Air Quality in Ontario

Report for 2010

Ontario

Acknowledgements

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2010 Report Highlights

AIR QUALITY IS IMPROVING

- The 2010 air quality report marks 40 years of long-term reporting on the state of air quality in Ontario. This report summarizes province-wide trends for key airborne pollutants impacting Ontario's air quality.
- Overall, air quality has improved significantly over the years, especially for nitrogen dioxide (NO_2), carbon monoxide (CO) and sulphur dioxide (SO_2) - pollutants emitted by vehicles and industry.

Decreasing Provincial Ambient Concentrations

Pollutant	2001-2010
NO_2	↓ 47%
CO	↓ 41%
SO_2	↓ 60%

EMISSIONS ARE DECREASING

- Emissions of nitrogen oxides (NO_X), CO and SO_2 continue to decrease 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, and Drive Clean emissions testing, which supports the federal vehicle emission standards and technologies, and lower sulphur content in transportation fuels.
- Transboundary influences, including the U.S., account for approximately half of Ontario's smog. Emission reductions in Ontario and the U.S. have contributed to decreases in fine particulate matter ($PM_{2.5}$) and peak ozone concentrations.

Decreasing Provincial Emissions*

Pollutant	2000-2009
NO_x	↓ 39%
CO	↓ 28%
SO_2	↓ 64%

*2010 emissions data not yet available.

THE ONTARIO AMBIENT AIR QUALITY CRITERIA (NO_2, CO, SO_2)

- The provincial Ambient Air Quality Criteria (AAQC) for NO_2 and CO were not exceeded at any of the ambient air monitoring locations in Ontario during 2010.

- The provincial one-hour AAQC for SO_2 was exceeded twice in Sudbury; however, the 24-hour and annual AAQCs for SO_2 were not exceeded at any of the ambient Air Quality Index (AQI) sites in 2010.

THE CANADA-WIDE STANDARDS (CWS) ($PM_{2.5}$ and Ozone)

- For a third year in a row, the CWS for $PM_{2.5}$ was not exceeded in Ontario.
- Most areas of Ontario are still above the CWS for ozone with the exception of two municipalities: Thunder Bay and Ottawa.

Table of Contents

1.0 Introduction

This annual report, the 40th in a series, summarizes the state of ambient air quality in Ontario during 2010 and examines air pollution trends. It reports on the measured levels of six common pollutants: ozone (O_3), fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), sulphur dioxide (SO_2) and (in the appendix only) total reduced sulphur (TRS) compounds. The report also summarizes the results from the Air Quality Index (AQI) and Smog Alert programs. The annual statistics and 10- and 20-year trends of ambient air quality data are presented in the attached appendix.

Ontario continues to benefit from one of the most comprehensive air monitoring systems in North America, comprised of 40 monitoring sites across the province that undergo regular maintenance and strict data quality assurance and quality control (QA/QC) procedures to ensure a high standard of data quality. The data, which are collected continuously at these sites, are used to determine the current state of air quality and reported in near real-time via an Air Quality Index (AQI) hourly reporting system (www.airqualityontario.com).

The Ministry of the Environment uses this information to:

- inform the public about Ontario's air quality;
- assess Ontario's air quality and evaluate long-term trends;
- identify areas where criteria and standards are exceeded;
- provide the basis for air policy/program development;
- determine the contribution from U.S. and Canadian sources on Ontario's air quality;
- provide scientists with air quality data to link environmental and human health effects to pollution levels; and
- provide smog advisories for public health protection.

2.0 Ground-Level Ozone

Ground-level ozone is a gas formed when nitrogen oxides (NO_X) and volatile organic compounds (VOCs) react in the presence of sunlight. While ozone at ground level is a major environmental and health concern, the naturally occurring ozone in the stratosphere is beneficial as it shields the earth from harmful ultraviolet radiation.

2.1 Characteristics, sources and effects

Ozone is a colourless, odourless gas at typical ambient concentrations, and is a major component of smog. Although ozone is not generally emitted directly into the atmosphere, the formation and transport of ozone are strongly dependent on meteorological conditions and emissions. Changing weather patterns contribute to differences in ozone concentrations hourly, daily, seasonally and year-to-year. In Ontario, elevated concentrations of ground-level ozone are typically recorded on hot and sunny days from May to September, between noon and early evening.

Figure 2.1 shows the 2009 estimates of Ontario's VOC emissions from point, area and transportation sources. Transportation sectors accounted for approximately 37 per cent of VOC emissions. General solvent use was the second largest source of VOC emissions, accounting for approximately 26 per cent. Figure 2.2 shows the 2009 estimates of Ontario's NO_X emissions from point, area and transportation sources. Transportation sectors accounted for approximately 73 per cent of NO_X emissions.

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 has been linked to increased hospital admissions and premature deaths. Ozone also causes agricultural crop loss each year in Ontario, with visible leaf damage in many crops, garden plants and trees, especially during the summer months.

2.2 Monitoring results for 2010

During 2010, ozone was monitored at all 40 Ontario Ministry of the Environment AQI monitoring stations. The highest annual mean was 35.0 parts per billion (ppb), measured at Grand Bend, a rural transboundary-influenced site situated on the eastern shore of Lake Huron. The lowest annual mean, 20.6 ppb, was measured at Toronto West, an urban site located near the major Highway 401, and directly impacted by local nitric oxide (NO) emissions from vehicles. Generally, ozone concentrations are lower in urban areas because ozone is reduced by reacting with NO emitted by vehicles and other local combustion sources.

Ground-level ozone concentrations continued to exceed the provincial one-hour ambient air quality criterion (AAQC) of 80 ppb across the province. In 2010, Ontario's one-hour AAQC for ozone was exceeded at 23 of the 40 AQI stations for at least one hour. The maximum one-hour ozone concentrations ranged from 67 ppb recorded in Thunder Bay to 113 ppb recorded at Grand Bend. Grand Bend also recorded the most instances (62) when ozone exceeded Ontario's one-hour AAQC.

Figure 2.1
Ontario Volatile Organic Compounds Emissions by Sector
(Emissions from Point/Area/Transportation Sources,
2009 Estimates)

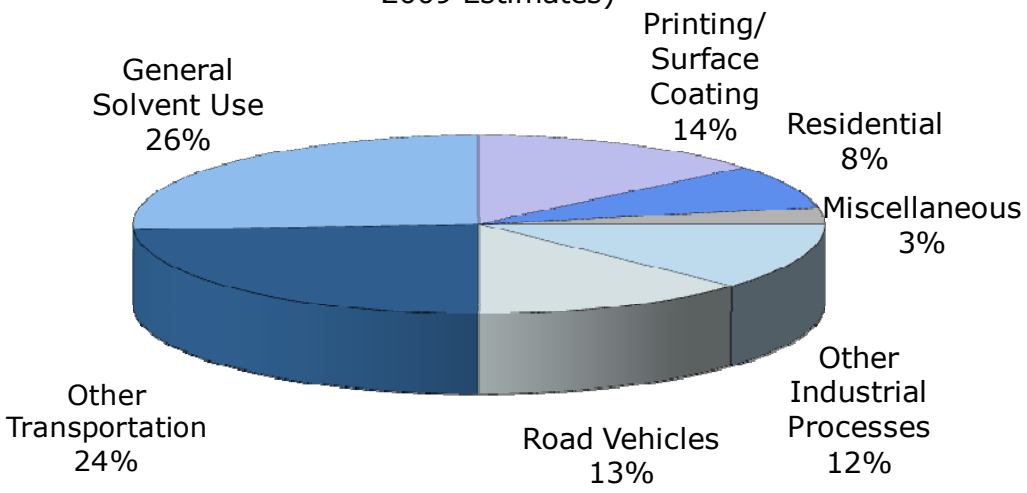
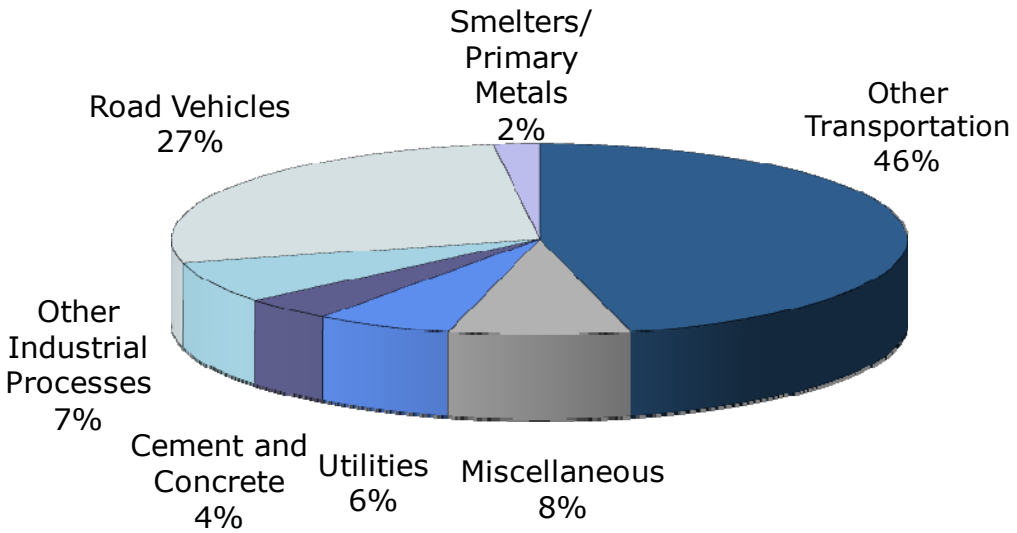
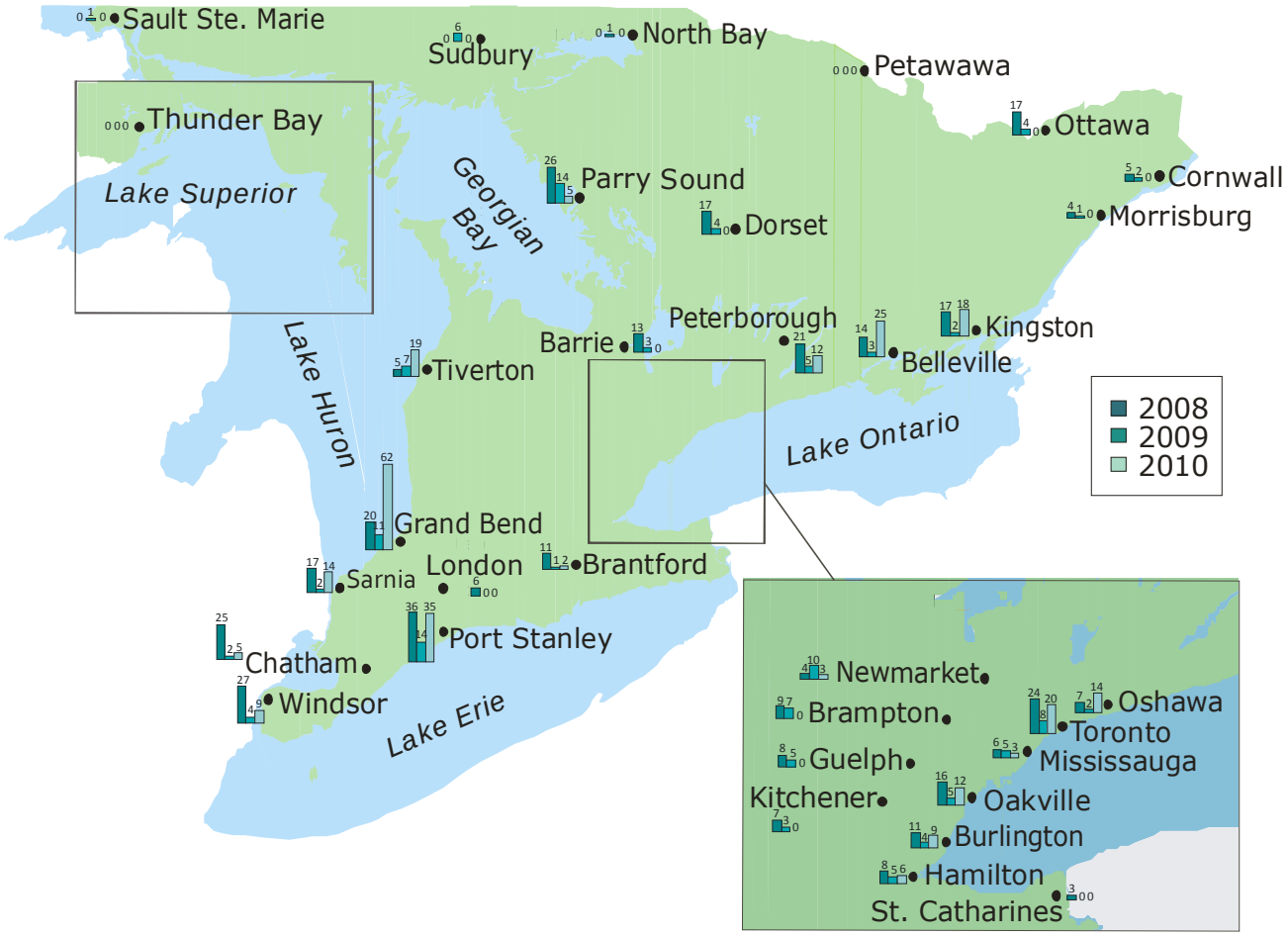


Figure 2.2
Ontario Nitrogen Oxides Emissions by Sector
(Emissions from Point/Area/Transportation Sources,
2009 Estimates)



The geographical distribution of the number of ozone exceedances across Ontario for 2008 to 2010 is shown in Figure 2.3. Generally the number of ozone exceedances typically decreased over central and eastern Ontario, and there were no significant changes in the north during the past three years. On average, there were more ozone exceedances in 2010, especially in southwestern Ontario, when compared to 2009. Parts of northeastern and eastern Ontario had no ozone exceedances, with the exception of Parry Sound which only had five ozone exceedances compared to the 14 ozone exceedances experienced in 2009. In 2010, the higher numbers of one-hour ozone exceedances were recorded on the northern shores of Lake Erie and Lake Ontario and the eastern shores of Lake Huron. As stated in the *Transboundary Air Pollution in Ontario* report, elevated ozone levels in these areas are generally attributed to the long-range transport of pollutants into Ontario from the United States. Transboundary air pollution is then combined with local emissions of smog-related pollutants, which can impact various areas of the province during a smog episode.

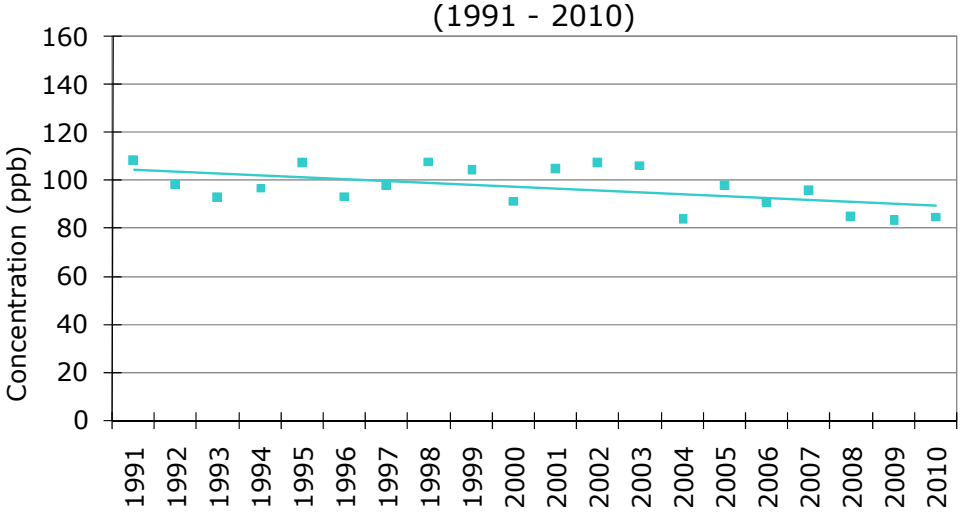
Figure 2.3
Geographical Distribution of Number of One-Hour Ozone Exceedances Across Ontario (2008, 2009, 2010)



2.3 Trends

The trend of the composite mean one-hour maximum ozone concentrations is shown for the 20-year period of 1991 to 2010 in Figure 2.4. For this period, the annual composite mean of the one-hour maximum concentrations ranges from a low of 83 ppb, recorded in 2009, to a high of 108 ppb, recorded both in 1991 and 1998. The data show an overall decreasing trend (14 per cent) in the annual composite means of the one-hour maximum ozone concentrations from 1991 to 2010. Over the past 10 years (2001 to 2010), the annual composite means of the one-hour maximum concentrations of ozone have decreased by approximately 22 per cent on average; most of this change has occurred over the last seven years. This overall decrease is largely due to the progressive reductions of NO_X emissions in Ontario and the U.S. resulting in the decrease of ozone production during the summer months, thus lowering the ozone maximums.

Figure 2.4
Trend of Ozone One-Hour Maximum
Concentrations in Ontario
(1991 - 2010)

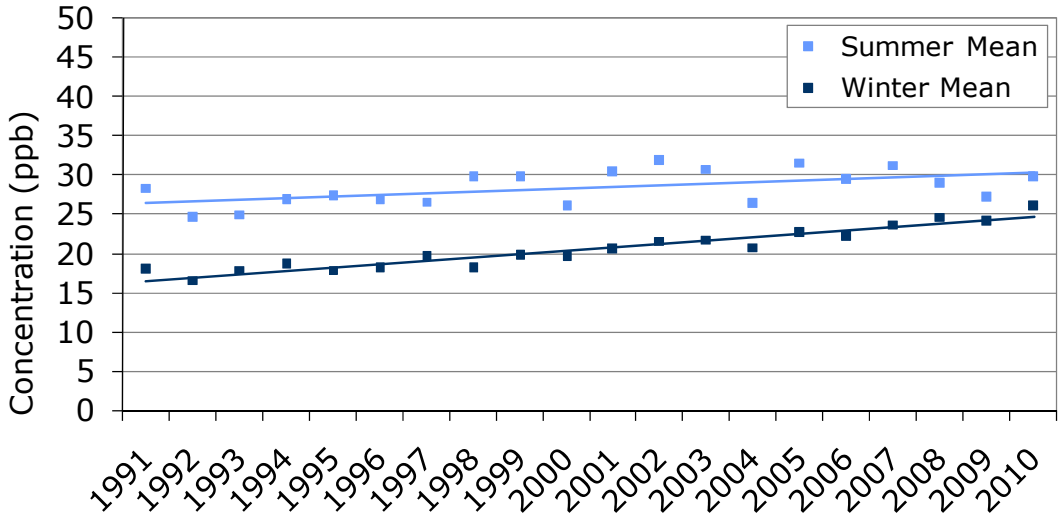


Note: Based on data from 19 ambient ozone sites operated over 20 years.
Ontario 1h AAQC = 80 ppb.

The trend of the ozone seasonal composite means (summer and winter) as recorded at 19 long-term ozone sites for the period 1991 to 2010 is shown in Figure 2.5. It shows that there has been an increasing trend in the ozone seasonal composite means during the 20-year period where the ozone summer composite means have increased by approximately 14 per cent and the winter composite means by approximately 49 per cent. The ozone seasonal composite means differ by 10 ppb in 1991 and only 4 ppb in 2010. For the 10-year period 2001 to 2010, summer composite means slightly decreased by approximately 6 per cent while the winter composite means increased by approximately 24 per cent. In 2001, the summer composite means were approximately 47 per cent higher than the winter composite

means; however, by 2010, the summer composite means were approximately 14 per cent higher than winter composite means. The increase in summer and winter ozone composite means appears to be largely related to the reductions in local NO_X emissions and the rising global background ozone concentrations. Potential contributions to the increases in the summer composite means over the long term may also be related to meteorological factors.

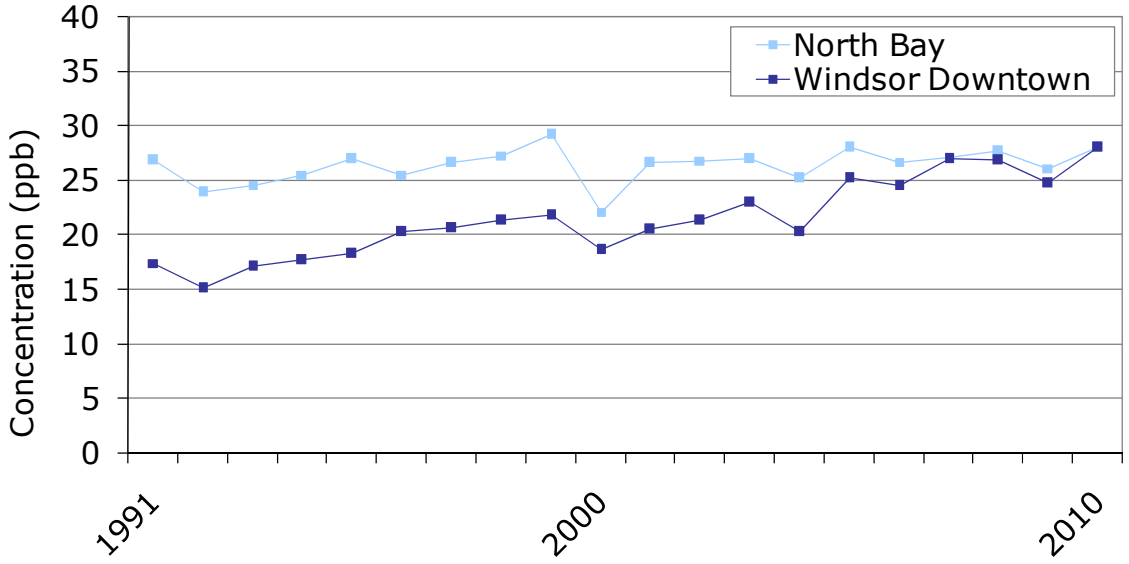
Figure 2.5
Trend of Ozone Seasonal Means at Sites Across Ontario
(1991 - 2010)



Note: Based on data from 19 ozone sites operated over 20 years.
Seasonal definitions - Summer (May to September);
Winter (January to April, October to December).

In Figure 2.6, the annual means for ozone are compared for Windsor Downtown, located in southwestern Ontario, and North Bay, located in northeastern Ontario, from 1991 to 2010. Throughout the 20-year period, the annual ozone mean concentrations at North Bay slightly increased by approximately 7 per cent whereas those reported for the Windsor Downtown site increased 66 per cent during the same period. The increase in the annual ozone mean concentrations at Windsor may be generally attributed to the reduction of NO_X emissions and the changeover in vehicle fleet which in turn lessened the effect of NO titration in the urban centre. In 1991, the annual ozone mean concentration reported for Windsor was approximately 9 ppb lower than that reported for North Bay. By 2010, there was no difference in the annual ozone means between the two sites.

Figure 2.6
Ozone Annual Mean Concentrations
at Windsor Downtown and North Bay
(1991 - 2010)



2.4 The Canada-wide Standard for Ozone

In 2000, the Canadian Council of Ministers of the Environment (CCME) developed a Canada-wide Standard (CWS) for ozone as a result of the pollutant's adverse effects on human health and the environment. As referenced in the *Guidance Document on Achievement Determination*, the CWS for ozone is 65 ppb, eight-hour running average time, based on the 4th highest annual ambient measurement averaged over three consecutive years. Jurisdictions are required to meet the CWS by 2010 and commence reporting to the CCME on the achievement of the CWS for ozone by 2011. In the interim, comprehensive reporting on progress toward meeting the CWS for ozone commenced in 2006.

Table 2.1 displays the calculated CWS ozone metric for designated sites across Ontario from 2005 to 2010. All of the sites exceeded the CWS of 65 ppb for ozone, with the exception of Ottawa and Thunder Bay, where 2010 ozone concentrations, based on the CWS metric, were 61 ppb and 54 ppb, respectively. The 2010 CWS ozone metrics are generally lower than the metrics reported for previous years.

Table 2.1: CWS Ozone Metric for Designated Sites Across Ontario

City	O_3 CWS Metric 2003 – 2005 (ppb)	O_3 CWS Metric 2004 – 2006 (ppb)	O_3 CWS Metric 2005 – 2007 (ppb)	O_3 CWS Metric 2006 – 2008 (ppb)	O_3 CWS Metric 2007 – 2009 (ppb)	O_3 CWS Metric 2008 – 2010 (ppb)
Windsor	82	81	89	85	81	74
Chatham	n/a	86	86	80	78	73
London	74	70	73	72	69	67
Kitchener	79	74	77	74	71	68
Guelph	79	77	79	75	73	70
St. Catharines	81	75	81	76	73	67
Hamilton Downtown	77	72	76	74	71	69
Hamilton Mountain	82	76	80	76	74	71
Burlington	75	72	76	74	71	68
Oakville	81	74	80	77	75	71
Mississauga	80	75	80	77	66	66
Brampton	80	75	79	76	74	69
Toronto	81	75	80	78	76	74
Oshawa	n/a	77	80	76	74	70
Barrie	72	69	72	71	70	67
Peterborough	81	72	73	71	73	73
Kingston	77	77	89	85	81	77
Ottawa Downtown	69	67	71	68	65	61
Sudbury	76	74	77	71	69	66
Thunder Bay	58	57	57	55	53	54

Notes:
The CWS for ozone is 65 ppb, eight-hour running average time, based on the 4th highest annual ambient measurement averaged over three consecutive years.
Toronto reporting is based on Toronto Downtown, Toronto North, Toronto East and Toronto West sites.
Red font indicates an exceedance of the CWS.

3.0 Particulate Matter in the Air

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

Particles originate from many different industrial and transportation sources, as well as natural sources. They may be emitted directly from a source or formed in the atmosphere by the transformation of gaseous emissions. This chapter discusses the monitoring results from Ontario's ambient $PM_{2.5}$ monitoring network.

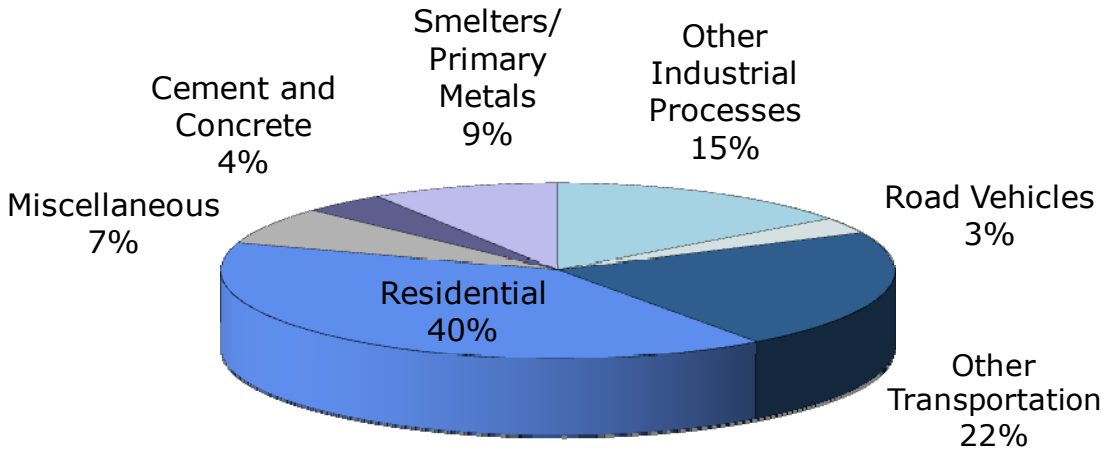
3.1 Characteristics, sources and effects

Particulate matter includes aerosols, smoke, fumes, dust, fly ash and pollen. Its composition varies with origin, residence time in the atmosphere, time of year and environmental conditions. Fine particulate matter may be emitted directly to the atmosphere as a by-product of fuel combustion. Major sources of $PM_{2.5}$ include motor vehicles, smelters, power plants, industrial facilities, residential fireplaces and wood stoves, agricultural burning and forest fires, or may be formed indirectly in the atmosphere through a series of complex chemical reactions.

Figure 3.1 shows the 2009 estimates of Ontario's primary $PM_{2.5}$ emissions from point, area and transportation sources. The residential and transportation sectors accounted for 40 per cent and 25 per cent of $PM_{2.5}$ emissions, respectively, whereas industrial processes accounted for 28 per cent. The major contributor to residential emissions is fuel wood combustion (e.g. fireplaces, wood stoves).

Significant amounts of $PM_{2.5}$ measured in southern Ontario are of secondary formation and of transboundary origin. During periods of elevated concentrations of $PM_{2.5}$ in Ontario, it is estimated that there are significant contributions from the U.S., specifically to border communities such as: Windsor; Port Stanley, located on the northern shore of Lake Erie; Grand Bend and Tiverton, located on the eastern shores of Lake Huron; and Parry Sound, located on the eastern shore of Georgian Bay.

Figure 3.1
Ontario $PM_{2.5}$ Emissions by Sector
(Emissions from Point/Area/Transportation Sources,
2009 Estimates)

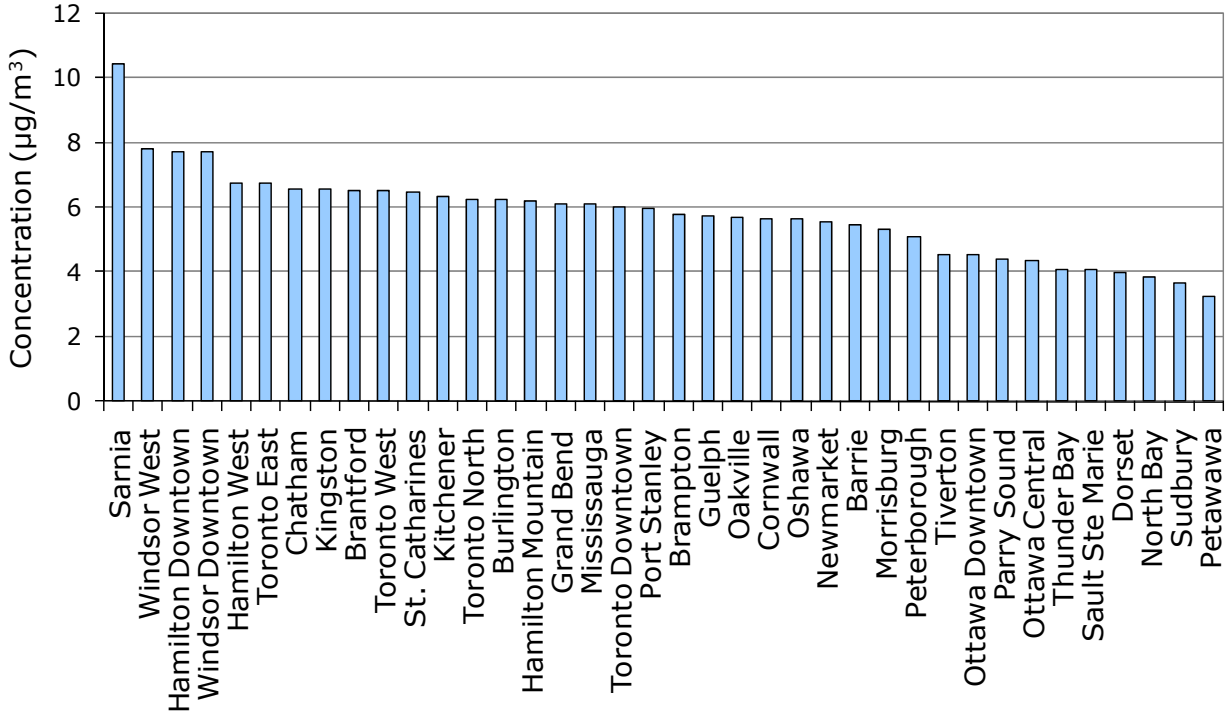


Exposure to $PM_{2.5}$ is associated with several serious health effects, including premature death. People with asthma, cardiovascular or lung disease, as well as children and elderly people, are considered to be the most sensitive to the effects of $PM_{2.5}$. Adverse health effects have been associated with exposure to $PM_{2.5}$ during both short periods such as a single day, and longer periods of a year or more. Fine particulate matter may also be responsible for environmental impacts such as corrosion, soiling, damage to vegetation and reduced visibility.

3.2 Monitoring results in 2010

In 2010, each of Ontario's 40 ambient air monitoring sites operated a Tapered Element Oscillating Microbalance (TEOM) instrument operating at 30°C with a Sample Equilibration System (SES) to measure the $PM_{2.5}$ concentrations on an hourly basis. As shown in Figure 3.2, the 2010 annual mean $PM_{2.5}$ concentrations ranged from 3.2 micrograms per cubic metre ($\mu g/m^3$) in Petawawa to 10.4 $\mu g/m^3$ in Sarnia. The 24-hour maximum $PM_{2.5}$ concentrations measured at urban sites ranged from 15 $\mu g/m^3$ reported in Thunder Bay to 57 $\mu g/m^3$ at Cornwall, and at rural sites ranged from 18 $\mu g/m^3$ in Petawawa to 58 $\mu g/m^3$ in Morrisburg. The 24-hour maximum $PM_{2.5}$ concentrations were recorded on May 31, 2010 at both Cornwall and Morrisburg due to the long-range transport of smoke from forest fires in the province of Quebec at the time. The $PM_{2.5}$ reference level of 30 $\mu g/m^3$ for a 24-hour period was exceeded at 10 of the 40 sites in 2010. Kingston and Sarnia each recorded six days, the highest number of days in Ontario, with 24-hour $PM_{2.5}$ concentrations greater than 30 $\mu g/m^3$.

Figure 3.2
Annual Mean $PM_{2.5}$ Concentrations Across Ontario
(2010)

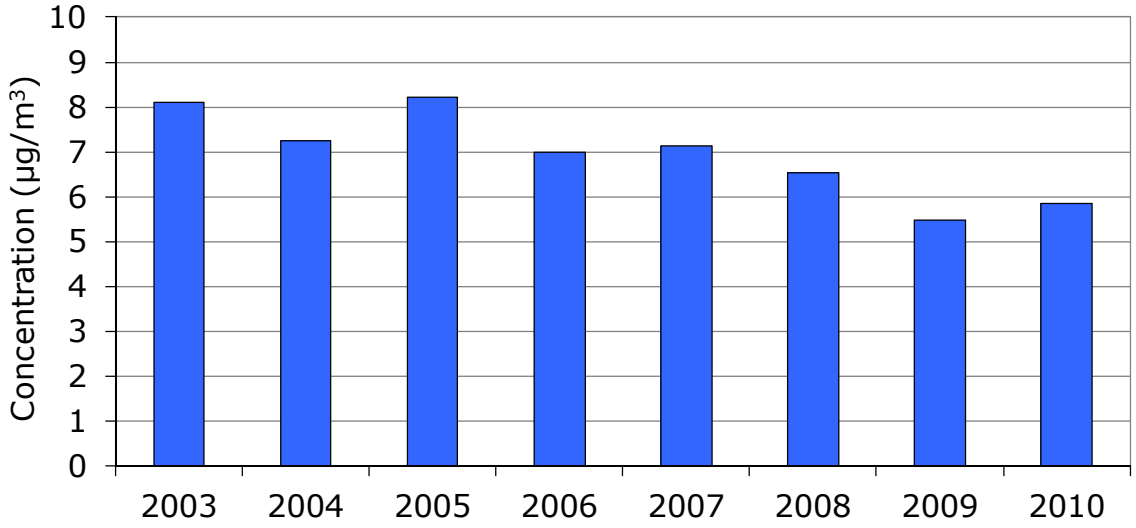


Note: London and Belleville did not meet the data requirements to report a valid annual mean.

3.3 Trends

The $PM_{2.5}$ annual composite mean during 2010 was 5.9 µg/m^3. This is a slight increase of 0.4 µg/m^3 when compared to 2009. Since 2003, there has been approximately a 30 per cent decrease in composite annual means, as shown in Figure 3.3. The slight increase in the 2005 annual composite mean is related to the high incidence of smog episodes experienced in the 2005 smog season, which resulted in the issuance of 15 smog advisories covering 53 days.

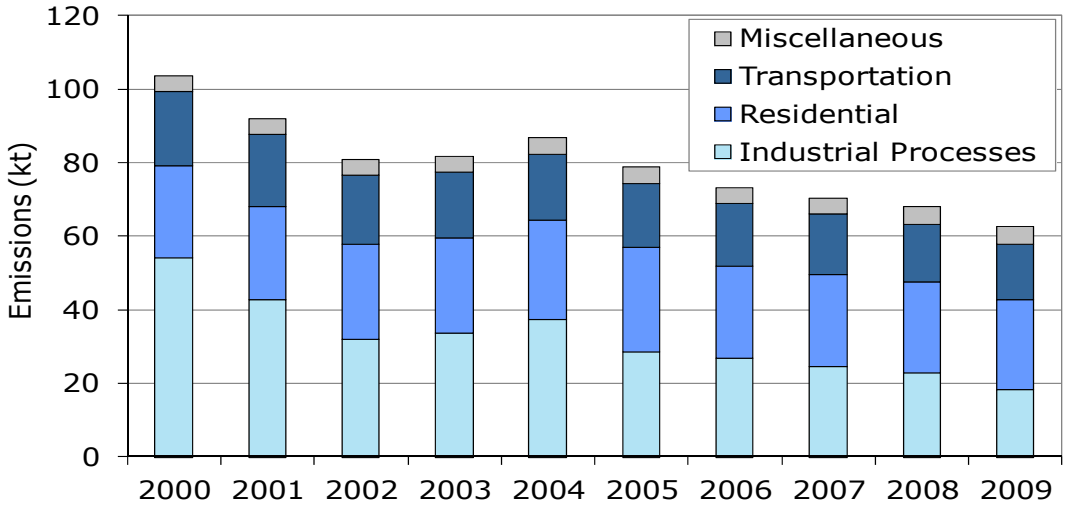
Figure 3.3
Provincial Annual Composite Mean $PM_{2.5}$ Concentrations
(2003 - 2010)



Note: Data are based on 36 ambient $PM_{2.5}$ sites operated over eight years.

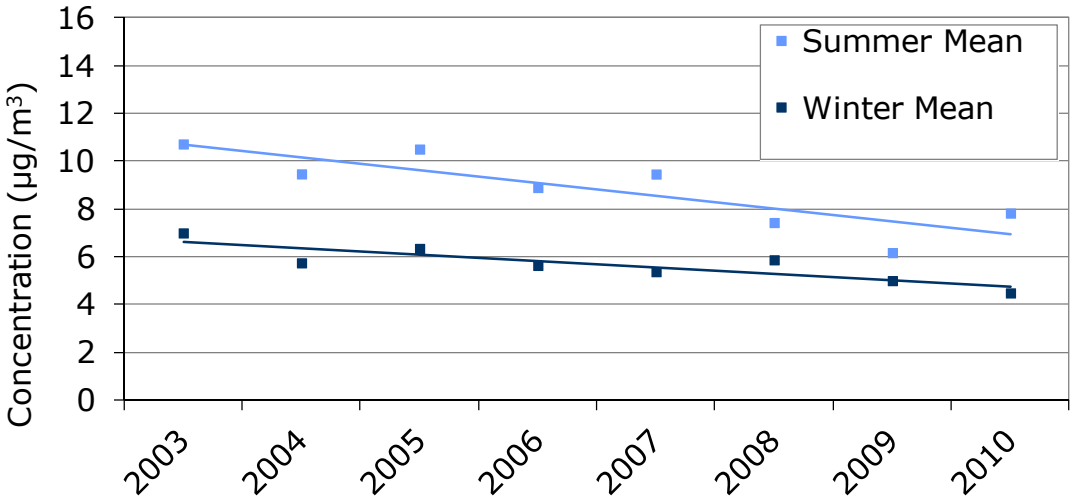
Overall, provincial $PM_{2.5}$ emissions have decreased approximately 40 per cent from 2000 to 2009, as shown in Figure 3.4. Fine particulate emissions from industrial processes have been reduced by over 66 per cent over the 10-year period from 2000 to 2009. Emissions from the transportation sector show a gradual decrease with the phase-in of new vehicles/engines having more stringent emission standards over the same period.

Figure 3.4
Ontario $PM_{2.5}$ Emission Trend
(2000 - 2009)



The trend of the $PM_{2.5}$ seasonal composite means (summer and winter) as recorded at 19 $PM_{2.5}$ sites for the period of 2003 to 2010 is shown in Figure 3.5. It shows that there has been a decreasing trend in the $PM_{2.5}$ seasonal composite means during the eight-year period, where the $PM_{2.5}$ summer means have decreased by approximately 35 per cent and the winter composite means by approximately 29 per cent, which coincides with a combined reduction of primary $PM_{2.5}$ emissions (as shown in Figure 3.4) and secondary $PM_{2.5}$ formation.

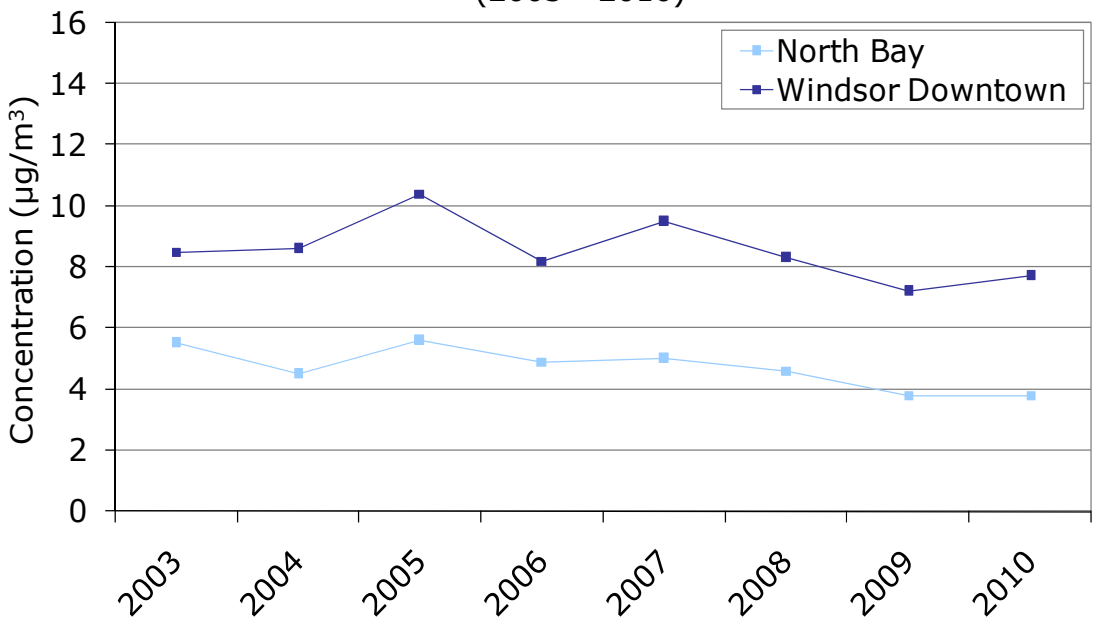
Figure 3.5
Trend of $PM_{2.5}$ Seasonal Means at Sites Across Ontario
(2003- 2010)



Note: Based on data from 19 $PM_{2.5}$ sites operated over 8 years. Seasonal definitions - Summer (May to September); Winter (January to April, October to December).

In Figure 3.6, the annual means for $PM_{2.5}$ are compared for Windsor Downtown, located in southern Ontario, and North Bay, located in northeastern Ontario, from 2003 to 2010. Throughout the entire eight-year period, the annual $PM_{2.5}$ mean concentrations at Windsor, an urban industrial centre, were consistently greater than those reported in North Bay; however, both sites had an overall decreasing trend. Windsor and North Bay $PM_{2.5}$ annual mean concentrations decreased by approximately 16 per cent and 28 per cent, respectively. Windsor and North Bay both show an annual decrease of 0.21 $\mu g/m^3$ per annum over the eight-year period.

Figure 3.6
$PM_{2.5}$ Annual Mean Concentrations
at Windsor Downtown and North Bay
(2003 - 2010)



3.4 The Canada-wide Standard for $PM_{2.5}$

In 2000, the Canadian Council of Ministers of the Environment developed a CWS for $PM_{2.5}$ as a result of the pollutant's adverse effects on human health and the environment. As referenced in the *Guidance Document on Achievement Determination*, the CWS for $PM_{2.5}$ is 30 $\mu g/m^3$, 24-hour averaging time, based on the 98th percentile annual ambient measurement averaged over three consecutive years. Jurisdictions are required to meet the CWS by 2010 and commence reporting by year 2011. In the interim, comprehensive reporting on progress toward meeting the CWS for $PM_{2.5}$ commenced in 2006.

Table 3.1 displays the calculated CWS $PM_{2.5}$ metric for designated CWS sites across Ontario from 2005 to 2010. The 2010 CWS $PM_{2.5}$ metrics are markedly lower than the metrics reported in 2005. On average there has been an approximate 38 per cent decrease in the $PM_{2.5}$ CWS metrics over the six-year period. The 2010 concentrations, based on the CWS metric for $PM_{2.5}$, ranged from 13 $\mu g/m^3$ reported for Thunder Bay and Sudbury to 23 $\mu g/m^3$ reported for Hamilton Downtown and Kingston. The CWS target of 30 $\mu g/m^3$ was not exceeded at any of the CWS designated sites.

Table 3.1: CWS $PM_{2.5}$ Metric for Designated Sites Across Ontario

City	$PM_{2.5}$ CWS Metric 2003 – 2005 ($\mu g/m^3$)	$PM_{2.5}$ CWS Metric 2004 – 2006 ($\mu g/m^3$)	$PM_{2.5}$ CWS Metric 2005 – 2007 ($\mu g/m^3$)	$PM_{2.5}$ CWS Metric 2006 – 2008 ($\mu g/m^3$)	$PM_{2.5}$ CWS Metric 2007 – 2009 ($\mu g/m^3$)	$PM_{2.5}$ CWS Metric 2008 – 2010 ($\mu g/m^3$)
Windsor	31	29	29	25	23	21
Chatham	n/a	28	28	25	23	20
London	30	28	26	23	22	20
Kitchener	34	30	29	25	22	19
Guelph	34	30	28	24	21	19
St. Catharines	29	30	31	27	23	20
Hamilton Downtown	34	32	32	29	25	23
Hamilton Mountain	32	31	29	26	23	21
Burlington	30	29	28	25	22	21
Oakville	34	30	28	24	21	19
Mississauga	34	32	29	27	19	19
Brampton	31	29	28	24	22	19
Toronto	33	31	30	25	22	20
Oshawa	n/a	29	29	25	21	19
Barrie	30	29	28	24	21	18
Peterborough	28	29	28	23	20	17
Kingston	n/a	n/a	30	28	24	23
Ottawa Downtown	30	26	25	20	17	15
Sudbury	n/a	20	21	18	16	13
Thunder Bay	n/a	n/a	16	15	14	13

Notes:
The CWS for $PM_{2.5}$ is 30 $\mu g/m^3$, 24-hour average time, based on the 98^{th} percentile annual ambient measurement averaged over three consecutive years.
Toronto reporting is based on Toronto Downtown, Toronto North, Toronto East and Toronto West sites.
Red font indicates an exceedance of the CWS.

4.0 Other Air Pollutants

Characteristics, sources and effects of NO_2, CO and SO_2 are discussed in this chapter, as well as their ambient concentrations during 2010, and including trends of ambient concentrations and emissions, where appropriate.

4.1 NITROGEN DIOXIDE

4.1.1 Characteristics, sources and effects

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 to form organic compounds, which contribute to the formation of fine particulate matter in the atmosphere.

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. Ontario's NO_X emission estimates by sector are displayed in Figure 2.2 of Section 2.1.

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.

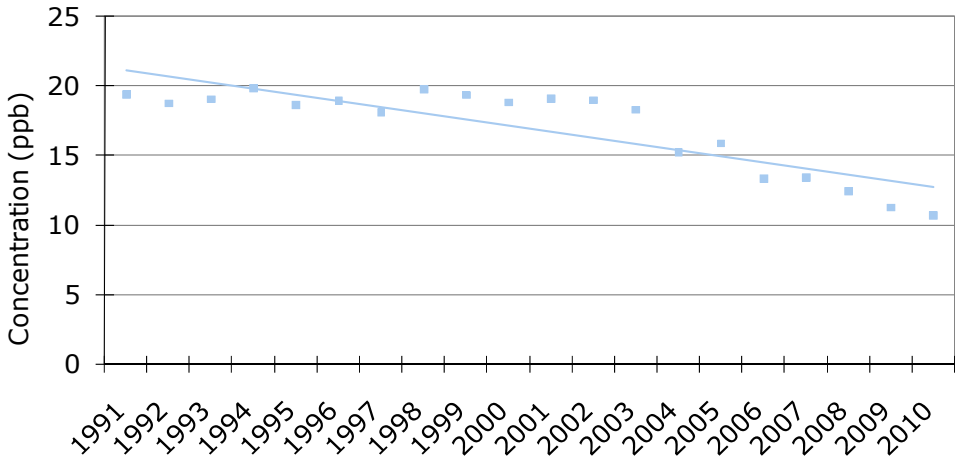
4.1.2 Monitoring results for 2010

The Toronto West site, located in an area of Toronto influenced by significant vehicular traffic, recorded the highest annual mean (20.1 ppb) for NO_2 during 2010, whereas Tiverton, a rural site, recorded the lowest NO_2 annual mean (1.9 ppb). Typically, the highest NO_2 means are recorded in large urbanized areas, such as the Golden Horseshoe area of southern Ontario which includes the GTA. The Windsor Downtown air monitoring station recorded the highest 24-hour average concentration (45 ppb), and the highest one-hour concentration (82 ppb) in 2010. The provincial 24-hour criterion of 100 ppb and one-hour criterion of 200 ppb for NO_2 have not been exceeded at any of the monitoring locations in Ontario since 1991.

4.1.3 Trends

The composite annual means for NO_2 concentrations decreased by approximately 40 per cent over the 20-year period of 1991 to 2010, as shown in Figure 4.1, and 47 per cent over the last decade, 2001 to 2010.

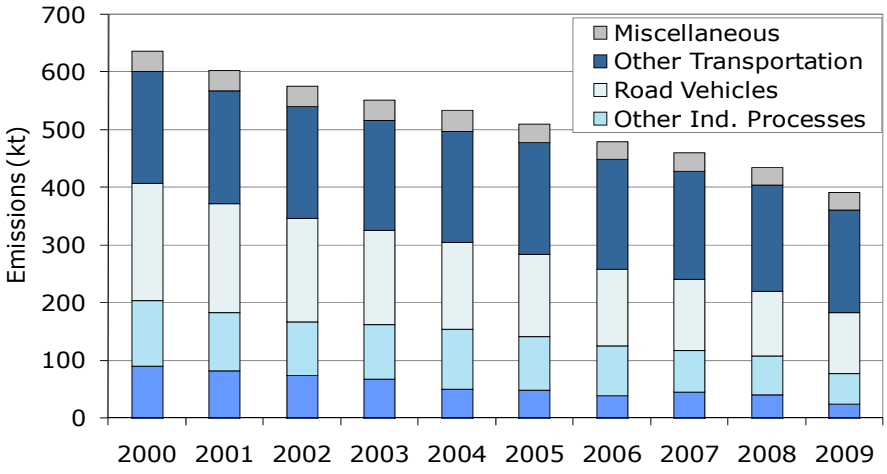
Figure 4.1
Trend of Nitrogen Dioxide Annual Means in Ontario
(1991 - 2010)



Note: Annual composite mean based on 14 ambient sites operated over 20 years.

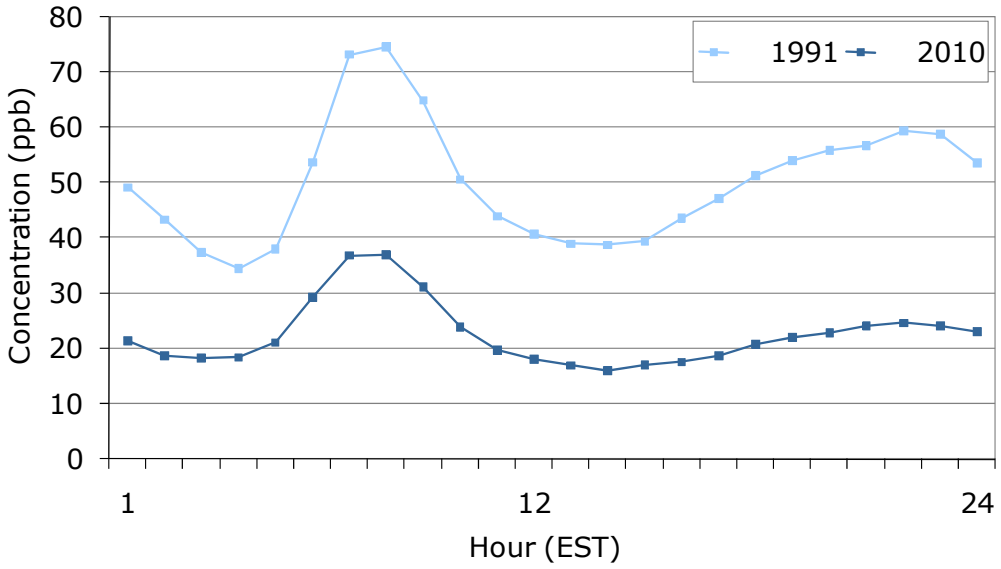
Figure 4.2 displays the NO_X emission trend from 2000 to 2009. Overall, NO_X emissions have decreased approximately 39 per cent from 2000 to 2009. Ontario's emissions trading regulations on sulphur dioxide and nitrogen oxides (O. Reg. 397/01 and O. Reg. 194/05) have contributed to the reduction in nitrogen oxides emissions in recent years. The NO_X emissions from on-road vehicles also decreased due to the phase-in of new vehicles having more stringent emission standards. The implementation of the Ontario "Drive Clean" vehicle test program in southern Ontario in 1999 also helped to further reduce the NO_X emissions from light duty gasoline vehicles.

Figure 4.2
Ontario Nitrogen Oxides Emission Trend
(2000 - 2009)



The diurnal air quality trends of NO_X at the Toronto East station are shown for years 1991 and 2010 in Figure 4.3. The Toronto East station is located near a busy roadway and is greatly influenced by vehicular traffic, a major source of NO_X. This is evident during the morning rush-hour period (6 a.m. to 10 a.m.) when temperature inversions near the ground typically occur with light winds which in turn cause less dispersion and local build-up of pollutants. Overall, the diurnal trends show a considerable decrease in NO_X concentrations measured in 2010 when compared to previous years. The reduction in NO_X emissions over time are due to a cleaner vehicle fleet, and in part to Ontario's Drive Clean program. A decrease of 38 ppb has occurred at the 8 a.m. NO_X concentration between 1991 and 2010.

Figure 4.3
Diurnal Trend of NO_X at Toronto East
(1991 and 2010)

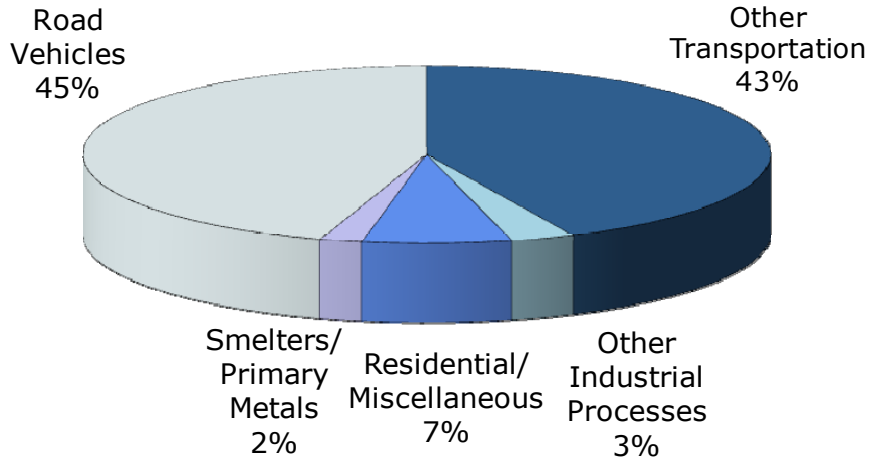


4.2 CARBON MONOXIDE

4.2.1 Characteristics, sources and effects

Carbon monoxide is colourless, odourless, tasteless and, at high concentrations, a 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 linked 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. As displayed in Figure 4.4, the transportation sector accounted for 88 per cent of all CO emissions.

Figure 4.4
Ontario Carbon Monoxide Emissions by Sector
(Emissions from Point/Area/Transportation Sources, 2009 Estimates)



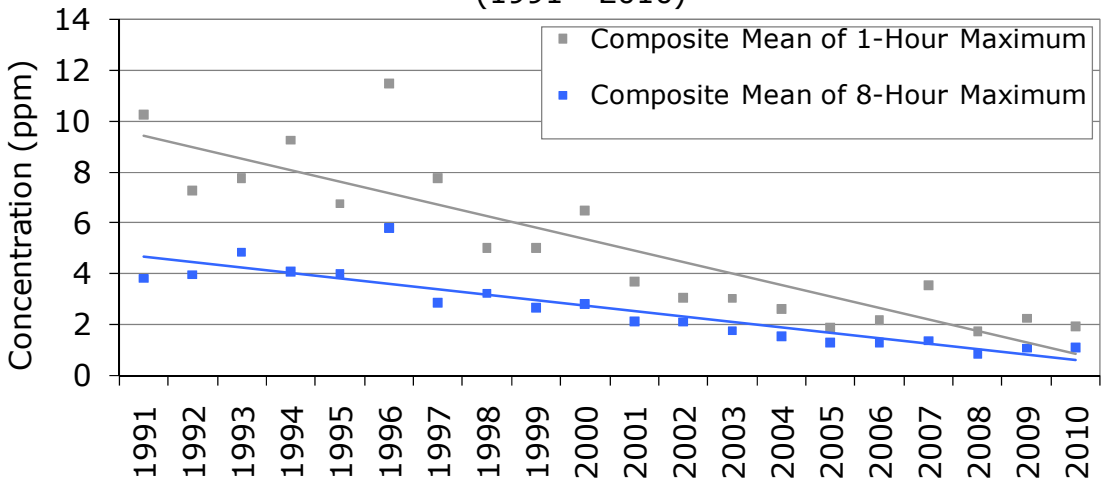
4.2.2 Monitoring results for 2010

In 2010, the highest one-hour maximum CO value, 2.46 parts per million (ppm) was measured at the Windsor Downtown air monitoring site and the highest eight-hour maximum CO value, 1.53 ppm, was measured at the Toronto West site. Typically, higher CO concentrations are recorded in urban centres as a result of vehicle emissions. Ontario's one-hour (30 ppm) and eight-hour (13 ppm) ambient air quality criteria for CO have not been exceeded at any of the monitoring sites in Ontario since 1991.

4.2.3 Trends

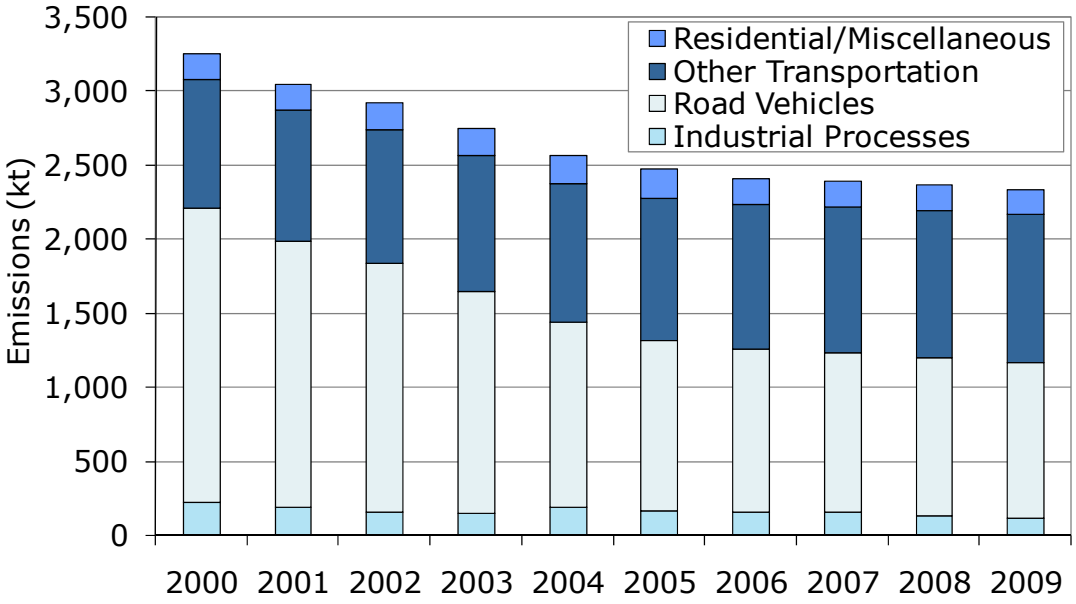
Ambient CO concentrations, as measured by the composite mean of the one-hour and eight-hour maximums, decreased by approximately 91 per cent and 89 per cent, respectively, over the 20-year period of 1991 to 2010, as shown in Figure 4.5. Over the last decade, 2001-2010, there has been a decrease in the composite mean of the one-hour and eight-hour maximums of approximately 41 per cent and 57 per cent, respectively, while CO emissions, as shown in Figure 4.6, have been reduced by approximately 28 per cent from 2000 to 2009.

Figure 4.5
Trends of Carbon Monoxide 1-Hour
and 8-Hour Maximums in Ontario
(1991 - 2010)



Note: Data are based on four ambient CO sites operated over 20 years.
Ontario's 1-hour AAQC = 30 ppm.
Ontario's 8-hour AAQC = 13 ppm.

Figure 4.6
Ontario Carbon Monoxide Emission Trend
(2000 - 2009)



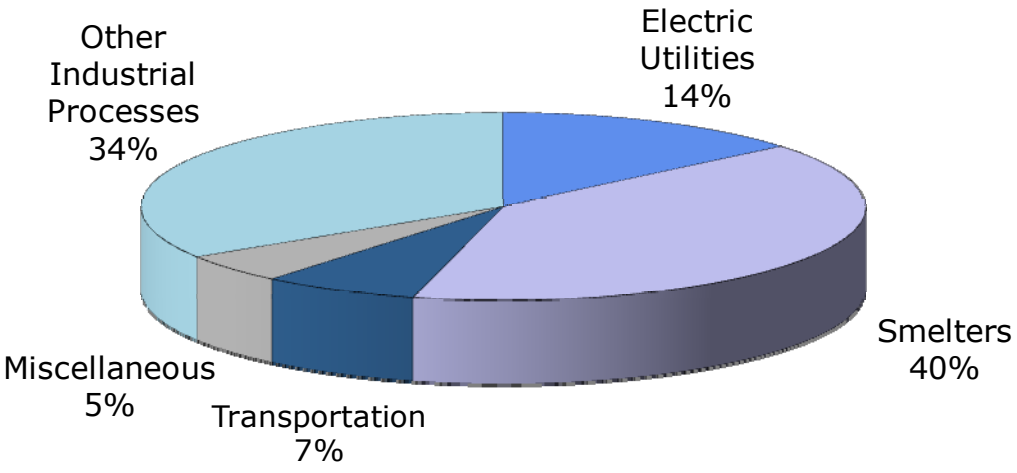
4.3 SULPHUR DIOXIDE

4.3.1 Characteristics, sources and effects

Sulphur dioxide is a colourless gas that smells like burnt matches. Sulphur dioxide can also be oxidized to form sulphuric acid aerosols. In addition, sulphur dioxide is a precursor to sulphates, one of the main components of airborne fine particulate matter.

Electric utilities and smelters are the major contributors to SO_2 emissions in Ontario, accounting for approximately 54 per cent of the provincial SO_2 emissions, as shown in Figure 4.7. Other industrial processes (e.g. petroleum refining, cement and concrete manufacturing) accounted for an additional 34 per cent. The transportation sector and miscellaneous sources accounted for the remaining 12 per cent of all SO_2 emissions.

Figure 4.7
Ontario Sulphur Dioxide Emissions by Sector
(Emissions from Point/Area/Transportation Sources,
2009 Estimates)



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 also damages trees and crops. Sulphur dioxide, like NO_2, is also a precursor of acid rain, which contributes to the acidification of soils, lakes and streams, accelerated corrosion of buildings, and reduced visibility. Sulphur dioxide also leads to the formation of microscopic particles, which have serious health implications and contribute to climate change.

4.3.2 Monitoring results for 2010

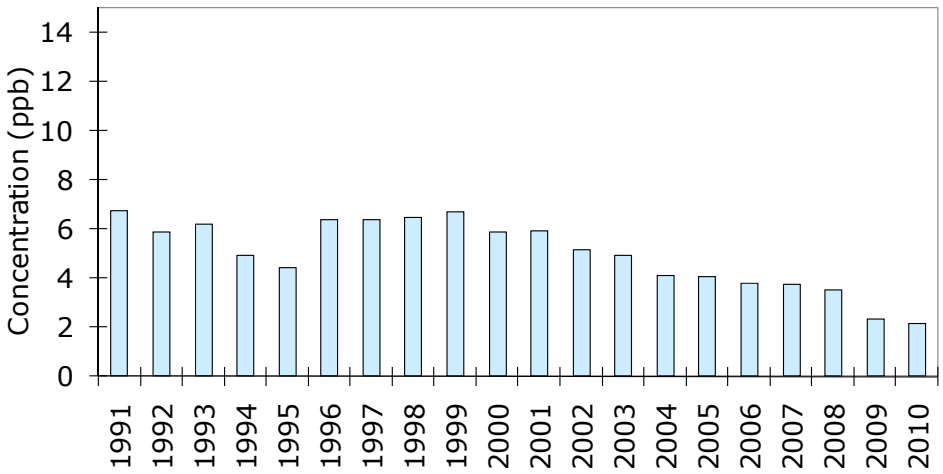
Sarnia recorded the highest annual mean (3.9 ppb) and 24-hour maximum concentration (45 ppb) of SO_2 during 2010, whereas Sudbury recorded the highest one-hour maximum (372 ppb). The highest concentrations of SO_2 historically have been recorded in the vicinity of large industrial facilities such as smelters and utilities. The provincial one-hour AAQC of 250 ppb for SO_2 was exceeded twice in Sudbury, whereas the 24-hour and annual AAQC of 100 ppb and 20 ppb, respectively, for SO_2 were not exceeded at any of the ambient AQI sites in 2010.

4.3.3 Trends

Figure 4.8 shows the measured composite annual means for ambient SO_2 concentrations from 1991 to 2010 and Figure 4.9 shows the SO_2 emissions from 1991 to 2009. SO_2 concentrations have decreased by approximately 54 per cent over the 20-year period, while SO_2 emissions have been reduced by approximately 80 per cent from 1991 to 2009. Over the last decade, 2001 to 2010, there has been a decrease of approximately 60 per cent in SO_2 concentrations, while SO_2 emissions have been reduced by approximately 64 per cent from 2000 to 2009. The reduction of SO_2 emissions over the years is the result of various initiatives which include but are not limited to:

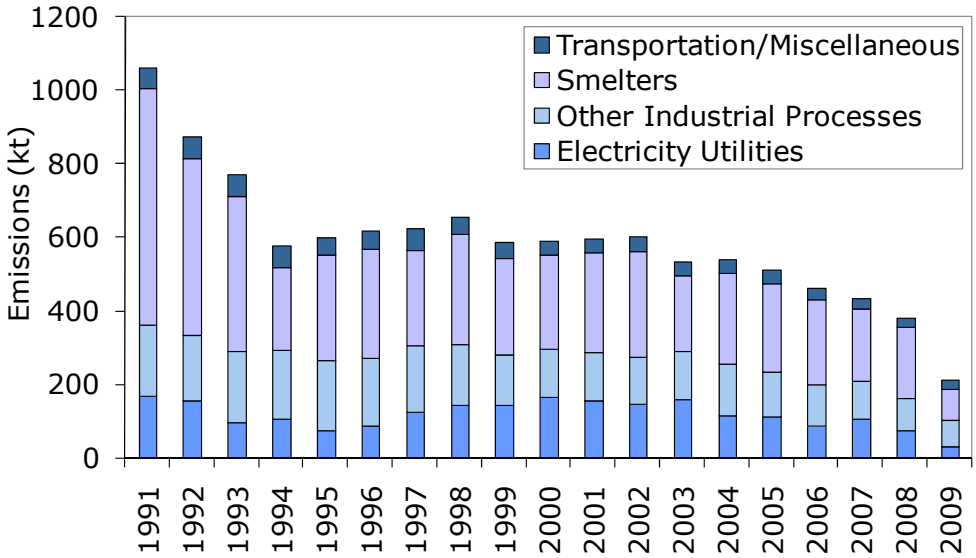
i) Control orders for Ontario smelters;
ii) Countdown Acid Rain program and Canada-wide Acid Rain Strategy;
iii) Ontario's emissions trading regulations on sulphur dioxide and nitrogen oxides (O. Reg. 397/01 and O. Reg. 194/05);
iv) Phase-out of coal-fired generating stations, with Lakeview Thermal Generating Station shut down in 2005; and
v) Low sulphur content in transportation fuels.

Figure 4.8
Ontario Sulphur Dioxide Annual Mean Concentrations
(1991 - 2010)



Note: Annual composite mean based on eight ambient sites operated over 20 years.

Figure 4.9
Ontario Sulphur Dioxide Emission Trend
(1991 - 2009)



5.0 Air Quality Index and Smog Advisories

This chapter focuses on the Air Quality Index (AQI) and smog advisories. The ministry's AQI program was established in 1988, and originally included ozone, NO_2, SO_2, CO, suspended particles (SP) and TRS compounds. On August 23, 2002, the ministry replaced SP in the AQI with $PM_{2.5}$, commonly known as fine particulate matter, making Ontario the first province in Canada to do so. In association with the AQI program, the ministry launched the Air Quality Advisory Program in 1993. In 2000, this program was expanded to the Smog Alert program under which smog advisories are now issued.

5.1 Air Quality Indices

The Ministry of the Environment operates an extensive network of air quality monitoring sites across the province. In 2010, 40 of these sites formed the basis of the AQI network. The Air Quality Office of the Environmental Monitoring and Reporting Branch continuously obtains data for criteria air pollutants from these 40 sites.

Figure 5.1
Air Quality Index (AQI) Monitoring Sites in Ontario
(2010)

The AQI network, shown in Figure 5.1, provides the public with air quality information, every hour, 24 hours a day, from across the province. The AQI is based on pollutants that have adverse effects on human health and the environment. The pollutants are O_3, $PM_{2.5}$, NO_2, CO, SO_2 and TRS compounds. At the end of each hour, the concentration of each pollutant measured at each site is converted into a number ranging from zero upwards using a common scale or index. The calculated number for each pollutant is referred to as a sub-index.

At a given air monitoring site, the highest sub-index for any given hour becomes the AQI reading for that hour. The index is a relative scale, in that the lower the index, the better the air quality. The index values, corresponding categories, and potential health and environmental effects are shown in Table 5.1.

If the AQI value is below 32, the air quality is categorized as good. For AQI values in the 32-49 range (moderate category), there may be some adverse effects for very sensitive people. For index values in the 50-99 range (poor category), the air quality may have adverse effects for sensitive members of human and animal populations, and may cause significant damage to vegetation and property. With an AQI value of 100 or more (very poor category), the air quality may have adverse effects for a large proportion of those exposed.

Computed AQI values are released to the public every hour. The public can access the index values by calling the ministry's air quality information Interactive Voice Response (IVR) system. (To access an English recording, call 1-800-387-7768, or in Toronto, call 416-246-0411. For a French recording, call 1-800-221-8852). The AQI values can also be obtained from the ministry's website at www.airqualityontario.com. Air quality forecasts, based on regional meteorological conditions and current pollution levels in Ontario and bordering U.S. states, are also provided daily on this website.

Table 5.1: Air Quality Index Pollutants and Their Impacts*

Index	Category	Ozone (O_3)	Fine Particulate Matter ($PM_{2.5}$)	Nitrogen Dioxide (NO_2)	Carbon Monoxide (CO)	Sulphur Dioxide (SO_2)	Total Reduced Sulphur (TRS) Compounds
0-15	Very Good	No health effects are expected in healthy people	Sensitive populations may want to exercise caution	No health effects are expected in healthy people	No health effects are expected in healthy people	No health effects are expected in healthy people	No health effects are expected in healthy people
16-31	Good	No health effects are expected in healthy people	Sensitive populations may want to exercise caution	Slight odour	No health effects are expected in healthy people	Damages some vegetation in combination with ozone	Slight odour
32-49	Moderate	Respiratory irritation in sensitive people during vigorous exercise; people with heart/lung disorders at some risk; damages very sensitive plants	People with respiratory disease at some risk	Odour	Blood chemistry changes, but no noticeable impairment	Damages some vegetation	Odour
50-99	Poor	Sensitive people may experience irritation when breathing and possible lung damage when physically active; people with heart/lung disorders at greater risk; damages some plants	People with respiratory disease should limit prolonged exertion; general population at some risk	Air smells and looks brown; some increase in bronchial reactivity in asthmatics	Increased symptoms in smokers with heart disease	Odour; increasing vegetation damage	Strong odour
100-over	Very Poor	Serious respiratory effects, even during light physical activity; people with heart/lung disorders at high risk; more vegetation damage	Serious respiratory effects even during light physical activity; people with heart disease, the elderly and children at high risk; increased risk for general population	Increasing sensitivity for asthmatics and people with bronchitis	Increasing symptoms in non-smokers with heart diseases; blurred vision; some clumsiness	Increasing sensitivity for asthmatics and people with bronchitis	Severe odour; some people may experience nausea and headaches

* Please note that the information in this table is subject to change.

Table 5.2 shows the percentage distribution of hourly AQI readings for the 40 monitoring sites by the AQI descriptive category and the number of days with at least one hour AQI value greater than 49. Air quality readings in the very good and good categories ranged from approximately 87 per cent at Port Stanley to 98 per cent at Thunder Bay. On average, the AQI sites in 2010 reported air quality in the very good and good categories approximately 93 per cent of the time and moderate to poor categories about 7 per cent of the time. This is in contrast to the year 2009, when air quality sites on average reported air quality in the very good and good categories approximately 96 per cent of the time and moderate to poor air quality about 4 per cent of the time. The Grand Bend AQI site recorded at least one hour of air quality in the poor category on 18 days during 2010. In 2009, this site recorded only two such days.

Table 5.2: Air Quality Index Summary (2010)

City/Town	Valid Hours	Percentage of Valid Hours AQI in Range					No. of Days At Least 1 Hour > 49
		Very Good	Good	Moderate	Poor	Very Poor	
		0-15	16-31	32-49	50-99	100+	
Windsor Downtown	8751	31.4	57.0	11.4	0.1	0.0	8
Windsor West	8663	32.6	57.5	9.8	0.1	0.0	6
Chatham	8758	23.1	67.2	9.6	0.1	0.0	4
Port Stanley	8753	18.5	68.6	12.5	0.4	0.0	9
London	8749	33.0	59.9	7.2	0.0	0.0	0
Sarnia	8755	18.2	69.1	12.5	0.2	0.0	7
Grand Bend	8757	16.1	72.5	10.7	0.7	0.0	18
Tiverton	8713	17.1	75.6	7.1	0.2	0.0	7
Brantford	8752	27.7	62.8	9.4	0.1	0.0	4
Kitchener	8749	26.6	64.6	8.8	<0.1	0.0	3
Guelph	8685	25.8	65.0	9.2	0.0	0.0	0
St. Catharines	8734	30.2	61.2	8.7	0.0	0.0	0
Hamilton Mountain	8735	28.4	62.1	9.4	0.1	0.0	4
Hamilton West	8754	38.6	54.5	6.9	0.1	0.0	2
Hamilton Downtown	8751	32.7	57.8	9.3	0.1	0.0	4
Burlington	8753	36.5	56.6	6.8	0.1	0.0	4
Oakville	8748	34.0	58.7	7.1	0.1	0.0	4
Mississauga	8676	37.7	56.3	6.0	<0.1	0.0	2
Brampton	8747	33.7	59.2	7.1	0.0	0.0	0
Toronto West	8733	54.0	40.3	5.5	0.1	0.0	3

Table 5.2: Air Quality Index Summary (2010) - Continued

City/Town	Valid Hours	Percentage of Valid Hours AQI in Range					No. of Days At Least 1 Hour > 49
		Very Good	Good	Moderate	Poor	Very Poor	
		0-15	16-31	32-49	50-99	100+	
Toronto Downtown	8745	40.5	53.0	6.2	0.2	0.0	8
Toronto North	8747	39.6	55.2	5.2	<0.1	0.0	2
Toronto East	8715	47.0	47.0	5.9	0.1	0.0	2
Oshawa	8739	30.6	63.5	5.7	0.2	0.0	5
Newmarket	8749	24.9	65.8	9.3	<0.1	0.0	2
Barrie	8756	33.6	61.3	5.1	0.0	0.0	0
Peterborough	8755	27.3	65.8	6.8	0.1	0.0	5
Belleville	8755	30.8	62.3	6.7	0.3	0.0	9
Kingston	8601	21.2	69.8	8.8	0.2	0.0	5
Morrisburg	8752	31.0	63.1	5.7	0.2	0.0	2
Cornwall	8747	32.0	62.5	5.3	0.2	0.0	2
Ottawa Central	8760	37.1	59.9	3.0	<0.1	0.0	1
Ottawa Downtown	8758	39.1	57.9	2.9	0.1	0.0	1
Petawawa	8758	35.2	61.5	3.3	0.0	0.0	0
Dorset	8662	31.6	63.4	5.0	0.0	0.0	0
Parry Sound	8754	23.8	69.1	7.0	0.1	0.0	1
North Bay	8733	32.2	64.1	3.7	0.0	0.0	0
Sudbury	8756	30.7	66.0	3.3	<0.1	0.0	1
Sault Ste. Marie	8693	31.0	65.1	4.0	0.0	0.0	0
Thunder Bay	8759	37.7	60.6	1.7	0.0	0.0	0

Figure 5.2
Air Quality Index Summary
(2010)

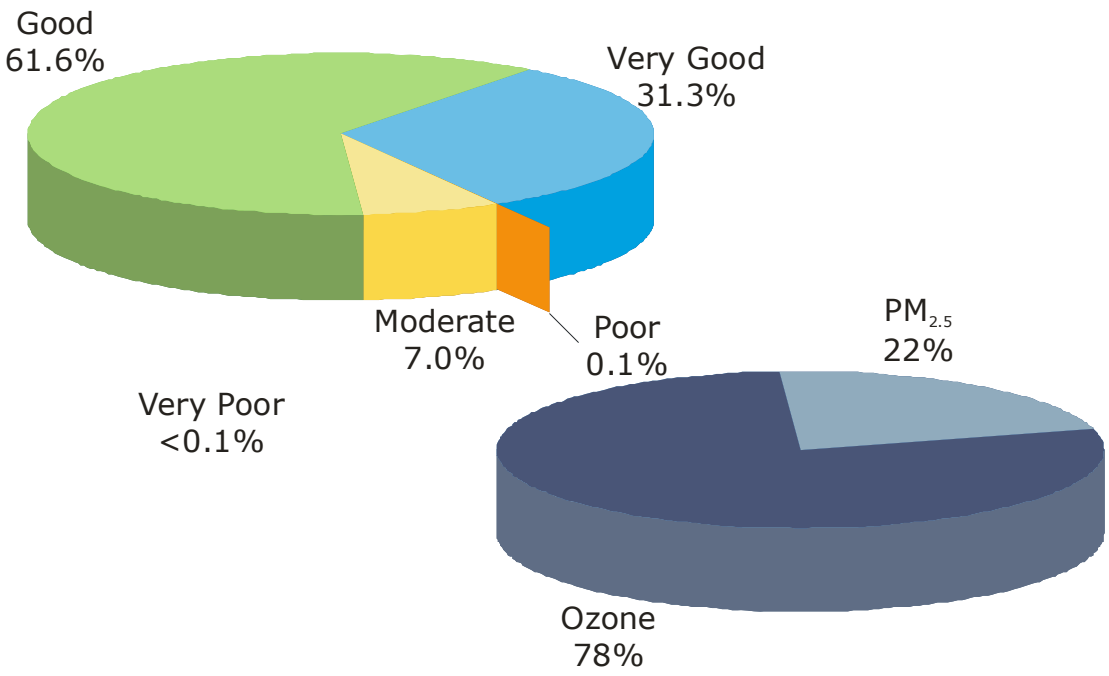


Figure 5.2 shows the provincial average for the percentages of time the AQI was in the various air quality categories as recorded by all sites across the province in 2010. The pie diagram at the top left shows the category percentages. The pie diagram at the bottom right breaks down the poor air quality (0.1 per cent) into percentages of pollutants associated with the AQI above 49. Approximately 78 per cent of the poor AQI values were due to ozone, and 22 per cent were due to fine particulate matter.

5.2 Smog Advisories

Under the Smog Alert program, smog advisories are issued to the public when AQI values are forecast to be greater than 49 due to elevated, widespread and persistent levels of O_3 and/or $PM_{2.5}$. Generally, smog advisories are issued 24 hours in advance; however, if elevated smog conditions occur without warning, and weather conditions conducive to elevated smog levels are expected to continue for several hours, a smog advisory is issued effective immediately.

Smog advisories are available to the public and media via:

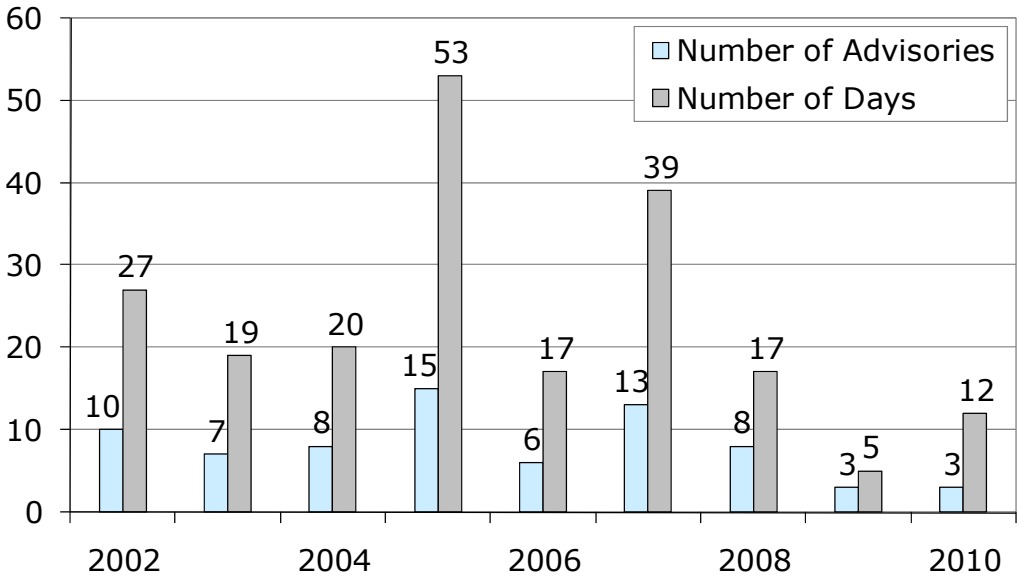
i) A public website, www.airqualityontario.com;
ii) Smog alerts emailed directly to everyone who subscribes to the ministry's Smog Alert network at the above website; and
iii) Toll-free numbers by which anyone at anytime can get updated information on air quality (1-800-387-7768 in English and 1-800-221-8852 in French).

5.2.1 2010 Smog Advisories

For 2010, Ontarians experienced only three smog advisories covering just 12 days, all of which occurred during the traditional smog season (May 1 to September 30 inclusive).

2010, like 2009, had three smog advisories; however, in 2010, these advisories covered 12 days instead of the five days recorded in 2009. The five smog advisory days recorded in 2009 were the lowest on record since $PM_{2.5}$ was included in the Smog Alert program in 2002. The smog advisories recorded in both 2009 and 2010 were in marked contrast to the high number of smog advisories and smog advisory days in 2005 (15 smog advisories covering 53 days) and 2007 (13 smog advisories covering 39 days). A history of smog advisories and smog advisory days since 2002 is shown in Figure 5.3.

Figure 5.3
Summary of Smog Advisories Issued
(2002 - 2010)



GLOSSARY

Acidic deposition	-	refers to wet and dry deposition of a variety of airborne acidic pollutants (acids or acid-forming substances such as sulphates and nitrates) on biota or land or in waters of the Earth's surface.
Air Quality Index	-	real-time information system that provides the public with an indication of air quality in cities, towns and in rural areas across Ontario.
AQI 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.
Airshed	-	a geographical region of influence or spatial extent of the air pollution burden.
Ambient air	-	outdoor or open air.
Carbon monoxide	-	a colourless, odourless, tasteless, and at high concentrations, poisonous gas.
Continuous pollutants	-	pollutants for which a continuous 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.
Diurnal	-	recurring every day; actions that are completed in 24 hours and repeated every 24 hours.

Glossary continued...

Exceedance	-	violation of the air pollutant concentration levels established by environmental protection criteria or other environmental standards.
Fine Particulate Matter	-	particles smaller than 2.5 microns 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.
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.
Micron	-	a millionth of a metre.
Nitrogen dioxide	-	a reddish-brown gas with a pungent and irritating odour.
Particulate matter	-	refers to all airborne finely divided solid or liquid material with an aerodynamic diameter smaller than 44 microns.
Percentile value	-	percentage of the data set that lies below the stated value; if the 70 percentile value is 0.10 ppm, then 70 per cent of the data are equal to or below 0.10 ppm.
Photochemical oxidation	-	a complex mixture of chemicals produced in the atmosphere; these air pollutants are formed by the action of sunlight on oxides of nitrogen and VOCs.
Photochemical smog	-	see *smog.*
Photochemical reaction	-	Chemical reaction influenced or initiated by light, particularly ultraviolet light.

Glossary continued...

Primary pollutant	-	pollutant emitted directly to the atmosphere.
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, and may include fine particulate matter, and other contaminants; tends to be a brownish haze.
Smog advisory	-	smog advisories are issued to the public when there is a strong likelihood that widespread, elevated and persistent smog levels are expected.
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 much ultraviolet radiation and prevents it from reaching the Earth.
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.

ACRONYMS

AAQC	-	Ambient Air Quality Criteria (Ontario)
AQI	-	Air Quality Index
CCME	-	Canadian Council of Ministers of the Environment
CO	-	carbon monoxide
CWS	-	Canada-wide Standard
GTA	-	Greater Toronto Area
IVR	-	Interactive Voice Response
NO	-	nitric oxide
NO_2	-	nitrogen dioxide
NO_X	-	nitrogen oxides
O_3	-	ozone
$PM_{2.5}$	-	fine particulate matter
SES (TEOM)	-	Sample Equilibration System
SO_2	-	sulphur dioxide
TEOM	-	Tapered Element Oscillating Microbalance
TRS	-	total reduced sulphur
VOCs	-	volatile organic compounds
kt	-	kilotonnes
$\mu g/m^3$	-	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

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APPENDICES

The Appendices are intended for use in conjunction with the 2010 Annual Air Quality in Ontario report. The Appendices briefly describe the provincial Air Quality Index (AQI) network, quality assurance and quality control procedures, and the Ministry of the Environment'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 10- and 20-year periods.

MONITORING NETWORK OPERATIONS

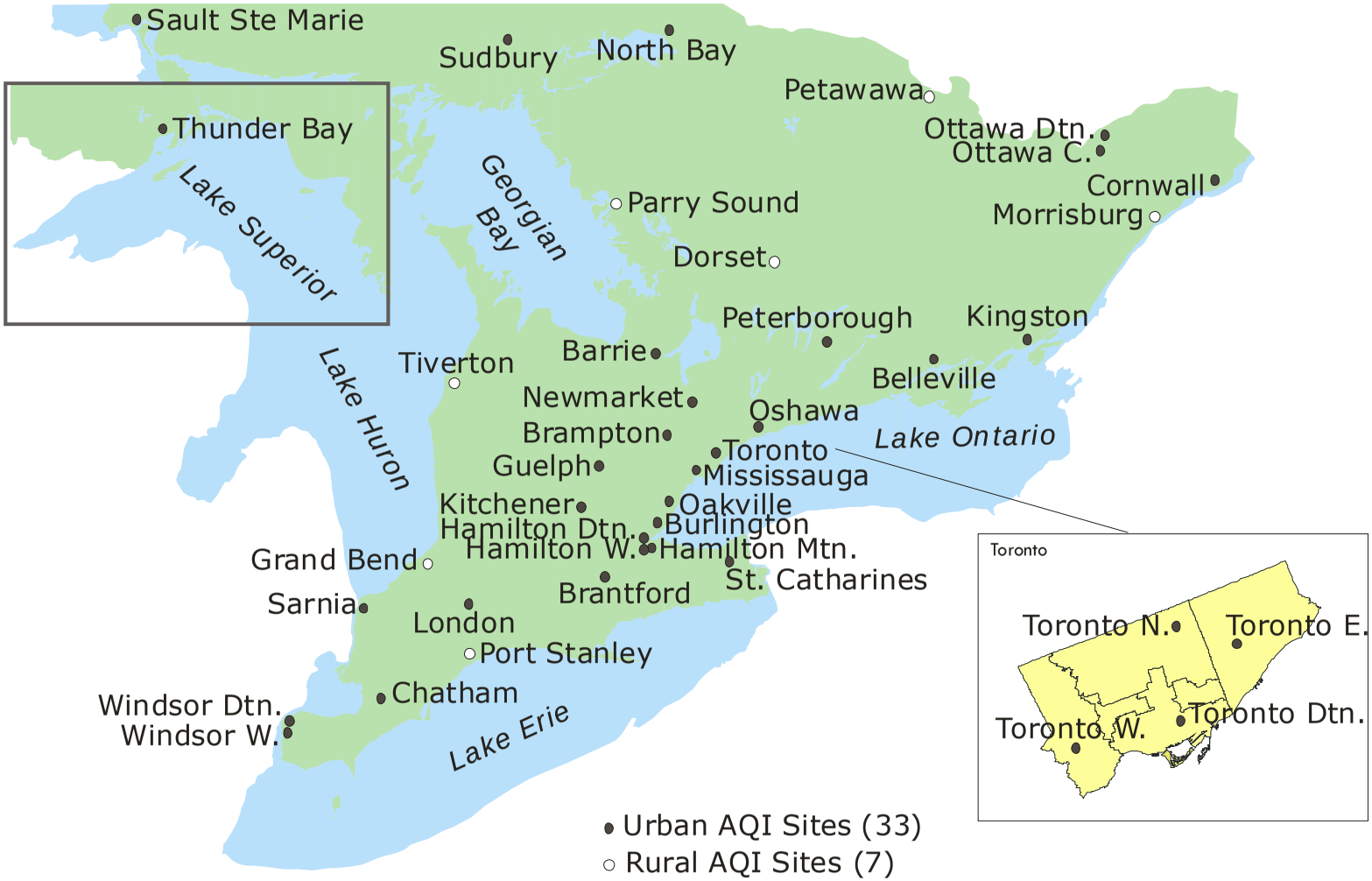
Network Description

In 2010, the AQI network was comprised of 142 continuous monitoring instruments at 40 sites. These instruments have the capability of recording minute data (approximately 74.6 million data points per year) that are used to scan and validate the continuous hourly data. During 2010, the Environmental Monitoring and Reporting Branch (EMRB) operated all of the ambient air monitoring sites. Monitoring site locations for the AQI network are illustrated in Map 1.

Quality Assurance and Quality Control

Day-to-day air monitoring and maintenance of the instruments are administered by Environmental Monitoring and Reporting Branch (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.

Map 1
AQI Monitoring Sites in Ontario
(2010)



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 activity is recorded using FieldWorker Inc., 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:

- Ozone – TE49C/I
- Fine Particulate Matter – TEOM 1400AB/SES
- Nitrogen Oxides – TE42C/I
- Carbon Monoxide – TE48C/I
- Total Reduced Sulphur – TE43C/CDN101
- Sulphur Dioxide – TE43C/I

The 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 Pollution Measurement Division of Environment Canada. The secondary transfer standards used by station operators are referenced and certified to EMRB's NIST primary standards on a quarterly basis. Primary weighed filter standards from Thermo Electron Corporation are used to calibrate the TEOM twice a year.

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 2010 ambient air quality monitoring network had greater than 98 per cent valid data from over 3 million data points.

Data Base

The ambient air quality data used in this report are stored in the ministry's air quality information system (AQUIS). 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 obtained from automated ambient air monitoring instruments that operate continuously 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, ANNUAL STATISTICS AND TRENDS

The AQI network for 2010 is summarized in Table 1. 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.

Table 1 also identifies the *type* of air monitoring site: ambient, road-side, CWS, and/or 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. Sites designated as CWS have populations greater than 100, 000, and NAPS sites are supported under the federal-provincial NAPS Memorandum of Understanding.

The 2010 statistical data and 10-year trends for various continuous pollutants are provided in Appendices A and B, respectively. 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 2001-2010. The 20-year trends for ozone, NO_2 and SO_2 are provided in Appendices C-E. To be included in the 20-year trend analysis, a site must have valid annual means for a minimum of 15 years over the 20-year period from 1991-2010. A linear regression was applied to each of the trends presented in Appendices B-E to calculate the per cent change in concentrations over time.

Table 1
2010 Ontario Continuous Ambient Air Monitoring Network

ID	STATION NAME	STATION LOCATION	YEAR	LATITUDE (D:M:S)	LONGITUDE (D:M:S)	AIR INTAKE (AGL)	TYPE	AQI	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	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	.	.	.
15025	LONDON	900 HIGHBURY AVE. N.	1995	43°00`24.2``	-81°12`23.1``	4	A/C/N	Y	T	T	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	.	.	.	.
18007	TIVERTON	4th CONCESSION/BRUCE RD. 23	1979	44°18`52.1``	-81°32`59.0``	4	A/N	Y	T	T	T	T	.	.
21005	BRANTFORD	324 GRAND RIVER AVE.	2004	43°08`19.0``	-80°17`33.5``	5	A/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	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	T	.
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/N	Y	T	T	T	T	T	.

Table 1
2010 Ontario Continuous Ambient Air Monitoring Network

ID	STATION NAME	STATION LOCATION	YEAR	LATITUDE (D:M:S)	LONGITUDE (D:M:S)	AIR INTAKE (AGL)	TYPE	AQI	O_3	$PM_{2.5}$	NO_2	SO_2	CO	TRS
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	.	.	.	.
52022	KINGSTON	752 KING ST. W.	2006	44°12`58.5``	-76°31`41.9``	13	A/C/N	Y	T	T	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	.	.	.
56010	MORRISBURG	COUNTY RD. 2, MORRISBURG WATER TOWER	2005	44°53`59.1``	-75°11`23.8``	5	A/N	Y	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	.	.	.
77219	SUDBURY	1222 RAMSEY LAKE RD.	2004	46°28`32.5``	-80°57`46.6``	3	A/C/N	Y	T	T	.	T	.	.
TOTAL								40	40	40	35	15	8	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 = CWS, N = NAPS

AQI - Air Quality 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 A1
2010 Ozone (O_3) Statistics
Unit: parts per billion (ppb)
O_3 1-hour AAQC is 80 ppb

ID	City/Town	Location	Valid h	PERCENTILES							Maximum		No. of Times Above Criterion
				10%	30%	50%	70%	90%	99%	Mean	1h	24h	1h
12008	Windsor Downtown	467 University Ave. W.	8733	8	19	27	35	49	70	28.0	94	54	9
12016	Windsor West	College Ave./South St.	8649	6	18	26	33	46	67	26.7	96	52	6
13001	Chatham	435 Grand Ave. W.	8750	16	25	31	38	49	68	31.9	83	61	5
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8735	14	23	30	37	47	70	30.7	90	56	14
15020	Grand Bend	Point Blake Conservation Area	8747	19	28	35	40	51	77	35.0	113	72	62
15025	London	900 Highbury Ave. N.	8722	11	21	28	34	46	62	28.2	77	63	0
16015	Port Stanley	43665 Dexter Line, Elgin Water T. Plt	8743	18	27	33	40	53	75	34.6	104	69	35
18007	Tiverton	4th Concession/Bruce Rd. 23	8698	20	28	34	39	47	67	33.8	98	65	19
21005	Brantford	324 Grand River Ave.	8747	10	22	30	36	48	68	29.4	82	57	2
26060	Kitchener	West Ave./Homewood Ave.	8745	12	23	30	36	46	64	29.4	76	61	0
27067	St. Catharines	Argyle Cres., Pump Stn.	8729	9	21	28	35	46	65	28.3	80	62	0
28028	Guelph	Exhibition St./Clark St. W.	8676	12	23	31	37	48	67	30.7	80	58	0
29000	Hamilton Downtown	Elgin St./Kelly St.	8729	9	20	26	33	45	64	26.9	81	64	1
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8720	12	22	29	36	48	67	29.7	85	65	6
29118	Hamilton West	Main St. W./Hwy 403	8752	4	17	24	32	42	61	24.5	78	60	0
31103	Toronto Downtown	Bay St./Wellesley St. W.	8722	9	18	25	32	44	66	26.1	102	61	20
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8706	6	16	22	29	41	61	23.0	104	58	7
34020	Toronto North	Hendon Ave./Yonge St.	8728	8	18	25	31	41	60	24.8	98	57	4
35125	Toronto West	125 Resources Rd.	8713	3	12	19	27	40	63	20.6	95	56	12
44008	Burlington	North Shore Blvd. E./Lakeshore Rd.	8751	8	19	26	33	45	61	26.6	87	61	9
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8746	11	21	28	34	45	64	28.0	95	62	12
45026	Oshawa	2000 Simcoe St. N., Durham College	8721	11	22	28	34	42	64	28.0	96	55	14
46089	Brampton	525 Main St. N., Peel Manor	8718	9	20	28	34	45	63	27.5	77	60	0
46108	Mississauga	3359 Mississauga Rd. N., U Of T Campus	8656	6	18	26	33	44	62	25.9	83	64	3
47045	Barrie	83 Perry St.	8751	8	21	28	33	43	59	26.8	77	54	0
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8719	14	25	32	38	49	66	31.5	87	60	3
49005	Parry Sound	7 Bay St.	8745	14	25	32	37	47	64	31.3	85	63	5
49010	Dorset	1026 Bellwood Acres Rd.	8654	10	22	29	35	45	60	28.6	80	57	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8750	10	19	26	32	41	56	25.7	75	57	0

Table A1
2010 Ozone (O_3) Statistics
Unit: parts per billion (ppb)
O_3 1-hour AAQC is 80 ppb

ID	City/Town	Location	Valid h	PERCENTILES							Maximum		No. of Times Above Criterion
				10%	30%	50%	70%	90%	99%	Mean	1h	24h	1h
51002	Ottawa Central	960 Carling Ave.	8740	10	20	27	33	42	57	26.6	72	55	0
51010	Petawawa	Petawawa Research Forest Facility	8751	11	21	28	35	43	56	27.9	75	62	0
52022	Kingston	752 King St. W.	8595	17	26	32	37	48	73	32.6	89	70	18
54012	Belleville	2 Sidney St., Water Treatment Plant	8648	13	23	30	35	47	71	30.0	96	67	25
56010	Morrisburg	County Rd. 2, Morrisburg Water Tower	8745	12	22	29	34	44	62	28.6	76	62	0
56051	Cornwall	Bedford St./3rd St. W.	8715	11	21	28	34	44	60	27.9	74	64	0
59006	Peterborough	10 Hospital Dr.	8680	14	24	30	36	46	67	30.5	91	59	12
63203	Thunder Bay	421 James St. S.	8752	8	20	27	32	41	53	25.7	67	52	0
71078	Sault Ste. Marie	Sault College	8690	14	23	28	34	42	59	28.4	73	56	0
75010	North Bay	Chippewa St. W., Dept. National Defence	8730	11	22	29	34	44	60	28.0	79	59	0
77219	Sudbury	1222 Ramsey Lake Rd.	8748	14	23	29	34	42	59	28.7	75	58	0

Table A2

2010 Fine Particulate Matter ($PM_{2.5}$) Statistics

Unit: micrograms per cubic metre ($\mu g/m^3$)

ID	City/Town	Location	Valid h	PERCENTILES							Maximum		No. of Times Above Reference Level
				10%	30%	50%	70%	90%	99%	Mean	1h	24h	24h
12008	Windsor Downtown	467 University Ave. W.	8636	1	3	6	10	18	29	7.7	73	24	0
12016	Windsor West	College Ave./South St.	8594	1	3	6	10	18	29	7.8	73	25	0
13001	Chatham	435 Grand Ave. W.	8700	1	2	5	8	15	26	6.5	58	25	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8728	3	5	8	12	21	35	10.4	80	35	6
15020	Grand Bend	Point Blake Conservation Area	8656	0	2	4	8	15	28	6.1	50	28	0
15025	London	900 Highbury Ave. N.	7126	0	2	5	8	16	27	INS	71	28	0
16015	Port Stanley	43665 Dexter Line, Elgin Water T. Plt	8629	0	2	4	7	14	27	5.9	39	28	0
18007	Tiverton	4th Concession/Bruce Rd. 23	8673	0	1	3	5	12	23	4.5	32	23	0
21005	Brantford	324 Grand River Ave.	8602	0	2	5	8	16	30	6.5	56	27	0
26060	Kitchener	West Ave./Homewood Ave.	8632	0	2	4	8	15	29	6.3	51	29	0
27067	St. Catharines	Argyle Cres., Pump Stn.	8635	0	2	5	8	15	29	6.5	43	26	0
28028	Guelph	Exhibition St./Clark St. W.	8585	0	2	4	7	14	28	5.7	40	28	0
29000	Downtown	Elgin St./Kelly St.	8608	1	3	5	9	18	33	7.7	64	33	2
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8688	0	2	4	7	15	29	6.2	53	27	0
29118	Hamilton West	Main St. W./Hwy 403	8562	0	2	5	8	16	30	6.8	58	30	2
31103	Toronto Downtown	Bay St./Wellesley St. W.	8653	0	2	4	7	14	28	6.0	44	29	0
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8654	1	3	5	8	15	31	6.7	63	32	3
34020	Toronto North	Hendon Ave./Yonge St.	8701	0	2	4	8	14	28	6.2	38	28	0
35125	Toronto West	125 Resources Rd.	8671	1	3	5	8	15	27	6.5	46	26	0
44008	Burlington	North Shore Blvd. E./Lakeshore Rd.	8656	0	2	4	7	15	29	6.2	46	28	0
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8657	0	2	4	7	13	27	5.7	43	25	0
45026	Oshawa	2000 Simcoe St. N., Durham College	8660	0	2	4	7	14	29	5.6	44	30	1
46089	Brampton	525 Main St. N., Peel Manor	8594	0	2	4	7	14	26	5.8	54	27	0
46108	Mississauga	3359 Mississauga Rd. N., U Of T Campus	8566	0	2	4	7	14	26	6.1	45	26	0
47045	Barrie	83 Perry St.	8696	0	2	4	7	13	25	5.4	58	26	0
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8293	0	2	4	7	13	26	5.6	34	27	0
49005	Parry Sound	7 Bay St.	8694	0	1	3	5	11	22	4.4	35	25	0

Table A2

2010 Fine Particulate Matter ($PM_{2.5}$) Statistics

Unit: micrograms per cubic metre ($\mu g/m^3$)

ID	City/Town	Location	Valid h	PERCENTILES							Maximum		No. of Times Above Reference Level
				10%	30%	50%	70%	90%	99%	Mean	1h	24h	24h
49010	Dorset	1026 Bellwood Acres Rd.	8598	0	1	3	5	10	20	4.0	66	22	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8691	0	1	3	5	11	22	4.5	117	45	1
51002	Ottawa Central	960 Carling Ave.	8700	0	1	3	5	10	22	4.3	122	46	1
51010	Petawawa	Petawawa Research Forest Facility	8725	0	1	2	4	8	17	3.2	38	18	0
52022	Kingston	752 King St. W.	8511	1	3	4	7	15	36	6.5	46	37	6
54012	Belleville	2 Sidney St., Water Treatment Plant	7708	0	2	3	5	10	20	INS	30	25	0
56010	Morrisburg	County Rd. 2, Morrisburg Water Tower	8687	0	2	3	6	12	29	5.3	133	58	2
56051	Cornwall	Bedford St./3rd St. W.	8695	0	2	4	6	13	30	5.7	136	57	2
59006	Peterborough	10 Hospital Dr.	8692	0	2	3	6	12	26	5.1	49	26	0
63203	Thunder Bay	421 James St. S.	8552	0	1	3	5	10	17	4.1	37	15	0
71078	Sault Ste. Marie	Sault College	8670	0	1	3	5	10	19	4.1	39	16	0
75010	North Bay	Chippewa St. W., Dept. National Defence	8716	0	1	3	4	9	19	3.8	31	18	0
77219	Sudbury	1222 Ramsey Lake Rd.	8728	0	1	2	4	9	18	3.6	31	16	0

Notes:

Measurements taken by Tapered Element Oscillating Microbalance (TEOM) sampler operated at 30 degrees Celsius with a Sample Equilibrium System (SES).

INS indicates there was insufficient data in any one quarter to calculate a valid annual mean.

The $PM_{2.5}$ reference level is 30 $\mu g/m^3$ for a 24-hour period (based on CWS).

Table A3
2010 Nitric Oxide (NO) Statistics
Unit: parts per billion (ppb)

ID	City/Town	Location	Valid h	PERCENTILES							Maximum	
				10%	30%	50%	70%	90%	99%	Mean	1h	24h
12008	Windsor Downtown	467 University Ave. W.	8570	0	0	1	3	10	66	4.7	425	86
12016	Windsor West	College Ave./South St.	8582	0	1	2	4	10	90	6.1	356	100
13001	Chatham	435 Grand Ave. W.	8645	0	1	2	3	6	16	2.6	58	11
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8736	0	1	1	1	4	28	2.2	204	26
15020	Grand Bend	Point Blake Conservation Area	6347	0	0	0	0	1	4	INS	19	3
15025	London	900 Highbury Ave. N.	8740	0	1	1	2	5	34	2.9	146	25
18007	Tiverton	4th Concession/Bruce Rd. 23	7740	0	0	1	1	1	3	0.7	42	2
21005	Brantford	324 Grand River Ave.	8747	0	0	0	1	3	22	1.3	96	27
26060	Kitchener	West Ave./Homewood Ave.	8743	0	0	1	1	3	56	2.5	209	49
27067	St. Catharines	Argyle Cres., Pump Stn.	8693	0	0	1	1	4	46	2.8	165	36
28028	Guelph	Exhibition St./Clark St. W.	8677	0	1	1	1	3	29	2.0	98	25
29000	Hamilton Downtown	Elgin St./Kelly St.	8740	0	1	1	3	11	66	5.0	315	99
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8730	0	0	1	1	4	32	2.2	149	50
29118	Hamilton West	Main St. W./Hwy 403	6372	0	1	1	4	18	99	INS	246	117
31103	Toronto Downtown	Bay St./Wellesley St. W.	8723	0	1	2	3	8	43	4.1	201	61
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8493	0	2	4	7	17	75	7.8	289	65
34020	Toronto North	Hendon Ave./Yonge St.	8742	1	2	2	4	11	62	5.7	158	58
35125	Toronto West	125 Resources Rd.	8698	0	2	5	12	31	130	13.4	322	144
44008	Burlington	North Shore Blvd. E./Lakeshore Rd.	8751	0	1	2	3	10	64	5.0	197	49
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8723	1	1	2	2	6	44	3.6	183	68
45026	Oshawa	2000 Simcoe St. N., Durham College	8725	0	0	1	2	5	22	2.3	91	19
46089	Brampton	525 Main St. N., Peel Manor	8663	0	1	1	2	6	52	3.7	272	80
46108	Mississauga	3359 Mississauga Rd. N., U Of T Campus	8502	0	0	1	2	7	71	4.1	201	72
47045	Barrie	83 Perry St.	8750	0	1	1	1	6	81	4.3	250	77
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8712	0	0	1	2	4	34	2.3	136	33
49005	Parry Sound	7 Bay St.	6617	0	0	0	0	1	12	0.7	45	9
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8745	0	0	1	1	3	22	1.6	116	27
51002	Ottawa Central	960 Carling Ave.	8753	0	0	0	0	2	27	1.4	135	38
52022	Kingston	752 King St. W.	8591	0	0	0	0	1	4	0.3	25	6

Table A3
2010 Nitric Oxide (NO) Statistics
Unit: parts per billion (ppb)

ID	City/Town	Location	Valid h	PERCENTILES							Maximum	
				10%	30%	50%	70%	90%	99%	Mean	1h	24h
54012	Belleville	2 Sidney St., Water Treatment Plant	8747	0	1	1	2	5	23	2.3	112	22
56051	Cornwall	Bedford St./3rd St. W.	8689	0	0	1	1	3	31	2.0	150	53
59006	Peterborough	10 Hospital Dr.	8502	0	1	1	2	3	17	1.7	93	14
63203	Thunder Bay	421 James St. S.	8747	0	1	2	3	12	46	4.6	124	41
71078	Sault Ste. Marie	Sault College	8689	0	1	1	2	4	15	1.9	44	9
75010	North Bay	Chippewa St. W., Dept. National Defence	8727	1	1	2	2	6	38	3.4	157	29

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

Table A4

2010 Nitrogen Dioxide (NO_2) Statistics

Unit: parts per billion (ppb)

NO_2 1-hour AAQC is 200 ppb

NO_2 24-hour AAQC is 100 ppb

ID	City/Town	Location	Valid h	PERCENTILES							Maximum		No. of Times Above Criteria	
				10%	30%	50%	70%	90%	99%	Mean	1h	24h	1h	24h
12008	Windsor Downtown	467 University Ave. W.	8570	5	9	13	18	31	50	15.6	82	45	0	0
12016	Windsor West	College Ave./South St.	8582	5	8	12	17	28	47	14.5	80	40	0	0
13001	Chatham	435 Grand Ave. W.	8645	1	3	5	8	14	27	6.4	43	23	0	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8736	2	3	6	10	17	32	8.0	60	28	0	0
15020	Grand Bend	Point Blake Conservation Area	6347	1	1	2	4	7	15	INS	27	15	0	0
15025	London	900 Highbury Ave. N.	8740	2	4	7	10	19	35	8.8	68	34	0	0
18007	Tiverton	4th Concession/Bruce Rd. 23	7740	0	1	1	2	4	9	1.9	25	12	0	0
21005	Brantford	324 Grand River Ave.	8747	1	3	4	7	13	24	5.8	38	23	0	0
26060	Kitchener	West Ave./Homewood Ave.	8743	2	4	6	8	15	34	7.7	64	30	0	0
27067	St. Catharines	Argyle Cres., Pump Stn.	8693	3	5	7	10	19	35	9.1	49	28	0	0
28028	Guelph	Exhibition St./Clark St. W.	8677	2	3	5	8	14	29	6.7	55	29	0	0
29000	Hamilton Downtown	Elgin St./Kelly St.	8740	4	7	11	15	25	40	12.7	59	37	0	0
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8730	2	4	6	10	20	36	8.9	53	30	0	0
29118	Hamilton West	Main St. W./Hwy 403	6372	4	6	10	15	24	36	INS	52	34	0	0
31103	Toronto Downtown	Bay St./Wellesley St. W.	8729	6	10	14	19	29	48	16.1	69	41	0	0
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8493	5	9	12	18	28	46	14.8	67	35	0	0
34020	Toronto North	Hendon Ave./Yonge St.	8742	4	7	12	18	29	46	14.3	65	44	0	0
35125	Toronto West	125 Resources Rd.	8698	8	13	18	24	35	51	20.1	66	44	0	0
44008	Burlington	North Shore Blvd. E./Lakeshore Rd.	8751	4	7	10	15	24	39	12.2	53	32	0	0
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8723	2	4	7	11	20	37	9.2	61	27	0	0
45026	Oshawa	2000 Simcoe St. N., Durham College	8725	2	3	5	8	15	29	7.2	41	26	0	0
46089	Brampton	525 Main St. N., Peel Manor	8663	3	5	7	12	24	41	10.7	62	40	0	0
46108	Mississauga	3359 Mississauga Rd. N., U Of T Campus	8502	3	5	8	12	21	37	10.4	47	31	0	0
47045	Barrie	83 Perry St.	8750	3	4	6	9	18	40	8.7	67	35	0	0
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8712	2	3	5	8	16	32	7.2	57	28	0	0
49005	Parry Sound	7 Bay St.	6617	1	1	2	3	7	19	3.1	36	13	0	0

Table A4

2010 Nitrogen Dioxide (NO_2) Statistics

Unit: parts per billion (ppb)

NO_2 1-hour AAQC is 200 ppb

NO_2 24-hour AAQC is 100 ppb

ID	City/Town	Location	Valid h	PERCENTILES							Maximum		No. of Times Above Criteria	
				10%	30%	50%	70%	90%	99%	Mean	1h	24h	1h	24h
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8745	2	3	5	8	16	31	7.4	46	26	0	0
51002	Ottawa Central	960 Carling Ave.	8753	1	2	4	7	14	31	6.2	45	29	0	0
52022	Kingston	752 King St. W.	8591	1	2	3	5	9	20	4.3	40	16	0	0
54012	Belleville	2 Sidney St., Water Treatment Plant	8747	1	2	4	6	12	27	5.5	42	17	0	0
56051	Cornwall	Bedford St./3rd St. W.	8689	2	3	4	7	13	32	6.5	46	27	0	0
59006	Peterborough	10 Hospital Dr.	8502	1	2	3	6	11	24	5.0	38	21	0	0
63203	Thunder Bay	421 James St. S.	8747	2	4	6	9	17	34	7.8	49	26	0	0
71078	Sault Ste. Marie	Sault College	8689	2	3	4	6	11	27	5.5	46	21	0	0
75010	North Bay	Chippewa St. W., Dept. National Defence	8727	2	3	5	7	17	41	7.6	55	32	0	0

Note:

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

Table A5
2010 Nitrogen Oxides (NO_x) Statistics
Unit: parts per billion (ppb)

ID	City/Town	Location	Valid h	PERCENTILES							Maximum	
				10%	30%	50%	70%	90%	99%	Mean	1h	24h
12008	Windsor Downtown	467 University Ave. W.	8570	6	9	14	21	40	108	20.2	500	126
12016	Windsor West	College Ave./South St.	8582	6	10	14	20	38	131	20.6	409	131
13001	Chatham	435 Grand Ave. W.	8645	2	4	7	11	18	39	9.0	98	33
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8736	2	4	7	11	20	56	10.2	243	48
15020	Grand Bend	Point Blake Conservation Area	6347	1	2	3	4	8	17	INS	34	17
15025	London	900 Highbury Ave. N.	8740	3	6	8	12	23	66	11.7	185	49
18007	Tiverton	4th Concession/Bruce Rd. 23	7740	1	1	2	3	5	11	2.6	68	13
21005	Brantford	324 Grand River Ave.	8747	2	3	5	8	15	42	7.2	127	46
26060	Kitchener	West Ave./Homewood Ave.	8743	3	4	6	10	18	87	10.3	248	72
27067	St. Catharines	Argyle Cres., Pump Stn.	8693	3	5	8	12	24	72	11.8	189	52
28028	Guelph	Exhibition St./Clark St. W.	8677	2	4	5	9	17	56	8.6	115	43
29000	Hamilton Downtown	Elgin St./Kelly St.	8740	5	8	13	19	35	100	17.8	366	131
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8730	2	5	7	12	24	64	11.2	189	80
29118	Hamilton West	Main St. W./Hwy 403	6373	4	8	12	19	41	123	INS	297	146
31103	Toronto Downtown	Bay St./Wellesley St. W.	8729	8	12	16	22	36	84	20.3	269	93
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	8493	6	11	17	25	43	115	22.6	350	91
34020	Toronto North	Hendon Ave./Yonge St.	8742	5	9	14	22	40	100	20.0	212	88
35125	Toronto West	125 Resources Rd.	8698	9	16	25	36	64	174	33.5	373	184
44008	Burlington	North Shore Blvd. E./Lakeshore Rd.	8751	4	8	12	18	34	98	17.2	237	76
44017	Oakville	Eighth Line/Glenashton Dr., Halton Res.	8723	3	5	8	13	26	78	12.8	221	93
45026	Oshawa	2000 Simcoe St. N., Durham College	8725	2	4	6	10	20	48	9.5	132	38
46089	Brampton	525 Main St. N., Peel Manor	8663	4	6	9	15	29	89	14.4	320	110
46108	Mississauga	3359 Mississauga Rd. N., U Of T Campus	8502	4	6	9	14	28	101	14.5	233	97
47045	Barrie	83 Perry St.	8750	3	5	7	11	25	115	13.1	305	100
48006	Newmarket	Eagle St. W./McCaffrey Rd.	8712	3	4	6	9	19	58	9.5	186	54
49005	Parry Sound	7 Bay St.	6617	1	1	2	3	9	30	3.9	74	20
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8745	2	4	6	9	19	48	9.0	146	54
51002	Ottawa Central	960 Carling Ave.	8753	1	3	4	7	16	54	7.5	165	67
52022	Kingston	752 King St. W.	8591	2	2	3	5	9	22	4.7	64	22
54012	Belleville	2 Sidney St., Water Treatment Plant	8747	2	4	5	8	15	46	7.8	153	35

Table A5
2010 Nitrogen Oxides (NO_x) Statistics
Unit: parts per billion (ppb)

ID	City/Town	Location	Valid h	PERCENTILES							Maximum	
				10%	30%	50%	70%	90%	99%	Mean	1h	24h
56051	Cornwall	Bedford St./3rd St. W.	8689	2	4	5	8	16	59	8.5	172	75
59006	Peterborough	10 Hospital Dr.	8502	2	3	5	7	13	38	6.7	119	30
63203	Thunder Bay	421 James St. S.	8747	3	5	8	12	27	76	12.4	159	64
71078	Sault Ste. Marie	Sault College	8689	2	3	5	7	15	37	7.4	90	27
75010	North Bay	Chippewa St. W., Dept. National Defence	8727	3	5	6	10	23	74	11.0	189	59

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

Table A6
2010 Carbon Monoxide (CO) Statistics

Unit: parts per million (ppm)
CO 1-hour AAQC is 30 ppm
CO 8-hour AAQC is 13 ppm

ID	City/Town	Location	Valid h	PERCENTILES						Mean	Maximum		No. of Times Above Criteria	
				10%	30%	50%	70%	90%	99%		1h	8h	1h	8h
12008	Windsor Downtown	467 University Ave. W.	8583	0.08	0.17	0.23	0.28	0.42	0.79	0.25	2.46	1.39	0	0
15025	London	900 Highbury Ave. N.	8690	0.07	0.14	0.19	0.23	0.30	0.52	0.19	1.10	0.63	0	0
29000	Hamilton Downtown	Elgin St./Kelly St.	7876	0.07	0.14	0.19	0.26	0.42	0.87	0.23	2.23	1.08	0	0
31103	Toronto Downtown	Bay St./Wellesley St. W.	8620	0.16	0.20	0.24	0.29	0.39	0.58	0.26	1.52	1.20	0	0
35125	Toronto West	125 Resources Rd.	8673	0.07	0.14	0.20	0.25	0.34	0.72	0.21	1.77	1.53	0	0
46108	Mississauga	3359 Mississauga Rd. N., U Of T Campus	8517	0.09	0.15	0.19	0.23	0.31	0.59	0.20	1.15	1.06	0	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8593	0.18	0.23	0.27	0.33	0.40	0.56	0.29	1.54	0.91	0	0
52022	Kingston	752 King St. W.	8560	0.13	0.16	0.18	0.21	0.27	0.33	0.19	0.55	0.37	0	0

Table A7

2010 Sulphur Dioxide (SO_2) Statistics

Unit: parts per billion (ppb)

SO_2 1-hour AAQC is 250 ppb

SO_2 24-hour AAQC is 100 ppb

SO_2 1-year AAQC is 20 ppb

ID	City/Town	Location	Valid h	PERCENTILES							Maximum		No. of Times Above Criteria		
				10%	30%	50%	70%	90%	99%	Mean	1h	24h	1h	24h	1y
12008	Windsor Downtown	467 University Ave. W.	8741	0	1	1	3	9	32	3.5	82	31	0	0	0
12016	Windsor West	College Ave./South St.	8555	0	0	1	2	10	30	3.2	74	24	0	0	0
13001	Chatham	435 Grand Ave. W.	8751	0	0	1	1	3	8	1.3	26	8	0	0	0
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8671	0	1	1	3	9	44	3.9	103	45	0	0	0
15025	London	900 Highbury Ave. N.	8742	0	0	1	1	2	6	0.9	19	6	0	0	0
18007	Tiverton	4th Concession/Bruce Rd. 23	8703	0	0	1	1	2	6	1.0	16	6	0	0	0
29000	Hamilton Downtown	Elgin St./Kelly St.	7894	0	1	1	2	8	35	3.3	79	30	0	0	0
29114	Hamilton Mountain	Vickers Rd./E. 18th St.	8725	0	1	1	3	7	27	2.9	73	24	0	0	0
31103	Toronto Downtown	Bay St./Wellesley St. W.	8744	0	0	1	1	2	5	0.9	22	7	0	0	0
35125	Toronto West	125 Resources Rd.	8727	0	0	1	1	2	6	0.9	27	5	0	0	0
46108	Mississauga	3359 Mississauga Rd. N., U Of T Campus	8661	0	0	1	1	2	7	1.0	22	5	0	0	0
51001	Ottawa Downtown	Rideau St./Wurtemburg St.	8666	0	0	0	0	1	2	0.2	5	3	0	0	0
52022	Kingston	752 King St. W.	8592	0	0	0	1	1	3	0.5	8	4	0	0	0
71078	Sault Ste. Marie	Sault College	8688	0	0	0	0	1	16	0.7	52	8	0	0	0
77219	Sudbury	1222 Ramsey Lake Rd.	8745	0	0	0	1	2	26	1.3	372	44	2	0	0

Table A8
2010 Total Reduced Sulphur (TRS) Compounds Statistics
Unit: parts per billion (ppb)

ID	City/Town	Location	Valid h	PERCENTILES							Maximum	
				10%	30%	50%	70%	90%	99%	Mean	1h	24h
12016	Windsor West	College Ave./South St.	7782	0	0	0	1	1	5	0.7	34	4
14064	Sarnia	Front St. N./CN Tracks, Centennial Park	8455	0	0	0	0	0	1	0.1	4	1
29000	Hamilton Downtown	Elgin St./Kelly St.	8562	0	0	0	1	1	3	0.5	10	4
71078	Sault Ste. Marie	Sault College	8685	0	0	0	0	1	1	0.2	4	1

Table B1
10-Year Trend for O_3

Annual Mean (ppb)

ID	City/Town	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Per cent Change Over Time
12008	Windsor Downtown	20.5	21.9	22.9	20.2	26.0	24.6	27.0	26.9	24.8	28.0	+ 33
12016	Windsor West	19.0	20.2	22.8	22.6	25.6	24.3	25.3	25.9	24.9	26.7	+ 33
14064	Sarnia	25.6	26.5	24.7	23.8	27.4	26.7	28.6	28.7	26.6	30.7	+ 18
15020	Grand Bend	31.6	29.8	30.7	25.8	32.5	29.7	31.7	31.3	29.6	35.0	+ 9
15025	London	24.2	25.3	26.9	23.6	26.1	25.1	27.2	27.0	25.1	28.2	+ 10
18007	Tiverton	34.7	34.7	33.2	28.1	31.8	28.9	34.3	32.6	31.4	33.8	- 3
26060	Kitchener	25.7	27.3	28.1	24.8	28.0	26.6	28.6	28.1	27.0	29.4	+ 9
27067	St. Catharines	21.2	24.1	25.3	23.6	26.3	26.2	28.1	27.5	25.6	28.3	+ 24
28028	Guelph	28.6	28.4	24.4	25.9	28.6	26.8	28.1	27.9	27.3	30.7	+ 7
29000	Hamilton Downtown	18.8	20.4	21.7	20.1	23.2	23.2	24.8	25.1	24.3	26.9	+ 37
29114	Hamilton Mountain	24.2	27.7	28.4	24.6	28.2	27.5	29.2	29.0	27.2	29.7	+ 13
29118	Hamilton West	18.6	20.5	22.0	19.2	21.2	20.9	23.0	23.3	21.8	24.5	+ 23
31103	Toronto Downtown	22.0	24.0	23.6	22.8	24.5	22.6	25.7	26.0	24.6	26.1	+ 14
33003	Toronto East	21.7	21.0	21.8	19.9	22.4	22.0	23.2	21.6	22.1	23.0	+ 7
34020	Toronto North	23.4	25.1	23.6	22.5	24.5	23.3	24.5	22.7	22.1	24.8	+ 2
35125	Toronto West	-	-	18.7	17.6	20.3	19.0	21.1	20.7	19.5	20.6	+ 12
44008	Burlington	24.6	26.3	22.8	21.0	23.9	23.4	24.6	24.9	24.1	26.6	+ 5
44017	Oakville	22.9	25.1	INS	24.6	27.7	26.1	27.5	27.0	25.5	28.0	+ 15
45026	Oshawa	23.4	23.2	24.1	23.3	28.6	25.1	28.0	27.0	25.5	28.0	+ 19
46108	Mississauga	22.4	23.1	24.8	20.7	23.1	22.4	23.3	24.6	24.0	25.9	+ 11
49010	Dorset	31.0	32.4	30.1	28.8	32.3	28.9	29.9	29.3	27.7	28.6	- 10
51001	Ottawa Downtown	25.0	24.9	24.7	21.7	23.3	23.6	24.7	23.3	23.4	25.7	0
56051	Cornwall	29.0	24.8	25.9	23.8	27.7	27.5	28.3	26.6	25.5	27.9	+ 2
59006	Peterborough	30.7	30.5	29.7	27.1	31.2	24.9	27.6	28.2	27.7	30.5	- 6
63203	Thunder Bay	24.4	23.4	26.1	22.0	22.3	23.5	24.2	23.0	24.2	25.7	+ 2
71078	Sault Ste. Marie	25.2	24.2	26.8	27.0	30.2	29.1	29.7	28.9	27.8	28.4	+ 15
75010	North Bay	26.6	26.8	27.0	25.2	28.0	26.7	27.1	27.7	26.1	28.0	+ 3
77219	Sudbury	29.1	29.2	28.5	27.7	31.0	28.4	28.1	27.9	25.9	28.7	+ 6

Notes:
INS indicates there was insufficient data in the 2nd and/or 3rd quarter to calculate a valid annual mean.
Station 44017 replaced station 44015 as the Oakville site in 2003.
Station 45026 replaced station 45025 as the Oshawa site in 2005.
Station 46108 replaced station 46109 as the Mississauga site in 2009.
Station 46109 replaced station 46110 as the Mississauga site in 2004.
Station 63203 replaced station 63200 as the Thunder Bay site in 2004.
Station 71078 replaced station 71068 as the Sault Ste. Marie site in 2004.
Station 77219 replaced station 77203 as the Sudbury site in 2004.

Table B2
10-Year Trend for $PM_{2.5}$

Annual Mean ($\mu g/m^3$)

ID	City/Town	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Per cent Change Over Time
12008	Windsor Downtown	-	-	8.5	8.6	10.4	8.2	9.5	8.3	7.2	7.7	- 16
12016	Windsor West	-	-	9.6	9.5	10.5	9.2	9.8	8.9	7.4	7.8	- 22
13001	Chatham	-	-	n/a	INS	9.1	7.4	7.9	7.3	6.3	6.5	- 28
14064	Sarnia	-	-	11.9	12.2	12.9	11.3	12.2	11.4	9.8	10.4	- 17
15020	Grand Bend	-	-	INS	7.0	7.4	6.5	6.7	6.8	5.8	6.1	- 17
15025	London	-	-	7.9	7.8	8.8	6.9	6.5	6.8	5.7	INS	- 28
16015	Port Stanley	-	-	8.0	7.5	8.6	7.3	7.2	6.7	5.6	5.9	- 29
18007	Tiverton	-	-	6.5	5.8	6.6	5.6	5.6	5.0	4.0	4.5	- 34
21005	Brantford	-	-	INS	7.5	8.9	7.6	7.7	6.8	5.8	6.5	- 25
26060	Kitchener	-	-	8.1	8.1	9.5	7.7	8.0	7.1	5.8	6.3	- 29
27067	St. Catharines	-	-	7.8	7.3	8.6	7.9	8.2	7.4	6.0	6.5	- 20
28028	Guelph	-	-	7.3	7.8	8.8	7.0	7.5	6.5	5.6	5.7	- 29
29000	Hamilton Downtown	-	-	10.6	8.9	10.0	9.1	8.9	8.3	6.8	7.7	- 29
29114	Hamilton Mountain	-	-	9.6	9.3	9.8	8.1	7.8	7.3	6.3	6.2	- 39
29118	Hamilton West	-	-	INS	8.4	9.6	8.2	8.3	7.6	6.1	6.8	- 29
31103	Toronto Downtown	-	-	8.4	7.1	8.5	7.3	7.3	6.6	5.6	6.0	- 30
33003	Toronto East	-	-	8.8	7.4	8.4	7.6	7.8	6.7	5.9	6.7	- 27
34020	Toronto North	-	-	8.3	7.7	9.4	7.6	7.8	7.3	5.9	6.2	- 29
35125	Toronto West	-	-	9.8	9.8	10.0	8.2	8.4	7.5	6.1	6.5	- 39
44008	Burlington	-	-	8.6	7.9	9.1	7.6	7.3	6.9	5.9	6.2	- 32
44017	Oakville	-	-	INS	8.1	8.9	7.4	7.6	6.7	5.3	5.7	- 33
45026	Oshawa	-	-	INS	INS	8.1	6.8	6.8	6.3	5.2	5.6	- 32
46089	Brampton	-	-	8.2	7.7	8.9	7.2	7.4	6.8	5.6	5.8	- 32
47045	Barrie	-	-	7.5	6.9	8.1	6.7	6.9	6.1	5.2	5.4	- 31
48006	Newmarket	-	-	7.3	6.4	7.7	6.4	6.6	6.0	5.1	5.6	- 27
49005	Parry Sound	-	-	INS	5.3	6.1	5.3	5.5	4.7	3.9	4.4	- 28
49010	Dorset	-	-	5.9	4.7	5.8	4.5	5.0	4.5	3.6	4.0	- 33
51001	Ottawa Downtown	-	-	7.2	6.5	7.7	6.1	6.0	5.3	4.6	4.5	- 40
54012	Belleville	-	-	6.9	6.4	7.0	6.2	6.2	6.1	4.9	INS	- 22
56010	Morrisburg	-	-	INS	6.2	7.0	6.8	6.2	5.7	5.0	5.3	- 24
56051	Cornwall	-	-	INS	6.8	7.6	6.5	6.4	6.1	5.4	5.7	- 25
59006	Peterborough	-	-	6.7	5.9	7.5	6.3	6.4	6.0	4.9	5.1	- 25
63203	Thunder Bay	-	-	n/a	4.2	4.4	4.8	4.4	4.2	3.8	4.1	- 10
71078	Sault Ste Marie	-	-	INS	4.5	5.4	5.2	5.3	4.4	4.0	4.1	- 21
75010	North Bay	-	-	5.5	4.5	5.6	4.9	5.0	4.6	3.8	3.8	- 27
77219	Sudbury	-	-	n/a	INS	5.1	4.6	4.9	4.1	3.4	3.6	- 33

Notes:
Ontario standardized the $PM_{2.5}$ monitoring method in 2003; therefore, data are reported from 2003 for consistency.
n/a indicates pollutant not monitored.
INS indicates there was insufficient data in any one quarter to calculate a valid annual mean.

Table B3
10-Year Trend for NO

Annual Mean (ppb)

ID	City/Town	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Per cent Change Over Time
12008	Windsor Downtown	11.0	10.9	INS	10.5	7.8	7.2	6.4	5.9	5.6	4.7	- 60
14064	Sarnia	6.7	7.1	5.0	3.7	3.8	3.7	3.2	3.2	2.8	2.2	- 69
15025	London	6.6	INS	INS	6.0	5.5	4.4	3.6	3.1	2.8	2.9	- 63
26060	Kitchener	5.7	3.8	INS	4.9	4.4	3.5	2.7	2.5	2.1	2.5	- 60
29000	Hamilton Downtown	11.5	10.4	11.7	9.6	9.9	8.0	7.7	6.5	5.8	5.0	- 56
31103	Toronto Downtown	10.0	8.2	8.7	7.6	7.2	6.9	5.9	5.0	5.1	4.1	- 57
33003	Toronto East	17.9	16.1	17.0	16.0	14.4	12.5	10.8	9.2	7.8	7.8	- 61
34020	Toronto North	14.3	12.4	12.4	INS	10.8	10.0	8.3	7.7	7.1	5.7	- 57
35125	Toronto West	-	-	30.2	26.6	26.1	20.1	17.5	16.2	13.5	13.4	- 61
44008	Burlington	13.2	11.8	15.5	11.1	12.3	9.8	8.8	6.5	5.9	5.0	- 63
44017	Oakville	11.9	INS	INS	5.3	5.2	4.3	3.9	4.0	3.5	3.6	- 77
45026	Oshawa	13.7	10.0	9.3	8.2	INS	3.8	3.2	3.2	3.0	2.3	- 93
51001	Ottawa Downtown	7.3	INS	5.8	3.2	3.3	3.0	3.4	2.7	2.4	1.6	- 77

Note:
INS indicates there was insufficient data to calculate a valid annual mean.
Station 44017 replaced station 44015 as the Oakville site in 2003.
Station 45026 replaced station 45025 as the Oshawa site in 2005.

Table B4
10-Year Trend for NO_2

Annual Mean (ppb)

ID	City/Town	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Per cent Change Over Time
12008	Windsor Downtown	19.4	19.1	INS	18.3	16.9	17.2	17.2	15.2	14.4	15.6	- 24
14064	Sarnia	16.8	17.5	13.0	11.7	12.7	11.0	11.3	10.8	8.2	8.0	- 53
15025	London	17.3	INS	INS	13.7	14.1	12.3	11.7	10.8	9.0	8.8	- 50
26060	Kitchener	14.1	11.9	INS	13.1	12.9	10.8	9.7	9.0	8.6	7.7	- 44
29000	Hamilton Downtown	22.5	20.9	21.3	16.8	19.3	17.0	17.0	14.7	13.6	12.7	- 43
31103	Toronto Downtown	27.1	23.3	23.2	20.0	20.7	19.1	18.2	17.0	16.5	16.1	- 40
33003	Toronto East	22.9	22.0	21.3	19.8	20.1	17.4	17.2	16.5	14.9	14.8	- 37
34020	Toronto North	22.0	21.0	20.4	INS	19.2	17.4	16.7	16.5	15.8	14.3	- 34
35125	Toronto West	-	-	26.2	24.8	26.6	22.3	22.1	20.8	19.0	20.1	- 28
44008	Burlington	16.5	17.9	17.3	15.3	17.2	16.2	16.0	13.6	12.5	12.2	- 28
44017	Oakville	16.2	INS	INS	13.5	14.5	12.4	13.0	12.0	11.1	9.2	- 38
45026	Oshawa	19	17.2	16.2	14.15	INS	8.9	8.1	8.5	7.4	7.2	- 70
51001	Ottawa Downtown	14.3	INS	13.7	11.1	9.8	8.6	8.7	11.4	8.6	7.4	- 45

Notes:
INS indicates there was insufficient data to calculate a valid annual mean.
Station 44017 replaced station 44015 as the Oakville site in 2003.
Station 45026 replaced station 45025 as the Oshawa site in 2005.

Table B5: 10-Year Trend for NO_x

Annual Mean (ppb)

ID	City/Town	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Per cent Change Over Time
12008	Windsor Downtown	30.5	29.2	INS	29.3	24.9	24.4	23.6	21.1	20.0	20.2	- 37
14064	Sarnia	23.6	24.6	18.1	15.7	16.8	14.7	14.5	13.9	11.0	10.2	- 58
15025	London	23.1	INS	INS	19.4	19.4	16.7	15.3	13.9	11.9	11.7	- 50
26060	Kitchener	19.5	15.5	INS	18.2	17.4	14.3	12.4	11.5	10.8	10.3	- 47
29000	Hamilton Downtown	34.4	31.4	33.3	27.7	30.0	24.9	24.7	21.2	19.5	17.8	- 48
31103	Toronto Downtown	36.6	31.5	32.1	28.1	28.2	26.1	24.2	22.1	21.6	20.3	- 44
33003	Toronto East	40.3	37.7	37.9	36.3	34.7	29.9	28.0	25.7	22.7	22.6	- 47
34020	Toronto North	36.2	33.4	33.0	28.3	30.4	27.5	25.0	24.3	22.8	20.0	- 42
35125	Toronto West	-	-	56.9	51.2	52.4	42.4	39.6	37.0	32.5	33.5	- 46
44008	Burlington	29.0	28.4	32.5	26.1	29.3	26.0	24.8	20.0	18.4	17.2	- 32
44017	Oakville	27.8	INS	INS	18.3	19.5	16.7	16.9	16.1	14.6	12.8	- 51
45026	Oshawa	32.6	27.2	25.5	22.5	INS	12.7	11.3	11.7	10.4	9.5	- 79
51001	Ottawa Downtown	21.0	INS	20.1	14.7	13.7	11.5	12.0	14.0	11.0	9.0	- 55

Notes:
INS indicates there was insufficient data to calculate a valid annual mean.
Station 44017 replaced station 44015 as the Oakville site in 2003.
Station 45026 replaced station 45025 as the Oshawa site in 2005.

Table B6: 10-Year Trend for CO

1h Maximum (ppm)
CO 1-hour AAQC is 30 ppm

ID	City/Town	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Per cent Change Over Time
12008	Windsor Downtown	4.9	4.3	4.3	2.3	1.3	2.9	5.0	1.3	1.4	2.5	- 60
15025	London	3.5	2.3	2.4	2.3	2.4	1.8	1.2	1.0	1.4	1.1	- 70
29000	Hamilton Downtown	3.7	2.3	3.1	4.0	2.6	2.8	6.0	3.3	5.0	2.2	+ 24
31103	Toronto Downtown	3.2	2.9	2.4	1.9	1.6	1.5	1.7	0.9	1.1	1.5	- 70
35125	Toronto West	-	-	0.5	0.4	0.4	0.4	0.3	0.2	0.2	0.2	- 62
51001	Ottawa Downtown	2.9	2.8	2.2	2.2	2.0	1.4	1.5	1.3	1.4	1.5	- 57

Table B7: 10-Year Trend for SO_2

Annual Mean (ppb)
SO_2 1-year AAQC is 20 ppb

ID	City/Town	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Per cent Change Over Time
12008	Windsor Downtown	6.1	5.7	5.9	4.8	4.9	5.0	5.5	4.5	3.5	3.5	- 39
12016	Windsor West	9.3	7.9	6.3	4.6	5.1	4.9	5.2	4.7	3.6	3.2	- 62
14064	Sarnia	12.5	10.4	7.1	8.2	7.8	8.3	8.0	7.7	4.5	3.9	- 58
15025	London	3.5	2.2	INS	2.2	2.3	1.9	1.9	2.2	1.0	0.9	- 64
29000	Hamilton Downtown	6.0	4.9	5.0	4.0	5.3	4.8	4.2	4.3	3.3	3.3	- 39
29114	Hamilton Mountain	5.3	4.8	5.3	INS	INS	3.3	3.5	3.0	3.0	2.9	- 50
31103	Toronto Downtown	5.0	4.0	3.2	2.2	2.8	1.9	1.9	1.6	0.9	0.9	- 86
35125	Toronto West	-	-	2.9	2.7	2.3	2.0	1.5	1.4	1.2	0.9	- 70
51001	Ottawa Downtown	2.3	2.9	INS	1.0	1.5	1.1	0.9	0.9	0.9	0.2	- 86
71078	Sault Ste. Marie	2.0	1.7	2.0	0.9	1.5	1.4	1.8	1.2	0.6	0.7	- 56
77219	Sudbury	2.6	3.1	2.0	INS	2.8	2.4	2.3	2.0	1.1	1.3	- 49

Notes:
n/a indicates pollutant not monitored.
INS indicates there was insufficient data to calculate a valid annual mean.
Station 71078 replaced station 71068 as the Sault Ste. Marie site in 2004.
Station 77219 replaced station 77203 as the Sudbury site in 2004.

Appendix C 20-Year Ozone Trends (1991-2010)

Figure C1
Ozone Annual Mean at Windsor Downtown

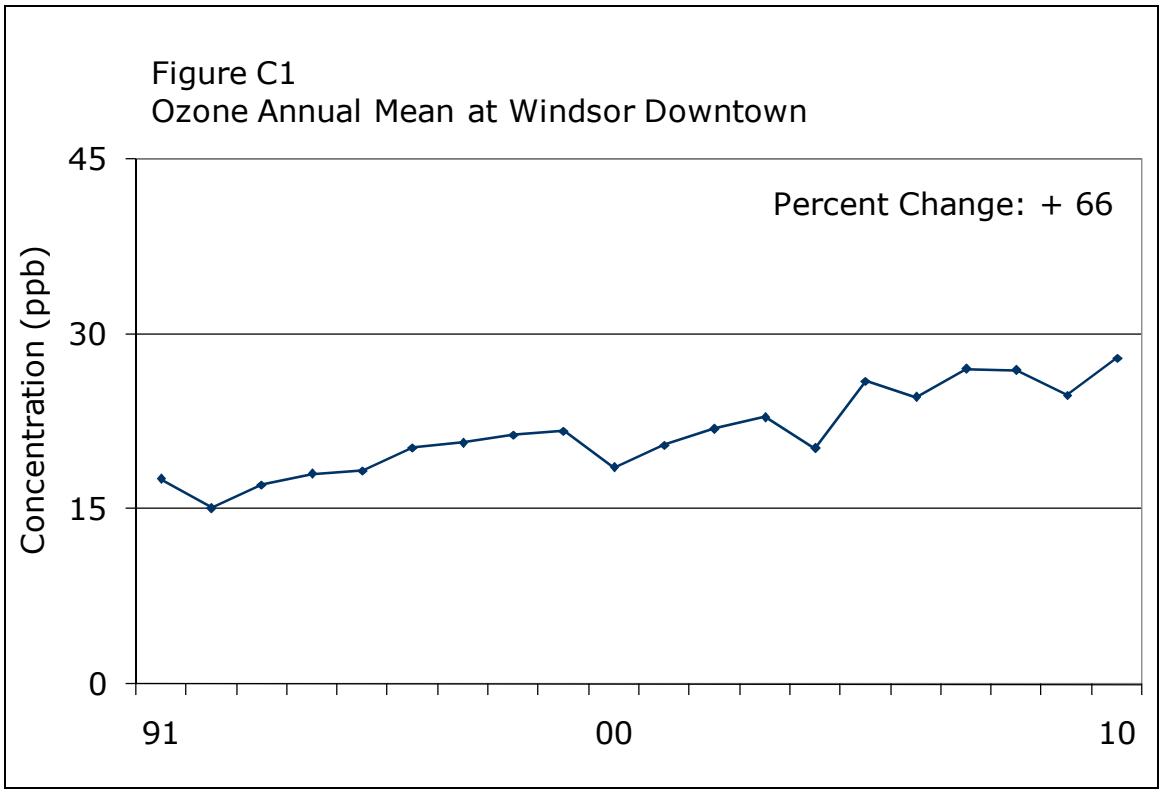


Figure C2
Ozone Annual Mean at Windsor West

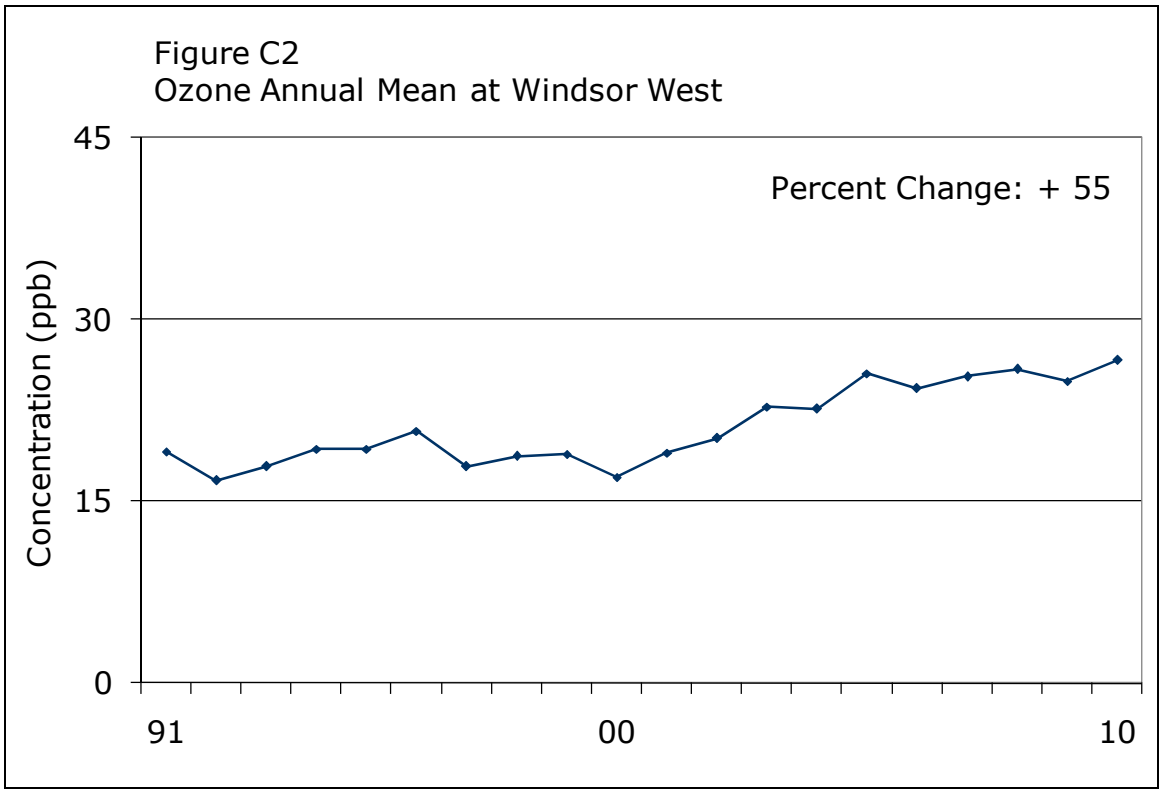


Figure C3
Ozone Annual Mean at London

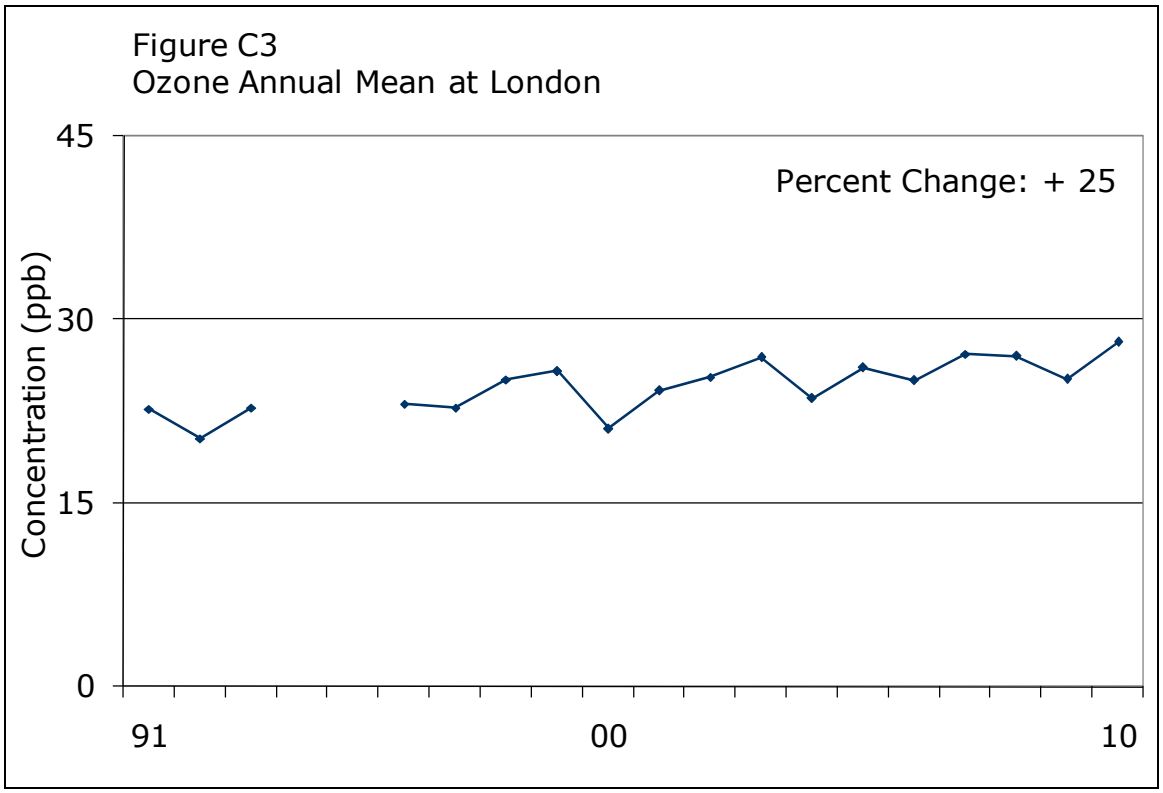


Figure C4
Ozone Annual Mean at Sarnia

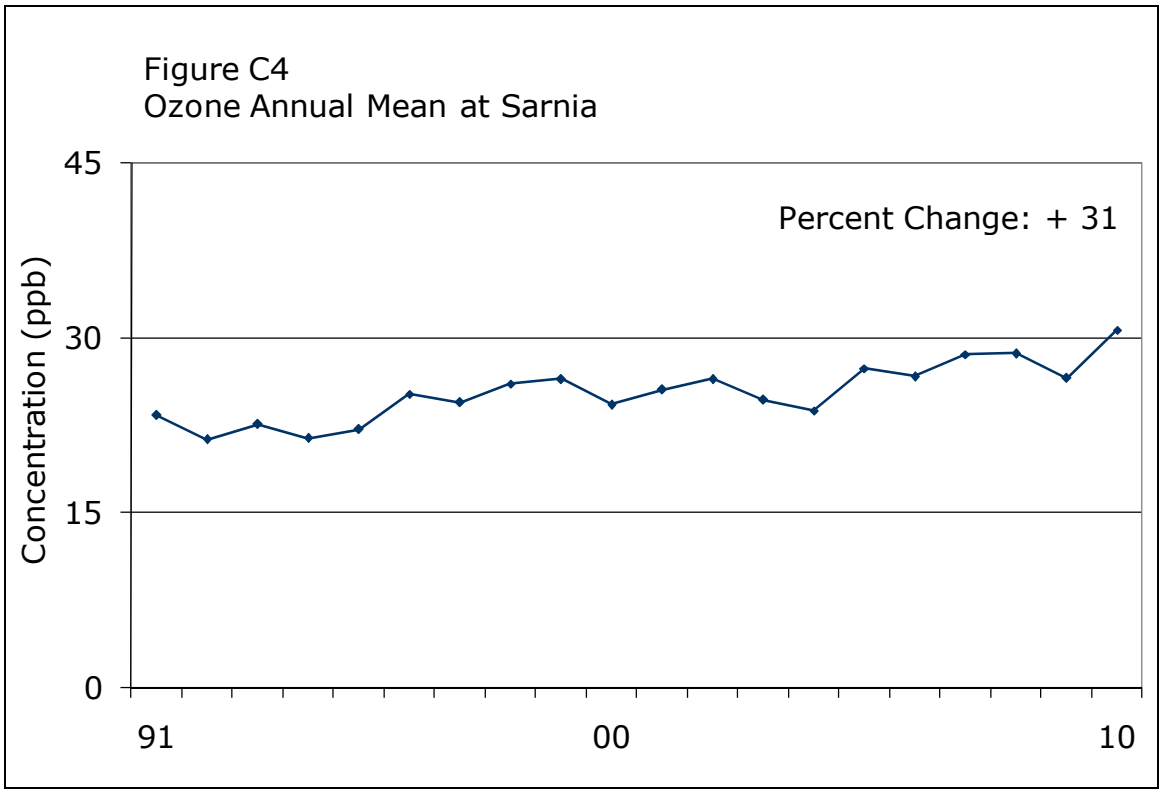


Figure C5
Ozone Annual Mean at Grand Bend

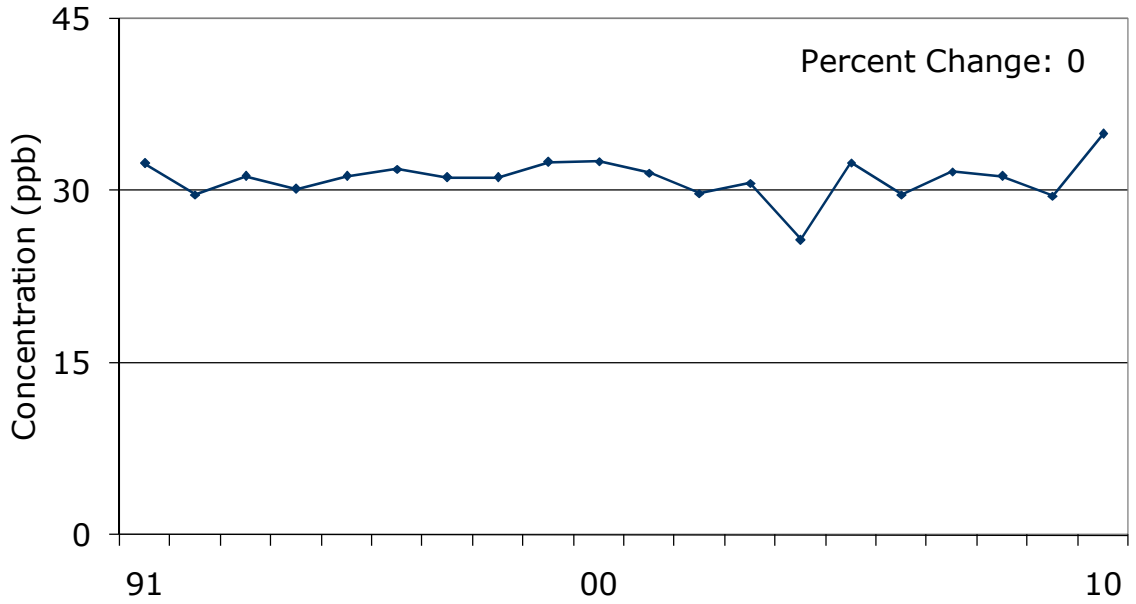


Figure C6
Ozone Annual Mean at Tiverton

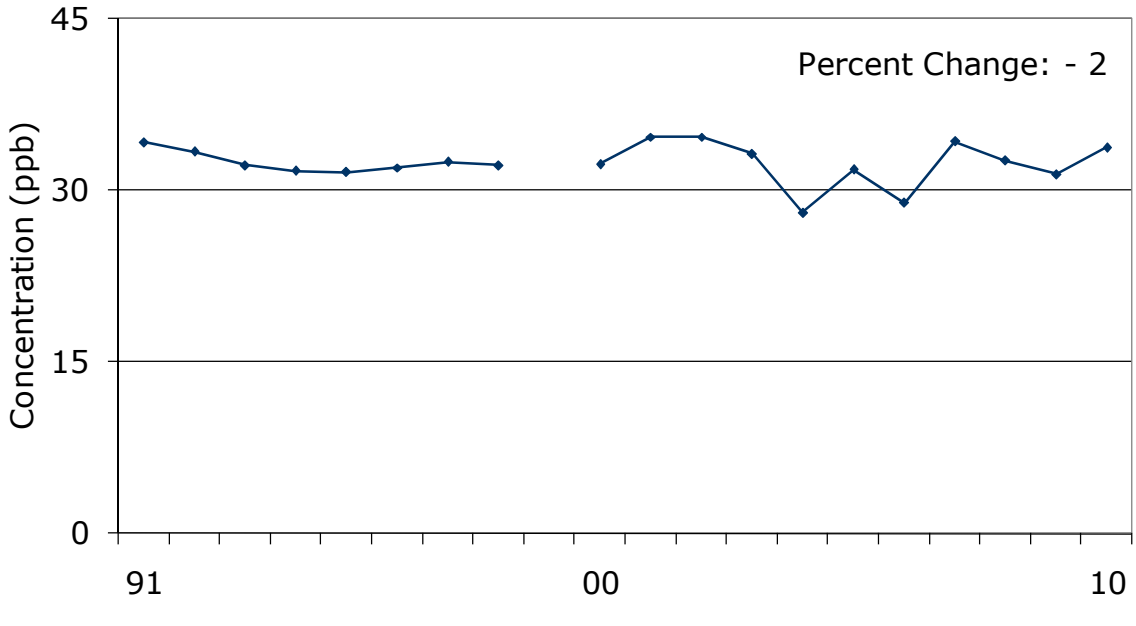


Figure C7
Ozone Annual Mean at Kitchener

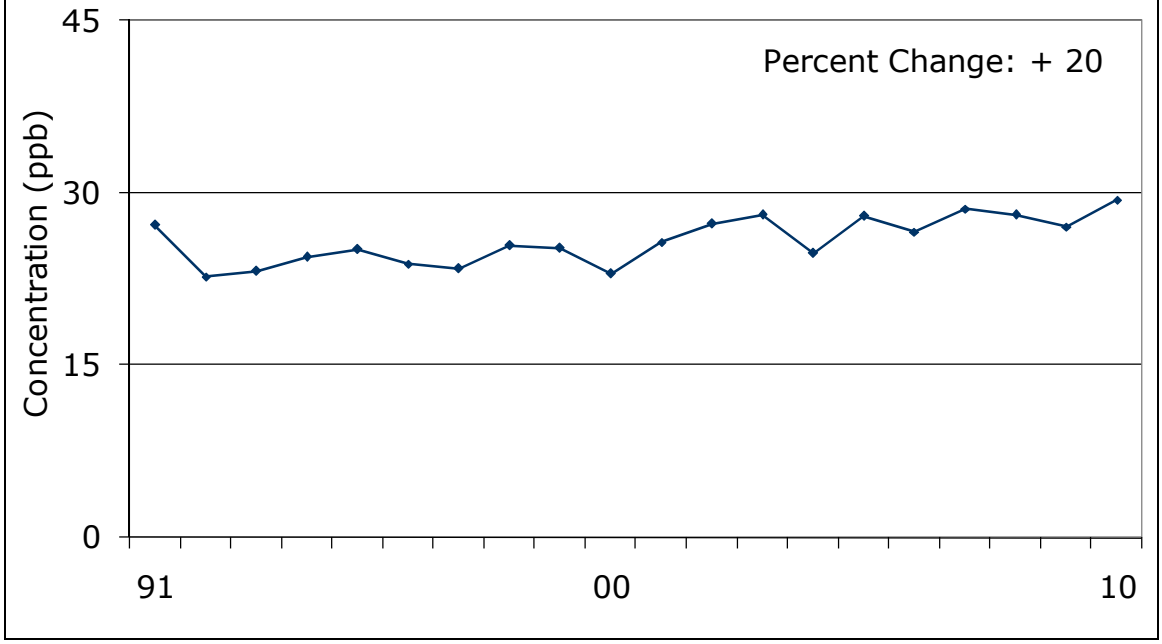


Figure C8
Ozone Annual Mean at St. Catharines

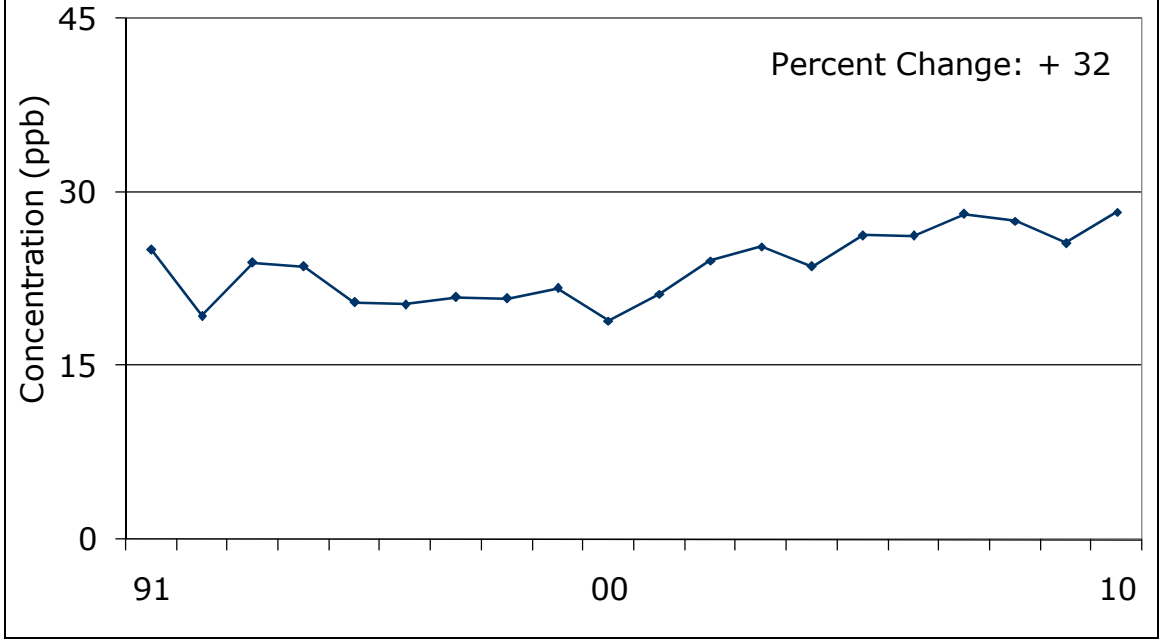


Figure C9
Ozone Annual Mean at Hamilton Mountain

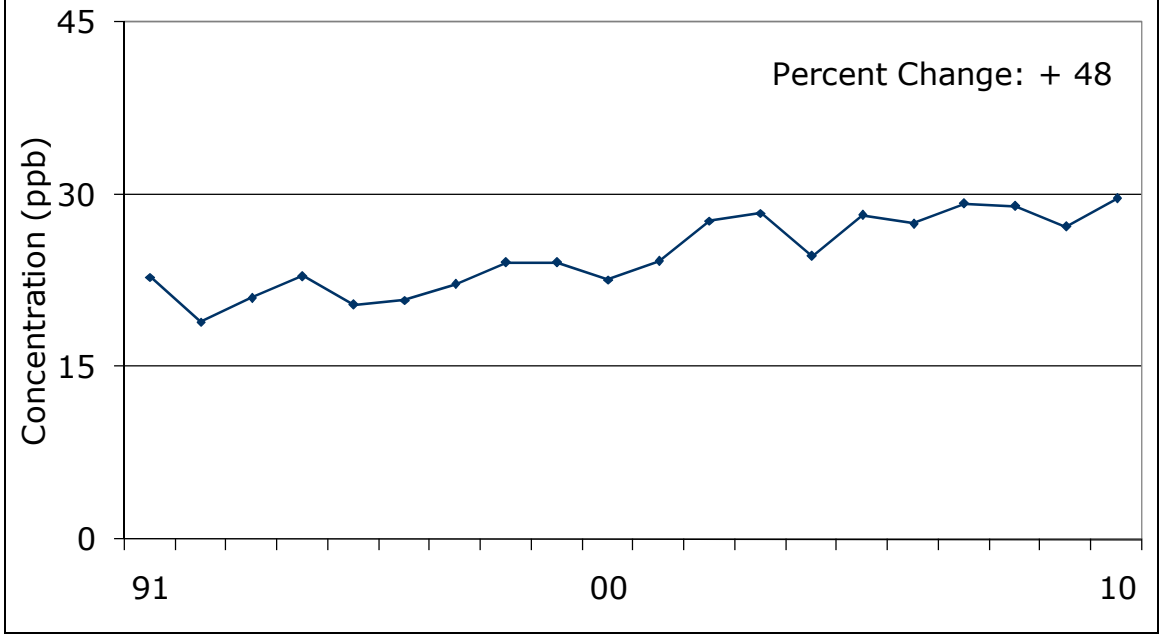


Figure C10
Ozone Annual Mean at Hamilton West

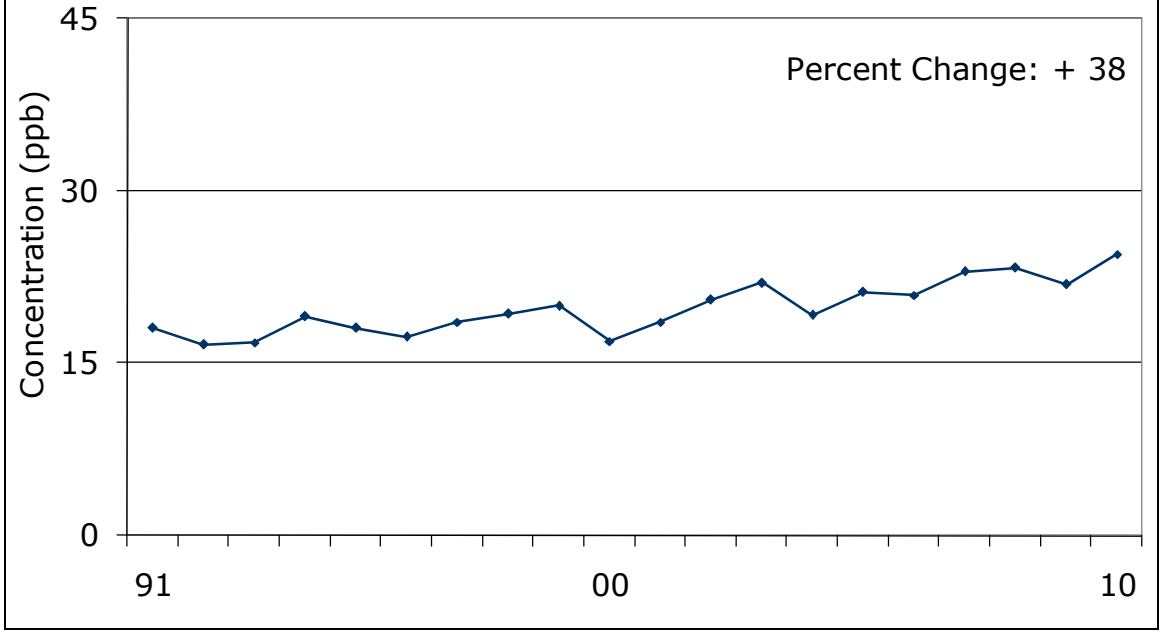


Figure C11
Ozone Annual Mean at Hamilton Downtown

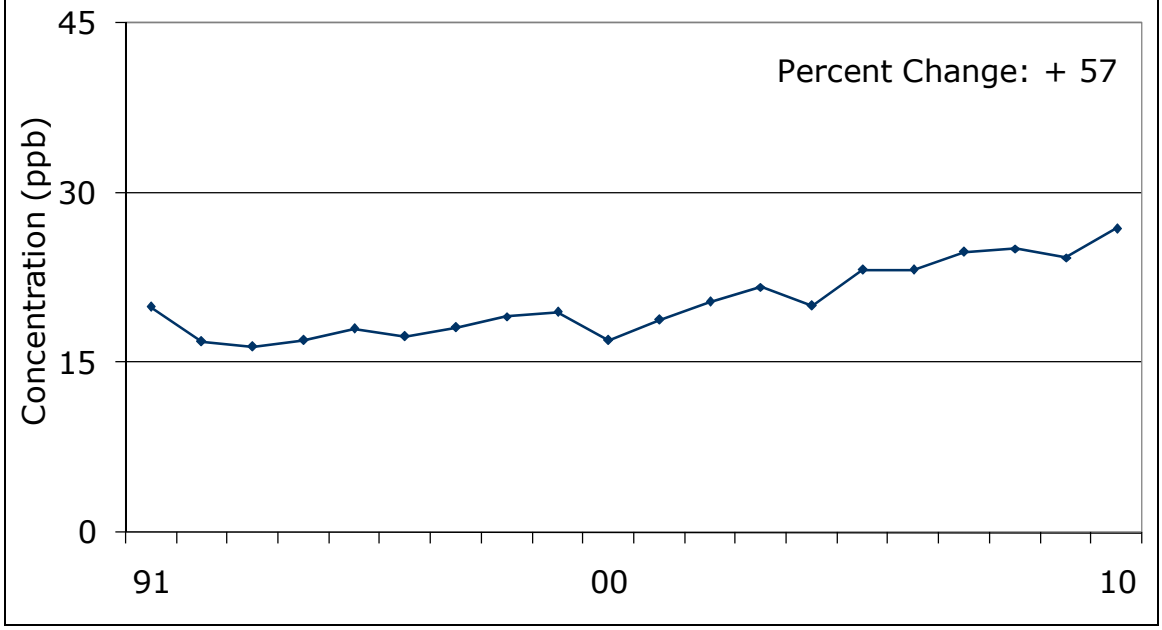


Figure C12
Ozone Annual Mean at Burlington

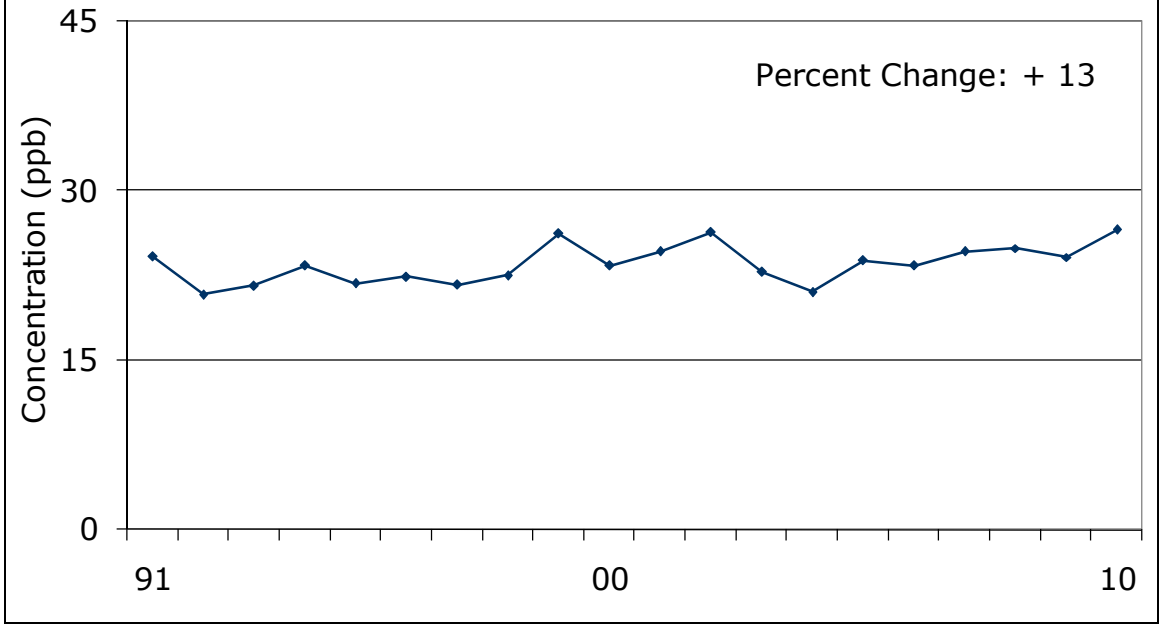


Figure C13
Ozone Annual Mean at Oakville

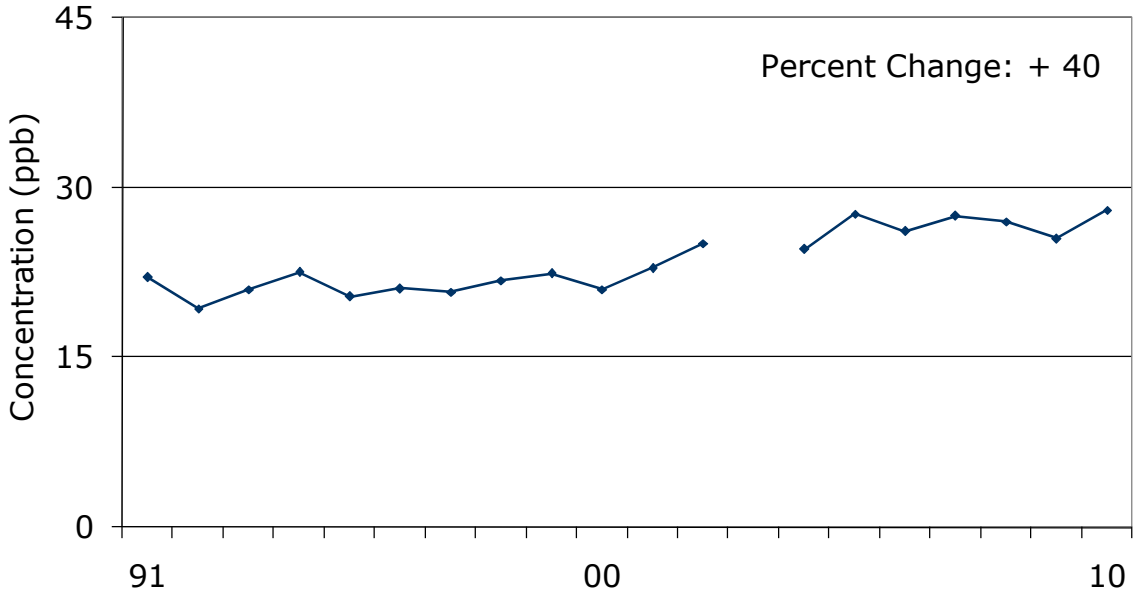


Figure C14
Ozone Annual Mean at Mississauga

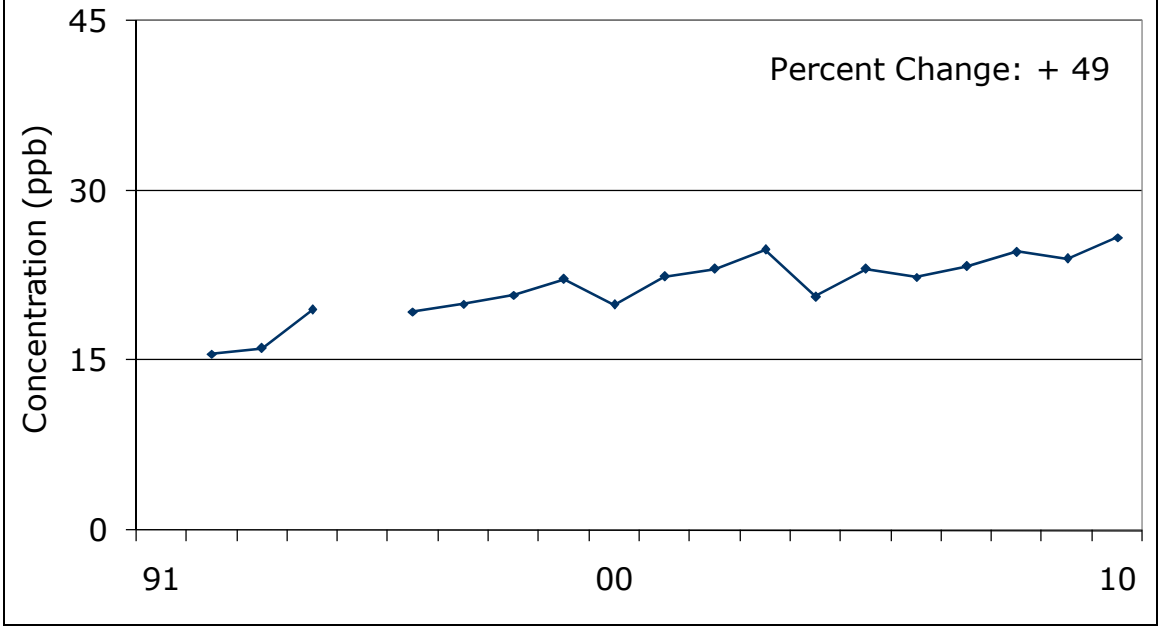


Figure C15
Ozone Annual Mean at Toronto Downtown

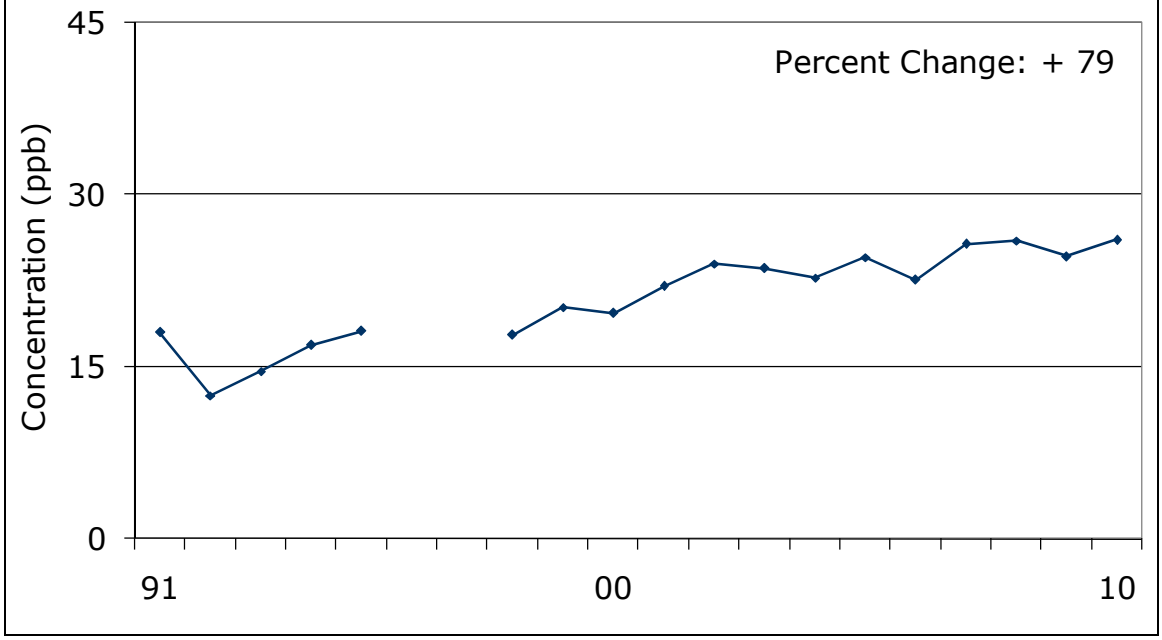


Figure C16
Ozone Annual Mean at Toronto North

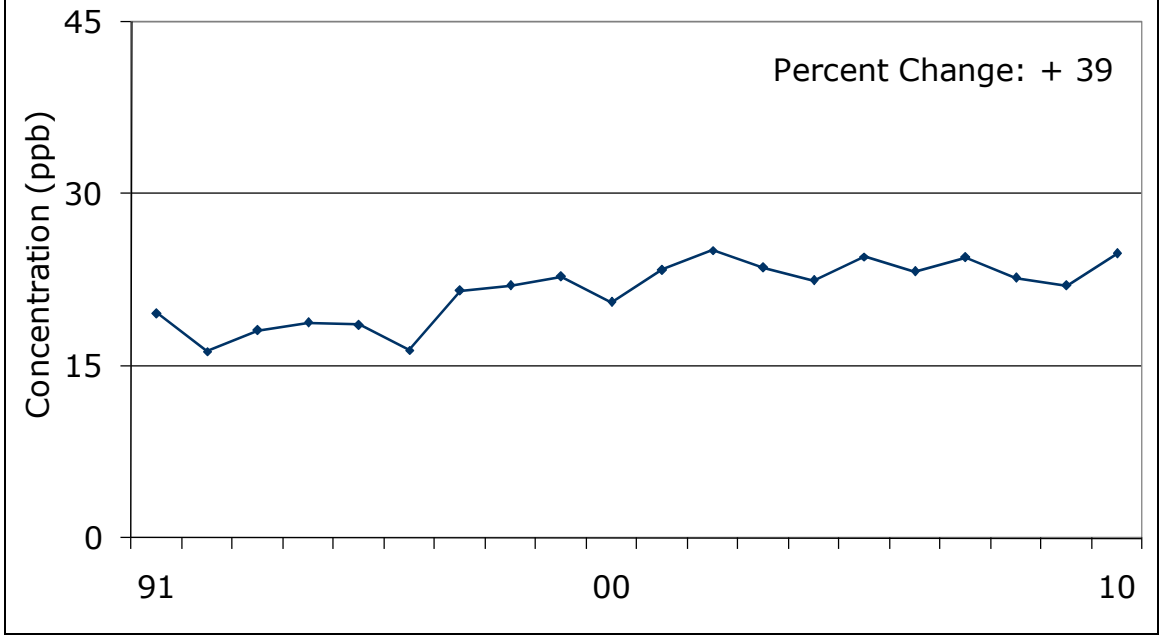


Figure C17
Ozone Annual Mean at Toronto East

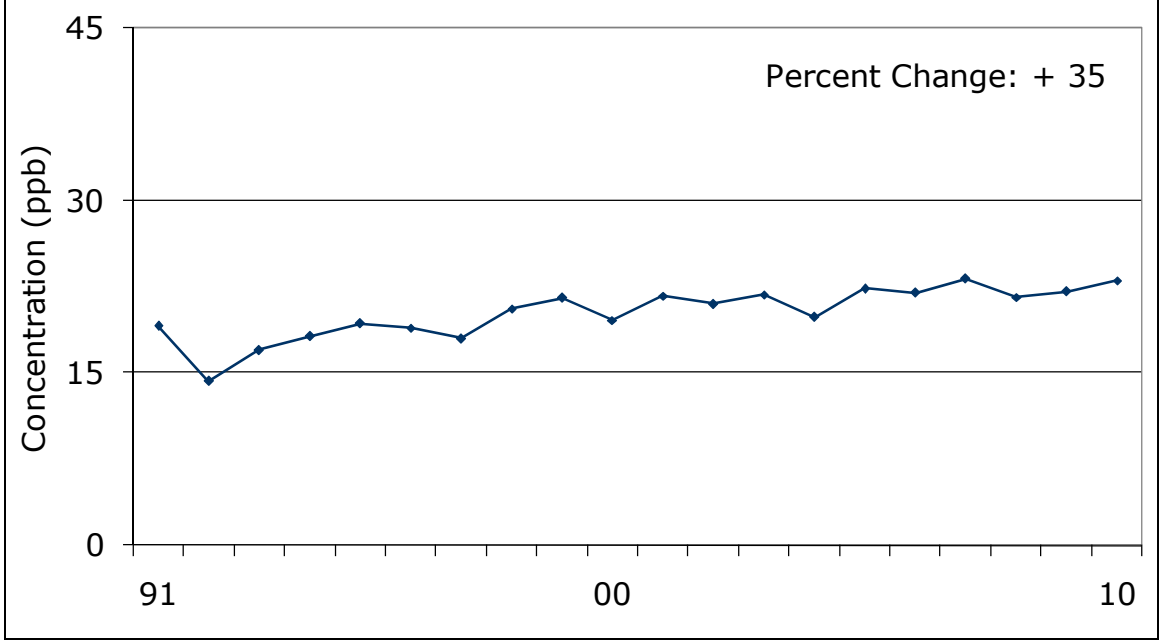


Figure C18
Ozone Annual Mean at Oshawa

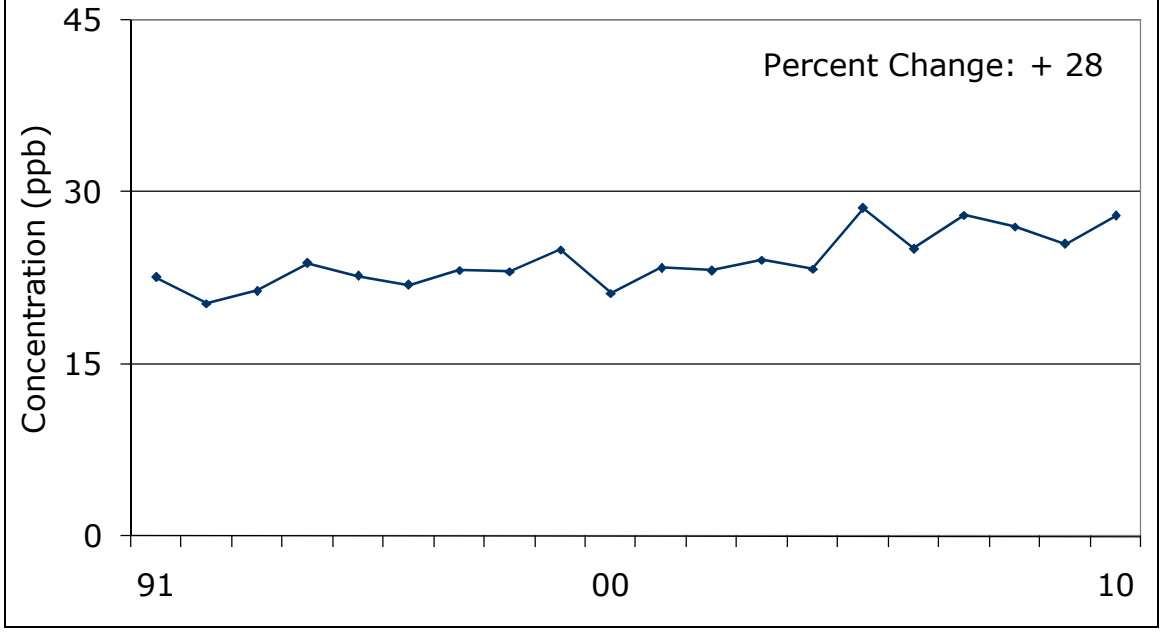


Figure C19
Ozone Annual Mean at Cornwall

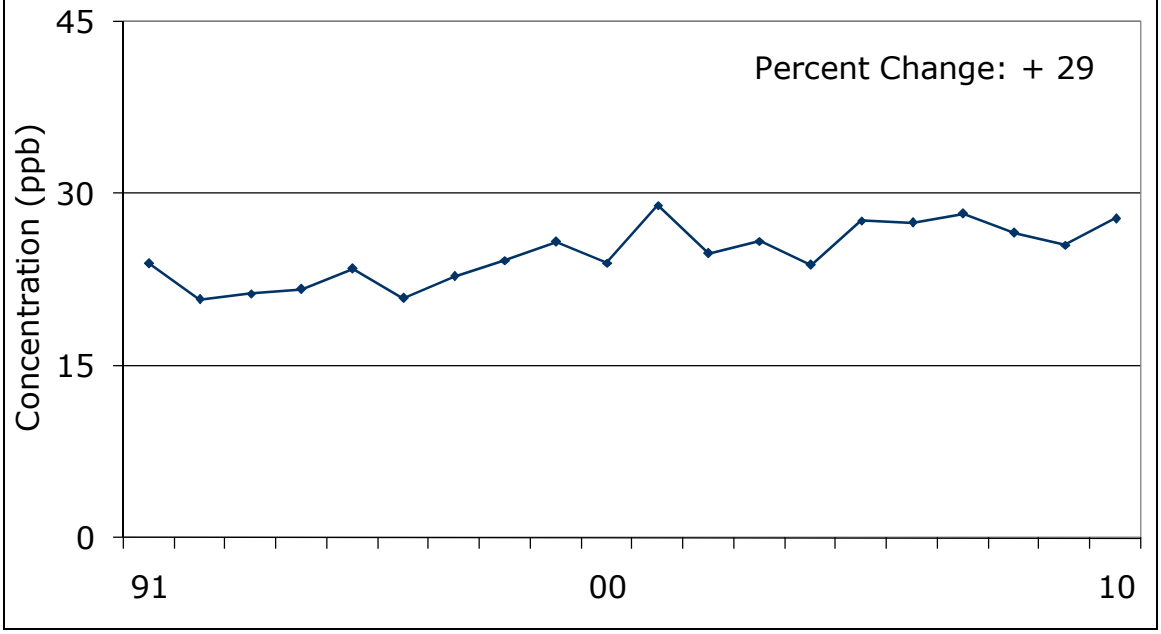


Figure C20
Ozone Annual Mean at Ottawa Downtown

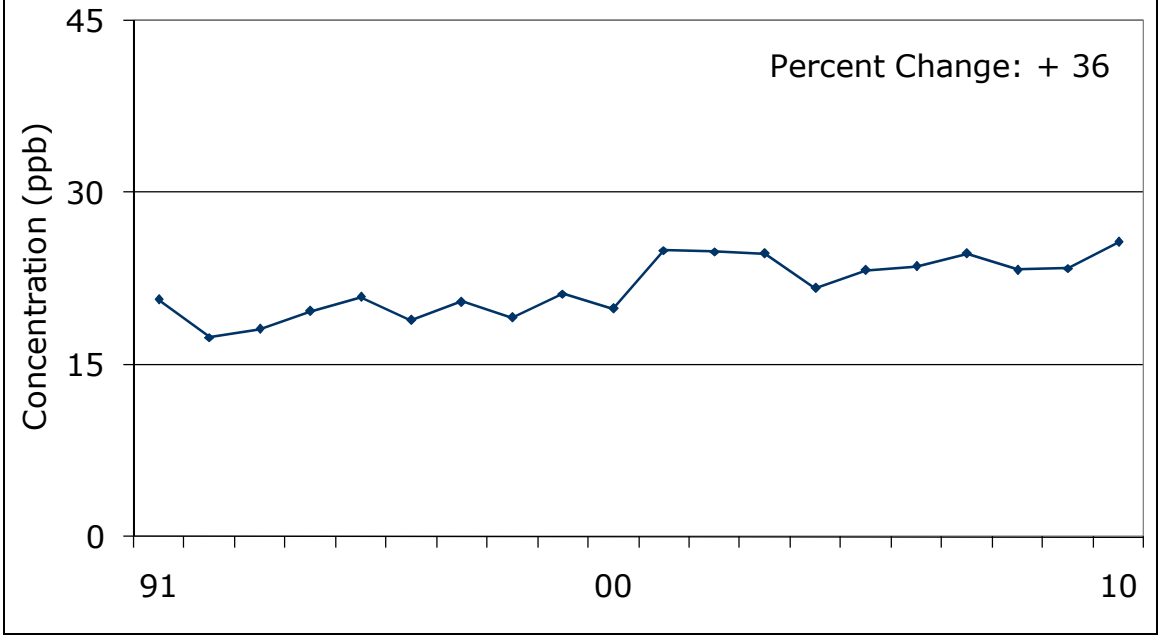


Figure C21
Ozone Annual Mean at Dorset

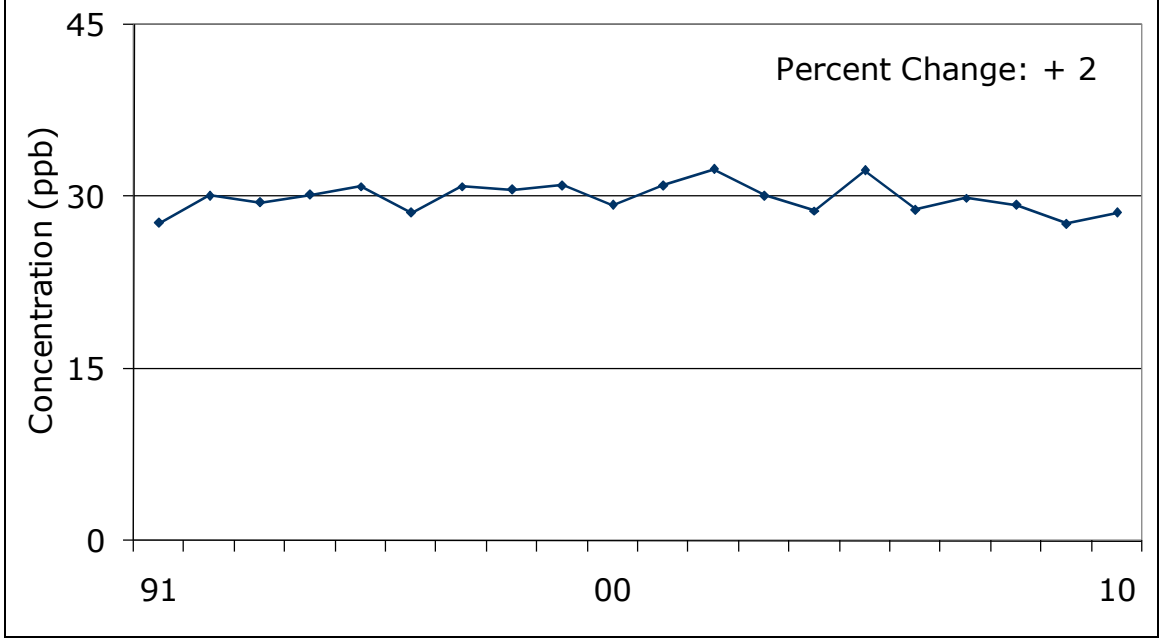


Figure C22
Ozone Annual Mean at Sudbury

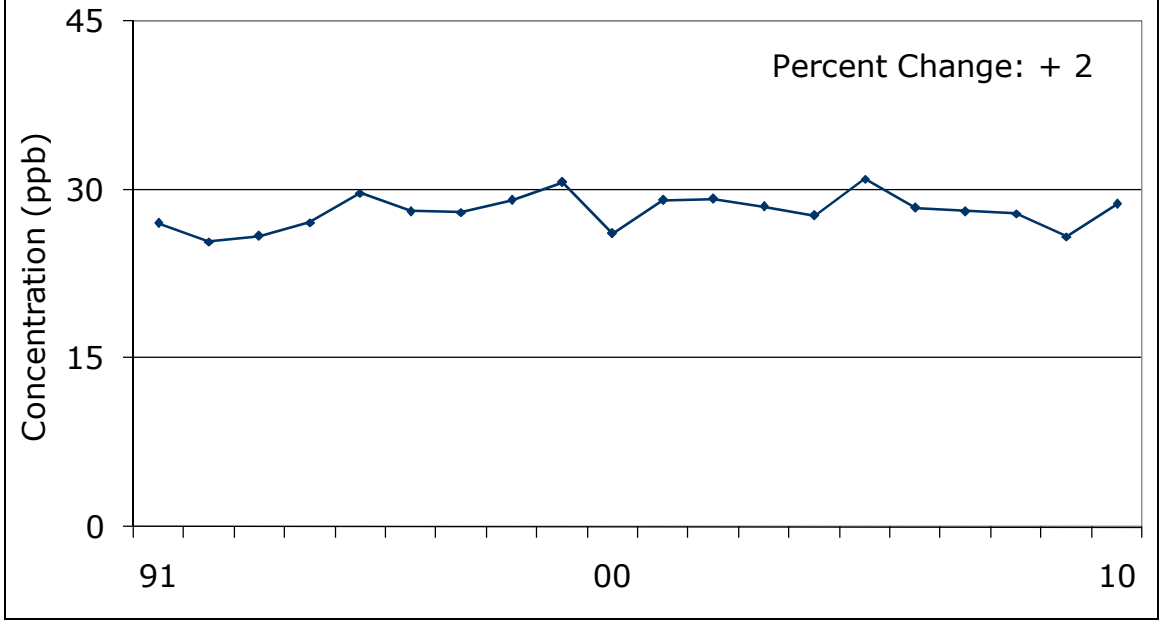


Figure C23
Ozone Annual Mean at Sault Ste. Marie

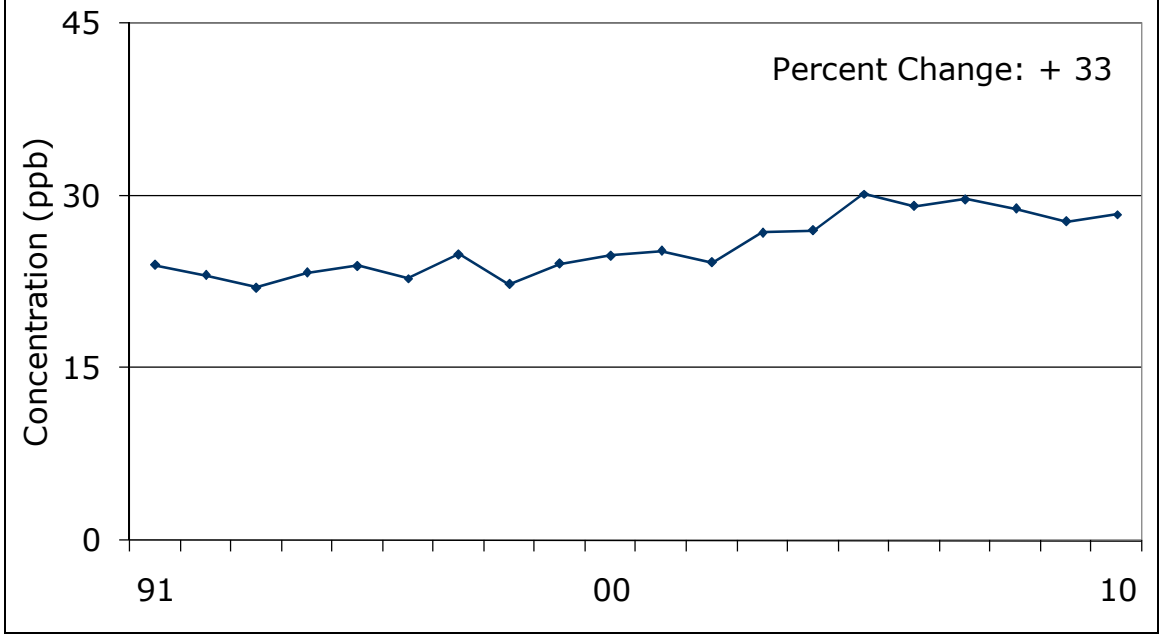
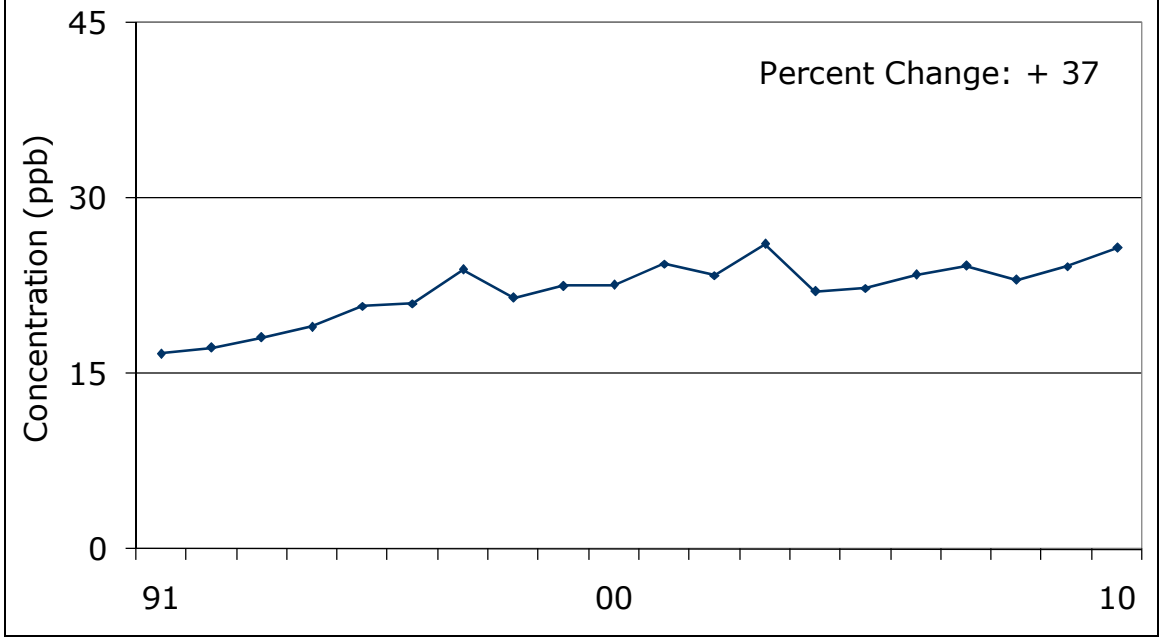


Figure C24
Ozone Annual Mean at Thunder Bay



Appendix D 20-Year NO_2 Trends (1991-2010)

Figure D1
NO_2 Annual Mean at Windsor Downtown

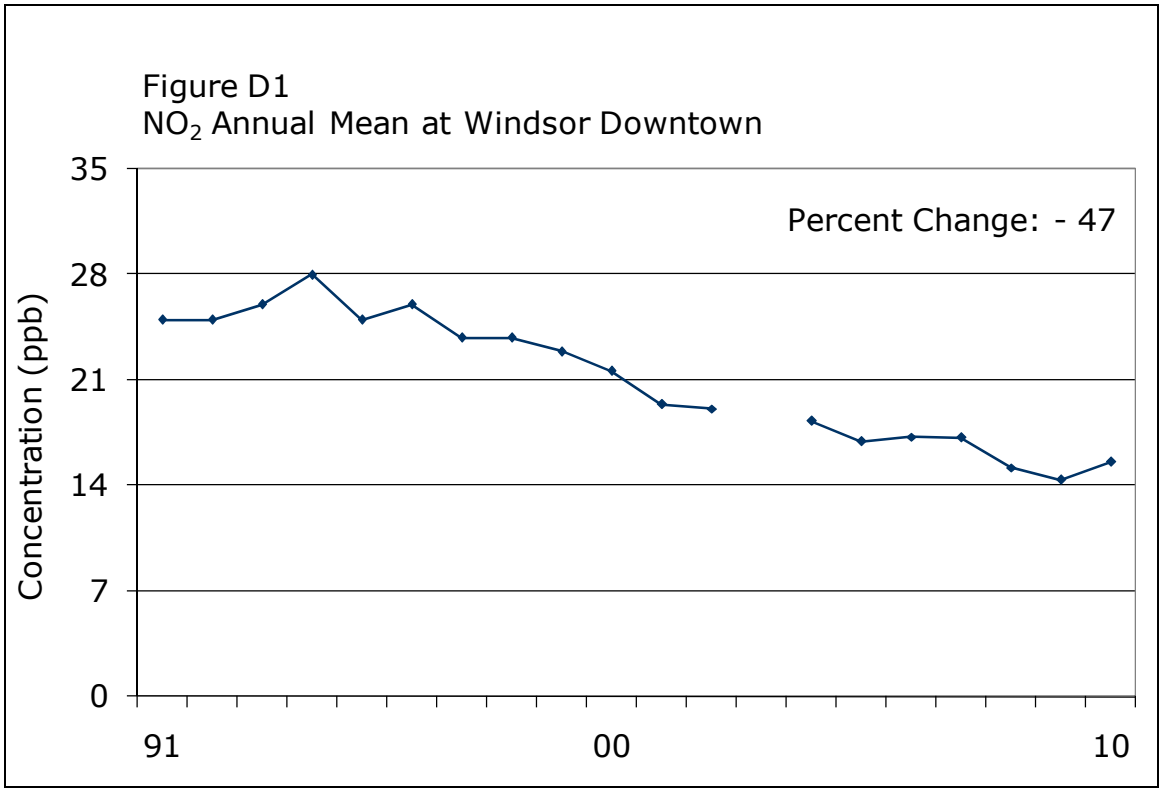


Figure D2
NO_2 Annual Mean at London

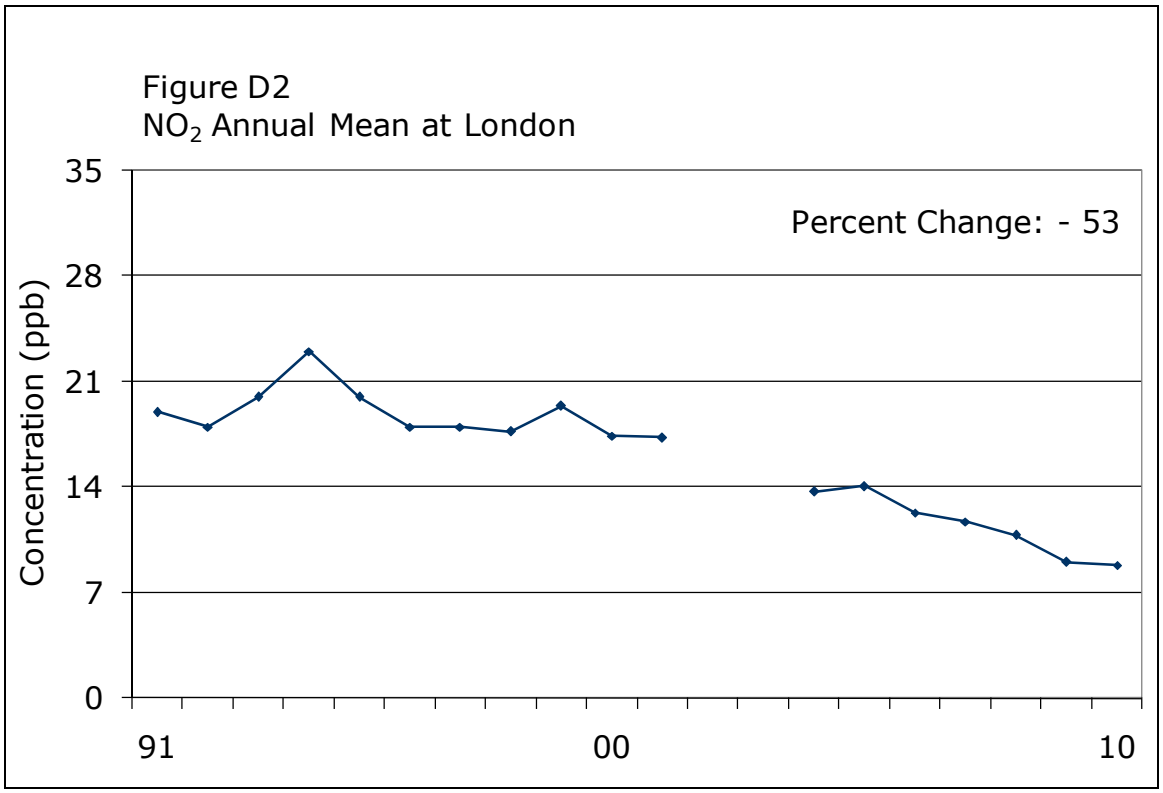


Figure D3
NO_2 Annual Mean at Sarnia

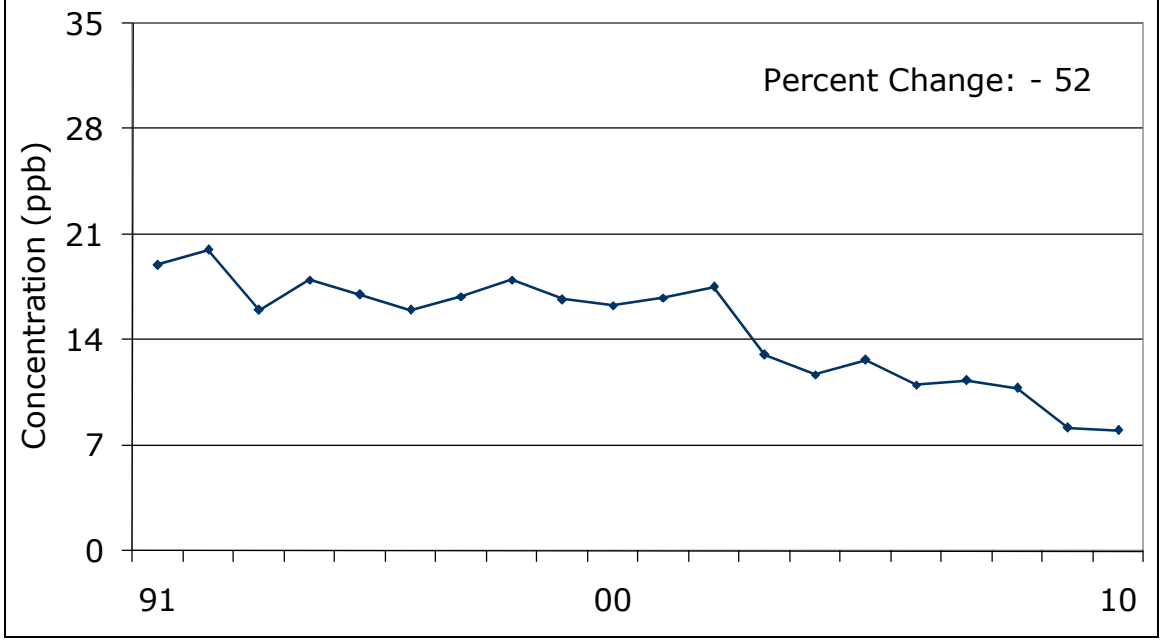


Figure D4
NO_2 Annual Mean at Kitchener

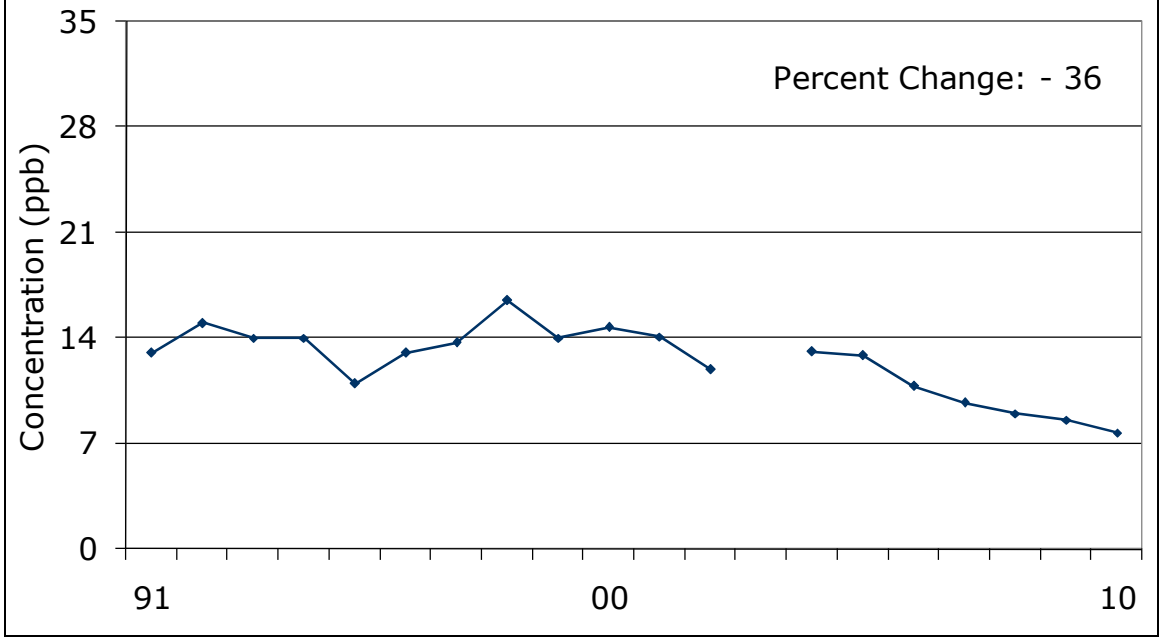


Figure D5
NO_2 Annual Mean at Hamilton Downtown

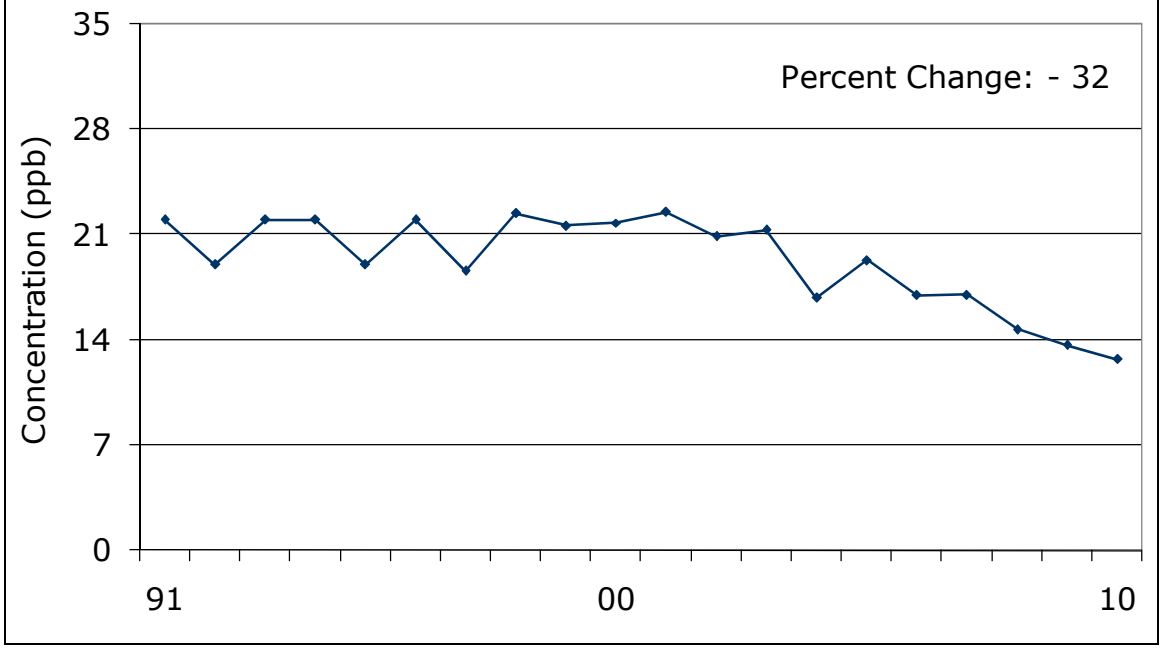


Figure D6
NO_2 Annual Mean at Burlington

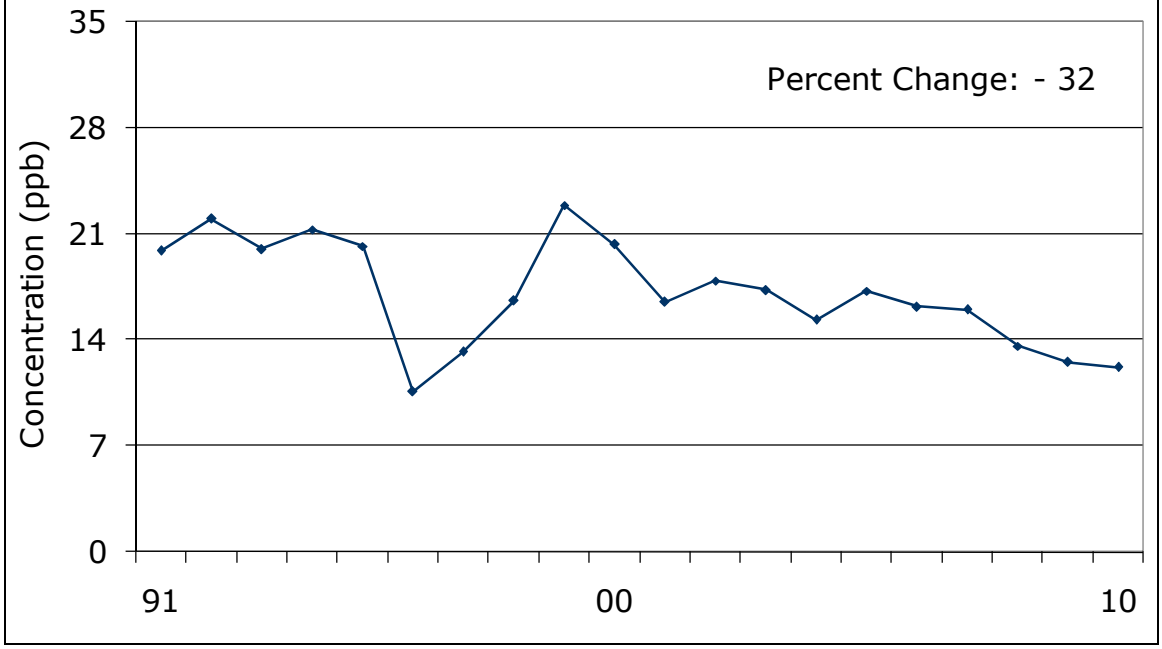


Figure D7
NO_2 Annual Mean at Oakville

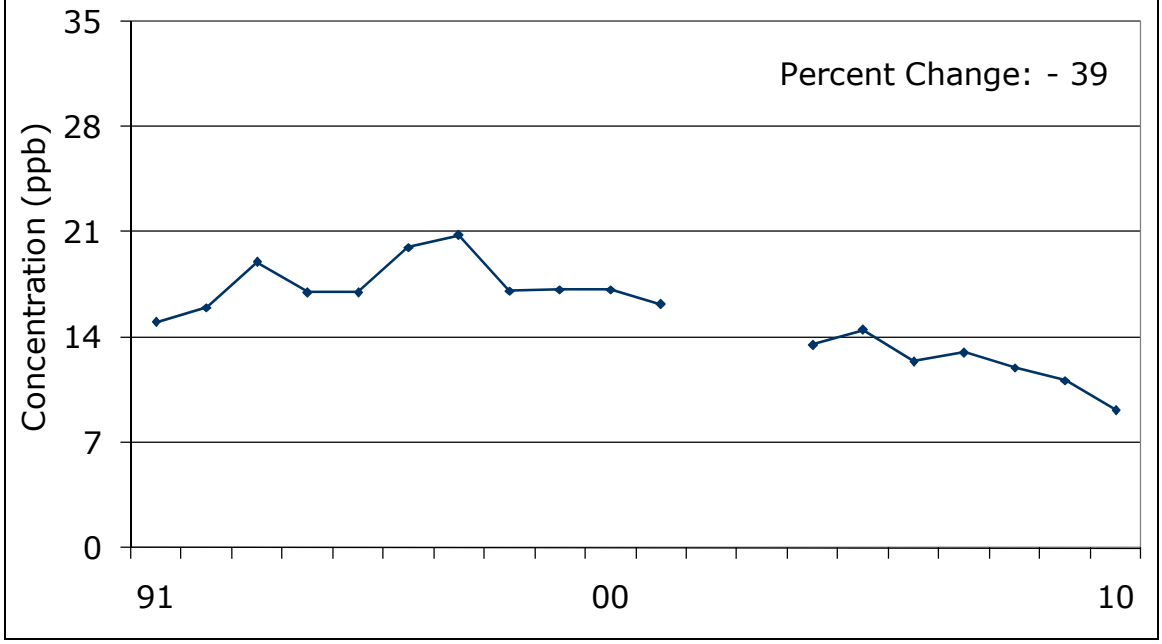


Figure D8
NO_2 Annual Mean at Toronto Downtown

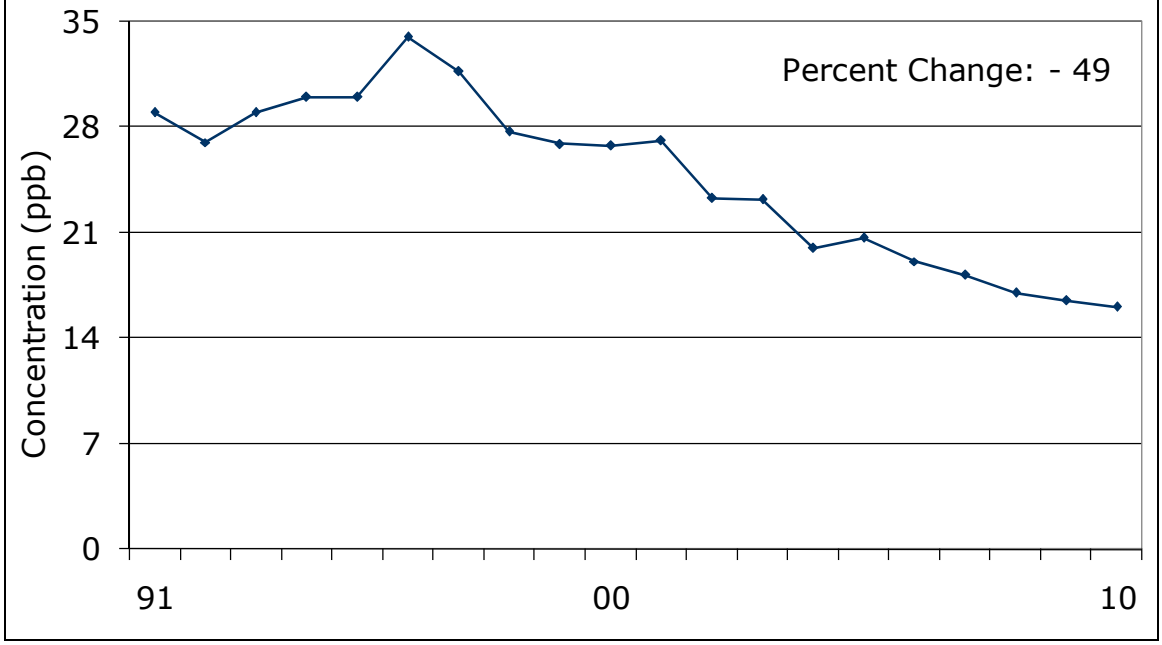


Figure D9
NO_2 Annual Mean at Toronto North

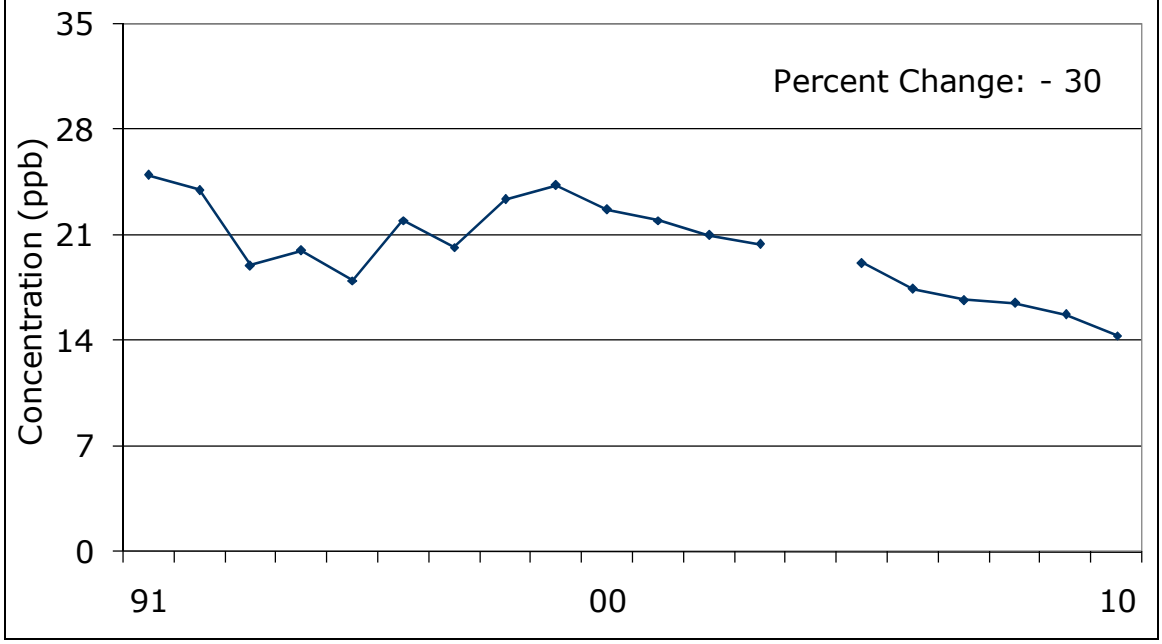


Figure D10
NO_2 Annual Mean at Toronto East

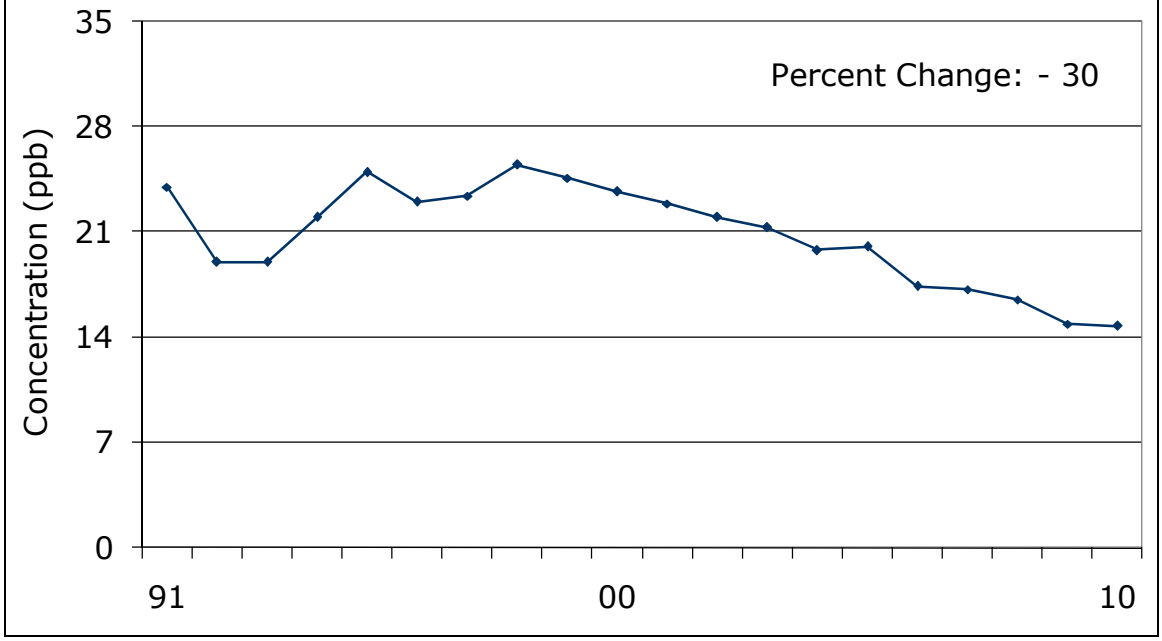


Figure D11
NO_2 Annual Mean at Oshawa

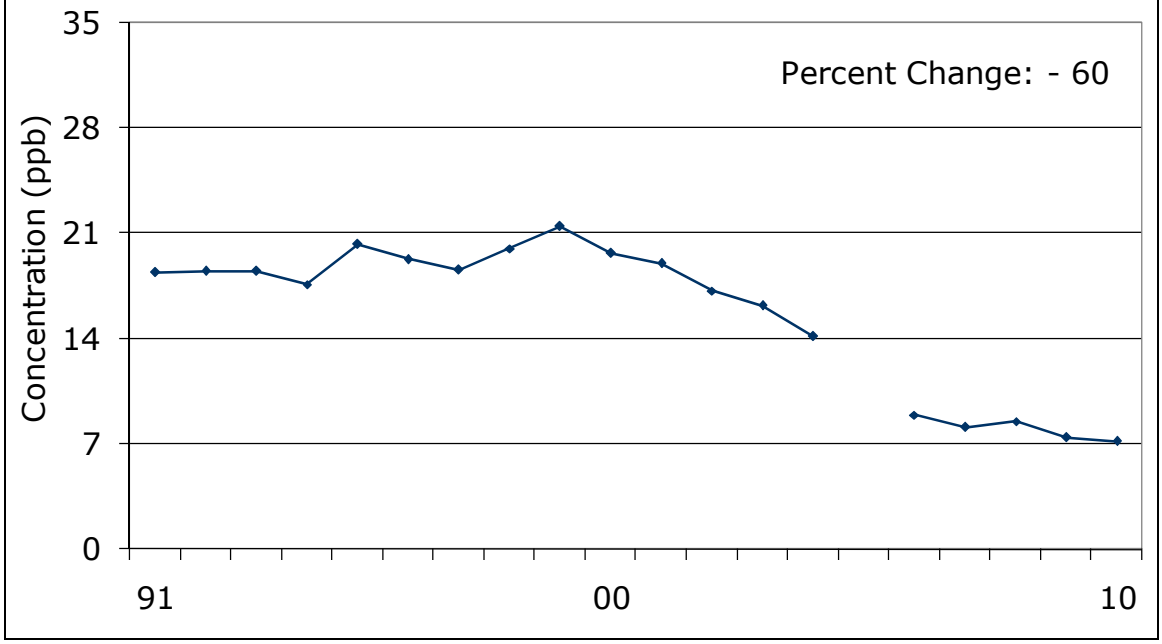
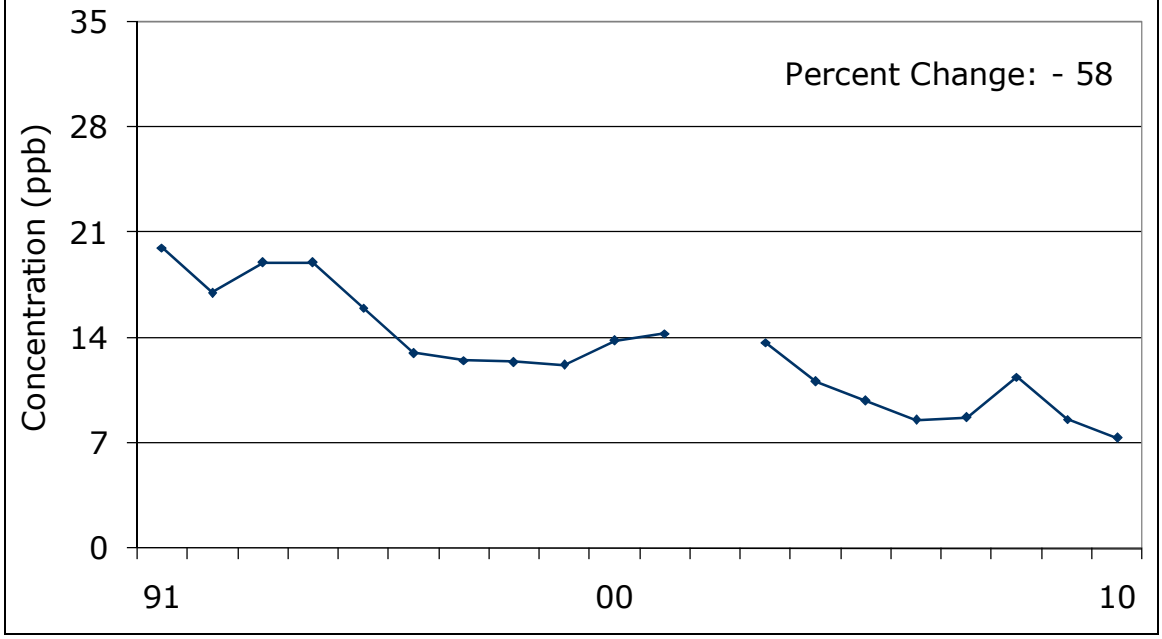


Figure D12
NO_2 Annual Mean at Ottawa Downtown



Appendix E 20-Year SO_2 Trends (1991-2010)

Figure E1
SO_2 Annual Mean at Windsor Downtown

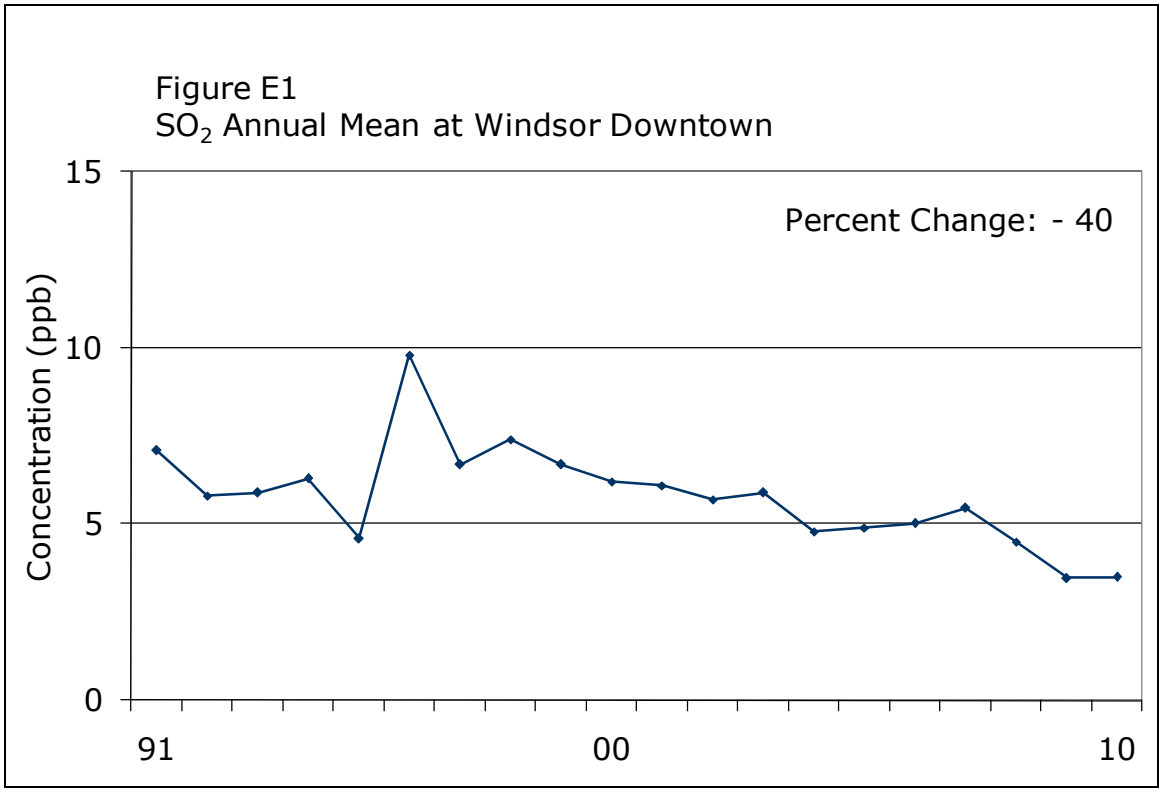


Figure E2
SO_2 Annual Mean at Windsor West

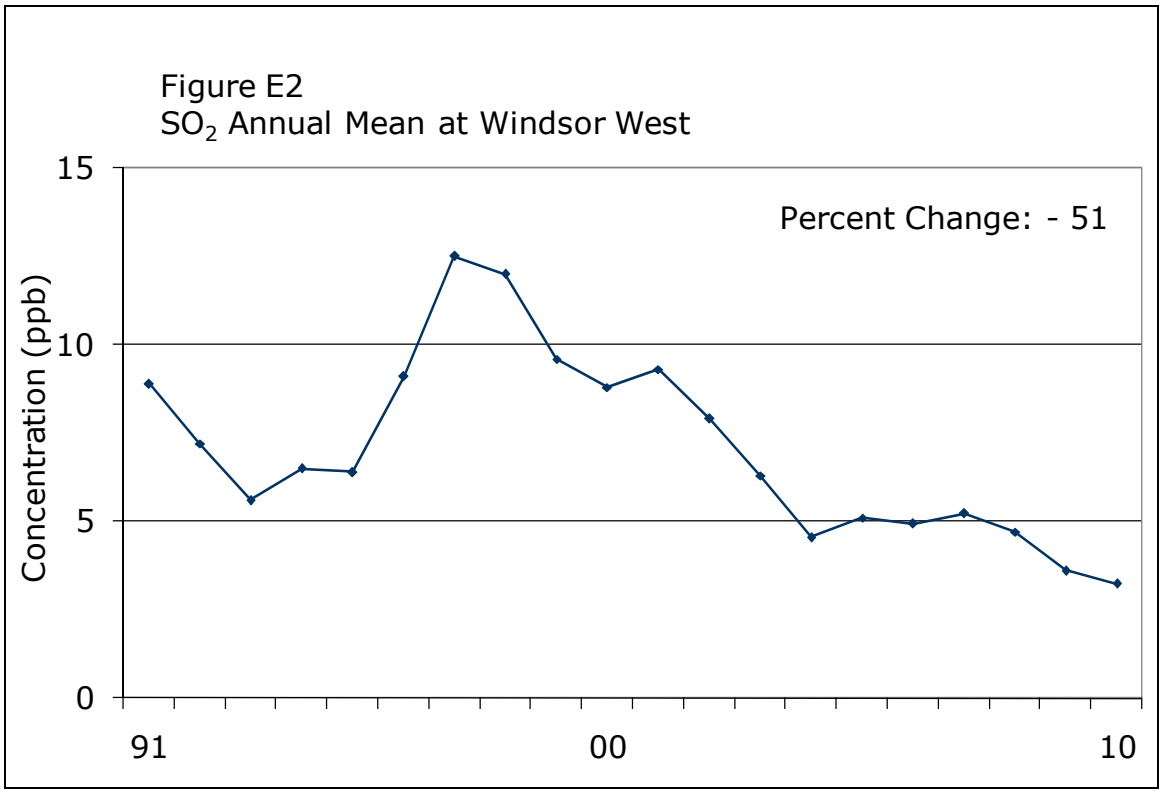


Figure E3
SO_2 Annual Mean at London

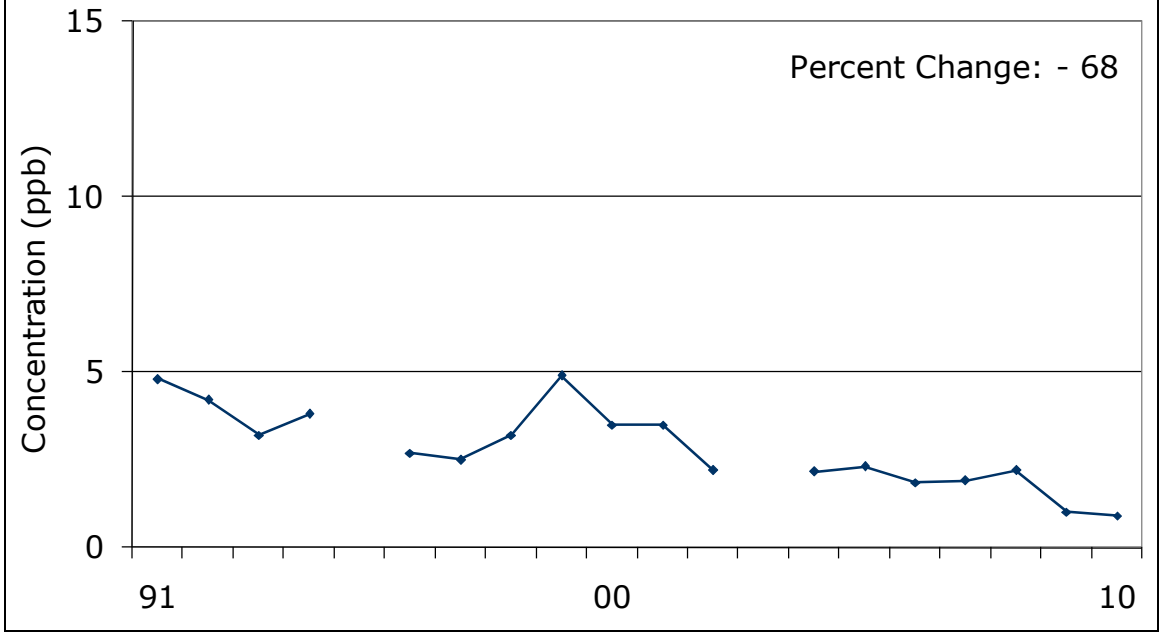


Figure E4
SO_2 Annual Mean at Sarnia

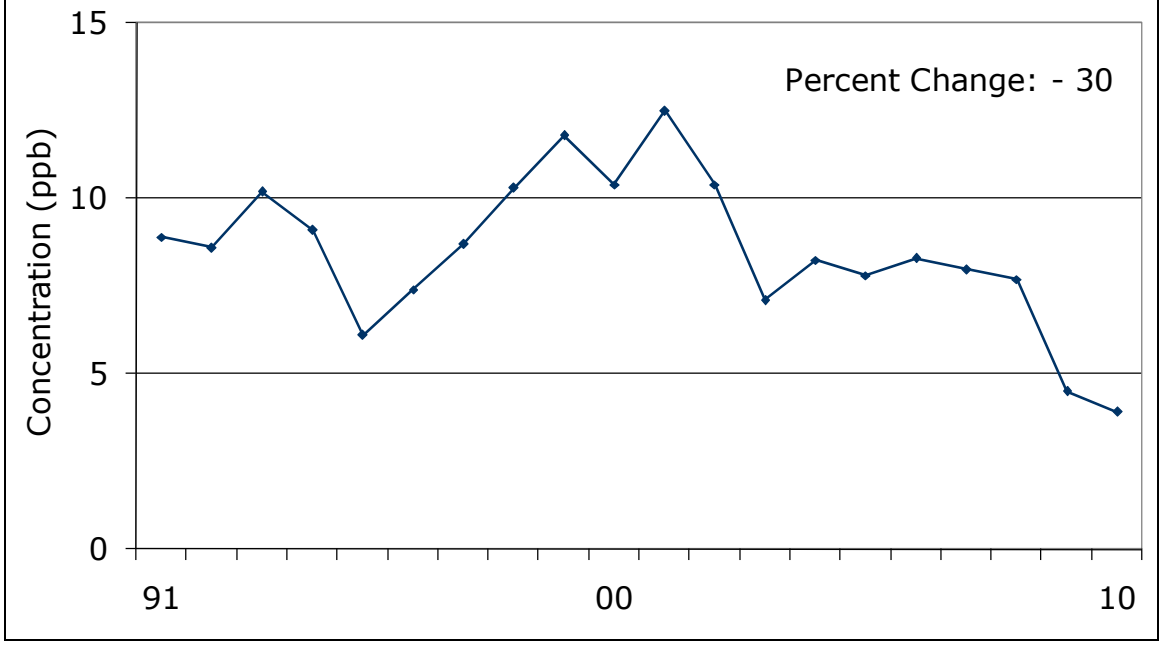


Figure E5
SO_2 Annual Mean at Hamilton Mountain

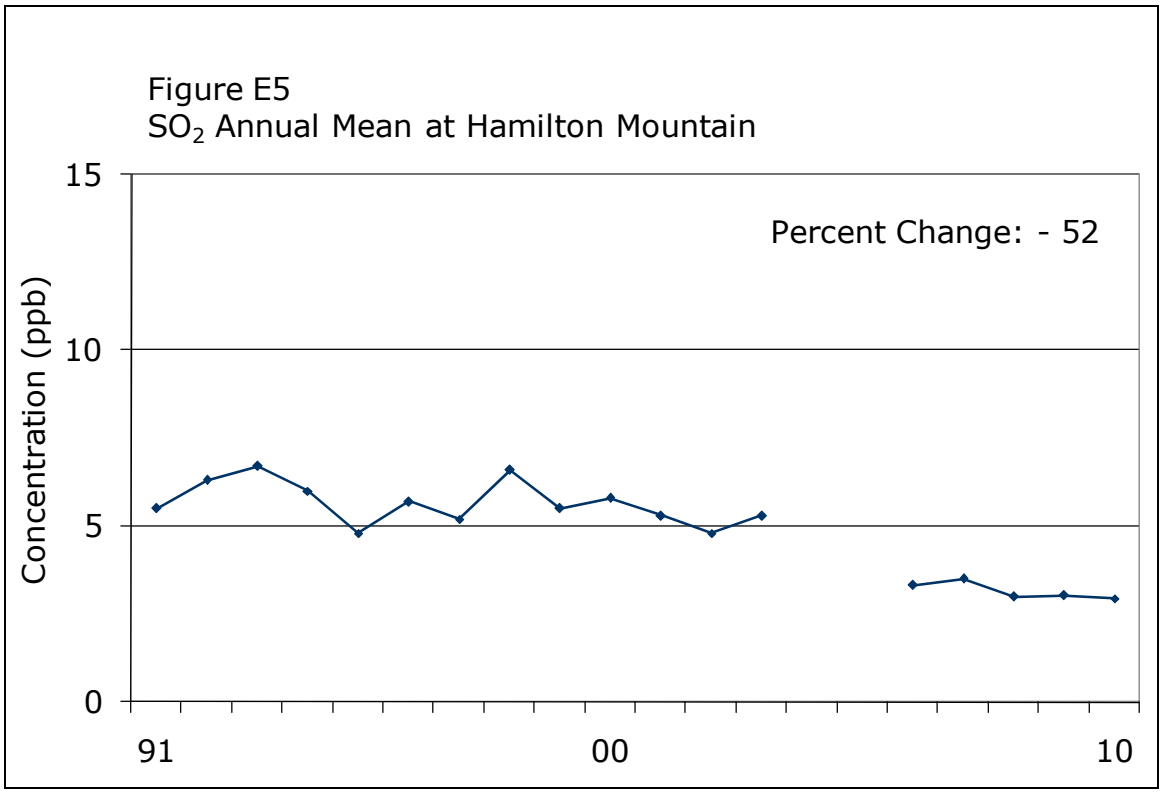


Figure E6
SO_2 Annual Mean at Hamilton Downtown

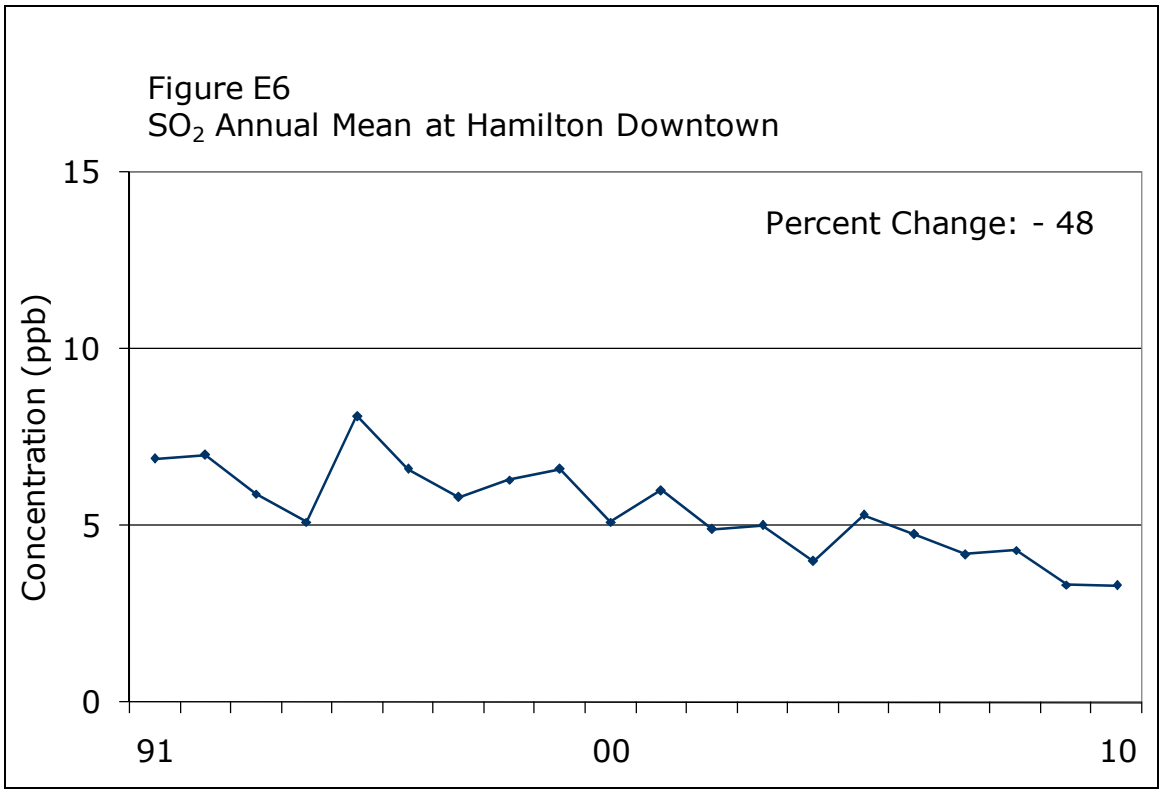


Figure E7
SO_2 Annual Mean at Toronto Downtown

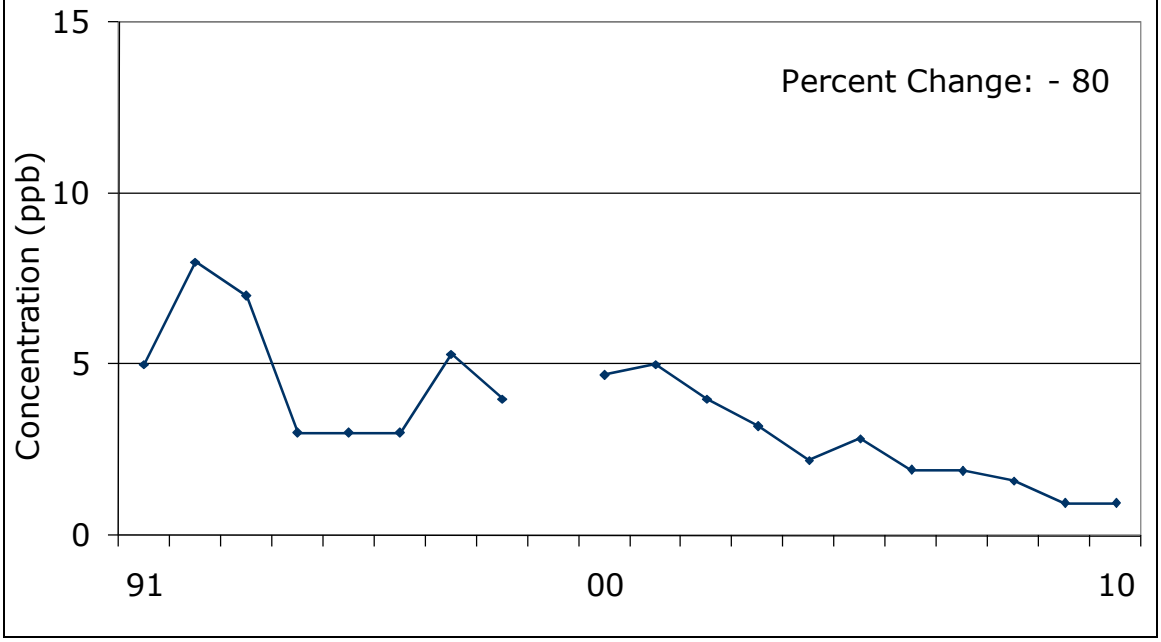


Figure E8
SO_2 Annual Mean at Ottawa Downtown

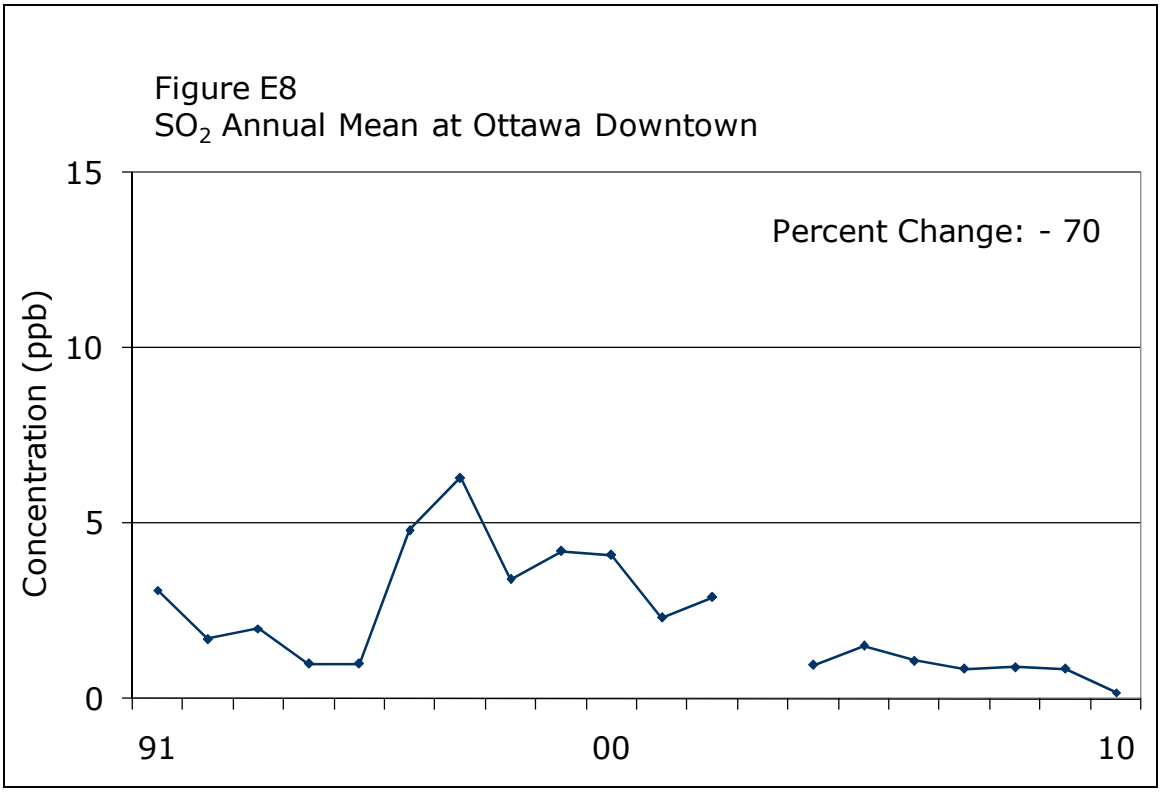


Figure E9
SO_2 Annual Mean at Sudbury

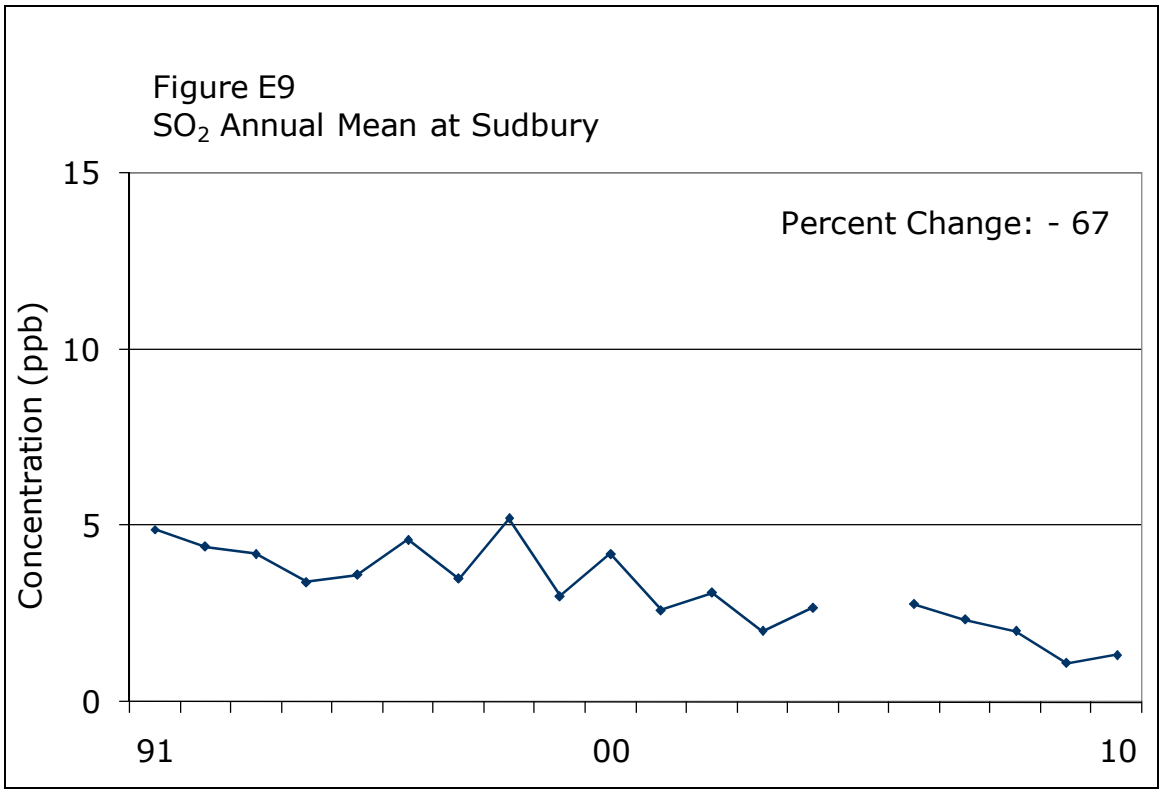


Figure E10
SO_2 Annual Mean at Sault Ste. Marie