Technical Memorandum

2019 Mobile Air Monitoring Survey of St. Marys Cement (St. Marys, Ontario)

Ontario Ministry of the Environment, Conservation and Parks

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Executive Summary

- The Ontario Ministry of the Environment, Conservation and Parks conducted real time air monitoring in the vicinity of St. Marys Cement located in St. Marys, Ontario over five days on June 20, June 24, June 27, and July 4 and August 20, 2019 using two mobile air monitoring vehicles. This survey was a continuation of previous mobile air monitoring completed near St. Marys Cement in 2017 and 2018.
- Concentrations of volatile organic compounds (VOCs), nitrogen dioxide (NO_2) and particulate matter 10 micrometres or less in diameter (PM_{10}) were measured, along with meteorological conditions, at several locations upwind and downwind of St. Marys Cement.
- Half-hour average concentrations of benzene, toluene, styrene, xylenes, trimethylbenzene, NO_2 and PM_{10} up to 1.7, 6.8, 6.3, 23.0, 13.4, 32 and 44 µg m^{-3}, respectively, were observed during stationary measurements downwind of the facility. Downwind concentrations were close to background concentrations on all five survey days.
- VOC measurements were compared to Ontario Regulation 419/05 – Local Air Quality (O. Reg. 419/04) air standards and Ambient Air Quality Criteria (AAQC) using converted half-hour assessment values where necessary. Concentrations of the measured pollutants did not exceed applicable O. Reg. 419 air quality standards, AAQC or converted assessment values during the Ministry's 2019 mobile air monitoring survey. Real time PM_{10} measurements were used for screening purposes only.

Survey Background

At the request of the London District Office, the Environmental Monitoring and Reporting Branch (EMRB) of the Ontario Ministry of the Environment, Conservation and Parks (MECP or Ministry) completed a mobile air monitoring survey near St. Marys Cement located in St. Marys, Ontario in 2019. The survey was requested in response to dust and odour complaints received from residents in the community. The purpose of the survey was to measure ambient concentrations of volatile organic compounds (VOCs), nitrogen dioxide (NO_2) and particulate matter (PM) and to compare the results to *Ontario Regulation 419/05 Air Pollution - Local Air Quality* (Ont. Reg. 419/05) air quality standards or guidelines and Ontario's Ambient Air Quality Criteria (AAQC) where applicable. Similar mobile air monitoring surveys were conducted using EMRB's Trace Atmospheric Gas Analyzer (TAGA) units in 2017 and 2018. The 2017 and 2018 findings were reported in the technical memoranda "2017 Mobile TAGA Survey in the vicinity of St. Marys Cement" and "2018 Mobile TAGA Survey in the vicinity of St. Marys Cement", respectively.

St. Marys Cement is located at 585 Water Street South, St. Marys, Ontario. It is a quarrying and cement processing facility (http://www.stmaryscement.com). The National Pollutant Release Inventory (NPRI) of Environment and Climate Change Canada (http://pollution-waste.canada.ca/national-release-inventory/archives/index.cfm) indicates that St. Marys Cement released 12 tonnes of benzene, 3.9 tonnes of toluene, 1.8 tonnes of styrene, 1.9 tonnes of xylenes, 1,478 tonnes of NO_2 and 80 tonnes of particulate matter smaller than 10 µm in diameter (PM_{10}) to the air in 2017.

St. Marys Cement is subject to O. Reg. 419/05 Schedule 3 standards or guidelines, which are based on annual or 24-hour averages. Ontario's AAQC are benchmarks used to assess general air quality resulting from all sources of a contaminant to air. They are based on effects on human health, vegetation, soil, visibility, odour detection and approaches taken by other jurisdictions. In general, these standards and benchmarks are set at protective levels and based on effects that occur after long-term exposure and therefore direct comparison of shorter-term measurements is not always appropriate. To give context to the mobile air monitoring results, O. Reg. 419/05 standards/guidelines/jurisdictional screening levels (found on the Ministry's Air Contaminants

Benchmarks List) and AAQC were converted to half-hour assessment values as described in Section 17 of the regulation (Appendix A). Since this conversion only considers meteorological variation and does not account for other factors, such as changes in facility operations, the calculated assessment values are for screening purposes only and cannot be used to determine non-compliance or whether an adverse health effect has occurred or will occur. Additional information on the use of the O. Reg. 419/05 air standards, guideline values, and other screening levels to interpret air monitoring results is provided in Appendix A.

Survey Methodology

Real-time air monitoring of VOCs was performed using two mobile TAGA units: a truck equipped with a mass spectrometer (Ionicon) featuring a Proton Transfer Reaction (PTR) source and a van equipped with a mass spectrometer (AB Sciex) using a Low Pressure Chemical Ionization (LPCI) source. Both units are calibrated for the quantification of aromatic hydrocarbons and chlorinated VOCs. Mobile monitoring was conducted while the TAGA vehicles were in motion to acquire measurement data in real time and to identify locations featuring the highest concentrations of pollutants in the vicinity of the facility. The mass spectrometers used here cannot separate the contributions of xylenes and ethylbenzene, and instead measure the sum of these species. For clarity xylenes/ethylbenzene are simply referred to as "xylenes" throughout. NO_2 concentrations were calculated as the difference between simultaneous NOx and NO measurements made using Thermo Scientific 42C analyzers. PM_{10} concentrations were also recorded for screening level purposes using a TSI Dusttrak DRX Aerosol Monitor. Site selection for stationary measurements was based on mobile monitoring results, meteorological conditions and odour observations by TAGA staff. One half-hour concentration of VOCs measured by the TAGA is the average of 360 five-second readings. Concentrations of VOCs, NO_2 and PM_{10} were determined upwind and downwind of St Marys Cement while the mobile unit was stationary.

Mobile Monitoring Results

Air monitoring near St. Marys Cement was conducted over five days on June 20, June 24, June 27, July 4 and August 20, 2019. No odours were noted by the TAGA staff upwind of the facility

however mild odours were noted occasionally downwind of the facility. TAGA staff also observed visible dust downwind of the facility and resuspended dust caused by passing vehicles. An example of benzene mobile monitoring data made while driving around the facility on August 20 from 12:16 to 12:31 is shown in Figure 1. Benzene concentrations were at background levels both upwind and downwind of the facility, with small increases of up to 2.1 µg m^{-3} caused by passing vehicles. PM_{10} measurement data from the same monitoring period is shown in Figure 2. PM_{10} concentrations are also at background levels upwind and downwind of the facility, with increases of up to 50 µg m^{-3} caused by resuspended dust from passing vehicles. The PM_{10} concentrations reported here are considered screening level due to accuracy limitations of the Dusttrak instrument (Kingham et al., 2006; Yanosky et al., 2002). NO_2 measurement data, again from the same monitoring period, are shown in Figure 3. Elevated NO_2 concentrations of up to 28 µg m^{-3} were observed directly downwind of St. Marys Cement, while upwind concentrations were at background levels, and the NO_2 plume is visible to the north-northeast of the facility in Figure 4. The observation of elevated NO_2 downwind of St. Marys Cement confirms that this facility is a source of NO_2, consistent with reported NPRI data.

Figure 1: Mobile monitoring of benzene near St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, August 20, 2019. The wind was from the south-southwest during these measurements (12:16-12:31). The maximum instantaneous concentration of benzene observed was 2.1 µg m^{-3}.

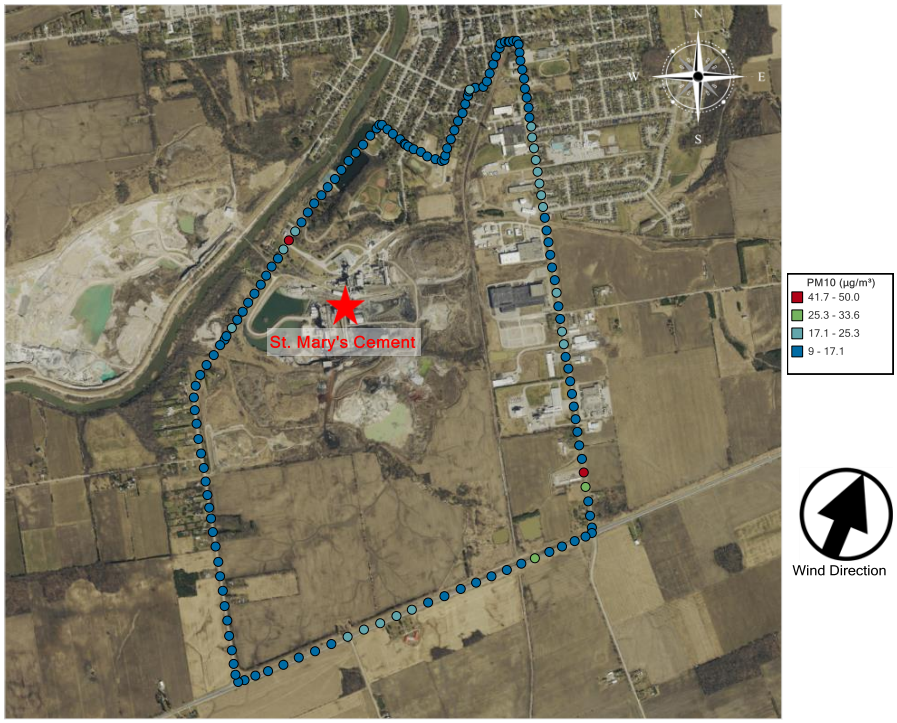

Figure 2: Mobile monitoring of PM_{10} near St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, August 20, 2019. The wind was from the south-southwest during these measurements (12:16-12:31). The maximum instantaneous concentration of PM_{10} observed was 50 µg m^{-3}.

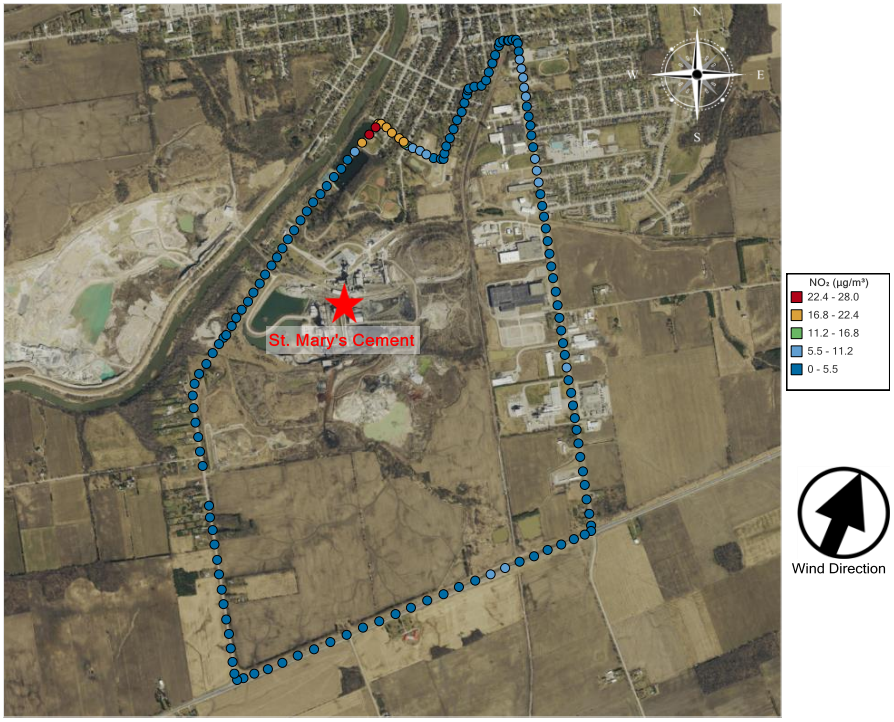

Figure 3: Mobile monitoring of NO_2 near St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, August 20, 2019. The wind was from the south-southwest during these measurements (12:16-12:31). The maximum instantaneous concentration of NO_2 observed was 28 µg m^{-3}.

Stationary Monitoring Results

The locations used for stationary monitoring are shown in Figure 4. In total, 21 half-hour measurements of concentrations of five VOCs (benzene, toluene, styrene, xylenes, trimethylbenzene), NO_2 and particulate matter (PM_{10}) were collected at several sites downwind of St. Marys Cement. Tables 1 (upwind) and 2 (downwind) summarize the data collected during the mobile air monitoring survey including sampling times, monitoring sites, on-site meteorological data and half-hour average concentrations. Average downwind concentrations of VOCs, NO_2 and PM_{10} were similar to upwind concentrations on all five survey days. Table 3 highlights the highest half-hour concentrations of the five VOCs and NO_2, their respective converted half-hour assessment values, and their respective standards and guidelines. Ambient concentrations of the measured VOCs did not exceed applicable O. Reg. 419 air quality standards, guidelines, AAQC or converted assessment values during the 2019 survey.

Figure 4: Stationary monitoring sites near St. Marys Cement, St. Marys, Ontario used during the TAGA air monitoring survey 2019.

Table 1: Ten-minute average stationary measurement concentrations of VOCs and PM_{10} upwind of St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, June-August 2019.

Date	Start Time (1)	Site (2)	Wind direction (from) (3)	Wind speed (km h^{-1}) (3)	Benzene (4)	Toluene (4)	Styrene (4)	Xylenes (4)	Trimethyl-benzenes (4)	NO_2 (4,5)	PM_{10} (4,6)
June 20, 2019	10:57	A	NE	13	<0.3	<0.4	<0.3	<0.4	<0.3	n. m.	n. m.
June 24, 2019	11:09	A	S	13	1.3	5.3	2.7	15.0	10.8	78	19
June 27, 2019	11:37	B	W	6	0.5	0.9	0.7	3.0	1.8	40	18
July 4, 2019	11:37	F	SE	11	0.4	1.3	0.8	3.8	2.0	0	28
August 20, 2019	12:05	B	SW	6	0.7	2.1	1.1	5.6	2.7	6	14

Notes:
(1) Local starting time for each ten-minute sampling period.
(2) Monitoring sites upwind of the facility - see Figure 4.
(3) Weather conditions were recorded on-site by meteorological equipment on-board the mobile unit (average of 10 one-minute readings).
(4) Concentrations are in micrograms per cubic metre (µg m^{-3}).
(5) Concentrations converted from ppb to µg m^{-3} using on-board ambient temperature and pressure data.
(6) Concentrations are for screening purposes only.
n. m. = not measured

Table 2: Half-hour average stationary measurement concentrations of VOCs, NO_2 and PM_{10} downwind of St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, June-August 2019.

Date	Start Time (1)	Site (2)	Wind direction (from) (3)	Wind speed (km h^{-1}) (3)	Benzene (4)	Toluene (4)	Styrene (4)	Xylenes (4)	Trimethyl-benzenes (4)	NO_2 (4,5)	PM_{10} (4,6)
June 20, 2019	11:35	B	NE	12	<0.3	0.7	0.7	0.9	0.5	n. m.	n. m.
	12:05	B	NE	11	<0.3	0.5	0.6	0.7	0.6	n. m.	n. m.
	12:35	B	NE	10	<0.3	0.6	<0.3	0.9	0.6	n. m.	n. m.
	13:08	C	ENE	12	<0.3	<0.4	0.4	0.6	0.5	n. m.	n. m.
	13:38	C	NE	11	<0.3	<0.4	<0.3	0.5	0.5	n. m.	n. m.
June 24, 2019	12:55	D	S	9	1.6	6.1	3.2	21.0	12.8	25	29
	13:25	D	S	5	1.7	6.8	3.3	22.5	13.4	10	43
	13:55	D	S	11	1.6	6.1	6.0	23.0	13.1	19	28
	14:25	D	S	10	1.6	5.5	6.3	22.3	12.0	15	44
June 27, 2019	11:55	E	W	5	0.6	1.0	0.7	3.2	1.8	32	15
	12:25	E	SSE	5	0.5	0.9	0.7	3.7	2.0	19	12
	12:55	E	S	6	0.4	0.9	0.7	3.8	1.9	8	12
	13:25	E	SW	5	0.5	0.9	0.8	4.2	2.0	18	16
July 4, 2019	12:17	G	S	4	0.5	1.2	0.7	3.0	1.9	15	34
	12:47	G	SW	5	0.5	1.3	0.8	4.0	2.2	17	29
	13:17	G	SW	4	0.7	1.2	0.9	4.0	2.2	28	27
	13:47	G	S	3	0.6	1.2	0.9	4.3	2.3	24	32
August 20, 2019	12:37	H	SSW	7	0.7	2.1	1.1	5.5	2.7	8	18
	13:07	H	SSW	8	0.6	2.0	1.1	5.6	2.5	5	19
	13:37	H	SSW	7	0.6	1.9	1.1	6.0	2.6	4	18
	14:07	H	SSW	8	0.6	1.9	1.1	6.3	2.7	4	23

Notes:
(1) Local starting time for each half-hour sampling period.
(2) Monitoring sites downwind of the facility - see Figure 4.
(3) Weather conditions were recorded on-site by meteorological equipment on-board the mobile unit (average of 10 one-minute readings).
(4) Concentrations are in micrograms per cubic metre (µg m^{-3}).
(5) Concentrations converted from ppb to µg m^{-3} using on-board ambient temperature and pressure data.
(6) Concentrations are for screening purposes only.
n. m. = not measured

Table 3: Summary of maximum half-hour concentrations of VOCs and NO_2 measured of St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, June-August 2019.

Pollutant	Survey highest half-hour concentration (1)	Converted half-hour Assessment Value (1,2)	O. Reg. 419/05 Standard/AAQC (3)
Benzene	1.7	6.8	0.45 (S, annual)
Toluene	6.8	5913	2000 (A, 24-hour)
Styrene	1.1	1183	400 (S, 24-hour)
Xylenes	23.0	2158	730 (S, 24-hour)
Trimethylbenzene	13.4	650	220 (S, 24-hour)
NO_2 (4)	32	591	200 (S, 24-hour)
PM_{10} (5)	44	149	50 (A, 24-hour)

Notes:
(1) Concentrations are in micrograms per cubic metre (µg m^{-3}).
(2) Converted half-hour assessment values are provided for comparison purposes only.
(3) Benchmarks for which a converted assessment value was calculated with respective averaging periods- (S) O. Reg. 419/05 Schedule 3 Standard, (A) AAQC.
(4) Concentrations converted from ppb to µg m^{-3} using on-board ambient temperature and pressure data.
(5) Concentrations are for screening purposes only.

Comparison of 2019 Results with Previous Mobile Monitoring Surveys

In addition to the 2019 survey, two previous mobile monitoring surveys were also performed in the vicinity of St. Marys Cement in 2017 and 2018. The same air pollutants were measured in all three surveys with the exception of NO_2 which was exclusively measured in 2019. The average concentrations of VOCs and PM_{10} measured downwind of St. Marys Cement during the three surveys are shown in Figure 5. It is important to note that differences in measured downwind concentrations between years do not necessarily represent changes in emission rates of these pollutants from St. Marys Cement. Downwind concentrations are also dependent on sampling location, meteorology and background air quality. Concentrations of the measured pollutants were broadly similar during each survey and did not exceed their respective half-hour converted assessment values for applicable standards or AAQC at any time during any of the three surveys.

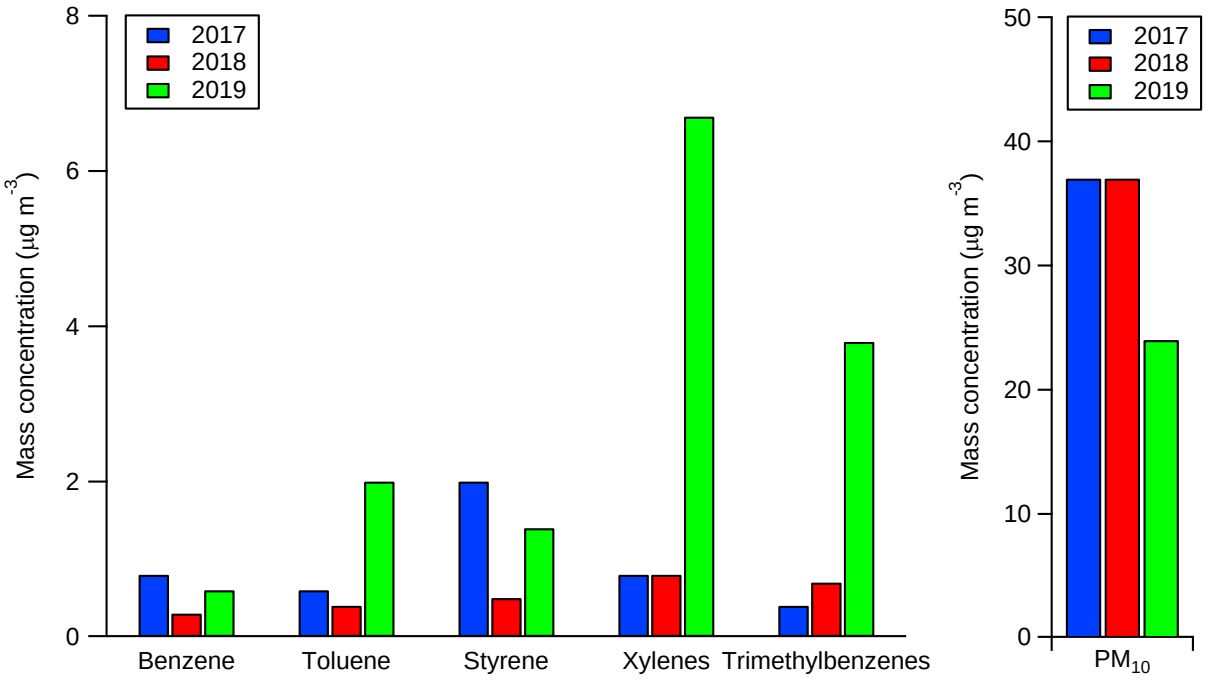

Figure 5: Average concentrations of VOCs and PM_{10} measured downwind of St. Marys Cement, St. Marys, Ontario during the 2017, 2018 and 2019 mobile air monitoring surveys.

Summary and Conclusions

The Ministry conducted real time air monitoring in the vicinity of St. Marys Cement located in St. Marys, Ontario in June-August 2019. Real-time mobile measurements of VOCs, NO_2 and PM_{10} were combined with concurrent Global Positioning System and meteorological data to produce spatial air pollutant maps. Half-hour average benzene, toluene, styrene, xylenes, trimethylbenzene, NO_2 and PM_{10} concentrations up to 1.7, 6.8, 1.1, 23.0, 13.4, 32 and 44 $\mu g\ m^{-3}$, respectively, were observed during stationary measurements downwind of the facility. Measured air pollutant concentrations were compared with Ontario Regulation 419/05 standards and AAQC using converted half-hour assessment values where applicable. The concentrations of the measured pollutants did not exceed their respective half-hour converted assessment values for applicable standards or AAQC during the survey period. The results of this survey are also consistent with similar surveys performed in 2017 and 2018.

Mobile monitoring surveys are relatively short in duration and provide a snapshot of air pollutant concentrations downwind of industrial sources over a period of a few days, with an emphasis on VOC concentrations. A more comprehensive assessment of air quality impacts of the St. Marys Cement facility is provided in the Ministry's Technical Memorandum "2017-2018 Airpointer Survey of St. Marys Cement (St. Marys): Final Report". Briefly, continuous measurements of nitrogen oxides, SO_2 and particulate matter were performed at a site in a residential area of St. Marys between July 2017 and December 2018. The results of this long-term deployment demonstrate that although St. Marys Cement is a likely contributor to concentrations of SO_2, NO_2, and particulate matter measured at the site, the concentrations observed are similar to those measured at other comparable Ministry AQHI ambient air monitoring stations.

References

Kingham, S., Durand, M., Aberkane, T., Harrison, J., Gaines Wilson, J., & Epton, M. (2006). Winter comparison of TEOM, MiniVol and DustTrak PM10 monitors in a woodsmoke environment. *Atmospheric Environment, 40*(2), 338-347.

Yanosky, J. D., Williams, P. L., & MacIntosh, D. L. (2002). A comparison of two direct-reading aerosol monitors with the federal reference method for PM2.5 in indoor air. *Atmospheric Environment, 36*(1), 107-113.

Appendix A

Conversion of O. Reg 419/05 Standards/Guidelines/Jurisdictional Screening Levels and Ontario's Ambient Air Quality Criteria (AAQC) to Converted Assessment Values

To compare a short-term monitoring value to a benchmark with a longer averaging period a conversion factor was applied. Conversion factors were calculated using the method described in Section 17 of O. Reg. 419/05. This conversion only takes meteorological variation into account.

Calculation of a Conversion Factor for monitoring periods shorter than the averaging period specified by the standard/guideline/jurisdictional screening level or AAQC.

$(t_0 \div t_1)^n$

t_0 = the averaging period specified by the standard/guideline, expressed in hours
t_1 = the averaging period used for monitoring, expressed in hours
n = 0.28

The standard is multiplied by this calculated conversion factor to give a Converted Assessment Value

Use of the O. Reg. 419/05 air standards, guideline values, AAQC and other screening levels to interpret air monitoring results

Ontario regulates contaminants released to air by various sources, including local industrial and commercial facilities, to limit exposure to substances that can affect human health and the environment. The Ministry's *Ontario Regulation 419/05 – Local Air Quality* (O. Reg. 419/05) air standards, guideline values, and other screening levels are found on the Air Contaminants Benchmarks List. These standards and guidelines are used under the general provisions of the *Environmental Protection Act*, including compliance purposes under O. Reg. 419/05. These values are, however, sometimes used to interpret air quality outside of the purposes of O. Reg. 419/05.

Ontario's AAQC are benchmarks used to assess general air quality resulting from all sources of a contaminant to air. They are based on effects on human health, vegetation, soil, visibility, odour detection and approaches taken by other jurisdictions. They are set at concentrations that are protective against adverse effects.

Many of the applicable standards or guidelines are based on annual or 24-hour averages. In general, they are set at protective levels and based on effects that occur following long-term exposure. Therefore, direct comparison of short-term measurements is not always appropriate. To give context to the short-term monitored results (i.e., half-hour TAGA survey measurements), applicable O. Reg. 419/05 standards or guidelines are converted to half-hour assessment values, as described in Section 17 of O. Reg. 419/05. Since this conversion only considers meteorological variation and not factors such as changes in facility operations, these calculated assessment values are for screening purposes only, and cannot be used to determine non-compliance or whether an adverse health effect has occurred or will occur. However, these calculated assessment value comparisons can be used to provide context to monitoring results. Short-term monitoring results that are elevated with respect to the assessment values may be used to flag potential issues worthy of further investigation.

In these situations, monitoring results that are elevated with respect to the half-hour assessment values do not necessarily indicate that an adverse effect has occurred or will occur. Rather, an air quality analyst or risk assessor should consider, on a case-specific basis, whether there is potential for adverse effects when using the converted O. Reg. 419/05 standards or guidelines to interpret air monitoring data. This could include considerations of the nature of the contaminant, how the air limits were developed, supplementary monitoring or air dispersion modelling, or other elements typical of a human health risk assessment (i.e., frequency, magnitude and duration of elevated values).

For additional details regarding the development of the Ministry's air standards, and the Ministry's framework for managing risk, please refer to the following document: *Guideline A-12: Guideline for the Implementation of Air Standards in Ontario* (GIASO).
https://www.ontario.ca/page/guideline-12-guideline-implementation-air-standards-ontario