2016 Annual Ambient Air Quality Monitoring Report for the Durham York Energy Centre

Durham York Energy Centre

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Sign-off Sheet

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Executive Summary

The Regional Municipalities of Durham and York constructed the Durham York Energy Centre (DYEC) which is an Energy-from-Waste (EFW) Facility intended to provide a long-term, sustainable solution to manage municipal solid waste remaining after diversion from the Regions. The facility commenced commercial operation on February 1, 2016.

The Ambient Air Quality Monitoring Plan - Durham York Residual Waste Study (Stantec, 2012), was developed in 2011-2012 based on the Regional Council's mandate to provide ambient air quality monitoring in the area of the DYEC for a three-year period. An ambient air quality monitoring and reporting program was also a requirement laid out in the Provincial Environment Minister's Notice of Approval to Proceed with the Undertaking, detailed in Condition 11 of the Notice of Approval (MOECC, 2010). The air monitoring plan was also developed to satisfy the conditions of the Environmental Compliance Approval and the environmental mitigation and commitments set out in the Environmental Assessment (Jacques Whitford, 2009). The predominantly downwind station is located along Rundle Road, south of Baseline Road. The predominantly upwind station is sited at the Courtice Water Pollution Control Plant (WPCP). Since May 2013, measurements of the following air contaminants have been made at the two stations:

- Continuously monitored:
  - Sulphur Dioxide (SO_2)
  - Nitrogen Oxides (NO_X)
  - Particulate Matter smaller than 2.5 microns ($PM_{2.5}$)
- Non-Continuously monitored:
  - Metals in Total Suspended Particulate (TSP) matter
  - Polycyclic Aromatic Hydrocarbons (PAHs)
  - Dioxins and Furans

Operation of the non-continuous monitors was temporarily discontinued from June 28, 2014 to February 1, 2016 as per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012). The EFW facility became fully operational on February 1, 2016, and monitoring of non-continuous air quality parameters resumed. The first sampling day for non-continuous monitors was February 6, 2016. At the request of the Regional Municipality of Durham, dioxin and furan sampling that was outside the scope of the Ambient Monitoring Plan (Stantec, 2012) was conducted from October 21, 2015 to January 25, 2016. The Regional Municipality of Durham also requested that the dioxin/ furan sampling frequency at the Courtice WPCP and Rundle Road monitoring stations be increased from once every 24 days to once every 12 days for a 3-month period starting on September 9, 2016 and ending on November 20, 2016. The results of the additional sampling in 2016 have been included in this report.

A third Fence Line Station, which measures non-continuous parameters (metals and total particulate matter), was installed prior to full operation of the DYEC. As per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012), the Fence Line station, which collects non-continuous parameters began operation on February 1, 2016 upon start of commercial operations. The Fence Line Station was scheduled to run for a one-year period but this period has been extended by one year for a total of two years.

Meteorological data is also measured at the Courtice WPCP and Rundle Road stations. The predominantly downwind Rundle Road station measures horizontal wind speed, wind direction, atmospheric temperature, relative humidity, and rainfall. The predominantly upwind Courtice WPCP Station measures atmospheric temperature, relative humidity, rainfall, and barometric pressure. Wind speed and wind direction data at the predominantly upwind location are measured and provided by the Courtice Water Pollution Control Plant.

The Ministry of Environment and Climate Change (MOECC) requires that annual reports be issued for the measurements conducted in each calendar year. This annual report provides a summary of the ambient air quality data collected at the three stations (Courtice, Rundle and Fence Line) for the period January to December 2016.

In 2016, the air quality monitoring data were collected primarily when the DYEC was in commercial operation. The following observations and conclusions were made from a review of the measured ambient air quality monitoring data:

1. Measured concentrations of NO_2, SO_2 and $PM_{2.5}$ were below the applicable O. Reg. 419/05 Standards or human health risk assessment (HHRA) health-based criteria presented in Table 2-2 of this report for hourly, 24-hour and annual averaging periods.
2. The 98th percentiles of the measured daily average $PM_{2.5}$ levels during the 2016 monitoring period were 21.6 µg/m^3 at the Courtice WPCP station and 32.9 µg/m^3 at the Rundle Road station. The annual average $PM_{2.5}$ concentrations measured at the Courtice WPCP and Rundle Road station over the monitoring period were 6.8 and 9.6 µg/m^3, respectively. As detailed below, these values for the 2016 measurements should not be used for direct comparison against the Canadian Ambient Air Quality Standard as more data are needed to make a valid comparison.
3. The 24-hour and annual $PM_{2.5}$ Canadian Ambient Air Quality Standards (CAAQS) criteria both require a three-calendar year average for comparison, with the data considered valid if an annual 98th percentile value is available for at least two of the three calendar years. Using the measured $PM_{2.5}$ data at each station for calendar years 2014 to 2016, average annual 98th percentile daily average and annual average $PM_{2.5}$ levels were calculated and a comparison to their CAAQS criteria was made. The measured data (with statistics applied) on ambient $PM_{2.5}$ levels were below their respective CAAQS criteria at both stations.
4. The maximum measured concentrations of TSP and all metals with MOECC air quality criteria were below their applicable criteria (presented in Table 2-3 in this report).

5. The maximum measured concentrations of the PAHs with MOECC Ambient Air Quality Criteria (AAQC), were almost all below their applicable 24-hour criteria (presented in Table 2-4) at both stations. The exceptions are twelve (12) benzo(a)pyrene (B(a)P) measurements. Out of twenty-six (26) samples collected at the Rundle Road Station, seven (7) samples exceeded the Ontario 24-hour B(a)P AAQC of 0.05 ng/m^3 by 3% to 315%. Out of twenty-seven (27) B(a)P measurements collected at the Courtice WPCP Station, five (5) measurements exceeded the MOECC AAQC by 1% to107%. However, all of the exceedances were well below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419/05 24-hour average guideline, and the HHRA health based criteria. Discussion of the meteorology and potential sources for these events, which is required by the MOECC to be included in each annual report, is provided in Section 4.4.

   Based on the air quality assessments completed during the Environmental Assessment Study and the Environmental Compliance Approval application for the DYEC, the facility will not be a significant contributor of B(a)P. Therefore, ambient B(a)P levels are not expected to be substantially impacted by the operation of the DYEC.

6. The maximum toxic equivalent dioxin and furan concentration measured over this period was well below the applicable criteria presented in **Table 2-4**.

In summary, the concentrations of almost all measured air contaminants were below their applicable MOECC Standards during the 2016 monitoring period, with the exception of benzo(a)pyrene as noted above. Further, the measured levels of monitored contaminants were below their applicable HHRA health-based criteria.

Abbreviations

AAQC	Ambient Air Quality Criteria
ACB List	Air Contaminants Benchmark List: Standards, Guidelines and Screening Levels for Assessing Point of Impingement Concentrations of Air Contaminants
CAAQS	Canadian Ambient Air Quality Standards
CAC	Criteria Air Contaminants
CDD	Chlorinated Dibenzo-p-dioxins
CDF	Chlorinated Dibenzo-p-furans
DAS	Data acquisition system
D/Fs	Dioxins and Furans
DYEC	Durham York Energy Centre
EFW	Energy from Waste
MOECC	Ontario Ministry of the Environment and Climate Change
SO_2	Sulphur Dioxide
NO_X	Nitrogen Oxides
O_3	Ozone
PAH	Polycyclic aromatic hydrocarbons
Particulate	A particle of a solid or liquid that is suspended in air.
PCB	Polychlorinated biphenyl
PCDD/PCDF	Polychlorinated dibenzo-p-dioxins and dibenzofurans
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter smaller than 2.5 microns
TEQ	Toxic equivalent quotient
TEQs	Toxic Equivalents
TSP	Total Suspended Particulate
WPCP	Water Pollution Control Plant
Elements	
Cd	Cadmium
Hg	Mercury
Pb	Lead
Al	Aluminum
As	Arsenic
Be	Beryllium
Cr	Chromium
Cu	Copper

Mn	Manganese
Ni	Nickel
Ag	Silver
Tl	Thallium
Sn	Tin
V	Vanadium
Zn	Zinc
Miscellaneous	
°C	Temperature in degrees Celsius
N/A	Not available
%	Percent
ppm	Part per million
ppb	Part per billion
ppbv	Parts per billion by volume
ppt	Part per trillion
min	Minimum
max	Maximum
mm	Millimetre
m	Metre
km/hr	Kilometres per hour
mg/m^3	Milligrams per cubic metre
$\mu g/m^3$	Microgram per cubic metre
ng/m^3	Nanograms per cubic metre
pg/m^3	Picograms per cubic metre
pg TEQ/m^3	Picograms of toxic exposure equivalents per cubic metre

1.0 INTRODUCTION

1.1 BACKGROUND AND OJECTIVES

The Regional Municipalities of Durham and York constructed the Durham York Energy Centre (DYEC) which is an Energy-from-Waste (EFW) Facility intended to provide a long-term, sustainable solution to manage municipal solid waste remaining after diversion from the Regions. The site location of the DYEC is shown in **Figure 1-1** The facility commenced commercial operation on February 1, 2016.

An Ambient Air Quality Monitoring Plan – Durham York Residual Waste Study (Ambient Monitoring Plan) was developed and included two monitoring stations referred to as the Courtice Water Pollution Control Plant (WPCP) Station and the Rundle Road Station (as well as a temporary Fence Line Station). The plan developed for these stations was based on the Regional Council's mandate to provide ambient air quality monitoring in the area of the DYEC for a three-year period.

The purposes of the ambient air quality monitoring program are to:

1. Quantify any measurable ground level concentrations resulting from emissions from the DYEC that may act cumulatively to influence local air quality, including validating the predicted concentrations from the dispersion modelling conducted in the Environmental Assessment (Jacques Whitford, 2009).
2. Monitor concentrations of EFW-related air contaminants in nearby residential areas.
3. Quantify background ambient levels of air contaminants in the area.

Two monitoring stations (Courtice WPCP and Rundle Road Stations) in the vicinity of the DYEC were set up in April 2013 by Stantec Consulting Ltd. (Stantec) and Stantec's equipment sub-consultant for this project, Valley Environmental Services Inc. (Valley Environmental). Since May 2013, the following air contaminants have been measured at the two stations:

- Continuously monitored:
  - Sulphur Dioxide (SO_2)
  - Nitrogen Oxides (NO_X)
  - Particulate Matter smaller than 2.5 microns ($PM_{2.5}$)
- Non-Continuously monitored:
  - Metals in Total Suspended Particulate (TSP) matter
  - Polycyclic Aromatic Hydrocarbons (PAHs)
  - Dioxins and Furans

Quarterly reports presenting the ambient air quality data collected at these two stations for 2016 were prepared by Stantec and submitted to the Region. This Annual Report summarizes the results of the ambient air monitoring from January to December 2016.

Operation of the non-continuous monitors was temporarily discontinued from June 28, 2014 (after completion of the background air quality data collection period) onwards through the rest of construction and commissioning, as per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012). The EFW facility commenced commercial operation on February 1, 2016, and non-continuous monitoring resumed (as specified in the Ambient Monitoring Plan). The first sampling day for non-continuous monitors was February 6, 2016.

At the request of the Regional Municipality of Durham, dioxin and furan sampling that was outside the scope of the Ambient Monitoring Plan (Stantec, 2012) was conducted from October 21, 2015 to January 25, 2016. The Regional Municipality of Durham also requested that the dioxin/ furan sampling frequency at the Courtice WPCP and Rundle Road monitoring stations be increased from once every 24 days to once every 12 days for a 3-month period starting on September 9, 2016 and ending on November 20, 2016. The results of the additional sampling in 2016 have been included in this report.

A third Fence Line Station, which measures non-continuous parameters (metals and total particulate matter), was installed prior to full operation of the DYEC. As per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012), the Fence Line station, which collects non-continuous parameters began operation on February 1, 2016 upon start of commercial operations. The Fence Line Station was scheduled to run for a one-year period but the period has been extended by one year for a total of two years.

1.2 LOCATIONS OF AMBIENT AIR QUALITY MONITORING STATIONS

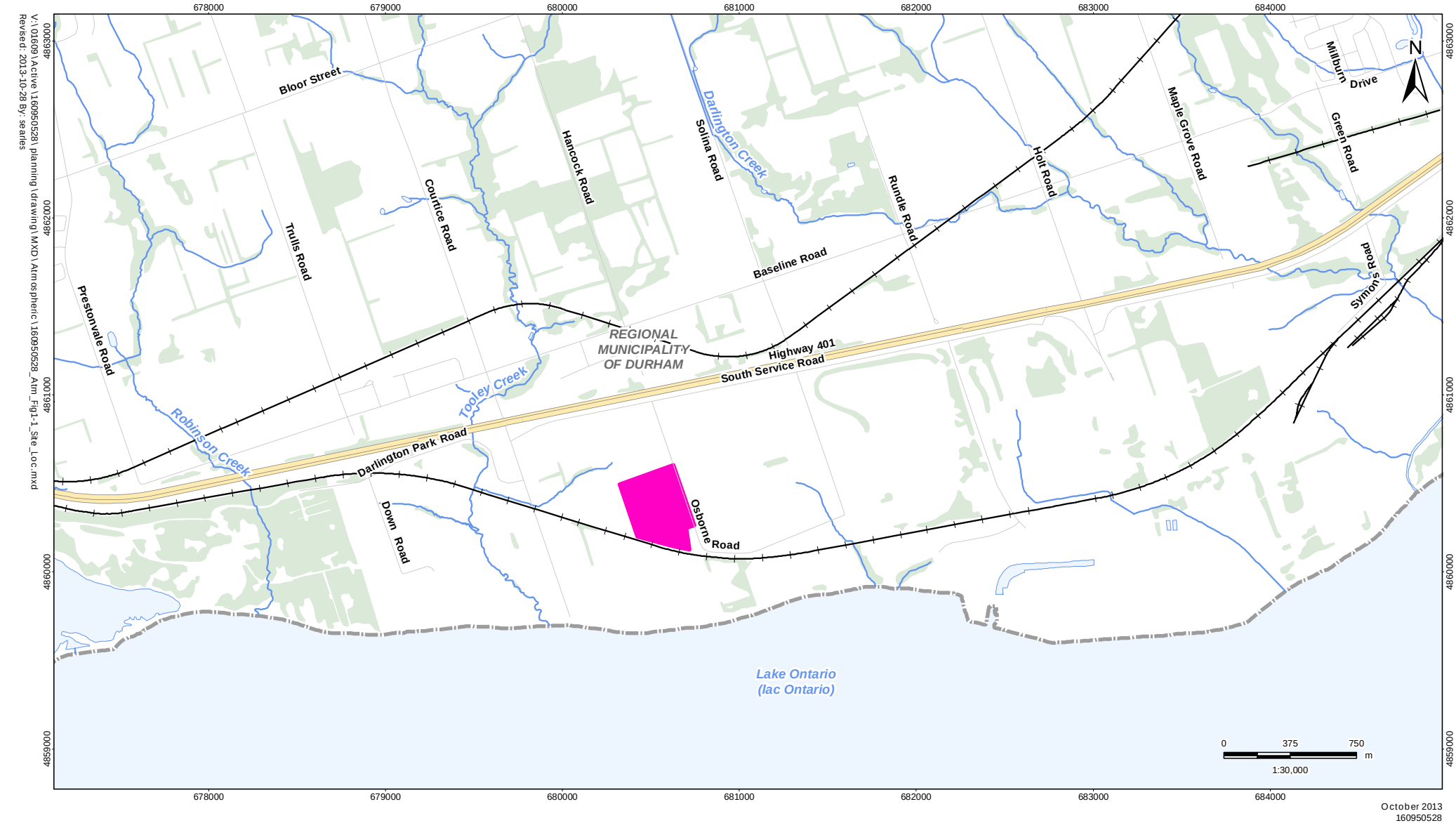
The selection of sites for the monitoring stations was done in consultation with the Ontario Ministry of Environment and Climate Change (MOECC) and Regional Municipality of Durham and York representatives based on the results of air quality modelling done in support of the environmental assessment for the project, the locations of nearby sensitive receptors, and general MOECC siting criteria. Two monitoring stations (one predominantly downwind and one predominantly upwind) were chosen for the ambient air quality program. The final locations of the monitoring stations were influenced by the availability of electrical power, accessibility of each location, and security. Details of the siting requirements are presented in the Ambient Monitoring Plan.

The Rundle Road Station is sited northeast of the DYEC in the vicinity of residential receptors predominantly downwind of the DYEC, and within the area where maximum annual concentrations are predicted to occur. This predominantly downwind station is located along Rundle Road, south of Baseline Road. Its location is shown in **Figure 1-2** and **Figure 1-3**. The monitoring station measures all the air contaminants listed in Section 1.1 and meteorological data.

Introduction
May 9, 2017

The predominantly upwind Courtice WPCP Station is located at the Courtice Water Pollution Control Plant (WPCP) to the southwest of the DYEC with the objective of measuring background air quality in a predominantly upwind location. The location is presented in **Figure 1-2** and **Figure 1-4**. This monitoring station measures the air contaminants presented in Section 1.1, as well as meteorological data, with the exception of wind speed and wind direction, which are measured and provided by the Courtice Water Pollution Control Plant.

A third Fence Line Station, which measures non-continuous parameters (metals and total particulate matter), was installed prior to full operation of the DYEC. As per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012), the Fence Line Station, which collects non-continuous parameters began operation after the Facility commenced commercial operation on February 1, 2016. The location is presented in **Figure 1-2** and **Figure 1-5**.



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Revised: 2013-10-28 By: searles

October 2013
160950528

Stantec

Legend

- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse
- Waterbody
- Wooded Area

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

Client/Project

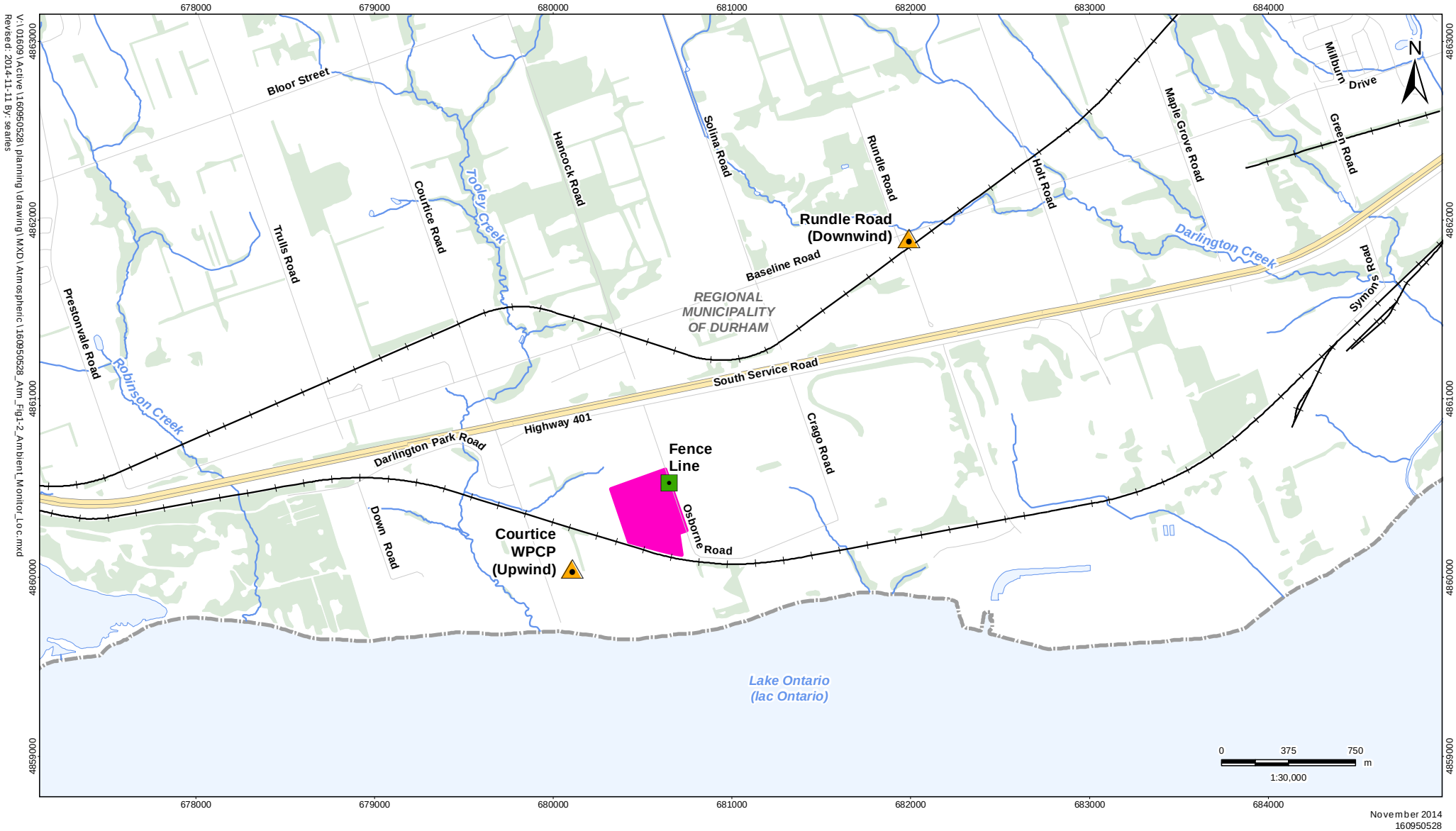
The Region of Durham
Durham York Energy Centre

Figure No.

1-1

Title

Site Location Plan



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Revised: 2014-11-11 By: searles

Stantec

Legend

- Station Location
- Fence Line Station Location (Monitoring to begin after DYEC commissioning period)
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse
- Waterbody
- Wooded Area

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

1-2

Title

Locations of Ambient Monitoring Stations

Figure 1-3 View of the Rundle Road Ambient Air Quality Monitoring Station

Figure 1-4 View of the Courtice WPCP Ambient Air Quality Monitoring Station

Figure 1-5 View of the Fence Line Ambient Air Quality Monitoring Station

2.0 KEY COMPONENTS ASSESSED

2.1 METEOROLOGY

Meteorological parameters are measured at the Rundle Road and Courtice WPCP monitoring stations, as shown in Table 2-1.

Table 2-1 Summary of Meteorological Parameters Measured at Each Station

Courtice WPCP (Upwind) Ambient Air Quality Monitoring Station	Rundle Road (Downwind) Ambient Air Quality Monitoring Station
Wind Speed and Direction at 20 m height	Wind Speed and Direction at 10 m height
Ambient Temperature at 2 m height	Ambient Temperature at 2 m height
Relative Humidity	Relative Humidity
Rainfall	Rainfall
Barometric Pressure	

2.2 AIR QUALITY CONTAMINANTS OF CONCERN

The ambient air quality monitoring program for the DYEC includes the following contaminants specified in the Ambient Air Quality Monitoring Plan (Stantec 2012):

- Continuously monitored criteria air contaminants (CACs):
  - Sulphur Dioxide (SO_2)
  - Nitrogen Oxides (NO_X)
  - Particulate Matter smaller than 2.5 microns ($PM_{2.5}$)
- Non-Continuously monitored:
  - Metals in Total Suspended Particulate (TSP) matter
  - Polycyclic Aromatic Hydrocarbons (PAHs)
  - Dioxins and Furans

Operation of the non-continuous monitors was temporarily discontinued between June 28, 2014 and January 31, 2016 as per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012). The EFW facility started full commercial operation on February 1, 2016, and monitoring of non-continuous monitors resumed, as specified in the Ambient Monitoring Plan (Stantec, 2012).

2.2.1 Nitrogen Oxides (NO_X)

Nitrogen oxides (NO_X) are produced in most combustion processes, and are almost entirely made up of nitric oxide (NO) and nitrogen dioxide (NO_2). Together, they are often referred to as NO_X. NO_2 is an orange to reddish gas that is corrosive with an irritating odour. Most NO_2 in the atmosphere is formed by the oxidation of NO, which is emitted directly by combustion processes, particularly those at high temperature and pressure. NO is a colourless gas. The levels of NO and NO_2, and the ratio of the two gases, together with the presence of hydrocarbons and sunlight, are the most important factors in the formation of ground-level ozone (O_3). Further oxidation and combination with water in the atmosphere forms what is known as "acid rain".

Nitrogen oxides are emitted from a variety of combustion sources including vehicles, industrial heaters and boilers, and residential gas-fired furnaces and hot water boilers. Generally, for combustion, 5 to 10% of the initial total emissions of NO_X are NO_2 with the remaining 90-95% being NO. The conversion of the majority of NO occurs after release to the atmosphere. The rate of conversion depends on the oxidizing potential of the atmosphere at the time of release. For example, if the ambient concentration of O_3 is high at the time of release, the conversion might be expected to be higher than if the ambient concentration of O_3 was low at that time.

2.2.2 Sulphur Dioxide (SO_2)

Sulphur dioxide (SO_2) is a colourless gas with a distinctive pungent sulphur odour. It is produced in combustion processes by the oxidation of sulphur in the fuel. The presence of SO_2 can, at high enough concentrations, cause damage to vegetation and health effects to animals through their respiratory system. The SO_2 can also be further oxidized and combines with water to form the sulphuric acid component of "acid rain."

Sulphur dioxide is emitted mainly from industrial sources utilizing coal, coke or oil fired heaters and boilers.

2.2.3 Particulate Matter

Total suspended particulate matter (TSP) is a measure of the particles in the atmosphere that are too small to settle out quickly, but remain suspended for significant periods of time. Generally, this means particles with an aerodynamic diameter of less than 44 µm. TSP is produced by a variety of emissions sources including wind erosion of agricultural fields and other open areas, abrasion of vehicle tires on paved and unpaved roads, agricultural activities, and combustion processes (e.g., industrial boilers and heaters, power generation, vehicle emissions).

Although total suspended particulate matter is an excellent measure of the loading of particulate matter in the air, it does not necessarily reflect the health risks of the particulate matter. The larger aerodynamic particles (PM_{10}) are trapped by the upper airways, and do not enter the lungs. Smaller diameter particles ($PM_{2.5}$) can make their way deep into the lungs, and may become lodged there. Over the past few years, greater concern regarding these fine particles has led to research resulting in new sampling methods and criteria.

2.2.4 Metals

Metals may exist in elemental form or in a variety of inorganic or organic compounds. Most environmental regulators do not make distinctions between metal species, and refer to them as metals and their compounds. Both natural (biogenic) and man-made (anthropogenic) processes and sources may emit metals and their compounds into the air. The processing of minerals, fuel combustion, and the wearing out of motor vehicle tires and brake pads result in the emission of metals associated with particulate matter. Metals occur naturally in soil and rock - weathering of the rocks, mining/construction activities, etc. can release metals into air as particulate matter.

The following is a list of the specific metals being measured. The rationales for the choice of air contaminants being monitored are provided in the Ambient Air Quality Monitoring Plan (Stantec, 2012).

Metals:

- Aluminum (Al)
- Antimony (Sb)
- Arsenic (As)
- Barium (Ba)
- Beryllium (Be)
- Bismuth (Bi)
- Boron (B)
- Cadmium (Cd)
- Cobalt (Co)
- Copper (Cu)
- Chromium (Cr) (Total)
- Iron (Fe)
- Lead (Pb)
- Magnesium (Mg)
- Manganese (Mn)
- Mercury (Hg)
- Molybdenum (Mo)
- Nickel (Ni)
- Phosphorus (Ph)
- Selenium (Se)
- Silver (Ag)
- Strontium (Sr)
- Thallium (Tl)
- Tin (Sn)
- Titanium (Ti)
- Uranium (U)
- Vanadium (V)
- Zinc (Zn)
- Zirconium (Zr)

2.2.5 Polycyclic Aromatic Hydrocarbons (PAH)

Polycyclic aromatic hydrocarbons (PAHs) are a large group of organic compounds with two or more fused aromatic rings. PAHs are formed mainly as a result of pyrolytic processes, especially the incomplete combustion of organic materials during industrial and other human activities, such as processing of coal and crude oil, combustion of natural gas, vehicle traffic, cooking and tobacco smoking.

The following is a list of PAHs being measured for the ambient air monitoring program. Rationales for the choice of contaminants being monitored are provided in the Ambient Air Quality Monitoring Plan (Stantec, 2012).

Polycyclic Aromatic Hydrocarbons:

- 1-Methylnaphthalene
- 2-Methylnaphthalene
- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)fluorene
- Benzo(a)pyrene
- Benzo(b)fluorene
- Benzo(b)fluoranthene
- Benzo(e)pyrene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Biphenol
- Chrysene
- Dibenz(a,h)anthracene
- Dibenz(a,c)anthracene
- Fluoranthene
- Indeno(1,2,3-cd) pyrene
- Naphthalene
- Perylene
- Phenanthrene
- Pyrene
- Tetralin
- o-Terphenyl
- Total PAH

2.2.6 Dioxins and Furans

"Dioxins and furans" refers to a family of toxic substances that share a similar chemical structure. Dioxins and furans contain chlorine and can occur in different configurations, called congeners. Most dioxins and furans are not produced intentionally, but are created when other chemicals or products are manufactured. Of all the dioxins and furans, one cogener 2,3,7,8-tetrachloro-p-dibenzo-dioxin (2,3,7,8 Tetra CDD) is considered the most toxic. International toxicity equivalency factors (I-TEFs) are applied to 17 dioxin and furan isomers to convert them into an equivalent 2,3,7,8 Tetra CDD concentration (I-TEQ) for comparison to ambient air quality criteria.

Concentrations of the following dioxins and furans are measured:

Dioxins and furans:

- 2,3,7,8-Tetra CDD
- 1,2,3,7,8-Penta CDD
- 1,2,3,4,7,8-Hexa CDD
- 1,2,3,6,7,8-Hexa CDD
- 1,2,3,7,8,9-Hexa CDD
- 1,2,3,4,6,7,8-Hepta CDD
- Octa CDD
- Total Tetra CDD
- Total Penta CDD
- Total Hexa CDD
- Total Hepta CDD
- 2,3,7,8-Tetra CDF
- 1,2,3,7,8-Penta CDF
- 2,3,4,7,8-Penta CDF
- 1,2,3,4,7,8-Hexa CDF
- 1,2,3,6,7,8-Hexa CDF
- 2,3,4,6,7,8-Hexa CDF
- 1,2,3,7,8,9-Hexa CDF
- 1,2,3,4,6,7,8-Hepta CDF
- Octa CDF
- Total Tetra CDF
- Total Penta CDF
- Total Hexa CDF
- Total Hepta CDF
- Total toxic equivalency (I-TEQ)

2.3 AIR QUALITY CRITERIA

Two sets of criteria were used for comparison to the air quality data as specified in the Ambient Monitoring Plan (Stantec, 2012); one based on regulatory limits, and the second developed in the human health risk assessment (HHRA) completed as part of the Environmental Assessment of the DYEC. The regulatory criteria include:

- Schedule 3 Standards of O. Reg. 419/05
- Schedule 6 Upper Risk Thresholds (URT) of O. Reg. 419/05
- Ontario Ambient Air Quality Criteria (AAQC)
- Canadian Ambient Air Quality Standard (CAAQS).

Not all chemicals have regulatory criteria, or in some instances updated health-based criteria were used in the human health risk assessment (HHRA) conducted in support of the Environmental Assessment (July 31, 2009 - December 10, 2009). These health-based values, which were reported in Table 7-2 (Summary of Inhalation TRVs and Inhalation Benchmarks Selected for CACs) and Table 7-3 (Inhalation TRVs and Inhalation Benchmarks for Selected COPCs) of the HHRA (Stantec, 2009) were used as the second set of criteria.

The previously applicable 24-hour Canada-Wide Standard (CWS) for $PM_{2.5}$ of 30 µg/m^3 (98th percentile averaged over 3 consecutive years) has been superseded by the new Canadian Ambient Air Quality Standard (CAAQS) of 28 µg/m^3 (98th percentile averaged over 3 consecutive years) and the annual objective of 10 µg/m^3 as noted in **Table 2-2**. The proposed CAAQS 24-hour objective for 2020 is 27 µg/m^3.

A summary of the relevant ambient air quality criteria is presented in **Table 2-2** to **Table 2-4**.

Table 2-2 Summary of Air Quality Criteria for CACs

Contaminant	CAS	Regulatory Criteria			HHRA Health-Based Criteria		
		1-Hour (ppb / µg/m³)	24-Hour (ppb / µg/m³)	Annual (ppb / µg/m³)	1-Hour (ppb / µg/m³)	24-Hour (ppb / µg/m³)	Annual (ppb / µg/m³)
Sulphur dioxide	7446095	250 /690	100 / 275	20 / 55	250 / 690	100 / 275	11 / 29
Nitrogen oxides [A]	10102-44-0	200 /400	100 / 200	-	200 / 400	100 / 200	30 / 60
Contaminant	**CAS**	**Canadian Ambient Air Quality Standards (CAAQS)**			**HHRA Health-Based Criteria**		
		1-Hour (µg/m³)	24-Hour (µg/m³)	Annual (µg/m³)	1-Hour (µg/m³)	24-Hour (µg/m³)	Annual (µg/m³)
$PM_{2.5}$	N/A	-	28 [B]	10 [C]	-	30 [D]	-

Notes:

A. The Schedule 3 Standard for NO_X is based on health effects of NO_2, as NO_2 has adverse health effects at much lower concentrations than NO. Therefore, the Standard was compared to NO_2 in this report. However, as per the current (December 2016) version of the Air Contaminants Benchmark List: Standards, Guidelines and Screening Levels for Assessing Point of Impingement Concentrations of Air Contaminants, the Standard was also compared to the monitored NO_X.

B. Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the 98th percentile over 3 consecutive years.

C. Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the three-year average of the annual average concentrations.

D. HHRA Health-Based criterion for $PM_{2.5}$ was selected referencing CCME (2006).

Table 2-3 Summary of Air Quality Criteria for Metals

Contaminant	CAS	Regulatory Criteria			HHRA Health-Based Criteria		
		1-Hour (µg/m³)	24-Hour (µg/m³)	Other time Period (µg/m³)	1-Hour (µg/m³)	24-Hour (µg/m³)	Annual (µg/m³)
Total Particulate	NA	-	120	-	-	120	60
Aluminum	7429-90-5	-	4.8	-	-	-	-
Antimony	7440-36-0	-	25	-	5	25	0.2
Arsenic	7440-38-2	-	0.3	-	0.2	0.3	0.015 [A] 0.0043 [B]
Barium	7440-39-3	-	10	-	5	10	1
Beryllium	7440-41-7	-	0.01	-	0.02	0.01	0.007 [A] 0.0024 [B]
Bismuth	7440-69-9	-					
Boron	7440-42-8	-	120	-	50	-	5
Cadmium	7440-43-9	-	0.025	0.005; annual	0.1	0.025	0.005 [A] 0.0098 [B]

Table 2-3 Summary of Air Quality Criteria for Metals

Contaminant	CAS	Regulatory Criteria			HHRA Health-Based Criteria		
		1-Hour (µg/m³)	24-Hour (µg/m³)	Other time Period (µg/m³)	1-Hour (µg/m³)	24-Hour (µg/m³)	Annual (µg/m³)
Chromium (Total)	7440-47-3	-	0.5	-	1	-	60
Cobalt	7440-48-4	-	0.1	-	0.2	0.1	0.1
Copper	8440-50-8	-	50	-	-	-	-
Iron	15438-31-0	-	4	-	-	-	-
Lead	7439-92-1	-	0.5	0.2; 30-day	1.5	0.5	0.5
Magnesium	7439-95-4	-					
Manganese	7439-96-5	-	0.4	-	-	-	-
Mercury	7439-97-6	-	2	-	0.6	2	0.3
Molybdenum	7439-87-7	-	120	-	-	-	-
Nickel	7440-02-0	-	0.2	0.04; annual	6	-	0.05
Phosphorus	7723-14-0	-	-	-	-	-	6.4×10^7
Selenium	7782-49-2	-	10	-	2	10	0.2
Silver	7440-22-4	-	1	-	0.1	1	0.01
Strontium	7440-24-6	-	120	-	-	-	-
Thallium	7440-28-0	-	-	-	1	-	0.1
Tin	7440-31-5	-	10	-	20	10	2
Titanium	7440-32-6	-	120	-	-	-	-
Vanadium	7440-62-2	-	2	-	0.5	1	1
Uranium	7440-61-1	-	1.5	0.03; annual	-	-	-
Zinc	7440-66-6	-	120	-	50	-	5
Zirconium	7440-67-7	-	20	-	-	-	-

Notes:

A. Annual Average

B. Carcinogenic Annual Average

Table 2-4 Summary of Air Quality Criteria for PAHs and D/Fs

Contaminant	CAS	Regulatory Criteria			HHRA Health-Based Criteria			
		1-Hour (ng/m^3)	24-Hour (ng/m^3)	Other time Period (ng/m^3)	1-Hour (ng/m^3)	24-Hour (ng/m^3)	Annual (ng/m^3)	Toxic Equivalency Factor Annual [A, G] $(ng/m^3)^{-1}$
1-Methylnaphthalene	90-12-0	-	12,000	-	-	-	3,000	-
2-Methylnaphthalene	91-57-6	-	10,000	-	-	-	3,000	-
Acenaphthene	83-32-9	-	-	-	1,000	-	-	1
Acenaphthylene	208-96-8	-	3,500	-	1,000	-	-	10
Anthracene	120-12-7	-	200	-	500	-	50	-
Benzo(a)anthracene	56-55-3	-	-	-	500	-	-	100
Benzo(b)fluoranthene	205-99-2	-	-	-	500	-	-	100
Benzo(k)fluoranthene	207 -08-9	-	-	-	500	-	-	100
Benzo(a)fluorene	238-84-6	-	-	-	500	-	50	-
Benzo(b)fluorene	243-17-4	-	-	-	500	-	50	-
Benzo (g,h,i) perylene	191-24-2	-	-	-	500	-	-	100
Benzo(a)pyrene	50-32-8	-	0.05 [B] 5 [C] 1.1 [D]	0.01; annual	-	1	87 [A]	-
Benzo(e)pyrene	192-97-2	-	-	-	500	-	-	10
Biphenyl	92-52-4	-	-	-	-	-	224,000	-
Chrysene	218-01-9	-						-
Dibenzo(a,c)anthracene	215-58-7	-	-	-	-	-	-	100
Dibenzo(a,h)anthracene	53-70-3	-	-	-	500	-	-	1,000
Fluoranthene	206-44-0	-	-	-	500	-	-	1
Indeno(1,2,3-cd) pyrene	193-39-5	-	-	-	500	-	-	100
Naphthalene	91-20-3	-	22,500	-	-	22,500	3,000	-
o-Terphenyl	84-15-1	-	-	-	50,000	-	5,000	-
Perylene	198-55-0	-	-	-	500	-	-	1
Phenanthrene	85-01-8	-	-	-	500	-	-	1

Table 2-4 Summary of Air Quality Criteria for PAHs and D/Fs

Contaminant	CAS	Regulatory Criteria			HHRA Health-Based Criteria			
		1-Hour (ng/m^3)	24-Hour (ng/m^3)	Other time Period (ng/m^3)	1-Hour (ng/m^3)	24-Hour (ng/m^3)	Annual (ng/m^3)	Toxic Equivalency Factor Annual [A, G] $(ng/m^3)^{-1}$
Pyrene	129-00-0	-	-	-	500	-	-	1
Tetralin	119-64-2	-						-
Dioxins and Furans Total Toxic Equivalency [E]	NA	-	0.1 (pg TEQ/m^3) [F] 1 (pg TEQ/m^3) [C]	-	-	-	-	-

Notes:

A. Carcinogenic Annual Average. Units in $(ng/m^3)^{-1}$.

B. Ontario Ambient Air Quality Criteria - The Standard for benzo(a)pyrene (B(a)P) is for B(a)P as a surrogate for PAHs.

C. O. Reg. 419/05 Schedule 6 Upper Risk Thresholds.

D. O. Reg. 419/05 24 Hour Guideline.

E. Application of the air Standard for dioxins, furans, and dioxin-like PCBs requires the calculation of the total toxicity equivalent (TEQ) concentration contributed by all dioxin-like compounds in the mixture. TEQ is calculated using the methodology as per the ACB List, and the corresponding WHO_{2005} toxic equivalency factors (TEFs).

F. O. Reg. 419/05 Schedule 3 Standard phased in after July 1, 2016.

G. Toxic Equivalency Factors (TEFs) are shown as benzo(a)pyrene equivalents.

3.0 INSTRUMENTATION AND OPERATIONS SUMMARY

3.1 INSTRUMENTATION

The measurement program at the monitoring sites includes both continuous and non-continuous monitors to sample air contaminant concentrations.

Monitoring for respirable particulate matter ($PM_{2.5}$), nitrogen oxides (NO_X) and sulphur dioxide (SO_2) is conducted on a continuous basis. A summary of the continuous monitors and a brief description of their principle of operation are provided in **Table 3-1** below.

Table 3-1 Summary of Continuous Ambient Air Quality Monitors

Contaminant	Monitor	Principle of Operation	Range	Time Interval
$PM_{2.5}$	Thermo Sharp 5030 Synchronized Hybrid Ambient Real-time Particulate Monitor	Light Scattering Photometry / Beta Attenuation - Consists of a carbon14 source, detector and light scattering Nephelometer in a rack-mountable enclosure. The Thermo Sharp utilizes a continuous (non-step wise) hybrid mass measurement and a combination of beta attenuation and light scattering technology. The unit's filter tape is automatically advanced based upon a user defined frequency or particulate loading.	0 - 10 mg/m^3	1 minute
NO, NO_2, NO_X	API Model 200E Chemiluminescence Analyzer	Chemiluminescence - Uses a chemiluminescence detection principle and microprocessor technology for ambient continuous emissions monitoring (CEM). Measurements are automatically compensated for temperature and pressure changes.	0 – 1000 ppb	1 second
SO_2	Teledyne Monitor Labs Sulphur Dioxide Analyzer Model T100	Pulsed Florescence - SO_2 levels are measured based on the principle that SO_2 has a strong ultraviolet (UV) absorption at a wavelength between 200 and 240 nanometres (nm). The absorption of photons at these wavelengths results in the emission of fluorescence photons at a higher wavelength. The amount of fluorescence measured is directly proportional to the concentration of SO_2.	0 – 1000 ppb	1 second

Two manually operated, High-Volume (Hi-Vol) air samplers are installed at both the Courtice WPCP (predominantly upwind) and Rundle Road (predominantly downwind) Stations to collect metals in total suspended particulate (TSP), polycyclic aromatic hydrocarbons (PAHs), and dioxins and furans. Sampling for these contaminants is conducted following the methodology and analyses described in the Ambient Monitoring Plan (Stantec, 2012), as presented in **Table 3-2**. Monitoring for metals in TSP is also conducted at the Fence Line Station. The samples were submitted to Maxxam Analytics Inc., a Canadian Association for Laboratory Accreditation Inc. (CALA) / Standards Council of Canada (SCC) accredited laboratory, for analysis.

Table 3-2 Summary of Non-Continuous Ambient Air Quality Monitors

Contaminant	Sampler	Filter Media	Lab Analysis	Sampling Schedule
TSP and metals	Tisch Environmental TE-5170 mass-flow high volume sampler	Pre-weighed, conditioned Teflon coated glass fibre filters	Weighed for particulate loading and analysed using the Atomic Emission Spectroscopy / Inductively Coupled Plasma (AES/ICP) technique to determine metals content	24 hour sample taken every 6 days
PAHs	Tisch Environmental TE-1000 mass-flow high volume air sampler	Dual chambered sampling module with a Teflon-coated glass fibre filter and a Poly-Urethane Foam (PUF) cartridge	Gas Chromatography / Mass Spectrometry (GC/MS)	24 hour sample taken every 12 days
Dioxins and Furans				24 hour sample taken every 24 days. At the request of the Region this frequency was increased to once every 12 days from September 9 to November 20, 2016.

Horizontal wind speed, wind direction, atmospheric temperature, relative humidity and rainfall are measured at the predominantly downwind Rundle Road station. The meteorological sensors at the Rundle Road station are mounted on an external 10 m aluminum tower. Atmospheric temperature, relative humidity, rainfall, and barometric pressure are measured at the predominantly upwind Courtice WPCP Station. Wind speed and wind direction data at the predominantly upwind location are measured on a 20 m tower and are provided by the Courtice Water Pollution Control Plant.

The meteorological equipment is summarized in **Table 3-3.**

Table 3-3 Summary of Meteorological Equipment

Parameter	Equipment
Wind Speed/Wind Direction	Met One Instruments Inc. Model 034B
Temperature/Relative Humidity	Campbell Scientific Model HMP60
Atmospheric Pressure	Campbell Scientific Model CS106
Rainfall	Texas Electronic TE525M

A Campbell Scientific CRX1000 station data acquisition system (DAS) is used to collect continuous instrument monitoring data and status codes from the ambient air quality monitors. Continuous station data are maintained in the data loggers, and data is viewed locally using a laptop and the relevant DAS software applications. Remote data transmission is accomplished by the periodic transmission of collected station air quality data via cellular phone.

3.2 MONITORING STATION VISITS AND REGULAR MAINTENANCE ACTIVITIES

Visits to the monitoring stations were conducted by employees from Stantec and Valley Environmental Services (Valley Environmental) for routine maintenance, setup of the non-continuous monitoring runs, and on an as-needed basis to verify the operation of the monitoring equipment as prescribed by the Ambient Monitoring Plan (Stantec, 2012). During the station visits, the integrity and operation of the sampling and monitoring equipment and of the data acquisition systems were verified. These checks were done to ensure the collection of valid and complete data, as well as to support the continued safe and secure environment at the station.

Station visits in 2016 were documented in the site logbook, and visual checks of the equipment were documented during each site visit in an Ambient Pod Checklist. A list of the regular and major preventative maintenance activities performed by Stantec and/or Valley Environmental during the station visits in 2016 is presented in **Table A-1** in **Appendix A**.

Daily diagnostic tests were performed remotely on the continuous monitoring equipment and station parameters to check for anomalous data and assess whether the equipment was functioning normally. Any issues identified were immediately assessed and rectified as soon as possible. If required, Valley Environmental was notified to dispatch a trained technician to address the issue.

3.3 DATA ACQUISITION/ARCHIVING

Data from the continuous monitors at each station are maintained in the data loggers. These data were viewed and collected via the automated data acquisition systems and cell phone modems.

- On a daily basis during weekdays, each data logger was remotely accessed and the current data were reviewed to check the operational status of each monitor and for anomalous data.
- Data was downloaded and backed-up once a week (to a separate file location) to avoid any file overwriting or data loss.
- The full set of collected data was reviewed including manual verification of values, invalidating false / suspicious / calibration data, etc. The protocols used to invalidate continuous data followed those provided in Table 5 of the MOECC Operations Manual (MOECC, 2008).

Details of the data editing are presented in the four Quarterly Ambient Air Quality Monitoring Report for the Durham York Energy Centre (Stantec, 2016a; Stantec, 2016b; Stantec, 2016c; Stantec, 2017).

3.4 INSTRUMENTATION CALIBRATION

Continuous Monitors

On-going performance checks and external calibrations of the continuous monitors were performed monthly. This meets the recommended calibration schedule listed in the MOECC Operations Manual (MOECC, 2008). The external calibrations for the NO_X and SO_2 monitors involved challenging each monitor with certified calibration gases (each referenced to a primary standard) for zero and span measurements.

Non-Continuous Monitors

The high volume air samplers were calibrated at a minimum monthly (or after any motor maintenance) during the sampling period. The calibration frequency exceeded the MOECC Operations Manual (MOECC, 2008) requirement of quarterly calibrations.

A summary of the calibration tasks that are required and have been performed for each sampler are provided in **Table A-2** in **Appendix A**.

3.5 MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE MONITOR PERFORMANCE AND SITE AUDIT

Four MOECC audits of the continuous monitors ($PM_{2.5}$, SO_2, and $NO_X/NO_2/NO$) were conducted in 2016. These were done on February 3, May 13, September 7, and December 13 at both the Courtice WPCP and Rundle Road Stations. The continuous monitors passed the MOECC performance and site audits, with the exception of the SO_2 monitor at the Rundle Road Station on December 13, 2016. This unit's span setting was found to be outside of MOECC allowable range during the December 13 audit. The issue was determined to be due to Valley Environmental's calibration gas cylinder going off-specification. The monitor was immediately recalibrated during the audit using the MOECC's calibration gas. Span adjustments were applied to affected data and no data was lost. Valley Environmental acquired another SO_2 calibration gas cylinder and had its certified concentration verified by the MOECC laboratory prior to re-calibrating the Rundle SO_2 monitor. Valley Environmental will have their calibration gas cylinders checked by the MOECC's laboratory on a periodic basis to avoid a reoccurrence of this issue.

MOECC performance and site audits of the non-continuous air samplers (TSP/metals and PAH/Dioxin and Furans) were conducted on March 11, May 13, and September 7 in 2016. The monitors passed the MOECC performance and site audits with the exception of the performance audit of the TSP/metals samplers at the Couritce WPCP, Rundle Road and Fence Line Stations on May 13, 2016. During the May 13 audit, the Hi-Vol sampler at the Courtice WPCP Station was not functioning due to a malfunctioning mass flow controller. The mass flow controller on this unit was replaced on May 17, 2016 and the unit re-calibrated and flow adjusted. In consultation with the MOECC, an update to the manufacturer recommended calibration and operation protocol for these units was implemented. The Hi-Vols passed an MOECC re-audit conducted on June 7, 2016.

3.6 INSTRUMENTATION ISSUES

There were some instrumentation issues encountered during 2016. These were generally associated with power outages and wildlife interactions. There were some minor equipment issues that commonly occur when operating instrumentation continuously for extended periods of time.

A summary of operational issues and the resolution for each measurement parameter during the 2016 monitoring period is presented in **Tables A-3, A-4** and **A-5** in **Appendix A** for the Courtice WPCP, Rundle Road, and Fence Line Stations respectively.

3.7 DATA RECOVERY RATES

Data recovery rates for each continuous monitor at the two monitoring stations during the 2016 sampling period (January to December 2016) are presented in **Tables 3-4** and **3-5**. The data recovery rates for the measured air contaminants at both stations met or surpassed MOECC requirements for data validity. Data recovery rates for the three stations ranged from 93% to 100%.

Table 3-4 Summary of Data Recovery Rates for the Courtice WPCP Station (Upwind) – 2016 Monitoring Period

Parameter	Valid Measurement Hours	Data Recovery Rate (%)
SO_2	8478	97% [A]
NO_X	8631	98% [A]
$PM_{2.5}$	8687	99% [A]
Temperature	8780	100% [A]
Rainfall	8682	99% [A]
Relative Humidity	8683	99% [A]
Pressure	8782	100% [A]
Wind Speed/Direction	8783	100% [A]
TSP/Metals	52 [B]	95%
PAHs	27 [B]	96%
Dioxins and Furans	20 [B, C]	100%

Notes:

A. Includes instrumentation issues summarized in Appendix Table A3, quarterly MOECC audit and monthly calibrations.

B. Number of filters/24-hour average samples.

C. Includes additional dioxins and furans sampling requested by the Regional Municipality of Durham

Table 3-5 Summary of Data Recovery Rates for the Rundle Road Station (Downwind) – 2016 Monitoring Period

Parameter	Valid Measurement Hours	Data Recovery Rate (%)
SO_2	8728	99% [A]
NO_X	8723	99% [A]
$PM_{2.5}$	8342	95% [A]
Temperature	8778	100% [A]
Rainfall	8777	100% [A]
Relative Humidity	8777	100% [A]
Wind Speed/Direction	8749	100% [A]

Table 3-5 Summary of Data Recovery Rates for the Rundle Road Station (Downwind) – 2016 Monitoring Period

Parameter	Valid Measurement Hours	Data Recovery Rate (%)
TSP/Metals	55 [B]	100%
PAHs	26 [B]	93%
Dioxins and Furans	19 [B, C]	95%

Notes:

A. Includes instrumentation issues summarized Appendix Table A4, quarterly MOECC audit and monthly calibrations.
B. Number of filters/24-hour average samples.
C. Includes additional dioxins and furans sampling requested by the Regional Municipality of Durham

Table 3-6 Summary of Data Recovery Rates for the Fence Line Station – 2016 Monitoring Period

Parameter	Valid Measurements	Data Recovery Rate (%)
TSP/Metals	53 [A]	96%

Notes:

A Includes instrumentation issues summarized Appendix Table A5. Number of filters/24-hour average samples

3.8 FIELD CONDITION OBSERVATIONS

During 2016, activities in the vicinity of the ambient air monitoring stations were observed that had the potential to affect air quality levels. These observations were noted by Stantec and Valley Environmental personnel during field visits and by Regional Municipality of Durham personnel located at the DYEC.

Construction of Highway 418, which will connect with Highway 401 between Courtice and Crago Roads commenced in April 2016. Highway 418 will provide a north-south link between Highway 401 and the Phase 2 expansion of Highway 407. The Highway 401/418 interchange will be located almost directly north of the DYEC.

In April and May, tree clearing and grubbing was observed on the north and south sides of the Highway 401/ Courtice Road Intersection.

In August, excavations and general earth work were observed in a large area approximately 300 m north of the DYEC between Energy Drive and Highway 401. Through September, October, and November the contractor continued to work in this area on the relocation/re-alignment of the South Service Road. The new South Service Road will be located south of the existing South Service Road and run between Courtice Road and Crago Road. Photographs of the South Service Road realignment are shown in **Figures 3-1** and **3-2**. Significant dust/particulate emissions are visible in **Figure 3-2** from these construction activities.

Throughout the latter half of 2016, construction activities for Highway 418 north of Baseline Road were observed. The highway construction contractor located a construction camp along Baseline Road about 1.5 km west of the Rundle Road Station. Visible dust emissions from heavy trucks entering and exiting this camp were observed by Stantec personnel during site visits. Construction of the highway was also on-going, with clearing, grading and other activities causing dust suspension from haul trucks, bulldozers, graders and excavators. These activities were occurring about 1.5 km to the west of the Rundle Road Station. Photographs of these construction activities are presented in **Figures 3-3** and **3-4**.

Other activities in the vicinities of the monitoring stations that had the potential to affect local air quality in 2016 included:

- excavation of fields to the south of the Courtice WPCP Station on August 12, 2016
- trucks idling while loading and unloading supplies at the WPCP Chemical Building (approximately 50 m north of the Courtice WPCP Station)
- increased heavy vehicle (dump truck) activity along Baseline Road and Rundle Road north of Baseline Road
- hydro crews working on the perimeter of the new South Service Road construction area in December 2016
- a fire on the roof of the DYEC on December 11, 2016, lasting from approximately 10:00 – 12:00.

Figure 3-1 View from Crago Road Looking West at the New South Service Road Construction Area (Photograph taken on September 2, 2016)

Figure 3-2 View of South Service Road Realignment Construction (Looking North from the DYEC) (Photograph taken on August 29, 2016)

Figure 3-3 View from Baseline Road Looking Southwest at Highway 418 Construction Activities (Photograph taken on October 12, 2016)

Figure 3-4 View from Baseline Road (between Solina Road and Courtice Road) Looking Northwest at Highway 418 Construction Activities (Photograph taken on October 25, 2016)

4.0 SUMMARY OF AMBIENT MEASUREMENTS

The following sections provide summaries of the validated data for each measured parameter.

4.1 METEOROLOGICAL DATA

A summary of the maximum, minimum, arithmetic mean, and standard deviation of the hourly average meteorological parameters measured at the two monitoring stations for January - December 2016 is presented in **Table 4-1**.

Table 4-1 Summary of Hourly Meteorological Measurements – 2016 Monitoring Period

Parameter		Courtice WPCP (Upwind)	Rundle Road (Downwind)	Units
Temperature	Maximum	32.5	33.6	C
	Minimum	-27.2	-27.2	C
	Mean	9.1	8.9	C
	Standard Deviation	10.2	10.6	C
Rainfall	Maximum	15.6	20.3	mm
	Minimum	0.0	0.0	mm
	Mean	0.05	0.06	mm
	Standard Deviation	0.40	0.46	mm
Relative Humidity	Maximum	96.6	100.0	%
	Minimum	19.9	21.7	%
	Mean	68.8	72.4	%
	Standard Deviation	14.6	16.3	%
Pressure [A]	Maximum	30.4	-	in Hg
	Minimum	28.8	-	in Hg
	Mean	29.7	-	in Hg
	Standard Deviation	0.2	-	in Hg
Wind Speed [B]	Maximum	47.6	43.5	km/hr
	Minimum	0.0	0.0	km/hr
	Mean	12.1	10.8	km/hr
	Standard Deviation	7.0	6.6	km/hr

Notes:

A. Pressure is not measured at the Rundle Road Station.

B. Wind speed at the Courtice WPCP Station is measured at 20 m and at the Rundle Road Station at 10 m.

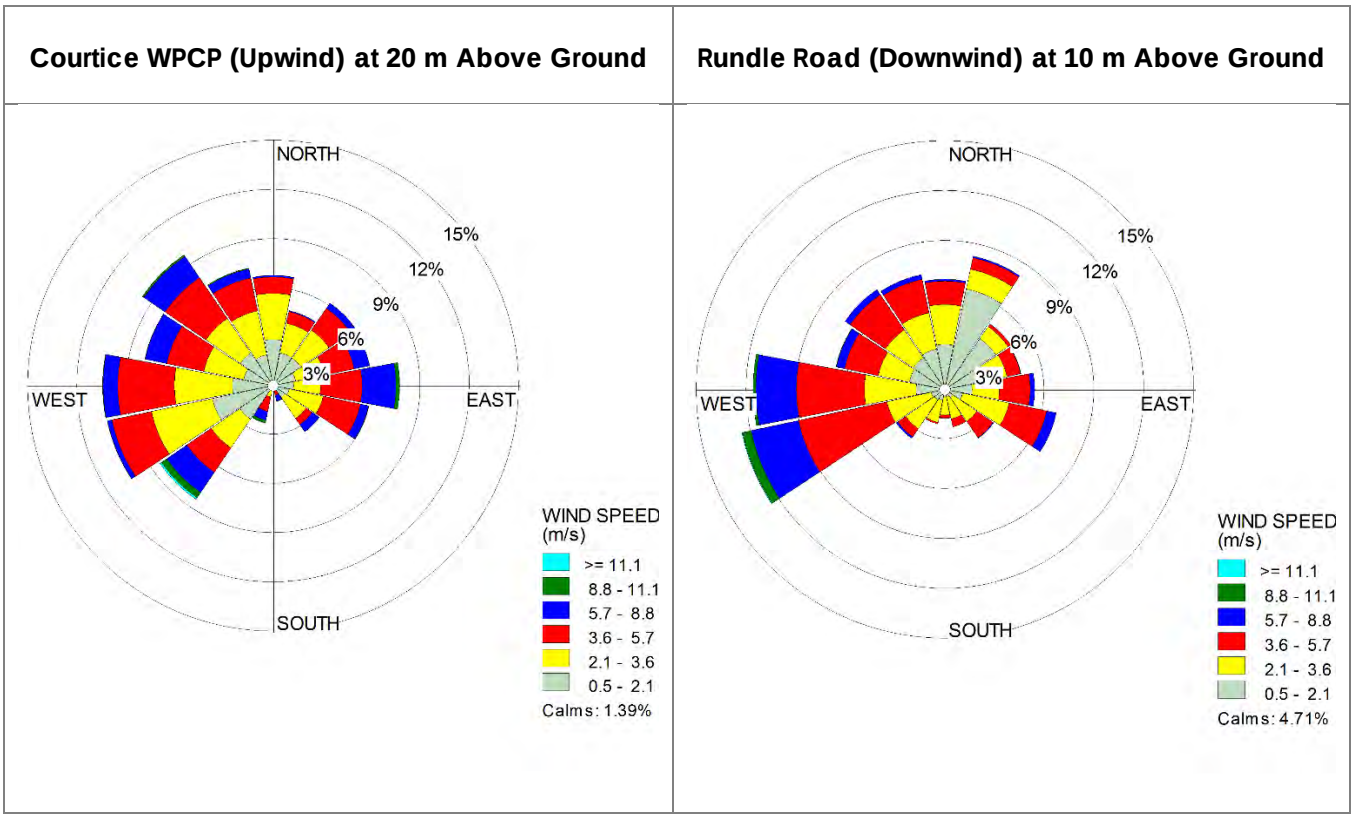
Summary of Ambient Measurements
May 9, 2017

At the Courtice WPCP (Upwind) Station (located near Lake Ontario), wind data were measured and provided by the Courtice Water Pollution Control Plant on a 20 m tower, while at the Rundle Road (Downwind) Station they were measured on a 10 m tower.

Wind roses showing the directionality and speed at each location are presented in **Figure 4-1**. The length of the radial barbs gives the total percent frequency of winds from the indicated direction, while portions of the barbs of different widths indicate the frequency associated with each wind speed category.

Winds over the twelve-month monitoring period in 2016 at the Courtice WPCP Station occurred predominantly from southwesterly to northwesterly directions. Winds blew infrequently from the south. At the Rundle Road Station, the predominant wind directions were winds blowing from westerly to west-southwesterly and north-northeasterly directions. As with the Courtice WPCP Station, the wind contribution from the south was low for the Rundle Road Station.

Figure 4-1 Wind Roses for the 2016 Monitoring Period (Jan-Dec 2016)



4.2 CAC AMBIENT AIR QUALITY MEASUREMENTS

A summary of the maximum, minimum, arithmetic mean, and standard deviation of the CAC pollutant concentrations measured at each station are presented in **Table 4-2**. Also presented in **Table 4-2** are the number of exceedances (if any) of the relevant Ontario ambient air quality criteria (AAQC) or health-based criteria for each contaminant.

The measured concentrations of the air contaminants monitored were all below their applicable hourly, 24-hour, and annual average criteria during 2016.

The concentration of nitric oxide (NO) has no regulatory criteria as discussed in Section 4.2.2 below. The hourly and 24-hour AAQC values for NO_X are based on health effects of NO_2; therefore, the AAQCs were compared to measured NO_2 concentrations in this report (MOECC, 2012). However, as per the December 2016 version of the Air Contaminants Benchmark List: Standards, Guidelines and Screening Levels for Assessing Point of Impingement Concentrations of Air Contaminants (ACB List) (MOECC, 2016), the Schedule 3 Standard for NO_X was also compared to the monitored NO_X levels.

A comparison of the maximum measured data to their respective air quality criteria is presented graphically in **Figure 4-2**.

Table 4-2 Summary of Ambient CAC Monitoring Data - 2016 Monitoring Period

Pollutant	Averaging Period	Regulatory and HHRA Health-Based Criteria			Courtice WPCP (Upwind)		Rundle Road (Downwind)	
		ppb	µg/m³		Concentration (ppbv)	Concentration (µg/m³)	Concentration (ppbv)	Concentration (µg/m³)
SO_2	1	250	690	Maximum	57.1	153.6	30.7	81.0
				Minimum	0.0	0.0	0.0	0.0
				Mean	1.7	4.8	0.8	2.1
				Standard Deviation	3.5	9.7	1.4	3.7
				# of Exceedances	0	0	0	0
	24	100	275	Maximum	13.0	36.5	6.2	16.3
				Minimum	0.0	0.0	0.0	0.0
				Mean	1.7	4.8	0.8	2.1
				Standard Deviation	1.8	5.0	0.8	2.3
				# of Exceedances	0	0	0	0
	Annual	20 / 11 [A]	55 / 29 [A]	Mean (Period)	1.7	4.8	0.8	2.1
				# of Exceedances	0	0	0	0
$PM_{2.5}$	24	N/A	28 [B]	Maximum	-	34.7	-	43.1
				Minimum	-	0.2	-	0.0
				Mean	-	6.8	-	9.6
				98th Percentile [C]	-	21.6	-	32.9
				Standard Deviation	-	4.8	-	7.5
				# of Exceedances	-	N/A[G]	-	N/A[G]
	Annual	N/A	10 [D]	Mean (Period)	-	6.8	-	9.6
				# of Exceedances	-	N/A[H]	-	N/A[H]

Table 4-2 Summary of Ambient CAC Monitoring Data - 2016 Monitoring Period

Pollutant	Averaging Period	Regulatory and HHRA Health-Based Criteria			Courtice WPCP (Upwind)		Rundle Road (Downwind)	
		ppb	µg/m³		Concentration (ppbv)	Concentration (µg/m³)	Concentration (ppbv)	Concentration (µg/m³)
NO_2	1	200 [E]	400 [E]	Maximum	62.4	125.9	36.2	70.8
				Minimum	0.0	0.0	0.0	0.0
				Mean	6.4	12.7	5.4	10.7
				Standard Deviation	6.4	13.0	5.0	10.1
				# of Exceedances	0	0	0	0
	24	100 [E]	200 [E]	Maximum	23.1	47.8	21.5	44.1
				Minimum	0.4	0.8	0.0	0.0
				Mean	6.4	12.7	5.4	10.7
				Standard Deviation	3.6	7.3	3.5	7.2
				# of Exceedances	0	0	0	0
	Annual	30	60	Mean	6.4	12.7	5.4	10.7
				# of Exceedances	0	0	0	0
NO [F]	1	NA	NA	Maximum	69.5	94.4	42.8	54.5
				Minimum	0.0	0.0	0.0	0.0
				Mean	2.5	3.3	2.1	2.7
				Standard Deviation	5.3	6.9	2.8	3.6
				# of Exceedances	0	0	0	0
	24	NA	NA	Maximum	21.9	29.7	9.2	11.9
				Minimum	0.1	0.1	0.1	0.1
				Mean	2.5	3.3	2.1	2.7
				Standard Deviation	2.7	3.5	1.4	1.8
				# of Exceedances	0	0	0	0

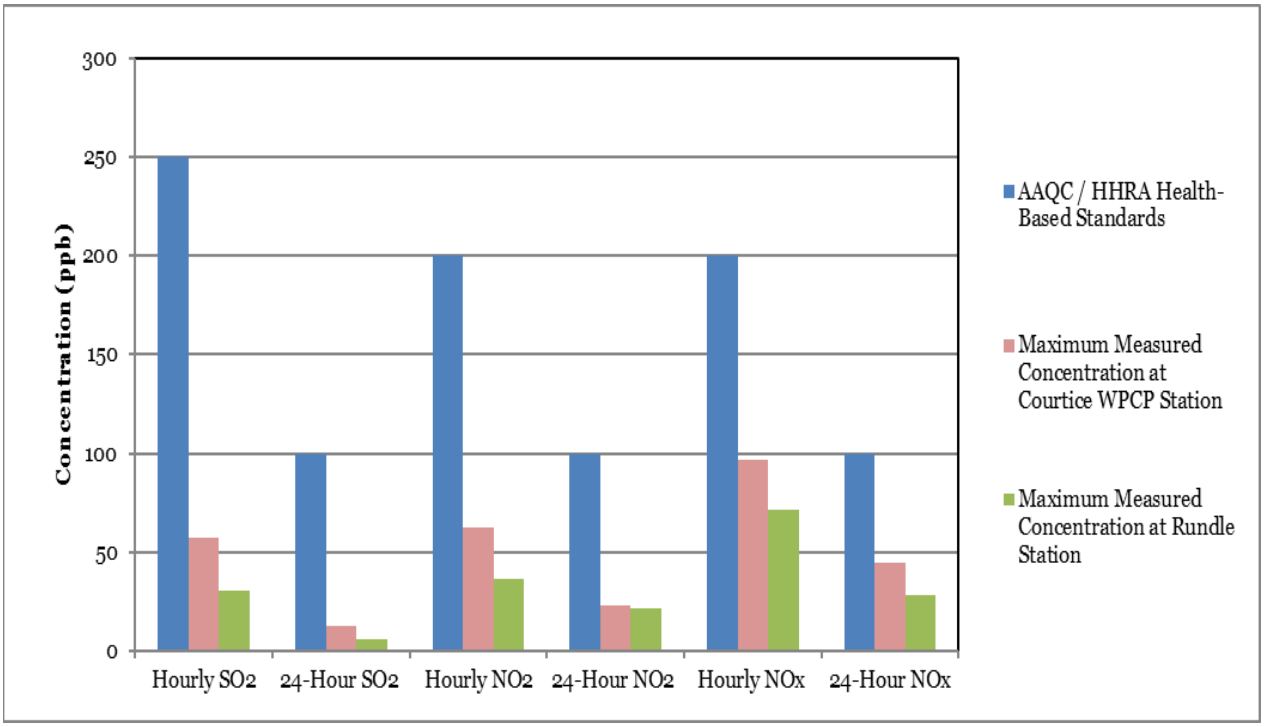
Table 4-2 Summary of Ambient CAC Monitoring Data - 2016 Monitoring Period

Pollutant	Averaging Period	Regulatory and HHRA Health-Based Criteria			Courtice WPCP (Upwind)		Rundle Road (Downwind)	
		ppb	µg/m³		Concentration (ppbv)	Concentration (µg/m³)	Concentration (ppbv)	Concentration (µg/m³)
NO_X	1	200 [E]	400 [E]	Maximum	97.1	202.3	71.3	139.5
				Minimum	0.0	0.0	0.0	0.0
				Mean	8.8	17.5	7.1	14.1
				Standard Deviation	10.4	21.0	6.8	13.6
				# of Exceedances	0	0	0	0
	24	100 [E]	200 [E]	Maximum	44.7	92.7	28.3	57.8
				Minimum	0.6	1.1	0.0	0.0
				Mean	8.8	17.5	7.1	14.1
				Standard Deviation	5.7	11.6	4.4	8.9
				# of Exceedances	0	0	0	0
	Annual	30	60	Mean	8.8	17.5	7.1	14.1
				# of Exceedances	0	0	0	0

Notes:

A. Annual AAQC / Annual HHRA.
B. Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the 98th percentile over three consecutive years.
C. The 98th percentile of the daily average $PM_{2.5}$ measurements in the period.
D. Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to a three-year average of the annual average concentrations.
E. As per the current December 2016 version of the ACB List, the air Standard for NO_X is compared to a monitored NO_X concentration, although the Reg. 419/05 Schedule 3 Standard for NO_X is based on health effects of NO_2.
F. NO has no regulatory criteria.
G. Daily $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires averaging the 98th percentile concentrations over three consecutive years, as compared to the 12-month period covered by this report.
H. Annual $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires a three-year average of the annual average concentrations over three consecutive years, as compared to the 12-month period covered by this report.

Figure 4-2 Comparison of NO_2 / NO_X and SO_2 Ambient Monitoring Data to Applicable Criteria – 2016 Monitoring Period



Maximum measured hourly concentrations at each monitoring station in each quarter of 2016 along with other available local and regional air quality data, wind directionality, and potential emissions sources are presented in **Tables 4-3 and 4-4** for the Courtice WPCP and Rundle Road Stations respectively.

Additional details on the results for each measured contaminant are presented in the following sections.

Table 4-3 Maximum Measured Concentrations by Quarter in 2016 – Courtice Station

Pollutant	Averaging Period (hr)		Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_2	1	Maximum Measured Concentration (ppb / µg/m³)	25.6 / 72	57.1 / 153.6	29.5 / 82.5	40.6 / 113.9
		Wind Direction	East-northeast	North-northeast	North-northeast	Northeast
		Potential Emission Sources	Agricultural activities, the Courtice WPCP Plant or CN railroad are potential emissions sources	Highway 401, a CN railroad and Highway 418 Construction activities are potential emissions sources	Highway 401, a CN railroad and Highway 418 Construction activities are potential emissions sources	The DYEC, Highway 401, a CN railroad and Highway 418 construction activities are potential emissions sources
NO_2	1	Maximum Measured Concentration (ppb / µg/m³)	62.4 / 125.9	43.6 / 85.8	36.4 / 70	35.5 / 77
		Wind Direction	East	West-southwest	North	North
		Oshawa MOECC Station Concentration in the same hour (ppb	9	2	5	8
		Potential Emission Sources	Agricultural activities or a CN railroad are potential emissions sources	Agricultural activities are potential emissions sources	Highway 401, a CN railroad and Highway 418 construction activities are potential emissions sources	Highway 401, a CN railroad and Highway 418 construction activities are potential emissions sources
NOx	1	Maximum Measured Concentration (ppb / µg/m³)	85.3 / 178.9	97.1 / 202.3	69.0 / 135	88.0 / 178.8
		Wind Direction	North-northeast	North-northeast	North	North
		Potential Emission Sources	Highway 401 or a CN railroad are potential emissions sources	Highway 401, a CN railroad and Highway 418 construction activities are potential emissions sources	Highway 401, a CN railroad and Highway 418 construction activities are potential emissions sources	Highway 401, a CN railroad and Highway 418 construction activities are potential emissions sources

Table 4-3 Maximum Measured Concentrations by Quarter in 2016 – Courtice Station

Pollutant	Averaging Period (hr)		Quarter 1	Quarter 2	Quarter 3	Quarter 4
$PM_{2.5}$	24	Maximum Measured Concentration ($\mu g/m^3$)	29.5	34.7	16.8	24.0
		Wind Direction	East	East-northeast	East-northeast	West-southwest
		Oshawa MOECC Station Concentration in the same 24-hour period ($\mu g/m^3$)	8.3	12.1	10.5	20.2
		Potential Emission Sources	Agricultural activities or a CN railroad are potential emissions sources	Agricultural activities, the Courtice WPCP Plant or CN railroad are potential emissions sources	Regional sources and local agricultural activities, the Courtice WPCP Plant or CN railroad are potential emissions sources	Regional sources and local agricultural activities are potential emissions sources

Table 4-4 Maximum Measured Concentrations by Quarter in 2016 – Rundle Station

Pollutant	Averaging Period (hr)		Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_2	1	Maximum Measured Concentration (ppb / µg/m³)	14.4 / 42.8	30.0 / 80.3	30.7 / 81	7.8 / 21.6
		Wind Direction	Southeast	Southeast	Southeast	North-northwest
		Potential Emission Sources	St. Mary's Cement Facility and a CP railroad are potential emissions sources	St. Mary's Cement Facility and a CP railroad are potential emissions sources	St. Mary's Cement Facility and a CP railroad are potential emissions sources	Agricultural activities and local roads are potential emissions sources
NO_2	1	Maximum Measured Concentration (ppb / µg/m³)	36.2 / 70.8	33.4 / 65.2	25.9 / 48.5	31.0 / 63.3
		Wind Direction	West-southwest	West-southwest	East-southeast	Northeast
		Oshawa MOECC Station Concentration in the same hour (ppb)	29	13	4	29
		Potential Emission Sources	Regional sources and local commercial facilities along Baseline Road and a CP railroad are potential emissions sources	Highway 418 construction activities and a CP railroad are potential emissions sources	St. Mary's Cement Facility and a CP railroad are potential emissions sources	Regional sources and local roads and a CP railroad are potential emissions sources
NOx	1	Maximum Measured Concentration (ppb / µg/m³)	57.1 / 123	61.9 / 122.7	37.7 / 73.3	71.3 / 139.5
		Wind Direction	West-northwest	East-southeast	Northwest	West-southwest
		Potential Emission Sources	Agricultural activities and local roads are potential emissions sources	St. Mary's Cement Facility and a CP railroad are potential emissions sources	Agricultural lands and Highway 418 construction activities are potential emissions sources	Highway 418 construction activities and a CP railroad are potential emissions sources

Table 4-4 Maximum Measured Concentrations by Quarter in 2016 – Rundle Station

Pollutant	Averaging Period (hr)		Quarter 1	Quarter 2	Quarter 3	Quarter 4
$PM_{2.5}$	24	Maximum Measured Concentration ($\mu g/m^3$)	43.1	26.9	43.0	41.8
		Wind Direction	Southwest	Southwest	Southeast	West-northwest
		Oshawa MOECC Station Concentration in the same 24-hour period ($\mu g/m^3$)	17.2	14.4	3.5	13.8
		Potential Emission Sources	Agricultural lands and the DYEC are potential emissions sources	Agricultural lands, the DYEC and Highway 418 construction activities are potential emissions sources	St. Mary's Cement Facility and a CP railroad are potential emissions sources	Local roads and Highway 418 construction activities are potential emissions sources

4.2.1 Sulphur Dioxide (SO_2)

Time history plots of the hourly and 24-hour average SO_2 concentrations over the measurement period are presented in **Appendix B, Figures B1** and **B2**. For the hourly and 24-hour average plots, the Ontario AAQCs of 250 and 100 ppb (690 µg/m³ and 275 µg/m³) are shown with blue lines in the respective plot. As shown in these figures, measured ambient SO_2 concentrations at both stations were well below the Ontario AAQCs. The annual Ontario AAQC for SO_2 is 20 ppb (55 µg/m³), and the annual HHRA criterion is 11 ppb (29 µg/m³).

The maximum hourly, 24-hour, and annual average concentrations measured at the Courtice WPCP station during the 2016 monitoring period were 57.1, 13, and 1.7 ppb (153.6, 36.5, and 4.8 µg/m³) which are 22.8%, 13%, and 15.9% of the applicable ambient 1-hour, 24-hour, and annual air quality criteria.

The maximum hourly, 24-hour, and annual average concentrations measured at the Rundle Road Station during 2016 were 30.7, 6.2, and 0.8 ppb (81, 16.3 and 2.1 µg/m³), respectively, which are 12.3%, 6.2%, and 7.1% of the applicable ambient 1-hour, 24-hour, and annual air quality criteria.

Pollution roses of hourly average SO_2 concentrations measured at the Courtice WPCP Station and the Rundle Road Station are presented in **Figure 4-3**. A pollution rose plot presents measured hourly average contaminant concentrations versus measured wind direction (over 10° wind sectors). Concentrations less than 2 ppb, which account for about 78% and 91% of the measurements at the Courtice WPCP and Rundle Road Stations, respectively, were removed from both plots to allow the distribution of maximum levels to be more clearly visible in the figure. Plots of the measured hourly average SO_2 concentrations versus wind direction are presented in **Appendix B, Figures B3** and **B4**.

Higher measured concentrations at the Courtice WPCP Station occurred for winds blowing from the north. The maximum measured concentration at this station occurred for a north-northeasterly wind – a direction in which the Courtice Water Pollution Control Plant, a CN railway, and Highway 401 were upwind of the monitoring station. For the Rundle Road station, the measured hourly average concentrations were higher for southeasterly and west-southwesterly winds relative to other directions. The highest measured concentration at this station occurred for winds blowing from the southeast for which St. Mary's Cement, Highway 401 and a CP railway were upwind of the Rundle Road Station.

At the Courtice WPCP Station, the highest measured 24-hour average SO_2 concentration was on February 9, 2016 with winds from the east for which agricultural activities and a CN railroad were upwind. The highest measured 24-hour average SO_2 concentration at the Rundle Road Station was on July 27, 2016 with winds blowing from the northwest for which agricultural lands and Highway 418 construction activities were upwind.

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- St Mary's Cement Facility Location
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

Concentration (ppb)

- 20 - 100
- 10 - 20
- 5 - 10
- 2 - 5
- Direction of Maximum Measured Concentration

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
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3. Orthoimagery © First Base Solutions, 2013.
4. Courtice WPCP: Concentrations less than 2ppb, which account for 78% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure. Rundle Road: Concentrations less than 2ppb, which account for 91% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

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Durham York Energy Centre

Figure No.

4-3

Title

Pollution Roses of Measured Hourly Average SO_2 Concentrations - 2016 Monitoring Period

A summary of the maximum measured hourly concentrations in each quarter of 2016 at each monitoring station along with other available local and regional air quality data, wind directionality and potential emissions sources are presented in **Tables 4-3 and 4-4**.

4.2.2 Nitrogen Dioxide (NO_2)

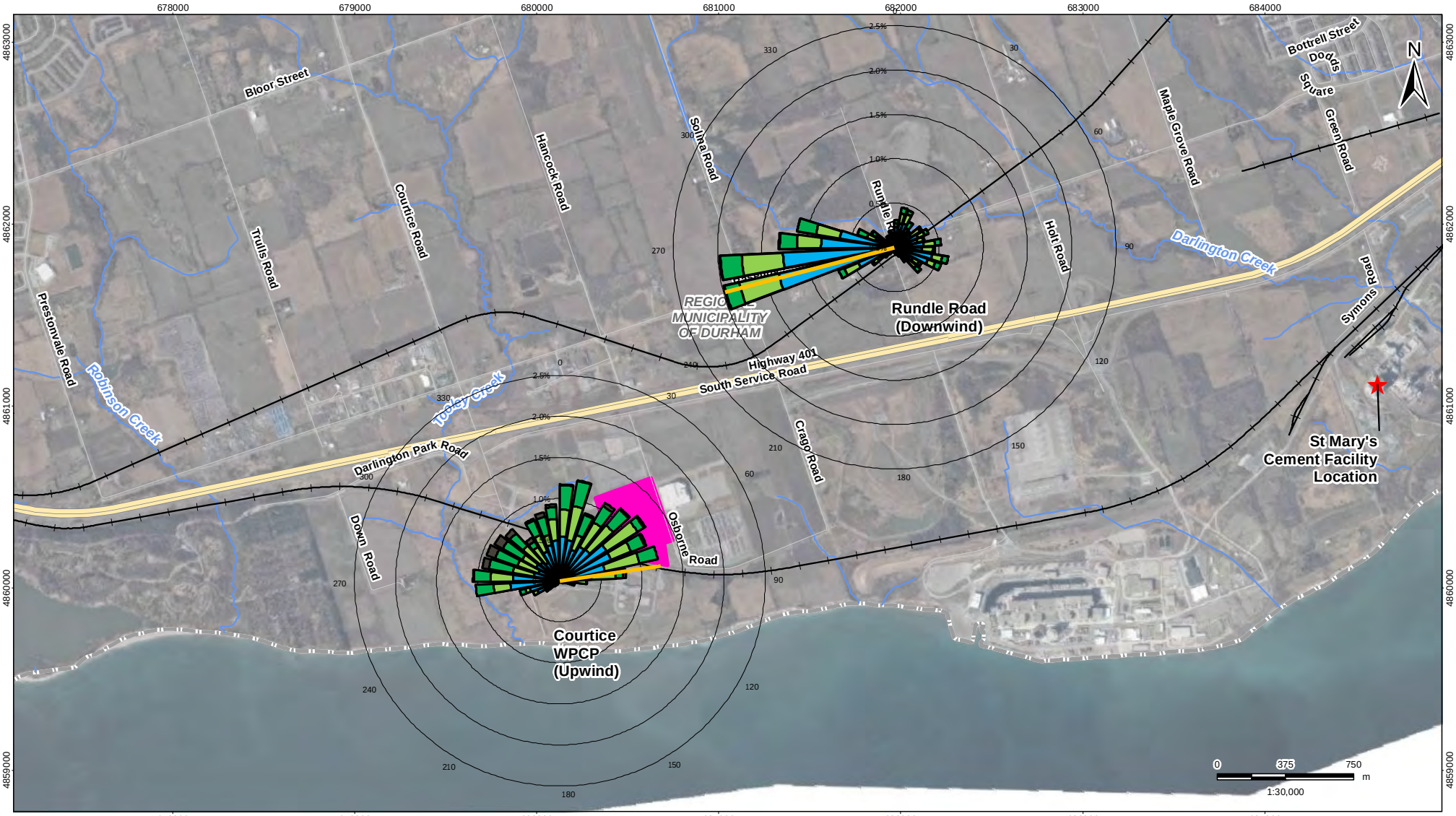
Nitrogen oxides (NO_X) are almost entirely made up of nitric oxide (NO) and nitrogen dioxide (NO_2). Together, they are often referred to as NO_X. Most NO_2 in the atmosphere is formed by the oxidation of NO, which is emitted directly by combustion processes, particularly those at high temperature and pressure. Exposure to both NO and NO_2 can result in adverse health effects to an exposed population. NO_2 is the regulated part of NO_X. Similar to other jurisdictions (e.g., Alberta Environment, World Health Organization), the O. Reg. 419/05 Schedule 3 Standards for NO_X are based on health effects of NO_2, as health effects are seen at much lower concentrations of NO_2 than NO. In this report, because NO_2 is the regulated species of NO_X, the AAQC were compared to measured NO_2 concentrations (MOECC, 2012). However, as per the current December 2016 version of the ACB List (MOECC, 2016), the NO_X Schedule 3 Standard was also compared to the monitored NO_X concentrations (see Section 4.2.3 below).

Time history plots of the hourly and 24-hour average NO_2 concentrations over the measurement period are presented in **Appendix C, Figures C1** and **C2**. For hourly and 24-hour averages, the respective Ontario AAQCs of 200 and 100 ppb (400 µg/m³ and 200 µg/m³) are shown as blue lines on the time history plots. The annual HHRA criterion is 30 ppb (60 µg/m³). As shown in these figures, measured ambient NO_2 concentrations at both stations were well below the criteria.

The maximum hourly, 24-hour, and annual average NO_2 concentrations measured at the Courtice WPCP station during 2016 were 62.4, 23.1, and 6.4 ppb (125.9, 47.8, and 12.7 µg/m³), respectively which are 31.2%, 23.1% and 21.2% of the applicable ambient 1-hour, 24-hour and annual air quality criteria. At the Rundle Road Station, the maximum measured hourly, 24-hour, and annual average concentrations were 36.2, 21.5, and 5.4 ppb (70.8, 44.1, and 10.7 µg/m³), which are 18.1%, 21.5%, and 18% of the applicable air quality criteria.

Pollution roses of hourly NO_2 concentrations are presented in **Figure 4-4**. Concentrations less than 10 ppb which account for 77% and 83% of measurements at the Courtice and Rundle Stations, respectively were removed from the plots. Plots of measured hourly average NO_2 concentrations versus measured wind direction are presented in **Appendix C, Figures C3** and **C4**.

Higher measured hourly concentrations for the Courtice WPCP station occurred more frequently from northwesterly to northerly directions. The maximum measured hourly average NO_2 concentration for the Courtice WPCP Station occurred on February 8, 2016 at 7:00 during an easterly wind; which is a direction in which the CN railway, Courtice WPCP, and an agricultural area are upwind of the station. The measured hourly NO_2 concentration at the MOECC Oshawa Station at the same time was 9 ppb which is lower than the Courtice WPCP Station.



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- St Mary's Cement Facility Location
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

Concentration (ppb)

- 30 - 80
- 20 - 30
- 15 - 20
- 10 - 15
- Direction of Maximum Measured Concentration

Notes

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3. Orthoimagery © First Base Solutions, 2013.
4. Courtice Concentrations less than 10ppb, which account for 77% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.
   Rundle Road: Concentrations less than 10ppb, which account for 83% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

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Durham York Energy Centre

Figure No.

4-4

Title

Pollution Roses of Measured Hourly Average NO_2 Concentrations - 2016 Monitoring Period

At the Rundle Road Station, higher hourly average NO_2 concentrations were measured for winds blowing from the west-southwest. The maximum measured hourly average concentration at the Rundle Road Station (on March 9, 2016 at 22:00) was from the west-southwest for which commercial businesses along Baseline Road (such as equipment rental companies and building component manufacturers) are upwind of the station. The measured NO_2 concentration at the MOECC Oshawa Station in the same hour was 29 ppb which is comparable to the Rundle Road Station suggesting regional sources influenced both stations. The maximum measured hourly average NO_2 concentration at the MOECC Oshawa Station in 2016 was 43 ppb which is comparable to the maximum Rundle Road Station measurement in this year.

The wind direction at the Courtice WPCP Station during the maximum measured 24-hour average NO_2 concentration on January 7, 2016 was from the northeast for which the DYEC, Highway 401, and a CN railroad were upwind. DYEC personnel reported no upset conditions at the DYEC on this day. The hourly average NOx concentrations measured by the continuous emissions monitors on each boiler at the DYEC on January 7, 2016 were in the normally measured range of 111-113 mg/Rm^3. On the same day the MOECC Oshawa station measured a comparable 24-hour NO_2 concentration of 24 ppb suggesting both stations were largely influenced by regional conditions in that period.

At the Rundle Road Station, the highest measured 24-hour average NO_2 concentration was on December 22, 2016 with winds from the west for which local commercial facilities along Baseline Road along Baseline Road were upwind. The maximum measured 24-hour average NO_2 concentration (30.2 ppb) at the MOECC Oshawa Station during this quarter was also measured on December 22, 2016 and was higher than the Rundle Road Station measurements.

Maximum measured hourly concentrations at each monitoring station in each quarter of 2016 along with other available local and regional air quality data, wind directionality, and potential emissions sources are presented in **Tables 4-3 and 4-4**.

4.2.3 Nitrogen Oxides (NO_X)

Time history plots of hourly and 24-hour average NO_x concentrations over the measurement period are presented in **Appendix D, Figures D1, and D2**. For hourly and 24-hour averages, the Schedule 3 Standard of 200 and 100 ppb (400 and 200 µg/m^3) are shown as blue lines on the corresponding time history plot. As indicated in the section above, although the criteria were compared to the measured NO_X concentrations in this report, the Standards for NO_X are based on health effects of NO_2. As shown in these figures, the maximum measured ambient hourly and 24-hour average NO_X concentrations at the Courtice WPCP and Rundle Road station were below the Schedule 3 Standard during the monitoring period.

As presented in **Table 4-2**, the maximum hourly average NO_X concentration measured at the Courtice WPCP station was 97.1 ppb (202.3 µg/m^3), which is 48.5% of the 1-hour ambient criteria. The 24-hour and annual average NO_X concentrations measured at this station were 44.7 and 8.8 ppb (92.7 µg/m^3 and 17.5 µg/m^3), which are 44.7% and 29.3% of the applicable ambient air

quality criteria. At the Rundle Road Station, the maximum hourly, 24-hour, and annual average concentrations measured in 2016 were 71.3, 28.3, and 7.1 ppb (139.5, 57.8, and 14.1 µg/m³), which are 35.7%, 28.3%, and 23.7% of the applicable air quality criteria.

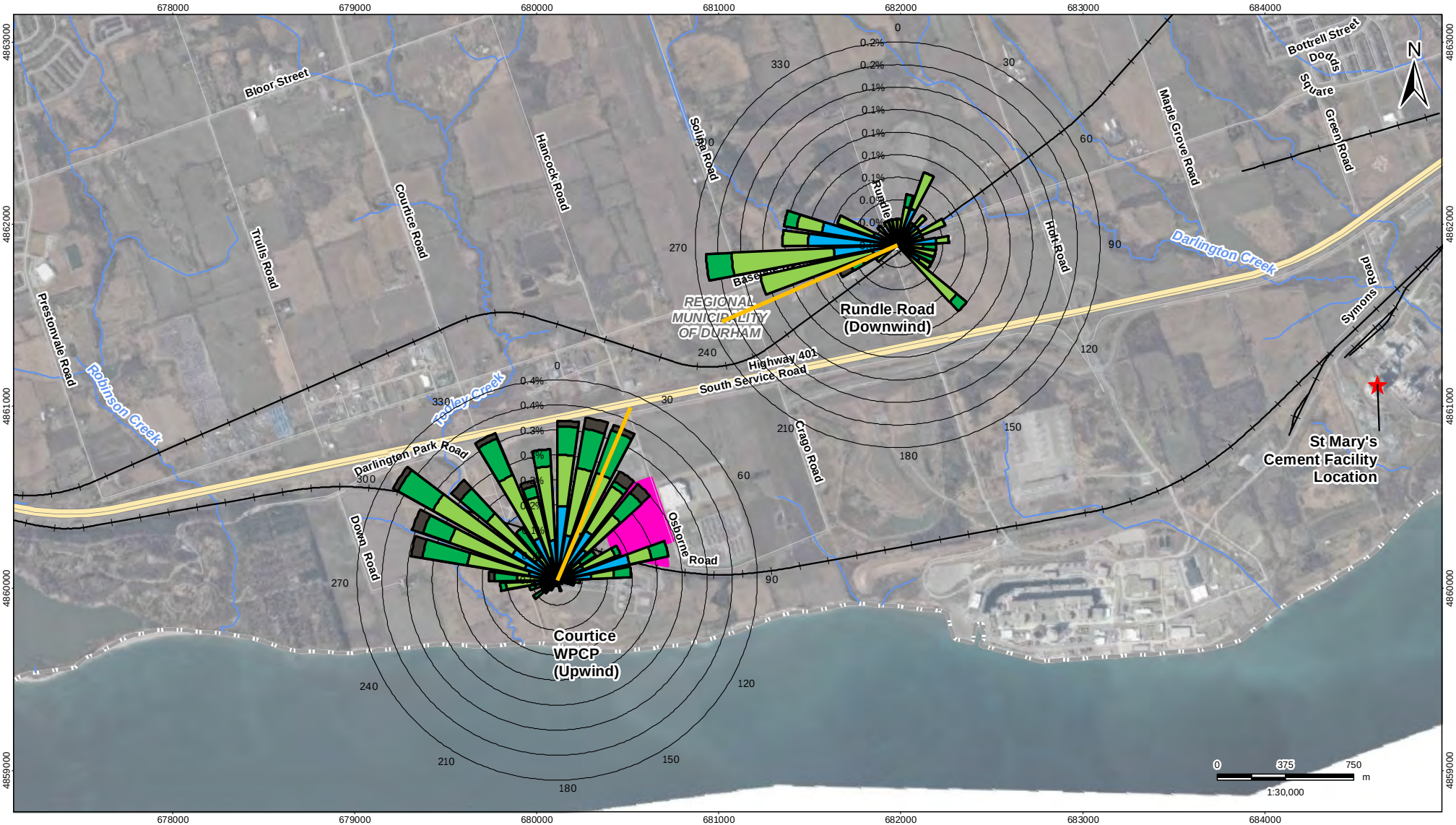
Pollution roses of hourly average NO_X concentrations for the Courtice WPCP Station and the Rundle Road Station are presented in **Figure 4-5**. The wind roses in this figure present measured concentrations above 30 ppb to allow the higher levels to be more easily visible (concentrations less than 30 ppb accounted for 93% and 97% of the NOx measurements at the Courtice WPCP and Rundle Road Stations respectively). Plots of wind direction versus measured NO_X concentrations are presented in **Appendix D, Figures D3 and D4**.

Higher measured hourly average NO_X concentrations for the Courtice WPCP Station typically occurred for winds blowing from northwesterly to northeasterly directions. The maximum measured concentration was on April 13, 2016 at 6:00 for a wind blowing from the north-northeast, for which Highway 401, and the CN railway were upwind.

At the Rundle Road Station, higher measured hourly average NO_X concentrations occurred for westerly to west-southwesterly directions. The maximum measured hourly average NO_X concentration occurred on November 16, 2016 at 12:00 for a west-southwesterly wind. In this direction, Highway 418 construction activities, commercial businesses along Baseline Road (such as equipment rental companies and building component manufacturers) were situated upwind of the monitoring station.

The maximum measured 24-hour average NOx concentrations at the Courtice WPCP and Rundle Road Stations were observed on January 7, 2016 and December 22, 2016 respectively. Wind directions during this period at the Courtice WPCP Station were from the northeast while the Rundle Road Station experienced winds blowing from the west. Highway 401, the CN railroad, and the DYEC were upwind of the Courtice WPCP Station, while local commercial facilities along Baseline Road were upwind of the Rundle Road Station. The hourly NOx concentrations measured by the continuous emissions monitors on each boiler at the DYEC on January 7, 2016 were in the normally measured range of 111-113 mg/Rm³. DYEC personnel did not report any unusual operations in this period.

Tables 4-3 and 4-4 present maximum measured hourly concentrations at each monitoring station in each quarter of 2016 along with other available local and regional air quality data, wind directionality and potential emissions sources.



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Notes

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3. Orthoimagery © First Base Solutions, 2013.
4. Courtice WPCP: Concentrations less than 30ppb, which account for 93% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure. Rundle Road: Concentrations less than 30ppb, which account for 97% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

Legend

- St Mary's Cement Facility Location
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

Concentration (ppb)

- 70 - 100
- 50 -70
- 50 - 35
- 30 - 35
- Direction of Maximum Measured Concentration

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Figure No.

4-5

Title

Pollution Roses of Measured Hourly Average NO_x Concentrations – 2016 Monitoring Period

4.2.4 Particulate Matter Smaller than 2.5 Microns ($PM_{2.5}$)

Time history plots of the measured 24-hour average $PM_{2.5}$ concentrations over the measurement period are presented in **Appendix E, Figures E1 and E2**.

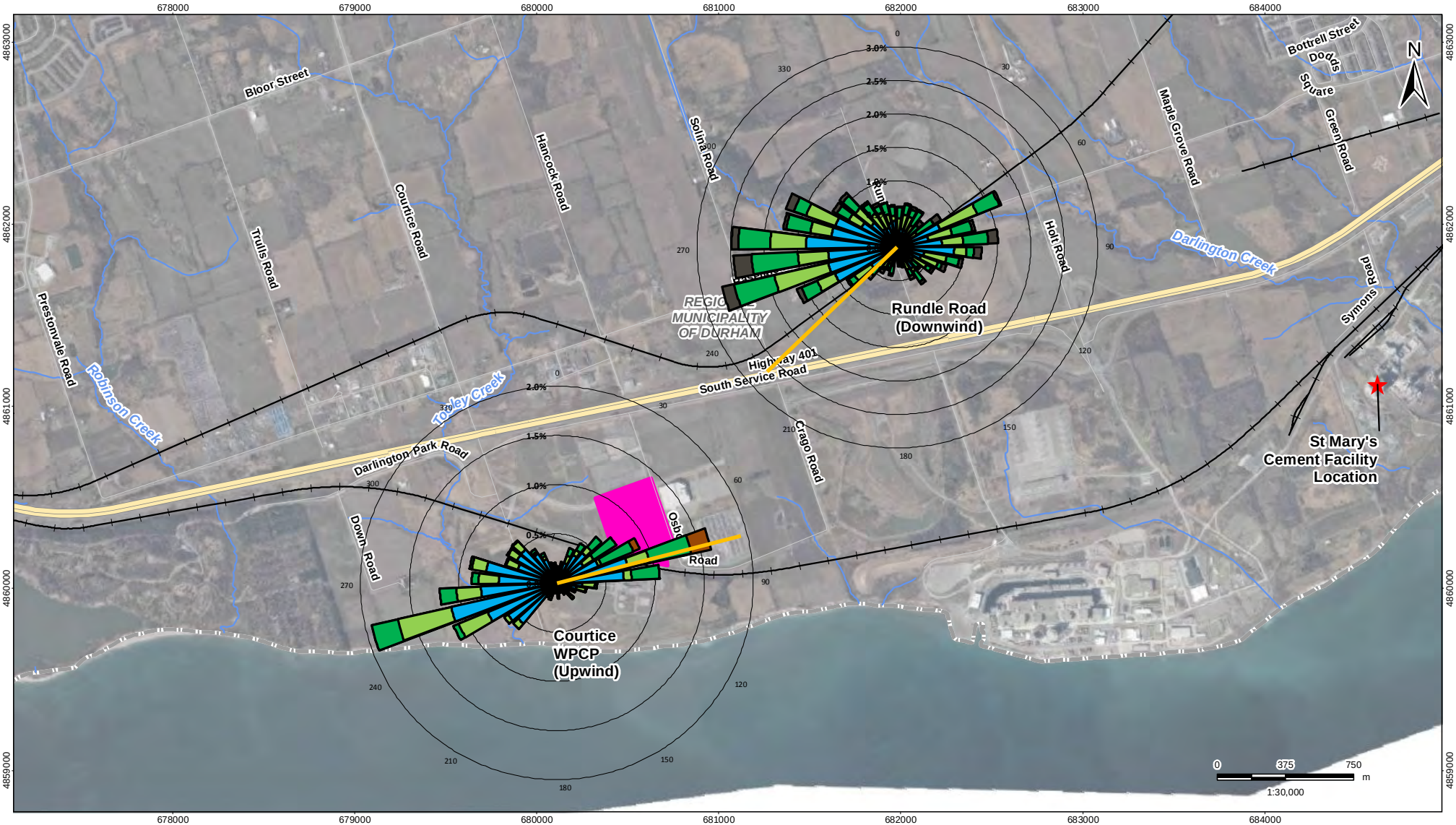
The maximum 24-hour average $PM_{2.5}$ concentration measured at the Courtice WPCP station over the monitoring period was 34.7 µg/m³. The maximum measured 24-hour average $PM_{2.5}$ concentration at the Rundle Road Station was 43.1 µg/m³. In 2016, the 98th percentiles of the daily average $PM_{2.5}$ concentrations measured over the monitoring period were 21.6 µg/m³ at the Courtice WPCP Station and 32.9 µg/m³ at the Rundle Road Station. As detailed below, these values for the 98th percentile should not be used for comparison against the Canadian Ambient Air Quality Standard individually. The annual average $PM_{2.5}$ concentrations measured at the Courtice WPCP and Rundle Road Stations over the monitoring period were 6.8 and 9.6 µg/m³, respectively.

Pollution roses showing measured 24-hour average ambient $PM_{2.5}$ concentrations versus wind direction are shown in **Figure 4-6** for both monitoring stations. Concentrations less than 10 µg/m³ which accounted for approximately 81% of measurements at the Courtice WPCP and 60% at the Rundle Road Station were not included in this figure to more clearly show the distribution of higher levels. Plots of measured 24-hour average ambient $PM_{2.5}$ concentrations versus measured 24-hour average wind direction are presented in **Appendix E, Figures E-3 and E-4**.

Higher measured $PM_{2.5}$ concentrations at the Courtice WPCP Station occurred for east-northeasterly winds, with the maximum measured 24-hour concentration occurring on May 26, 2016 with winds from the east-northeast. For this wind direction the CN railway, Courtice WPCP, and Highway 401 were located upwind of the monitoring station. During the same day, the MOECC Oshawa Station measured an ambient $PM_{2.5}$ level of 12.1 µg/m³ suggesting a local source(s) may have influenced the measured concentrations at the Courtice WPCP Station.

At the Rundle Road Station, higher measured 24-hour average $PM_{2.5}$ concentrations were measured in 2016 for west-southwesterly to west-northwesterly, and easterly winds. The maximum measured concentration occurred on February 7, 2016 for a southwesterly wind, and for this wind direction Highway 401, a CP railroad, and the DYEC were located upwind of the Rundle Road station. In this same period, the MOECC Oshawa station measured 17.2 µg/m³ suggesting a local source or sources may have influenced the Rundle Road Station. Based on the DYEC's operational records, the opacity measured by the continuous emissions monitors on each boiler during this period was 0%.

A summary of maximum measured 24 hour concentrations at each monitoring station in each quarter of 2016 along with other available local and regional air quality data, wind directionality, and potential emissions sources are presented in **Tables 4-3 and 4-4**.



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Notes

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2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthoimagery © First Base Solutions, 2013.
4. Courtice WPCP:Concentrations less than 10µg/m³, which account for 81% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure. Rundle Road: Concentrations less than 10µg/m³, which account for 60% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

Legend

- St Mary's Cement Facility Location
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

Concentration (µg/m³)

- 30 - 50
- 20 - 30
- 15 - 20
- 10 - 15
- Direction of Maximum Measured Concentration

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

4-6

Title

Pollution Roses of Measured 24-Hour Average $PM_{2.5}$ Concentrations – 2016 Monitoring Period

The 24-hour and annual $PM_{2.5}$ CAAQS criteria both require a 3-calendar year average for comparison, with the data considered valid if an annual 98th percentile value is available for at least two of the required three calendar years. Since **Table 4-2** only covers the year 2016, the measurements presented in that table were not explicitly compared to the CAAQS criteria.

With the completion of the 2016 monitoring period, three calendar years of $PM_{2.5}$ measurements are now available to compare against the CAAQS criteria. The three-year average of the annual 98th percentile of the daily 24-hour average $PM_{2.5}$ concentrations and the three-year average of the annual average $PM_{2.5}$ concentrations (for calendar years 2014 to 2016) at both stations are compared in **Table 4-5.** The measured ambient $PM_{2.5}$ levels at both stations were below the respective CAAQS for both the 24-hour and annual averaging periods.

A summary of maximum measured 24 hour concentrations at each monitoring station in each quarter of 2016 along with other available local and regional air quality data, wind directionality, and potential emissions sources are presented in **Tables 4-3 and 4-4.**

Table 4-5 Comparison of Ambient $PM_{2.5}$ Levels to the CAAQS (2014 to 2016 Measurement Data)

Pollutant	Averaging Period	CAAQS Criteria (µg/m³)	Courtice WPCP Concentration (µg/m³) (Predominantly Upwind)	Rundle Road Concentration (µg/m³) (Predominantly Downwind)
			2014 – 2016	2014 – 2016
$PM_{2.5}$	24-hour	28 [A]	23.7	27.5
	Annual	10 [B]	7.7	9.2

Notes:

A Canadian Ambient Air Quality Standard for Respirable Particulate Matter. The Respirable Particulate Matter Objective is referenced to the average of the 98th percentile of the daily average over three consecutive years.

B Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the three-year average of the annual average concentrations.

4.3 AMBIENT TSP/ METALS CONCENTRATIONS

A summary of the maximum, minimum, and mean measured daily average TSP and metals concentrations are presented in **Table 4-6**.

The maximum measured concentrations of TSP and all metals with MOECC air quality criteria during the 2016 monitoring period (February to December 2016) for these contaminants were below their applicable 24-hour criteria (shown in **Table 4-6** below) at all three stations.

Summary of Ambient Measurements
May 9, 2017

Table 4-6 Summary of Measured Ambient TSP/Metals Concentrations – 2016 Monitoring Period

Contaminant	Units	MOECC Standard (Daily Average)	HHRA Health Based Criteria (Daily Average)	Courtice WPCP (Predominantly Upwind)				Rundle Road (Predominantly Downwind)				Fence Line			
				Max	Min	Period Arithmetic Mean	No. of Exceedances	Max	Min	Period Arithmetic Mean	No. of Exceedances	Max	Min	Period Arithmetic Mean	No. of Exceedances
Particulate	µg/m³	120	120	95	8	27 / 23 [B]	0	97	9	32 / 28 [B]	0	80	11	33 / 29 [B]	0
Total Mercury (Hg)	µg/m³	2	2	3.62E-05	5.74E-06 [A]	1.02E-05	0	2.50E-05	5.55E-06 [A]	9.68E-06	0	4.79E-05	5.76E-06 [A]	1.26E-05	0
Aluminum (Al)	µg/m³	4.8	-	6.78E-01	1.58E-02 [A]	1.23E-01	0	7.86E-01	1.63E-02 [A]	1.80E-01	0	7.07E-01	4.17E-02	1.87E-01	0
Antimony (Sb)	µg/m³	25	25	3.67E-03 [A]	2.87E-03 [A]	3.22E-03	0	3.57E-03 [A]	2.77E-03 [A]	3.16E-03	0	3.53E-03 [A]	2.83E-03 [A]	3.16E-03	0
Arsenic (As)	µg/m³	0.3	0.3	2.20E-03 [A]	1.72E-03 [A]	1.93E-03	0	4.72E-03	1.66E-03 [A]	1.95E-03	0	2.12E-03 [A]	1.70E-03 [A]	1.90E-03	0
Barium (Ba)	µg/m³	10	10	3.39E-02	2.93E-03	9.17E-03	0	2.37E-02	2.69E-03	9.06E-03	0	2.29E-02	3.23E-03	1.02E-02	0
Beryllium (Be)	µg/m³	0.01	0.01	3.67E-04 [A]	2.87E-04 [A]	3.22E-04	0	3.57E-04 [A]	2.77E-04 [A]	3.16E-04	0	3.53E-04 [A]	2.83E-04 [A]	3.16E-04	0
Bismuth (Bi)	µg/m³	-	-	2.20E-03 [A]	1.72E-03 [A]	1.93E-03	-	2.14E-03 [A]	1.66E-03 [A]	1.90E-03	-	2.12E-03 [A]	1.70E-03 [A]	1.90E-03	-
Boron (B)	µg/m³	120	-	8.50E-03	1.72E-03 [A]	2.19E-03	0	7.45E-03	1.66E-03 [A]	2.19E-03	0	8.49E-03	1.73E-03 [A]	2.32E-03	0
Cadmium (Cd)	µg/m³	0.025	0.025	7.34E-04 [A]	5.74E-04 [A]	6.43E-04	0	7.13E-04 [A]	5.55E-04 [A]	6.33E-04	0	1.13E-02	5.77E-04 [A]	1.34E-03	0
Chromium (Cr)	µg/m³	0.5	-	7.74E-03	1.44E-03 [A]	2.25E-03	0	7.93E-03	1.39E-03 [A]	2.44E-03	0	8.22E-03	1.44E-03 [A]	2.59E-03	0
Cobalt (Co)	µg/m³	0.1	0.1	7.34E-04 [A]	5.74E-04 [A]	6.43E-04	0	2.78E-03	5.55E-04 [A]	6.72E-04	0	7.07E-04 [A]	5.66E-04 [A]	6.33E-04	0
Copper (Cu)	µg/m³	50	-	1.27E-01	6.87E-03	4.50E-02	0	1.16E-01	1.28E-02	5.22E-02	0	7.70E-02	1.14E-02	4.30E-02	0
Iron (Fe)	µg/m³	4	-	1.58E+00	9.05E-02	3.99E-01	0	1.83E+00	9.00E-02	5.21E-01	0	1.36E+00	1.01E-01	4.93E-01	0
Lead (Pb)	µg/m³	0.5	0.5	7.52E-03	8.61E-04 [A]	2.19E-03	0	7.25E-03	8.32E-04 [A]	2.31E-03	0	1.02E-02	8.65E-04 [A]	3.21E-03	0
Magnesium (Mg)	µg/m³	-	-	1.14E+00	5.07E-02	2.01E-01	-	1.10E+00	5.29E-02	2.51E-01	-	1.01E+00	6.97E-02	2.65E-01	-
Manganese (Mn)	µg/m³	0.4	-	4.86E-02	2.76E-03	1.29E-02	0	6.56E-02	3.24E-03	1.62E-02	0	4.65E-02	3.81E-03	1.71E-02	0
Molybdenum (Mo)	µg/m³	120	-	3.15E-03	8.61E-04 [A]	1.16E-03	0	6.24E-03	8.32E-04 [A]	2.13E-03	0	5.25E-03	8.65E-04 [A]	1.38E-03	0
Nickel (Ni)	µg/m³	0.2	-	2.40E-03	8.61E-04 [A]	1.08E-03	0	1.94E-02	8.32E-04 [A]	1.67E-03	0	3.39E-03	8.65E-04 [A]	1.16E-03	0
Phosphorus (P)	µg/m³	-	-	4.60E-01	7.18E-03 [A]	3.81E-02	-	1.03E-01	7.17E-03 [A]	3.80E-02	-	3.34E-01	7.21E-03 [A]	4.45E-02	-
Selenium (Se)	µg/m³	10	10	3.67E-03 [A]	2.87E-03 [A]	3.22E-03	0	3.57E-03 [A]	2.77E-03 [A]	3.16E-03	0	3.53E-03 [A]	2.83E-03 [A]	3.16E-03	0
Silver (Ag)	µg/m³	1	1	1.83E-03 [A]	1.44E-03 [A]	1.61E-03	0	1.78E-03 [A]	1.39E-03 [A]	1.58E-03	0	1.77E-03 [A]	1.42E-03 [A]	1.58E-03	0
Strontium (Sr)	µg/m³	120	-	1.86E-02	1.20E-03	5.19E-03	0	2.11E-02	9.26E-04	6.05E-03	0	1.86E-02	1.38E-03	5.88E-03	0
Thallium (Tl)	µg/m³	-	-	3.67E-03 [A]	2.87E-03 [A]	3.22E-03	-	3.57E-03 [A]	2.77E-03 [A]	3.16E-03	-	3.53E-03 [A]	2.83E-03 [A]	3.16E-03	-
Tin (Sn)	µg/m³	10	10	3.67E-03 [A]	2.87E-03 [A]	3.22E-03	0	4.12E-02	2.77E-03 [A]	3.95E-03	0	3.53E-03 [A]	2.83E-03 [A]	3.16E-03	0
Titanium (Ti)	µg/m³	120	-	2.82E-02	2.87E-03 [A]	7.00E-03	0	3.50E-02	2.77E-03 [A]	9.74E-03	0	4.63E-02	2.88E-03 [A]	1.06E-02	0
Vanadium (V)	µg/m³	2	1	1.83E-03 [A]	1.44E-03 [A]	1.61E-03	0	3.14E-03	1.39E-03 [A]	1.61E-03	0	1.77E-03 [A]	1.42E-03 [A]	1.58E-03	0
Zinc (Zn)	µg/m³	120	-	9.54E-02	7.85E-03	3.11E-02	0	6.66E-02	6.02E-03	2.51E-02	0	7.96E-02	1.18E-02	3.51E-02	0
Zirconium (Zr)	µg/m³	20	-	1.83E-03 [A]	1.44E-03 [A]	1.61E-03	0	1.78E-03 [A]	1.39E-03 [A]	1.58E-03	0	1.77E-03 [A]	1.42E-03 [A]	1.58E-03	0
Total Uranium (U)	µg/m³	1.5	-	1.65E-04 [A]	1.29E-04 [A]	1.45E-04	0	1.60E-04 [A]	1.25E-04 [A]	1.42E-04	0	1.59E-04 [A]	1.27E-04 [A]	1.42E-04	0

Notes:
A. Measured concentration was less than the laboratory method detection limit.
B. Period Arithmetic Mean/ Period geometric mean are presented for TSP.

4.4 AMBIENT PAH CONCENTRATIONS

A summary of the maximum, minimum, and arithmetic mean daily average ambient PAH concentrations are presented in **Table 4-7**. In this summary both individual PAHs as well as a total PAH concentration are reported. PAHs were monitored from February to December 2016 in accordance with the Ambient Monitoring Plan (Stantec, 2012).

Twelve (12) benzo(a)pyrene (B(a)P) measurements out of a total of fifty-three (53) valid samples exceeded the MOECC air quality criteria. The concentrations of other PAHs at both stations were below the applicable 24-hour criteria (presented in **Table 4-7**).

The current Ontario 24-hour B(a)P AAQC was introduced in 2011 and levels above this AAQC are commonly measured throughout Ontario. In the period 2010-2013, B(a)P levels exceeding the Ontario 24-hour AAQC were measured in all years and at all Ontario stations monitoring this contaminant with the exception of one station for a single year out of the three-year period. Measurement data available from the National Air Pollutant Surveillance (NAPS) network for 2013 (the most recently available data for three stations reported in Ontario – Simcoe, Toronto and Hamilton) all had maximum levels above the AAQC (varying between 136% -6220% of the criteria). In 2011, NAPS data available for seven Ontario stations (Windsor, Toronto, Etobicoke, Hamilton, Simcoe, Pt. Petrie, and Burnt Island) showed exceedances at six of the seven stations, with only the remote Burnt Island Ontario station reporting a maximum level below the MOECC AAQC. In 2010, all of these stations, including the Burnt Island station, measured B(a)P levels above the AAQC.

Benzo(a)pyrene is a byproduct of a wide variety of natural and man-made combustion processes (including motor vehicles, natural gas, wood, refuse, oil, forest fires, etc.) and is widely present in the environment.

Seven (7) out of twenty-six (26) valid samples collected at the Rundle Road Station on February 18, April 6, April 18, May 24, September 9, September 21, and November 8, 2016 exceeded the Ontario 24-hour B(a)P AAQC by levels varying between 3% and 315%. Out of twenty-seven (27) valid samples, five (5) measurements of B(a)P at the Courtice WPCP Station collected on February 18, April 6, April 18, May 24, and November 8, 2016 exceeded the MOECC Ambient Air Quality Criteria by levels varying between 1% and 107%. However, all twelve samples were well below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419/05 24-hour average guideline, and the HHRA health based criteria (as shown in **Table 4-7**).

A summary of the wind directions and potential source contributions for these measurements (as required by the MOECC for inclusion in annual reports) is presented in **Table 4-8**.

Based on the air quality assessments completed during the Environmental Assessment Study and the Environmental Compliance Approval application for the DYEC, the facility is not a significant contributor of B(a)P. Therefore, ambient B(a)P levels are not expected to be substantially impacted by the operation of the DYEC.

Table 4-7 Summary of Measured Ambient PAH Concentrations – 2016 Monitoring Period

Contaminant	Units	MOECC Daily Average Criteria	HHRA Health Based Daily Average Criteria	Courtice WPCP (Predominantly Upwind)				Rundle Road (Predominantly Downwind)			
				Max	Min	Period Arithmetic Mean	No. of Exceedances	Max	Min	Period Arithmetic Mean	No. of Exceedances
Benzo(a)pyrene	ng/m³	0.05 [A] 5 [B] 1.1 [C]	1	0.104	0.006	0.028	5 0 0	0.207	0.005 [F]	0.043	7 0 0
1-Methylnaphthalene	ng/m³	12000	-	2.40E+01	1.22E+00	6.25E+00	0	2.38E+02	8.95E-01	2.01E+01	0
2-Methylnaphthalene	ng/m³	10000	-	5.04E+01	1.91E+00	1.13E+01	0	5.02E+02	1.34E+00	4.04E+01	0
Acenaphthene	ng/m³	-	-	2.96E+01	1.05E-01 [F]	5.70E+00	-	3.03E+02	1.03E-01 [F]	2.49E+01	-
Acenaphthylene	ng/m³	3500	-	2.79E-01	6.34E-02 [F]	1.09E-01	0	3.32E+00	6.57E-02 [F]	2.88E-01	0
Anthracene	ng/m³	200	-	5.11E-01	6.34E-02 [F]	1.25E-01	0	7.54E+00	6.77E-02 [F]	8.80E-01	0
Benzo(a)anthracene	ng/m³	-	-	1.10E-01 [F]	6.34E-02 [F]	9.09E-02	-	2.30E-01	6.57E-02 [F]	9.82E-02	-
Benzo(a)fluorene	ng/m³	-	-	2.20E-01 [F]	1.27E-01 [F]	1.82E-01	-	3.75E-01	1.31E-01 [F]	1.93E-01	-
Benzo(b)fluoranthene	ng/m³	-	-	2.48E+00	6.34E-02 [F]	1.89E-01	-	4.90E-01	6.57E-02 [F]	1.08E-01	-
Benzo(b)fluorene	ng/m³	-	-	2.20E-01 [F]	1.27E-01 [F]	1.82E-01	-	2.19E-01 [F]	1.31E-01 [F]	1.85E-01	-
Benzo(e)pyrene	ng/m³	-	-	2.20E-01 [F]	1.27E-01 [F]	1.82E-01	-	2.19E-01 [F]	1.31E-01 [F]	1.85E-01	-
Benzo(g,h,i)perylene	ng/m³	-	-	2.45E+00	6.34E-02 [F]	1.83E-01	-	1.10E-01 [F]	6.57E-02 [F]	9.23E-02	-
Benzo(k)fluoranthene	ng/m³	-	-	2.51E+00	6.34E-02 [F]	1.80E-01	-	1.10E-01 [F]	6.57E-02 [F]	9.23E-02	-
Biphenyl	ng/m³	-	-	1.11E+01	5.58E-01	3.03E+00	-	1.26E+02	5.03E-01	1.01E+01	-
Chrysene	ng/m³	-	-	2.08E-01	6.34E-02 [F]	9.59E-02	-	4.05E-01	6.57E-02 [F]	1.05E-01	-
Dibenz(a,h) anthracene	ng/m³	-	-	2.79E+00	6.34E-02 [F]	1.94E-01	-	1.10E-01 [F]	6.57E-02 [F]	9.23E-02	-

Table 4-7 Summary of Measured Ambient PAH Concentrations – 2016 Monitoring Period

Contaminant	Units	MOECC Daily Average Criteria	HHRA Health Based Daily Average Criteria	Courtice WPCP (Predominantly Upwind)				Rundle Road (Predominantly Downwind)			
				Max	Min	Period Arithmetic Mean	No. of Exceedances	Max	Min	Period Arithmetic Mean	No. of Exceedances
Dibenzo(a,c) anthracene + Picene [D]	ng/m³	-	-	3.00E+00	1.27E-01 [F]	3.07E-01		4.33E-01 [F]	1.31E-01 [F]	2.04E-01	-
Fluoranthene	ng/m³	-	-	3.16E+00	9.96E-02 [F]	8.98E-01	-	1.47E+01	1.05E-01 [F]	2.66E+00	-
Indeno (1,2,3-cd)pyrene	ng/m³	-	-	2.82E+00	6.34E-02 [F]	1.92E-01	-	1.81E-01	6.57E-02 [F]	9.64E-02	-
Naphthalene	ng/m³	22500	22500	6.09E+01	6.83E+00	2.31E+01	0	2.95E+02	5.48E+00	3.95E+01	0
o-Terphenyl	ng/m³	-	-	2.20E-01 [F]	1.27E-01 [F]	1.82E-01	-	2.19E-01 [F]	1.31E-01 [F]	1.85E-01	-
Perylene	ng/m³	-	-	2.20E-01 [F]	1.27E-01 [F]	1.82E-01	-	2.19E-01 [F]	1.31E-01 [F]	1.85E-01	-
Phenanthrene	ng/m³	-	-	2.31E+01	7.17E-01	5.41E+00	-	2.10E+02	6.71E-01	2.19E+01	-
Pyrene	ng/m³	-	-	1.34E+00	9.86E-02 [F]	4.11E-01	-	6.58E+00	1.04E-01 [F]	1.21E+00	-
Tetralin	ng/m³	-	-	3.83E+00	6.31E-01	1.71E+00	-	4.37E+00	6.36E-01	1.84E+00	-
Total PAH [E]	ng/m³	-	-	2.09E+02	1.51E+01	6.04E+01	-	1.71E+03	1.24E+01	1.66E+02	-

Notes:

A. Ontario Ambient Air Quality Criteria. The Standard for benzo(a)pyrene (B(a)P) is for B(a)P as a surrogate for PAHs.

B. O. Reg. 419/05 Schedule 6 Upper Risk Thresholds

C. O. Reg. 419/05 24 Hour Guideline

D. Based on laboratory analyses, dibenzo(a,c)anthracene co-elutes with dibenz(a,h)anthracene. Picene elutes after dibenz(a,h)anthracene

E. The reported total PAH is the sum of all analyzed PAH species

F. Measured concentration was less than the laboratory method detection limit.

Table 4-8 Source Contribution Analysis – 2016 B(a)P Exceedances

Date	Station	% above the MOECC B(a)P Criterion	Wind Direction	Potential Source Contributions
February 18, 2016	Courtice WPCP	17%	North	Land use in this direction is primarily agricultural with Highway 401 and a CN rail line also located to the north. Potential sources could be agricultural activities (equipment operation) or transportation emissions.
	Rundle Road	315%	North	Land use in this wind direction is mainly agricultural.
April 6, 2016	Courtice WPCP	1%	East-Southeast	Land use in this direction is primarily agricultural with some commercial usage (including the Courtice WPCP). Potential sources could be agricultural activities or a nearby poorly controlled commercial / residential combustion source operating.
	Rundle Road	3%	Southeast	Land use in this direction is primarily agricultural with Highway 401 and a Canadian Pacific rail line also located to the southeast.
April 18, 2016	Courtice WPCP	66%	West	Land use in this direction is primarily agricultural. Potential sources could be agricultural activities.
	Rundle Road	21%	Northwest	Land use in this wind direction is mainly agricultural. Potential sources could be agricultural activities or a residence with a poorly controlled combustion source operating.
May 24, 2016	Courtice WPCP	47%	West	Land use in this direction is primarily agricultural. Potential sources could be agricultural activities.
	Rundle Road	33%	West	Land use in this direction is a mix of agricultural and commercial. Potential sources could be a nearby business or residence with a poorly controlled combustion source operating.
September 9, 2016	Rundle Road	28%	Northwest	Land use in this direction is mainly agricultural with some residences. Highway 418 construction activities were also occurring upwind of the Rundle Road Station during this period. Potential sources could be agricultural activities, a residence with a poorly controlled combustion source operating, construction vehicle exhaust, or land clearing associated with the construction activities.

Table 4-8 Source Contribution Analysis – 2016 B(a)P Exceedances

Date	Station	% above the MOECC B(a)P Criterion	Wind Direction	Potential Source Contributions
September 21, 2016	Rundle Road	42%	Northwest	Land use in this direction is mainly agricultural with some residences. Highway 418 construction activities were also occurring upwind of the Rundle Road Station during this period. Potential sources could be agricultural activities, a residence with a poorly controlled combustion source operating, construction vehicle exhaust, or land clearing associated with the construction activities.
November 8, 2016	Courtice WPCP	107%	Northwest	Highway 401, local roads and the CN railroad are located northwest of the Courtice WPCP Station. Potential sources could be vehicle or locomotive exhaust emissions.
	Rundle Road	250%	Northwest	Land use in this direction is mainly agricultural with some residences. Highway 418 construction activities were also occurring upwind of the Rundle Road Station during this period. Potential sources could be agricultural activities, a residence with a poorly controlled combustion source operating, construction vehicle exhaust, or land clearing/soil movement associated with the construction activities.

4.5 AMBIENT DIOXIN AND FURAN CONCENTRATIONS

A summary of the maximum, minimum, and arithmetic mean daily average ambient dioxin and furan concentrations are presented in **Table 4-9**. In this summary both individual dioxin and furan concentrations (pg/m^3) as well as the total toxic equivalency concentration (TEQ) are reported.

The maximum measured toxic equivalent dioxin and furan concentrations at both stations were well below the applicable 24-hour criteria AAQC of 0.1 pg TEQ/m^3 (as shown in **Table 4-9**) for the 2016 monitoring period (January to December 2016).

Table 4-9 Summary of Measured Ambient Dioxin and Furan Concentrations – 2016 Monitoring Period

Contaminant	Units	MOECC Criteria	HHRA Health Based Criteria	Courtice WPCP (Upwind)				Rundle Road (Downwind)			
				Max	Min	Period Arithmetic Mean	No. of Exceedances	Max	Min	Period Arithmetic Mean	No. of Exceedances
2,3,7,8-Tetra CDD *	pg/m³			5.54E-03 [A]	2.61E-03 [A]	4.30E-03		5.85E-03	2.61E-03	4.24E-03	
1,2,3,7,8-Penta CDD	pg/m³			7.31E-03	3.29E-03 [A]	4.69E-03		1.29E-02	2.49E-03	5.07E-03	
1,2,3,4,7,8-Hexa CDD	pg/m³			1.12E-02	2.50E-03 [A]	4.80E-03		8.86E-03	2.91E-03	4.78E-03	
1,2,3,6,7,8-Hexa CDD	pg/m³			2.45E-02	3.31E-03 [A]	6.20E-03		1.47E-02	3.49E-03	6.34E-03	
1,2,3,7,8,9-Hexa CDD	pg/m³			3.03E-02	3.79E-03 [A]	7.88E-03		2.21E-02	3.01E-03	8.82E-03	
1,2,3,4,6,7,8-Hepta CDD	pg/m³			2.09E-01	4.46E-03 [A]	5.67E-02		2.37E-01	8.29E-03	7.88E-02	
Octa CDD	pg/m³			5.33E-01	3.48E-02	2.12E-01		1.07E+00	4.35E-02	3.36E-01	
Total Tetra CDD	pg/m³			5.19E-02	2.81E-03 [A]	1.16E-02		3.71E-02	2.61E-03	1.13E-02	
Total Penta CDD	pg/m³			9.05E-02	3.93E-03 [A]	1.23E-02		2.79E-02	3.62E-03	1.05E-02	
Total Hexa CDD	pg/m³			2.19E-01	5.29E-03 [A]	4.56E-02		1.37E-01	5.05E-03	4.33E-02	
Total Hepta CDD	pg/m³			4.54E-01	1.03E-02	1.28E-01		4.89E-01	2.07E-02	1.77E-01	
2,3,7,8-Tetra CDF **	pg/m³			3.00E-02 [A]	2.64E-03 [A]	6.68E-03		2.10E-02	3.99E-03	6.84E-03	
1,2,3,7,8-Penta CDF	pg/m³	-	-	1.10E-02	2.36E-03 [A]	4.76E-03	N/A	8.73E-03	2.91E-03	4.96E-03	N/A
2,3,4,7,8-Penta CDF	pg/m³			2.04E-02	2.36E-03 [A]	5.24E-03		8.73E-03	2.91E-03	5.08E-03	
1,2,3,4,7,8-Hexa CDF	pg/m³			6.91E-02	2.89E-03 [A]	8.09E-03		2.10E-02	2.49E-03	6.20E-03	
1,2,3,6,7,8-Hexa CDF	pg/m³			2.35E-02	2.76E-03 [A]	5.31E-03		8.58E-03	2.35E-03	4.21E-03	
2,3,4,6,7,8-Hexa CDF	pg/m³			3.70E-02	2.92E-03 [A]	5.91E-03		1.13E-02	2.49E-03	4.68E-03	
1,2,3,7,8,9-Hexa CDF	pg/m³			7.04E-03	3.16E-03 [A]	4.62E-03		5.67E-03	2.63E-03	4.51E-03	
1,2,3,4,6,7,8-Hepta CDF	pg/m³			1.66E-01	3.59E-03 [A]	1.82E-02		4.26E-02	3.76E-03	1.56E-02	
1,2,3,4,7,8,9-Hepta CDF	pg/m³			2.53E-02	2.78E-03 [A]	5.70E-03		7.19E-03	2.77E-03	4.55E-03	
Octa CDF	pg/m³			1.82E-01	4.25E-03 [A]	2.05E-02		6.16E-02	4.46E-03	1.81E-02	
Total Tetra CDF	pg/m³			3.05E-01	2.64E-03 [A]	2.56E-02		9.16E-02	3.99E-03	1.56E-02	
Total Penta CDF	pg/m³			2.51E-01	2.36E-03 [A]	2.02E-02		7.28E-02	2.91E-03	1.12E-02	
Total Hexa CDF	pg/m³			3.05E-01	2.89E-03 [A]	2.24E-02		7.44E-02	3.33E-03	1.38E-02	
Total Hepta CDF	pg/m³			2.84E-01	4.00E-03 [A]	2.55E-02		9.04E-02	4.05E-03	2.50E-02	
TOTAL TOXIC EQUIVALENCY [B]	pg TEQ/m³	0.1 [C] 1 [D]	-	0.044	0.011	0.017	0 0	0.026	0.011	0.017	0 0

Note:
A. Measured concentration was less than the laboratory method detection limit.
B. Total Toxicity Equivalent (TEQ) concentration contributed by all dioxins, furans and dioxin-like PCBs calculated as per O. Reg. 419/05 methodology using corresponding WHO_{2005} toxic equivalency factors (TEFs) and a value of half the minimum detection limit (MDL) substituted for concentrations less than the MDL.
C. O. Reg. 419/05 Schedule 3 Standard phased in after July 1, 2016.
D. O. Reg. 419/05 Schedule 6 Upper Risk Thresholds
* CDD - Chloro Dibenzo-p-Dioxin, ** CDF - Chloro Dibenzo-p-Furan

5.0 AMBIENT AIR QUALITY TRENDS

Ambient air quality measurements from both the Courtice WPCP and Rundle Road monitoring stations from 2013 to 2016 are compared in this section. The ambient monitoring program was initiated in 2013 and ambient air quality data were collected for the period May to December in that year. The MOECC requires that a minimum of 9 months of data out of the 12 months in a year (a minimum 75% data recovery rate) be available for calculation of annual averages. Since the length of the measurement period in 2013 was less than 9-months, the 2013 period averages were not compared to available MOECC annual criteria, nor are they directly comparable to the 2014 to 2016 annual averages.

5.1 CRITERIA AIR CONTAMINANT (CAC) COMPARISONS

A summary of the maximum, minimum, and arithmetic mean CAC concentrations, along with the number of exceedances of the relevant Ontario ambient air quality criteria (AAQC) or health-based criteria for each contaminant (if any occurred) at each station from 2013 to 2016 are presented in **Table 5-1** below. Also presented is the percentage of the applicable criteria for the maximum measured value in each year. The following observations were made from comparing the 2013 to 2016 CAC data:

- All monitored CACs were below their applicable hourly, 24-hour and annual average criteria for all four years.
- The maximum measured hourly and 24-hour average SO_2 concentrations were higher at the Courtice WPCP Station in all four years than at the Rundle Road Station, but were all well below their relevant MOECC criteria.
- The 98th percentile daily average $PM_{2.5}$ concentrations were similar in 2013 and 2014 at the Rundle Road Station (21.7 and 21.1 µg/m^3), with higher levels measured in 2015 and 2016 (28.4 and 32.9 µg/m^3). The 98th percentile daily average $PM_{2.5}$ concentrations at the Courtice WPCP Station were similar in 2013, 2014 and 2016 (21.5, 22.3 and 21.6 µg/m^3) with 2015 measuring higher levels at 27.3 µg/m^3. Both stations were below the 24-hour and annual CAAQS criteria for the period 2014 to 2016. $PM_{2.5}$ data for the MOECC Oshawa station shows relatively consistent $PM_{2.5}$ measurements from 2013 to 2015 with a slight decrease in 2016.
- Maximum measured hourly, 24-hour, and annual average NO_2 concentrations at the Courtice WPCP Station were typically higher or similar in magnitude to those measured at the Rundle Station.
- The maximum measured hourly and 24-hour NO and NO_X concentrations were higher at the Courtice WPCP Station relative to the Rundle Station for all four years.

It should be noted that since the monitoring periods in 2013 was different versus 2014 - 2016 (8 months in 2013 versus 12 months in the subsequent three years), the data from 2013 are not directly comparable to 2014 to 2016, as the 2013 measurements did not encompass a full year

including winter months (during which time there is normally a higher percentage of stable meteorological conditions).

Plots of the annual variations in measured hourly, 24-hour, and annual average SO_2, NO_2 and $PM_{2.5}$ concentrations are presented in **Figures 5-1 to 5-3**. The following observations were noted from these plots:

- The maximum measured hourly SO_2 concentrations at the Courtice WPCP and Rundle Road Station had similar trends with decreases seen between 2014 and 2015 and increases between 2015 and 2016.
- The maximum 1-hour, 24-hour, and annual average SO_2 concentrations are generally higher at the Courtice WPCP Station than the Rundle Road Station from year-to-year.
- The maximum measured 24 hour and annual average NO_2 concentrations at both stations show similar trends (as seen in **Figure 5-2)**. Maximum measured 24-hour concentrations at both stations peaked in 2014 and have decreased in 2015 and 2016 while the annual measured concentrations at both stations were relatively constant for all years.
- The maximum measured hourly NO_2 concentration at the Rundle Road Station in 2014 was higher than other years at the same station while at the Courtice WPCP station the maximum measured concentrations increased steadily from 2013 to 2015 and stayed constant for 2016.
- Measured 98th percentile 24-hour $PM_{2.5}$ concentrations at both stations display similar trends from 2013 to 2015 (as seen in **Figure 5-3**) with relatively consistent concentrations in 2013 and 2014 followed by an increase of approximately 6 µg/m^3 in 2015. In 2016, the Rundle Road Station concentration increased by about 4.6 µg/m^3 relative to 2015, while the Courtice WPCP station concentration decreased to a level similar to those in 2014-2015.
- Measured annual average $PM_{2.5}$ concentrations at the Rundle Road station increased slightly while at the Courtice WPCP station, a slight decrease in annual average concentrations was observed.

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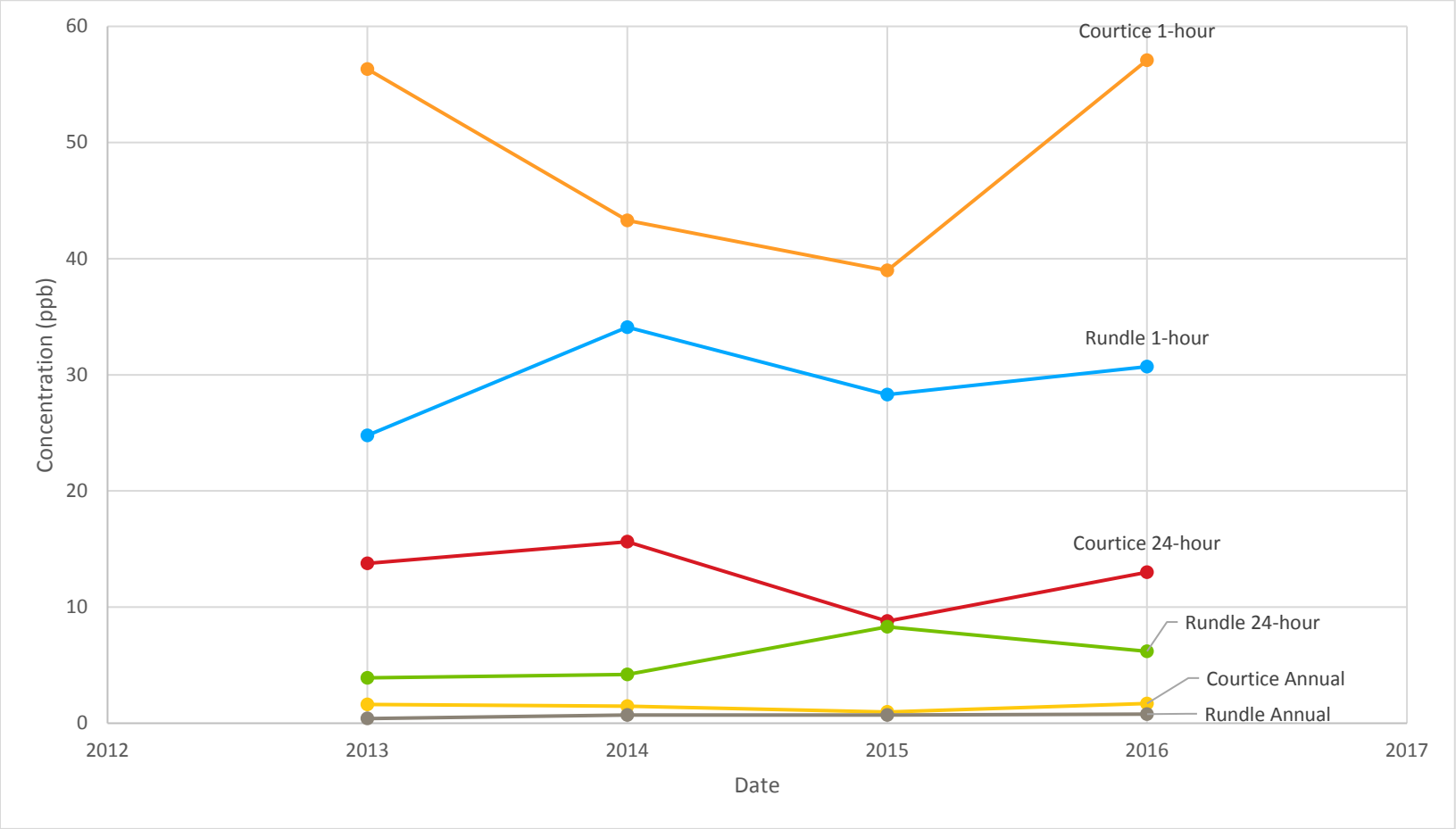
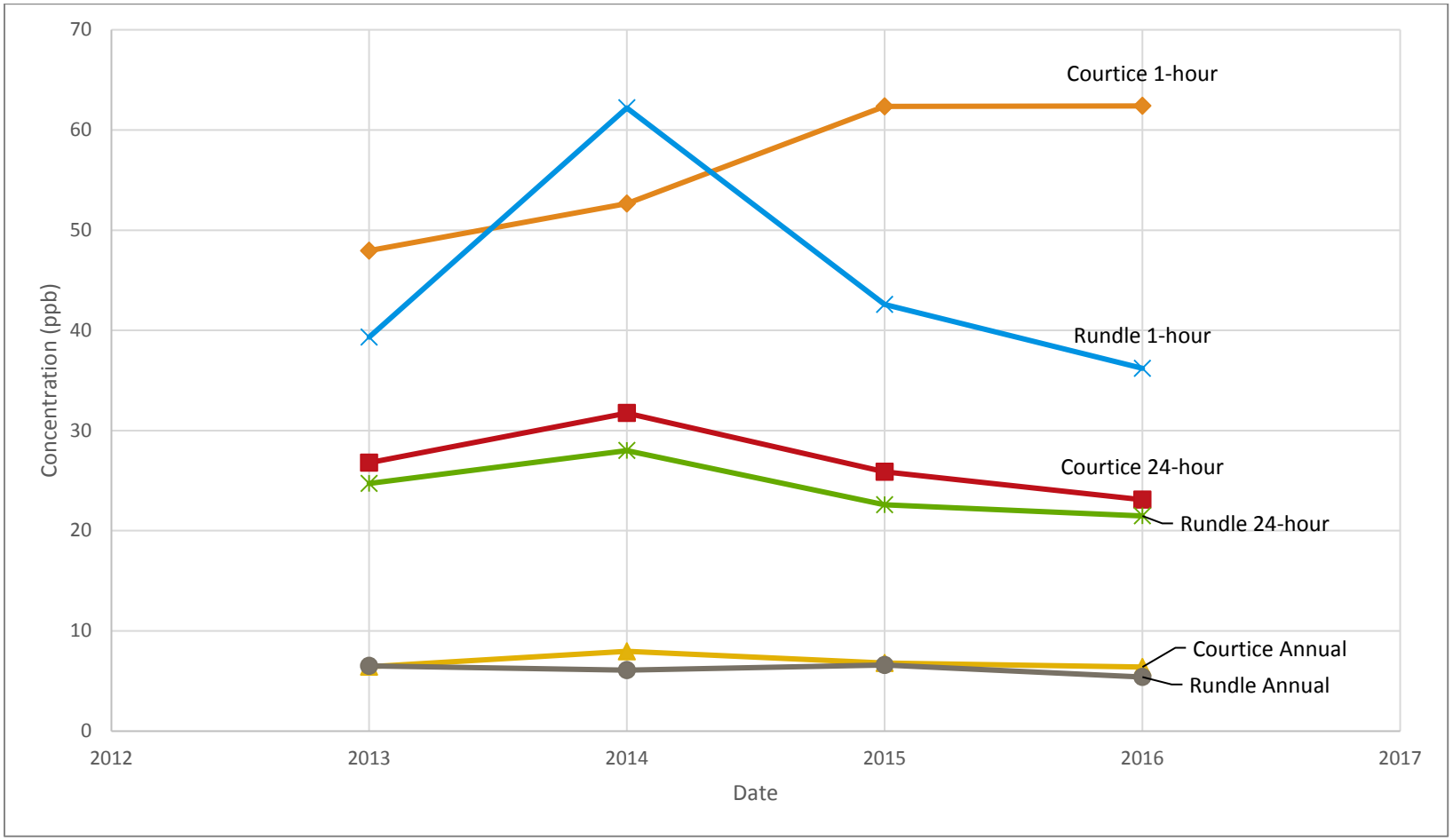
Figure 5-1 Maximum Measured SO_2 Concentrations by Year (2013-2016)



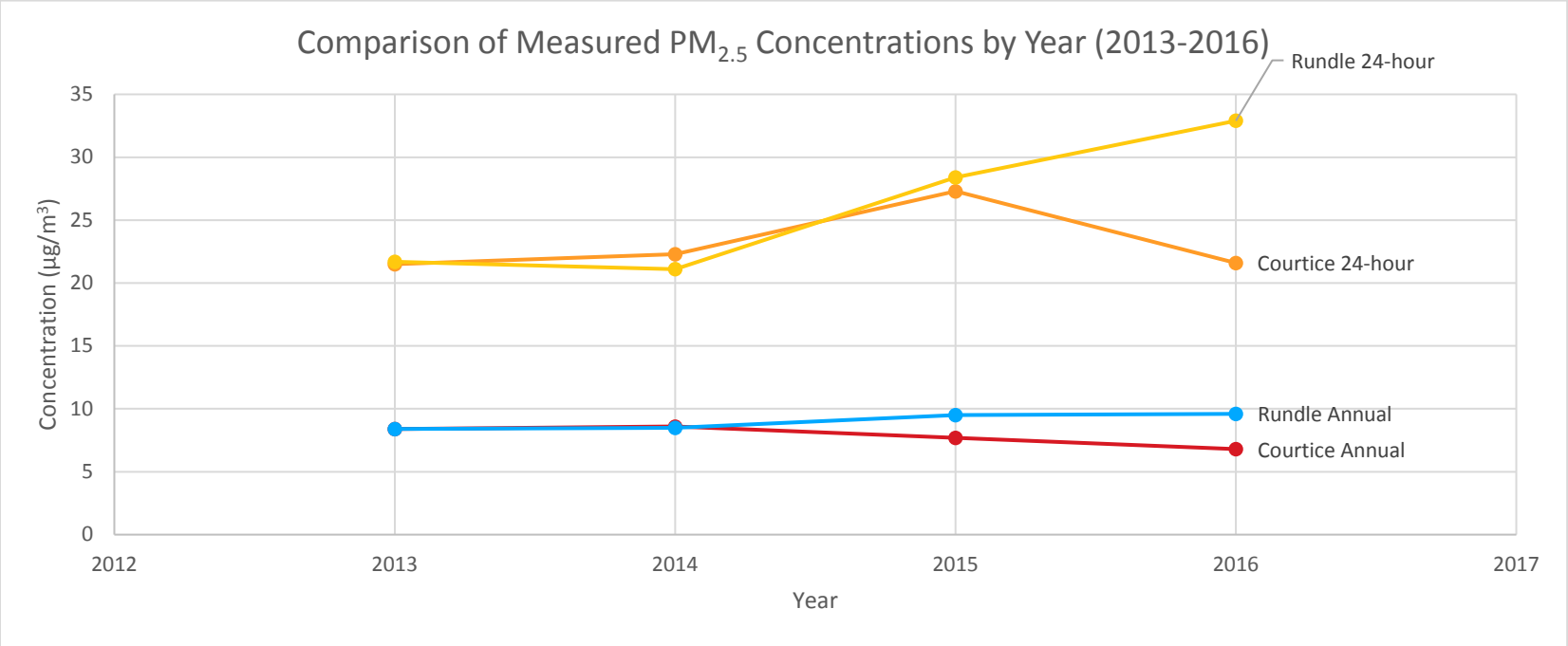
Note:
The length of the measurement period in 2013 was less than 9-months, averages presented for this year are not directly comparable to the other years but are included for reference.

Figure 5-2 Maximum Measured NO_2 Concentrations by Year (2013-2016)



Note:
The length of the measurement period in 2013 was less than 9-months, averages presented are not directly comparable to the other years but are included for reference.

Figure 5-3 Comparison of Measured 98th Percentile $PM_{2.5}$ Concentrations by Year (2013-2016)



Notes:

A. 24-hour averaging periods. Canadian Ambient Air Quality Standard for Respirable Particulate Matter. The Respirable Particulate Matter Objective is referenced to the average of the 98th percentile of the daily average over 3 consecutive years.

B. Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the three-year average of the annual average concentrations.

C. The length of the measurement period in 2013 was less than 9-months, averages presented are not directly comparable to other years but are included for reference.

Table 5-1 Comparison of Measured Ambient CAC Concentrations (2013 - 2016)

Pollutant	Averaging Period	MOECC / HHRA Criteria	Units		Courtice WPCP (Upwind)								Rundle Road (Downwind)							
					Measurement				% of Criteria				Measurement				% of Criteria			
					2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
SO_2	1	250	ppb	Maximum	56.3	43.3	39.0	57.1	22.5	17.3	15.6	22.8	24.8	34.1	28.3	30.7	9.9	13.6	11.3	12.3
				Minimum	0	0	0	0					0	0	0	0				
				# of Exceedances	0	0	0	0					0	0	0	0				
	24	100	ppb	Maximum	13.8	15.6	8.8	13.0	13.8	15.6	8.8	13	3.9	4.2	8.3	6.2	3.9	4.2	8.3	6.2
				Minimum	0	0	0	0					0	0	0	0				
				# of Exceedances	0	0	0	0					0	0	0	0				
	Annual	20 / 11 [A]	ppb	Mean (Period)	1.6	1.5	1.0	1.7	N/A [B]	13.3	8.8	15.9	0	0.7	0.7	0.8	N/A [B]	6.1	6.7	7.1
				# of Exceedances	N/A [B]	0	0	0					N/A [B]	0	0	0				
$PM_{2.5}$	24	28 [C]	µg/m³	Maximum	27	43.2	59.6	34.7	N/A [E]	N/A [E]	N/A[E]	85	50.6	41.3	64.7	43.1	N/A [E]	N/A [E]	N/A[E]	98
				Minimum	1.8	0.2	0.2	0.2					0.6	0.2	0.2	0				
				Mean	8.6	8.6	7.8	6.8					8.4	8.5	9.5	9.6				
				98th Percentile [D]	21.5	22.3	27.3	21.6					21.7	21.1	28. 4	32.9				
				98th Percentile 3-year Average	-	-	-	23.7					-	-	-	27.5				
				# of Exceedances	N/A [E]	N/A [E]	N/A [E]	0					N/A [E]	N/A [E]	N/A [E]	0				
	Annual	10 [F]	µg/m³	Mean (Period)	8.4	8.6	7.7	6.8	N/A[G]	N/A [G]	N/A[G]	77	8.4	8.5	9.5	9.6	N/A[G]	N/A [G]	N/A[G]	92
				3-year Average	-	-	-	7.7					-	-	-	9.2				
				# of Exceedances	N/A [G]	N/A [G]	N/A [G]	0					N/A [G]	N/A [G]	N/A [G]	0				
NO_2	1	200 [H]	ppb	Maximum	48.0	52.7	62.3	62.4	24	26.3	31.2	31.2	39.3	62.2	42.6	36.2	19.7	31.1	21.3	18.1
				Minimum	0	0	0	0					0	0	0	0				
				# of Exceedances	0	0	0	0					0	0	0	0				
	24	100 [H]	ppb	Maximum	26.8	31.7	25.9	23.1	26.8	31.7	25.9	23.1	24.7	28	22.6	21.5	24.7	28	22.6	21.5
				Minimum	0.3	0.1	0	0.4					0.2	0	0	0				
				# of Exceedances	0	0	0	0					0	0	0	0				
	Annual	30	ppb	Mean	6.4	8.0	6.8	6.4	N/A [B]	26.6	22.6	21.2	6.5	6.1	6.6	5.4	N/A [B]	20.3	21.9	18
				# of Exceedances	N/A [B]	0	0	0					N/A [B]	0	0	0				
NO [I]	1	NA	ppb	Maximum	111.1	79.1	88.5	69.5					40.7	38.2	90.9	42.8				
				Minimum	0	0.1	0	0					0	0	0.4	0				
				# of Exceedances	N/A	N/A	N/A	N/A					N/A	N/A	N/A	N/A				
	24	NA	ppb	Maximum	22.9	21.7	22.3	21.9					10.6	11.2	15.9	9.2				
				Minimum	0	0.5	0	0.1					0.5	0	0.7	0.1				
				# of Exceedances	N/A	N/A	N/A	N/A					N/A	NA	N/A	N/A				

Table 5-1 Comparison of Measured Ambient CAC Concentrations (2013 - 2016)

Pollutant	Averaging Period	MOECC / HHRA Criteria	Units		Courtice WPCP (Upwind)								Rundle Road (Downwind)							
					Measurement				% of Criteria				Measurement				% of Criteria			
					2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
NO_X	1	200 [H]	ppb	Maximum	151.3	122.2	148.5	97.1	75.6	61.1	74.3	48.5	68.5	70	102	71.3	34.2	35	51	35.7
				Minimum	0	0	0	0					0	0	0	0				
				# of Exceedances	0	0	0	0					0	0	0	0				
	24	100 [H]	ppb	Maximum	49.6	52.1	42.6	44.7	49.6	52.1	42.6	44.7	34.9	38.6	31.9	28.3	34.9	38.6	31.9	28.3
				Minimum	0.1	1.4	0	0.6					0.3	0	0	0				
				# of Exceedances	0	0	0	0					0	0	0	0				
	Annual	30	ppb	Mean	9.6	10.8	9.1	8.8	N/A [B]	35.9	30.2	29.3	8.0	7.8	8.2	7.1	N/A [B]	25.9	27.2	23.7
				# of Exceedances	N/A [B]	0	0	0					N/A [B]	0	0	0				

Notes:

A. Annual AAQC / Annual HHRA.
B. As the length of the measurement period in 2013 was less than 9-months, the period (i.e. 8-months) averages presented in this report were not compared to available MOECC annual criteria.
C. Canadian Ambient Air Quality Standard for Respirable Particulate Matter. The Respirable Particulate Matter Objective is referenced to the average of the 98th percentile of the daily average over 3 consecutive years.
D. The 98th percentile of the daily average $PM_{2.5}$ measurements in the period.
E. Daily $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard, which requires averaging the 98th percentile concentrations over three consecutive years, as compared to the 8-month period covered in 2013 and the 12-month period covered in 2014 and 2015.
F. Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the three-year average of the annual average concentrations.
G. Annual $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard, which requires the three-year average of the annual average concentrations compared to the 12-month period considered in this report for 2014 and 2015 and the 8-month period for 2013.
H. As per current (December 2016) version of the ACB List, the Standard for NO_X is compared to a monitored NO_X concentration, although the O. Reg. 419/05 Schedule 3 Standard for NO_X is based on health effects of NO_2.
I. NO has no regulatory criteria.

5.2 TSP COMPARISONS

A summary of the maximum measured daily average TSP and metals concentrations for 2013, 2014, and 2016 are presented in **Table 5-2**. The maximum measured 24-hour average concentrations of TSP and all metals with MOECC air quality criteria during these three years were below their applicable 24-hour criteria at both stations. Since the measurement period in 2013 was 8-months (April-December) and 6-months (January-June) in 2014, and 11 months (February-December) in 2016 due to the non-continuous monitoring being temporarily discontinued as per the ambient monitoring plan, caution should be exercised in comparing the data as the measurement period lengths were different and cover different periods of each year (with different meteorological conditions).

The maximum measured daily average TSP concentrations was lowest in 2014 and highest in 2016. Similarly, maximum measured daily average total mercury concentrations were lowest in 2014 and highest in 2016. The maximum measured daily average iron concentrations were similar in 2013 and 2014 but was higher in 2016. Some contaminants such as arsenic, beryllium, and cadmium had lower measured maximum daily average concentrations in 2016 compared to the other years.

Table 5-2 Comparison of Measured Ambient TSP and Metals Concentrations (2013 to 2016)

Contaminant	Units	MOECC (Daily Average) Criteria	HHRA Health Based (Daily Average) Criteria	Courtice WPCP (Predominantly Upwind)								Rundle Road (Predominantly Downwind)								Fence Line	
				Maximum Measured Concentration				% of Criteria				Maximum Measured Concentration				% of Criteria				Maximum Measured Concentration	% of Criteria
				2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2016	2016
Particulate (TSP)	µg/m³	120	120	62	57		94.7	51.7	47.5		78.9	78	59		97.1	65.0	49.2		80.9	80.2	66.8
Total Mercury (Hg)	µg/m³	2		3.12E-05	2.15E-05		3.62E-05	<0.1	<0.1		<0.1	5.14E-05	2.94E-05		2.50E-05	<0.1	<0.1		<0.1	4.79E-05	<0.1
Aluminum (Al)	µg/m³	4.8	-	3.34E-01	3.57E-01		6.78E-01	7.0	7.4		14.1	4.54E-01	2.90E-01		7.86E-01	9.5	6.0		16.4	7.07E-01	14.7
Antimony (Sb)	µg/m³	25	25	2.69E-03	3.91E-03		3.67E-03	<0.1	<0.1		<0.1	2.86E-03	3.41E-03		3.57E-03	<0.1	<0.1		<0.1	3.53E-03	<0.1
Arsenic (As)	µg/m³	0.3	0.3	3.79E-03	2.35E-03		2.20E-03	1.3	0.8		0.7	1.76E-03	2.05E-03		4.72E-03	0.6	0.7		1.6	2.12E-03	0.7
Barium (Ba)	µg/m³	10	10	1.58E-02	1.90E-02		3.39E-02	0.2	0.2		0.3	1.61E-02	1.18E-02		2.37E-02	0.2	0.1		0.2	2.29E-02	0.2
Beryllium (Be)	µg/m³	0.01	0.01	2.69E-04	3.91E-04		3.67E-04	2.7	3.9		3.7	2.86E-04	3.41E-04		3.57E-04	2.9	3.4		3.6	3.53E-04	3.5
Bismuth (Bi)	µg/m³	-	-	1.66E-03	2.35E-03		2.20E-03	-	-			1.76E-03	2.05E-03		2.14E-03	-	-		-	2.12E-03	-
Boron (B)	µg/m³	120	-	1.13E-02	5.61E-03		8.50E-03	<0.1	<0.1		<0.1	1.45E-02	4.43E-03		7.45E-03	<0.1	<0.1		<0.1	8.49E-03	<0.1
Cadmium (Cd)	µg/m³	0.025	0.025	5.59E-04	1.18E-03		7.34E-04	2.2	4.7		2.9	8.99E-04	6.83E-04		7.13E-04	3.6	2.7		2.9	1.13E-02	45.3
Chromium (Cr)	µg/m³	0.5	-	3.82E-03	6.29E-03		7.74E-03	0.8	1.3		1.5	1.78E-02	4.75E-03		7.93E-03	3.6	1.0		1.6	8.22E-03	1.6
Cobalt (Co)	µg/m³	0.1	0.1	5.59E-04	7.83E-04		7.34E-04	0.6	0.8		0.7	5.95E-04	6.83E-04		2.78E-03	0.6	0.7		2.8	7.07E-04	0.7
Copper (Cu)	µg/m³	50	-	7.68E-02	5.95E-02		1.27E-01	0.2	0.1		0.3	2.36E-01	1.93E-01		1.16E-01	0.5	0.4		0.2	7.70E-02	0.2
Iron (Fe)	µg/m³	4	-	9.90E-01	9.26E-01		1.58E+00	24.8	23.2		39.4	1.31E+00	9.30E-01		1.83E+00	32.8	23.3		45.8	1.36E+00	34.0
Lead (Pb)	µg/m³	0.5	0.5	6.47E-03	5.50E-03		7.52E-03	1.3	1.1		1.5	6.80E-03	7.34E-03		7.25E-03	1.4	1.5		1.4	1.02E-02	2.0
Magnesium (Mg)	µg/m³	-	-	5.71E-01	4.13E-01		1.14E+00	-	-		-	6.76E-01	2.97E-01		1.10E+00	-	-		-	1.01E+00	-
Manganese (Mn)	µg/m³	0.4	-	3.31E-02	3.08E-02		4.86E-02	8.3	7.7		12.1	1.02E-01	2.60E-02		6.56E-02	25.5	6.5		16.4	4.65E-02	11.6
Molybdenum (Mo)	µg/m³	120	-	1.65E-03	2.36E-03		3.15E-03	<0.1	<0.1		<0.1	3.79E-03	2.76E-03		6.24E-03	<0.1	<0.1		<0.1	5.25E-03	<0.1
Nickel (Ni)	µg/m³	0.2	-	4.35E-03	2.78E-03		2.40E-03	2.2	1.4		1.2	4.67E-03	4.58E-03		1.94E-02	2.3	2.3		9.7	3.39E-03	1.7
Phosphorus (P)	µg/m³	-	-	1.45E-01	1.05E-01		4.60E-01	-	-		-	1.59E-01	1.85E-01		1.03E-01	-	-		-	3.34E-01	-
Selenium (Se)	µg/m³	10	10	2.69E-03	3.91E-03		3.67E-03	<0.1	<0.1		<0.1	2.86E-03	3.41E-03		3.57E-03	<0.1	<0.1		<0.1	3.53E-03	<0.1
Silver (Ag)	µg/m³	1	1	1.89E-03	1.96E-03		1.83E-03	0.2	0.2		0.2	2.33E-03	1.71E-03		1.78E-03	0.2	0.2		0.2	1.77E-03	0.2
Strontium (Sr)	µg/m³	120	-	1.10E-02	1.34E-02		1.86E-02	<0.1	<0.1		<0.1	1.95E-02	1.09E-02		2.11E-02	<0.1	<0.1		<0.1	1.86E-02	<0.1
Thallium (Tl)	µg/m³	-	-	2.69E-03	3.91E-03		3.67E-03	-	-		-	2.86E-03	3.41E-03		3.57E-03	-	-		-	3.53E-03	-
Tin (Sn)	µg/m³	10	10	4.79E-03	3.91E-03		3.67E-03	0.1	<0.1		<0.1	2.86E-03	3.41E-03		4.12E-02	<0.1	<0.1		0.4	3.53E-03	<0.1
Titanium (Ti)	µg/m³	120	-	1.73E-02	2.26E-02		2.82E-02	<0.1	<0.1		<0.1	2.40E-02	1.71E-02		3.50E-02	<0.1	<0.1		<0.1	4.63E-02	<0.1
Vanadium (V)	µg/m³	2	1	1.92E-03	1.96E-03		1.83E-03	0.1	0.1		0.2	3.22E-03	1.71E-03		3.14E-03	0.2	0.1		0.3	1.77E-03	0.2
Zinc (Zn)	µg/m³	120	-	6.50E-02	1.14E-01		9.54E-02	0.1	0.1		0.1	7.43E-02	1.24E-01		6.66E-02	0.1	0.1		0.1	7.96E-02	0.1
Zirconium (Zr)	µg/m³	20	-	1.39E-03	1.96E-03		1.83E-03	<0.1	<0.1		<0.1	1.48E-03	1.71E-03		1.78E-03	<0.1	<0.1		<0.1	1.77E-03	<0.1
Total Uranium (U)	µg/m³	1.5	-	1.24E-04	1.76E-04		1.65E-04	<0.1	<0.1		<0.1	1.32E-04	1.54E-04		1.60E-04	<0.1	<0.1		<0.1	1.59E-04	<0.1

N/A

5.3 PAH COMPARISONS

A summary of the maximum measured ambient PAH concentrations for 2013, 2014, and 2016 for the Courtice WPCP and Rundle Road Stations are presented in **Table 5-3**. Both individual PAHs and total PAH concentrations are presented. Also presented are the numbers of exceedances of the applicable criteria for each PAH. Similarly, as with TSP, since the measurement periods are not the same in each year, the data are not directly comparable.

With the exception of benzo(a)pyrene (B(a)P) measurements, the maximum measured concentrations of other PAHs were well below their applicable 24-hour criteria for each of the three years.

In 2013 (8-month monitoring period), three (3) B(a)P samples collected at the Rundle Road Station and one (1) sample collected at the Courtice WPCP Station exceeded the Ontario 24-hour B(a)P AAQC. In 2014 (6-month monitoring period), four (4) samples collected at the Rundle Road Station and three (3) samples collected at the Courtice WPCP Station exceeded the AAQC. In the 11-month monitoring period during 2016, seven (7) B(a)P samples collected at the Rundle Road Station and five (5) measurements of B(a)P at the Courtice WPCP Station exceeded AAQC. The highest B(a)P concentration measured over all years (0.41 ng/ m^3) occurred at the Rundle Road Station in 2013 when the stations were measuring background air quality.

Table 5-3 Comparison of Measured Ambient PAH Concentrations (2013 to 2016)

Contaminant	Units	MOECC Daily Average Criteria	HHRA Health Based Daily Average Criteria	Courtice WPCP (Upwind)												Rundle Road (Downwind)											
				Maximum Measurement				% of Criteria				No. of Exceedances				Maximum Measurement				% of Criteria				No. of Exceedances			
				2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
Benzo(a)pyrene	ng/m³	0.05 [A]	1	0.1	0.1		0.1	129.6	264		207.4	1	3		5	0.4	0.3		0.2	826	576		414.7	3	4		7
		5 [B]						1.3	2.6		2.1	0	0		0					8.3	5.8		4.1	0	0		0
		1.1 [C]						5.9	12		9.4	0	0		0					37.5	26.2		18.8	0	0		0
1-Methylnaphthalene	ng/m³	12000	-	27.2	8.2		24.0	0.2	0.1		0.2	0	0		0	26.6	10.8		238.2	0.2	0.1		2.0	0	0		0
2-Methylnaphthalene	ng/m³	10000	-	54.3	13.9		50.4	0.5	0.1		0.5	0	0		0	45.4	18.7		502.5	0.5	0.2		5.0	0	0		0
Acenaphthene	ng/m³	-	-	38.7	11.8		29.6	-	-		-	-	-		-	18.9	8.1		303.2	-	-		-	-	-		-
Acenaphthylene	ng/m³	3500	-	1.1	0.4		0.3	0.03	0.01		0.01	0	0		0	1.6	2.0		3.3	0.1	0.1		0.09	0	0		0
Anthracene	ng/m³	200	-	13.1	1.1		0.5	6.6	0.6		0.3	0	0		0	1.5	0.7		7.5	0.8	0.4		3.8	0	0		0
Benzo(a)anthracene	ng/m³	-	-	0.2	0.2		0.1	-	-		-	-	-		-	0.5	0.2		0.2	-	-		-	-	-		-
Benzo(a)fluorene	ng/m³	-	-	0.3	0.3		0.2	-	-		-	-	-		-	0.6	0.3		0.4	-	-		-	-	-		-
Benzo(b)fluoranthene	ng/m³	-	-	0.4	0.6		2.5	-	-		-	-	-		-	1.0	0.7		0.5	-	-		-	-	-		-
Benzo(b)fluorene	ng/m³	-	-	0.3	0.3		0.2	-	-		-	-	-		-	0.5	0.3		0.2	-	-		-	-	-		-
Benzo(e)pyrene	ng/m³	-	-	0.3	0.3		0.2	-	-		-	-	-		-	0.5	0.3		0.2	-	-		-	-	-		-
Benzo(g,h,i)perylene	ng/m³	-	-	0.4	0.3		2.5	-	-		-	-	-		-	0.6	0.3		0.1	-	-		-	-	-		-
Benzo(k)fluoranthene	ng/m³	-	-	0.4	0.3	N/A	2.5	-	-	N/A	-	-	-	N/A	-	0.3	0.2	N/A	0.1	-	-	N/A	-	-	-	N/A	-
Biphenyl	ng/m³	-	-	14.9	4.5		11.1	-	-		-	-	-		-	7.4	5.8		125.9	-	-		-	-	-		-
Chrysene	ng/m³	-	-	0.2	0.5		0.2	-	-		-	-	-		-	0.9	0.7		0.4	-	-		-	-	-		-
Dibenz(a,h) anthracene	ng/m³	-	-	0.3	0.5		2.8	-	-		-	-	-		-	0.2	0.2		0.1	-	-		-	-	-		-
Dibenzo(a,c) anthracene + Picene [D]	ng/m³	-	-	0.3	0.3		3.0	-	-		-	-			0	0.4	0.3		0.4	-	-		-	-	-		0
Fluoranthene	ng/m³	-	-	4.5	4.0		3.2	-	-		-	-	-		-	7.7	3.5		14.7	-	-		-	-	-		-
Indeno(1,2,3-cd)pyrene	ng/m³	-	-	0.4	0.5		2.8	-	-		-	-	-		-	0.5	0.3		0.2	-	-		-	-	-		-
Naphthalene	ng/m³	22500	22500	143.0	38.7		60.9	0.6	0.2		0.3	0	0		0	94.1	92.6		294.6	0.4	0.4		1.3	0	0		0
o-Terphenyl	ng/m³	-	-	0.3	0.3		0.2	-	-		-	-	-		-	0.5	0.3		0.2	-	-		-	-	-		-
Perylene	ng/m³	-	-	0.3	0.3		0.2	-	-		-	-	-		-	0.5	0.3		0.2	-	-		-	-	-		-
Phenanthrene	ng/m³	-	-	33.9	14.2		23.1	-	-		-	-	-		-	29.4	13.0		209.7	-	-		-	-	-		-
Pyrene	ng/m³	-	-	1.7	2.5		1.3	-	-		-	-	-		-	3.2	1.9		6.6	-	-		-	-	-		-
Tetralin	ng/m³	-	-	5.8	25.3		3.8	-	-		-	-	-		-	5.1	4.0		4.4	-	-		-	-	-		-
Total PAH [E]	ng/m³	-	-	327.0	95.0		208.7	-	-		-	-	-		-	165.0	153.9		1710.2	-	-		-	-	-		-

Notes:

A. Ontario Ambient Air Quality Criteria. The Standard for benzo(a)pyrene (B(a)P) is for B(a)P as a surrogate for PAHs.

B. O. Reg. 419/05 Schedule 6 Upper Risk Thresholds.

C. O. Reg. 419/05 24 Hour Guideline.

D Based on laboratory analyses, dibenzo(a,c)anthracene co-elutes with dibenz(a,h)anthracene. Picene elutes after dibenz(a,h)anthracene

E The reported total PAH is the sum of all analysed PAH species.

5.4 DIOXIN AND FURAN COMPARISONS

The maximum measured ambient toxic equivalent dioxin and furan concentrations at each station in 2013-2016 are presented in **Table 5-4**.

Table 5-4 Comparison of Maximum Measured Dioxin and Furan Concentrations (2013-2016)

Year	Measurement Period in each Year	Courtice WPCP (pg TEQ/m^3)	Rundle Road (pg TEQ/m^3)
2013	May - December	0.036	0.029
2014	January - June	0.038	0.065
2015	October - December	0.017	0.021
2016	February - December	0.044	0.026

The maximum measured toxic equivalent dioxin and furan concentrations at both stations were below the applicable 24-hour criteria of 0.1 pg TEQ/m^3 for all four years.

It should be noted that since the monitoring periods in 2013, 2014, 2015, and 2016 were different (as shown in **Table 5-4**), the data between the four years are not directly comparable. Caution should be exercised in comparing the data as the measurement periods were different and cover different periods of each year (with different meteorological conditions).

5.5 REVIEW OF MTO MONITORING FOR 2016

The Ministry of Transportation Ontario (MTO) installed an ambient air monitoring station at 1939 Highway 2, Courtice, Ontario, that has been operating since March 4, 2016. This sampling is being conducted as a condition of the Environmental Assessment (EA) notice of approval for the Highway 407 East Phase 2 construction project. The MTO Station is located approximately 3.5 km north-northwest of the Rundle Road Station and 4.4 km north of the DYEC. The station measures PM_{10}, $PM_{2.5}$ and NOx. NOx is measured using a chemiluminescence monitor which uses a similar principle of operation to the DYEC monitors, while PM_{10} and $PM_{2.5}$ are measured using Beta Attenuation Monitors (BAMs). The DYEC stations measure $PM_{2.5}$ with monitors based on light scattering photometry with beta attenuation, which is believed to more accurately measure the aerosol fraction of $PM_{2.5}$ relative to a BAM (which typically underestimates the aerosol fraction).

The DYEC monitoring stations, as discussed in the Ambient Monitoring Plan (Stantec, 2012), are located to capture neighbourhood scales of representativeness (100's of metres to about 4 km). Given the distance between the MTO Station and the DYEC, the DYEC monitors would not typically be expected to be representative of ambient air quality levels in the vicinity of the MTO Station – the DYEC monitoring stations are influenced by local sources including Highway 401, St. Mary's Cement, the Courtice WPCP and CN/CP rail lines, as well as the DYEC. The MTO Station is more distant from these sources and therefore is influenced less from them than the DYEC monitoring stations. The MTO quarterly reports issued for the monitoring (RWDI, 2016 a, b; RWDI, 2017) do not discuss the scale of representativeness that the MTO Station was situated for, but it is expected to be similar or less than that of the DYEC stations - therefore the MTO Station measurements would not typically be representative of air quality near the DYEC.

The MTO Station data for March to December 2016 (RWDI, 2016a, b; RWDI, 2017) were reviewed and compared to the measurements at the Courtice WPCP and Rundle Road Stations for the same period:

- The maximum measured 1-hour and 24-hour NO_2 concentrations at the MTO station in 2016 were 30 ppb and 18 ppb, respectively. The maximum measured hourly average NO_2 concentrations at the Courtice WPCP and Rundle Road Stations were higher than the MTO Station (maximum hourly average NO_2 Concentration of 43.6 and 36.2 ppb respectively), while the maximum measured daily average NO_2 concentrations in 2016 were similar to the MTO Station (maximum daily average concentrations of 18.8 and 21.5 ppb respectively).
- The maximum 24-hour average $PM_{2.5}$ concentration measured at the MTO Station in 2016 was 23 $\mu g/m^3$ while those at the Courtice WPCP and Rundle Road Stations were 34.7 and 43.0 $\mu g/m^3$.
- The maximum measured 24-hour average PM_{10} concentration at the MTO station in 2016 was 121 $\mu g/m^3$ and there were nine (9) measured exceedances of the MOECC PM_{10} AAQC of 50 $\mu g/m^3$. The DYEC stations do not measure PM_{10} and the MTO measurements are not comparable to the DYEC data.

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The ability to compare and draw conclusions between the DYEC and MTO Station data is limited since the MTO reports do not include information on the timing and type of construction occurring in proximity to the MTO Station, which would likely have influenced measured concentrations differently relative to the construction activities observed near the DYEC. Construction sources such as a contractor's camp located approximately 1 km to the west (upwind) of the Rundle Road Station would have a larger influence on this station than the MTO Station which is situated approximately 3.5 km north-northwest of the same contractor's camp.

6.0 RESPONSE TO MOECC QUARTERLY REVIEW COMMENTS

The MOECC conducted a review and issued a comment letter (dated January 10, 2017) regarding the Q2 and Q3 2016 quarterly reports. The letter requested that some responses be included in the annual report. This section provides responses to the MOECC's comments.

MOECC Comment #2 (Continuous Parameters) (page 2 of 3): *Zero drift corrections should be applied to the $PM_{2.5}$ data as noted above, so that the annual report has the revised concentrations.*

Stantec Response: The $PM_{2.5}$ Sharp monitor does not record values below zero. If the instrument has negative drift, negative values are not recorded and therefore a zero offset cannot be estimated from the measurement data. The monitor measures a mass concentration based on both the nephelometer and beta attenuation readings. The relationship between the beta concentration and nephelometer concentration may indicate zero drift in the instrument and could be used for correcting zero drift. However, the individual nephelometer and beta detector readings cannot be logged and downloaded via the analog data logger setup utilized in the monitoring stations as per the Ambient Monitoring Plan. The Sharp monitor's internal memory cannot retain long-term records (more than one week). As such, these data were not available to estimate zero drift corrections for the $PM_{2.5}$ data recorded in April 2016.

MOECC Comment #4 (Continuous Parameters) (page 2 of 3): *During the third quarter, as reported in section 3.4 of the quarterly report, there were zero drifts beyond 5 ppb for NO_2 and SO_2 concentrations. Please note as per the Operations Manual for Air Quality Monitoring in Ontario, NO_2 and SO_2 concentrations should be corrected if a zero drift exceeds 5 ppb. Please revisit the data and if any corrections are applicable they should be reflected in the annual report.*

Stantec Response: Section 3.4 of the Q3 2016 quarterly report provides a summary of monitor internal calibrations – these are not required information to be included in quarterly reports by the MOECC Operations Manual, but have been included at the request of the MOECC. The internal zero/span checks utilize uncertified zero and SO_2 permeation tube sources, which Section 4.3 of the MOECC Operations Manual notes are not recommended for auto span adjustment. The MOECC Operations Manual requires zero drift corrections to be performed when external performance checks with calibration equipment certified to a primary reference standard (e.g., United States National Institute of Standards and Technology (NIST)) are utilized. As per the Environment Canada document, "*National Air Pollution Surveillance Network Quality Assurance and Quality Control Guidelines*", which is referenced in the MOECC Operations Manual and discussed in Section 3.4 of the Q3 2016 quarterly report, daily internal zero checks are not recommended as a basis for analyzer zero or span adjustments, calibration updates, or adjustment of ambient data. Rather, they should be used as a quick and convenient method to check for possible analyzer malfunction or drift between calibrations.

Section 3.4 of the Q3 2016 quarterly report discusses the instances for which the auto zeros were greater than 5 ppb and the rationales for not adjusting the data – review of the instrument measurements around each occurrence did not support the instrument zero actually having drifted by greater than 5 ppb. Additional detail for each occurrence is provided below:

- *Rundle NOx monitor (September 8, 2016 – Automatic NOx zero was 10.7ppb)*: Ambient NOx measurements within 24 hours prior to and after this check ranged from 0.1 to 13.8 ppb. The measurements were within the normal operating range of the instrument and the variation in the measured levels over this period did not show evidence of the instrument drift actually being greater than 5 ppb.
- *Rundle SO_2 monitor (July 27, 2016 – Automatic zero was 7.3 ppb)*: Ambient SO_2 measurements within 24 hours before and after the check ranged from 0.9 – 10.8 ppb. The measurements were within the normal operating range of the instrument and did not show evidence of the instrument drift actually being greater than 5 ppb.
- *Rundle SO_2 monitor (August 2, 2016 – Automatic zero was 6.3 ppb)*: Ambient SO_2 measurements within 24 hours before and after the auto-zero ranged from 2.6 – 22.6 ppb and did not show evidence of the instrument drift actually being greater than 5 ppb.

MOECC Comment #2 (Non-Continuous Parameters) (page 2 of 3): *The TSP and metals data at Courtice were invalid on May 6 and May 12 based on the Hi-Vol flow being below the 40 CFM ministry's requirement. However, on May 6 and May 12, Rundle and fenceline Hi-Vol flows were 10% above the ministry's flow requirement and the data was still reported. Please provide a rationale in the annual report as to why the data were not invalidated.*

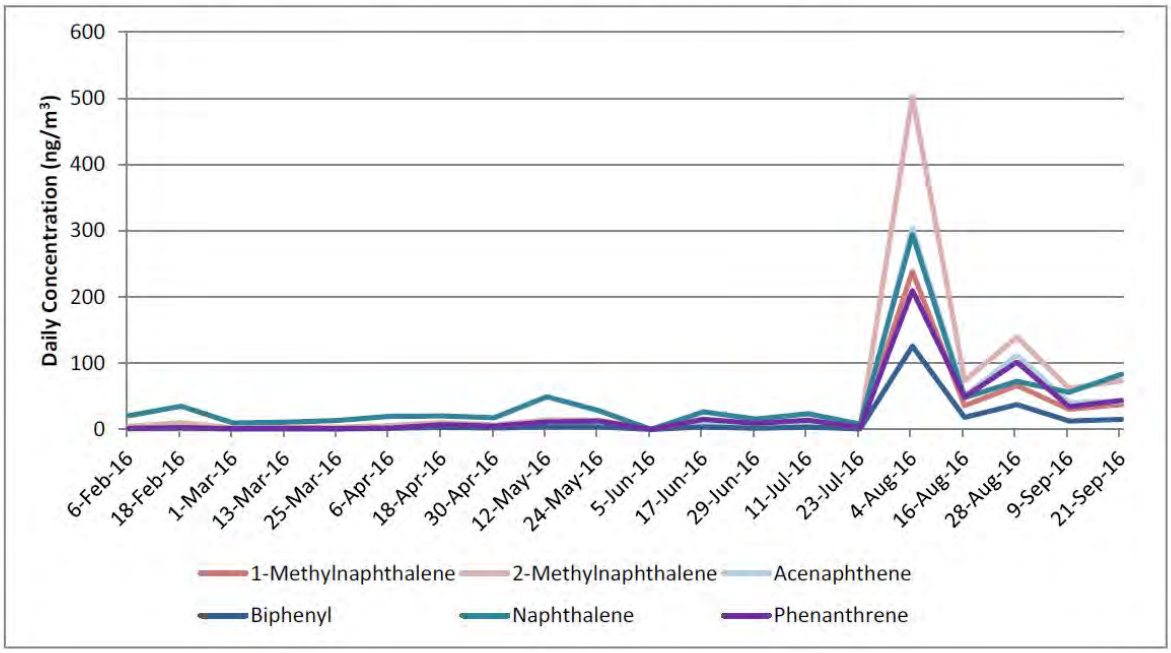
Stantec Response: The TSP and metals data at the Courtice WPCP stations were invalidated on May 6 and 12 due to the unit's mass flow controller malfunctioning and being unable to maintain a consistent flowrate, which resulted in the Hi-Vol flow being below the 40 cfm MOECC requirement.

As discussed with the MOECC at the initiation of the monitoring program and also discussed at a meeting with the MOECC on July 28, 2016, during the May 6 and 12 runs, Stantec was operating the TSP/metals Hi-Vol samplers following the U.S. Environmental Protection Agency (U.S. EPA) reference method for TSP Hi-Vol sampling (IO-2.1) and reviewing the flow data following the requirements of Section 11.4.1 of IO-2.1. Following the IO-2.1 methodology, the May 6 and 12 runs at the Rundle Road and Fence Line Stations were within ± 10% of 40 cfm (-1% to 1% at the Rundle Road Station and -7% to -1% at the Fence Line Station).

At the July 28, 2016 meeting, Stantec and the MOECC agreed to utilize, going forward, a Hi-Vol sampling methodology for TSP/metals corresponding with a MOECC method rather than the U.S. EPA protocol.

MOECC Comment #3 (Non-Continuous Parameters) (page 2 of 3): *For the third quarter at Rundle Station, it was noticed that selected PAHs were significantly greater by a factor of 10 and in a few cases a factor of 100 compared to the first and second quarter concentrations. As illustrated in Figure 1, the individual PAHs that had elevated readings were 1-methylnapthalene, 2-methylnapthalene, acenaphthene, biphenyl, naphthalene and phenanthrene. Based on a spot check of the Lab Certificate Analysis, the concentrations which were reported appear to be in the correct units (ng/m3). However, a rationale in the annual report as to why these readings were significantly greater during the third quarter compared to the first and second quarter of 2016 must be discussed in the annual report.*

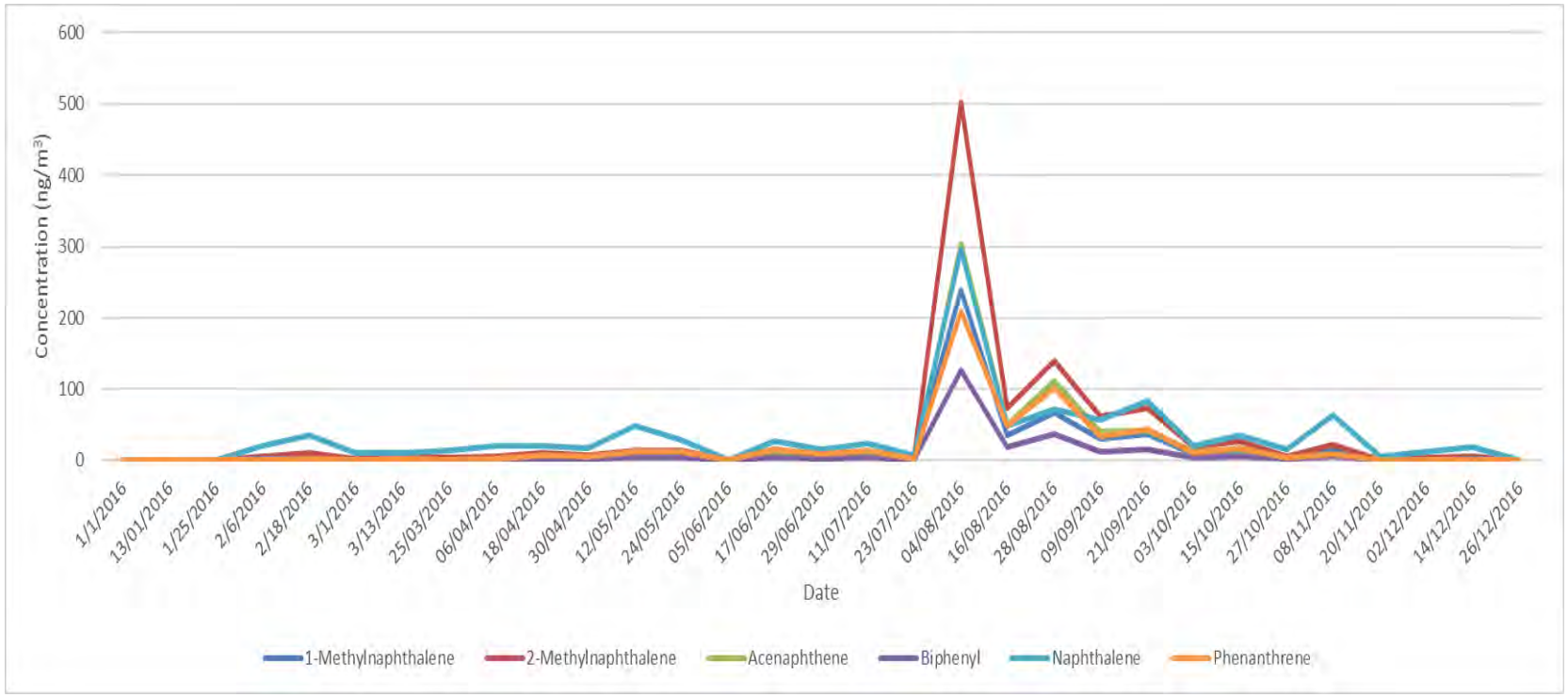
Figure 1 Selected 24-hour PAHs Measurements at Rundle Station during 2016



Stantec Response: During the data validation process for the Q3 report, Stantec confirmed with the analytical laboratory that the units for these data were correct. Although concentrations of these contaminants are higher than Q1 and Q2 measurements, they were still below their applicable MOECC criteria. These PAHs can be generated from a variety of activities including combustion sources such as vehicle exhaust or domestic heating, and earth movement (construction, agriculture, etc.). Stantec personnel observed mobile construction equipment (excavators, bulldozers, haul trucks, etc.) associated with Highway 418 construction activities operating in the area from August to the end of Q3. This timing is consistent with the elevated concentrations of these individual PAHs measured at the Rundle Road Station in Q3 relative to Q1 and Q2. As seen in **Figure 2**, which plots the concentrations of these individual PAHs over all of 2016, elevated levels of these PAHs correspond with the period for which Highway 418 mobile equipment were observed to be operating. Winds at the Rundle Road Station in Q3 were blowing predominately from the west-southwest – a direction for which the Highway 418 construction activities would be upwind of the Rundle Road Station.

For August 4, 2016, when the highest levels of these PAHs were measured, the wind directionality was highly variable, with winds blowing from all compass quadrants over the course of the day. There are therefore numerous potential contributors to this measurement including Highway 418 construction, Highway 401, a CN rail line, local roads and residences, agricultural activities, etc.

Figure 6-1 Measured 24-Hour Average PAH Concentrations for 2016 at the Rundle Road Station



7.0 CONCLUSIONS

This report provides a summary of the ambient air quality data collected at the two monitoring stations located predominantly upwind and predominantly downwind in the vicinity of the DYEC for the 2016 monitoring period. The following observations and conclusions were made from a review of the measured ambient air quality monitoring data:

1. Measured concentrations of NO_2, SO_2 and $PM_{2.5}$ were below the applicable O. Reg. 419/05 criteria or human health risk assessment (HHRA) health-based criteria presented in **Table 2-2** of this report for hourly, 24-hour, and annual averaging periods.
2. The 98th percentiles of the measured daily average $PM_{2.5}$ levels during the 2016 monitoring period were 21.6 µg/m^3 at the Courtice WPCP station and 32.9 µg/m^3 at the Rundle Road station. The annual average $PM_{2.5}$ concentration measured at the Courtice WPCP and Rundle Road station over the monitoring period was 6.8 and 9.6 µg/m^3, respectively. As detailed below, these values for the 2016 measurements should not be used for direct comparison against the Canadian Ambient Air Quality Standard.
3. The 24-hour and annual $PM_{2.5}$ Canadian Ambient Air Quality Standards (CAAQS) criteria both require a three-calendar year average for comparison, with the data considered valid if an annual 98th percentile value is available for at least two of the three calendar years. Using the measured $PM_{2.5}$ data at each station for calendar years 2014 to 2016, average annual 98th percentile daily average and annual average $PM_{2.5}$ levels were calculated and a comparison to their CAAQS criteria was made. The measured ambient $PM_{2.5}$ concentrations were below their respective CAAQS criteria at both stations.
4. The maximum measured concentrations of TSP and all metals with MOECC air quality criteria were below their applicable criteria (presented in **Table 2-3** in this report).
5. The maximum measured concentrations of all PAHs with MOECC Ambient Air Quality Criteria, were below their applicable 24-hour criteria (presented in **Table 2-4**) at both stations with the exception of twelve (12) benzo(a)pyrene (B(a)P) measurements. Out of twenty-six (26) samples collected at the Rundle Road Station, seven (7) samples exceeded the Ontario 24-hour B(a)P AAQC by levels varying between 3% and 315%. Out of twenty-seven (27) B(a)P measurements collected at the Courtice WPCP Station, five (5) measurements exceeded the MOECC Ambient Air Quality Criteria by levels varying between 1% and 107%. However, all of the exceedances were well below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419/05 24-hour average guideline, and the HHRA health based criteria. Discussion of the meteorology and potential sources for these events, which is required by the MOECC to be included in each annual report, is provided in Section 4.4.

   Based on the air quality assessments completed during the Environmental Assessment Study and the Environmental Compliance Approval application for the DYEC, the facility will not be a significant contributor of B(a)P. Therefore, ambient B(a)P levels are not expected to be substantially impacted by the operation of the DYEC.

6. The maximum toxic equivalent dioxin and furan concentration measured over this period was well below the applicable criteria presented in **Table 2-4**.

In summary, the measured concentrations of air contaminants were below their applicable MOECC Standards during the 2016 monitoring period with the exception of benzo(a)pyrene. Further, the measured levels of monitored contaminants were below their applicable HHRA health-based criteria.

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Appendix A EQUIPMENT MAINTENANCE, CALIBRATION SCHEDULE AND SUMMARY OF EQUIPMENT ISSUES

Table A-1 Summary of Preventative Maintenance

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule (to meet MOE and Ambient Monitoring Plan requirements)	Schedule / Comments	2016 Schedule Dates		
					Courtice	Rundle	Fenceline
SO_2	Teledyne Monitor Labs	Change particulate filter	Monthly	During monthly calibration	See note 1	See note 2	N/A
		Replace critical flow orifice and filters	Annual	During annual maintenance	25-Nov	18-Oct	
		Exchange chemical – external zero air scrubber	3 months	Every 3 months	23-Feb, 12-May, 18-Aug, 13-Oct	23-Feb, 12-May, 16-Aug, 13-Oct	
		Replace perm tube	8 months	During annual maintenance	11-Mar, 21-Apr, 25-Nov	15-Apr	
		Replace Pump diaphragm	8 months	During annual maintenance,	New pump installed 20-Apr	20-Oct. Installed a new lamp at same time	
		Clean sample chamber, windows and filters	As required	During annual maintenance,	25-Nov	18-Oct	
		Yearly maintenance	Annual	During annual maintenance,	25-Nov	20-Oct	
NOx	API Model 200E	Change particulate filter	Monthly	Done during monthly calibration	See note 1	See note 2	
		Exchange chemical – external zero air scrubber	3 months	3 months	23-Feb, 12-May, 18-Aug, 13-Oct	23-Feb, 12-May, 16-Aug, 20-Oct	
		Replace chemical – external dryer	3 months	3 months	23-Feb, 12-May, 18-Aug, 13-Oct	23-Feb, 12-May, 16-Aug, 20-Oct	
		Chemical change – ozone filter	3 months	3 months	23-Feb, 12-May, 18-Aug, 13-Oct	23-Feb, 12-May, 16-Aug, 20-Oct	
		Clean reaction cell window (annually or as necessary)	Annually	During annual maintenance,	13-Dec to end of year (spare installed during this time)	20-Oct to 11-Nov (Spare installed in this period)	
		Change particulate DFU filter	Annually	During annual maintenance,	13-Dec to end of year (spare installed during this time)	20-Oct to 11-Nov (Spare installed in this period)	
		Replace reaction cell O-rings & sintered filters	Annually or as required	During annual maintenance,	13-Dec to end of year (spare installed during this time)	20-Oct to 11-Nov (Spare installed in this period)	
		Rebuild pump head	When RCEL pressures exceeds 10 in Hg	As required	12-May	Not required	
		Replace inline exhaust scrubber	Annually	During annual maintenance,	13-Dec to end of year (spare installed during this time)	20-Oct to 11-Nov (Spare installed in this period)	
		Replace perm tube	Annually	During annual maintenance,	15-Apr and 13-Dec to end of year (spare installed during this time)	15-Apr and 20-Oct to 11-Nov (Spare installed in this period)	
		Replace inline exhaust scrubber	Annually	During annual maintenance,	13-Dec to end of year (spare installed during this time)	20-Oct to 11-Nov (Spare installed in this period)	
		Replace NO2 converter	Every 3 years or if conversion < 96%	Conversion checked every 6 months,	Checked on 29-Jan and 11-Nov	Checked on 29-Jan and 11-Nov	
		Yearly maintenance	Annual	During annual maintenance,	13-Dec to end of year (spare installed during this time)	20-Oct to 11-Nov (Spare installed in this period)	
$PM_{2.5}$	Thermo Sharp 5030	Replace filter tape	Upon 10% remaining	As required	Not required	16-Sep	
		Replace SHARP zeroing filters	6 months		11-Mar	11-Mar	
		Clean PM2.5 inlet	Monthly	During monthly calibration	See note 1	See note 2	
		Clean cyclone	Monthly	During monthly calibration	See note 1	See note 2	
		Clean air inlet system	Annually	During annual maintenance,	20-Oct	18-Oct	
		Rebuild vacuum pump	12-18 months	12-18 months or when pump load reaches 80%	18-Aug	16-Aug	
		Clean ambient temp/RH shield and assembly	Annually	During annual maintenance,	20-Oct	18-Oct	
TSP/metals	TE-5170	Ensure all gaskets sealing properly	Weekly	Check at weekly site visit	Monitoring resumed in February 2016. Maintenance performed weekly.		
		Power cord checks for damage/cracks	Weekly	Check at weekly site visit			
		Inspect screen and remove foreign deposits	Weekly	Check at weekly site visit			
		Inspect holder frame gasket	Every sample	Check at weekly site visit			
		Replace motor brushes	Every 500 hours	Replace as needed	Replaced motor brushes on 12-Sept-16. See note 3.	Replaced motor brushes on 29-Apr-16 and 12-Dec-16. See note 4.	Replaced motor brushes on 7-Apr-16, 11-Aug-16 and 12-Dec-16.
		Check elapsed time meter	Weekly	Check at weekly site visit	Monitoring resumed in February 2016. Maintenance performed weekly.		
		Check flow recorder pen/tubing	Weekly	Check at weekly site visit			
		Ensure all gaskets sealing properly	Weekly	Check at weekly site visit			

Table A-1 Summary of Preventative Maintenance

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule (to meet MOE and Ambient Monitoring Plan requirements)	Schedule / Comments	2016 Schedule Dates		
					Courtice	Rundle	Fenceline
PAH and D/F	TE-1000	Ensure all gaskets sealing properly	Weekly	Check at weekly site visit	Sampling resumed in February 2016. Checked at every site visit and calibration day.	Sampling resumed in February 2016. Checked at every site visit and calibration day.	N/A
		Power cord checks for damage/cracks	Weekly	Check at weekly site visit			
		Clean any dirt around module and filter holder	Weekly	Check at weekly site visit			
		Inspect dual sampling module gaskets	Every sample	Check at weekly site visit			
		Inspect and replace motor flange gasket and motor cushion	Routinely, minimum annually				
		Replace motor brushes	Every 400 hours	Replaced as needed	Replaced motor brushes on 20-Jun-16	Replaced motor brushes on 6-Jul-16	
Wind Speed and Direction (Rundle Road Station only)	Met One 034B	Physical inspection of equipment for signs of damage/erratic behavior	Weekly	Check at weekly site visit	N/A	Checked weekly	
		Replace wind speed sensor bearings and calibrate	Annually	During annual maintenance		11-Nov to 25-Nov (Spare installed during this time)	
		Replace wind vane potentiometer and bearings	24-months	To be replaced at 2 years		All bearings, potentiometers and factory calibration done in 2015. These maintenance items were not required this year.	
		Complete factory overhaul	24-36 months	To be replaced at 2 to 3 years			
Temperature	CS 107 (Rundle)/ HMP 60 (Courtice)	Check radiation shield free from debris	Weekly	Checked at weekly site visit	Weekly	Weekly	
		Annual maintenance	Annually	During annual maintenance	16-Sep	18-Oct	
Barometer	CS106	Annual maintenance	Annually	During annual maintenance	16-Sep	N/A	
Rainfall	TE525M	Inspect funnel and bucket mechanism for debris	Weekly	During weekly site visit	Weekly	Weekly	
		Annual maintenance	Annually	During annual maintenance	16-Sep	18-Oct	
Relative Humidity	CS HMP60	Change INTERCAP® Sensor	On out of spec calibration	As required	Not required	Not required	
		Sensor cleaning	As required	As required	See note 1	See note 2	
		Inspect/replace filter if blocked	Monthly	Done during monthly calibration	See note 1	See note 2	
		Annual maintenance	Annually	During annual maintenance	16-Sep	18-Oct	
Pod / others		Examine the external enclosure station conditions including the inlet probe for damage or blockage. Periodically review the station characteristics for any change or modification to the station	Weekly	Check at weekly site visit	Weekly	Weekly	
		Examine the manifold, the transfer lines and the inlet filters for dirt buildup and replace or clean as required. Examine the seals in the sampling system, the scrubbing and drying agents and replace as required	Weekly	Check at weekly site visit	Weekly	Weekly	
		Replace zero and span calibration cylinders when pressure is below 1,500 kPa (215 psig)		Check at weekly site visit	SO_2 bottle replaced 9-Sept and in December	SO_2 bottle replaced 9-Sept and in December	
		Ensure shelters and gates are locked upon departure	Weekly	Check at weekly site visit	Weekly	Weekly	

1. Courtice monthly calibration and maintenance dates in 2016: January 29, February 23, March 11, April 15, May 12, June 13, July 22, August 18, September 23, October 13, November 25, December 12,
2. Rundle monthly calibration and maintenance dates in 2016: January 29, February 23, March 11, April 15, May 12, June 14, July 20, August 16, September 23, October 13, November 11, December 12
3. Intermittent TSP motor operation at Courtice station. Motor replaced on 3-Feb-16. TSP motor unable to maintain conistent flow. Motor replaced 13-May-16.
4. Mouse damaged motor. Replaced motor on 12-Aug-16.

Table A-2 Summary of Equipment Calibration

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule	Schedule / Comments	2016 Schedule Dates		
					Courtice	Rundle	Fenceline
SO_2	API Model 100E	Verify test functions	Weekly	Checked weekly	Checked weekly	Checked weekly	N/A
		Evaluate Zero/Span check	Weekly	Checked daily	Checked weekly	Checked weekly	
		Zero/span external check	Monthly	Checked monthly	See note 1	See note 2	
		Zero/span calibration	3 months	Calibrated monthly	See note 1	See note 2	
		Flow check	6 months	Checked monthly	See note 1	See note 2	
		Pneumatic leak check	Annually or after repairs	Done when flow drops or checked annually	25-Nov	20-Oct	
		Calibrate UV lamp output	Prior to zero/span cal	Done prior to zero/span cal	See note 1	See note 2	
		PMT sensor hardware cal	On PMT/preamp changes or slope changes as specified	Done when instrument slope is outside of acceptable range	25-Nov	20-Oct	
NOx	API Model 200E	Verify test functions	Weekly	Checked weekly	Checked weekly	Checked weekly	
		Evaluate Zero/Span check	Weekly	Checked daily	Checked weekly	Checked weekly	
		Zero/span external check	Monthly	Checked monthly	See Note 1	See Note 2	
		Zero/span calibration	3 months	Calibrated monthly	See Note 1	See Note 2	
		Pneumatic sub-system check	Annually or after repairs	Checked after repairs	See Note 1	See Note 2	
		PMT sensor hardware cal	On PMT/preamp changes or slope changes as specified	Done when slope exceeds the acceptable range	See Note 1	See Note 2	
$PM_{2.5}$	Thermo Sharp 5030	Ambient temperature	Audit monthly, calibrate annually	Audit monthly.	See note 1 for audits. Annual calibration performed 20-Oct	See note 2 for audits. Annual calibration performed 18-Oct	
		Ambient pressure	Audit monthly, calibrate annually	Audit monthly.	See note 1 for audits. Annual calibration performed 20-Oct	See note 2 for audits. Annual calibration performed 18-Oct	
		Flow	Audit monthly, calibrate annually	Audit monthly.	See note 1 for audits. Annual calibration performed 20-Oct	See note 2 for audits. Annual calibration performed 18-Oct	
		Leak check	Monthly	See note 4	See note 4	See note 4	
		Analog output	Annually	Done annually	See note 1	See note 2	
		Proportional Counter	Audit annually	Done annually	See note 1	See note 2	
		Nephelometer zero	Audit quarterly	Done monthly	Checked at monthly calibrations. Adjusted when required.	Checked at monthly calibrations. Adjusted when required.	
TSP/metals	TE-5170	Flow calibration	Upon installation, monthly, or after any motor maintenance	Calibrated monthly and after motor maintenance.	Monitoring resumed in February 2016. Flows calibrated on the following dates: 04-Feb-16 25-Feb-16 07-Apr-16 19-Apr-16 17-May-16 27-May-16 27-Jun-16 25-Jul-16 29-Aug-16 12-Sep-16 28-Sep-16 28-Oct-16 28-Nov-16	Monitoring resumed in February 2016. Flows calibrated on the following dates: 03-Feb-16 25-Feb-16 07-Apr-16 19-Apr-16 29-Apr-16 17-May-16 27-May-16 03-Jun-16 27-Jun-16 21-Jul-16 25-Jul-16 12-Aug-16 29-Aug-16 28-Sep-16 28-Oct-16 28-Nov-16 12-Dec-16	Monitoring began in February 2016. Flows calibrated on the following dates: 04-Feb-16 25-Feb-16 07-Apr-16 19-Apr-16 17-May-16 27-May-16 27-Jun-16 25-Jul-16 11-Aug-16 29-Aug-16 28-Sep-16 28-Oct-16 28-Nov-16 12-Dec-16
PAH and D/F	TE-1000	Flow calibration	Upon installation, monthly, or after any motor maintenance	Calibrated monthly and after motor maintenance.	Monitoring resumed in February 2016. Flows calibrated on the following dates: 21-Jan-16 19-Feb-16 01-Apr-16 29-Apr-16 27-May-16 27-Jun-16 25-Jul-16 29-Aug-16 28-Sep-16 28-Oct-16 28-Nov-16	Monitoring resumed in February 2016. Flows calibrated on the following dates: 21-Jan-16 19-Feb-16 01-Apr-16 29-Apr-16 27-May-16 15-Jun-16 27-Jun-16 06-Jul-16 25-Jul-16 29-Aug-16 28-Sep-16 28-Oct-16 28-Nov-16	N/A
Wind Speed and Direction	Met One 034B	Wind speed calibration	Annually	Annually	N/A	11-Nov to 25-Nov (Spare installed during this time)	
		Potentiometer calibration	Annually	Annually	N/A	11-Nov to 25-Nov (Spare installed during this time)	
Temperature	HMP 60	External calibration	Annually	Annually	16-Sep	18-Oct	
Rainfall	TE525M	Field Calibration. Factory calibration if field calibration not passed.	Annually	Annually	16-Sep	18-Oct	
Relative Humidity	CS HMP60	Calibration (annually)	Annually	Annually	16-Sep	18-Oct	
Atmospheric Pressure	CS106	Re-calibration (2-years)	2-years	To be done at 2 years	16-Sep	N/A	
Data Acquisition	CS CR1000	Calibration every three years	3- years	To be done at 3 years	22-Jul to 16-Sept	14-Jun to 20-Jul	

1. Courtice monthly calibration and maintenance dates in 2016: January 29, February 23, March 11, April 15, May 12, June 13, July 22, August 18, September 23, October 13, November 25, December 12,
2. Rundle monthly calibration and maintenance dates in 2016: January 29, February 23, March 11, April 15, May 12, June 14, July 20, August 16, September 23, October 13, November 11, December 12
3. On December 13, 2016, the MOECC audit found the SO2 cal gas bottle was out of specifiction causing the Courtice SO2 monitor to be out of specification.
4. Although a leak check is not formally possible with this model, the MOECC introduced a methodology using a leak checker designed for the Sharp 5030i which has been implemented. The procedure is a lengthy process and was only performed when data is suspect.

Table A-3 Summary of Instrument Issues at the Courtice WPCP Station (Predominately Upwind)

Parameter	Issues	Time Frame	Remedial Action
SO_2	Low auto-calibration concentration.	29-Jan-16 to 11-Mar-16	Replaced permeation tube on February 23, cleaned a plugged valve and replaced permeation tube on 11-Mar-16. The low auto-calibration issue did not affect measurements.
	Internal pump and UV detector failed	15-Apr-16 to 21-Apr-16	Removed monitor for manufacturer repairs. Reinstalled and calibrated. Data during this time was not collected.
	Internal clock not synchronized with actual time	27-Jun-16, 22-Sep-16, 25-Oct-16 and 9-Nov-16	Adjusted internal clock. All data intact.
NO_X	Inconsistency between NO, NO_2 and NO_x measurements due to a loose data logger connection.	14-Jan-16 to 29-Jan-16 and 10-Mar-16 to 24-Mar-16	Connection repaired. Affected January NO_2 readings were replaced by deriving NO_2 concentrations from the NO_x - NO concentrations. Affected March data were replaced by data downloaded directly from the monitor. All data intact. Monthly check of cable connections added to scheduled routine maintenance.
	Evidence of temporary pump failure	Discovered 29-Apr-16 Replaced 12-May-16	Suspected to be due to a power outage. Pump replaced as a precaution. All data intact.
	Internal clock not synchronized with actual time	8-Jun-16, 27-Jun-16, 22-Sep-16, 25-Oct-16, 9-Nov-16, 28-Nov-16, 16-Dec-16	Adjusted internal clock. All data intact.
$PM_{2.5}$	Sample pump power trip/high internal relative humidity warning	Noted 25-Jul-16	Restarted pump. The power trip/RH warning was likely caused by a severe thunderstorm the morning of 25-Jul-16. The measurements were reviewed and 6-hours of suspect data were invalidated.

Table A-3 Summary of Instrument Issues at the Courtice WPCP Station (Predominately Upwind)

Parameter	Issues	Time Frame	Remedial Action
	Instrument errors following automatic zero checks.	Noted on 5, 12, 15 and 18-Aug-16	Reset monitor and replaced suspect data with data downloaded directly from monitor. Valley Environmental repaired monitor on 18-Aug-16. No data lost.
	High Voltage Power Supply (HVPS) issue causing analogue output to data logger to fail.	Noted on 22 and 25-Aug-16	Reset monitor. Adjusted HVPS, downloaded data directly from monitor on 30-Aug-16 and used it to replace suspect hours in the data logger files. Valley Environmental Services calibrated and adjusted HVPS. No data lost.
	Pump was not running (likely due to power trip) during weekly site visit.	Noted 28-Nov-16	Restarted monitor/ pump. Reviewed and invalidated 49 hours of data.
Other	Datalogger system compromised due to an external dial-in to the modem.	12-Feb-16 to 16-Feb-16	Restarted software program. Password added to all modems to deny access to unauthorized users. Data from the datalogger was lost for this time period.
	Power tripped.	1-Jul-16 at 15:45	Power came back on immediately. All data intact.
TSP/Metals Hi-Vol.	Intermittent motor operation.	3-Feb-16 to 4-Feb-16	Replaced motor. All data intact.
	Sampler flow rate not consistent due to mass flow controller probe malfunction.	6-May-16 to 17-May-16	Initially diagnosed as a motor issue during the station visit on May 11. Replacement motor ordered and installed, with no effect. Issue subsequently determined to be the mass flow controller (MFC). MFC removed and sent to manufacturer for repair. Replaced MFC with alternate on May 17. Samples on May 6 and 12 invalidated.
	Birds destroyed sample.	30-May-16 to 3-Jun-16	Cleaned hi-vol interior of nesting materials and installed barrier to prevent bird access. No sample collected.

Table A-3 Summary of Instrument Issues at the Courtice WPCP Station (Predominately Upwind)

Parameter	Issues	Time Frame	Remedial Action
	Filter was wet when collected, resulting in a low post-run flow check. Snow likely blew onto the filter during a precipitation event on 4-Dec-16.	2-Dec-16 sample. Issue noted on 5-Dec-16.	Review of the circular chart record indicates that the sampler was operating at 40 cfm throughout the sample run. Sample results were comparable to other stations, therefore, the results were considered valid.
PAHs/ D/ F Hi-Vol.	Birds damaged sample pre-filter and started bird nest inside housing.	28-Mar-16 to 30-Mar-16	Removed nesting materials, cleaned hi-vol interior, and installed barrier to prevent bird access.
	Minor bird damage to sample pre-filter. Bird nesting materials found in sampler.	Noted 6-Jun-16. Affected 5-Jun-16 sample.	Removed materials, cleaned hi-vol interior, and upgraded bird barrier. Sample results reviewed and deemed valid.
	Sampler ran too long due to operator error in setting the mechanical timer off-time set screw.	17-Jun-16 sample	Reviewed with operator requirement to confirm mechanical timer setup each site visit. PAH sample invalidated.

Table A-4 Summary of Instrument Issues at the Rundle Road Station (Predominately Downwind)

Parameter	Issues	Time Frame	Remedial Action
SO_2	Torn pump diaphragm.	Replaced 29-Jan-16	Repaired pump and replaced diaphragm. All data intact.
	System error likely due to temporary power outage.	Noted 19-Feb-16	Re-set instrument. All data intact.
	Evidence of power outage.	Noted 25-May-16	Cleared warning message. All data intact.
	Evidence of power outage.	Noted 8-Jun-16. Believed to have occurred 5-Jun-16.	Cleared warning message. All data intact.
	Internal clock not synchronized with actual time.	30-Jun-16, 11-Aug-16, 25-Oct-16 and 9-Nov-16	Adjusted internal clock. All data intact.
	Span setting was found to be outside of MOECC allowable range during the MOECC Audit on 13-Dec-16. Issue determined to be due to Valley Environmental Services' (VES) calibration gas cylinder going off-specification.	12-Dec-16 to 13-Dec-16	Monitor was recalibrated using the MOECC's calibration gas. Span adjustment applied to affected data. No data lost. VES has acquired another SO_2 calibration gas cylinder and will have the concentration confirmed by the MOECC's laboratory on a periodic basis. VES will review and update their SO_2 gas handling protocol.
NO_X	System error likely due to temporary power outage.	Noted 19-Feb-16	Re-set instrument. All data intact.
	Evidence of power outage.	Noted 25-May-16	Cleared warning message. All data intact.
	Evidence of power outage.	Noted 8-Jun-16. Believed to have occurred 5-Jun-16.	Cleared warning message. All data intact.
	Internal clock not synchronized with actual time.	30-Jun-16, 11-Aug-16, 25-Oct-16 and 9-Nov-16	Adjusted internal clock. All data intact.

Table A-4 Summary of Instrument Issues at the Rundle Road Station (Predominately Downwind)

Parameter	Issues	Time Frame	Remedial Action
	Elevated auto zero.	14-Nov-16 to 25-Nov-16	A critical flow orifice in the unit's auto-calibration system became partially blocked. The orifice was replaced by Valley Environmental. The issue did not affect routine measurements - all data intact.
	Evidence of a brief power outage.	Outage on 1-Dec-16	Reviewed and invalidated 1 minute of data. UPS powered all other units.
$PM_{2.5}$	Heater circuit failure and blown fuse.	15-Jan-16 to 29-Jan-16	Monitor was removed and sent to the manufacturer to replace the fuse and upgrade the heater circuit relay under warranty. No data collected in this period.
	Output data error due to broken physical connection.	31-Jan-16 to 10-Feb-16	Repaired wire connection. Data downloaded directly from the monitor. All data intact.
	High voltage power supply drifted.	31-Jan-16 to 10-Feb-16	Adjusted high voltage power supply. All data intact.
	System error likely due to temporary power outage.	Noted 19-Feb-16	Re-set instrument. All data intact.
	Aspiration pump failed.	Noted on 15-Aug-16	Pump repaired on 16-Aug-16. Reviewed and invalidated suspect data.
TSP/Metals Hi-Vol.	Flow rate deviation during MOECC audit.	13-May-16	Conducted check of unit's operation and replaced a motor gasket. Recalibrated and adjusted flow rate.
	Bird feces found on a small portion of filter.	23-Jul-16	Bird damage was minor, so the filter was sent for analysis. Lab results were comparable to other stations, therefore the results were considered valid.
	Mouse nest discovered in hi-vol motor housing during filter change. Motor wiring damaged.	Noted on 11-Aug-16	Removed nest, replaced motor with onsite spare and installed barrier. Lab results were comparable to other stations, therefore the results were considered valid.

Table A-4 Summary of Instrument Issues at the Rundle Road Station (Predominately Downwind)

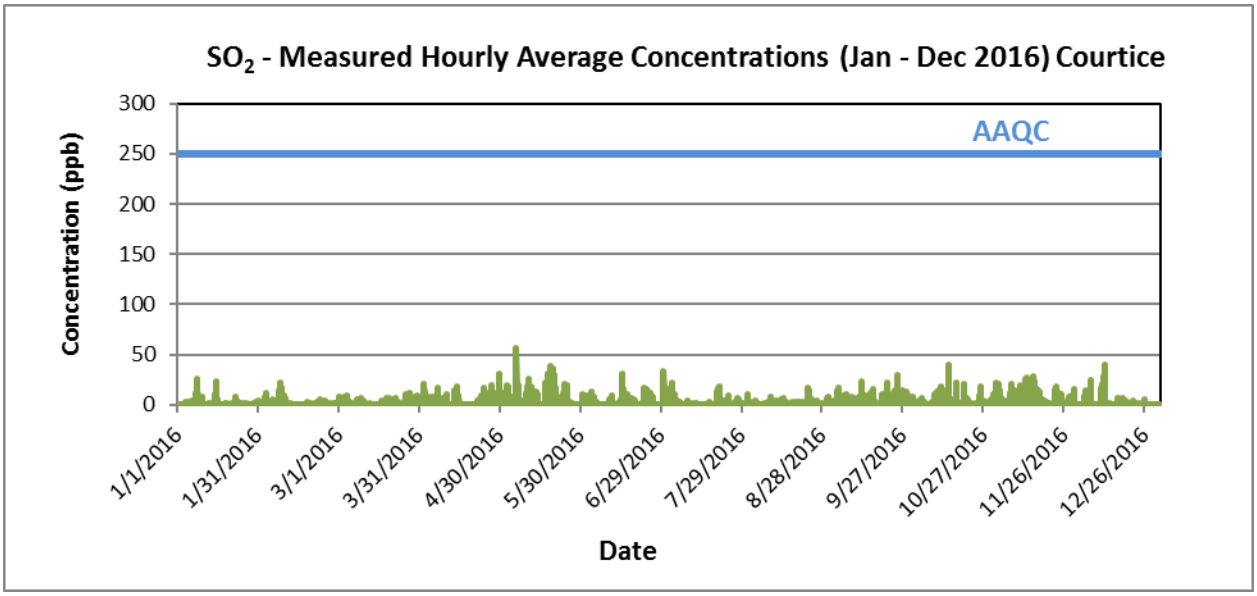
Parameter	Issues	Time Frame	Remedial Action
	Filter was wet when collected, resulting in a low post-run flow check. Snow likely blew onto the filter during a precipitation event on December 4, 2016.	2-Dec-16 sample. Issue noted on 5-Dec-16.	Review of the circular chart record indicates that the sampler was operating at 40 cfm throughout the sample run. Sample results were comparable to other stations, therefore, the results were considered valid.
PAHs/ D/F Hi-Vol.	Power outage during run.	Noted 8-Jun-16. Outage occurred on 5-Jun-16 during a thunderstorm.	Reset GFI receptacle. PAH/DF sample not collected.
	Hi-vol stopped partway through sample run due to the ground fault interrupter (GFI) being tripped during the run.	Noted 28-Dec-16, Affected 26-Dec-16 sample (PAH sample only)	Checked wiring and resealed plugs. Reset GFI. PAH sample invalidated since the hi-vol did not run for a sufficient duration.
Other	Unable to connect to data logger.	16-Feb-16	Reset data logger. All data intact.
	Anemometer observed during site visit to be frozen in place due to freezing rain.	24-Mar-16 to 25-Mar-16	Anemometer could not be accessed due to safety concerns. Data during this time period showing evidence of the anemometer being frozen was invalidated.
	Power outage evident in data files.	29-Mar-16 between 3:15 – 3:43	Invalidated 1 hour of data.
	Power outage due to storm.	17-Sept-16 from 14:57-16:19	Reviewed and invalidated affected data.
	Evidence of Power Outage.	17-Dec-16	Reviewed and invalidated 3 hours of data for all continuous parameters.

Table A-5 Summary of Instrument Issues at the Fence Line Station

Parameter	Issues	Time Frame	Remedial Action
TSP/Metals Hi-Vol.	Motor reacting slowly to mass flow controller adjustments	6-Feb-16 to 16-Feb-16	Oriented temperature probe correctly and readjusted mass flow. 2 samples outside MOECC allowable flow rate – invalidated.
	Flow rate deviation during MOECC audit. Unit's chart recorder reading not consistent with a manometer.	13-May-16 to 17-May-16	Replaced chart recorder with a spare on May 17. Recalibrated and adjusted flow rate.

Appendix B SO_2 PLOTS

Figure B-1 Time History Plots of Measured Hourly Average and 24 Hour Average SO_2 Concentrations – Courtice (WPCP) Station



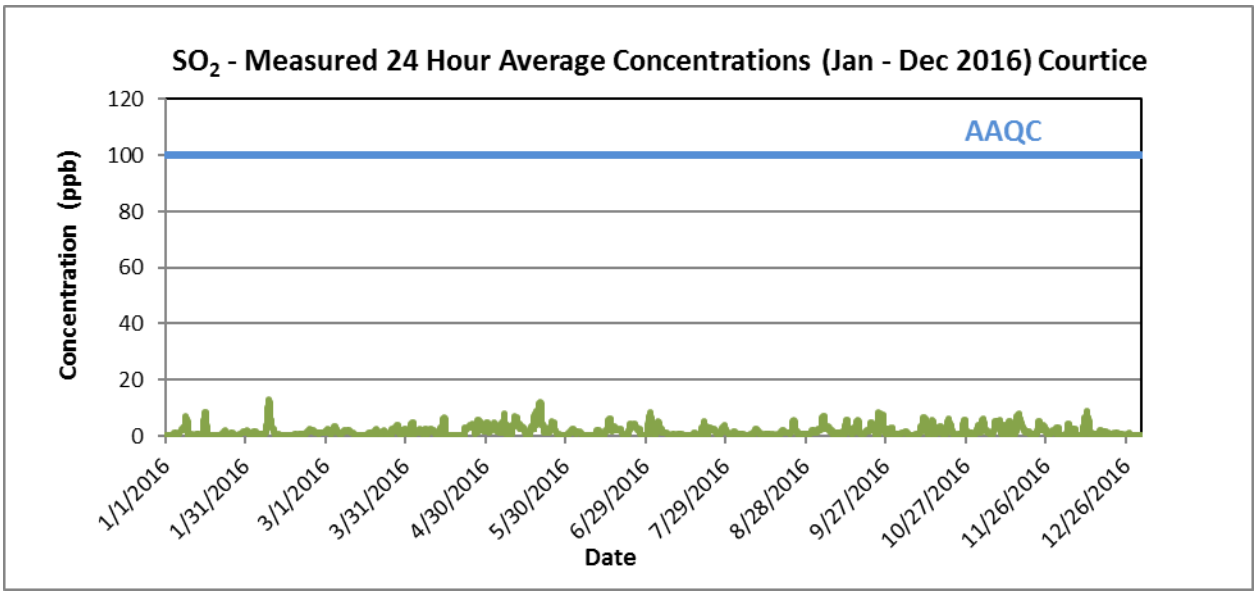
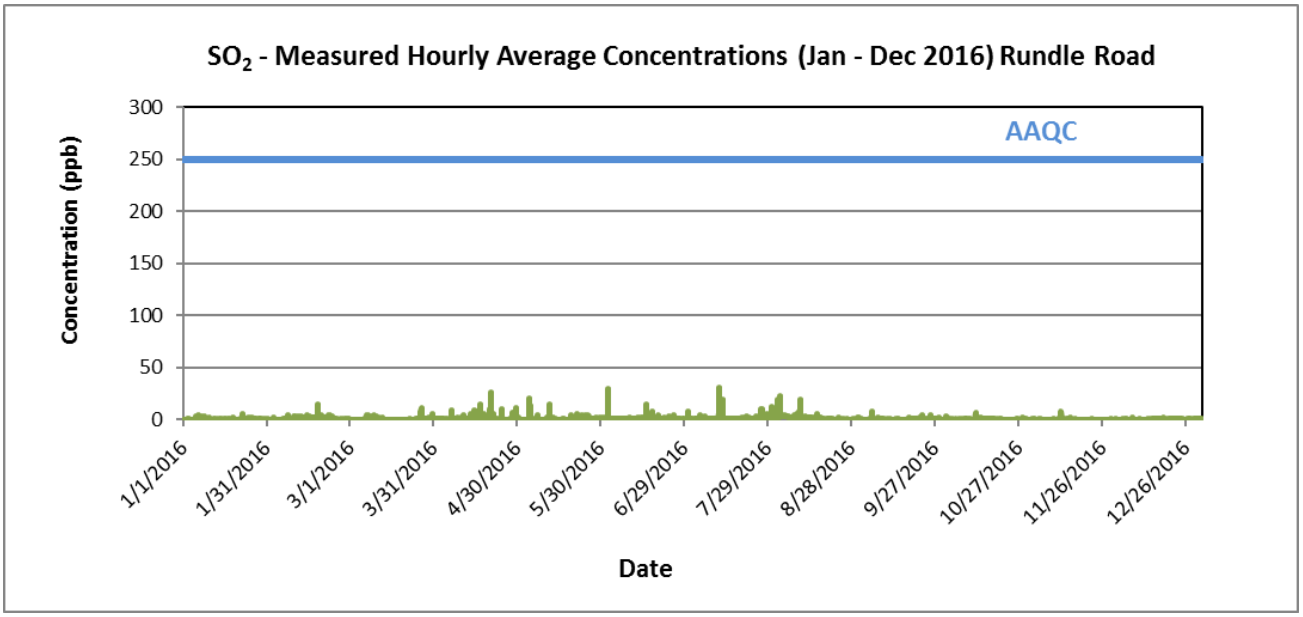


Figure B-2 Time History Plots of Measured Hourly Average and 24 Hour Average SO_2 Concentrations – Rundle Road Station



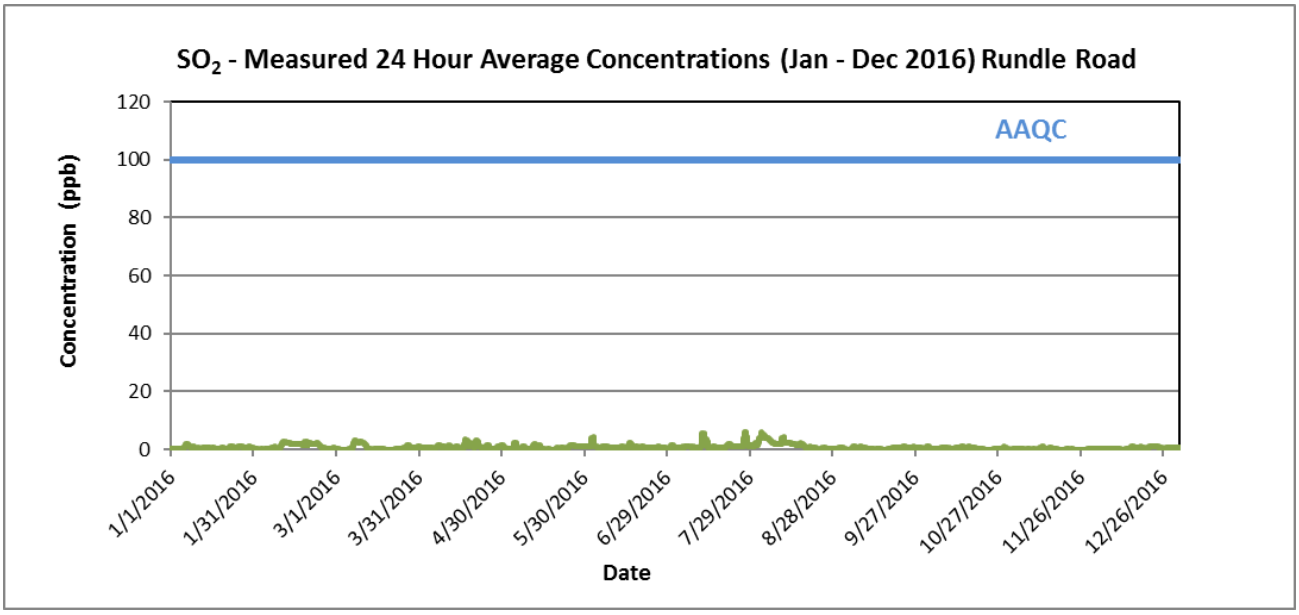


Figure B-3 Measured Hourly Average SO_2 Concentrations vs. Wind Direction – Courtice WPCP Station

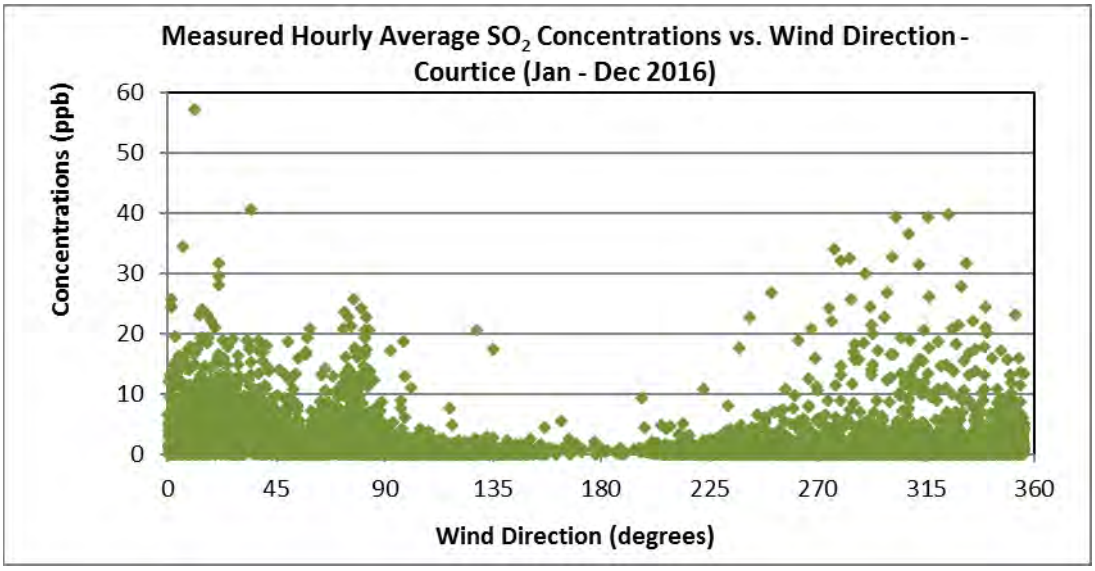
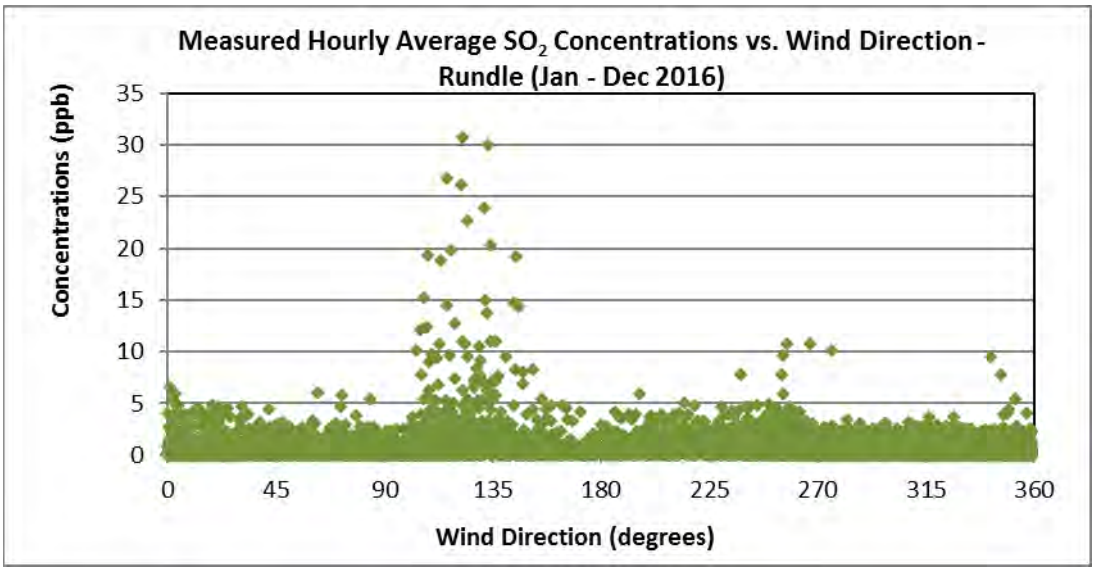
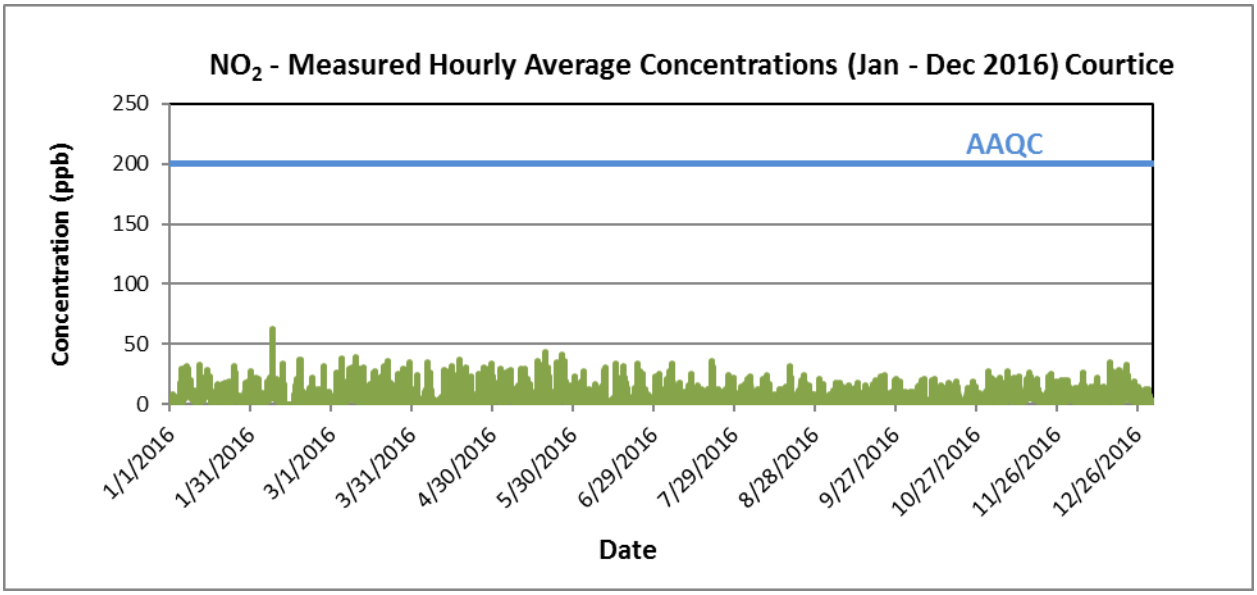


Figure B-4 Measured Hourly Average SO_2 Concentrations vs. Wind Direction - Rundle Road Station



Appendix C NO_2 PLOTS

Figure C-1 Time History Plots of Measured Hourly Average and 24 Hour Average NO_2 Concentrations – Courtice (WPCP) Station



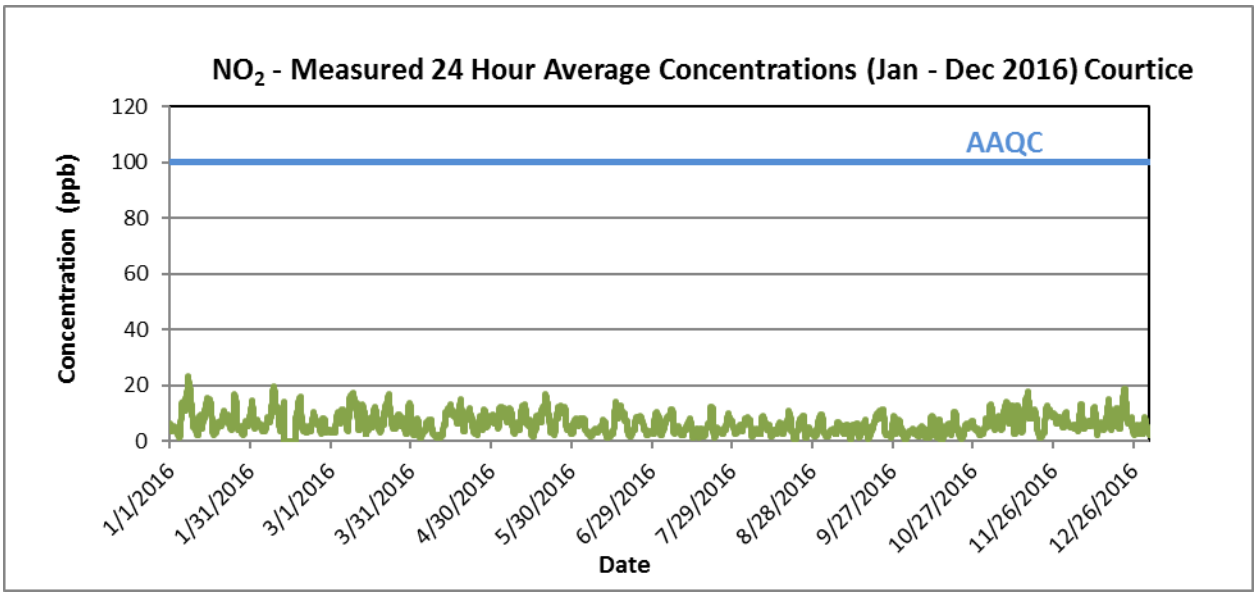
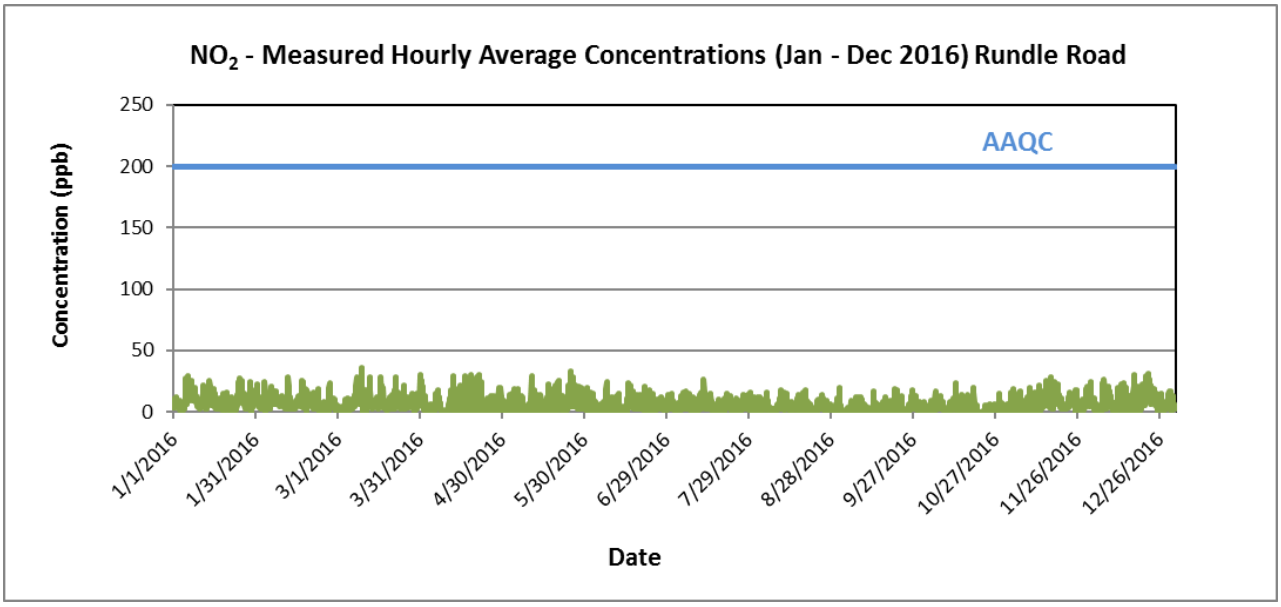


Figure C-2 Time History Plots of Measured Hourly Average and 24 Hour Average NO_2 Concentrations – Rundle Road Station



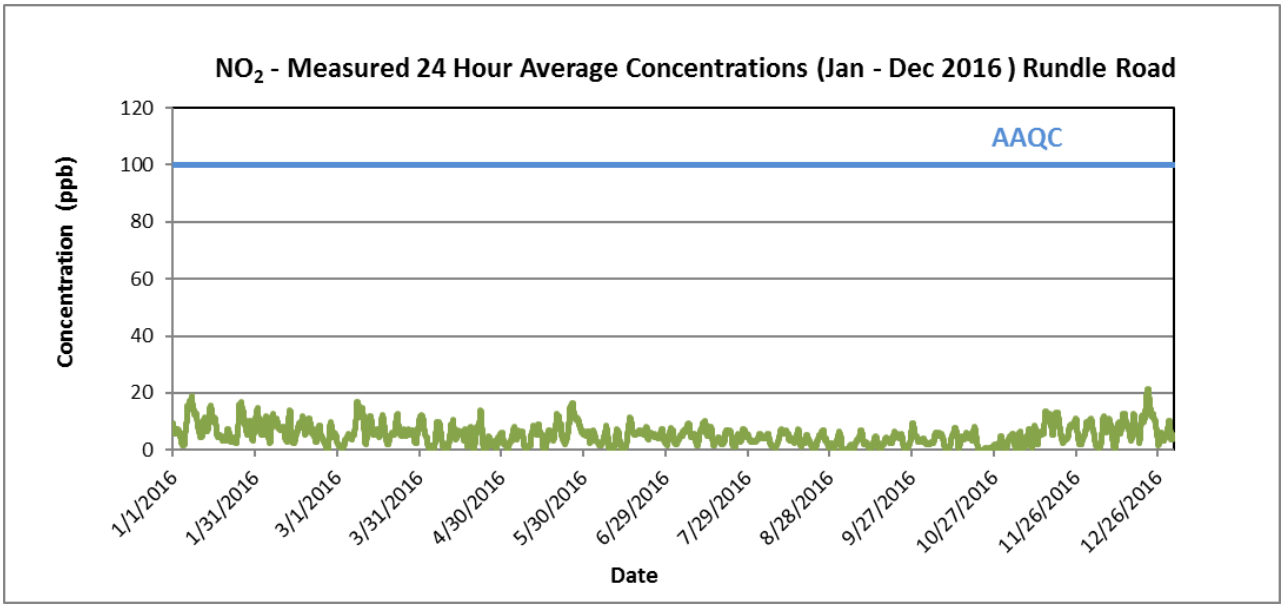


Figure C-3 Measured Hourly Average NO_2 Concentrations vs. Wind Direction – Courtice WPCP Station

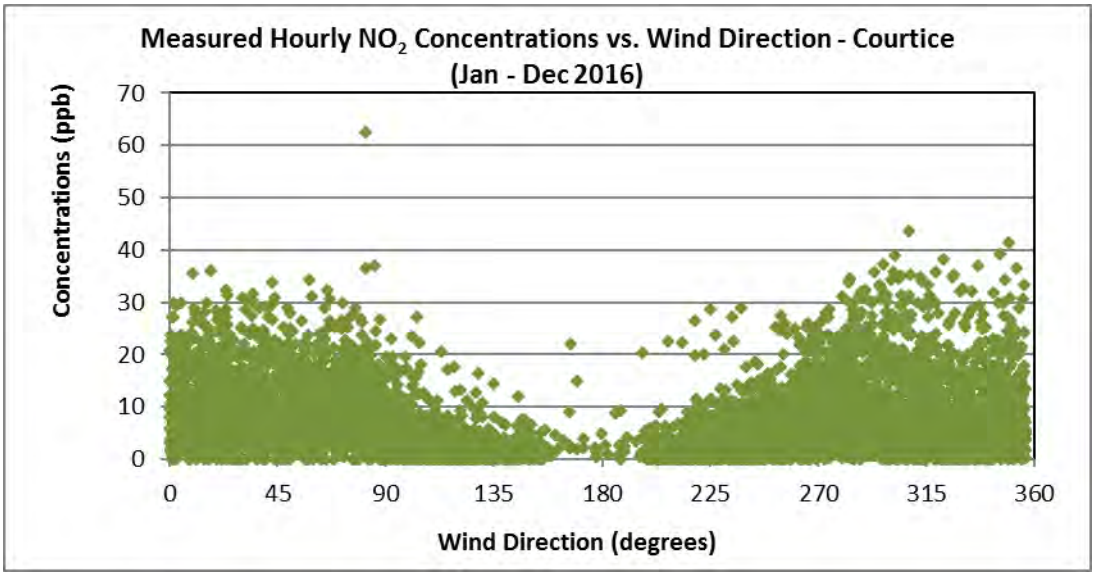
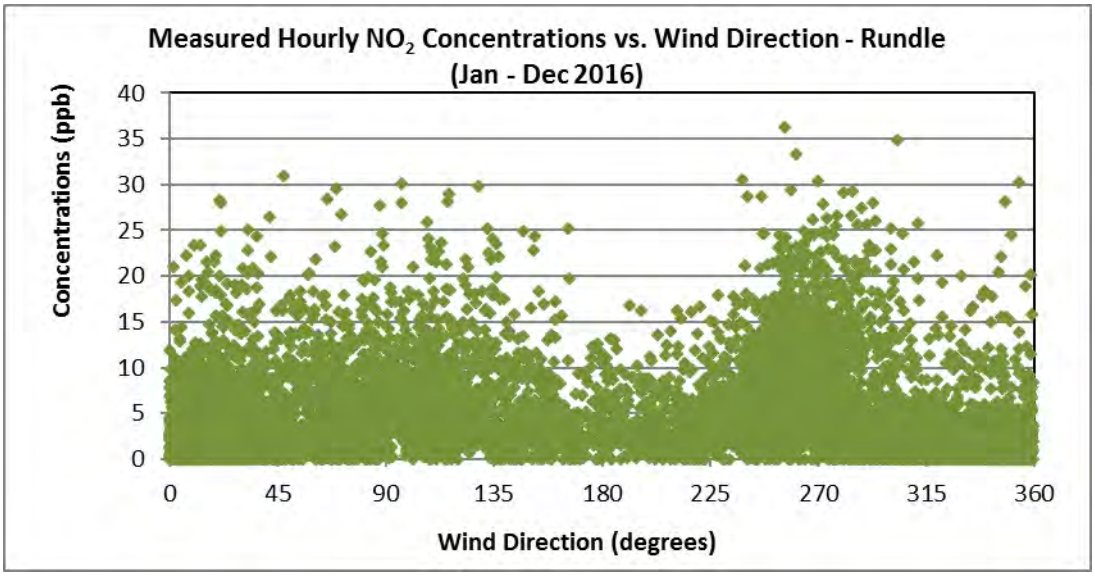
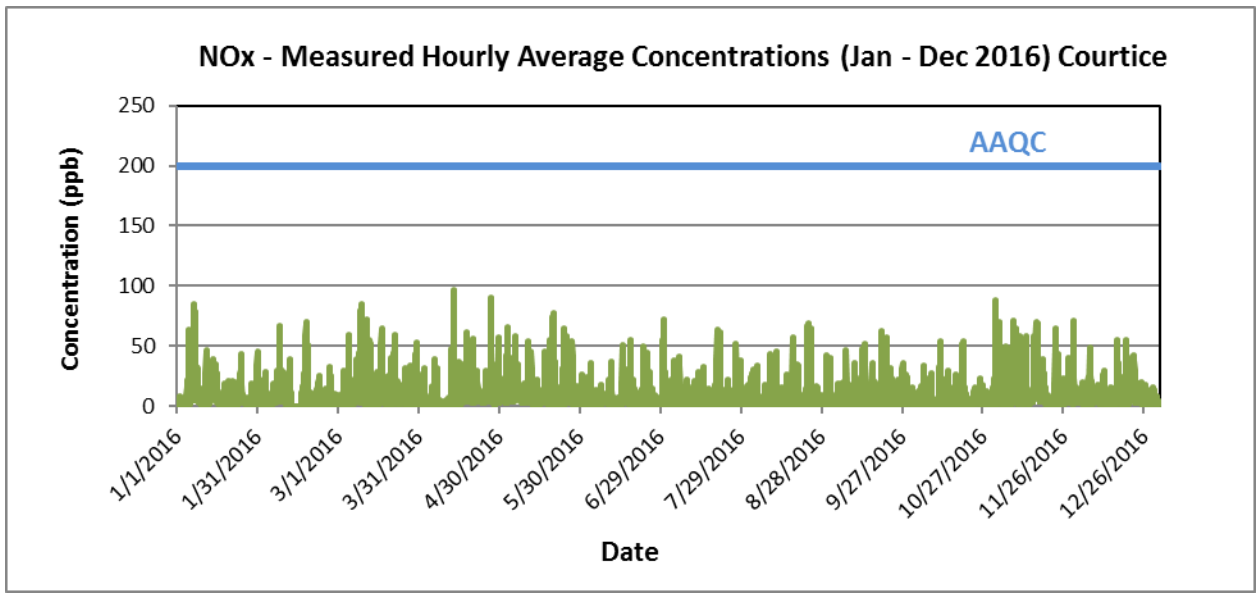


Figure C-4 Measured Hourly Average NO_2 Concentrations vs. Wind Direction - Rundle Road Station



Appendix D NO_X PLOTS

Figure D-1 Time History Plots of Measured Hourly Average and 24 Hour Average NO_x Concentrations – Courtice (WPCP) Station



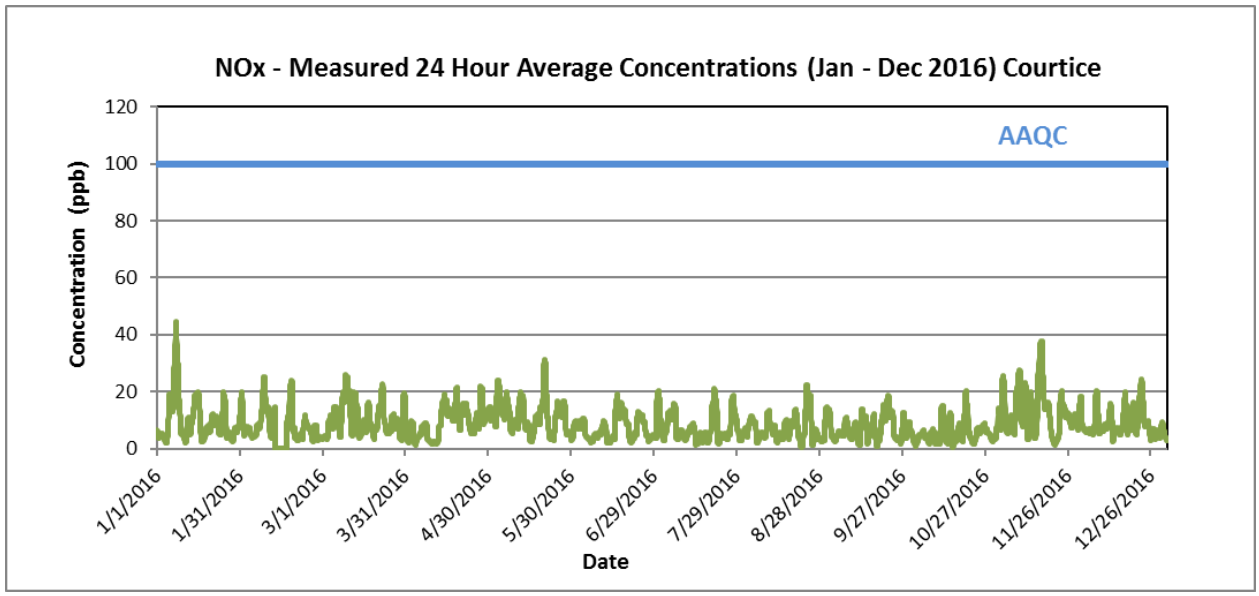
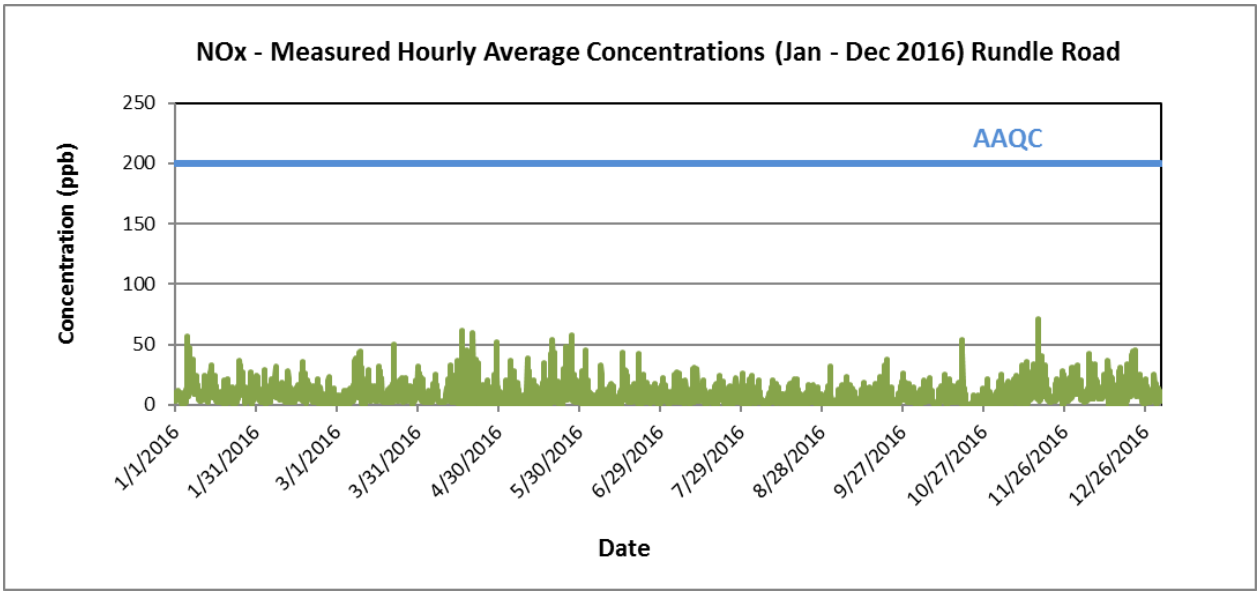


Figure D-2 Time History Plots of Measured Hourly Average and 24 Hour Average NO_x Concentrations – Rundle Road Station



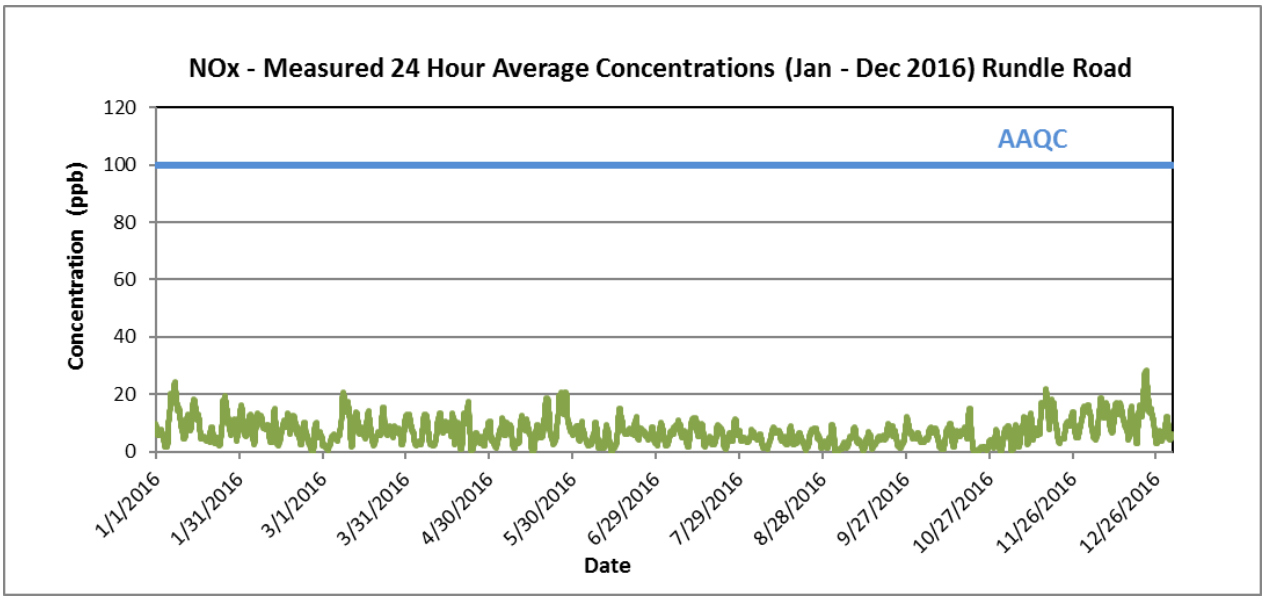


Figure D-3 Measured Hourly NO_X Concentrations vs. Wind Direction – Courtice WPCP Station

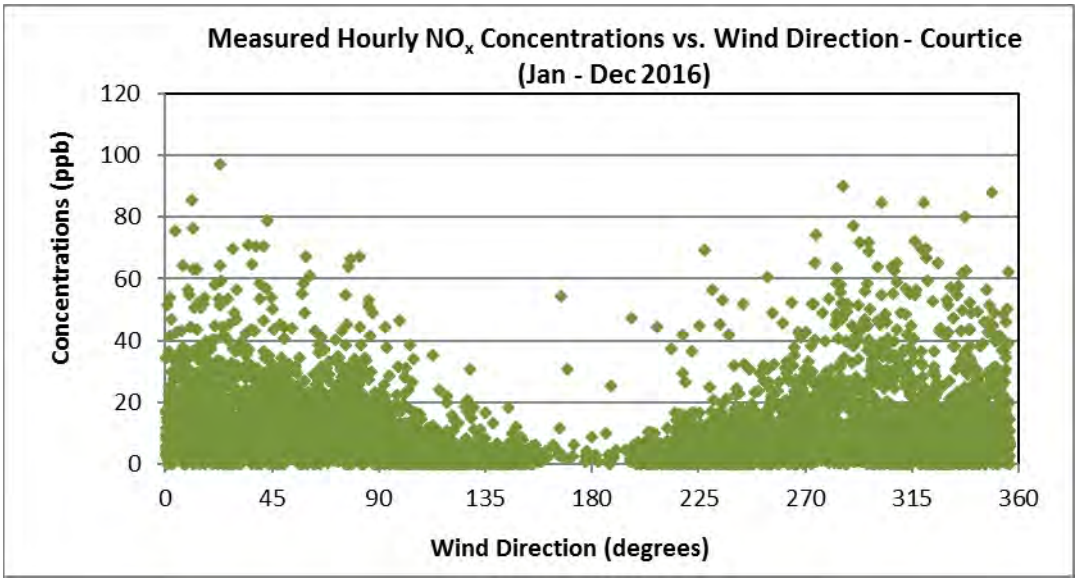
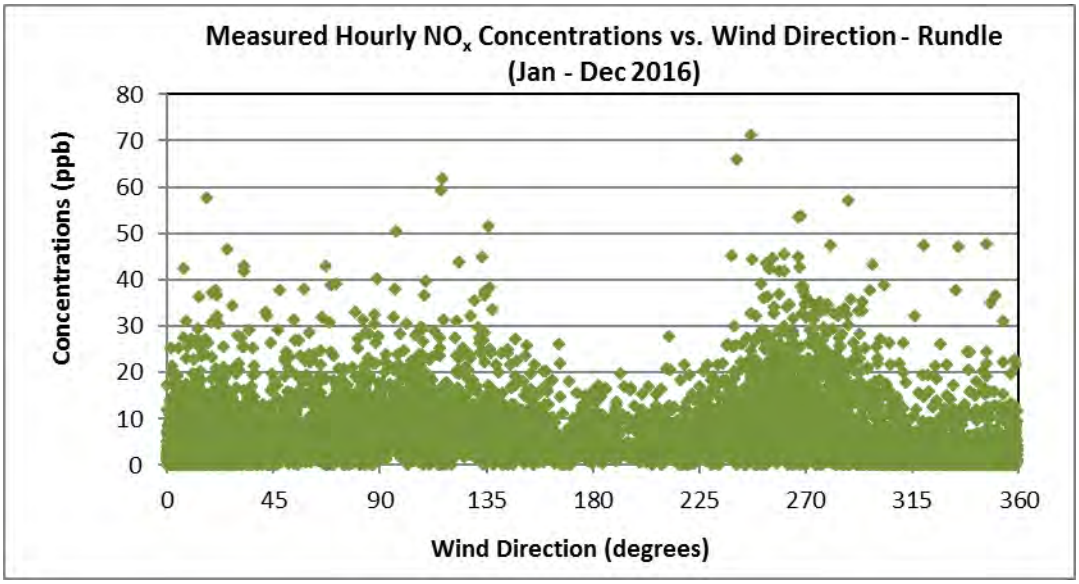


Figure D-4 Measured Hourly NO_X Concentrations vs. Wind Direction - Rundle Road Station



Appendix E PM2.5 PLOT

Figure E-1 Time History Plot of Measured 24 Hour Average $PM_{2.5}$ Concentrations – Courtice WPCP Station

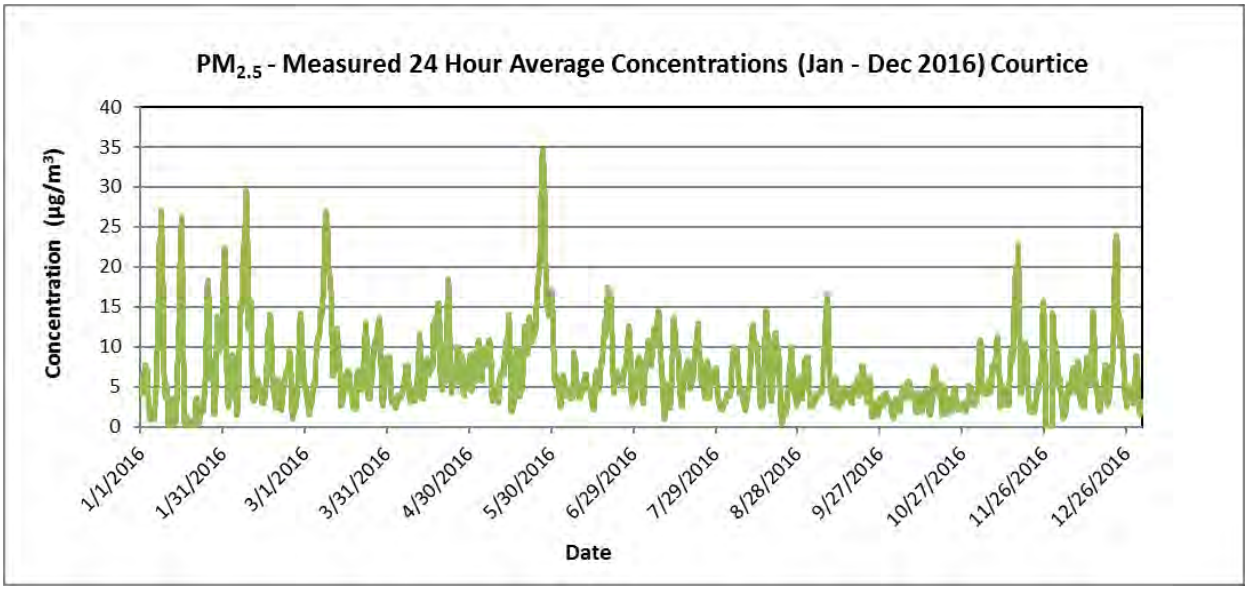


Figure E-2 Time History Plot of Measured 24 Hour Average $PM_{2.5}$ Concentrations – Rundle Road Station

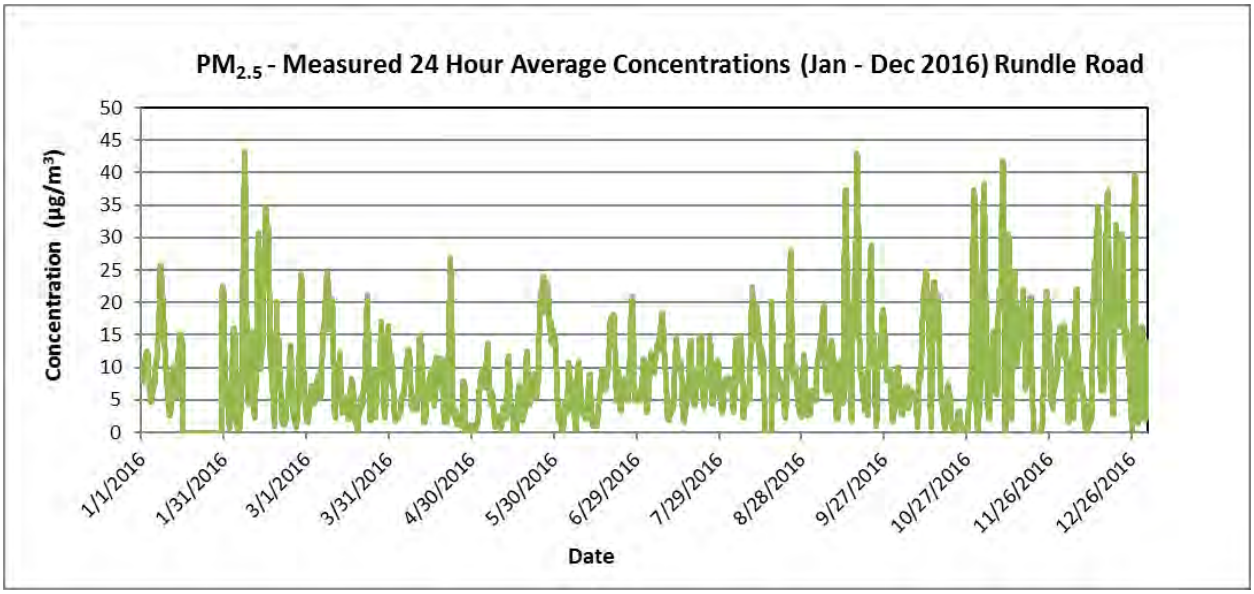


Figure E-3 Measured 24-Hour Average $PM_{2.5}$ Concentrations vs. Measured 24-Hour Vector Averaged Wind Direction Courtice WPCP Station

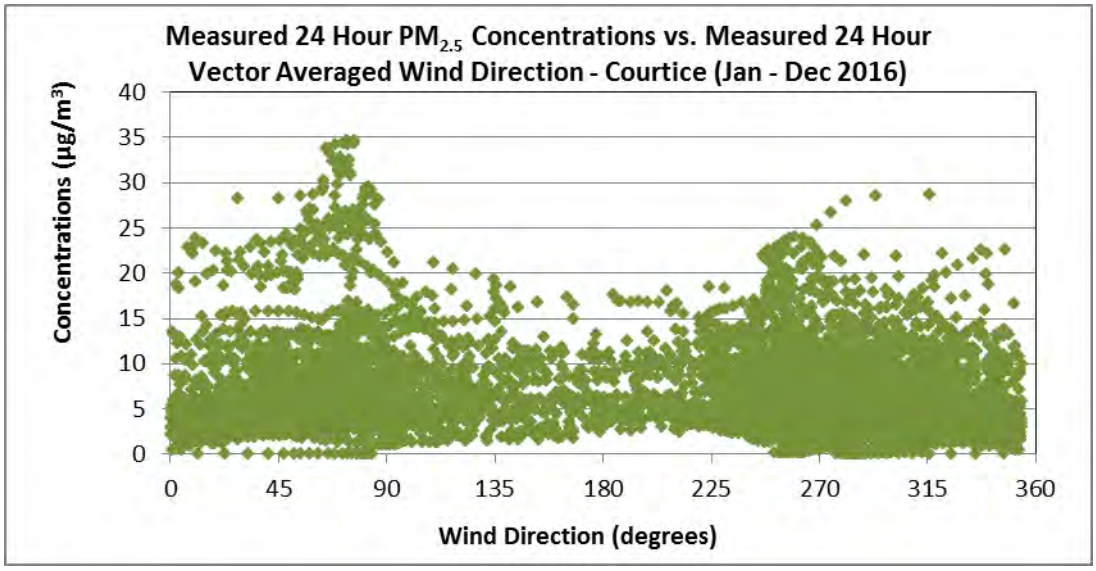


Figure E-4 Measured 24-Hour Average $PM_{2.5}$ Concentrations vs. Measured 24-Hour Vector Averaged Wind Direction – Rundle Road Station