24.8	20.0	18.4	17.2	16.4	15.6	15.6	15.5	14.3	↓ 46%
44017	Oakville	16.7	16.9	16.1	14.6	12.8	13.0	12.6	11.2	11.6	10.1	↓ 41%
45026	Oshawa	12.7	11.3	11.7	10.4	9.5	9.2	7.8	7.4	8.8	8.9	↓ 37%
46089	Brampton	24.2	19.9	18.9	19.9	14.4	15.9	14.8	13.9	14.6	13.7	↓ 43%
46108	Mississauga	n/a	n/a	18.4	17.3	14.5	14.7	13.4	12.6	12.1	12.3	↓ 36%
47045	Barrie	20.6	17.0	16.3	15.1	13.1	12.4	11.3	11.0	11.8	10.9	↓ 48%
48006	Newmarket	11.8	10.4	10.4	11.0	9.5	10.3	9.2	8.4	8.2	8.5	↓ 29%
51001	Ottawa Downtown	11.5	12.0	14.0	11.0	9.0	9.7	10.2	10.1	9.3	9.5	↓ 26%
51002	Ottawa Central	INS	10.2	10.8	8.4	7.5	8.1	8.7	9.4	7.1	7.5	↓ 25%
52023	Kingston	INS	6.3	6.5	5.7	4.7	5.3	4.6	3.8	4.8	5.3	↓ 28%
54012	Belleville	7.5	9.6	10.2	7.9	7.8	8.7	6.4	6.3	5.7	6.2	↓ 36%
56051	Cornwall	9.8	11.0	11.1	10.6	8.5	8.4	8.4	8.0	7.0	7.1	↓ 37%
59006	Peterborough	8.8	8.6	10.0	7.5	6.7	6.6	5.4	6.6	7.1	6.6	↓ 33%
63203	Thunder Bay	14.2	14.1	13.2	14.1	12.4	14.5	12.4	12.0	11.9	12.7	↓ 14%
71078	Sault Ste. Marie	6.9	6.4	6.9	6.9	7.4	7.2	6.4	6.3	7.3	6.6	↓ 1%
75010	North Bay	12.1	10.9	11.3	12.4	11.0	11.5	9.1	8.3	8.1	7.8	↓ 36%

Notes:

INS indicates there was insufficient data to calculate a valid annual mean.

n/a indicates data not available.

Station 15026 replaced station 15025 as the London site in 2013.

Station 45026 replaced station 45025 as the Oshawa site in 2005.

Station 52023 replaced station 52022 as the Kingston site in 2014.

Table A17: 10y Trend for CO

1h Maximum (ppm)
CO 1h AAQC: 30 ppm

ID	City/Town	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change Over Time
12008	Windsor Downtown	2.9	5.0	1.3	1.4	2.5	3.8	2.1	1.9	1.8	1.9	↓ 43%
29000	Hamilton Downtown	2.8	6.0	3.3	5.0	2.2	1.8	1.7	2.0	2.9	1.3	↓ 66%
35125	Toronto West	3.0	1.4	1.7	1.6	1.8	1.4	1.4	1.4	1.6	1.3	↓ 42%
51001	Ottawa Downtown	1.4	1.5	1.3	1.4	1.5	1.5	0.9	0.9	0.8	0.8	↓ 47%

Table A18: 10y Trend for SO_2

Annual Mean (ppb)
SO_2 1y AAQC: 20 ppb

ID	City/Town	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change Over Time
12008	Windsor Downtown	5.0	5.5	4.5	3.5	3.5	3.5	2.8	2.4	2.4	1.9	↓ 58%
12016	Windsor West	4.9	5.2	4.7	3.6	3.2	3.4	2.8	2.6	2.8	1.9	↓ 56%
14064	Sarnia	8.3	8.0	7.7	4.5	3.9	5.3	4.1	3.8	3.5	3.2	↓ 64%
29000	Hamilton Downtown	4.8	4.2	4.3	3.3	3.3	5.2	4.8	4.8	5.1	4.3	↑ 5%
29114	Hamilton Mountain	3.3	3.5	3.0	3.0	2.9	4.1	3.7	2.8	2.9	2.6	↓ 5%
35125	Toronto West	2.0	1.5	1.4	1.2	0.9	1.5	0.6	0.6	0.7	1.0	↓ 75%
46108	Mississauga	INS	n/a	1.6	1.1	1.0	1.3	0.6	0.7	1.3	1.1	↓ 71%
51001	Ottawa Downtown	1.1	0.9	1.0	0.9	0.2	0.4	0.3	0.3	0.3	0.4	↓ 94%
71078	Sault Ste. Marie	1.4	1.8	1.2	0.6	0.7	0.8	0.6	0.8	0.8	0.8	↓ 64%
77233	Sudbury	2.4	2.3	2.0	1.1	1.3	1.5	1.3	2.8	2.4	2.4	↓ 17%

Notes:

n/a indicates pollutant not monitored.

INS indicates there was insufficient data to calculate a valid annual mean.

Station 46108 replaced station 46109 as the Mississauga site in 2008.

Station 77233 replaced station 77219 as the Sudbury site in 2013.

Table A19: Ozone and $PM_{2.5}$ CAAQS Metric Values for Designated Sites Across Ontario (2015)

City/Town	8h Ozone (ppb)	24h $PM_{2.5}$ ($\mu g/m^3$)	Annual $PM_{2.5}$ ($\mu g/m^3$)
Windsor Downtown	69	22	9.5
Chatham	68	19	8.3
London	67	22	8.7
Brantford	68	22	8.8
Kitchener	65	24	9.0
Guelph	65	23	8.5
St. Catharines	64	20	8.6
Hamilton Downtown	64	26	10.4
Hamilton Mountain	66	23	9.3
Burlington	65	24	9.2
Oakville	65	22	8.2
Mississauga	64	24	8.4
Brampton	65	23	8.6
Toronto	67	23	8.7
Oshawa	62	20	7.5
Barrie	60	20	7.6
Peterborough	65	18	7.1
Kingston	64	17	6.5
Ottawa Downtown	57	20	7.0
Sudbury	61	15	6.0
Thunder Bay	52	15	6.5

Notes:

Designated sites include communities with populations greater than 100,000.

Toronto reporting is based on Toronto Downtown, Toronto North, Toronto East and Toronto West stations.

The CAAQS for ozone is based on the consecutive three year average of the annual 4th highest daily maximum eight-hour running average.

The CAAQS for 24h $PM_{2.5}$ is based on the 98th percentile measurement annually, averaged over three consecutive years.

The CAAQS for annual $PM_{2.5}$ is based on the annual mean averaged over three consecutive years.

Red font indicates an exceedance of the CAAQS; the calculated metrics presented in this table do not include weight of evidence (WOE) analysis.

Table A20: Ozone CAAQS Metric Values Using the Weight of Evidence Approach (2015)

City	Transboundary Flow Days	4th Highest Daily Max 8h Running Average			3y CAAQS Metric Value
		2013	2014	2015	
Windsor Downtown	included	68.0	69.3	70.1	69
	excluded	57.4	60.0	60.6	59
Chatham	included	70.5	66.4	65.9	68
	excluded	59.9	60.9	58.4	60
London	included	68.6	66.6	66.1	67
	excluded	59.0	61.4	59.3	60
Brantford	included	68.0	66.5	68.4	68
	excluded	56.9	61.0	60.8	60
Kitchener	included	65.6	64.9	65.1	65
	excluded	54.6	55.8	56.9	56
Guelph	included	63.3	66.1	65.9	65
	excluded	[63.3]	57.4	59.4	60
St. Catharines	included	65.0	61.8	66.4	64
	excluded	58.0	[61.8]	60.4	60
Hamilton Downtown	included	65.4	62.0	63.3	64
	excluded	58.5	[62.0]	62.6	61
Hamilton Mountain	included	65.4	65.0	67.3	66
	excluded	55.6	62.3	63.1	60
Burlington	included	67.5	63.9	63.5	65
	excluded	59.4	59.0	61.0	60
Oakville	included	67.1	62.4	65.0	65
	excluded	61.1	[62.4]	62.1	62
Mississauga	included	65.6	60.5	65.0	64
	excluded	57.6	[60.5]	61.3	60
Brampton	included	65.0	63.4	67.1	65
	excluded	55.8	[63.4]	62.9	61
Toronto	included	67.2	64.0	70.0	67
	excluded	62.0	57.4	67.8	60
Peterborough	included	61.6	62.6	70.3	65
	excluded	[61.6]	[62.6]	60.0	61
Kingston	included	64.0	65.6	63.8	64
	excluded	53.4	62.8	63.3	60

Notes:

Ozone concentrations reported in ppb.

Red font indicates an exceedance of the CAAQS.

Square brackets [] indicate a weight of evidence (WOE) analysis was not required.

Table A21: Number of Transboundary Flow Days Removed for Ozone, 2013-2015

City/Town	2013	2014	2015	Total Number of Transboundary Flow Days Removed
Windsor Downtown	17	15	11	43
Chatham	16	8	14	38
London	18	10	14	42
Brantford	20	10	9	39
Kitchener	19	15	10	44
Guelph	not required	11	9	20
St. Catharines	12	not required	11	23
Hamilton Downtown	7	not required	4	11
Hamilton Mountain	19	5	9	33
Burlington	8	2	4	14
Oakville	10	not required	4	14
Mississauga	11	not required	3	14
Brampton	12	not required	3	15
Toronto	4	7	8	19
Peterborough	not required	not required	6	6
Kingston	18	3	1	22

Note: The removal of transboundary flow days is not required when the corresponding annual 4th highest daily maximum eight-hour running average(s) meet the ozone CAAQS.

Table A22: 2015 Air Quality Health Index Summary

City/Town	No. of Valid Hours	Percentage of Valid Hours AQHI										No. of Days
		Low Risk			Moderate Risk			High Risk				At Least
		1	2	3	4	5	6	7	8	9	10	1 Hour > 6
Windsor Downtown	8728	2.0	30.1	46.4	17.8	3.4	0.3	0.03	0	0	0	1
Windsor West	8582	2.2	35.1	46.2	14.2	2.2	0.1	0.02	0	0	0	1
Chatham	8297	8.8	43.8	36.0	10.0	1.5	0	0	0	0	0	0
Sarnia	8678	5.3	43.6	36.6	11.7	2.6	0.2	0.05	0	0	0	2
Grand Bend	8349	16.2	52.1	24.0	6.4	1.2	0.01	0.1	0	0	0	4
London	8681	11.2	48.8	31.1	7.9	0.9	0.1	0.01	0	0	0	1
Port Stanley	7994	12.7	50.0	29.9	6.1	1.2	0.1	0.1	0	0	0	2
Tiverton	8596	14.4	59.4	21.2	4.6	0.4	0	0.01	0	0	0	1
Brantford	8646	11.2	50.1	30.7	7.1	0.9	0.05	0.01	0	0	0	1
Kitchener	8508	9.7	49.6	30.6	8.5	1.2	0.3	0.1	0.02	0	0	3
St. Catharines	8591	7.1	47.7	35.3	8.7	1.2	0.02	0	0	0	0	0
Guelph	8476	10.4	52.1	29.1	7.2	1.0	0.2	0.02	0	0	0	1
Hamilton Downtown	8733	3.3	34.1	42.3	16.1	3.2	0.9	0.1	0	0	0	4
Hamilton Mountain	8585	3.9	39.9	40.3	12.9	2.7	0.3	0.01	0	0	0	1
Hamilton West	8659	2.8	40.2	40.6	13.4	2.5	0.5	0.01	0	0	0	1
Toronto Downtown	8734	2.4	34.3	43.5	15.5	3.4	0.8	0	0	0	0	0
Toronto East	8696	4.6	36.4	39.3	15.0	3.9	0.7	0.2	0	0	0	5
Toronto North	8691	4.9	33.1	39.2	16.6	5.2	0.8	0.2	0	0	0	4
Toronto West	8594	2.2	32.3	43.7	16.7	4.4	0.5	0.2	0	0	0	4
Burlington	8675	4.9	39.9	39.9	12.3	2.6	0.3	0.1	0	0	0	2
Oakville	8230	7.7	52.6	30.2	8.0	1.2	0.2	0.01	0	0	0	1
Oshawa	8566	15.9	51.1	25.3	6.5	1.2	0.02	0	0	0	0	0
Brampton	8710	6.9	44.3	33.7	11.7	2.8	0.5	0.1	0	0	0	3
Mississauga	8529	7.4	49.2	32.9	8.3	1.8	0.4	0.02	0	0	0	1
Barrie	8632	13.6	52.3	27.2	6.1	0.8	0.01	0	0	0	0	0
Newmarket	8713	11.8	50.7	27.3	8.4	1.6	0.2	0.1	0	0	0	2
Parry Sound	8520	16.3	60.1	19.7	3.7	0.2	0	0.01	0	0	0	1
Dorset	8579	25.5	58.4	14.7	1.4	0.05	0	0	0	0	0	0
Ottawa Downtown	8670	15.8	49.6	26.5	7.0	1.1	0.05	0	0	0	0	0
Ottawa Central	8592	15.7	54.0	24.3	5.2	0.8	0.1	0	0	0	0	0
Petawawa	8526	28.9	55.3	14.7	1.0	0.02	0	0	0	0	0	0
Kingston	8702	12.6	55.8	27.4	4.1	0.1	0	0	0	0	0	0
Belleville	8375	12.4	56.3	25.5	5.5	0.3	0	0	0	0	0	0
Morrisburg	6356	13.9	56.7	26.2	3.2	0.03	0	0	0	0	0	0
Cornwall	8571	15.0	52.7	28.1	3.5	0.4	0.2	0.01	0	0	0	1
Peterborough	8647	14.9	51.8	25.6	6.6	1.0	0	0	0	0	0	0
Thunder Bay	8699	16.6	52.8	27.0	3.4	0.3	0	0	0	0	0	0
Sault Ste. Marie	8370	18.5	52.8	25.6	3.1	0.1	0	0	0	0	0	0
North Bay	8597	20.6	52.0	22.3	4.9	0.2	0	0	0	0	0	0
Sudbury	8709	14.8	54.9	24.0	5.6	0.7	0	0	0	0	0	0

Table A23: Summary of Air Quality Alerts (2015)

Air Quality Forecast Region	2015	
	SAQS	SAHA
Algonquin	0	0
Atikokan - Upsala - Quetico	0	0
Attawapiskat	0	0
Bancroft - Bon Echo Park	0	0
Barrie - Orillia - Midland	0	0
Belleville - Quinte - Northumberland	0	0
Big Trout Lake - Sachigo Lake	1	0
Brockville - Leeds and Grenville	0	0
Burk's Falls - Bayfield Inlet	0	0
Chapleau - Gogama	0	0
City of Hamilton	0	0
City of Ottawa	0	0
City of Thunder Bay	1	0
City of Toronto	1	0
Cornwall - Morrisburg	0	0
Dryden - Ignace	0	0
Dufferin - Innisfil	0	0
Dunnville - Caledonia - Haldimand	0	0
Elgin	0	0
Elliot Lake - Ranger Lake	0	0
Fort Frances - Rainy Lake	1	0
Fort Hope - Webequie	0	0
Fort Severn	1	0
Geraldton - Manitouwadge - Hornepayne	0	0
Greater Sudbury and Vicinity	0	0
Grey - Bruce	0	0
Haliburton	0	0
Halton - Peel	1	0
Huron - Perth	0	0
Kapuskasing - Hearst	0	0
Kenora - Nestor Falls	1	0
Kingston - Prince Edward	0	0
Kirkland Lake - New Liskeard - Temagami	0	0
Lake Nipigon - Wabakimi	0	0

Table A23: Summary of Air Quality Alerts (2015) (continued)

Air Quality Forecast Region	2015	
	SAQS	SAHA
London - Middlesex	0	0
Manitoulin - Blind River - Killarney	0	0
Manitoulin - Northshore - Killarney	0	0
Moosonee - Fort Albany	0	0
Niagara	0	0
Nipigon - Marathon - Superior North	0	0
North Bay - West Nipissing	0	0
Oxford - Brant	0	0
Parry Sound - Muskoka - Huntsville	0	0
Peawanuck	0	0
Peterborough - Kawartha Lakes	0	0
Pickle Lake - Wunnummin Lake	0	0
Prescott and Russell	0	0
Red Lake - Ear Falls	1	0
Renfrew - Pembroke - Barry's Bay	0	0
Sandy Lake - Pikangikum	1	0
Sarnia - Lambton	1	0
Sault Ste. Marie - Superior East	0	0
Simcoe - Delhi - Norfolk	0	0
Sioux Lookout - Savant Lake	0	0
Smiths Falls - Lanark - Sharbot Lake	0	0
Stirling - Tweed - South Frontenac	0	0
Superior West	1	0
Timmins - Cochrane	0	0
Waterloo - Wellington	0	0
Wawa - White River - Pukaskwa	0	0
Windsor - Essex - Chatham - Kent	1	0
York - Durham	1	0
ONTARIO	**7**	**0**

Table A24: 2014 Benzene Annual Statistics

Unit: micrograms per cubic metre (µg/m^3)
Benzene 24h AAQC: 2.3 µg/m^3
Benzene Annual AAQC: 0.45 µg/m^3

ID	City	Location	No. of Samples	PERCENTILES									No. of Times Above Criteria	
				10%	25%	50%	75%	90%	Max	Min	Mean	Std. Dev.	24h	Annual
12016	Windsor West	College Ave./South St.	58	0.350	0.466	0.557	0.735	0.942	1.629	0.151	0.610	0.253	0	1
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	57	0.232	0.362	0.569	0.755	1.385	17.371	0.123	1.007	2.299	4	1
15026	London	42 St. Julien St.	61	0.238	0.300	0.405	0.563	0.640	1.270	0.142	0.446	0.206	0	0
26060	Kitchener	West Ave./ Homewood Ave.	56	0.267	0.328	0.480	0.599	0.721	0.898	0.178	0.483	0.177	0	1
29000	Hamilton Downtown	Elgin St./Kelly St.	61	0.276	0.381	0.597	1.066	1.899	4.006	0.220	0.899	0.805	4	1
46089	Brampton	525 Main St. N., Peel Manor	55	0.250	0.338	0.468	0.668	0.768	1.250	0.158	0.508	0.233	0	1
48006	Newmarket	Eagle St. W./ McCaffrey Rd.	55	0.221	0.289	0.382	0.490	0.668	1.186	0.134	0.422	0.199	0	0
51001	Ottawa Downtown	Rideau St./ Wurtemburg St.	56	0.197	0.250	0.345	0.509	0.709	1.070	0.130	0.413	0.226	0	0

Table A25: 2014 Toluene Annual Statistics

Unit: micrograms per cubic metre (µg/m^3)
Toluene 24h AAQC (based on odour): 2,000 µg/m^3

ID	City	Location	No. of Samples	PERCENTILES									No. of Times Above Criteria
				10%	25%	50%	75%	90%	Max	Min	Mean	Std. Dev.	24h
12016	Windsor West	College Ave./South St.	58	0.523	0.654	1.070	1.895	3.531	6.468	0.273	1.542	1.279	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	57	0.183	0.427	0.927	1.867	4.254	18.318	0.125	1.908	3.050	0
15026	London	42 St. Julien St.	61	0.348	0.419	0.708	1.021	1.447	2.809	0.202	0.839	0.533	0
26060	Kitchener	West Ave./ Homewood Ave.	56	0.464	0.662	0.878	1.350	2.855	5.516	0.250	1.278	1.078	0
29000	Hamilton Downtown	Elgin St./Kelly St.	61	0.387	0.656	1.072	3.582	5.058	9.834	0.207	2.229	2.292	0
46089	Brampton	525 Main St. N., Peel Manor	55	0.349	0.448	0.800	2.067	3.364	4.618	0.202	1.348	1.211	0
48006	Newmarket	Eagle St. W./ McCaffrey Rd.	55	0.238	0.366	0.526	0.949	1.564	2.334	0.106	0.732	0.555	0
51001	Ottawa Downtown	Rideau St./ Wurtemburg St.	56	0.271	0.402	0.550	0.981	1.423	2.416	0.180	0.741	0.523	0

Table A26: 2014 Ethylbenzene Annual Statistics

Unit: micrograms per cubic metre (µg/m^3)
Ethylbenzene 24h AAQC: 1,000 µg/m^3

ID	City	Location	No. of Samples	PERCENTILES									No. of Times Above Criteria
				10%	25%	50%	75%	90%	Max	Min	Mean	Std. Dev.	24h
12016	Windsor West	College Ave./South St.	58	0.079	0.117	0.192	0.348	0.630	1.078	0.053	0.268	0.221	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	57	0.027	0.068	0.120	0.310	0.623	2.020	0.017	0.253	0.348	0
15026	London	42 St. Julien St.	61	0.056	0.068	0.111	0.145	0.208	0.360	0.032	0.122	0.071	0
26060	Kitchener	West Ave./ Homewood Ave.	56	0.056	0.087	0.126	0.177	0.367	0.704	0.028	0.168	0.135	0
29000	Hamilton Downtown	Elgin St./Kelly St.	61	0.062	0.101	0.155	0.246	0.390	0.576	0.036	0.193	0.134	0
46089	Brampton	525 Main St. N., Peel Manor	55	0.047	0.075	0.126	0.265	0.464	0.702	0.024	0.200	0.170	0
48006	Newmarket	Eagle St. W./ McCaffrey Rd.	55	0.034	0.062	0.092	0.157	0.264	0.406	0.018	0.126	0.095	0
51001	Ottawa Downtown	Rideau St./ Wurtemburg St.	56	0.036	0.054	0.074	0.131	0.190	0.450	0.012	0.102	0.078	0

Table A27: 2014 m-, and p-xylene Annual Statistics

Unit: micrograms per cubic metre (µg/m^3)

ID	City	Location	No. of Samples	PERCENTILES								
				10%	25%	50%	75%	90%	Max	Min	Mean	Std. Dev.
12016	Windsor West	College Ave./South St.	58	0.219	0.330	0.547	1.082	2.051	3.384	0.148	0.825	0.724
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	57	0.062	0.151	0.293	0.770	1.705	4.087	0.031	0.627	0.804
15026	London	42 St. Julien St.	61	0.130	0.178	0.286	0.405	0.570	1.013	0.072	0.323	0.206
26060	Kitchener	West Ave./ Homewood Ave.	56	0.141	0.208	0.370	0.495	0.952	2.386	0.060	0.473	0.429
29000	Hamilton Downtown	Elgin St./Kelly St.	61	0.159	0.289	0.423	0.692	1.402	2.005	0.039	0.595	0.474
46089	Brampton	525 Main St. N., Peel Manor	55	0.113	0.192	0.344	0.827	1.447	2.254	0.054	0.588	0.542
48006	Newmarket	Eagle St. W./ McCaffrey Rd.	55	0.080	0.154	0.234	0.423	0.706	1.206	0.020	0.336	0.287
51001	Ottawa Downtown	Rideau St./ Wurtemburg St.	56	0.096	0.142	0.198	0.346	0.693	1.560	0.006	0.317	0.303

Table A28: 2014 o-xylene Annual Statistics

Unit: micrograms per cubic metre (µg/m^3)

ID	City	Location	No. of Samples	PERCENTILES								
				10%	25%	50%	75%	90%	Max	Min	Mean	Std. Dev.
12016	Windsor West	College Ave./South St.	58	0.076	0.116	0.190	0.341	0.704	1.153	0.053	0.286	0.246
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	57	0.025	0.068	0.110	0.261	0.623	1.388	0.013	0.227	0.277
15026	London	42 St. Julien St.	61	0.053	0.064	0.105	0.144	0.191	0.354	0.028	0.118	0.071
26060	Kitchener	West Ave./Homewood Ave.	56	0.053	0.081	0.130	0.178	0.356	0.728	0.028	0.170	0.141
29000	Hamilton Downtown	Elgin St./Kelly St.	61	0.061	0.101	0.164	0.250	0.403	0.699	0.021	0.208	0.158
46089	Brampton	525 Main St. N., Peel Manor	55	0.043	0.066	0.128	0.270	0.465	0.736	0.022	0.201	0.176
48006	Newmarket	Eagle St. W./McCaffrey Rd.	55	0.033	0.060	0.090	0.155	0.275	1.206	0.010	0.138	0.174
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	56	0.042	0.060	0.081	0.138	0.230	0.488	0.004	0.115	0.091

Table A29: 2014 1,3-Butadiene Annual Statistics

Unit: micrograms per cubic metre (µg/m^3)
1,3-Butadiene Annual AAQC: 2.0 µg/m^3

ID	City	Location	No. of Samples	PERCENTILES									No. of Times Above Criteria
				10%	25%	50%	75%	90%	Max	Min	Mean	Std. Dev.	1y
12016	Windsor West	College Ave./South St.	58	0.018	0.029	0.039	0.055	0.076	0.151	0.009	0.046	0.028	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	57	0.010	0.018	0.034	0.083	0.430	1.111	0.005	0.124	0.221	0
15026	London	42 St. Julien St.	61	0.011	0.018	0.024	0.033	0.051	0.099	0.007	0.029	0.018	0
26060	Kitchener	West Ave./Homewood Ave.	56	0.013	0.018	0.027	0.039	0.060	0.078	0.010	0.032	0.017	0
29000	Hamilton Downtown	Elgin St./Kelly St.	61	0.017	0.023	0.031	0.044	0.058	0.086	0.011	0.036	0.018	0
46089	Brampton	525 Main St. N., Peel Manor	55	0.017	0.020	0.032	0.048	0.077	0.108	0.010	0.040	0.025	0
48006	Newmarket	Eagle St. W./McCaffrey Rd.	55	0.008	0.010	0.016	0.023	0.034	0.074	0.006	0.020	0.014	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	56	0.012	0.016	0.022	0.035	0.057	0.092	0.008	0.028	0.018	0

MINISTRY OF THE ENVIRONMENT
AND CLIMATE CHANGE

Air Quality in Ontario

2015 Report

For more information on Ontario's air quality, visit:
www.airqualityontario.com

ISSN 1710-8136

Ontario