



Clean Air Hamilton

2018 Air Quality Progress Report

December 2019

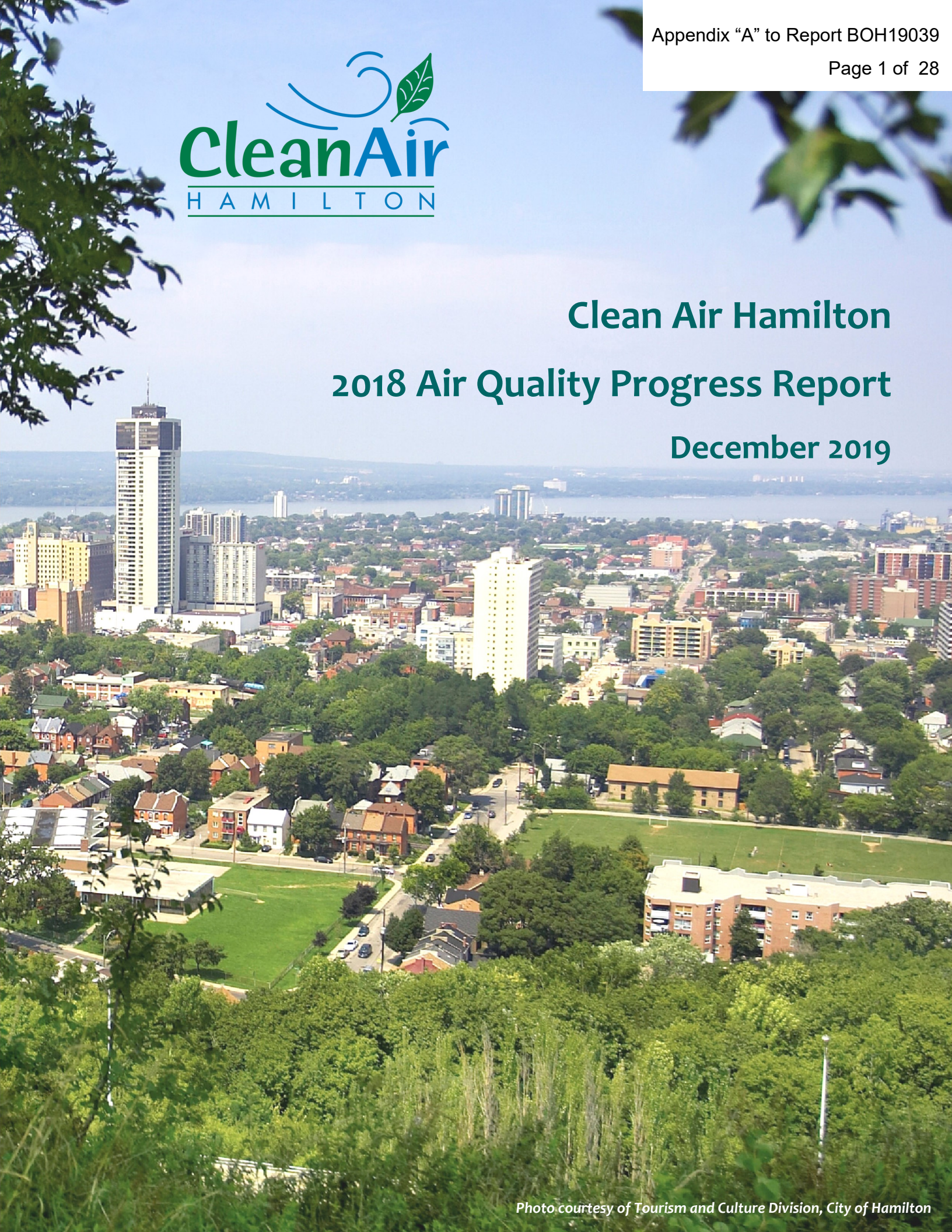


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Top Row (left to right): Brian Jantzi, Nico Strabac, George McKibbin, Bruce Newbold (Chair),
Dan Dobrin, Andrew Sebestyen, Ed Cocchiarella

Bottom Row (left to right): Trevor Imhoff, Denis Corr, Tiffany Singh, Shelley Rogers, Joel
Kaushansky, Lynda Lukasik, Waverley Birch, Karen Logan

Missing: Giuliana Casimirri, Robert Clackett, Rob Conley, Natalie Stacey, Charles Hostovsky, John
Lundrigan, Fran Scott, Sara Yonson

Message from the Chair

I am pleased to provide the Clean Air Hamilton 2018 report which provides annual air quality trends and our on-going work to improve air quality in Hamilton. The following is our Clean Air Hamilton 2018 report. For previous years' activities go to:

<http://www.cleanairhamilton.ca>.

Over the past year, we continued to learn about the local air quality and to make improvements to Hamilton's air quality. The Hamilton Airshed Modelling System (HAMS) was prepared by Golder Associates and released to the community at our bi-annual Upwind-Downwind conference. Funding was provided by the Hamilton Industrial Environmental Association (HIEA) and the City of Hamilton. The model helps us to better understand questions such as: Where is our air pollution coming from? How important are sources external to the city? How much does air pollution vary across the city? Answering these questions will provide us new insights into our local air quality, and ultimately new directions to address air quality in the City of Hamilton.

The Provincial government has also continued to recognize the need to improve air quality through legislation, with the province proposing new regulations on heavy duty vehicles. Clean Air Hamilton submitted feedback and participated along with other stakeholders in consultation around this legislation, and we look forward to bringing these changes to our City.

Our mandate includes involving and informing our citizens of all these issues and giving sound, science based advice and recommendations. In March of 2018, Clean Air Hamilton held it's bi-

annual Upwind Downwind Conference and Clean Air Fair, educating professionals and the public about air quality and health in and around Hamilton. Hamilton also hosted an Air Summit in September of 2018. The Summit included panels consisting of a number of Clean Air Hamilton Members. Presentations were made by the Environment Commissioner of Ontario's Office and Golder Associates. Topics of discussion included the HAMS, ambient air quality trends, emerging provincial standards and cumulative effects.

We thank the Healthy and Safe Communities Department within the City of Hamilton and City Council for their ongoing support of Clean Air Hamilton and its special projects. Funding has allowed us to work closely with local partner groups including Friendly Streets (a collaboration between Environment Hamilton and Cycle Hamilton), Corr Research and Green Venture on projects that have raised awareness amongst local citizens about air quality issues, as well as working to improve local air quality. Together, Clean Air Hamilton and its various partners are working to reduce emissions as well as our personal exposures and live healthier lives. Clean Air Hamilton's special projects and this report helps us to do that.



A handwritten signature in black ink, appearing to read "K.B. Newbold".

*Bruce Newbold, Ph.D.
Chair, Clean Air Hamilton*

Strategic Activities

Clean Air Hamilton is dedicated to improving air quality across the City of Hamilton. This will be accomplished through sound science based decision making, using the most up-to-date information and tools available, such as the Hamilton Airshed Model (HAMS). Clean Air Hamilton plans to focus on education and outreach, air quality monitoring, and to continue to update the HAMS and identify major sources of pollution to prioritize action for maximum air quality improvement and exposure reduction. Clean Air Hamilton has identified the following issues for research, communication and program activities in collaboration with our partners:

Governance & Structure:

To remain a multi-stakeholder group dedicated to improving air quality by increasing public perception and expanding Clean Air Hamilton membership while providing communication and promotion of realistic, science based decision making and sustainable practices.

Air Zone Management:

Comply with the Ministry of the Environment, Conservation and Parks (MECP) and Canadian Ambient Air Quality Standards. This will be done through implementation of a systems level approach and support towards an industrial mandatory monitoring regulation.

Transportation:

To encourage and facilitate more use of public and active transportation through commentary on transportation related matters, supporting educational programs and localized monitoring leading to detailed information to encourage changes in behaviour.

Air Monitoring:

To improve air monitoring activities across the City of Hamilton by providing support for additional portable air monitors and fixed air monitors that provide real-time monitoring for contaminants of concern in Hamilton.

Dust & PM_{2.5} Mitigation:

Lower concentrations of PM_{2.5} across the City of Hamilton below Canadian Ambient Air Quality Standards by effectively utilizing the airshed model to create partnerships and pollution inventory specific to street sweeper and dust mitigation programs.

2018 Meetings

January 8, 2018
February 12, 2018
April 9, 2018
May 14, 2018
June 11, 2018
July 9, 2018
August 13, 2018
September 8, 2018
October 15, 2018
November 12, 2018
December 10, 2018

2019 Meetings

January 14, 2019
February 11, 2019
March 11, 2019
April 8, 2019
May 13, 2019
June 10, 2019
August 12, 2019
September 9, 2019
October 7, 2019
November 18, 2019
December 2, 2019

Clean Air Hamilton Meetings

Clean Air Hamilton meetings are usually held on the second Monday of each month located at 71 Main Street West, City Hall, Room 192/93 .



Photo courtesy of Tourism and Culture Division, City of Hamilton

Clean Air Hamilton (CAH) - 2018

Clean Air Hamilton is an innovative, multi-stakeholder agent of change dedicated to improving air quality in our community. In 2018, Hamilton Public Health Services provided \$28,577 to fund projects resulting in air quality improvement and awareness. These projects have

reached hundreds of citizens and contribute to improving Hamilton's air quality through monitoring, promotion and spreading awareness. Clean Air Hamilton is proud to support the 2018 funded projects.

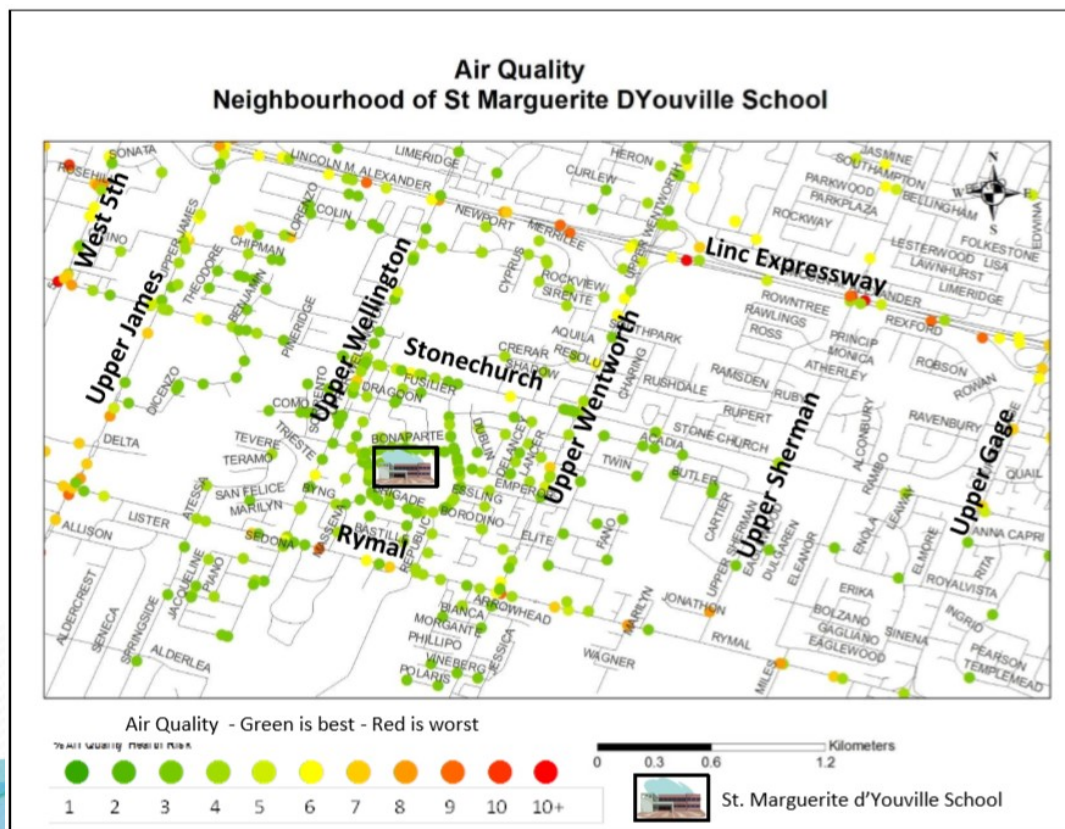
Fresh Air for Kids



In 2018, Green Venture and Corr Research teamed up to provide the Fresh Air for Kids program to five Hamilton elementary schools. The focus of the project is to educate students, teachers and the public about air quality around schools and the impact of engine idling. The program was

delivered to Franklin Road, Ancaster Meadows, Prince of Wales, and George L. Armstrong Public Elementary Schools and St. Marguerite D'Youville Catholic Elementary School. The program included classroom work, in-the-field air monitoring and anti-idling awareness.

Students were educated on the importance of air quality and the Air Quality Health Index. They also gained an awareness of how their actions can impact and improve the air in their neighbourhoods. Students measured PM_{2.5} and PM₁₀ in their neighbourhoods. The MECP Mobile Air Monitoring van was also used to monitor air quality near the schools. These data were developed into air quality maps which students used to decide on their best ways to travel to and from their school.



Clean Air Hamilton 2018 Funded Projects Cont'd...

Enhanced Fresh Air for Kids

In addition to the Fresh Air For Kids program, three of the participating five schools also participated in the Enhanced Fresh Air For Kids program which included anti-idling campaigns. The program included anti-idling education where Green Venture led classrooms in the development of posters, pamphlets, key chains and other advertising material. Audits of idling vehicles were conducted before and after the anti-idling campaigns to measure the success of the program.







Idling is a serious issue because it

- Causes dirty, smoggy, polluted air that's hard to breathe
- Leads to serious health problems, especially in children
- Contributes to climate change
- Wastes money and gasoline

IDLING INFRACTION

What is Idling?

When you're waiting or parked in your vehicle and you have the engine running you're idling.

Read on for more information about idling and what you can do to stop it.

Idling Facts

- 1) Over 10 seconds of idling uses more fuel than restarting your engine.
- 2) Idling isn't an effective way to warm up your vehicle, even in cold weather. The best way to warm up your vehicle is to drive it.
- 3) Excessive idling can damage your engine's components, including cylinders, spark plugs, and the exhaust system.

How to Avoid Idling

Step 1 - Reduce warm-up idling to 30 seconds

Step 2 - If you are going to be stopped for more than 10 seconds, turn your engine off (except in traffic).

Step 3 - Don't ever use a remote car starter as they encourage idling.

Step 4 - With really cold temperatures, consider using a block heater to warm your vehicle's engine before you start it.

Step 5 - Spread the anti-idling message to your family and friends.

Step 6 - Keep this card handy with you to remind yourself not to idle. Afterall, everyone can forget.

If you're waiting or parked
TURN OFF your engine.
Remember Idling Stinks!



The City of Hamilton [Anti-Idling By-law No. 07-160](https://www.hamilton.ca/government-information/by-laws-and-enforcement/city-hamilton-by-laws) can be found on the City's Bylaw website at:

<https://www.hamilton.ca/government-information/by-laws-and-enforcement/city-hamilton-by-laws>

Friendly Streets Hamilton

Friendly Streets Hamilton is a collaborative initiative of Cycle Hamilton and Environment Hamilton. The program encourages active, safe travel and aims to secure safer streets. The program piloted in 2017 with great success. In 2018, the program received Clean Air Hamilton funding to conduct street-level air quality monitoring with street audits.

The audits engaged 65 residents in the Beasley and Gibson-Landsdale neighbourhoods who measured PM_{2.5} levels using Dyllos air quality monitors along arterial roads and residential streets. The collected data showed that PM_{2.5} levels were higher along arterial roads and that citizens should consider using residential streets when using active transportation.

The program identified the top three concerns related to air quality in the Beasley area to be:

- Improving localized air quality;
- Industrial trucks shortcutting through the downtown core; and
- Enhancing tree canopy along arterial roads to improve shade and air quality.

Friendly Streets Hamilton partnered with the MacChangers program at McMaster University to increase engagement with students and is acting in a mentorship capacity for projects involving green transportation and truck routes.



Clean Air Hamilton 2018 Funded Projects Cont’d...

Bus Brains—School Bus Monitoring



The Bus Brains project by Green Venture aimed to increase uptake in electric school buses by testing air quality on school and HSR buses. In 2018, Green Venture worked with Fessenden Public and St. Marguerite D’Youville Catholic Elementary schools to collect data from regular school buses, and Delta Public Secondary School to collect data from Hamilton Street Railway buses. Students who do not take the bus were given the opportunity to use the air quality monitors to measure levels in their school building.

The main goals of the project were to teach students about air quality, how it can be affected by transient events and the impacts to environmental and human health, to gather baseline data about air quality on school buses and to provide students with real-world experience gathering data in a manner consistent with standard quantitative research techniques.

Data was collected over a two-week period using Dylos air quality monitors and sent to Dr. Matthew Adams with the University of Toronto for future research and conclusions.

The initial data was discussed as a class and led by Green Venture. In total, 120 students were directly involved in the monitoring.



Photo provided by Faye Parascandalo

2018 Upwind Downwind Conference: Hands On Air Quality

The Upwind Downwind conference is a bi-annual two-day event hosted by Clean Air Hamilton and members of Clean Air Hamilton. The event opened with a Clean Air Fair, a free event for the general public, on Sunday, March 4, 2018 at the Cotton Factory in Hamilton. The event was hosted by the Hamilton Industrial Environmental Association and was comprised of exhibitors focusing on Air Quality and Health within Hamilton.

The Upwind Downwind conference was held on Monday, March 5, 2019 at the Sheraton Hotel in Hamilton. The conference had a total of 98 participants. Speakers represented various levels of government, academia, Public Health Ontario and the Sarnia-Lambton Environmental Association. Presentations and discussions involved topics such as the Hamilton Airshed Modelling System, cumulative emissions, environmental health, air quality around school drop off locations, transboundary emissions and emerging government regulations.



UPWIND DOWNWIND

Hands On Hamilton:
Our Air Quality

When: Monday March 5, 2018 8:00AM to 4:00PM

Where: Sheraton Hotel, Downtown Hamilton
(116 King Street West, Hamilton, ON L8P 4V3)

Topic: Clean Air Hamilton and the City of Hamilton are pleased to announce the tenth biennial Upwind Downwind Conference. The 2018 conference is focusing on the City of Hamilton's airshed model, provincial air quality work, practical solutions and new partnerships to address air quality issues in Ontario.

Registration: <https://upwinddownwind2018.eventbrite.ca>

Logos at the bottom include: Hamilton, UPWIND DOWNWIND, and various environmental and community organization logos.

Hamilton Clean Air Summit 2018

On September 14, 2018, the half day Hamilton Air Summit was hosted in the City of Hamilton Council Chambers. The event was moderated by Dr. Denis Corr, former Chair of Clean Air Hamilton, and panelists included Clean Air Hamilton Members, and representatives from the office of the Environmental Commissioner of Ontario and Golder Associates.

Presentations were made on air quality public engagement, the Hamilton Airshed Modelling System, 2016 ambient air quality trends and comparisons, risk communication, the air quality health index and air zones. Panel discussions followed regarding cumulative effects, emerging provincial standards and particulate matter.

In 2018, the Hamilton Airshed Modelling System (HAMS) was completed by Golder Associates Ltd. and funded by the Hamilton Industrial Environmental Association and City of Hamilton Public Health Services. HAMS was presented at the 2018 Upwind Downwind Conference and was a successful accomplishment of one of the goals set out by Clean Air Hamilton's Air Quality Task Force Action Plan from 2013.

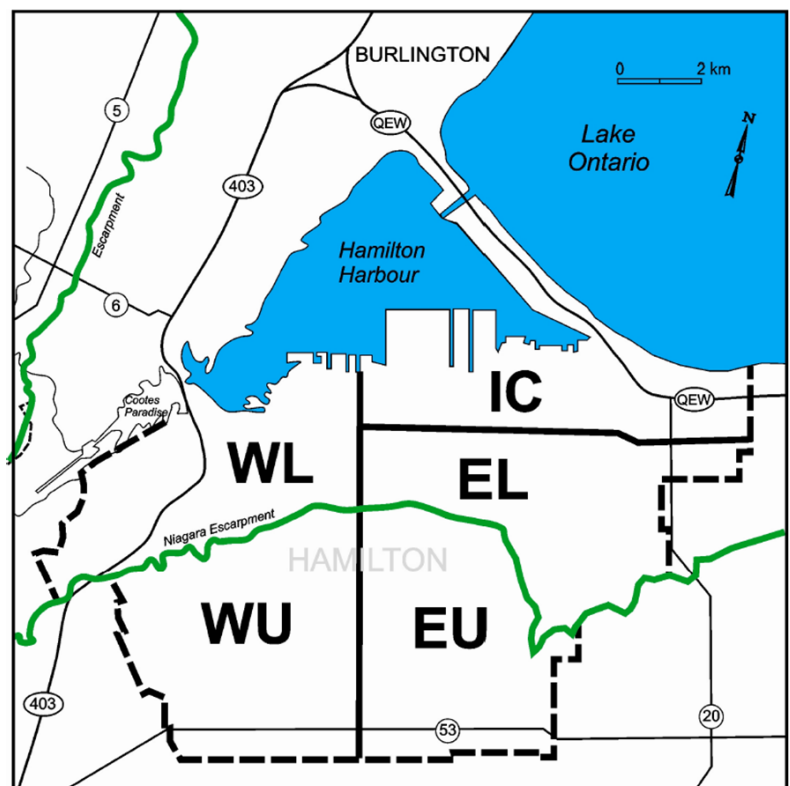
HAMS is built on the understanding of current science and uses local and transboundary data to establish a model of the local airshed down to a grid of 1.33km by 1.33km sections. Emission inventory sources included industrial, commercial, residential, on-road, non-road and biogenic/agricultural.

The model assisted the Clean Air Hamilton Air Quality Task Force to set three overarching priorities for future actions:

- Education and outreach;
- Air quality monitoring; and
- Model updating consistent with the best available data/evidence.

HAMS concluded that:

- Transportation related activities are significant contributors to air quality levels;
- Local industrial activities contribute less than 20% to air quality in the airshed except for Benzo[a]pyrene which is higher;
- Local industry and non-road sources contribute about 15% to SO₂ levels;
- ~75% of PM_{2.5} contributions are from transboundary sources outside of Hamilton;
- Transportation sources have the highest contribution of NO₂; and
- Source contribution varies seasonally with higher transboundary contribution in winter and more local source contribution in the summer.



HAMS was used to provide air quality information in specific domain areas of Hamilton via a sub-regional analysis model. The information was presented in 2018 to the Clean Air Hamilton's Air Quality Task Force. The sub-regional analysis divides the City into five domain areas: Industrial Core (IC), West Lower (WL), East Lower (EL), West Upper (WU), and East Upper (EU) (as seen above). Domain area source contributions were further analysed by industrial, on-road, non-road, transboundary and other.

The following pages show the results from the sub-regional analysis.

HAMS Airshed Sub-Regional Analysis

Ground Level Ozone (O₃)

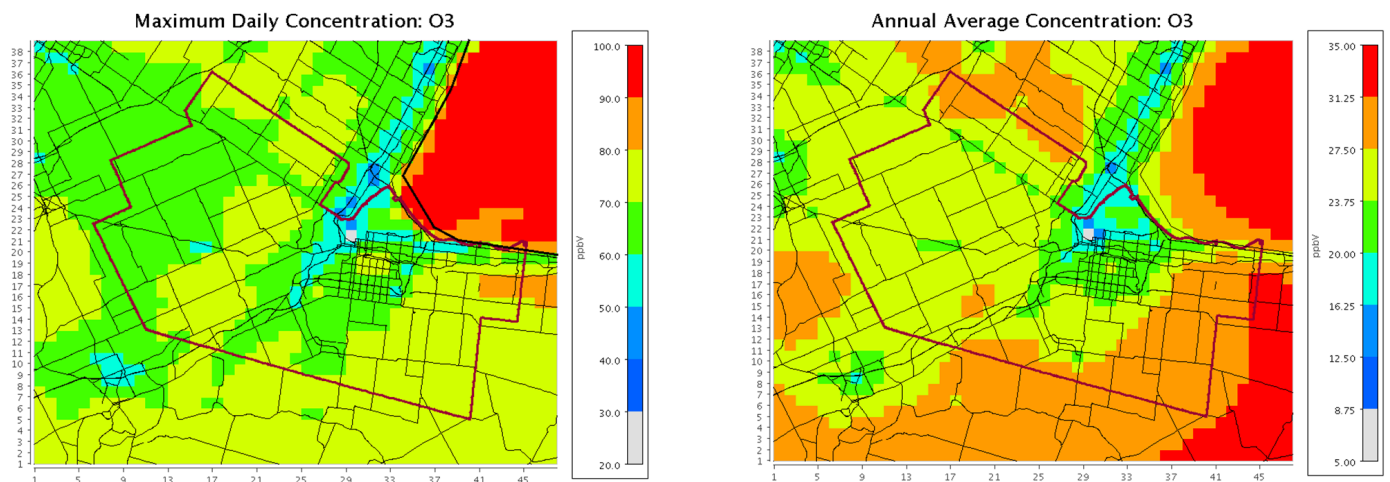
Ground level ozone (O₃ or tropospheric ozone) is formed when nitrogen oxides and volatile organic compounds react with the presence of sunlight¹. This is why O₃ concentrations are higher during summer months. Sources include: coal-fired power plants, vehicles and urban activities. The chemical reaction between nitrogen oxides and O₃ leads to an inverse relationship between O₃ levels (below) and Nitrogen Dioxide (NO₂) as seen on page 15 of this report.

O₃ is a contributor for the Air Quality Health Index, and high levels of O₃ for extended periods of time can lead to Special Air Quality Statements and Smog and Air Health Advisories².

The Government of Ontario has been dedicated to lowering O₃ precursor emissions by eliminating all coal-fired power plants in Ontario.

HAMS shows that higher levels of O₃ are found on the East Lower and East Upper areas and lower levels are found in the West Lower area.

See Appendix “A” - 2018 Air Quality Trends for 2018 ozone trends in Hamilton (pages 25-26) .



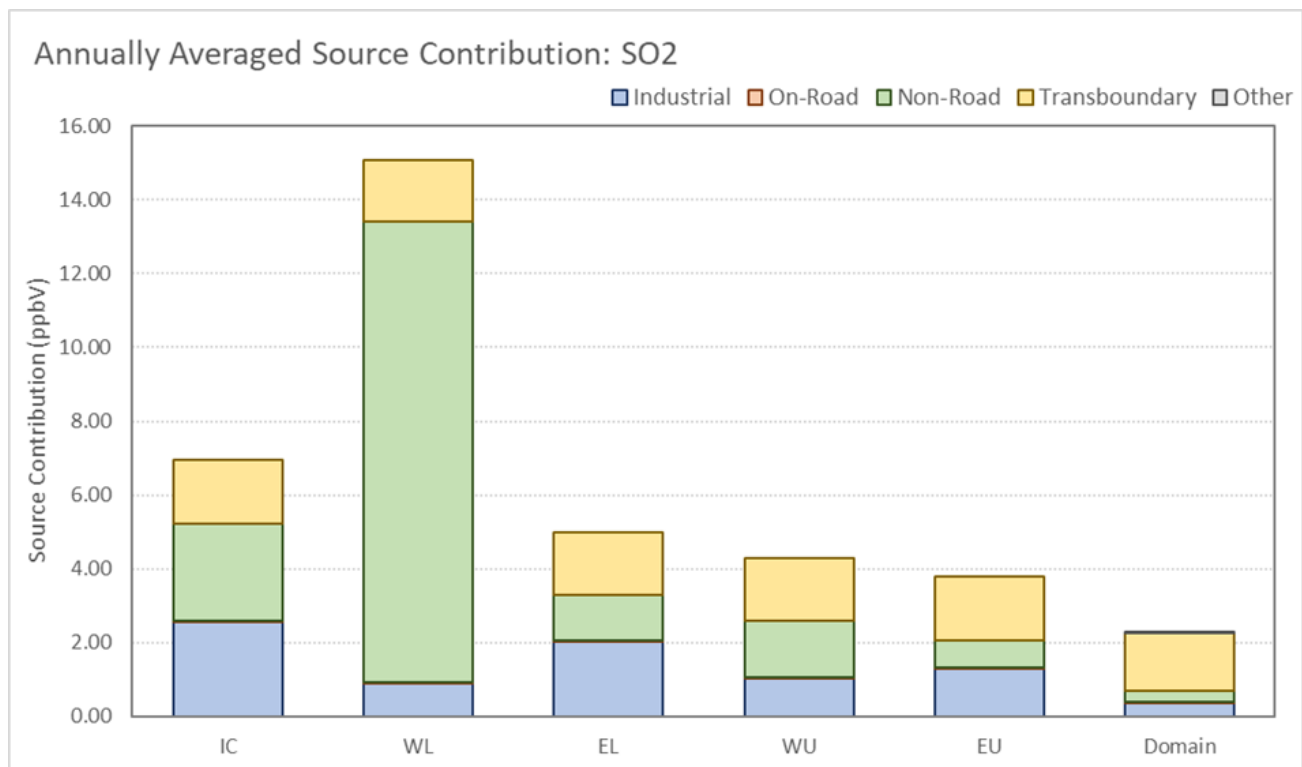
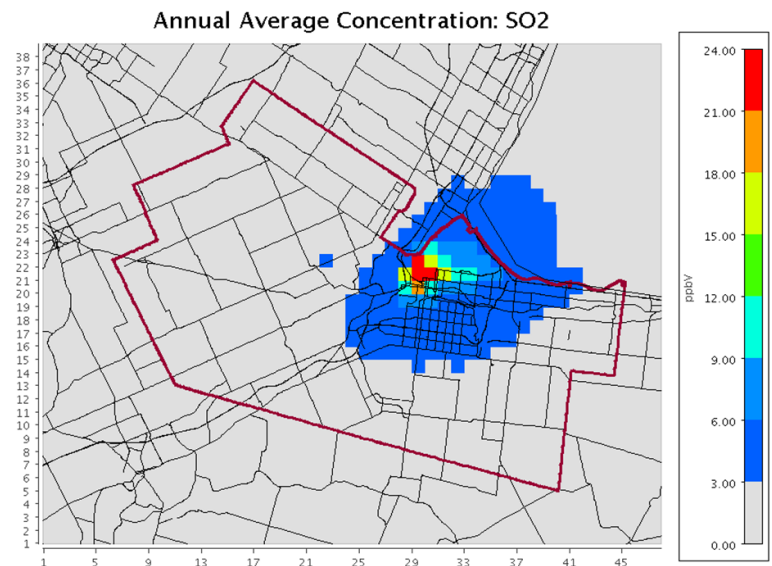
HAMS Airshed Sub-Regional Analysis Cont'd.

Sulphur Dioxide (SO₂)

Sulphur Dioxide can increase airway resistance when inhaled³. It is a product of industrial activity, however, the HAMS shows that overall, 20% of the SO₂ in Hamilton is emitted by the industrial sector.

The sub-regional analysis shows that the majority of SO₂ is due to non-road (airport, marine, rail and lawn mowers) and transboundary sources. It is highest in the West Lower area and lower in the East Lower, West Upper and East Upper areas.

See Appendix "A" - 2018 Air Quality Trends for 2018 SO₂ trends in Hamilton (page 23).



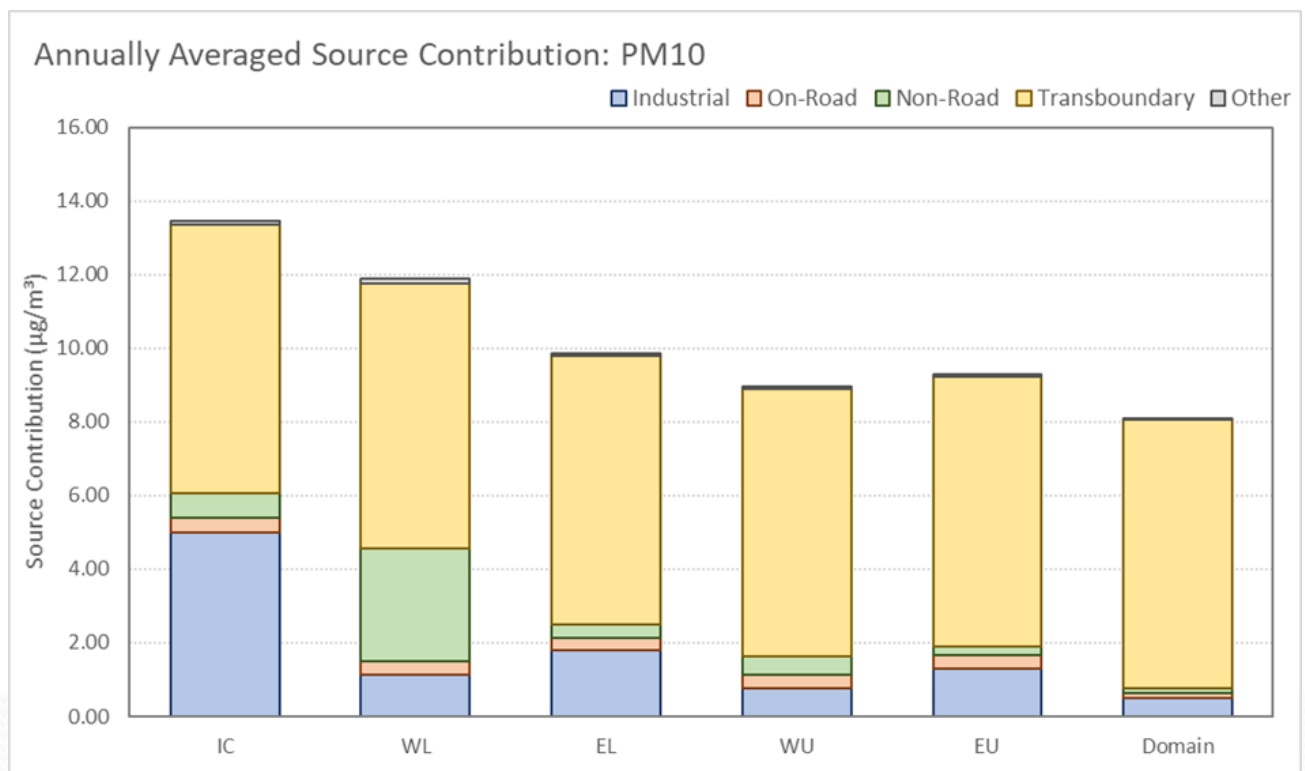
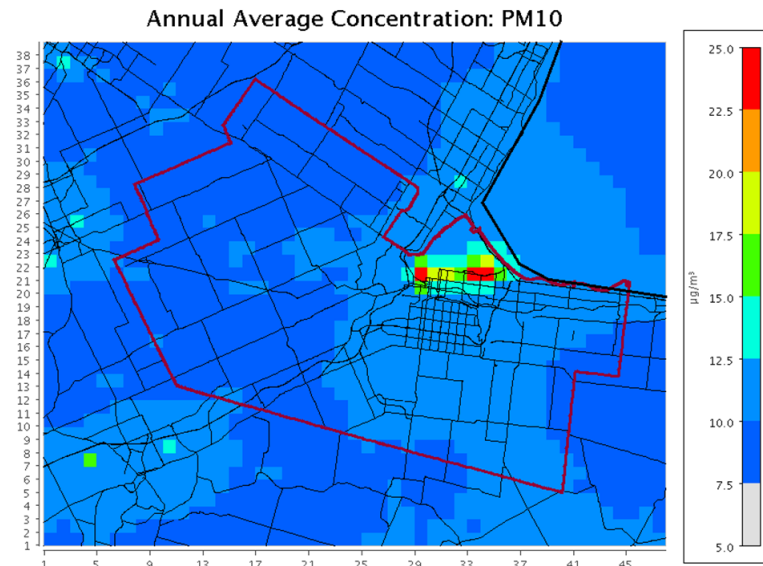
Particulate Matter: Inhalable Particulate Matter (PM₁₀)

Inhalable particulate matter (PM₁₀) has a diameter of 10 µm or less. PM₁₀ makes up 40-50% of total suspended particulate matter in Hamilton and has been linked to respiratory, cardiovascular and other health impacts in humans⁴.

PM₁₀ is primarily derived from vehicle exhaust emissions, industrial fugitive dusts, and the finer fraction of re-entrained road dust.

The sub-regional analysis shows the largest contribution of PM₁₀ in all areas of Hamilton are due to Transboundary sources.

See Appendix "A" - 2018 Air Quality Trends for 2018 PM₁₀ trends in Hamilton (page 21).



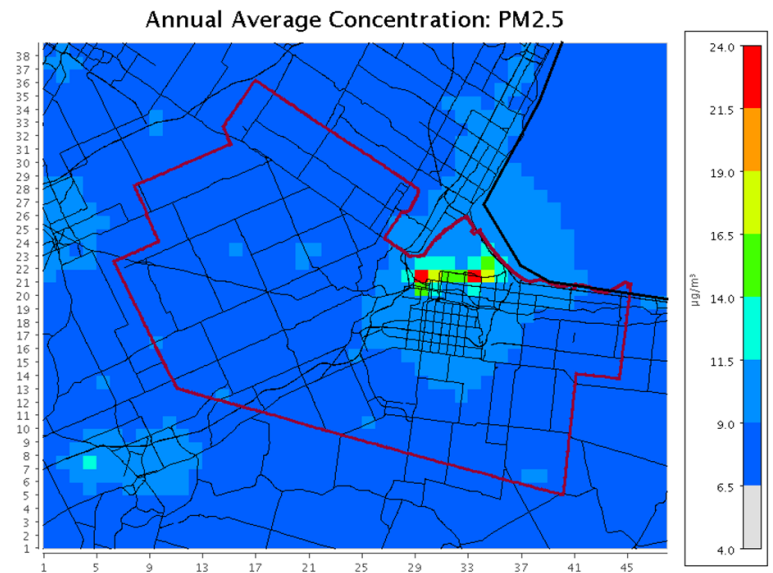
HAMS Airshed Sub-Regional Analysis Cont'd.

Particulate Matter: Respirable Particulate Matter (PM_{2.5})

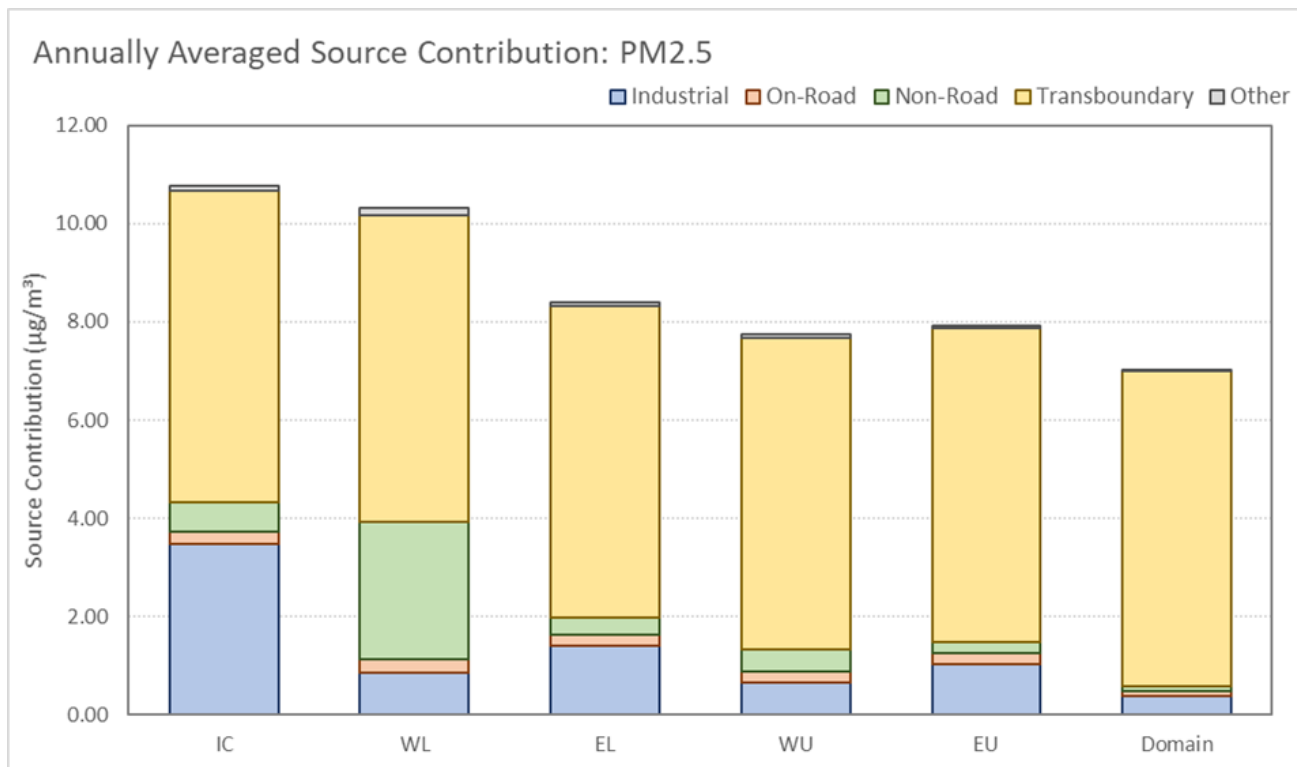
The Ontario government started measuring PM_{2.5} across Ontario in 1999. PM_{2.5} makes up about 60% of PM₁₀.

Scientists now agree that exposure to the small particles and organic substances is the likely cause of the observed respiratory and cardiovascular health impacts attributed to particulate matter exposure.⁴

The sub-regional analysis shows that the majority of PM_{2.5} in all areas is due to transboundary sources followed by industrial in the Industrial Core area and non-road sources in the West Lower area.



See Appendix "A" - 2018 Air Quality Trends for 2018 PM_{2.5} trends in Hamilton and other Cities (pages 22).

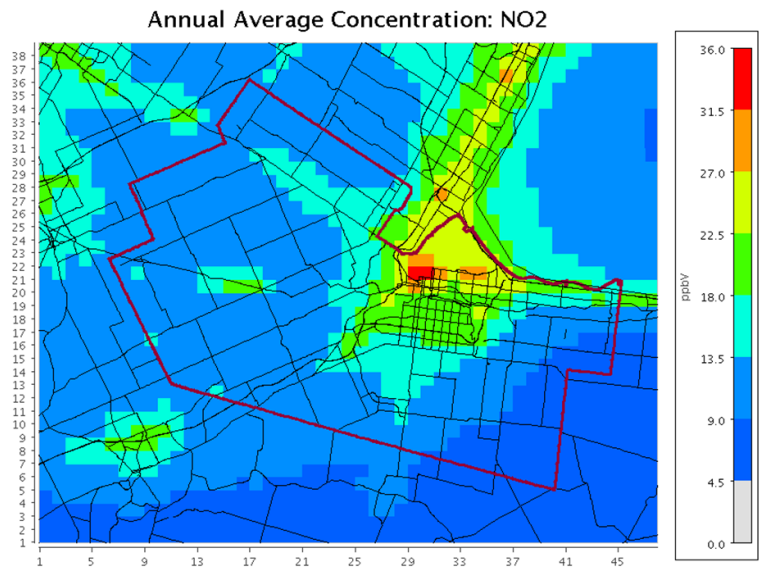


Nitrogen Dioxide (NO₂)

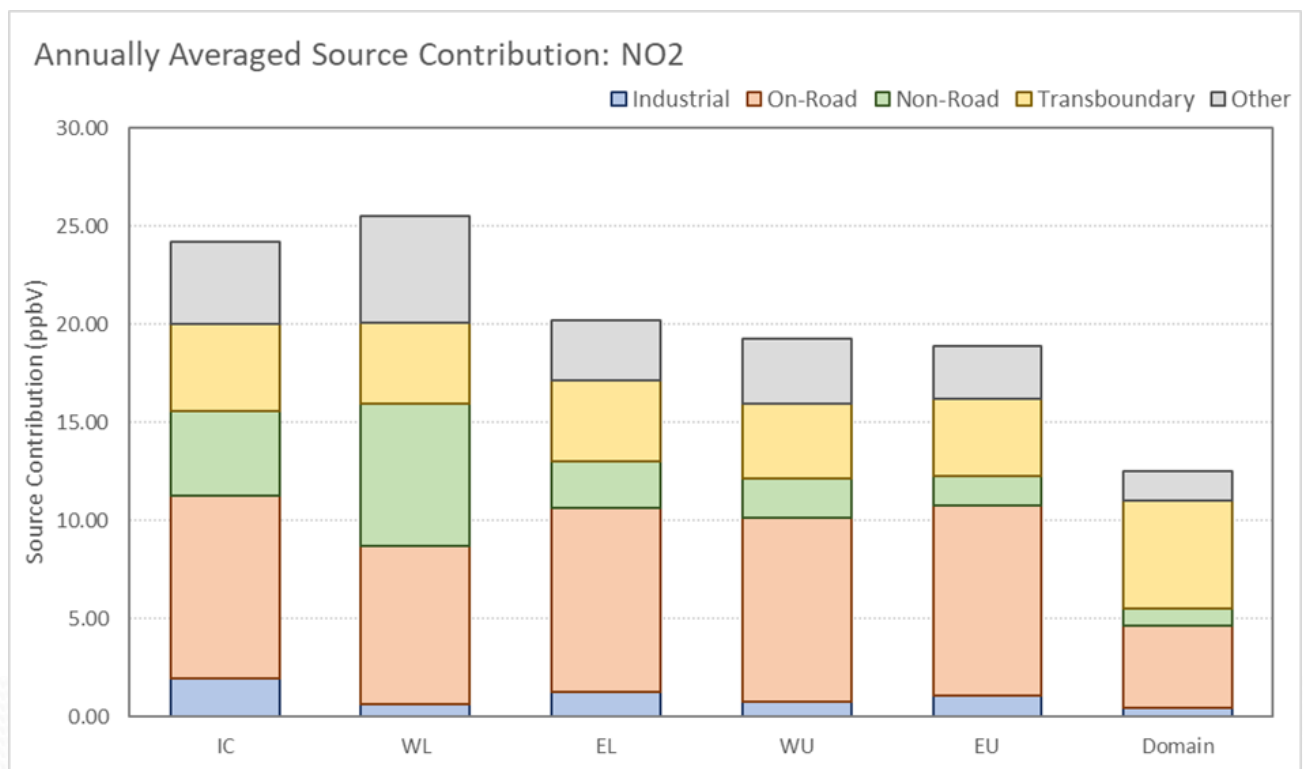
Nitrogen Dioxide (NO₂) is formed in the atmosphere from nitric oxide (NO) which is produced during combustion of fuels (i.e gasoline, diesel, coal, wood, oil and natural gas) and is responsible for the air pollution-related health impacts.

Both NO and NO₂ are routinely measured and their sum is reported as Nitrogen Oxides (NO_x) to reflect the presence of both species in urban areas. Ultimately all of the NO is converted to NO₂ which reacts with water in the atmosphere to produce nitric and nitrous acids (HNO₃ and HNO₂, respectively); these acids are converted into nitrate salts that constitute about 25% of the mass of fine particulate matter or PM_{2.5}.

The sub regional analysis shows the majority of NO₂ emissions in Hamilton are due to on-road sources, and non-road sources are also greater in the West Lower area.



See Appendix "A" - 2018 Air Quality Trends for 2018 NO₂ trends in Hamilton and other Cities (page 27) .



HAMS Airshed Sub-Regional Analysis Cont'd.

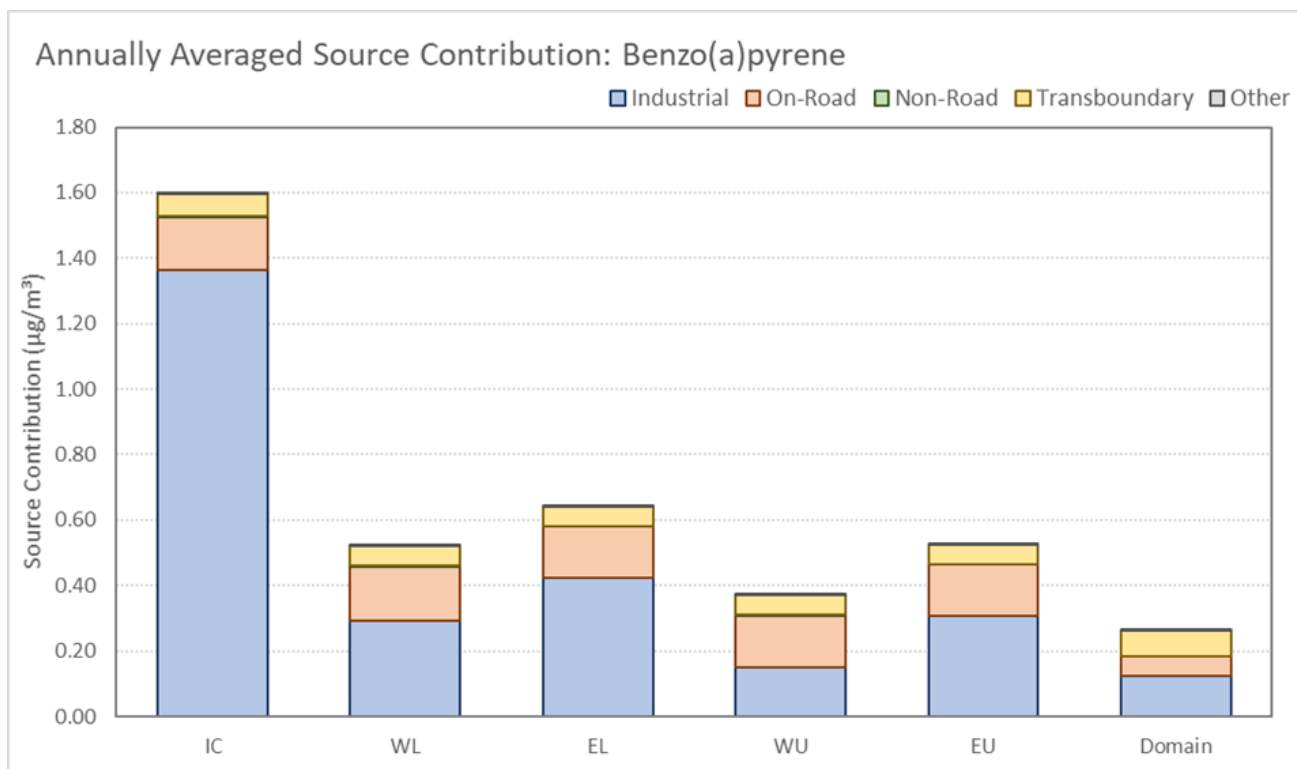
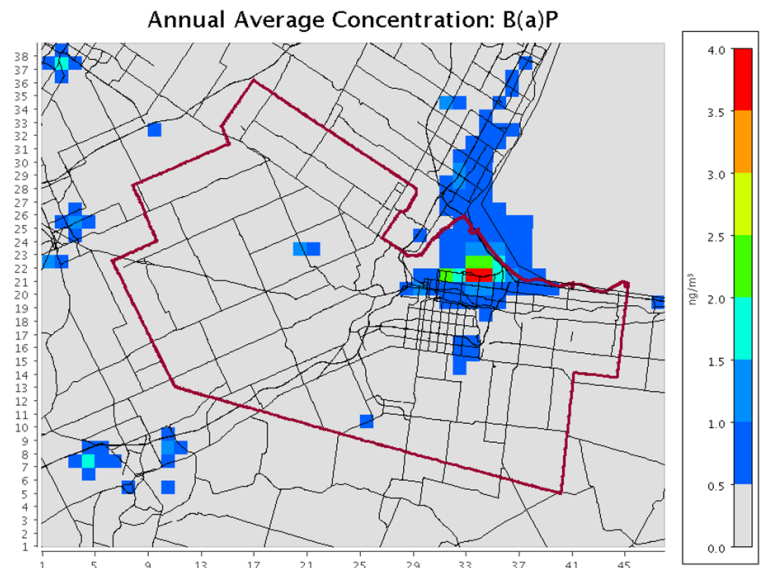
Benzo[a]pyrene

Benzo[a]pyrene (BaP) is a carcinogen and capable of causing cancer in both animals and humans. BaP is a member of a larger class of chemical compounds called polycyclic aromatic hydrocarbons (PAHs) which are emitted when carbon-based fuels such as coke, oil, wood, coal and diesel fuel are burned.

The principal sources of BaP in Hamilton are released from coke and coke by-products used within the steel industry. There have been significant decreases in BaP levels since the late 1990s.

The sub-regional analysis shows that the main source of BaP in most areas is due to industrial sources, followed by on-road sources. The highest contributions are found in the Industrial Core area. Opportunities implemented to lower BaP levels are critical to lowering exposures in Hamilton.

See Appendix "A" - 2018 Air Quality Trends for 2018 BaP trends in Hamilton (page 28).

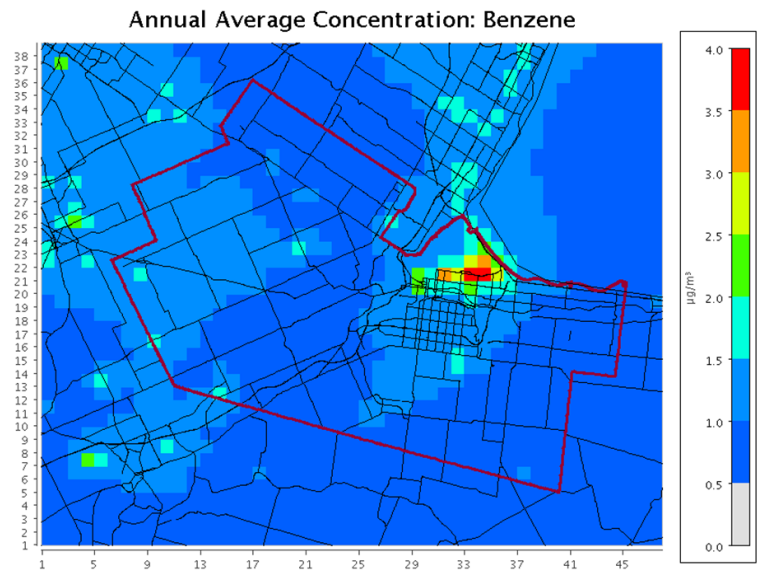


Benzene

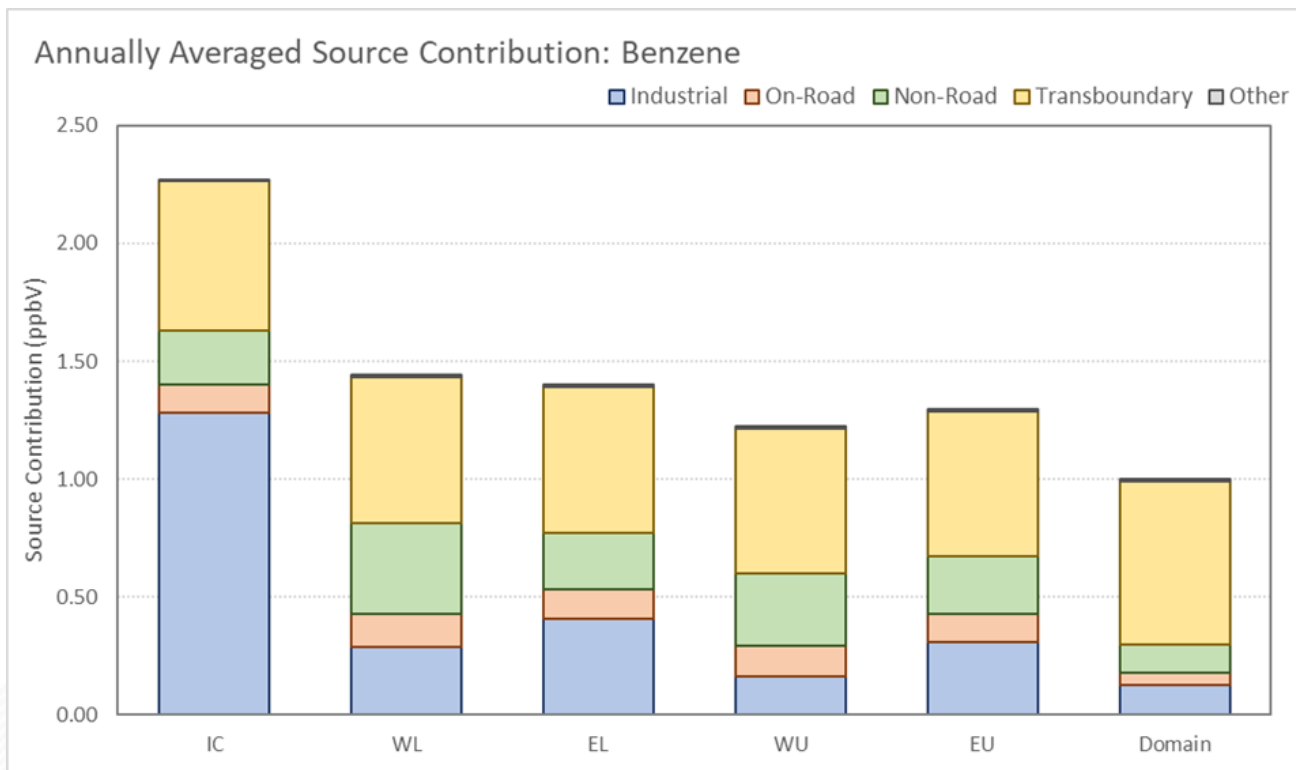
Benzene is also a carcinogenic (cancer causing agent) volatile organic compound (VOC) that is emitted from some operations within the steel industry, specifically coke ovens and coke oven by-product plant operations. Benzene is also a significant component of gasoline which can be up to 5% benzene. Vapours containing benzene are released during pumping at gasoline stations.

Air levels of benzene have been reduced dramatically since 1990's, due to significant upgrading of the coking plant operations, improved operating procedures and improved control of release of benzene vapours from the coke by-products. Opportunities implemented in lower benzene levels are critical to lowering exposures in Hamilton.

The sub-regional analysis shows that the greatest source of benzene concentration is due to industrial sources in the Industrial Core area, and that the highest concentration throughout the all other areas is due to transboundary sources.



See Appendix "A" - 2018 Air Quality Trends for 2018 Benzene trends in Hamilton (page 28).



Conclusions

In 2018, the City of Hamilton provided financial and in-kind support to Clean Air Hamilton and its activities. Descriptions of some of the programs supported by Clean Air Hamilton can be found on pages 5 - 8 in this report.

This annual funding is leveraged significantly in two ways: first, Clean Air Hamilton uses these funds in partnership with funds provided by other agencies and institutions to develop programs related to air quality; second, since all of the members of Clean Air Hamilton donate their time and expertise, there is a significant amount of in-kind support provided. It is estimated that Clean Air Hamilton's partners provide well over \$200,000 in in-kind support.



Bruce Newbold, Ph.D.
Chair, Clean Air Hamilton



**Hamilton Air Monitoring
Network Beach Strip Station 29102**

Public Health Services Airpointer



For more information contact Public Health Services (905) 546-2424 ext. 5288

¹ Air Quality Ontario, <http://www.airqualityontario.com/science/pollutants/ozone.php>

² Air Quality Ontario, <https://www.ontario.ca/document/air-quality-ontario-2016-report/air-quality-health-index-and-air-quality-alerts>

³ Air Quality Ontario, <http://www.airqualityontario.com/science/pollutants/sulphur.php>

⁴ SENES Consulting Ltd. (2011), *Health Impacts Exposure to Outdoor Air Pollution in Hamilton, Ontario*. Retrieved from www.cleanair.hamilton.ca/health-impact (i.e. Inhalable particulate matter (PM₁₀) is the airborne particles that have diameters of 10 µm or less. PM₁₀ makes up 40-50% of TSP in Hamilton and has been linked to respiratory, cardiovascular and other health impacts in humans.)

Air Quality - Additional Resources

To learn more about Clean Air Hamilton and our work visit www.cleanairhamilton.ca.

For annual air quality trends provided by the Ministry of the Environment, Conservation and Parks, please see Appendix “A” - Air Quality Trends 2018.

Air Quality and Health

To learn about how to protect your health visit:
www.airhealth.ca

To learn about Hamilton Public Health Services and actions on air quality visit:

<http://preview.hamilton.ca/public-health/health-topics/air-quality-pollution-smog>

Government Actions on Air Quality

To learn about the Province of Ontario’s actions on air quality visit: www.airqualityontario.com/

To learn about the Government of Canada’s actions on air quality visit: <http://www.ec.gc.ca/Air/default.asp?lang=En&n=14F71451-1>

Air Quality Monitoring

For a detailed model of hourly concentrations for a variety of pollutants across Hamilton visit:

<http://www.hamiltonaqhi.com>

To check our air pollution levels in Hamilton and Ministry run air monitors visit:

<http://www.airqualityontario.com/>

To check out the Hamilton Air Monitoring Network visit: <http://www.hamnair.ca/>

To check out Hamilton Air Quality Health Index website visit: <http://www.hamiltonaqhi.com>



Who we are:

"Clean Air Hamilton is an innovative, multi-stakeholder agent of change dedicated to improving air quality in our community. We are committed to improving the health and quality of life of citizens through communication and promoting realistic, science-based decision-making and sustainable practices."

2018 MEMBERS

Bruce Newbold, *Chair -McMaster University*

ArcelorMittal Dofasco

Citizens

City of Hamilton - *Community Initiatives**

City of Hamilton Planning - *Community Planning*

City of Hamilton Public Works - *Office of Energy Initiatives*

City of Hamilton Public Works - *Transportation Demand Management**

Corr Research

Cycle Hamilton Coalition Inc.

Environment Canada*

Environment Hamilton

Green Venture

Hamilton Conservation Authority

Hamilton Industrial Environmental Association

Hamilton Port Authority

Hamilton Public Health Services

Health Canada*

The Lung Association

McKibbin Wakefield Inc.

McMaster Institute for Healthier Environments

Ministry of Environment Conservation and Parks (MECP)

- *Hamilton Regional Office*

Mohawk College*

Ontario Environmental Assessment Corporation (OEAC)

Stelco

* indicates "observing member"



This report and the work of our members is dedicated to the memory of Clean Air Hamilton member

Peter Chernets (1949—2019)

Clean Air Hamilton, December 2019

Production: Public Health Services
City of Hamilton

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Robert Thompson Building

Phone: 905-546-2424 Ext. 1275

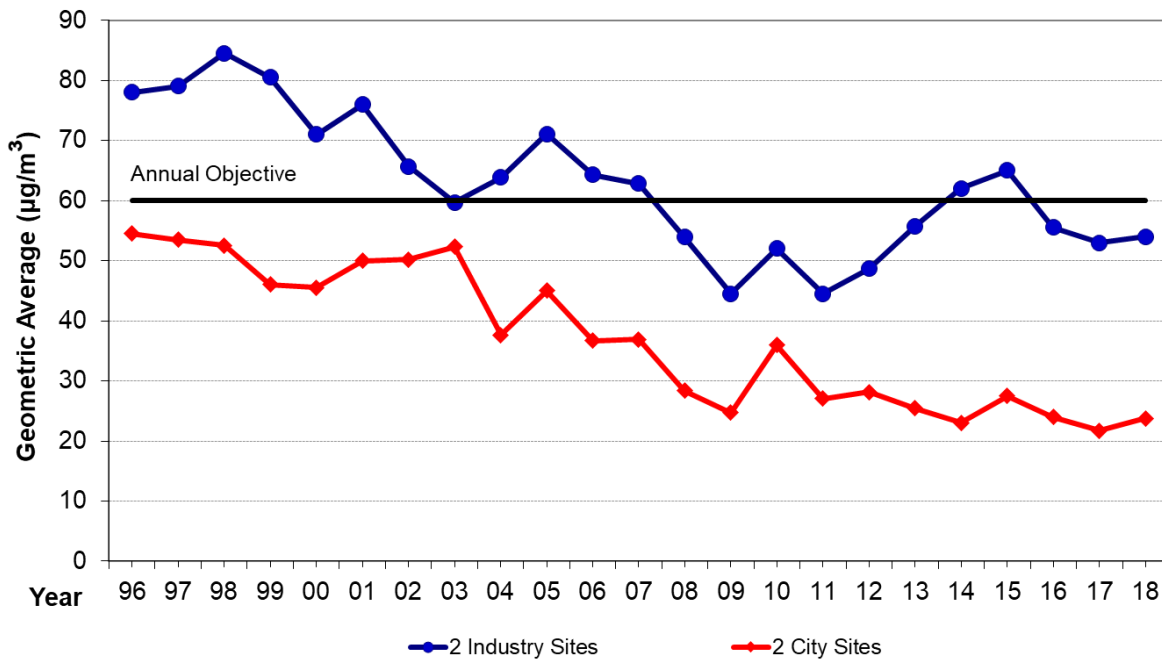
Email: cleanair@hamilton.ca

or visit our website:

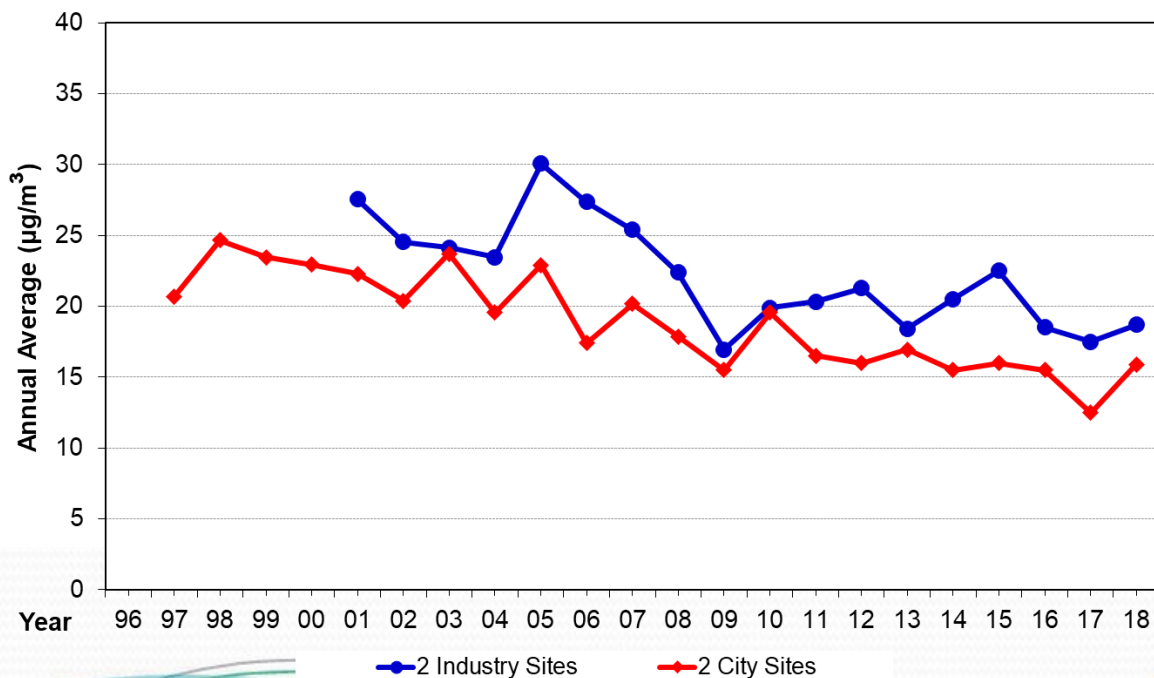
www.cleanairhamilton.ca

Appendix "A" - Hamilton's Air Quality Trends 2018

Total Suspended Particulate (TSP) Trend

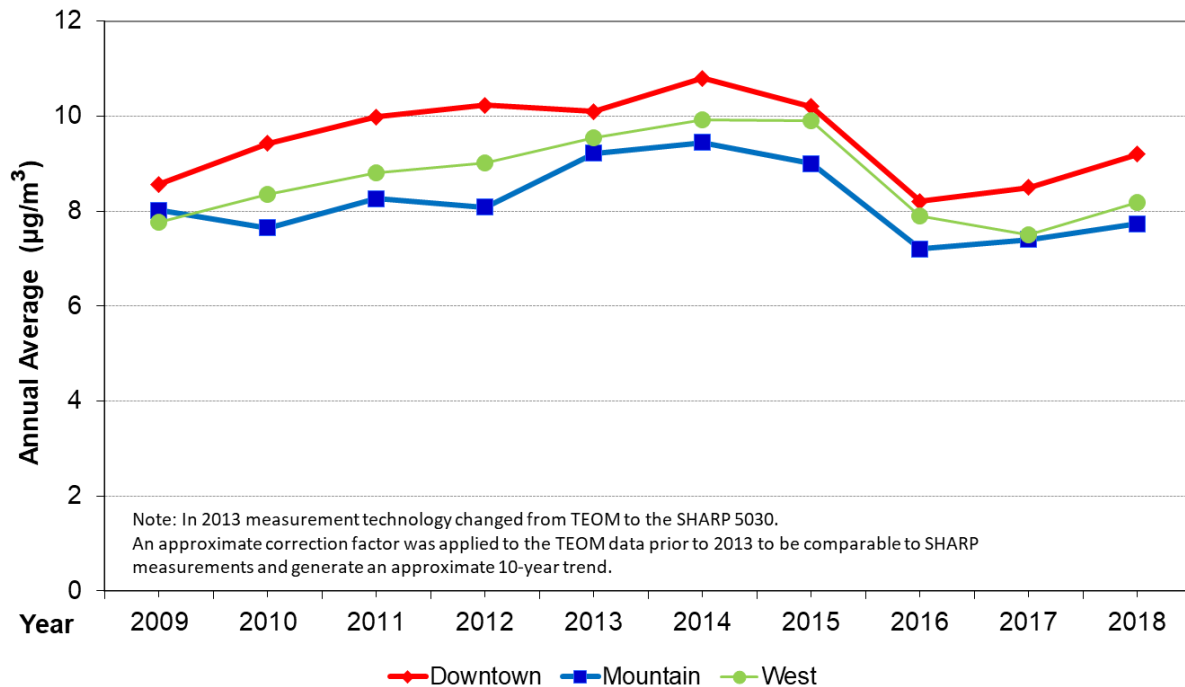


Inhalable Particulate (PM_{10}) Trend

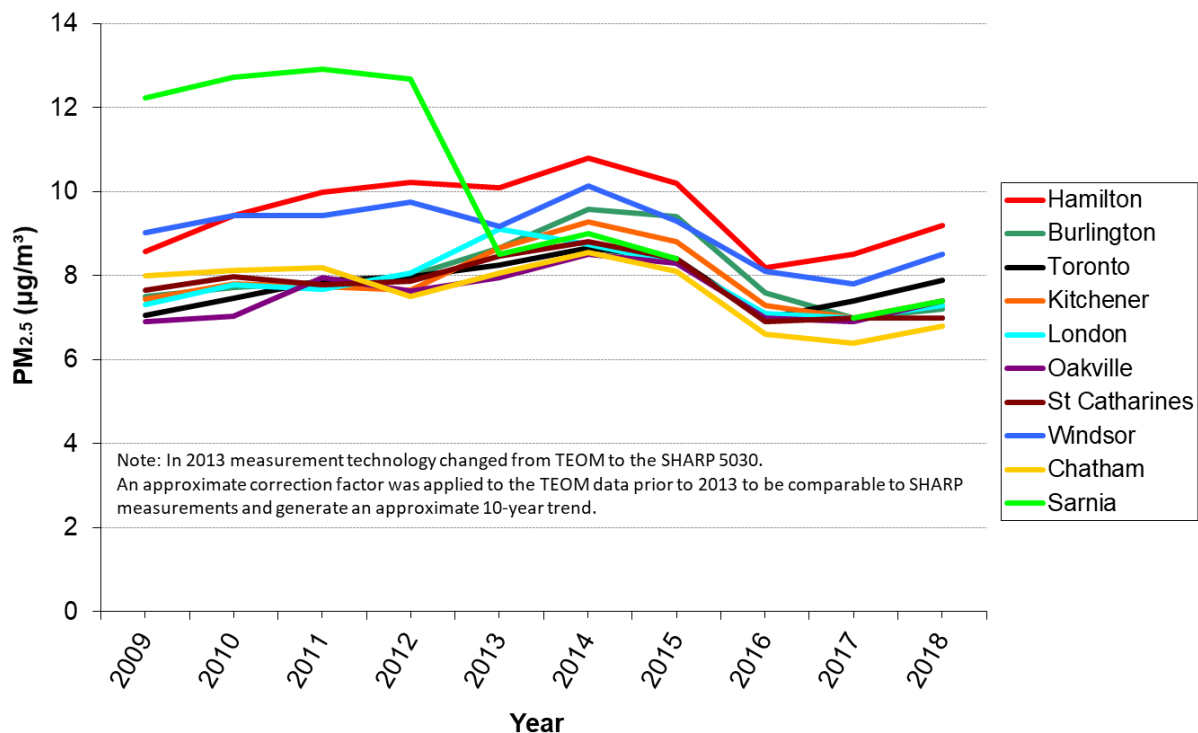


Appendix "A" - Air Quality Trends 2018 Cont.

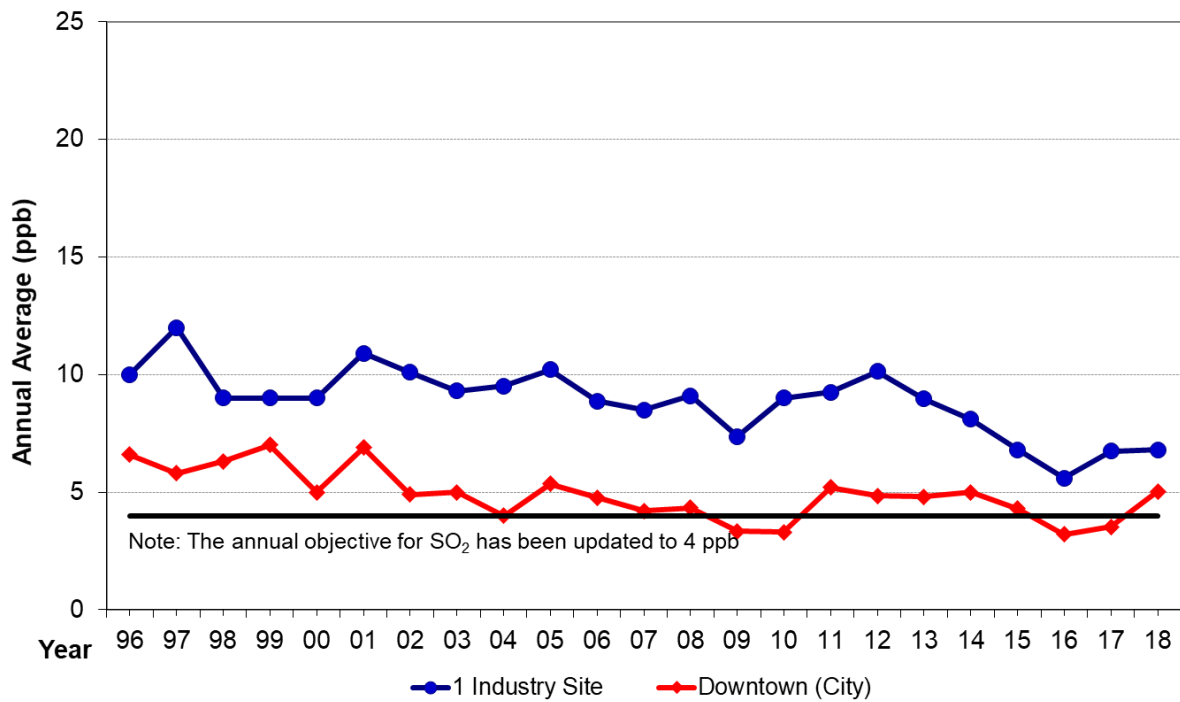
Respirable Particulate (PM_{2.5}) Trend



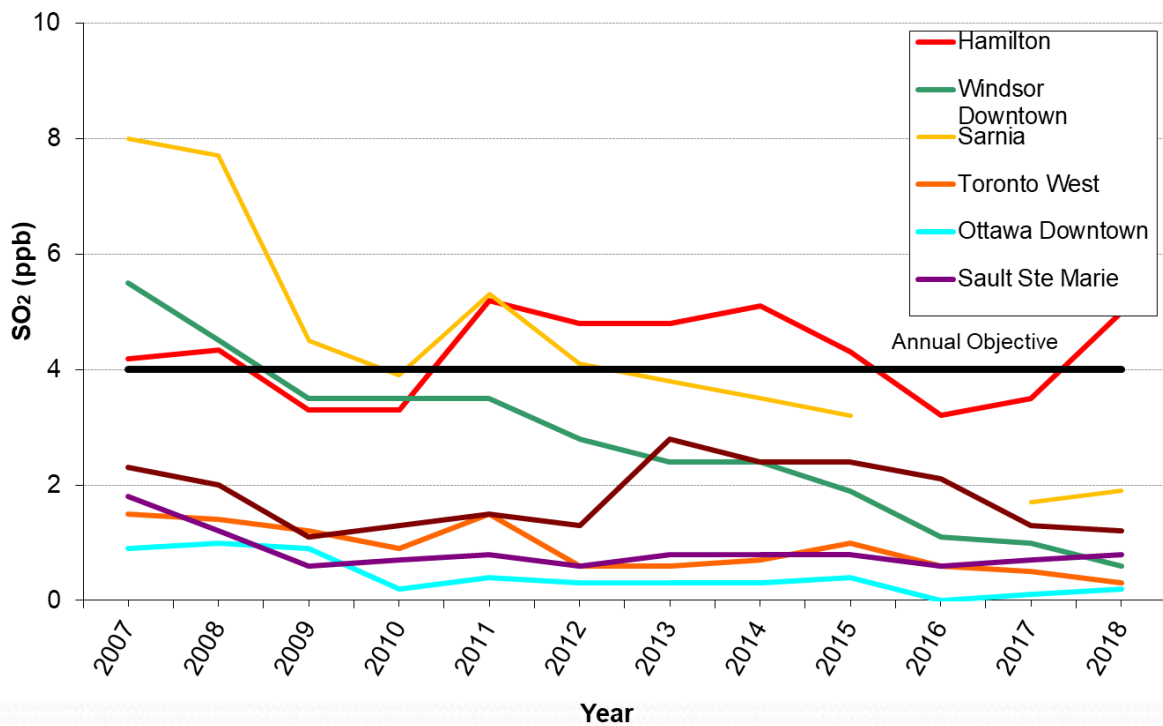
10-Year Trends for PM_{2.5} (Ten Ontario Cities)



Sulphur Dioxide Trend



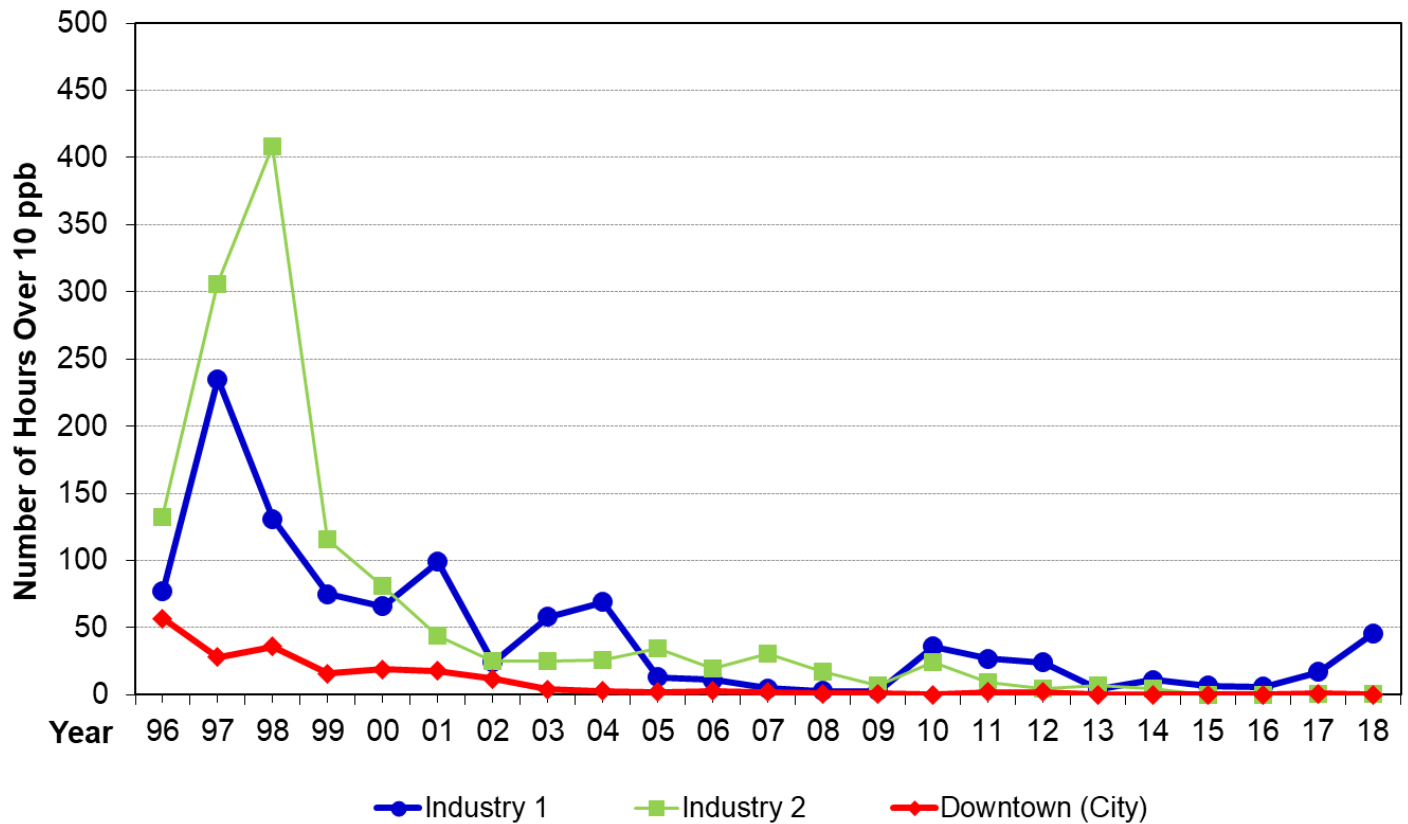
11-Year Trends for Sulphur Dioxide (Seven Cities)



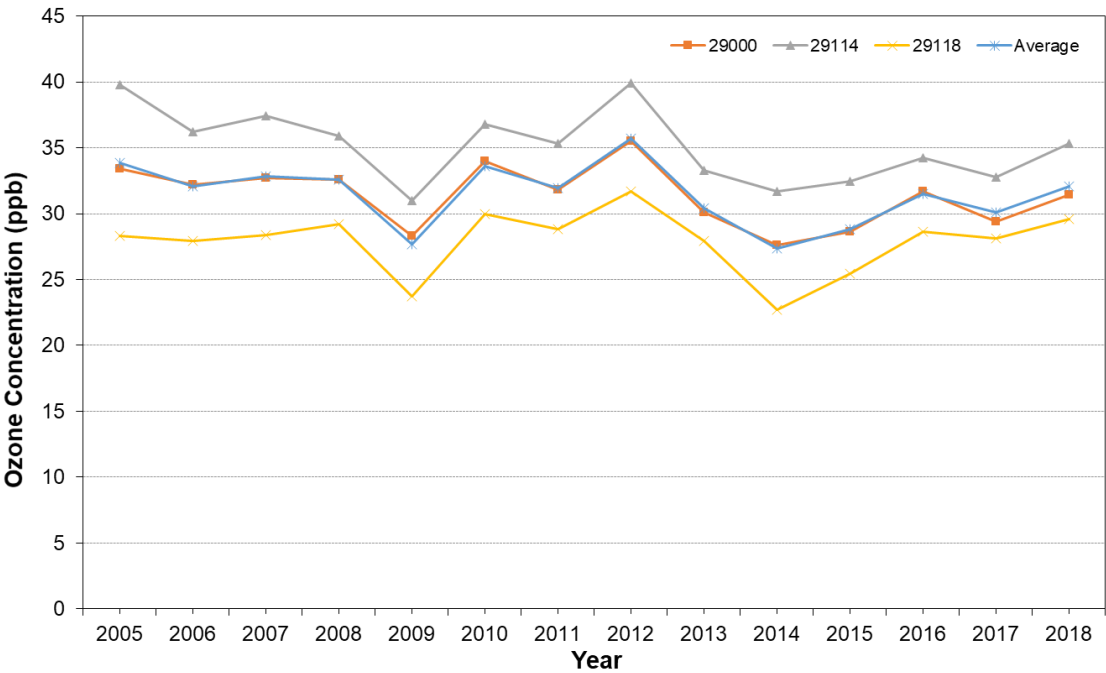
Appendix "A" - Air Quality Trends 2018 Cont.

Total Reduced Sulphur Trend

Hours Over 10 ppb Odour Threshold



Ground Level Ozone Trend

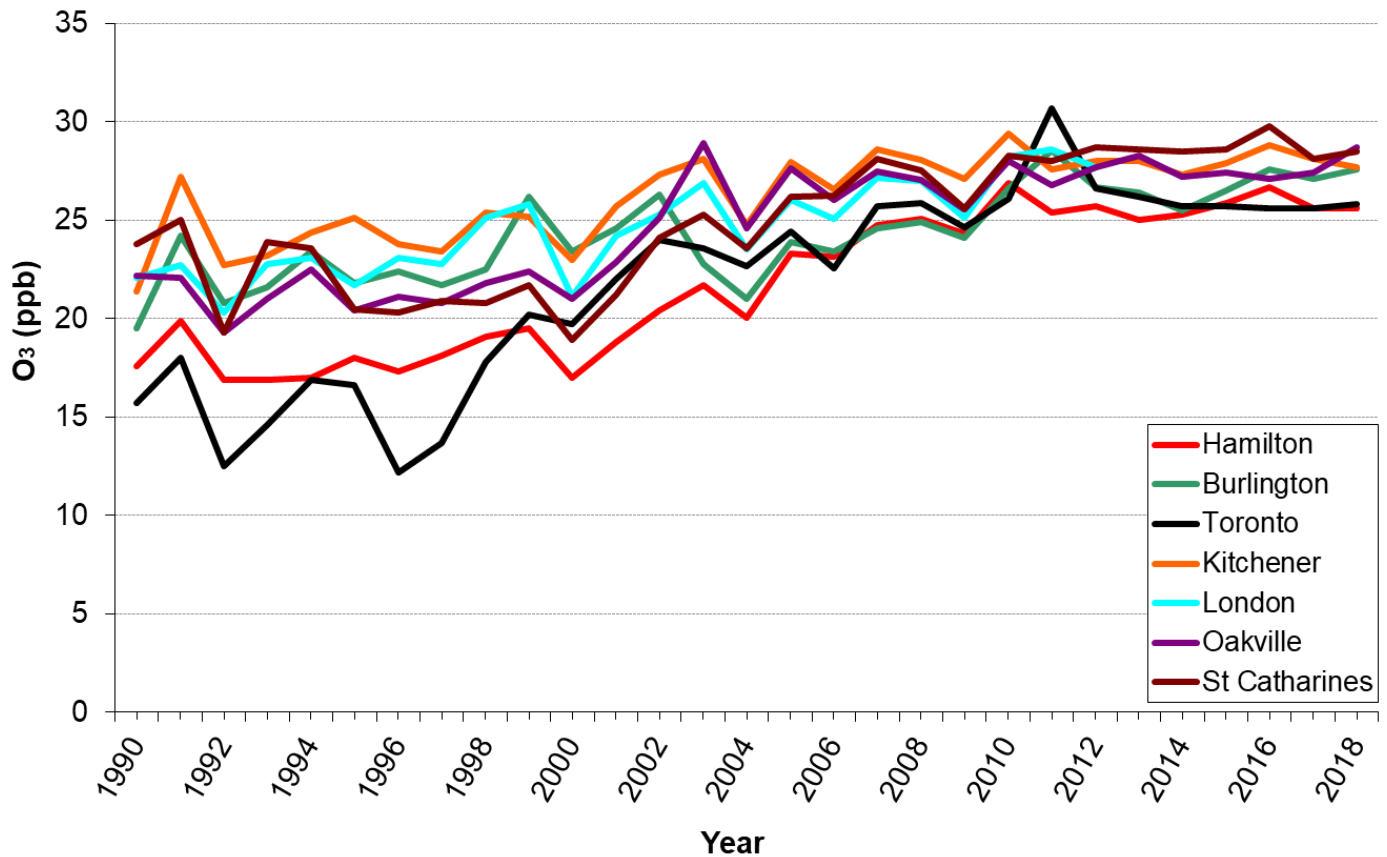


Ground Level Ozone Trend
Number of Hourly Exceeds >50 ppb 3 station average

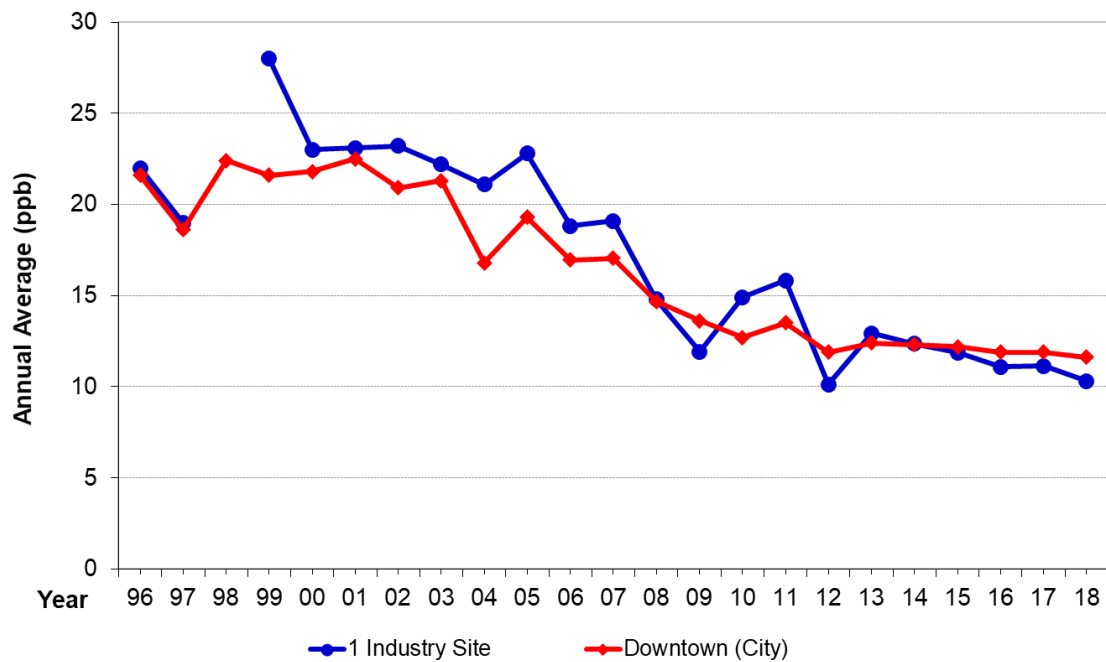


Appendix "A" - Air Quality Trends 2018 Cont.

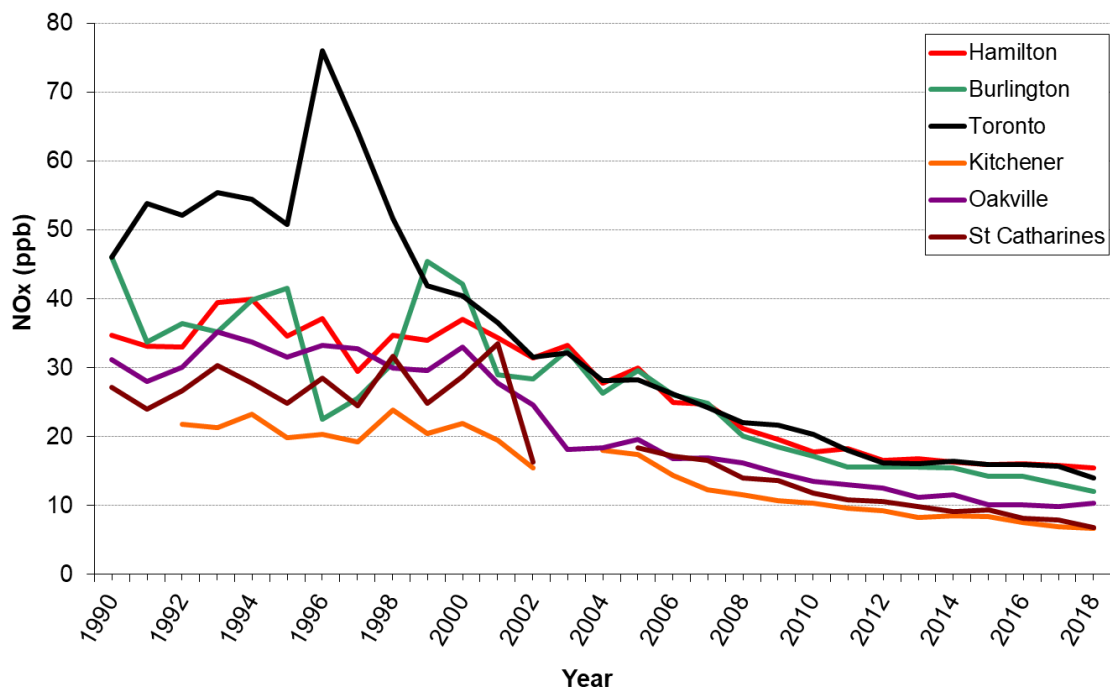
28-Year Trends for Ozone (Seven Cities)



Nitrogen Dioxide Trend

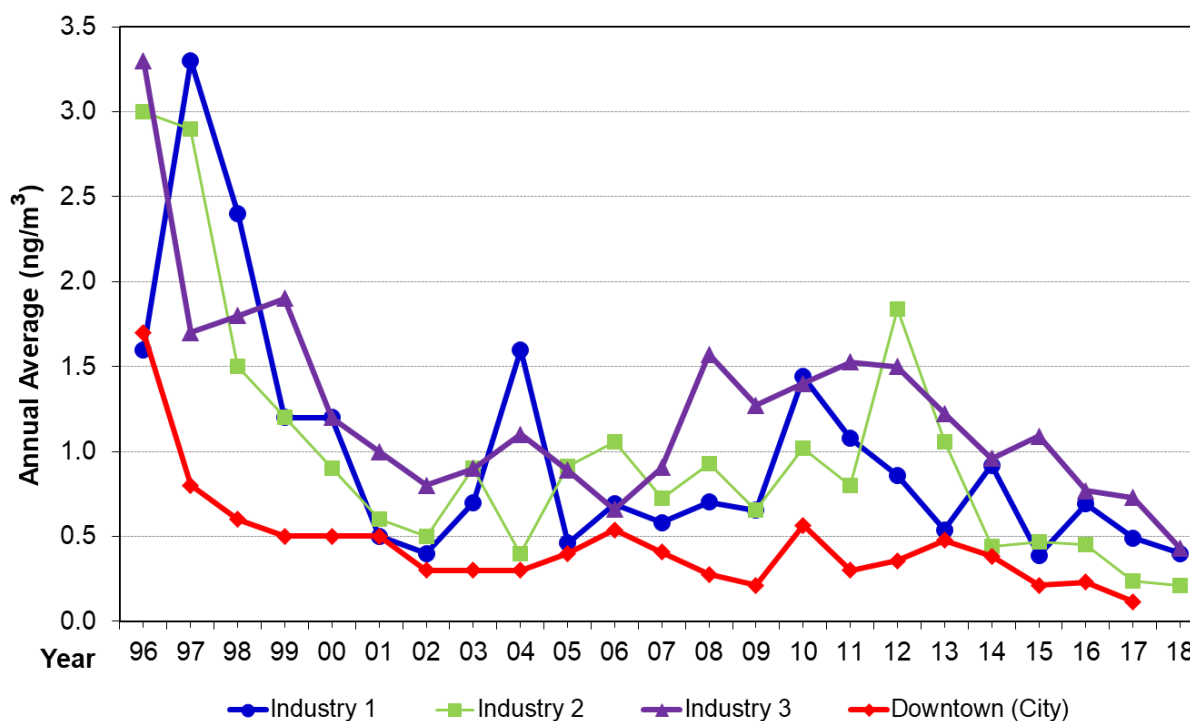


28-Year Trends for Nitrogen Oxides (Seven Cities)



Appendix "A" - Air Quality Trends 2018 Cont.

Benzo(a)pyrene Trend



Benzene Trend

