Technical Memorandum

2017-2018 Monitoring Survey in the Vicinity of St. Marys Cement: Interim Report

Ontario Ministry of the Environment & Climate Change

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Survey Background

At the request of the Ministry of the Environment and Climate Change's (MOECC or Ministry) London District Office, the Environmental Monitoring and Reporting Branch (EMRB) initiated an air monitoring survey of in the vicinity of St. Marys Cement, located at 585 Water Street South, St. Marys, Ontario, starting on July 5, 2017. The objective of this survey is to measure concentrations of sulphur dioxide (SO_2), particulate matter (PM) and nitrogen oxides (NO_X) in ambient air in the vicinity of St. Marys Cement over a period of at least one year. This interim report summarizes the first three months of data collected.

Summary of Activities

One monitoring site, using a temporary compact air monitoring station (Airpointer), was established for use in this survey. The air monitoring station was installed at the St. Marys Fire Department, which is located north east of the facility in a residential area of St. Marys (See Appendix A, Figure 1). The Airpointer was installed on July 5, 2017 with collection of valid real-time data starting on July 11, 2017. The air monitoring station is outfitted with sulphur dioxide (SO_2), nitrogen oxides (NO_X) and particulate matter air monitoring instrumentation along with an anemometer for local wind measurements.

The monitoring site was established in an area of the community that has voiced concern about the potential impacts of emissions from St. Marys Cement and is predominantly in a downwind position from the facility based on local wind patterns.

Comparison to Benchmarks

Sulphur Dioxide (SO_2)

Sulphur dioxide measurements are taken on a real-time, 1-minute average basis. Concentrations measured between July 11, 2017 and October 11, 2017 have been compared to applicable air quality standards found under *Ontario Regulation 419/05 – Local Air Quality* (O. Reg. 419/05) and Ontario's Ambient Air Quality Criteria (AAQCs). No exceedances of the air quality standards or AAQCs were measured at the station over the initial three month period. A summary of these measurements and the comparison to the air quality standards and AAQCs can be found in Table 1 and Table 6, Appendix B. For informational purposes, sulphur dioxide measurements were also compared to the proposed, updated SO_2 air quality standards and AAQCs, currently posted on the Environmental Registry for public comment. No levels were measured above the proposed standards and AAQCs. A summary of this comparison can be found in Table 2, Appendix B.

Nitrogen Oxides (NO_X)

Nitrogen oxides measurements are taken on a real-time, 1-minute average basis. Concentrations measured between July 11, 2017 and October 11, 2017 have been compared to applicable O. Reg. 419/05 air quality standards and AAQCs. No exceedances of the standards or AAQCs were measured at the station during the initial three month period. A summary of these measurements and comparison data can be found in Tables 3 and 6, Appendix B.

Particulate Monitoring ($PM_{2.5}$/PM_{10})

Particulate measurements are taken on a real-time, 1-minute average basis. Between July 11, 2017 and August 23, 2017 the particulate monitoring instrument was outfitted with a $PM_{2.5}$ size selective inlet which measures particulate matter with an aerodynamic diameter of less than 2.5 µm. After August 24, 2017, the size selective inlet was changed to PM_{10} that allows particles of less than 10 µm in aerodynamic diameter to be measured. Concentrations have been compared to applicable AAQCs. No exceedances of the AAQCs were measured at the station for $PM_{2.5}$ between July 11, 2017 and August 23, 2017. No exceedances of the AAQCs were measured at the station for PM_{10} between August 24, 2017 and October 11, 2017. A summary of these measurements and comparison data can be found in Tables 4, 5 and 6 of Appendix B.

Source Identification

Meteorological parameters are measured concurrently with the sulphur dioxide (SO_2), nitrogen oxides (NO_X) and particulate ($PM_{2.5}$/PM_{10}) measurements to assist in determining the potential source of emissions. The meteorological sensor is integrated with the Airpointer air monitoring station using a 2.5 m high tower. This height conforms to acceptable sighting requirements for tripod-mounted or temporary wind sensors (Operations Manual for Air Quality Monitoring in Ontario, PIBS 6687e); however these types of sensors are more subject to influence from surrounding topography and can thus be more representative of a microclimate. There was good correlation however with regional wind direction when the measurements were compared to other permanent meteorological towers in the area. Wind speed data collected by the Airpointer air monitoring station however were lower than measurements collected by the permanent regional meteorological towers indicating significant influence from the surrounding topography.

To visually assess potential emission sources, pollution roses have been created from the 1-hour average meteorological and pollutant data using valid data from July 11, 2017 to October 11, 2017. Pollution roses are a graphical representation of how pollutant concentration and wind direction are distributed at a particular location over a specified period of time. The data are plotted using a polar coordinate system. The spokes of the pollution rose indicate the direction from which the wind is coming and are divided into five degree increments. The length of the spoke shows the frequency of a particular wind direction expressed as a percentage of time as indicated by the horizontal axis scale. Each spoke is further divided into colour coded bands that indicate pollutant concentration ranges measured and their frequency.

Sulphur Dioxide (SO_2)

The pollution rose for sulphur dioxide shows that, for the majority of time, concentrations were ≤ 5 µg/m^3, indicated by the turquoise colour in the spokes (Appendix A, Figure 2). At times concentrations were measured between 5 and 10 µg/m^3 (green) for all wind directions other than the north and northwest. During a small percentage of time concentrations were measured between 10 and 25 µg/m^3 (purple) and up to 25 to 50 µg/m^3 (navy blue), but generally only when winds were from the southwest. Although no exceedances of the applicable standards or AAQC for sulphur dioxide were reported, areas in the vicinity of the air monitoring station occasionally

experienced SO_2 levels above typical background levels when winds were from the southwest, coming from the direction of St. Marys Cement.

The average SO_2 concentrations are similar to the average ambient SO_2 measurements collected by the MOECC's Windsor Downtown Air Quality Health Index (AQHI) air quality monitoring station for the same time period (Table 6, Appendix B). The Ministry's AQHI air monitoring stations have been located in cities across Ontario to determine the current state of ambient air quality within those communities. The St. Marys temporary air station measured an average SO_2 concentration of 2.4 $\mu g/m^3$ while the average SO_2 concentration measured by the Ministry's Windsor AQHI air monitoring station was 2.2 $\mu g/m^3$. The Windsor station, while indicative of general ambient air in Windsor, does show some influence from nearby heavy industry (e.g. Zug Island) and vehicular traffic on the Ambassador Bridge. The St. Marys station average SO_2 concentration was about half the measured value of the average SO_2 concentration measured at the Ministry's Hamilton Mountain AQHI air monitoring station (5.3 $\mu g/m^3$) over the same time period. The Hamilton AQHI station, located away from the industrial area of the city, is still influenced by local sources including iron and steel making facilities which are known sources of SO_2. St. Marys Cement's Emission Summary and Dispersion Modelling (ESDM) report confirms that the facility is an emitter of SO_2. This suggests that St. Marys Cement is a likely source of SO_2 in the area surrounding the Ministry's temporary air monitoring station.

Nitrogen Oxides (NO_X)

The NO_X pollution rose (Appendix A, Figure 3) shows that measured concentrations fell within three concentration ranges for all wind directions; ≤ 5 $\mu g/m^3$ (turquoise), 5-10 $\mu g/m^3$ (green) and 10-50 $\mu g/m^3$ (purple). On a few occasions, concentrations were measured between 50 and 100 $\mu g/m^3$ (navy blue) when winds were from the southwest. The pollution rose indicates that multiple sources of NO_X are being measured at the temporary air monitoring station. St. Marys Cement's ESDM report confirms that the facility emits NO_X, however many sources in urban and industrial environments generate NO_X. While no exceedances of the applicable O. Reg. 419/05 air quality standards or AAQCs were measured, areas in the vicinity of the air monitoring station experienced levels higher than background from all directions. A higher percentage of the 10-50 $\mu g/m^3$ concentrations (purple) were measured when winds were from the southwest, the direction of St. Marys Cement, with the lowest percentage being measured during west winds.

The average NO_X concentration measured at St. Marys (6.6 $\mu g/m^3$) was similar to levels measured at the Ministry's AQHI stations located in nearby cities: London (8.1 $\mu g/m^3$) and Brantford (6.4 $\mu g/m^3$), and lower than stations that are influenced by heavy industry and/or significant contributions from vehicular traffic. The Ministry's Hamilton Mountain AQHI air monitoring station measured an average NO_X concentration of 12.8 $\mu g/m^3$ while the Ministry's Windsor Downtown AQHI station measured an average NO_X concentration of 17.9 $\mu g/m^3$. Other potential sources of NO_X exist between St. Marys Cement and the Ministry's temporary air monitoring station including some industrial facilities located on James St. S. and vehicular traffic. St. Marys Cement is likely a contributing source of NO_X in the vicinity of the air monitoring station.

Particulate Monitoring ($PM_{2.5}$/PM_{10})

St. Marys Cement's ESDM report states that they are an emitter of total suspended particulate. This confirms that they generate particulate matter, but specifics about particle size distribution are not given. Total suspended particulate (TSP) matter is typically measured with non-continuous measurement technology, averaged over a 24-hour period, whereas PM_{10} and $PM_{2.5}$ are often measured in real-time.

Real-time particulate matter measurements of PM_{10} and $PM_{2.5}$ were chosen for this survey over TSP since they are more relevant for this type of community monitoring. Larger particulate matter (>10 µm) tends to settle out of the air quickly, is not transported large distances, and is less likely to travel into the community. Additionally, source identification and potential health impacts are more easily assessed with real-time PM_{10} and $PM_{2.5}$ measurements.

The $PM_{2.5}$ pollution rose shows that between July 11, 2017 and August 23, 2017 there was no discernable difference in concentration levels measured at the station with varying wind direction (Appendix A, Figure 4). In addition, $PM_{2.5}$ measured at Ministry AQHI air monitoring stations in other communities showed similar concentrations over the same time period; the average $PM_{2.5}$ concentration measured at St. Marys was 7.7 µg/m^3 versus 7.1 µg/m^3 in London, 7.8 µg/m^3 in Brantford, 7.2 µg/m^3 at Hamilton Mountain, and 7.9 µg/m^3 at Windsor Downtown. This indicates that $PM_{2.5}$ measured at the St. Marys station was dominated by regional area background levels.

The PM_{10} pollution rose shows that there were modest differences in concentration levels measured at the temporary St Mary's air monitoring station with wind direction between August 24, 2017 and October 11, 2017 (Appendix A, Figure 5). The average PM_{10} concentration of during this time period was 14.1 µg/m^3. Measured concentrations fell within in three concentration ranges for all wind directions; $\leq$ 5 µg/m^3 (turquoise), 5-15 µg/m^3 (green) and 15-30 µg/m^3 (purple). Additionally, when winds were coming from the northeast, southwest, east and southeast, concentrations were measured in the 30 to 50 µg/m^3 concentration range (navy blue) with occasional measurements between 50 and 100 µg/m^3 (yellow). The largest percentage of concentrations measured in the 30 to 50 µg/m^3 range (navy blue) occurred when winds were from the northeast.

The pollution rose suggests that PM_{10} was being measured from multiple sources from various wind directions. While no exceedances of the province's AAQC were measured, areas in the vicinity of the temporary air monitoring station experienced levels higher than background from multiple directions. A higher percentage of the 30-50 µg/m^3 concentrations (navy blue) were measured when winds were from the northeast, with some contributions coming from the direction of St. Marys Cement (southwest). The lowest concentrations were measured during northwest winds.

Summary of Findings

Results from the Ministry's temporary air monitoring station established in St. Marys, Ontario by the MOECC have been presented and discussed in this interim report for the time period of July 11, 2017 to October 11, 2017.

Monitoring results were compared to the existing applicable O. Reg. 419/07 air quality standards and AAQCs for all parameters and to the newly proposed air quality standards and AAQCs for SO_2. No exceedances of the air quality standards or the AAQCs were measured at the monitoring station for the time period referenced. Additionally, no levels were measured above the newly proposed air quality standards and AAQCs for SO_2 currently posted on the Environmental Registry for public review and comment.

While pollutant levels did not exceed any provincial air quality standards or benchmarks, pollution roses did show that some measured levels were above background and that St. Marys Cement was a potential contributor to levels measured in the vicinity of the Ministry's temporary air monitoring station.

- St. Marys Cement is a likely source of SO_2. The pollution rose showed a discernable increase in levels when winds were coming from the direction of the facility.
- St. Marys Cement is a likely contributing source of NO_X along with other nearby industrial facilities and urban activities including vehicular traffic. The pollution rose showed that levels were slightly elevated when winds were from southwest of the monitoring station compared to other directions.
- $PM_{2.5}$ measured at the St. Marys station was dominated by regional area background levels. The $PM_{2.5}$ pollution rose shows no discernable difference in concentration levels measured at the station amongst different wind directions.
- The air monitoring station measured PM_{10} from multiple sources from various wind directions, with possible contributions from St. Marys Cement. There were slightly elevated concentrations when winds were coming from the northeast, southwest, east and the southeast, with the lowest concentrations occurring during northwest winds.

In summary, St Marys Cement is a potential contributor to the concentrations of SO_2, NO_x, and particulate matter measured at the Ministry's temporary air monitoring station established in St Marys for the time period referenced. The average concentrations of SO_2, NO_X and $PM_{2.5}$ levels are similar to concentrations measured at other comparable Ministry AQHI ambient air monitoring stations.

The area in the vicinity of the Ministry's temporary St Marys air monitoring station experienced periods of time where concentrations of these common air pollutants were above background levels. This is typical of urban areas or areas in proximity to industrial activities and/or transportation related sources.

This is an interim report that summarizes and discusses the first three months of data collected as part of a survey which will last at least one complete year. Further data collection over a full year will provide a more comprehensive dataset that will facilitate a more representative assessment of the air quality at the site including potential seasonal variations and fluctuations in emissions from contributing sources.

Appendix A: Maps and Pollution Roses

Figure 1: Temporary Air Monitoring Station St. Marys Ontario, July 11 to October 11, 2017

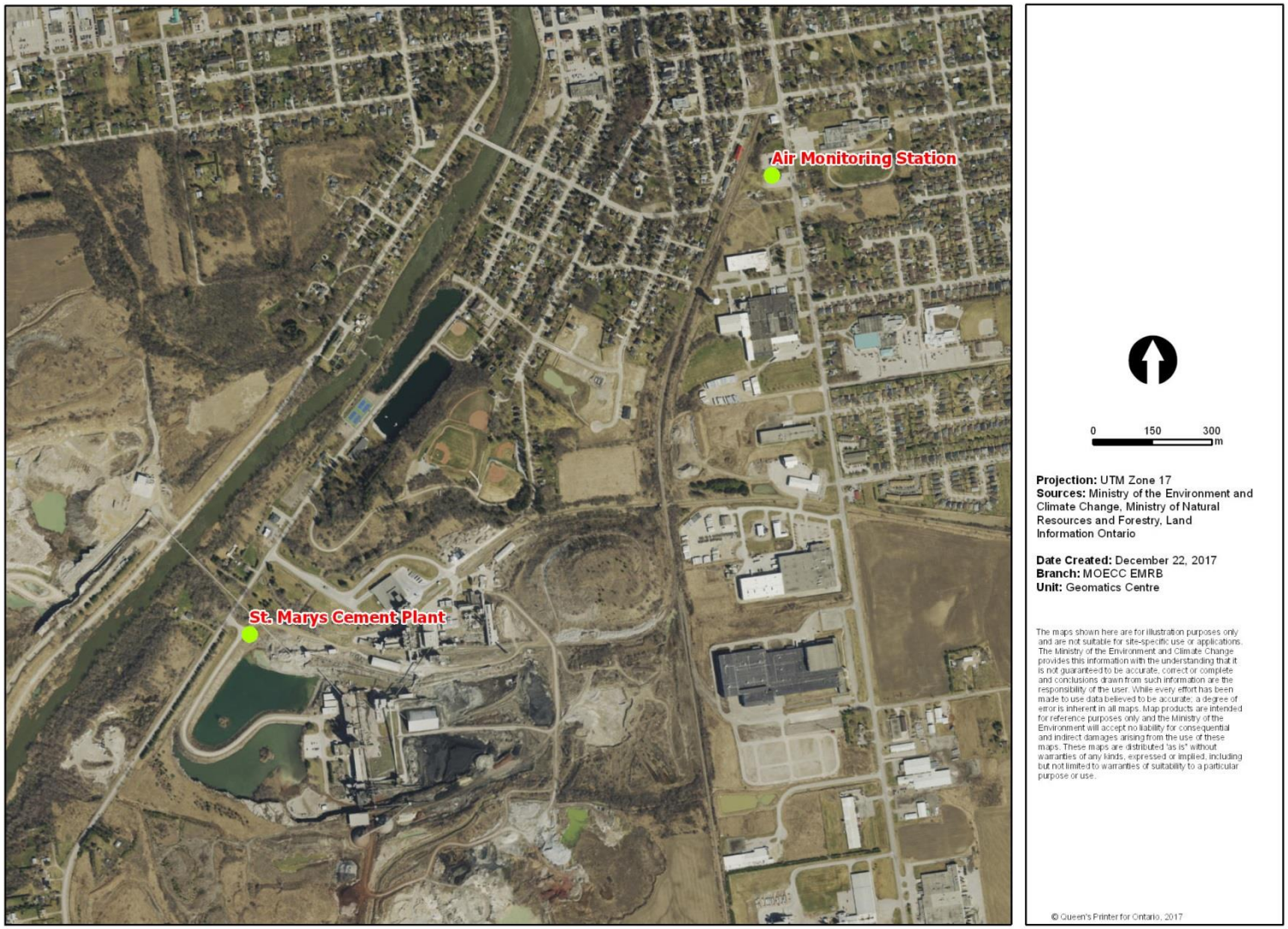


Figure 2: Pollution Rose for SO_2, St. Marys Ontario, July 11 to October 11, 2017

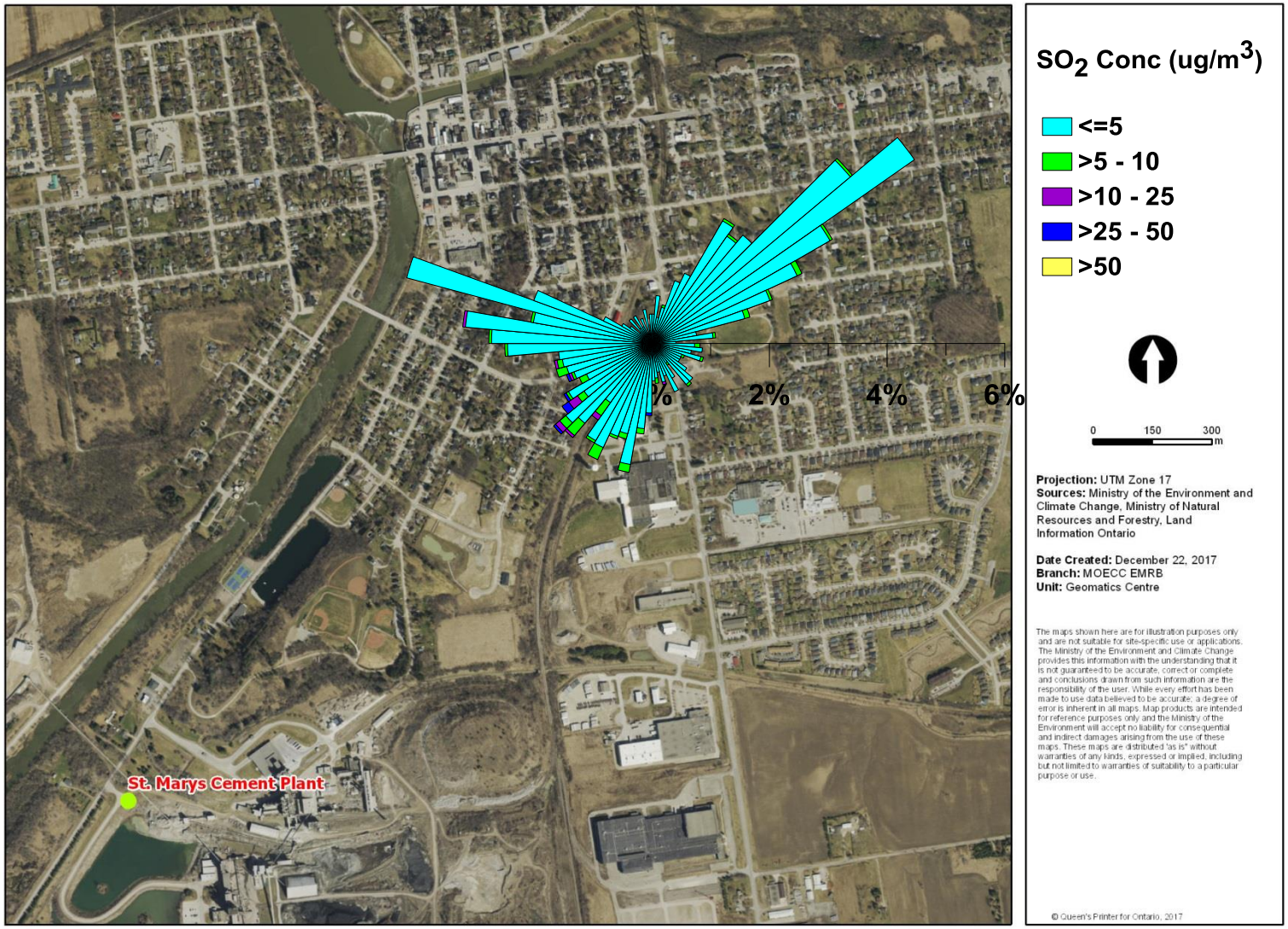


Figure 3: Pollution Rose for NO_X, St. Marys Ontario, July 11 to October 11, 2017

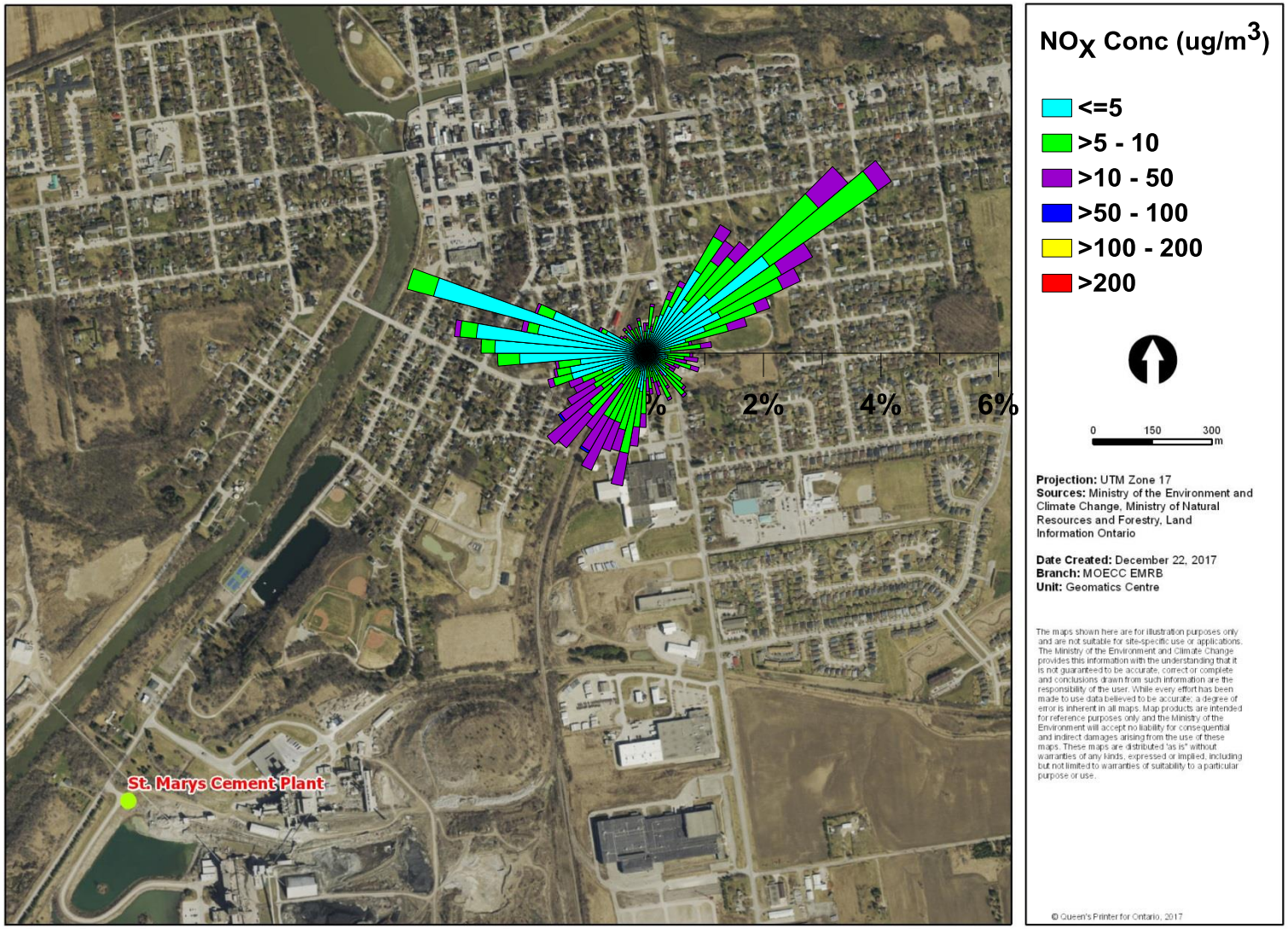


Figure 4: Pollution Rose for $PM_{2.5}$, St. Marys Ontario, July 11 to August 23, 2017

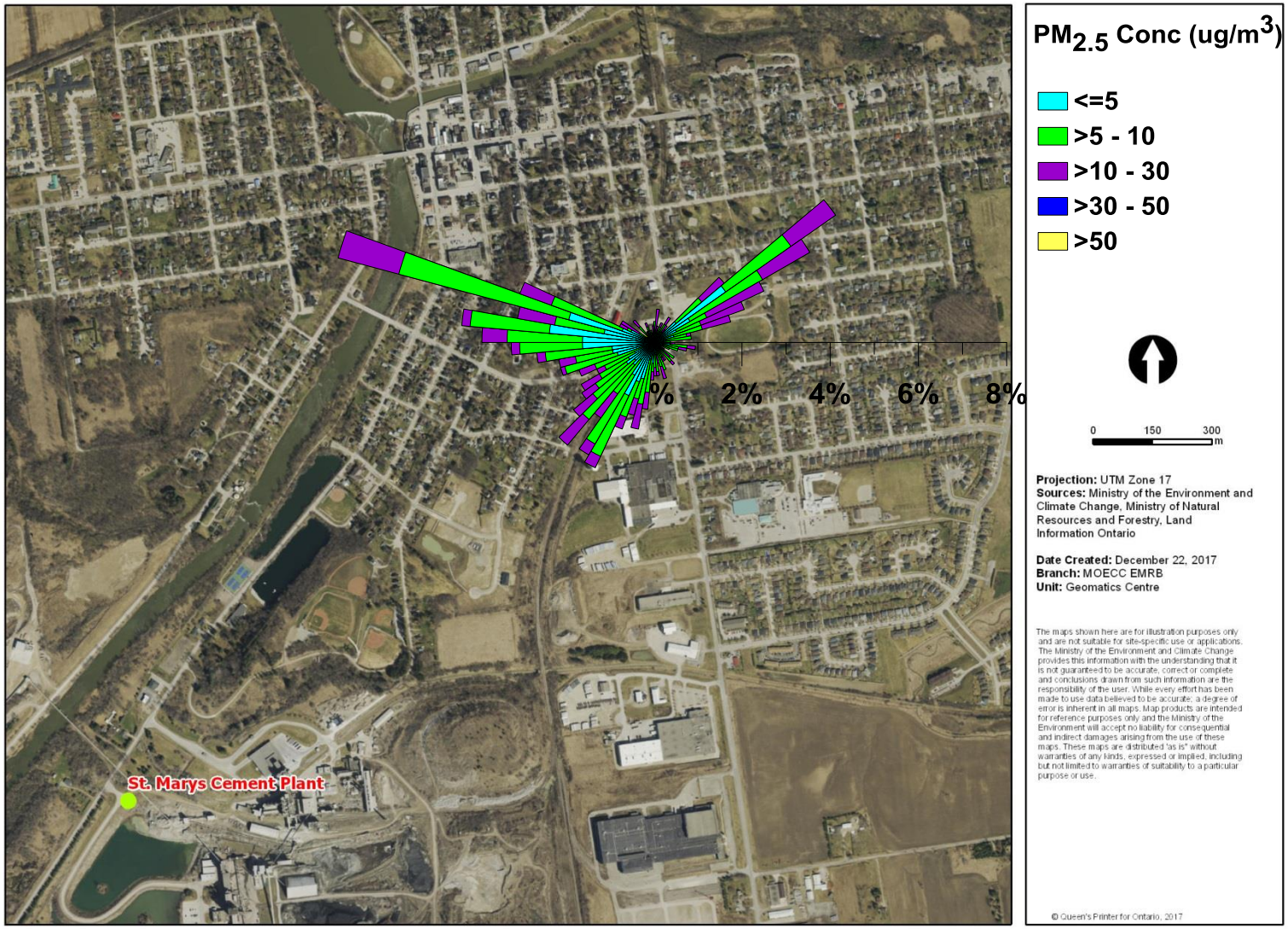
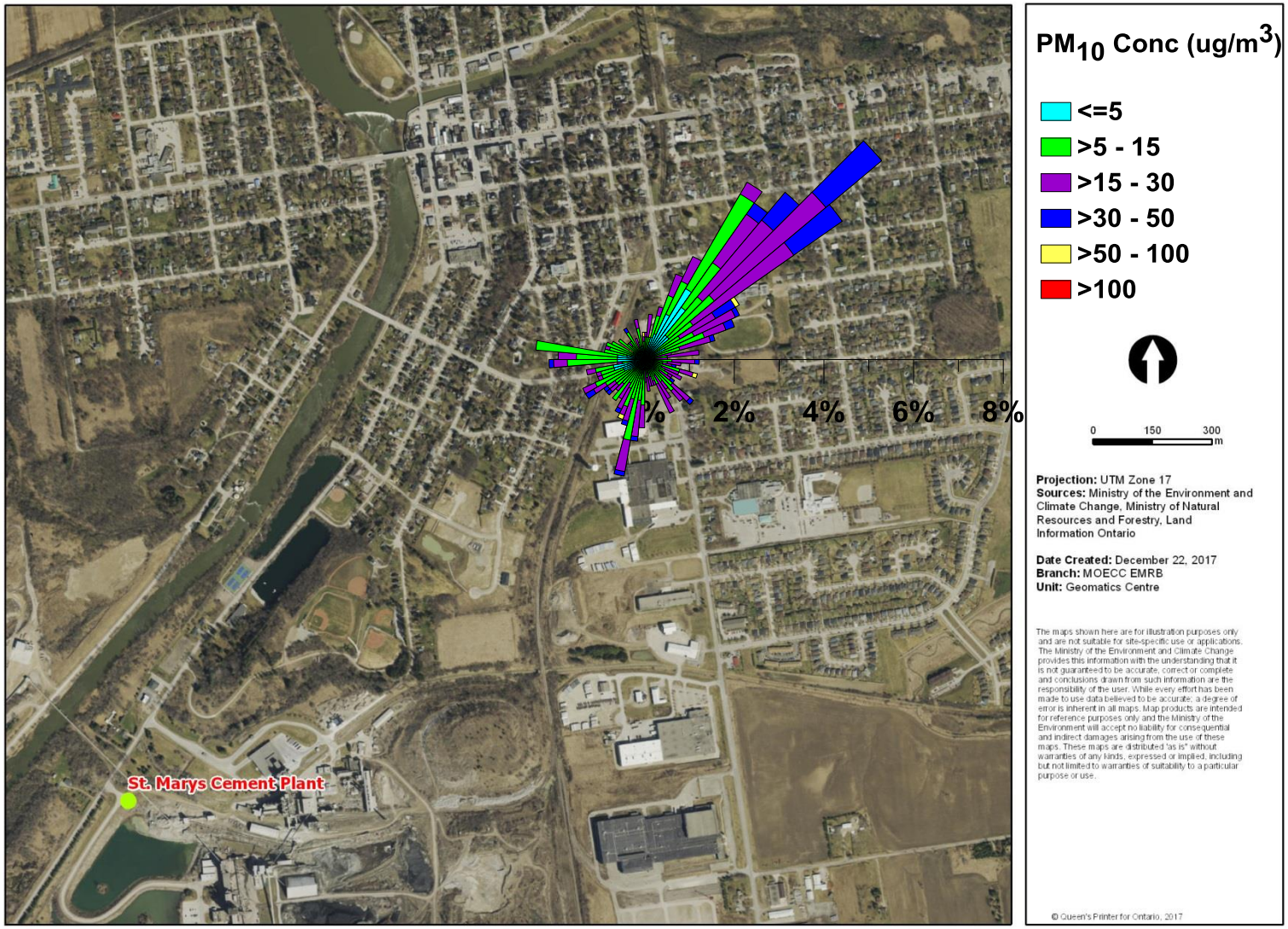


Figure 5: Pollution Rose for PM_{10}, St. Marys Ontario, July 11 to August 23, 2017



Appendix B: Summary Tables

Table 1: Exceedances of Current O. Reg. 419/05 Standards and AAQCs for SO_2, St. Marys Ontario, July 11 to October 11, 2017

Standard/AAQC					Exceedance Details		
O. Reg. 419/05 Schedule 3	AAQC	Averaging period	Value	Total Exceedances	Date	Time	Downwind of St. Marys Cement?
X	X	1-hour	690 $\mu g/m^3$	0	-	-	-
X	X	24-hour	275 $\mu g/m^3$	0	-	-	-
	X	annual	55 $\mu g/m^3$	N/A	-	-	-

Table 2: Measured Concentrations Above the Proposed O. Reg. 419/05 Standards and AAQCs for SO_2, St. Marys Ontario, July 11 to October 11, 2017

Proposed Standard/AAQC						Excursion Details		
O. Reg. 419/05 Schedule 3	O. Reg. 419/05 URT	AAQC	Averaging period	Value	Total # of excursions above benchmark	Date	Time	Downwind of St. Marys Cement?
		X	10-min	180 $\mu g/m^3$	0	-	-	-
X		X	1-hour	100 $\mu g/m^3$	0	-	-	-
X		X	annual	10 $\mu g/m^3$	N/A	-	-	-
	X		1-hour	690 $\mu g/m^3$	0	-	-	-
	X		½-hour	830 $\mu g/m^3$	0	-	-	-

Table 3: Exceedances of the O. Reg. 419/05 Standards and AAQCs for NO_X, St. Marys Ontario, July 11 to October 11, 2017

Standard/AAQC					Exceedance Details		
O. Reg. 419/05 Schedule 3	AAQC	Averaging period	Value	Total Exceedances	Date	Time	Downwind of St. Marys Cement?
X	X	1-hour	400 $\mu g/m^3$	0	-	-	-
X	X	24-hour	200 $\mu g/m^3$	0	-	-	-

Table 4: Exceedances of the AAQC for $PM_{2.5}$ July 11, 2017 to August 23, 2017, St. Marys Ontario

AAQC			Exceedance Details		
Averaging period	Value	Total Exceedances	Date	Time	Downwind of St. Marys Cement?
24-hour	30 µg/m^3	0	-	-	-

Table 5: Exceedances of the AAQC for PM_{10} August 24, 2017 to October 11, 2017, St. Marys Ontario

AAQC			Exceedance Details		
Averaging period	Value	Total Exceedances	Date	Time	Downwind of St. Marys Cement?
24-hour	50 µg/m^3	0	-	-	-

Table 6: Average Pollutant Concentrations July 11 to October 11, 2017 at select AQHI stations and St. Marys Air Monitoring Station

	NO_X µg/m^3	SO_2 µg/m^3	$PM_{2.5}$† µg/m^3	PM_{10}‡ µg/m^3
St. Marys Air Monitoring Station	6.6	2.4	7.7	14.1
London AQHI Station	8.1	nm	7.1	nm
Brantford AQHI Station	6.4	nm	7.8	nm
Hamilton Mountain AQHI Station	12.8	5.3	7.2	nm
Windsor Downtown AQHI Station	17.9	2.2	7.9	nm

nm = not measured

† measurements taken from July 11 to August 23, 2017.

‡ measurements taken from August 24 to October 11, 2017.

Conversions from ppb to µg/m^3 were calculated using T = 10^{o}C, P = 1atm.