Overview of Ambient Air Monitoring Programs in Durham Region

Ministry of the Environment, Conservation and Parks

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Table of Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

The ministry analyzed available air quality data for the Clarington area to observe possible trends, sources or patterns and to provide a picture of the general ambient air quality throughout the Town of Clarington. This memorandum summarizes analysis of air quality data in the region for the years 2013 to 2016.

Analysis shows that air quality in Durham Region is similar to that of other urban settings in southern Ontario and the Greater Toronto Area. A broad range of activities contributing to local air quality include industrial, construction, residential, commercial, agricultural, transportation and transboundary sources from outside the region and province.

The ministry reviewed data from air monitoring stations operated throughout the region by various parties including the Ministry of the Environment, Conservation and Parks, Environment and Climate Change Canada, the Durham York Energy Centre, St. Marys Cement, 407 East Construction, and Gerdau Ameristeel.

The monitoring data was compared against Ontario *Ambient Air Quality Criteria* (AAQC) when AAQCs were available. For parameters that have Canadian Ambient Air Quality Standards (CAAQS), such as fine particulate matter ($PM_{2.5}$), the 2015 CAAQS were used for comparison.

The monitoring stations are influenced by all sources in the area. Though results are representative of local conditions, it is difficult to definitively determine the contribution of any individual source to local air quality with accuracy.

Findings show that the pollutants monitored are below the CAAQS indicators and AAQC, except for a few exceedances of the 24-hour average $PM_{2.5}$ and benzo(a)pyrene (BaP) concentrations. This is typical of urban settings across southern Ontario.

A small increase of $PM_{2.5}$ (around 10%) was observed in the 2013-2016 period in south Clarington compared to the ministry's Oshawa and Toronto Stations which is likely due to changes in background concentrations and contributions from multiple sources of $PM_{2.5}$ in the area, including local industrial sources and construction projects.

Based on the ministry's review of the air quality data, there are a number of contributors to the air quality in Durham Region. These can include industrial sources, construction activities, residential / commercial, agricultural and transportation.

1.0 Introduction

The Ministry of the Environment, Conservation and Parks (MECP) York Durham District Office (the District) was asked by the Mayor of the Town of Clarington to provide an overview of the air monitoring programs in Durham Region, with a focus on particulate matter (PM_{10} and $PM_{2.5}$). Central Region's Technical Support Section (TSS) has prepared the following memorandum to summarize air quality measurements from various monitoring programs situated in Durham Region between 2013 and 2016.

The government-operated stations used to gather data include those operated by MECP and by Environment and Climate Change Canada as part of the National Air Pollution Surveillance (NAPS) network, which are named as follows:

- Oshawa (MECP)
- Newmarket (MECP)
- Toronto West (MECP)
- Gage (NAPS)
- Simcoe (NAPS)

The air quality stations used for this memorandum operated by stakeholders are named as follows:

- St. Marys Cement
- Durham York Energy Centre
- 407 East Construction Phase I & II
- Gerdau Ameristeel Company

The data presented in this memorandum is representative of numerous sources around the monitors including industrial, transportation, residential, commercial, agricultural, and construction activities, and may also be influenced by transboundary sources outside Durham Region including sources elsewhere in Ontario, Quebec and the United States (US). Based on the locations of the monitors, this data may be representative of the south Clarington, Whitby and Oshawa areas, but does not necessarily represent the general air quality for the entire Clarington area in Durham Region. Since each monitoring program was established for a unique purpose, there are differences in the duration of sampling, parameters measured and equipment used, resulting in measurements that may not be directly comparable. Furthermore, when taking into account these differences in addition to the high background variability, it is not possible to determine with accuracy the percent contributions from any specific source.

Nevertheless, there is still value in summarizing the various air quality monitoring programs in Durham Region to assess specific trends. A comparison or data overview between specific stations may highlight any observable trends, or indicate typical urban air quality levels.

The Air monitoring programs operated by stakeholders are used to measure specific contaminants based on the types of emissions associated with their activities. For example, some industries will monitor NO_2, SO_2 and $PM_{2.5}$ emissions that are by-products of combustion, whereas construction monitoring will sample mainly for PM_{10} and $PM_{2.5}$ that results from material handling activities and diesel construction equipment emissions. Government operated monitoring stations are designed specifically to measure general outdoor air quality in the area. The equipment used to measure ambient air quality captures all sources and is cumulative in nature.

1.1 Overview of Monitoring Programs in Durham Region

Monitoring stations in Durham Region are operated either by the MECP as part of the Air Quality Health Index network, Environment Canada as NAPS, or are operated by local stakeholders. Monitoring programs that are not operated by the MECP are reviewed and audited by TSS on a quarterly basis to ensure data validity, and to confirm that siting and performance criteria meet the *Operations Manual for Air Quality Monitoring in Ontario* (MOECC, 2018). Stakeholder operated monitoring programs in Durham Region include programs designed to monitor ambient air quality around the Durham York Energy Centre (DYEC), St. Marys Cement, Gerdau Ameristeel Corporation (Gerdau Whitby) and the Highway 407 East construction activities. In addition to these stations, this memorandum will also summarize measurements from the MECP's Oshawa station for comparison purposes. Monitoring stations and parameters that will be discussed are outlined in Table 1 and a map of the monitoring stations is provided in Figure 1. Of the stakeholder programs, DYEC has the most extensive monitoring network and for this reason the memorandum tends to focus heavily on the data from this program in comparison to the others. It is important to note that the stakeholder operated stations were established for a particular purpose, and while it is possible to provide some general comparisons between these stations and the regional monitoring stations, the stakeholder operated monitoring programs were not designed to reflect the general air quality in south Clarington.

This memorandum focuses on monitoring data between 2013, when the 407 East Phase 1 construction and DYEC monitoring programs began, and 2016, which is the most recent annual data set available to the ministry. For some stations, annual statistics will only be provided for 2014 to 2016, as the monitoring commenced mid-2013. The monitoring program for the 407 East construction project was operational for three months before construction and one year during construction for both Phase 1 and Phase 2. For this reason, annual statistics are provided only for the 2016 construction monitoring period.

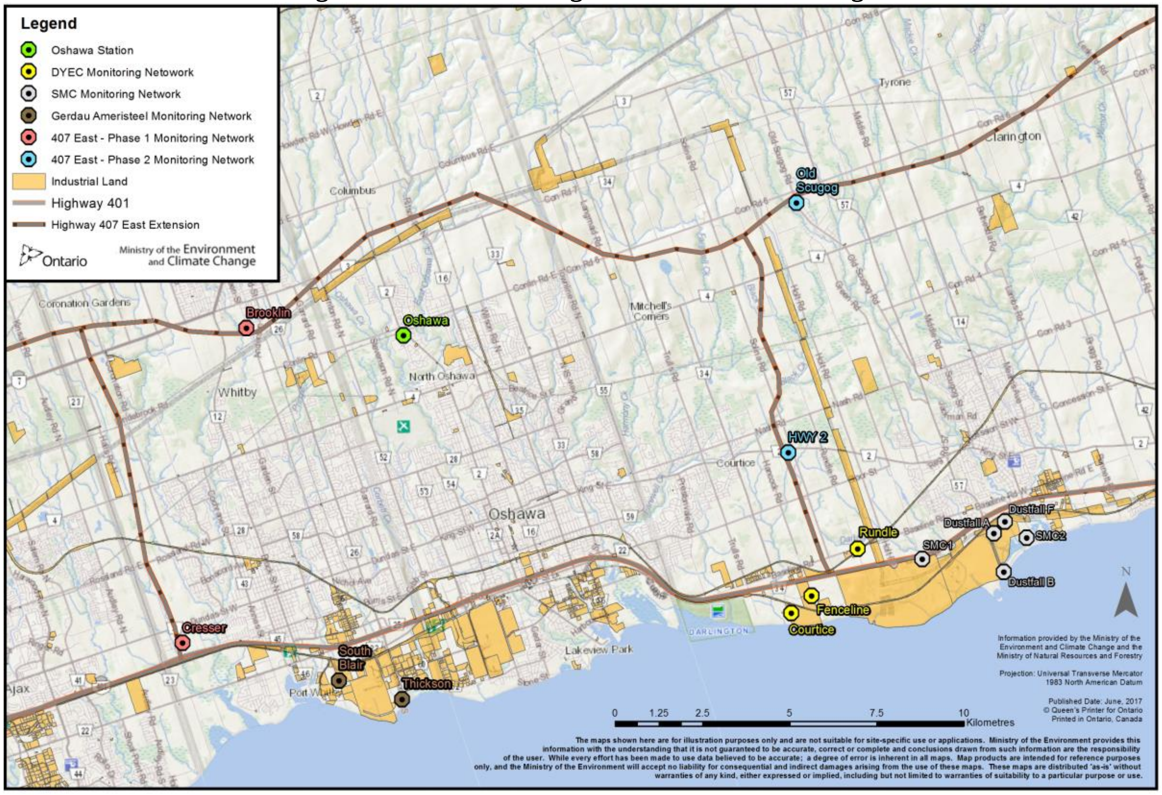
Some parameters are monitored continuously while other parameters, such as metals, BaP, dioxins and furans, are measured on a 24-hour basis every 6, 12, or 24 day cycle which is referred to as non-continuous sampling.

Table 1. Air Monitoring Stations and Parameters in Durham Region

Stakeholder Monitoring Program	Station	Data Collection Frequency	Relevant Parameter(s)	Start/End Date
DYEC	Courtice and Rundle Stations [a]	Continuous	$PM_{2.5}$, NO_2, SO_2	May 1, 2013 - ongoing
		Every 6-days	TSP and metals	May 4, 2013 - ongoing
		Every 12- days	PAHs	May 4, 2013 - ongoing
		Every 24-days	Dioxins and Furans	May 16, 2013 - ongoing
		Continuous	Meteorological parameters	May 1, 2013 - ongoing
	Fenceline Station	Every 6-days	TSP and metals	February 18, 2016 - ongoing
MECP	Oshawa	Continuous	$PM_{2.5}$, NO_2, CO, O_3	2005 [b] - Ongoing
St. Marys Cement	SMC1 and SMC2	Continuous	PM_{10}	April 1, 2011 - ongoing
	Sites A[c], B and F[d]	Every 6-days	PM_{10}	November, 2004 - ongoing
407 East – Phase One, Preconstruction and Construction	Cresser	Continuous	$PM_{2.5}$, PM_{10}, NO_2	April 15, 2012 – August 15, 2012 and February 1, 2013 – December 31, 2013
	Brooklin	Continuous	$PM_{2.5}$, PM_{10}, NO_2	May 16, 2012 – August 15, 2012 and February 1, 2013 – December 31, 2013
407 East – Phase Two, Preconstruction and Construction	Old Scugog	Continuous	$PM_{2.5}$, PM_{10}, NO_2	June 1, 2014 – August 31, 2014 and April 1, 2016 – April 30, 2017
	Highway 2	Continuous	$PM_{2.5}$, PM_{10}, NO_2	July 1, 2015 – September 30, 2015 and March 5, 2016 – March 31, 2017
Gerdau Ameristeel Corporation	Whitby	Every 6-days	TSP and metals	January 2015 – December. 31/2016

[a] Note: DYEC non-continuous parameters were not monitored during the commissioning phase of the DYEC (between July, 2014 and February 13, 2015).
[b] Previous to 2005 MECP Oshawa Station was situated at a different location.
[c] Site A was discontinued in January, 2015.
[d] Site F was temporarily shut down in June, 2016 due to construction activities on site.

Figure 1. Air Monitoring Stations in Durham Region



Monitoring data is compared against Ontario's Ambient Air Quality Criteria (AAQC), except for $PM_{2.5}$. AAQC are guidelines for maximum contaminant concentrations in ambient air, based on protection of human health and the environment that should not be exceeded. "The term 'ambient' is used to reflect general air quality independent of location or source of a contaminant. AAQC are most commonly used in environmental assessments, special studies using ambient air monitoring data, assessment of general air quality in a community and annual reporting on air quality across the province." (Ontario Air Quality in Ontario 2014 Report, MOECC).

Although some of the stakeholders monitoring programs discussed in this memorandum were designed around a specific source, the data is still compared against AAQCs as the stations are influenced by all sources in the area and therefore results are representative of local conditions.

For parameters that have Canadian Ambient Air Quality Criteria (CAAQS), such as $PM_{2.5}$, the 2015 CAAQS are used for comparison purposes. CAAQS are only applicable if the data reported is from a designated station, such as data from the ministry's Oshawa Station, as per the Canadian Council of Ministers of the Environment (CCME) guidelines. In addition, CAAQS reporting must follow the metrics as defined in the CCME guidelines, for example the 24-hour average CAAQS for $PM_{2.5}$ is based on the average of the 98^{th} percentile of three consecutive years of continuous hourly data. Since three years of data are required to determine if an exceedance of the CAAQS has occurred, the CAAQS values for $PM_{2.5}$ are provided below as an indicator for relative comparison purposes only, and are referenced herein as CAAQS indicators.

A list of the relevant AAQC and CAAQS indicators are provided in Attachment A.

2.0 Durham York Energy Centre Monitoring Program

The DYEC air monitoring network is comprised of three monitoring stations, referred to as the Courtice station, the Rundle station and the Fenceline station. Please refer to Figure 1 for a map of these locations.

The DYEC air monitoring program is divided into three phases: pre-operation, a brief commissioning phase and the operational period. The pre-operation phase captures the baseline conditions present before the DYEC began operations (2013-2014). A commissioning phase occurred between July 2014 and January 2015 when equipment was tested. The operation phase consists of the day to day operation of the facility from February 2015 to present.

Continuously monitored pollutants at the Courtice and Rundle stations include fine particulate matter ($PM_{2.5}$), Oxides of Nitrogen (NO, NO_2 and NO_x), and Sulphur Dioxide (SO_2). These stations continuously monitor meteorological parameters including wind speed and direction, ambient temperature, relative humidity, and barometric pressure. Continuously monitored parameters were monitored during the pre operation, commissioning and operations phases of the DYEC facility, which coincides with a monitoring period from May 4, 2013 to December 31, 2016.

Non-continuously monitored parameters at the Courtice and Rundle stations include total suspended particulate (TSP), metals, dioxins and furans (D/F) and polycyclic aromatic hydrocarbons (PAHs). The Fenceline station only measures TSP and metals to capture process fugitive emissions. The non-continuously monitored parameters were monitored only during pre-operation and operation phases for the DYEC facility and not during the commissioning phase as per the Environmental Assessment conditions and the approved ambient monitoring plan.

Ambient measurements at the DYEC monitoring stations are summarized in the sections below.

2.1 Continuous Parameters at DYEC

2.1.1 $PM_{2.5}$

$PM_{2.5}$ is either emitted directly into the atmosphere through fuel combustion (e.g. from motor vehicles, smelters, power plants, industrial facilities, residential fireplaces and wood stoves, agricultural burning and forest fires), or formed indirectly in the atmosphere through a series of complex chemical reactions. Since similar fuel combustion sources of $PM_{2.5}$ exist in the U.S. as well, Ontario's air quality is also affected by transboundary movement of pollutants from neighbouring U.S. States (Air Quality in Ontario 2014 Report, MOECC).

All continuous parameters monitored at the Courtice and Rundle stations are significantly below their respective criteria, except for the maximum 24-hour $PM_{2.5}$ concentrations which exceeded the 24-hour CAAQS indicator. A comparison of $PM_{2.5}$ data pre-operation and operation of DYEC was conducted, and Table 2 and below provide a statistical summary for $PM_{2.5}$ at the Courtice and Rundle Stations.

It is important to note that the 2014 annual $PM_{2.5}$ average reported in Table 2 includes the construction and commissioning phases of the DYEC facility and the annual average in 2015 and 2016 does not represent steady process conditions at the DYEC. For these reasons, the $PM_{2.5}$ statistics reported from the DYEC facility were not compared against the CAAQS (i.e. the maximum 98th percentile for 3 consecutive years) since the monitoring data does not represent steady operations from the DYEC facility for the entire 3-year period. Instead, as discussed in Section 1.1, $PM_{2.5}$ is compared to the CAAQS indicator as shown in Table 2.

Table 2. Annual & Period Average $PM_{2.5}$ Concentrations at DYEC

Station	2013[a]	2014	2015	2016	Pre-Operation (May 1, 2013 to Feb.12, 2015)	Operation (Feb. 13, 2015 to Dec.31, 2016)	Annual CAAQS Indicator
Courtice (ug/m^3)	8.5	8.6	7.7	6.8	8.5	7.2	10
Rundle (ug/m^3)	8.4	8.5	9.5	9.6	8.5	9.6	10

[a] There is insufficient data for a valid annual mean as the 2013 period captures 24-hour average concentrations only between May 1, 2013 and December 31, 2013.

In general, $PM_{2.5}$ average concentrations are similar during pre-operation and operation of the DYEC facility at the Courtice and Rundle Stations as shown in Table 2

However, the maximum 24-hour average $PM_{2.5}$ concentrations at the Courtice and Rundle Stations are higher during operation when compared to the pre-operation period as illustrated in Table 3. In addition, the frequency of 24-hour average elevated $PM_{2.5}$ events (higher than CAAQS indicator) increased in 2015 and 2016. The increase in elevated 24-hour average $PM_{2.5}$ concentrations is likely a result of meteorological variability combined with changes in local activities around the monitor.

Table 3. Maximum 24-hour Average $PM_{2.5}$ Concentrations at DYEC

	Courtice (µg/m^3)	Rundle (µg/m^3)	24-Hour CAAQS Indicator (µg/m^3)
Maximum 24-Hour Concentration - Pre Operation of DYEC[a]	40.4	40.6	28
Maximum 24-Hour Concentration - Operation of DYEC[b]	57.9	55.2	28
No. of 24-Hour CAAQS Indicator Exceedances Pre Operation of DYEC	4	6	n/a
No. of 24-Hour CAAQS Indicator Exceedances Operation of DYEC	6	19	n/a

[a] Pre Operation of DYEC is between May 1, 2013 and February 12, 2015.
[b] Operation of DYEC is between February 13, 2015 and December 31, 2016.
n/a Not Applicable

Pollution roses are tools to illustrate the direction from which contaminants recorded at the station originate and the wind direction from which the elevated concentrations come from. Pollution roses were developed to assess the direction from which $PM_{2.5}$ concentrations recorded at the Courtice and Rundle Stations were originating.

In general, the hourly pollution roses illustrate that many different sources from all wind directions contribute to $PM_{2.5}$ concentrations measured at the DYEC stations (see Attachment B)

The predominant winds in the area around the DYEC monitoring stations originate from the west/northwest during the winter months and from southwest during the summer months. These pollution roses do not include data from periods of calm winds (less than 3.6 km/hour) as the anemometer does not accurately capture wind direction under these conditions.

Hourly $PM_{2.5}$ pollution roses from 2013 to 2016 at the Courtice Station are provided in Figure 8, found in Attachment B. These graphs show that $PM_{2.5}$ originated from the West, Southwest, Northwest, Northeast and East directions, capturing a variety of sources such as Highway 401 traffic (870 metres away), construction emissions from ongoing work for the 407 East Phase 2 in 2016, and industrial sources among other potential local, regional and transboundary sources.

Figure 9 in Attachment B also provides the hourly annual 2013 to 2016 $PM_{2.5}$ pollution roses for the Rundle Station. These graphs show that $PM_{2.5}$ originated from the West, Southwest, Northwest, North, Northeast, and East-southeast directions, capturing emissions from various sources such as Highway 401 traffic emissions (541 metres away), 407 East Phase 2 construction activities and agricultural sources amongst other potential local and regional sources. Since the Rundle Station is situated closer to the CN Railway tracks (38 metres away), unlike the Courtice Station (1383 metres away), the contribution from locomotive engines is likely measured when the winds are blowing from the south.

Based on field staff observations in 2016, the Rundle Station was also impacted by the construction activities situated North and North-northwest of the station. The more frequent elevated $PM_{2.5}$ 24-hour average concentrations observed in 2016 when compared to 2013 could also be reflective of the unusually dry summer conditions, which typically results in more dust impacts due to lower moisture levels as a result of fewer rainfall events.

2.1.2 NO_2

Nitrogen oxides (NOx), of which NO_2 is a component, are measured continuously at the DYEC monitoring network. NOx is emitted mostly from vehicles, construction equipment and incomplete combustion from industrial, commercial or residential sources. This discussion focuses on NO_2 because it plays a major role in atmospheric reactions that produce ground-level ozone, a component of smog, and contributes to the formation of $PM_{2.5}$.

Table 4 below provides a statistical summary for NO_2 at the Courtice and Rundle Stations.

Table 4. Annual Average NO_2 Concentrations at DYEC

Station	2013[a]	2014	2015	2016	Pre-Operation (May 1, 2013 to Feb.12, 2015)	Operation (Feb. 13, 2015 to Dec.31, 2016)	Annual AAQC
Courtice (ppb)	6.4	8.0	6.8	6.3	7.5	6.3	n/a
Rundle (ppb)	6.5	6.1	6.6	5.3	6.4	5.9	n/a

n/a Not Applicable (there is only hourly or 24-hour average AAQC for NO_2)

No exceedances of the hourly or 24 hour average NO_2 AAQCs were identified (Table 5). Overall, NO_2 concentrations are similar during pre-operation and operation of the DYEC, though maximum 24-hour average NO_2 concentrations at the Rundle and Courtice Stations are slightly lower during operation compared to the pre-operation period. A pollution rose assessment was not warranted for this parameter since there were no AAQC exceedances.

Table 5. Maximum 24-hour Average NO_2 Concentrations at DYEC

	Courtice (ppb)	Rundle (ppb)	24-Hour AAQC (ppb)	1-Hour AAQC (ppb)
Maximum 24-Hour Concentration Pre-Operation of DYEC[a]	31.2	24.0	100	n/a
Maximum 24-Hour Concentration Operation of DYEC[b]	23.1	19.6	100	n/a
Maximum 1-Hour Concentration Pre -Operation of DYEC	52.6	62.0	n/a	200
Maximum 1-Hour Concentration Operation of DYEC	62.3	42.5	n/a	200
No. of 24-Hour AAQC Exceedances (Pre-Operation & Operation)	0 & 0	0 & 0	n/a	n/a
No. of 1-Hour AAQC Exceedances (Pre-Operation & Operation)	0 & 0	0 & 0	n/a	n/a

[a] Pre Operation of DYEC is between May 1, 2013 and February 12, 2015.
[b] Operation of DYEC is between February 13, 2015 and December 31, 2016.
n/a: Not Applicable

2.1.3 SO_2

Sulphur dioxide (SO_2) is a precursor to sulphates, one of the main components of airborne secondary $PM_{2.5}$. Major sources of SO_2 include smelters, industrial processes and electric utilities. Table 6 and Table 7 below provide a statistical summary for SO_2 at the Courtice and Rundle Stations. Overall, SO_2 concentrations are similar and well below the AAQC at the Courtice and Rundle Stations during pre-operation and operation of the DYEC facility with the exception of the maximum 24-hour average concentration at the Rundle Station during operations which is slightly higher. There were no exceedances of the annual, 24-hour or hourly SO_2 AAQCs and therefore a pollution rose assessment was not warranted for this parameter.

Table 6. Annual Average SO_2 Concentrations at DYEC

Station	2013[a]	2014	2015	2016	Pre-Operation (May 1, 2013 to Feb.12, 2015)	Operation (Feb. 13, 2015 to Dec.31, 2016)	Annual AAQC
Courtice (ppb)	1.63	1.45	0.94	1.73	1.5	1.4	20
Rundle (ppb)	0.43	0.66	0.73	0.77	0.6	0.8	20

[a] There is insufficient data for a valid annual mean as the 2013 period captures 24-hour average concentrations only between May 1, 2013 and December 31, 2013.

Table 7. Maximum 24-hour Average SO_2 Concentrations at DYEC

	Courtice (ppb)	Rundle (ppb)	24-Hour AAQC	1-Hour AAQC
Maximum 24-Hour Concentration Pre-Operation of DYEC[a]	13.7	4.1	100	n/a
Maximum 24-Hour Concentration Operation of DYEC[b]	12.9	8.1	100	n./a
Maximum 1-Hour Concentration Pre- Operation of DYEC	56.3	34.1	n/a	250
Maximum 1-Hour Concentration Operation of DYEC	57.1	30.7	n/a	250
No. of 24-Hour AAQC Exceedances (Pre-Operation & Operation)	0 & 0	0 & 0	n/a	n/a
No. of 1-Hour AAQC Exceedances (Pre-Operation & Operation)	0 & 0	0 & 0	n/a	n/a

[a] Pre-Operation of DYEC is between May 1, 2013 and February 12, 2015.
[b] Operation of DYEC is between February 13, 2015 and December 31, 2016.
n/a Not Applicable

2.2 Non-continuous Parameters at DYEC

2.2.1 PAHs

PAHs emissions originate from incomplete combustion and pyrolysis of fossil fuels from activities such as wood burning, diesel engines, industrial, agricultural and domestic sources. Typically, predominant sources for PAHs are motor vehicles and wood smoke (Ravindra K., et al., 2008).

At this location, polycyclic aromatic hydrocarbons (PAHs) are measured every 12 days following the National Ambient Pollution Surveillance (NAPS) program schedule which meets the ministry's *Operations Manual for Air Quality Monitoring in Ontario* (2018) guidance document requirements.

Table 8 and Table 9 below provide a statistical summary for benzo(a)pyrene (BaP) at the Courtice and Rundle Stations. Please note that BaP data is not available between June 2014 and February 13, 2015 because non-continuous parameters were not monitored during the commissioning phase of the DYEC.

Table 8. Annual & Period Average BaP Concentrations at DYEC

Station	2013/ 2014[a]	2015/ 2016[b]	2016	Pre-Operation (May 4, 2013 to June, 2014)	Operation (Feb. 13, 2015 to Dec.31, 2016)	Annual AAQC
Courtice (ng/m^3)	0.02	0.03	0.03	0.02	0.03	0.01
Rundle (ng/m^3)	0.04	0.04	0.04	0.04	0.04	0.01

[a] There is insufficient data for a 2013 valid annual mean (sampling only occurred between May 4, 2013 and December 26, 2013). There is insufficient data for a 2014 valid annual mean (sampling only occurred between January and June 28, 2014).
This period average captures 36 24-hour average samples from May 4, 2013 to June 28, 2014.
[b] There were no 24-hour average BaP measurements from June 2014 to January 2015 inclusive during the commissioning phase as per the approved monitoring plan.
This period average captures 27 samples from January to December 2016.

Table 9. Maximum 24-hour Average BaP Concentrations at DYEC

	Courtice (ng/m^3)	Rundle (ng/m^3)	24-hour AAQC
Maximum 24-Hour Concentration - Pre Operation of DYEC[a]	0.13	0.41	0.05
Maximum 24-Hour Concentration - Operation of DYEC[b]	0.10	0.21	0.05
No. of 24-Hour AAQC Exceedances (Pre Operation)	3	5	n/a
No. of 24-Hour AAQC Exceedances (Operation)	5	7	n/a

[a] Pre Operation of DYEC is between May 4, 2013 and June 28, 2014.
[b] Operation of DYEC is between February 13, 2015 and December 31, 2016.
n/a Not applicable / No criterion

Although, the 24-hour average BaP concentrations are similar during pre-operation and operation periods at DYEC monitoring stations, the number of 24-hour average BaP exceedance events increased by two days during operation of the DYEC facility. Between 2013 and 2016, there were a total of 8 24-hour average BaP exceedances at the Courtice Station and 12 at the Rundle

Station as shown in Table 9. Exceedances of BaP are typically found at other urban settings, such as Environment and Climate Change Canada's (ECCC) Gage NAPS Station in Toronto, and sometimes at rural monitoring stations, such as ECCC's Simcoe NAPS Station. This is a result of residential wood burning and other mobile combustion sources. These stations and others across Ontario show similar exceedances.

Figure 10 and Figure 11 in Attachment B provides the pollution roses for 24-hour average BaP concentrations measured at the Courtice and Rundle Stations from 2013 to 2016.

At the Courtice Station, 24-hour average BaP exceedances occurred mainly when winds were blowing from the West and Northeast during pre-operation and from all quadrants during operation, as shown in Figure 10. At the Rundle Station, 24-hour average BaP exceedances occurred mainly when the winds originated from the Northwest and Southeast quadrants during pre-operation, and 24-hour average BaP exceedances are seen from the same direction in addition to Northeast during the operational period, as shown in Figure 11. Potential sources from these wind quadrant directions are residential and commercial wood burning, agricultural equipment, locomotive engines and industrial sources.

The days that BaP exceeded the AAQC at the Courtice and Rundle Stations were more frequent when the winds were blowing from the Northwest quadrant, which is upwind of the DYEC facility. This trend was also observed during both pre-operation and operation periods of the DYEC facility. This implies that the background BaP concentrations at the Courtice and Rundle Stations are most likely due to Highway 401, Highway 407 East construction equipment, agricultural equipment, and potentially other local combustion sources, such as residential and or commercial wood burning. BaP concentrations observed are typical of an urban setting and also seen in some rural areas, like the Simcoe NAPS Station.

2.2.2 Dioxins and Furans

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, commonly known as dioxins and furans (D/F), are mainly released from waste incineration (municipal waste, hazardous waste, sewage sludge and medical waste), residential wood combustion, and industrial sources (CCME, 2001).

There were no reported 24-hour averages or annual exceedances of the total equivalency toxic (TEQ) Dioxins and Furans AAQCs between 2013 and 2016 at the Courtice and Rundle Stations. Table 10 and Table 11 below provide a statistical summary for D/F concentrations that were detectable above the method detection limit at the Courtice and Rundle Stations. The MDL is the minimum concentration of a substance that can be measured by the analytical equipment.

D/F 24-hour average concentrations are generally similar during pre-operation and operation of the DYEC facility as shown in Table 10. Please note that D/F data is not available between June, 2014 and February 13, 2015 because non-continuous parameters were not monitored during the commissioning phase of the DYEC.

Table 10. Annual & Period Average D/F Concentrations at DYEC

Station	2013/ 2014[a]	2015/ 2016[b]	2016 [d]	Pre-Operation (May 4, 2013 to June, 2014)	Operation (Feb. 13, 2015 to Dec.31, 2016)	Annual AAQC
Courtice (pg TEQ/m^3)	0.022	0.017	0.017	0.022[c]	0.017[d]	n/a
Rundle (pg TEQ/m^3)	0.022	0.016	0.016	0.022[e]	0.016[f]	n/a

[a] There is insufficient data for a 2013 valid annual mean (May 16, 2013 to December 31, 2013)
There is insufficient data for a 2014 valid annual mean (January to June 2014).
This period average captures 18 samples from May 16, 2013 to June 28, 2014.
[b] There were no 24-hour average BaP measurements in 2015 during the commissioning phase as per the approved monitoring plan. This period average captures 20 samples from January to December 2016.
[c] (18 samples)
[d] (20 samples)
[e] (18 samples)
[f] (20 samples)

Table 11. Maximum 24-hour Average D/F Concentrations at DYEC

	Courtice (pg TEQ/m^3)	Rundle (pg TEQ/m^3)	24-hour AAQC
Maximum 24-Hour Concentration – Pre-Operation of DYEC[a]	0.038	0.065	0.1
Maximum 24-Hour Concentration - Operation of DYEC[b]	0.044	0.026	0.1
No. of 24-Hour AAQC Exceedances (Pre-Operation & Operation)	0	0	-

[a] Pre Operation of DYEC is between May 16, 2013 and June, 2014.
[b] Operation of DYEC is between February 13, 2015 and December 31, 2016.
- Not applicable

There are multiple potential sources of D/F in the vicinity of the Courtice and Rundle Stations. Although, there were no reported 24-hour average D/F exceedances of the AAQC (0.1 pg TEQ/m^3), pollution roses were developed for the Courtice and Rundle Stations with the limited data available. Due to a very limited number of samples, it is not possible to assess trends, decipher sources of D/F, or properly assess pre-operation and operation concentrations from this limited data set.

The pollution roses provided in Figures 12 and 13 in Attachment B show the wind direction from which D/F are originating at the Courtice and Rundle Stations.

2.2.3 Total Suspended Particles (TSP) and Metals

At the DYEC facility, TSP and metals are measured at the Courtice, Rundle and Fenceline Stations every 6 days following the NAPS schedule. The Fenceline station monitors fugitive emissions from material handling activities from DYEC.

Table 12 and 13 provide a statistical summary for TSP at the Courtice, Rundle and Fenceline Stations. There were no exceedances of TSP between 2013 and 2016, and therefore pollution roses were not warranted for an assessment. Based on the limited data set, all metals are significantly lower than the 24-hour average AAQC.

Table 12. Annual & Period Average TSP Concentrations at DYEC

Station	2013[a]	2014[b]	2015	2016	Pre-Operation (May 4, 2013 to June, 2014)	Operation (Feb. 13, 2015 to Dec.31, 2016)	Annual AAQC
Courtice ($\mu g/m^3$)	18	24	---	27	20	27	60
Rundle ($\mu g/m^3$)	21	25	---	32	23	32	60
Fenceline[c] ($\mu g/m^3$)	---	---	---	33	---	33	60

[a] There is insufficient data for a valid annual mean as the 2013 period captures 24-hour average concentrations only between May 4, 2013 and December 31, 2013.
[b] There is insufficient data for a valid annual mean as the 2014 period captures 24- hour average concentrations only between January and June, 2014.
[c] The Fenceline Station began monitoring in February 18, 2016 and was not present during pre-operation of the DYEC.
--- Station not in operation.

Table 13. Maximum 24-hour Average TSP Concentrations at DYEC

	Courtice ($\mu g/m^3$)	Rundle ($\mu g/m^3$)	Fenceline ($\mu g/m^3$)	24-hour AAQC ($\mu g/m^3$)
Maximum 24-Hour Concentration Pre Operation of DYEC[a]	57	63	---	120
Maximum 24-Hour Concentration Operation of DYEC[b]	95	97	80	120
No. of 24-Hour AAQC Exceedances (Pre-Operation & Operation)	0	0	0	n/a

[a] Pre-Operation of DYEC is between May 4, 2013 and June, 2014.
[b] Operation of DYEC is between February 13, 2015 and December 31, 2016.
--- Station not in operation
n/a – Not Applicable

TSP 24-hour average measurements at the Courtice and Rundle Stations were lower prior to the operation of the DYEC and Highway 407 East Phase II construction activities when compared to operation activities as illustrated in Table 13. Based on field observations and TSP measurements, background TSP emissions in the area after 2015 have increased when compared to 2013.

TSP emissions in the area are typically attributed to localized sources such as fugitive and process emissions from industrial or commercial sources (e.g. waste incineration, wood burning, etc.) construction activities, agricultural activities, and re-suspension of dust from paved and unpaved roads.

As shown in Tables 14 through 16, 24-hour average metal measurements are significantly lower than their respective AAQC. A total of 29 metals are analyzed from the particulate filters, however around 19 metals on average are below the method detection limit (MDL). The remaining 10 metals that are above MDL are summarized in Table 14, Table 15 and Table 16. The MDL is the minimum concentration of a substance that can be measured by the analytical equipment.

Overall, the 24-hour average metal concentrations at the Courtice and Rundle Stations are similar during pre-operation and operation of the DYEC, with the exception of aluminum at the Courtice Station. The Fenceline metal concentrations are also similar on average to both stations. The maximum 24-hour average metal concentrations, however, is slightly higher at the Fenceline station when compared to the Courtice and Rundle Stations.

After a review of the metal data from the DYEC monitoring stations, the concentrations reported are well below the ministry's criteria. The ministry at this time has no concerns with the metal data from the DYEC monitoring stations.

Table 14 Metal 24-hour Average Statistics at Courtice during Pre-Operation and Operation of DYEC

Courtice Station	**Pre-Operation DYEC [a]**			**Operation DYEC [b]**			**24-hr Avg AAQC (µg/m^3)**	**Annual AAQC (µg/m^3)**
	Metal Concentrations (µg/m^3)			**Metal Concentrations (µg/m^3)**				
Parameter	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**		
Total Mercury (Hg)	0.00001	0.00002	0.000003	0.00001	0.00004	0.00001	2	-
Aluminum (Al)	0.091	0.357	0.012	0.123	0.678	0.016	120	-
Cadmium (Cd)	0.0004	0.001	0.0002	0.001	0.001	0.001	0.025	-
Total Chromium (Cr)	0.002	0.006	0.001	0.002	0.008	0.001	0.5	-
Copper (Cu)	0.027	0.077	0.009	0.045	0.127	0.007	50	-
Iron (Fe)	0.300	0.926	0.055	0.399	1.576	0.091	4	-
Lead (Pb)	0.002	0.005	0.000	0.002	0.008	0.001	0.5	-
Manganese (Mn)	0.010	0.031	0.002	0.013	0.049	0.003	0.4	-
Nickel (Ni)	0.001	0.004	0.000	0.001	0.002	0.001	0.2	0.04
Zinc (Zn)	0.020	0.114	0.005	0.031	0.095	0.008	120	-

[a] Pre-Operation of DYEC is between May 4, 2013 and June 28, 2014.
[b] Operation of DYEC is between February 6, 2016 and December 26, 2016.
- Not applicable – an annual AAQC does not exist

Table 15 Metal 24-hour Average Statistics at Rundle during Pre-Operation and Operation of DYEC

Rundle Station	Pre-Operation of DYEC [a] Metal Concentrations ($\mu g/m^3$)			Operation of DYEC [b] Metal Concentrations ($\mu g/m^3$)			24-hour AvgAAQC ($\mu g/m^3$)	Annual AAQC ($\mu g/m^3$)
Parameter	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**		
Total Mercury (Hg)	0.00001	0.00005	0.00001	0.00001	0.00002	0.00001	2	-
Aluminum (Al)	0.101	0.349	0.016	0.180	0.786	0.016	120	-
Cadmium (Cd)	0.0004	0.001	0.001	0.001	0.001	0.001	0.025	-
Total Chromium (Cr)	0.002	0.018	0.001	0.002	0.008	0.001	0.5	-
Copper (Cu)	0.071	0.236	0.013	0.052	0.116	0.013	50	-
Iron (Fe)	0.371	1.252	0.090	0.521	1.832	0.090	4	-
Lead (Pb)	0.002	0.007	0.001	0.002	0.007	0.001	0.5	-
Manganese (Mn)	0.012	0.102	0.003	0.016	0.066	0.003	0.4	-
Nickel (Ni)	0.001	0.005	0.001	0.002	0.019	0.001	0.2	0.04
Zinc (Zn)	0.022	0.124	0.006	0.025	0.067	0.006	120	-

[a] Pre-Operation of DYEC is between May 4, 2013 and June 28, 2014.
[b] Operation of DYEC is between February 6, 2016 and December 26, 2016.
- Not applicable– an annual AAQC does not exist

Table 16 Metal 24-hour Average Statistics at Fenceline Station during Operation of DYEC

Fenceline Station	Operation of DYEC [a]			24-hour Avg AAQC ($\mu g/m^3$)	Annual AAQC ($\mu g/m^3$)
Parameter	Metal Concentrations ($\mu g/m^3$)				
	Avg	**Max**	**Min**		
Total Mercury (Hg)	0.00001	0.00005	0.00001	2	-
Aluminum (Al)	0.187	0.707	0.042	120	-
Cadmium (Cd)	0.001	0.011	0.001	0.025	-
Total Chromium (Cr)	0.003	0.008	0.001	0.5	-
Copper (Cu)	0.043	0.077	0.011	50	-
Iron (Fe)	0.493	1.358	0.101	4	-
Lead (Pb)	0.003	0.010	0.001	0.5	-
Manganese (Mn)	0.017	0.046	0.004	0.4	-
Nickel (Ni)	0.001	0.003	0.001	0.2	0.04
Zinc (Zn)	0.035	0.080	0.012	120	-

[a]-Operation of DYEC is between February 18, 2016 and December 26, 2016.
- Not applicable– an annual AAQC does not exist

3.0 St. Marys Cement Monitoring Program

St. Marys Cement (SMC) monitoring stations are situated both upwind (SMC1, 45052) and downwind (SMC2, 45053) of the company's facility in Bowmanville, Ontario (see Figure 1).

The monitoring program measures dustfall and PM_{10}, which is the size of particulate most attributable to SMC operations. Since dustfall is not measured in any of the other monitoring programs that were reviewed for this memorandum and is specific to operations at SMC, dustfall statistics are not presented below.

Table 17 and Table 18 below provide a statistical summary of the PM_{10} continuous and non-continuous data at SMC from 2013 to 2016. Non-continuous sampling occurs on a 24-hour basis every 6-day cycle as per the Environment Canada and Climate Change NAPS schedule.

Table 17. Annual Average PM_{10} Concentrations at SMC

Year	PM_{10}-Continuous (µg/m^3)		PM_{10} -Non-Continuos (µg/m^3)		Annual AAQC (µg/m^3)
	SCM1	SMC2	Site B	Site F	
2013	15.2	12.3	18.7	18.5	n/a
2014	15.3	14.1	17.1	15.7	n/a
2015	17.8	13.4	19.8	18.2	n/a
2016	12.4	9.4	17.5	15.1	n/a

Notes: All 2016 data quality is currently under the ministry's review
n/a – Not Available– an annual AAQC does not exist

Table 18. Maximum 24-hour Average PM_{10} Concentrations at SMC

Year	PM_{10}-Continuous (µg/m^3))		PM_{10} -Non-Continuos (µg/m^3))		24-hour Average AAQC (µg/m^3)
	SCM1	SMC2	Site B	Site F	
2013	82	49	61	58	50
2014	86	77	57	29	50
2015	54	72	43	49	50
2016	87	52	47	52	50
No. of 24-Hour AAQC Exceedances (June 2013 to Feb. 2015)	0	0	1	2	50
No. of 24-Hour AAQC Exceedances (March 2015 to Dec. 2016)	0	0	0	1	50

Notes: All 2016 data quality is currently under the ministry's review
n/a not applicable

The annual averages from 2013 to 2016 are fairly similar with the exception of the continuous PM_{10} measurements reported in 2016 for SMC1 and SMC2, which shows slightly lower annual PM_{10} average concentrations compared to previous years. However a slight different trend is noted for the 24-hour maximum PM_{10} concentrations, where the lowest 24-hour average maximums were reported in 2015 as shown in Table 15. Pollution roses for continuously monitored PM_{10} are provided in Figure 14 and Figure 15 in Attachment B. Based on hourly pollution roses, the SMC contribution to PM_{10} levels are seen when the winds are blowing from the East direction at SMC1 (45052) and from the Southwest direction at SMC2 (45053). Similar to other stations, PM_{10} concentrations originate from all directions which imply there are multiple sources contributing to PM_{10} levels.

Typically, PM_{10} concentrations in the area are from the local fugitive sources including the operation of SMC and fluctuations in concentrations from year to year may be attributed to operations at the SMC facility, along with other local sources, such as mobile and agricultural sources, and different meteorological conditions from year to year.

4.0 Highway 407 East Construction Monitoring Program

The Ministry of Transportation is required to monitor PM_{10}, $PM_{2.5}$, NO_x (NO & NO_2) and CO during the Highway 407 East Phase 1 and 2 construction (407 East construction), as per condition 15 of its Environmental Assessment (EA) approval. The locations for these monitoring stations were selected based on proximity to residential areas that could potentially be impacted by the 407 East construction activities depending on the meteorological conditions.

The project includes the extension of Highway 407 from Brock Road to Highway 35/115 along with construction of two north-south connectors to Highway 401 – the West Link in Whitby and the East Link in Oshawa. The first phase of the construction includes extension of Hwy 407 from Brock Road to Simcoe Street North and the construction of the West Link, along with a number of interchanges. The second phase of the construction includes extension of Highway 407 from Simcoe Street North to Highway 35/115 along with the construction of the East Link.

The ambient air monitoring condition requirements are to monitor the baseline air quality before construction and the local air quality during construction.

Figure 1 shows the locations of the four 407 East construction stations: Cresser, Brooklin, Old Scugog and Highway 2, which operate intermittently (seasonally) to capture construction activities and schedules. Of the four 407 East construction stations, two are situated in Clarington (Highway 2 and Old Scugog – Phase II) and the other two stations are situated in Whitby (Cresser and Brooklin – Phase I). The discussion will focus primarily on particulate matter and nitrogen oxides, which are the main contaminants of concern for construction activities.

4.1 Particulate Matter

PM_{10} and $PM_{2.5}$ are measured in the vicinity of 407 East construction activities. Table 19 and Table 20 below provide a statistical summary of the $PM_{2.5}$ concentrations before and during construction of the 407 East Extension.

Table 19. Seasonal Average $PM_{2.5}$ Concentrations at 407 East

Station	2013 (Phase 1 construction)	2014 [a] (Phase 2 pre-construction)	2015 [b] (Phase 2 pre-construction)	2016 [c](Phase 2 construction)	Annual CAAQS Indicator
Cresser ($\mu g/m^3$)	6	---	---	---	10
Brooklin ($\mu g/m^3$)	8	---	---	---	10
Old Scugog ($\mu g/m^3$)	---	7	---	4	10
Highway 2 ($\mu g/m^3$)	---	---	7	5	10

[a].Data collected between June and August, 2014.
[b] Data collected between July and September, 2015.
[c] One year of construction. Data collected between March/April 2016 to March/April/2017.
--- no data available due to sampling schedule as approved in the monitoring plan as per EA condition.

Table 20. Maximum 24-hour Average $PM_{2.5}$ Concentrations at 407 East

	Cresser ($\mu g/m^3$)	Brooklin ($\mu g/m^3$)	Old Scugog ($\mu g/m^3$)	Highway 2 ($\mu g/m^3$)
Maximum 24-Hour Concentration – Pre-Construction	36	22	20[a]	18[b]
Maximum 24-Hour Concentration - Construction	37	38	17	31
No. of 24-Hour Concentrations elevated above the 28 $\mu g/m^3$ CAAQS indicator (Pre-construction)	2	0	0	0
No. of 24-Hour Concentrations elevated above the 28 $\mu g/m^3$ CAAQS indicator (During construction)	1	2	0	1

[a] This is a seasonal average for the summer months of June to August, 2014.
[b] This is a seasonal average for the summer months of July to September, 2015.

Based on an hourly $PM_{2.5}$ pollution rose assessment (Figure 16 and Figure 17 in Attachment B), contributions are seen from all directions but more frequently from the West and Southwest quadrants during construction at Highway 2 station, indicating that measurements are not only from construction activities but also other sources such as transportation. Cresser and Brooklin stations depicted higher 24-hour average $PM_{2.5}$ measurements during the construction period (2013 and 2014) than the pre-construction period (2012).

The other particulate size measured at 407 East construction stations is PM_{10} since it represents the coarser fraction of particulate that is relevant to construction activities, such as grading and material handling practices.

Table 21 and Table 22 below provide a statistical summary for PM_{10} concentrations before and during construction of the 407 East Extension. Of the Clarington construction monitoring stations, Highway 2 reported the highest number of non-conformance with the PM_{10} interim guideline of 50 $\mu g/m^3$. There were 15 non-conformances of 24-hour average PM_{10} concentrations from 2013 to 2016.

Table 21. Period Average PM_{10} Concentrations at 407 East

Station	2013 (Phase 1 construction)	2014 [a] (Phase 2 pre-construction)	2015 [b] (Phase 2 pre-construction)	2016 (Phase 2 construction)	Annual AAQC
Cresser ($\mu g/m^3$)	12	---	---	---	n/a
Brooklin ($\mu g/m^3$)	15	---	---	---	n/a
Old Scugog ($\mu g/m^3$)	---	16	---	12	n/a
Highway 2 ($\mu g/m^3$)	---	---	14	17	n/a

[a]. Data collected between June and August, 2014.
[b] Data collected between July and September, 2015.
--- Not in operation
n/a an Annual AAQC does not exist

The 24-hour average maximum PM_{10} concentrations generally increased during construction activities when compared to the pre-construction period.

Table 22. Maximum 24-hour Average PM_{10} Concentrations at 407 East

	Cresser [c] (µg/m³)	Brooklin [d] (µg/m³)	Old Scugog [a] (µg/m³)	Highway 2 [b] (µg/m³)	24-Hour AAQC (µg/m³)
Maximum 24-Hour Concentration – Pre-Construction	45.8	45.7	28	35	50
Maximum 24-Hour Concentration - Construction	52	78	40	121	
No. of 24-Hour Exceedances	1	5	0	9	

[a] This is a period average for the spring & summer months of June to August, 2014.(background for Old Scugog –Phase II)
[b] This is a period average for the spring & summer months of July to September, 2015 (background for Highway 2 Phase II)
[c] This is a period average for the spring & summer months of April 15 to August 15, 2012 (background for Cresser -Phase I for Cresser).
[d] This is a period average for the spring & summer months of May 16 to August 15, 2012 (background for Brooklin- Phase I).

4.2 NO_2

NO_2 is measured at the 407 East Phase I and II construction stations, which employ similar technology to that used at the DYEC and Oshawa monitoring stations. Table 23 and Table 24 below provide a statistical summary for NO_2 at 407 East stations. There were no exceedances of the hourly and 24 hour AAQC.

Table 23. Annual Average NO_2 Concentrations for the 407 East

Station	2013 (Phase 1 construction)	2014 [a] (Phase 2 pre-construction)	2015 [b] (Phase 2 pre-construction)	2016 (Phase 2 construction)	Annual AAQC
Cresser (ppb)	10.3	---	---	---	---
Brooklin (ppb)	6.5	---	---	---	---
Old Scugog (ppb)	---	3.3	---	4.2	---
Highway 2 (ppb)	---	---	3.2	4.6	---

[a] This is a period average for the spring & summer months of June to August, 2014.
[b] This is a period average for the spring & summer months of July to September, 2015.
--- Station not operational

Based on the hourly pollution roses found in Figure 18 in Attachment B, NO_2 concentrations in 2016 (Phase II construction) originate from all directions at Highway 2. The highest NO_2 concentrations are most frequently from West and Southwest directions, which correspond to the upwind construction activities.

Table 24. Maximum 24-hour Average & Hourly NO_2 Concentrations for the 407 East Stations

	Cresser (ppb)	Brooklin (ppb)	Old Scugog (ppb)	Highway 2 (ppb)	24-Hour AAQC	1-Hour AAQC
Maximum 24-Hour Concentration – Pre-Construction	20[d]	27[d]	6 [a]	7 [b]	100	n/a
Maximum 24-Hour Concentration - Construction	68 [c]	29 [c]	20	22	100	n/a
Maximum 1-Hour Concentration – Pre-Construction	39	79	25[a]	23[b]	n/a	200
Maximum 1-Hour Concentration – Construction	93	40	57	35	n/a	200
No. of 24-Hour & 1- hour Exceedances (Pre- Construction & Construction)	0	0	0	0	n/a	n/a

[a] This is a period average for the spring & summer months of June to August, 2014.
[b] This is a period average for the summer months of July to September, 2015.
[c] This is a period average for construction months from February to December, 2013.
[d] This is a period average for background (pre-construction) from May/June to August, 2012.
n/a – Not applicable

5.0 Gerdau Particulate Monitoring Program

Gerdau Ameristeel Corporation in Whitby operates an industrial ambient air quality monitoring program, which began in January, 2015 as required by their Environmental Compliance Approval.

Gerdau operates a meteorological tower and two monitoring stations that measure TSP and metals every 6 days following the NAPS schedule and the *Operations Manual for Air Quality Monitoring in Ontario* (MOECC, 2018). During prevailing wind conditions, South Blair Station is upwind of Gerdau and Thickson Station is downwind, as illustrated in Figure 1.

The parameters of concern that pertain to Gerdau operations are mainly particulates and metals. The monitoring program at Gerdau began in January 2015, however due to equipment issues, the Thickson Station did not meet the ministry's data validity requirements and for this reason only the 2016 annual average was reported.

In this memorandum, the statistics presented below are for particulates from 2015 to 2016. Some metals monitored at Gerdau, such as copper and iron, are also found naturally in the environment, and there are other sources in the area that potentially contribute to the background metal concentrations including off-road mobile sources and railway and locomotive engines.

Of the metals monitored, only one 24-hour average AAQC exceedance was reported for manganese with a concentration of 0.42 µg/m^3 at South Blair Station on May 6 / 2015, compared to the AAQC of 0.4 µg/m^3. The remaining metals are all below the AAQC, the statistics presented in the Table 25 below are only for TSP and Table 26 is for metals.

Table 25 Annual TSP Statistics at Gerdau Whitby Monitoring Network

Year	South Blair	Thickson	Annual AAQC (µg/m^3)
	TSP Concentration (µg/m^3)	TSP Concentration (µg/m^3)	
2015	36.3	INS	60
2016	28.7	23.7	60
No. of 24-Hour AAQC Exceedances	0	0	n/a

Notes: TSP measurements are based on 6-day frequency interval.
2015 – 9 & 14 samples were not collected at Blair & Thickson stations, respectively, due to technical errors
INS - Insufficient valid data in 2015 to calculate an annual average at Thickson (average = 24.7 µg/m^3).
n/a -not applicable.

Overall as shown in Table 25, the annual TSP concentrations generally are higher at the South Blair Station compared to Thickson Station with the highest annual average in 2015. Levels are slightly lower in 2016 than 2015. These differences are most likely due to local activities that occurred in the vicinity of the South Blair stations, such as construction, and not just the contribution from Gerdau operations, which is discussed further in Section 5.4. Pollution roses for 24-hour average TSP concentrations are provided in Figure 19 of Attachment B. Based on the limited data set, the pollution roses illustrate TSP emissions coming from all directions. The elevated TSP levels were observed from the East direction at South Blair Station, which includes background and Gerdau's contribution. The background contribution from the East direction can also been seen at the Thickson Station which is upwind from Gerdau's operations.

Of the 15 metals analyzed from the TSP filters, 8 are typically above the detection limit. This is shown in Table 26 and Table 27. With the exception of manganese, for which one sample slightly exceeded the manganese AAQC of 0.4 µg/m^3 in 2015, all metals analyzed are below the 24-hour average AAQC.

Table 26 Maximum 24-hour Average Concentrations for Selected Metals at Gerdau Ameristeel at Blair Station

Blair Station 45064	**2015**			**2016**			**24-hour Avg AAQC (µg/m^3)**	**Annual AAQC (µg/m^3)**
Parameter	**Metal Concentrations (µg/m^3)**			**Metal Concentrations (µg/m^3)**				
	Avg	**Max**	**Min**	**Avg**	**Max**	**Min**		
Aluminium (Al)	0.22	1.15	0.01	0.17	0.99	0.01	120	n/a
Total Chromium (Cr)	0.01	0.078	0.001	0.005	0.049	0.001	0.5	n/a
Copper (Cu)	0.015	0.056	0.003	0.044	0.112	0.010	50	n/a
Fe (Fe_2O_3)	1.29	6.40	0.14	0.79	5.21	0.12	25	n/a
Lead (Pb)	0.0095	0.046	0.0008	0.0049	0.024	0.0008	0.5	n/a
Manganese (Mn)	0.067	0.417	0.0086	0.039	0.353	0.00387	0.4	n/a
Nickel (Ni)	0.0021	0.0083	0.0008	0.0013	0.006	0.0008	0.2	0.04
Zinc (Zn)	0.15	1.32	0.01	0.069	0.676	0.0062	120	n/a

Notes: In 2015, nine samples were not collected at South Blair Station due to technical errors

n/a not applicable

Table 27 Maximum 24-hour Average Concentrations for Selected Metals at Gerdau Ameristeel at Thickson Station

Thickson Station 45065	**2015**			**2016**			**24-hour Average AAQC (ug/m^3)**	**Annual AAQC (ug/m^3)**
Parameter	**Metal Concentrations (µg/m^3)**			**Metal Concentrations (µg/m^3)**				
	Avg	**Max**	**Min**	**Avg**	**Max**	**Min**		
Aluminium (Al)	INS	0.74	0.01	0.14	0.57	0.01	120	n/a
Total Chromium (Cr)	INS	0.028	0.001	0.005	0.030	0.001	0.5	n/a
Copper (Cu)	INS	0.06	0.001	0.056	0.193	0.014	50	n/a
Fe(Fe2O3)	INS	4.79	0.11	0.66	2.48	0.08	25	n/a
Lead (Pb)	INS	0.007	0.003	0.004	0.002	0.0008	0.5	n/a
Manganese (Mn)	INS	0.0201	0.0205	0.017	0.006	0.003	0.4	n/a
Nickel (Ni)	INS	0.0008	0.0008	0.0008	0.0008	0.0008	0.2	0.04
Zinc (Zn)	INS	0.1	0.046	0.064	0.022	0.008	120	n/a

Notes: In 2015, fourteen samples were not collected at Thickson Station due to technical errors.

INS - Insufficient valid data in 2015 to calculate an annual average at Thickson

n/a not applicable

6.0 Oshawa Station

The ministry has a network of 39 ambient air monitoring stations across the province that collect real-time air pollution data. One of these monitoring stations is located in Oshawa at 2000 Simcoe Street North, on the Durham College campus. This station began monitoring in 2005 and has since reported air quality data. The Oshawa data from 2013 to 2016 will be summarized in this memorandum for comparison purposes with the other programs mentioned. The parameters currently monitored include ozone (O_3), PM $_{2.5}$, and NOx.

Table 28 below provides the annual statistics for PM $_{2.5}$ and NO_2 monitored at this site. O_3 is not discussed because it is not measured at the stakeholders stations discussed in this memorandum. Ozone is not generally emitted directly into the atmosphere, but it is formed through chemical reactions and strongly dependent on meteorological conditions (Air Quality in Ontario 2014 Report, MOECC).

Table 28 Annual and 24-Hour Average Statistics Reported at the Oshawa Station

Parameter	Annual Average Concentration [a]						Maximum 24-hour Average Concentration						
	2013	2014	2015	2016	2014 - 2016	CAAQS	2013	2014	2015	2016	2014 - 2016	CAAQS	AAQC
PM $_{2.5}$ (µg/m^3)	7.4	7.7	7.5	5.9	6.9	10 [b]	41	27	26	22	18 c	28 [b]	n/a
NO_2 (ppb)	5.9	6.8	6.6	6.3	n/a [c]	n/a [c]	22	27	26	29	n/a [c]	n/a [c]	100
No. of Exceedances	0	0	0	0	n/a	n/a	2	0	0	0	n/a	n/a	n/a

Notes:
All 2016 data quality is currently under ministry's review
n/a not applicable
[a] Annual average concentrations are based on hourly data and not based on the annual CAAQS metrics
[b] Criteria based on Canadian Ambient Air Quality Standards (CAAQS). Since this memorandum does not calculate the CAAQS for the other monitoring locations, this criteria is used as an indicator, and referred in this memorandum as CAAQS indicator
[c] NO_2 CAAQS effective starting in 2020. The 24-hour $PM_{2.5}$ CAAQS is based on the average of the 98th percentile for 3 consecutive years following the CCME metric guidelines.

The MECP Oshawa station is classified as a designated site as per the CCME guidelines since it includes communities with population greater than 100,000 as described in the *Air Quality in Ontario 2014 Report* (MOECC, 2014). The CAAQS for 24hr $PM_{2.5}$ at the Oshawa Station is 18 µg/m^{3,} which is significantly lower than the 24hr CAAQS of 28 µg/m^3. The annual $PM_{2.5}$ CAAQS at the Oshawa station is 6.9 µg/m^3, which is also lower than the annual CAAQS of 10 µg/m^3.

Hourly $PM_{2.5}$ and NO_2 Pollution roses for Oshawa AQHI Station are included in Attachment B. Similar to the stakeholder stations, $PM_{2.5}$ and NO_2 emissions originate from all wind directions implying there are multiple sources in the area as illustrated in Figure 20 and Figure 21.

7.0 Discussion: Common Pollutants across Networks

The parameters that are common across the monitoring networks discussed in this memorandum are TSP, $PM_{2.5}$, PM_{10} and NO_2 and for this reason they were selected for further discussion. BaP will also be discussed since there have been exceedances of the BaP AAQC at the DYEC monitoring stations.

An overview of how these parameters compared with other nearby stakeholder monitors and or nearby MECP and Environment Canada NAPS Stations was conducted. The ministry stations selected for further comparison include the Oshawa, Toronto West, and Newmarket Stations. The Environment and Climate Change Canada stations selected for comparison purposes include Toronto Gage and Simcoe Stations. Oshawa, Toronto Gage and Toronto West represent urban conditions, while the rural setting of the North Clarington area is represented by the Newmarket and Simcoe NAPS Stations, which is comprised mainly of residential/commercial, agricultural and transportation sources.

Please note that this analysis is based on limited data and is presented for various time periods (pre-operation and operation of the DYEC facility, and background conditions and construction of the 407 East Extension), making it difficult to observe trends or patterns. Based on the variability of the monitoring programs (different monitoring program schedules, purpose and equipment), and changes in background and transboundary sources, it is not possible to determine the percent contributions with accuracy from any particular source in the area. With this in mind, the results from this comparison are highlighted in section 7.2 below.

7.1 Data Limitations & Qualifiers

This section summarizes the limitations and qualifications that should be considered before data comparisons are made between stations.

1. Purpose
   Ministry’s stations were established to monitor general air quality in an area not dominated by one particular source of emissions, while stakeholder stations were established to monitor general air quality in the vicinity of a particular facility or activity. Stakeholder ambient monitoring programs will also often begin monitoring before activities in the area change in order to establish baseline concentrations for comparison with future monitoring results.

2. Instrumentation
   Although two monitoring programs may monitor the same parameter, if different equipment is used the data will not be directly comparable. In this memorandum, multiple federal equivalent methods recognized by the US EPA are employed for particulate monitoring. The Hwy 407 East monitoring program measures continuous PM_{10} and $PM_{2.5}$ using the BAM 1020 particulate monitor. SMC also measures continuous PM_{10} using a BAM in addition to measuring PM_{10} on a 6-day NAPS schedule using Hi-Vol monitoring equipment. The DYEC and the ministry stations, however, use a

Synchronized Hybrid Ambient Real-time Particulate (SHARP) monitor to measure continuous $PM_{2.5}$ concentrations.

These different technologies will result in slightly different measurements. For example, based on the ministry's field staff experience, the BAM $PM_{2.5}$ monitor is known to measure approximately 10-20% higher concentrations during high humidity conditions compared to the SHARP $PM_{2.5}$ measurements.

3. <u>Data Quality</u>
   Only good quality data that has been through a quality assurance/quality control assessment from proper operation of the equipment to sample analysis and data processing should be used for interpretation and comparison between stations.

   Please note that the ministry is currently reviewing the 2016 data from the ministry and stakeholder stations. Therefore, the 2016 statistics are considered preliminary and decisions should not be made based on the 2016 data presented in this memorandum. If any anomalies are discovered in the data, the ministry will update the data and prepare an addendum to this memorandum if required.

7.2 PM $_{2.5}$

When comparing the monitoring network at DYEC to that of 407 East, it is important to note that since the 407 East Construction stations operated intermittently from 2013 to 2016, comparisons performed were for the same time period to ensure consistent meteorological conditions. In addition, the construction monitoring time period also coincides with the highest particulate concentrations typically found in the spring and summer seasons.

Figure 2 illustrates 24-hour average $PM_{2.5}$ concentrations which are relatively similar when data from the 407 East Construction project is compared against other Durham Region stations or the nearest representative stations during the same time period.

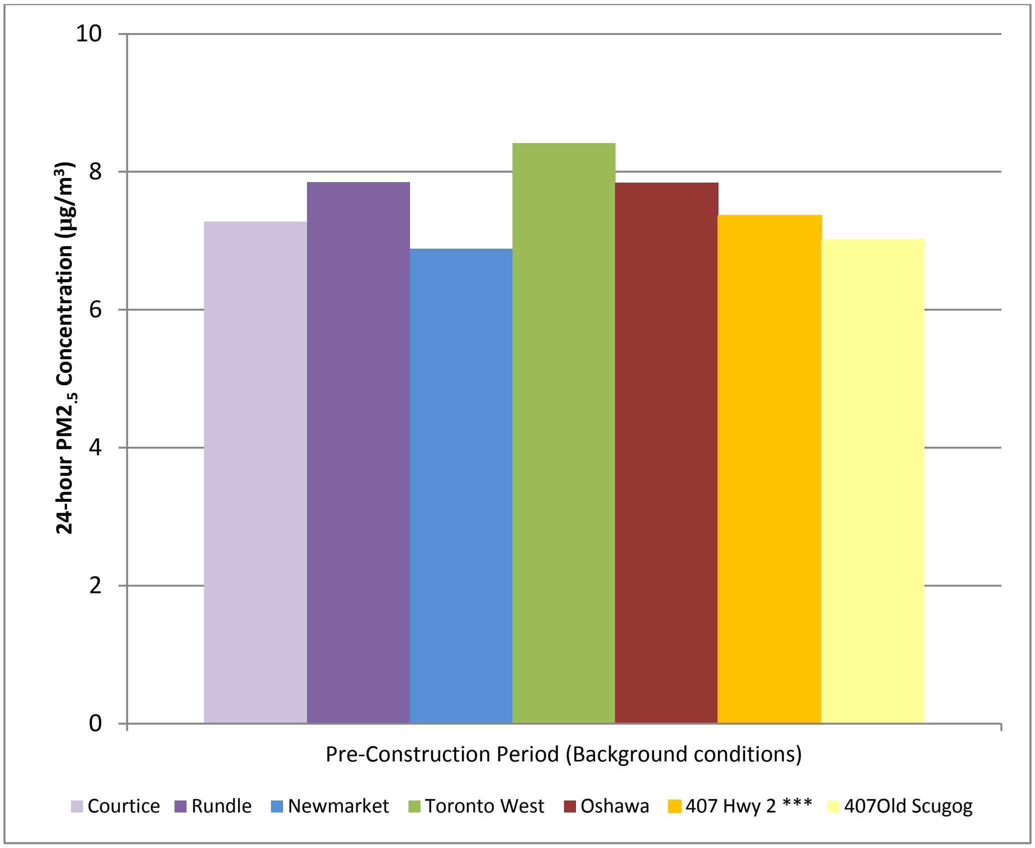
Based on this comparative assessment, the following observations can be made:

- The Courtice Station $PM_{2.5}$ measurements, which are representative of upwind conditions in relation to the DYEC facility, are similar when compared to the 407 East stations. However, when comparing the seasonal $PM_{2.5}$ average from the Courtice station to the Oshawa and Newmarket ministry stations, $PM_{2.5}$ is approximately 8% higher at Courtice which may be due to local activities occurring around the monitor, such as mobile traffic from Highway 401 and construction.

- The Rundle Station, which is situated downwind of the DYEC facility, is also downwind of other $PM_{2.5}$ sources such as Highway 401 and the CN Rail tracks. The $PM_{2.5}$ 24-hour average measurements at the Rundle Station were on average slightly lower (approximately 7%) when compared against the Toronto West Station during pre-operation. However, the $PM_{2.5}$ 24-hour average concentrations were on average slightly higher (approximately 9%) when compared against the Toronto West Station during operation as shown in Table 29. This difference in $PM_{2.5}$ observations is relatively small and is likely due to changes in background concentrations and multiple sources of $PM_{2.5}$ in the Clarington area, such as the 407 East Construction Phase 2 activities. Toronto West Station was used in this comparison since it is situated adjacent to the Highway 401 corridor like the Rundle Station.

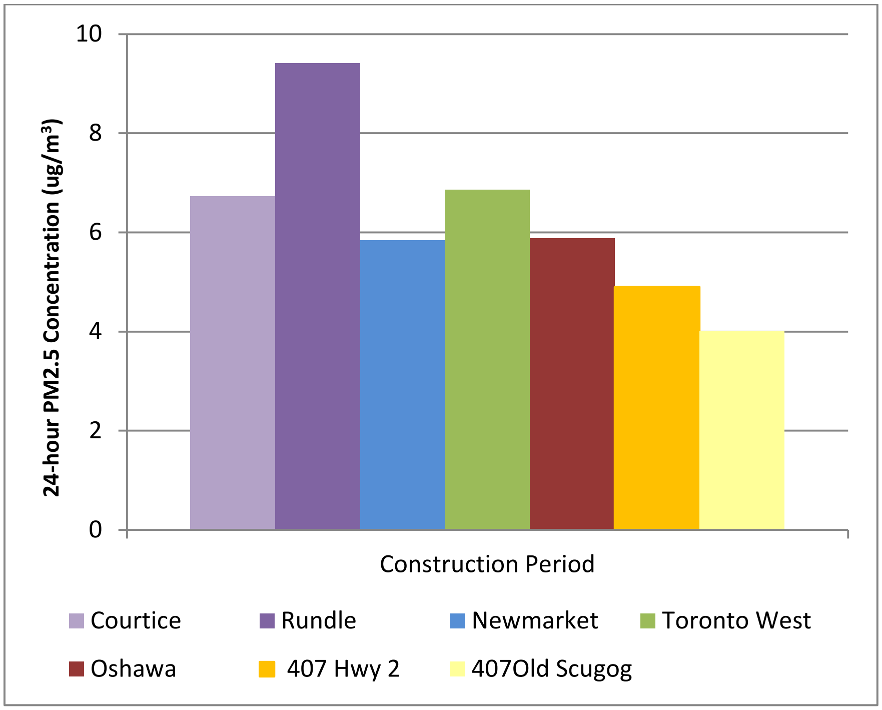
Furthermore, several roads were re-aligned in the vicinity of the Rundle station in 2016 and this is a contributing source to the $PM_{2.5}$ measurements recorded at the Rundle Station. There may also be other local sources that due to seasonal variability may have increased background $PM_{2.5}$ levels during the operation phase. These include residential and/or commercial wood burning or other utilities for comfort heating.

Figure 2. Period $PM_{2.5}$ Average Concentrations during 407 East Phase II Pre-Construction Period



Notes:
This graphs presents a 3-month period average which is the baseline monitoring conducted at the 407 East Phase II Construction.
$PM_{2.5}$ data is currently under review by the ministry. These reported averages may change.
*** Highway 2 station measurements are from July 1 to September 30, 2015
Old Scugog station measurements are from June 1 to August 31, 2014

Figure 3. Period $PM_{2.5}$ Average Concentrations during 407 East Phase II Construction Period



Notes:
This graphs presents a 3-month period average which is the baseline monitoring conducted at the 407 East Phase II Construction.
PM $_{2.5}$ data is currently under review by the ministry. These reported averages may change.
*** Highway 2 station measurements are from March – December 2016
Old Scugog station measurements are from April – December 2016

The annual average concentrations for $PM_{2.5}$ measured at the Rundle and Courtice Stations along with a select number of ministry and stakeholder stations are presented in the table below.

Table 29 Annual or Period PM $_{2.5}$ Average Concentrations at Stakeholder and Ministry Stations

Year	Annual / Period $PM_{2.5}$ Average Concentrations (µg/m^3)									Annual CAAQS INDICATOR
	Courtice	Rundle	Cresser[a]	Brook lyn[a]	Old Scugog[a]	High way2[a]	Oshawa	New market	Toronto West	
2013[a]	8.5	8.4	6	8	n/a	n/a	7.6	7.4	9.2	10
2014	8.5	8.5	n/a	n/a	Ins/ 7.0	n/a	7.7	7.3	9.1	10
2015	7.7	9.5	n/a	n/a	n/a	Ins/ 7.4	7.5	7.2	8.6	10
2016	6.8	9.6	n/a	n/a	4	5	5.9	6.0	7.0	10
Pre-Operation (Jun 30, 2013 to Feb.13/2015)	8.5	8.5	12	15	16	--	7.7	7.4	9.2	10
Operation (Feb.13, 2015 to Dec.31, 2016)	7.2	9.6	--	--	14	16	6.7	6.5	7.7	10

a $PM_{2.5}$ data is currently under review by the ministry.
2013 period captures 24-hour average concentration from June 30, 2013 to December 31, 2013 at the Courtice and Rundle Stations
n/a Phase 2 construction monitoring not in operation in 2013 and Phase 1 construction monitoring terminated in 2013
Ins Insufficient data for a valid annual mean and thus a 3 months seasonal average is reported instead
-- Station not operational due to the approved schedule as per the monitoring plan as per EA condition

During the construction period, $PM_{2.5}$ concentrations on average were generally similar with the exception of the Rundle Station which is slightly higher when compared to other ministry and 407 East construction stations in Durham Region. The data so far reported to the ministry suggest that there are multiple sources of $PM_{2.5}$ in the area and additional years of data are required to assess trends in $PM_{2.5}$ and compare against the CAAQS.

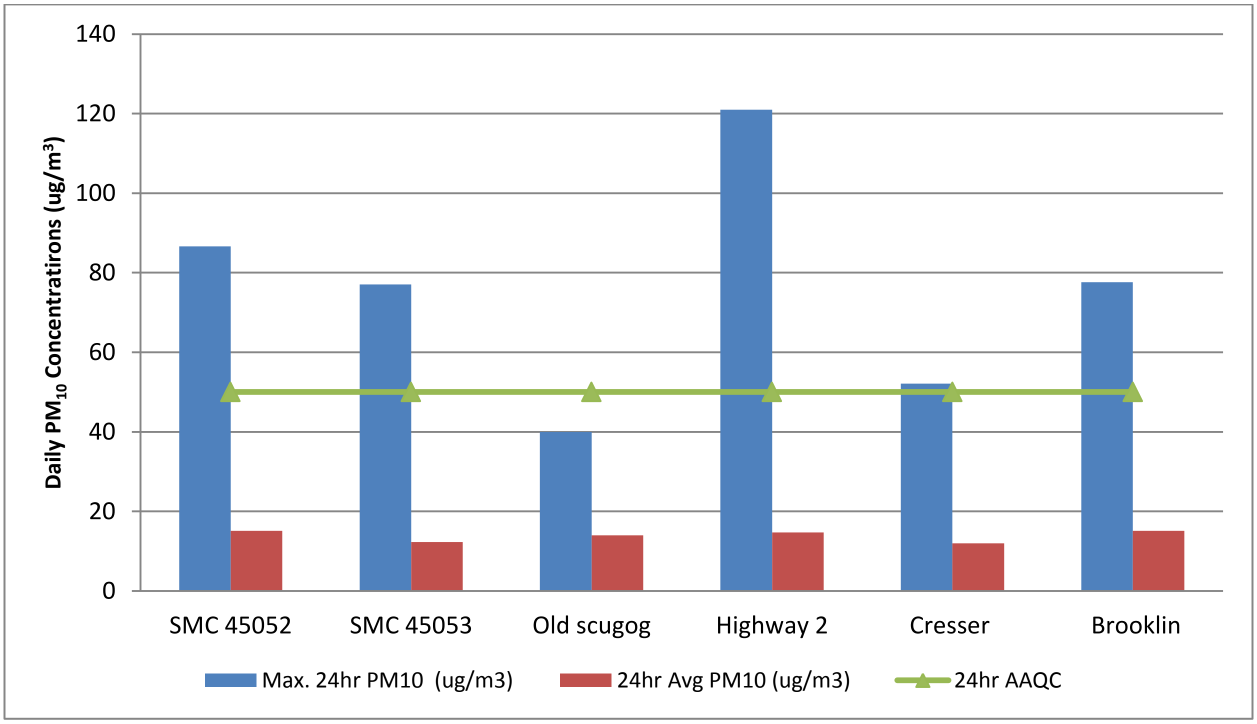
Lastly, $PM_{2.5}$ concentrations measured in Durham Region are not only from local sources, but also can be influenced by emission sources outside of regional or provincial boundaries, referred to as transboundary sources (for example the 2013 forest fires in Quebec), resulting in $PM_{2.5}$ impacts at Southern Ontario monitoring stations.

7.3 PM_{10}

Particulate matter smaller than 10 microns (PM_{10}) is monitored at SMC and the 407 East. PM_{10} 24-hour average non-conformances of the interim AAQC of 50 ug/m^3 were reported in both programs. PM_{10} is mostly from industrial fugitive emissions, re-suspension of dust from unpaved and paved roads, and from other local sources such as agricultural and construction activities.

In general, PM_{10} 24-hour average concentrations are similar among SMC and 407 East construction stations as seen in Figure 4. However, the maximum 24 hour PM_{10} concentrations reported are significantly higher at Highway 2 station when compared to SMC stations and the remaining 407 East Stations.

Figure 4. Annual or Period Average PM_{10} Concentrations at SMC and 407 East Construction



Notes: For 407 East Construction Stations, the average concentration is based on seasonal period

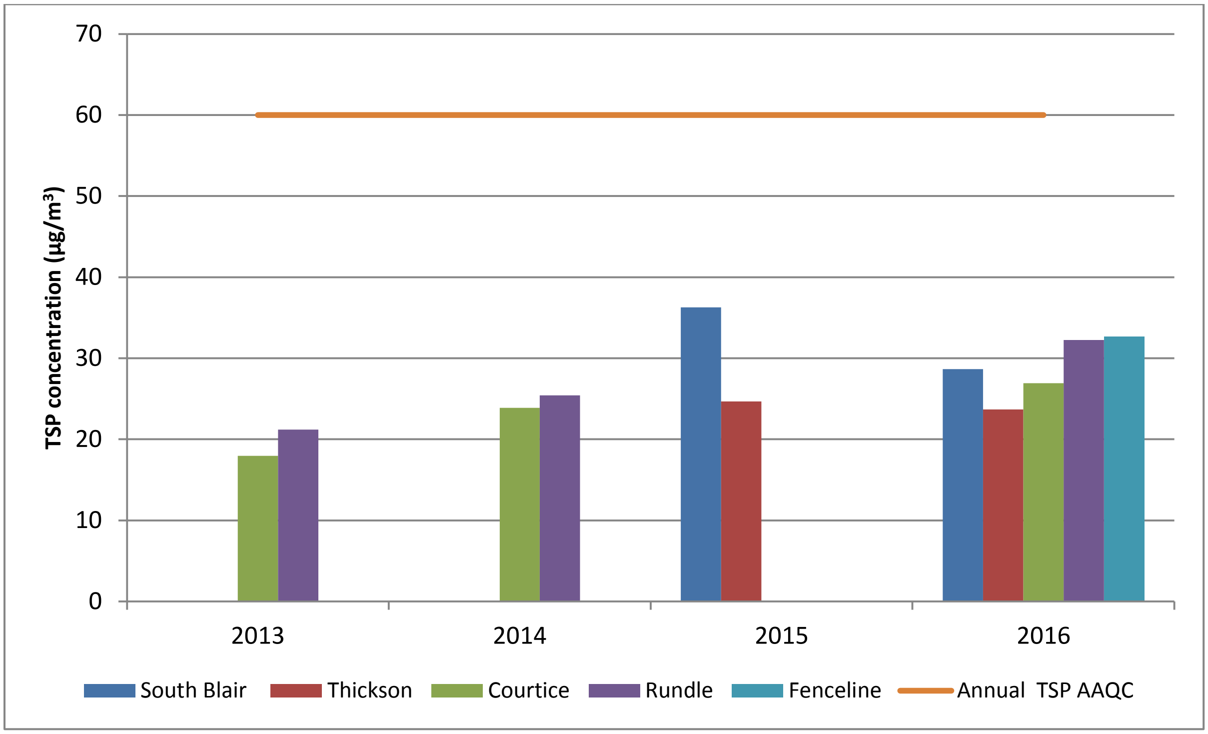
Despite the fact that PM_{10} 24-hour maximum concentrations were elevated, the 24- hour average concentrations were below the AAQC of 50 µg/m^3 as shown in Figure 4. The ministry is not concerned with the elevated values as these are typical when monitoring temporary construction activities and peak quarry operations.

7.4 TSP

Total suspended particulate (TSP) was another pollutant common to some of the stakeholder monitoring programs in Durham Region. When comparing TSP data across stations, one needs to consider the local activities present at the time of monitoring, potential sources and to consider the wind variability on sampling days. Further, TSP data is collected on a 6-day cycle and it is not monitored continuously like PM_{10} and $PM_{2.5}$. For these reasons, the ministry cannot comment on the percent contribution of TSP from different sources as discussed in previous sections. In all cases however, the monitors do capture transportation sources from major highways nearby and also captures re-suspension of road dust from paved and unpaved roads surrounding the monitors.

Figure 5 below illustrates the annual average TSP concentrations reported from each of the stakeholder monitoring programs from 2013 to 2016.

Figure 5. Annual 24-hour Average TSP Concentrations at Gerdau and DYEC facilities



Notes:
This figure does not contain bars for specific years due to insufficient measurements for a valid annual mean.
TSP annual averages are based on arithmetic mean and not geometric mean.

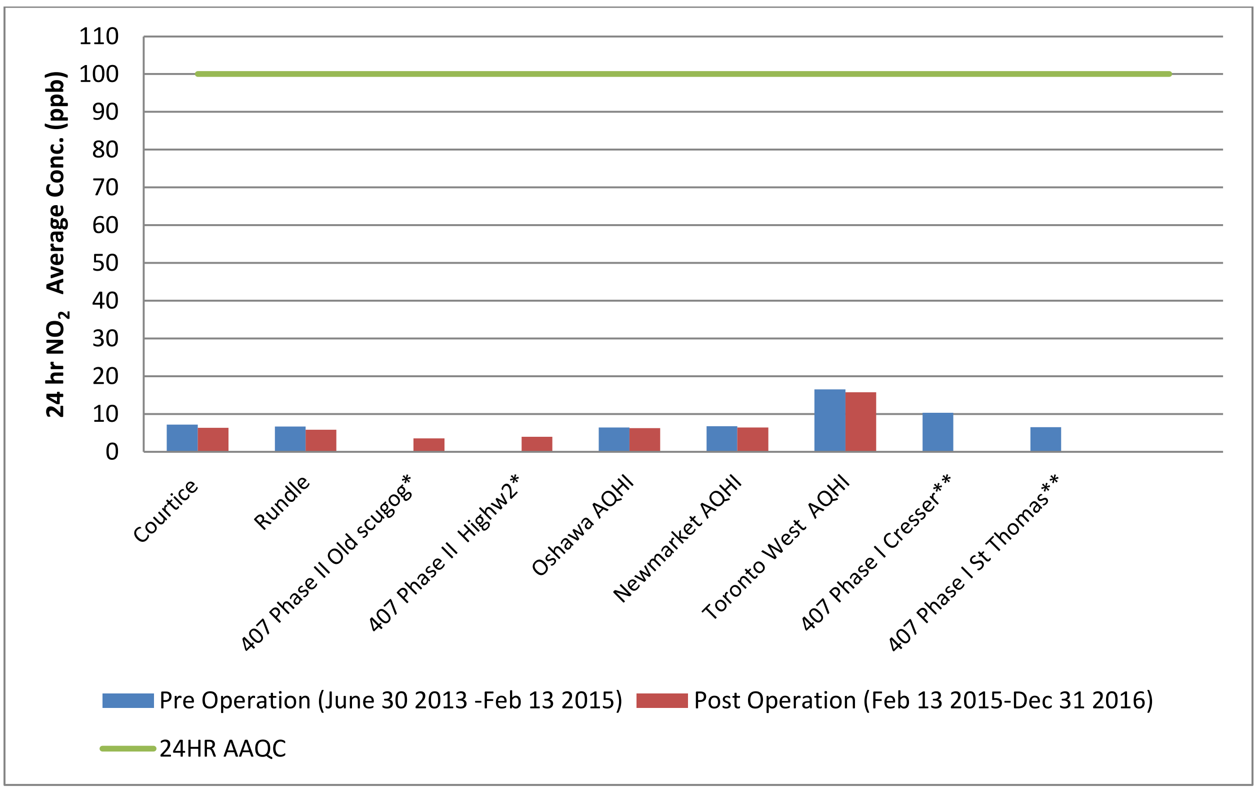
Figure 5 shows that the 24-hour TSP average at the South Blair Station is higher than at Thickson in 2015, this may be due to local construction activities, such as grade separation and heavy material handling from a rail construction project which occurred northwest of the South Blair Street station. Although 24-hour average TSP levels occasionally exceeded the 24-hour TSP AAQC of 120 $\mu g/m^3$, on an annual average basis there were no exceedances. Furthermore, on average TSP concentrations at the Courtice and Rundle Stations have increased over the years when compared to 2013.

7.5 NO_2

Nitrogen dioxides (NO_2) are also released from multiple sources in Durham Region, such as vehicle emissions, wood burning activities, and industrial combustion sources like the DYEC facility. Based on the current stakeholder monitoring stations in Durham Region and the ministry's Oshawa station, NO_2 is below the hourly and 24-hour average AAQC.

At both the Courtice and Rundle Stations the NO_2 24-hour average concentrations for the pre-operation and operation of the DYEC facility are generally the same as illustrated in Figure 6. A similar trend is also noted when the DYEC stations are compared against the 407 East Extension monitors and the Oshawa station. Generally, NO_2 concentrations are similar on average with the exception of the Toronto West station, which is slightly higher. The difference observed at the Toronto West station is likely due to the fact that traffic volumes are different between Durham Region and Toronto especially along Highway 401.

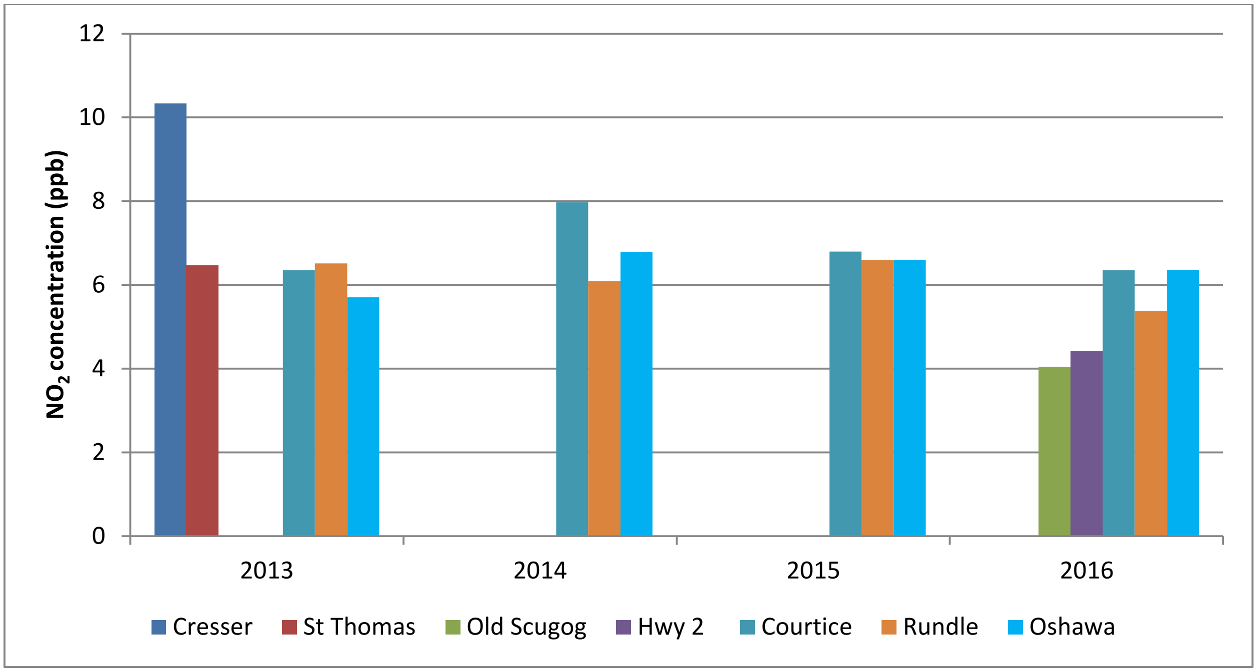
Figure 6. NO_2 24-Hour Average Concentrations at Various Ministry and Stakeholder Stations



Notes:
*407 Phase II Old Scugog and Highway 2 stations collected data from background and during construction
Background - Old Scucog from June 1, 2014 to August 31, 2014 and Highway 2 from July 1 to September 2015
Construction – Old Scugog from April 1 to December 31, 2016 and Highway 2 from March 5 to December 31, 2016
**407 Phase I Cresser and Brooklin stations only include data during construction from February 1 to December 31, 2013 since pre-construction occurred in 2012.

Similarly to the 24-hour average NO_2 concentrations reported from 2013 to 2016, the annual 24-hour average NO_2 concentrations are also similar across Durham Region as shown in Figure 7 below.

Figure 7. Annual NO_2 Average Concentrations at Various Ministry and Stakeholder Stations



Notes:
* Annual valid average not reported for specific stations in 2013-2015 due to insufficient measurements or not in operation
No Annual AAQC for NO_2.

7.6 Benzo(a)pyrene

PAHs are only monitored at the DYEC stations in Durham Region. Based on the limited benz(a)pyrene (BaP) data and the pollution rose assessment presented in Section 2 of this memorandum, the days that BaP exceeded the AAQC at the Courtice and Rundle Stations were more frequent when the winds were blowing from the Northwest quadrant, which is upwind of the DYEC facility. This trend was also observed during both pre-operation and operation periods of the DYEC facility. This implies that the background BaP concentrations at the Courtice and Rundle Stations are most likely due to Highway 401, Highway 407 East construction equipment, agricultural equipment, and potentially other local combustion sources, such as residential and or commercial wood burning.

Furthermore, BaP is commonly measured above the 24-hour average AAQC throughout Ontario, not only in urban settings but also at rural locations due to the contribution of combustion sources and diesel engines. For example, BaP measurements in 2013 for Simcoe and Toronto all had maximum levels above the AAQC. Due to the limited BaP data that the ministry has from the Courtice and Rundle Stations, no comparisons were made with other representative NAPS stations.

7.7 Metals

Metals are monitored at the DYEC and Gerdau Ameristeel stations in Durham Region. The data currently shows metal concentrations to be below the 24-hour average AAQC with the exception of one 24-hour average manganese sample collected in 2015 at South Blair Station which exceeded the AAQC by 4 percent. The metal concentrations when compared to the nearest NAPS station, which is Gage Station situated in downtown Toronto, are relatively similar with the exception of certain parameters like manganese and total chromium where the concentrations are typically 10 times higher on average in Gerdau Ameristeel stations. Although 10 times higher, the total chromium and manganese on average are lower than the AAQC by 1 to 2 and 8 to 17 percent of the AAQC, respectively. These differences are mainly due to the multiple sources in the local area such as industrial emissions which are not found in the general vicinity of the NAPS stations.

In summary, the metal concentrations reported meet the ministry's AAQC, with the exception of one 24-hour average manganese sample at Gerdau Ameristeel, and for this reason there are no concerns based on the limited data.

8.0 Summary

This memorandum summarizes air quality measurements from various monitoring programs situated in Durham Region between the time period of 2013 to 2016. It also highlights the fact that there are numerous sources that contribute to $PM_{2.5}$, NO_2, TSP and BaP emissions.

Each monitoring program was established for a particular purpose. The stations discussed in this memorandum were not sited to obtain general air quality levels in the south Clarington area, nor in Durham Region. For this reason, one cannot extrapolate on the limited data collected from the DYEC facility, St. Marys Cement, Gerdau Whitby, and the 407 East Extension construction monitoring locations to represent the general air quality levels in Clarington.

Although there are limitations with the data, the findings of this assessment are as follows:

1. In general, $PM_{2.5}$ concentrations across Durham Region are similar in comparison to other urban settings across Ontario. The 24-hour average $PM_{2.5}$ concentrations and BaP AAQC (0.05 ng/m^3) exceedances are not only seen in Clarington, but across other southern Ontario Stations.

2. Based on field observations and pollution rose assessments, background sources have changed from 2013 to 2016 in South Clarington, mainly due to the changes in local activities near the monitors, and 407 East construction activities.

3. In every monitoring network, there are multiple sources that contribute to the measurements observed at the station. Therefore, it is almost impossible to decipher the contribution with accuracy from a particular source based on air measurement data.

4. Based on stakeholder monitoring stations and the hourly pollution rose assessments, industrial sources are not the only contributor to air quality issues. Other sources such as construction activities, residential and commercial, agricultural and transportation sources contribute significantly to the air quality measurements observed at the monitoring stations in Durham Region.

5. Lastly, it is also important to note that when comparing data, fluctuations in meteorological conditions must be considered. Meteorological variations from year to year influence the air quality measurements observed at each station. For example, particulate matter impacts are typically highest during dry summer conditions due to less rainfall events resulting in higher dust impacts if unpaved surface emissions are not mitigated. During cold winters as a result of increased heating requirements, products of combustion result in higher emissions which is seen at the different monitoring stations across Durham Region. On the other hand, during very wet conditions or rainfall events, particulate matter typically is at its lowest. Thus, meteorology will influence the activities that occur around a specific monitoring location which in turn influences the air quality measurements.

9.0 References

1. Canadian Council of Ministers of the Environment, 2001. *Canada-Wide Standards for Dioxins and Furans.*

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

3. Department of Health & Human Services – USA and Center for Disease Control and Preventions (CDC) Environmental Health, 2009. *Polycyclic Aromatic Hydrocarbons (PAHs)*.

4. Ontario Ministry of the Environment and Climate Change. 2015. *Air Quality in Ontario 2013 Report*.

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

6. Ontario Ministry of the Environment and Climate Change. 2017. *Air Quality in Ontario 2015 Report*

7. Ontario Ministry of the Environment and Climate Change. 2018. *Operations Manual for Air Quality Monitoring in Ontario Report*.

8. Ravindra K., et al., *Atmospheric polycyclic aromatic hydrocarbons: Source attribution, emission factors and regulation*. Atmospheric Environment (2008), doi:10.1016/j.atmosenv.2007.12.010

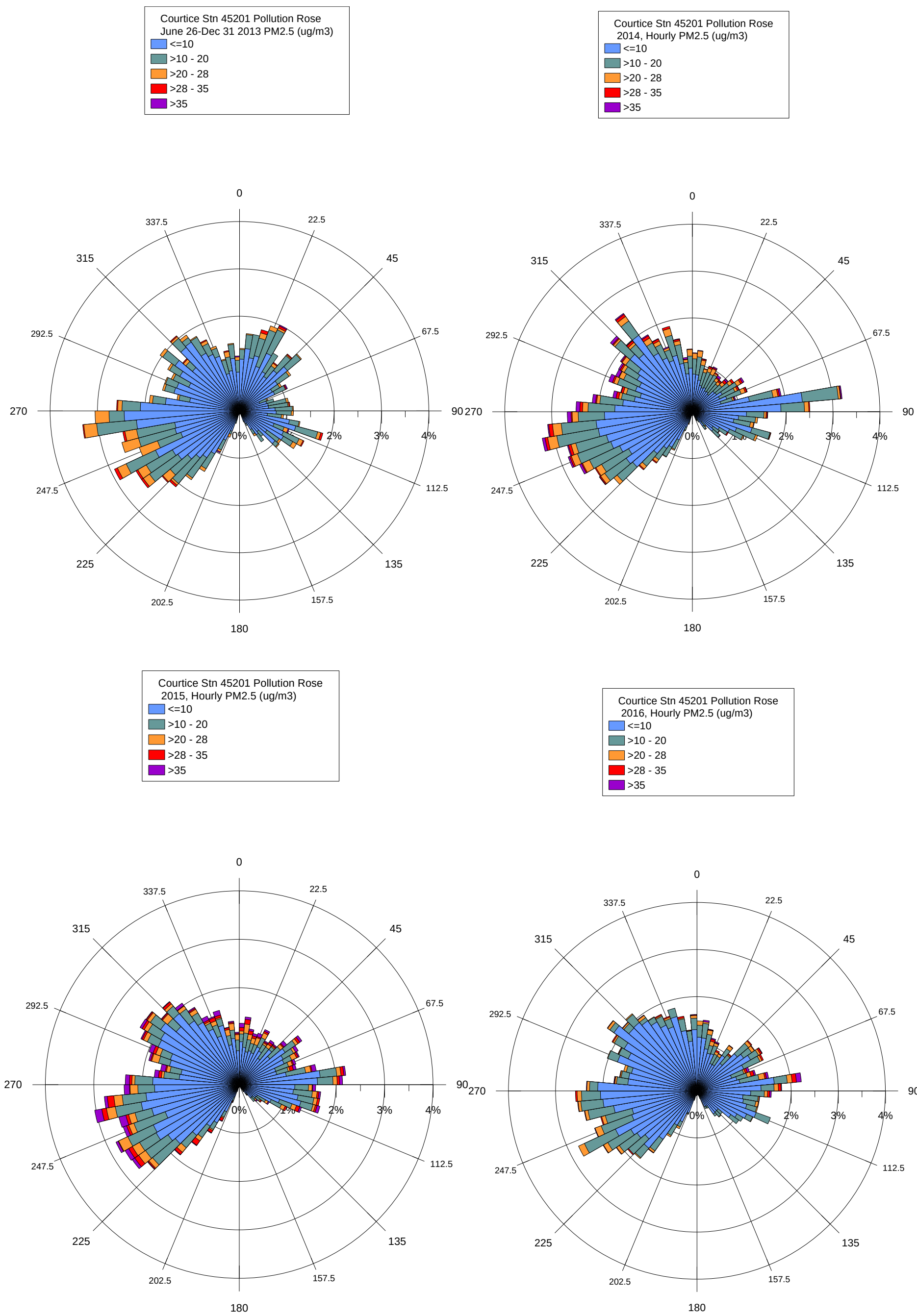
ATTACHMENT A - AAQCs and CAAQS INDICATORS for Relevant Parameters

Contaminant	1- Hour AAQC	8-Hour AAQC	24-Hour AAQC	24-Hour CAAQS INDICATOR	30 Day AAQC	Annual AAQC	Annual CAAQS INDICATOR
NO_2	200 ppb	---	100 ppb	---	---	---	---
$PM_{2.5}$	---	---	---	28 ug/m^3 [a]	---	---	10 ug/m^3 [b]
PM_{10}	---	---	50 ug/m^3 [c]	---	---	---	---
TSP	---	---	120 ug/m^3	---	---	60 ug/m^3	---
Dustfall	---	---	---	---	7 g/m^2	4.6 g/m^2	---
SO_2	250 ppb	---	100 ppb	---	---	20 ppb	---
CO	30 ppm	13 ppm	---	---	---	---	---
Total Mercury (Hg)			2 ug/m^3				
Aluminum (Al)			120 ug/m^3				
Cadmium (Cd)			0.025 ug/m^3				
Total Chromium (Cr)			0.5 ug/m^3				
Copper (Cu)			50 ug/m^3				
Iron (Fe)			4 ug/m^3				
Lead (Pb)			0.5 ug/m^3				
Manganese (Mn)			0.4 ug/m^3				
Nickel (Ni)			0.2 ug/m^3			0.04 ug/m^3	
Zinc (Zn)			120 ug/m^3				
BaP	---	---	0.05 ng/m^3	---	---	0.01 ng/m^3	---
Dioxins/Furans	---	---	0.1 pg TEQ/m^3	---	---	---	---

[a] This value of 28 ug/m^3 is the 2015 *Canadian Ambient Air Quality Standard* (CAAQS) for $PM_{2.5}$ which is based on the 24 hour 98th percentile ambient measurement annually, averaged over three consecutive years.
[b] This value of 10 ug/m^3 is the 2015 CAAQS for $PM_{2.5}$ which is based on the three year average of the annual average concentrations.
[c] This value of 50 ug/m^3 (24 hour) is an interim AAQC and is provided here as a guide for decision making (with no conversion to other averaging times).

ATTACHMENT B - POLLUTION ROSES

Figure 8. $PM_{2.5}$ Hourly Pollution Roses – DYEC Monitoring Program - Courtice



Notes:
This Figure indicates that no wind is coming from the direction of 155-200 degrees at Courtice during the sampling periods.
Please note that the Courtice meteorological tower is set 10 metres above ground.

A pollution rose is a tool to illustrate the frequency of wind direction and pollutant concentration blowing from each direction. Each 'spike" in the pollution rose represents the pollutant concentration from a specific wind direction. The different colour segments within a "spike" illustrate the concentration levels measured from that direction. The length of the colour segment indicates the frequency at which the concentrations were measured.

Figure 9. $PM_{2.5}$ Hourly Pollution Roses – DYEC Monitoring Program - Rundle

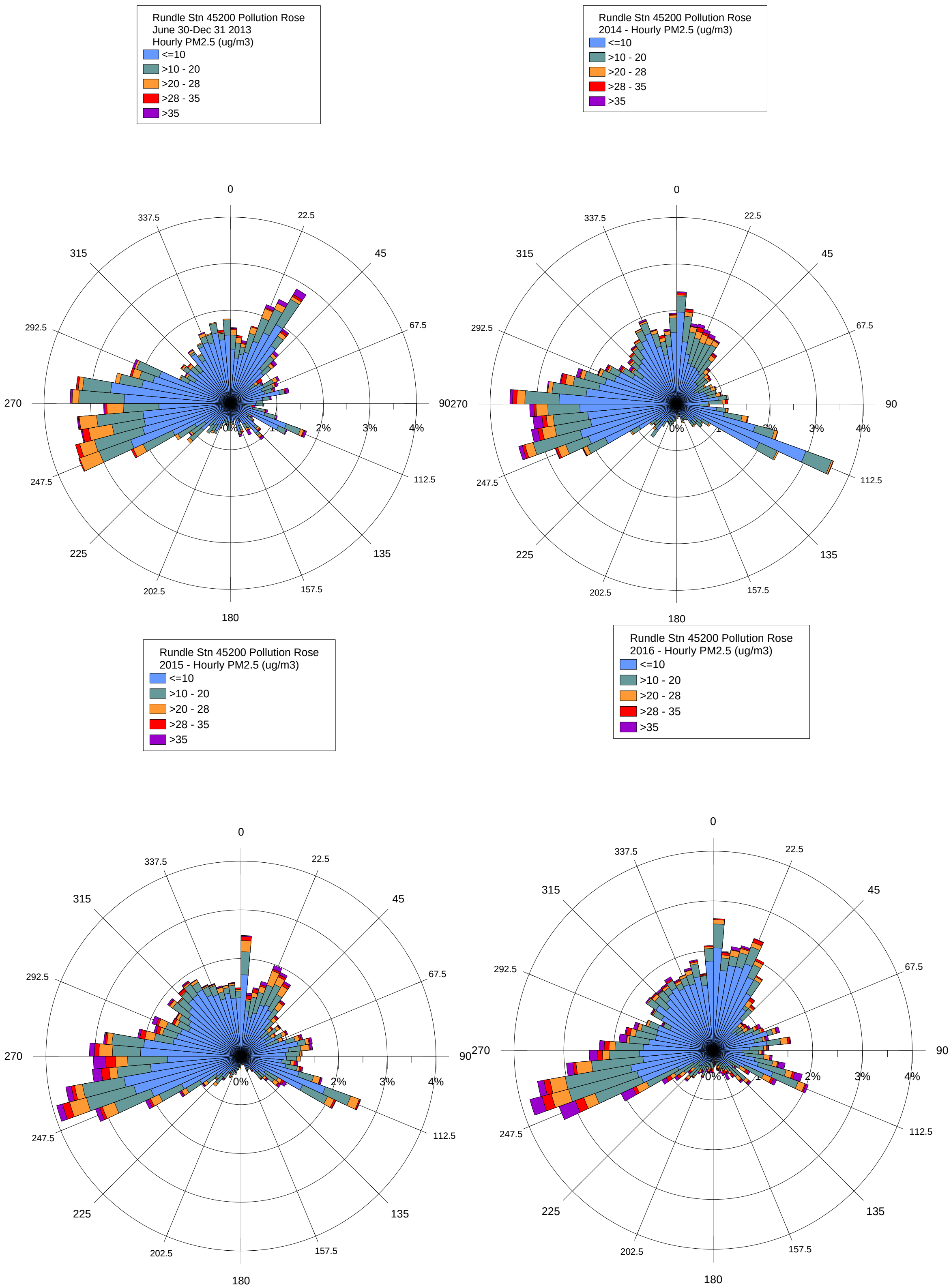


Figure 10. Benzo(a)pyrene 24-hour Average Pollution Roses – DYEC Monitoring Program - Courtice

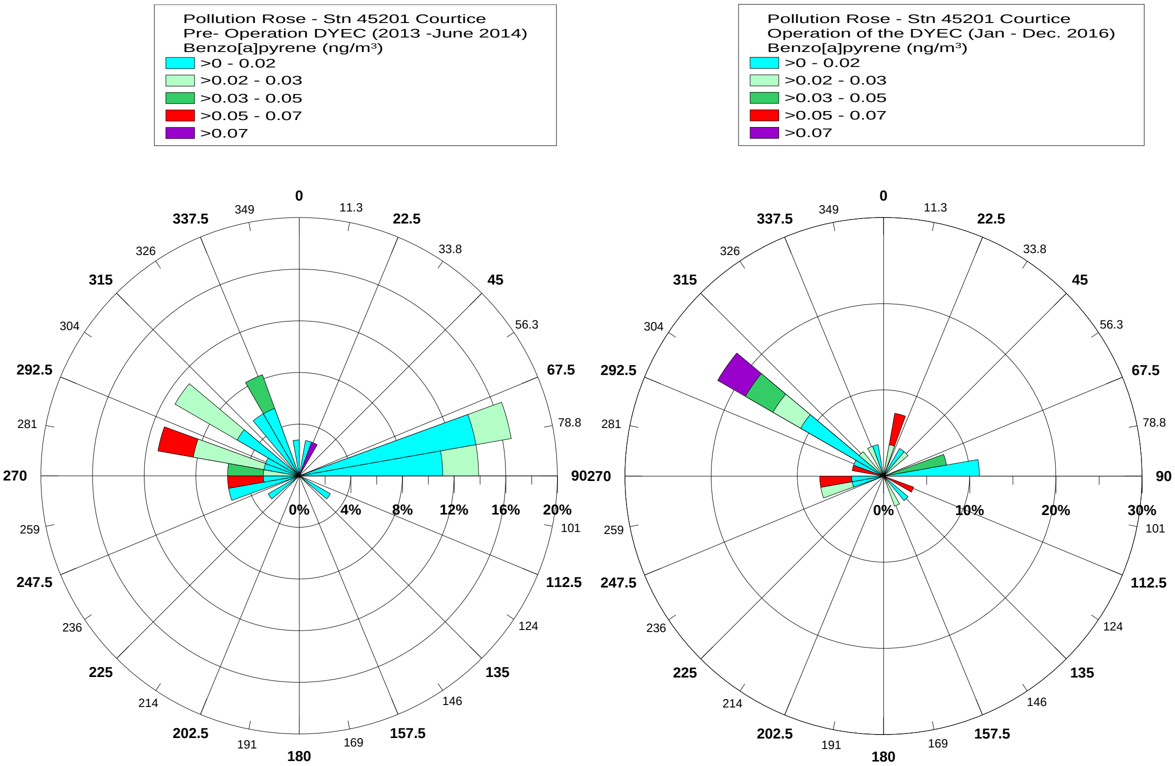
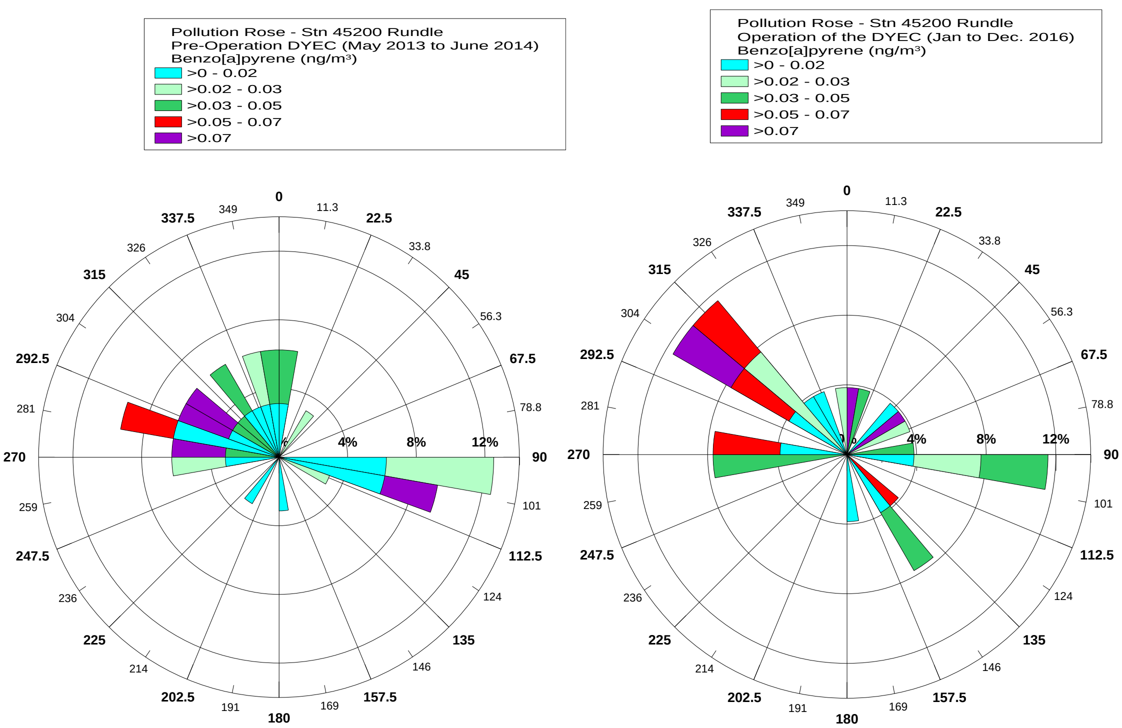


Figure 11. Benzo(a)pyrene 24-hour Average Pollution Roses – DYEC Monitoring Program - Rundle



Notes:
24-hour average Pollution Roses are based on limited data set.
BaP 24-hour average AAQC = 0.05 ng/m^3

Figure 12. Dioxins and Furans 24-hour Average Pollution Roses – DYEC Monitoring Program - Courtice

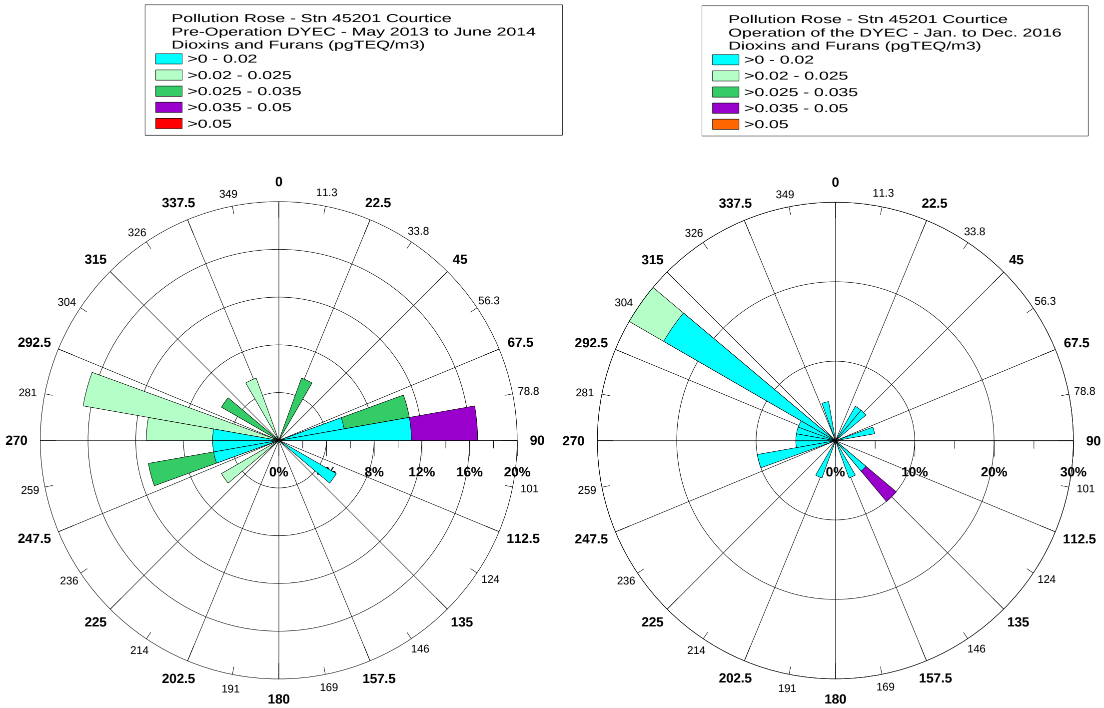
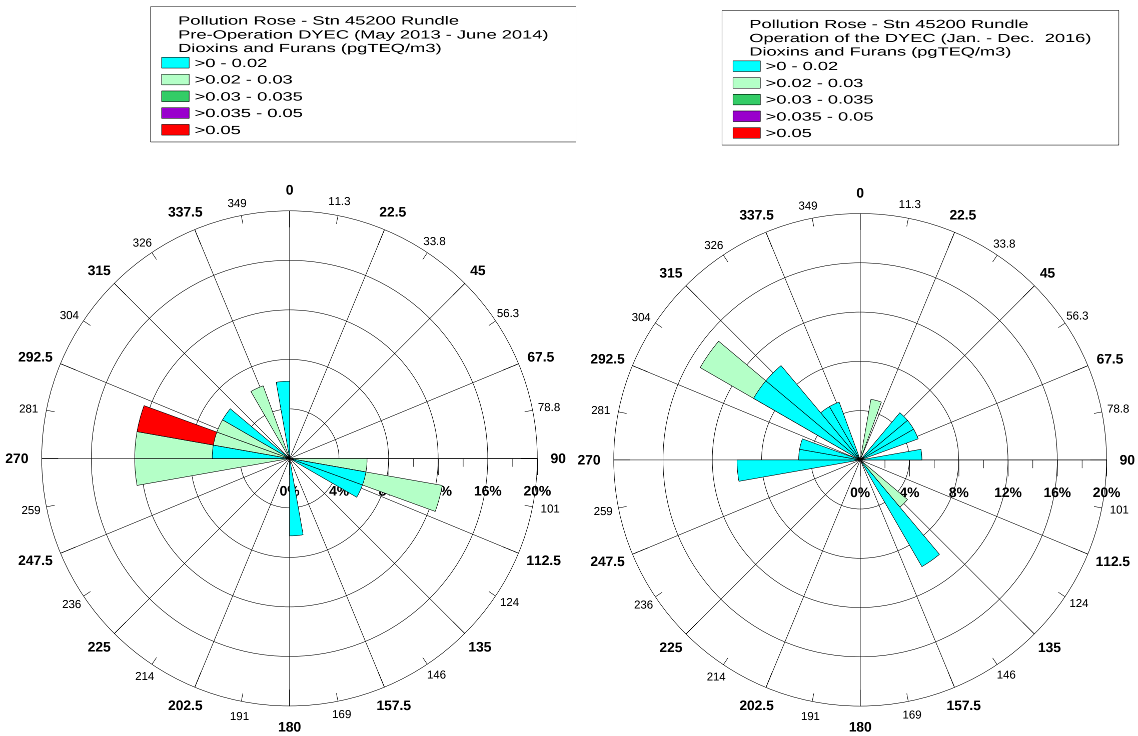


Figure 13. Dioxins and Furans 24-hour Average Pollution Roses – DYEC Monitoring Program - Rundle



Notes:
24-hour average Pollution Roses are based on limited data set.
Dioxins and Furans 24-hour average AAQC = 0.1 pg TEQ/m^3

Figure 14. PM$_{10}$ Hourly Pollution Roses– St. Mary's Cement Monitoring Program - SMC1 (45052)

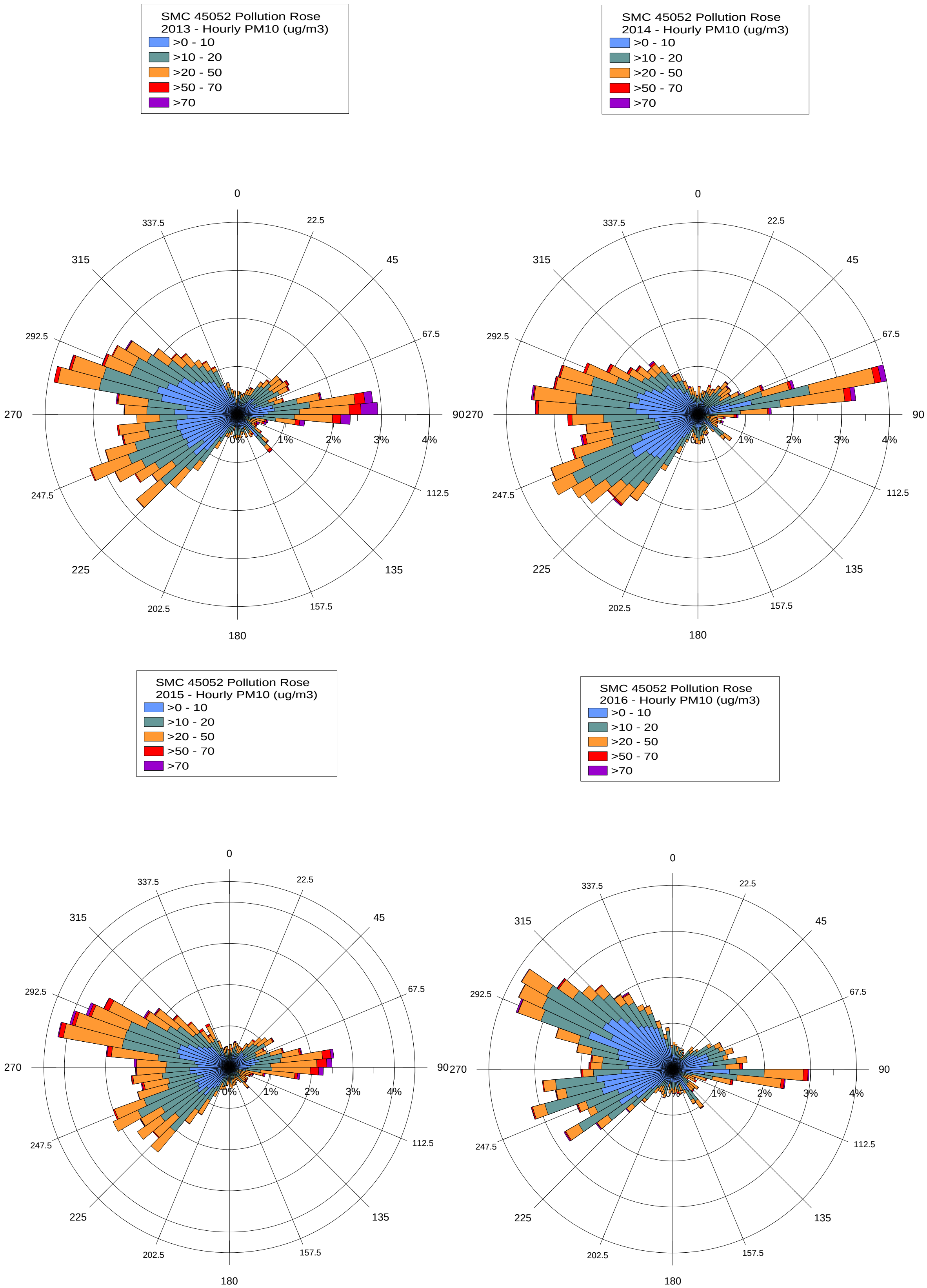


Figure 15. PM_{10} Hourly Pollution Roses – St. Mary's Cement Monitoring Program - SMC2 (45053)

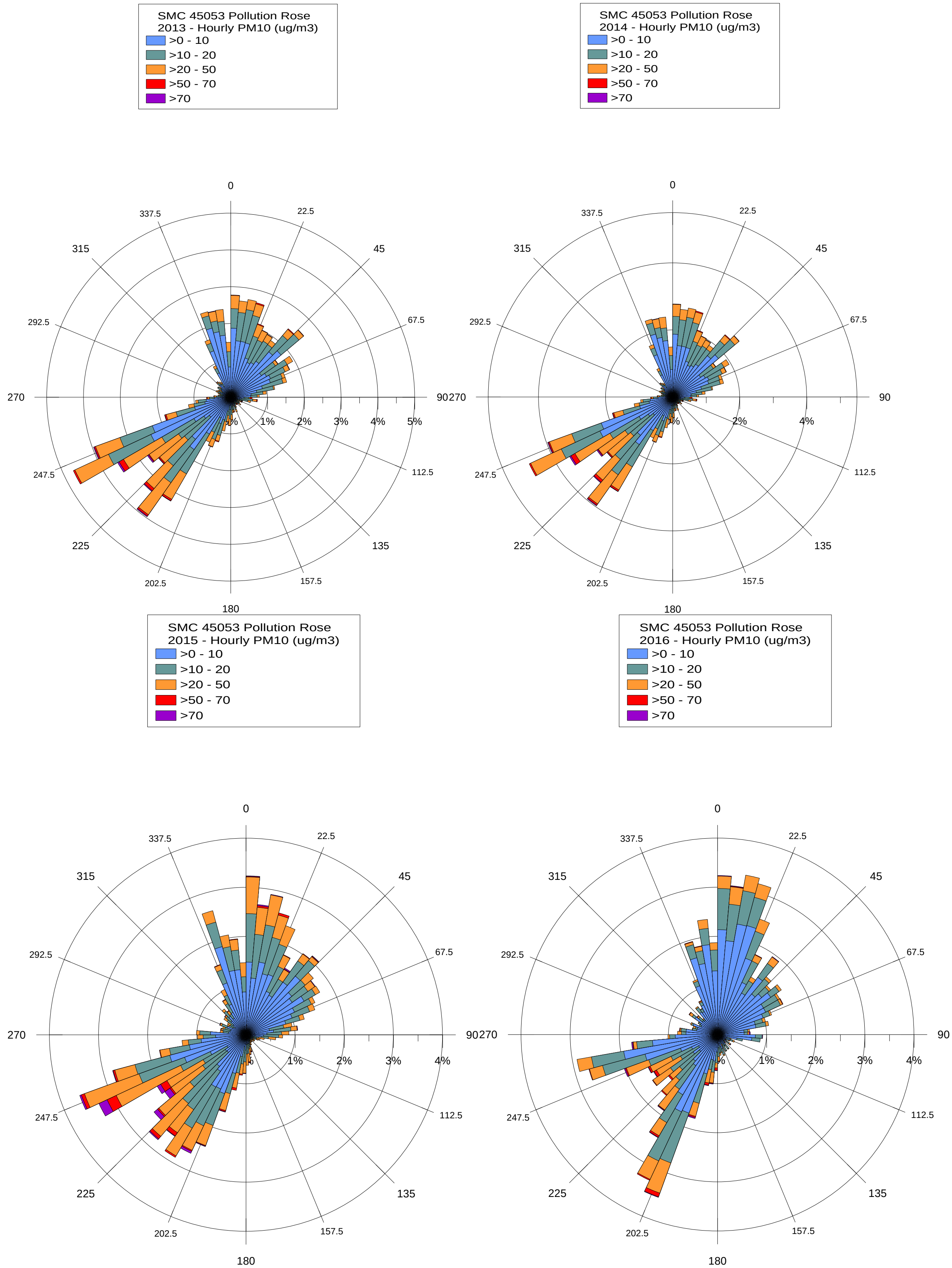
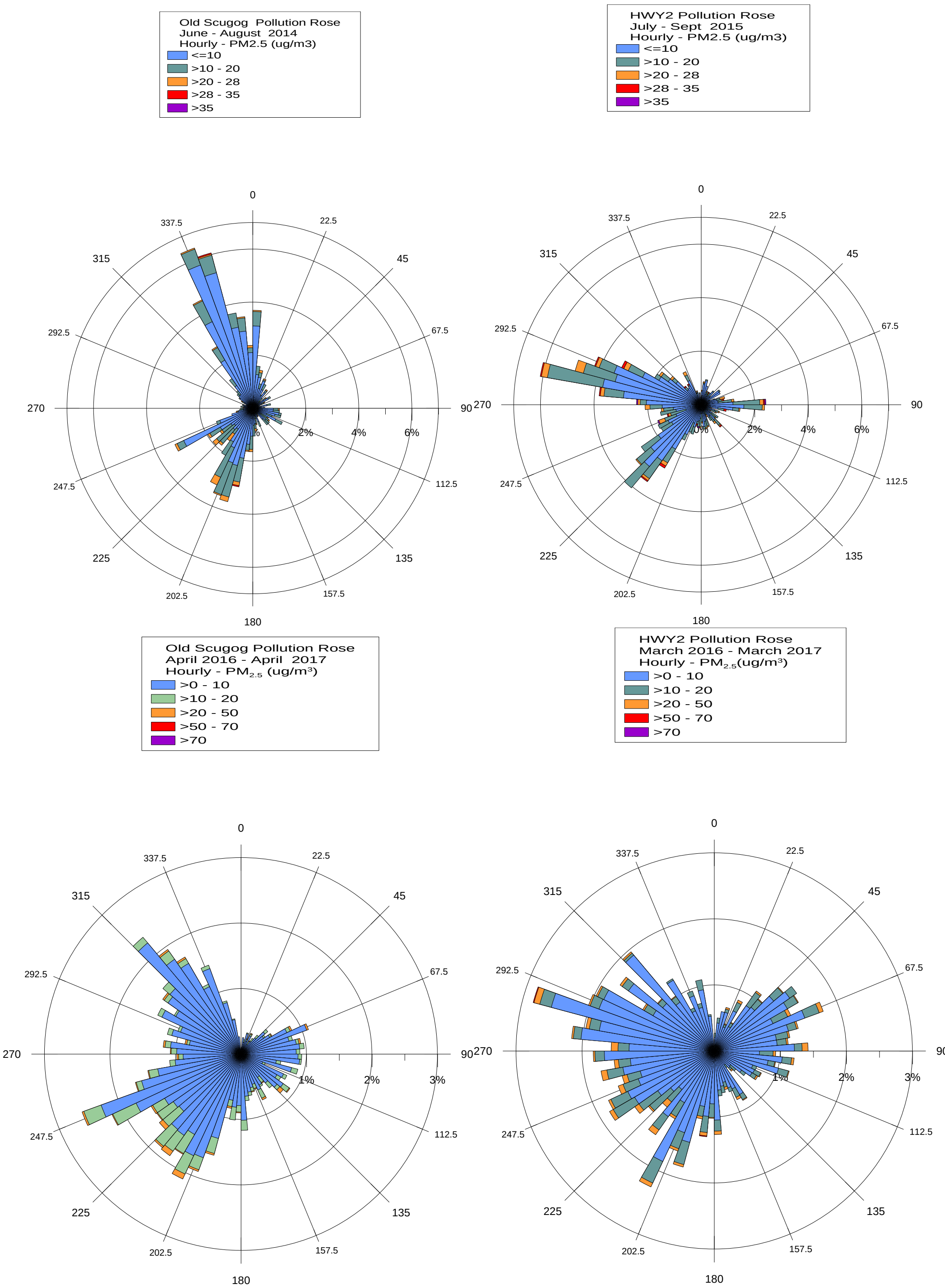
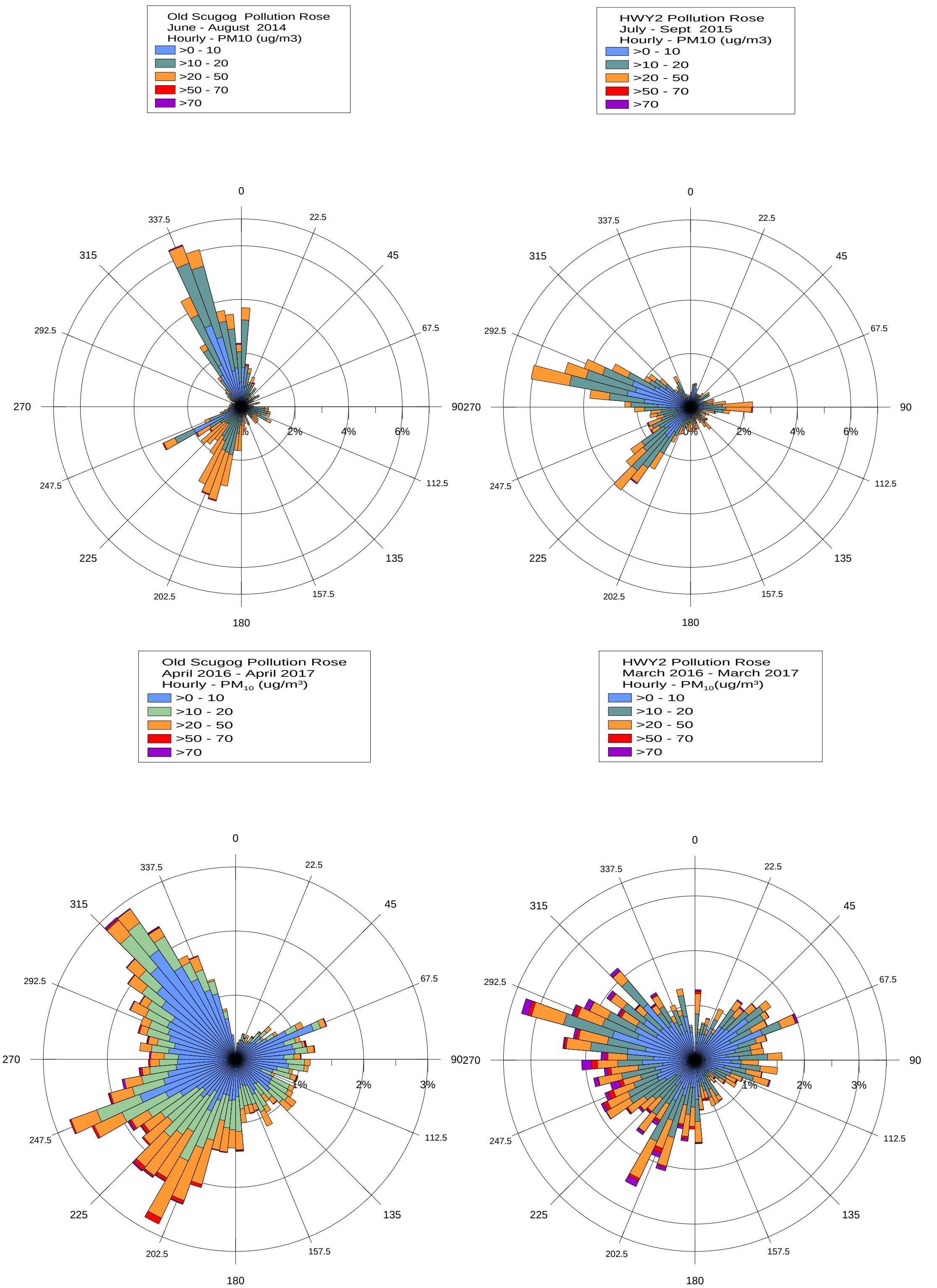


Figure 16. $PM_{2.5}$ – Hourly Pollution Roses – 407 East Construction Monitoring Program - Old Scugog and Hwy 2



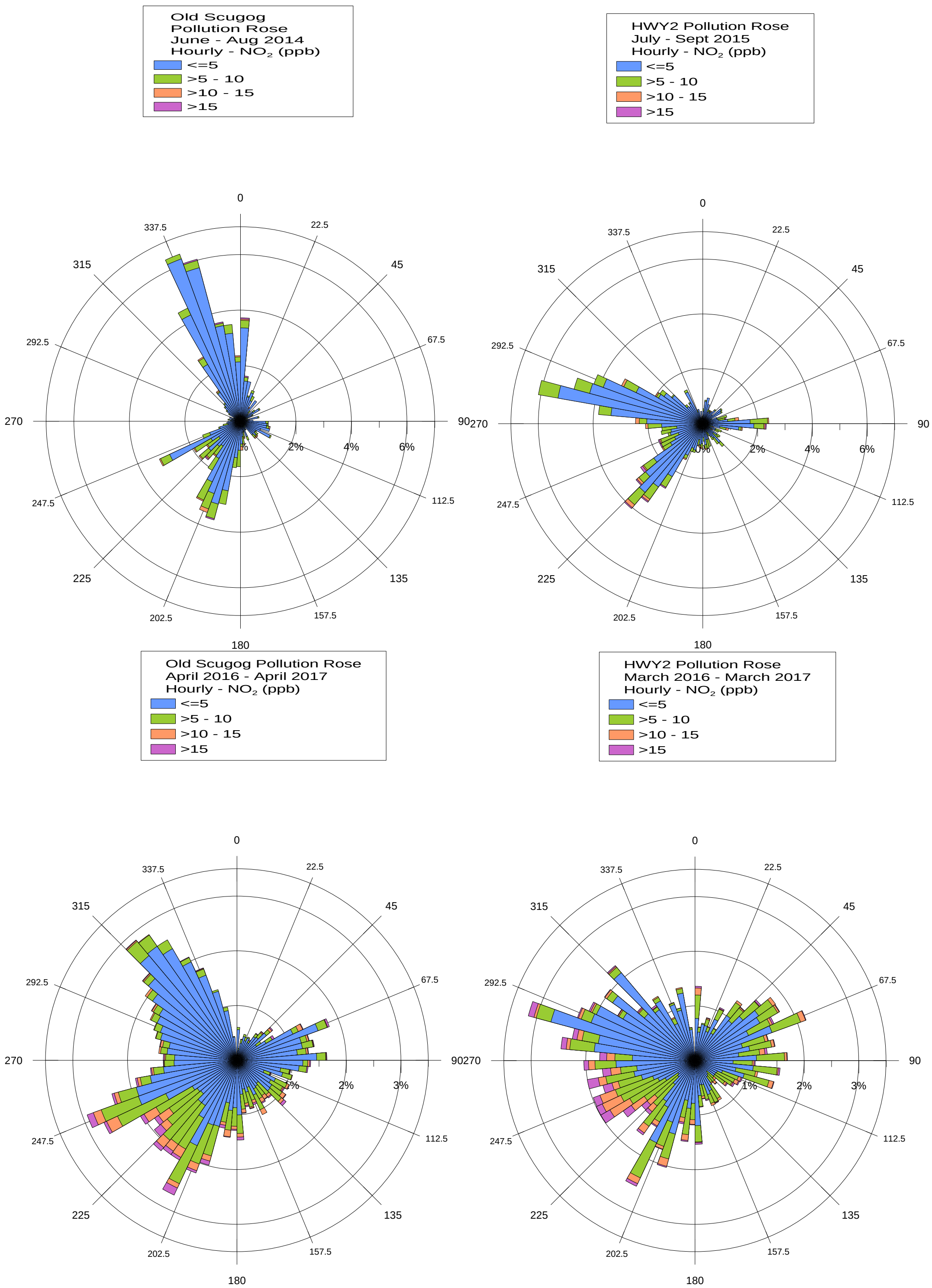
Notes:
The meteorological tower at Old Scugog and Highway 2 were relocated from the Pre-Construction period. Please note that during the Construction period, both Old Scugog and Highway 2 meteorological sensors were relocated to address the tree blockage from the Northeast and North-northeast directions, respectively. The meteorological towers were set at 10 meters above grade.

Figure 17. PM_{10} Hourly Pollution Roses - 407 East Construction Monitoring Program - Old Scugog and Hwy 2



Notes:
The meteorological tower at Old Scugog and Highway 2 were relocated from the Pre-Construction period. Please note that during the Construction period, both Old Scugog and Highway 2 meteorological sensors were relocated to address the tree blockage from the Northeast and North-northeast directions, respectively. The meteorological towers were set at 10 meters above grade.

Figure 18. NO_2 Hourly Pollution Roses - 407 East Construction Monitoring Program -Old Scugog and Hwy 2



Notes:
The meteorological tower at Old Scugog and Highway 2 were relocated from the Pre-Construction period. Please note that during the Construction period, both Old Scugog and Highway 2 meteorological sensors were relocated to address the tree blockage from the Northeast and North-northeast directions, respectively. The meteorological towers were set at 10 meters above grade.

Figure 19. TSP 24-hour Average Pollution Roses – Gerdau Monitoring Program

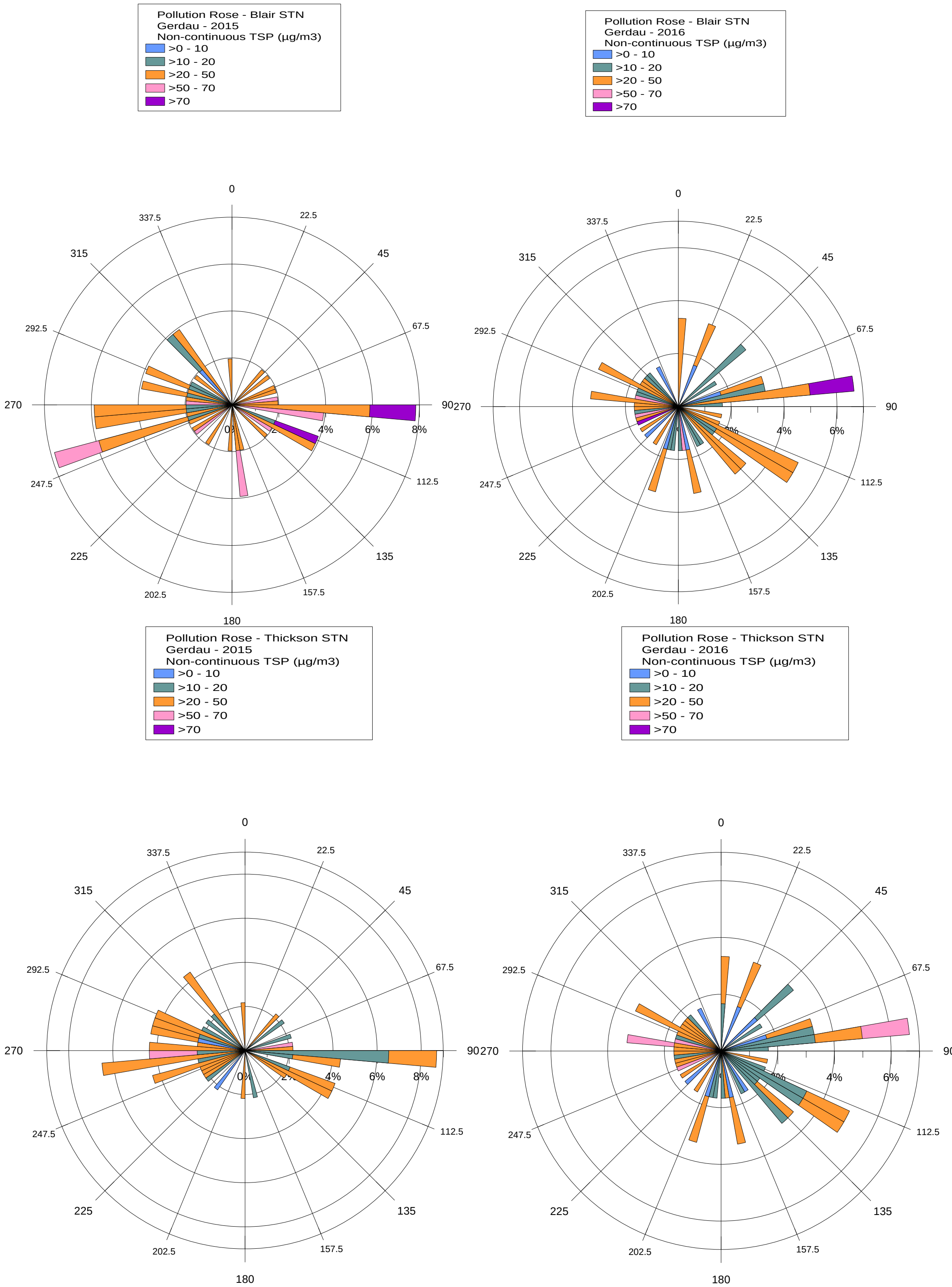


Figure 20 Hourly $PM_{2.5}$ Pollution Roses – Oshawa AQHI Station

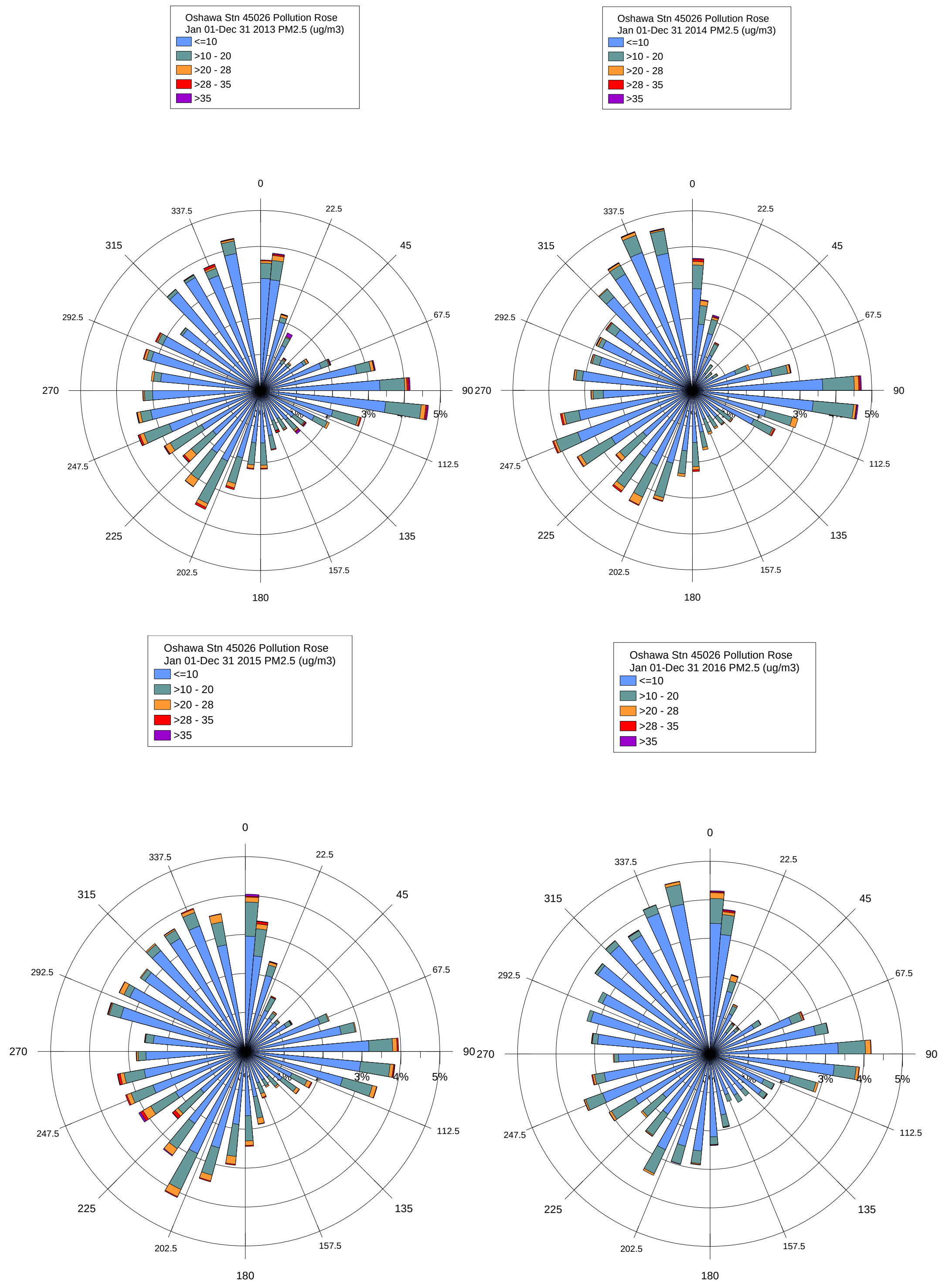


Figure 21 Hourly NO_2 Pollution Roses – Oshawa AQHI Station