2014 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 are constructing 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 Ambient Air Quality Monitoring Plan - Durham York Residual Waste Study (Stantec, May 8, 2012), was developed 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 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). Concentrations of the following air contaminants were measured at the two stations:

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

Operation of the non-continuous monitors was temporarily discontinued on June 28, 2014 as per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012), which calls for collection of continuous parameters only during commissioning of the Facility. When the EFW facility is fully operational, monitoring of non-continuous monitors will resume (as specified in the Ambient Monitoring Plan).

Meteorological data is also measured at the two stations. The predominantly downwind Rundle Road station measures horizontal wind speed, wind direction, atmospheric temperature, relative humidity and rainfall. The predominantly upwind Courtice station measures atmospheric temperature, relative humidity, rainfall and barometric pressure. Wind speed and wind direction data at the predominantly upwind location are available from 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 two stations for the period January to December 2014.

The 2014 monitoring collected background air quality levels (i.e. air quality without the DYEC operating) while the DYEC was under construction in 2014. The following observations and conclusions were made from a review of the measured ambient air quality monitoring data:

1. Measured levels 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 standards 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 2014 monitoring period were 22.3 µg/m^3 at the Courtice WPCP station and 21.1 µg/m^3 at the Rundle Road station. The Canada Wide Standard (CWS) of 30 µg/m^3 is based on the average of the 98th percentile levels in each of three consecutive years. Due to the different averaging periods, the CWS and the 2014 measurements are not directly comparable;

3. The maximum measured concentrations of TSP and all metals with MOECC air quality criteria were well below their applicable criteria (presented in **Table 2-3** in this report);

4. The maximum measured concentrations of all PAHs with MOECC Ambient Air Quality Criteria, were well below their applicable 24-hour criteria (presented in **Table 2-4**) at both stations with the exception of seven (7) 24-hour average benzo(a)pyrene (B(a)P) measurements. Out of fifteen (15) samples collected at the Rundle Road Station, four (4) samples on January 14, February 8, February 28 and March 24, 2014 exceeded the Ontario 24-hour B(a)P AAQC by levels varying between 34% and 476%. Out of fifteen (15) B(a)P measurements collected at the Courtice WPCP Station, three (3) measurements on February 4, March 24 and June 28, 2014 exceeded the MOECC Ambient Air Quality Criteria by levels varying between 19% and 165%. However, all seven samples were well below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419 24-hour average guideline, and the HHRA health based standard (as shown in **Table 4-4**). 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 (Jacques Whitford, 2009). Therefore, ambient B(a)P levels are not expected to be substantially impacted by the operation of the DYEC.

5. The maximum measured toxic equivalent dioxin and furan concentration was well below the applicable criteria presented in **Table 2-4**; and,

6. In summary, all monitored contaminants were below their applicable MOE criteria during the 2014 monitoring period with the exception of seven (7) benzo(a)pyrene measurements. All measured levels of all monitored contaminants were below their applicable HHRA health-based standards.

Abbreviations

AAQC	Ambient Air Quality Criteria
CAC	Criteria Air Contaminants
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
ppt	part per trillion
min	minimum
max	maximum
µg/m³	microgram per cubic metre

1.0 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

The Regional Municipalities of Durham and York are constructing 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** below.

A monitoring plan, Ambient Air Quality Monitoring Plan - Durham York Residual Waste Study (Stantec, 2012), was developed 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 measureable ground level concentrations resulting from emissions from the DYEC cumulative to local air quality, including validating the predicted concentrations from the dispersion modelling conducted in the Environmental Assessment (Jacques Whitford, 2009);

2. Monitor concentration levels of EFW-related air contaminants in nearby residential areas; and,

3. Quantify background ambient levels of air contaminants in the area.

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

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

Quarterly reports presenting the ambient air quality data collected at these two stations for 2014 were prepared by Stantec and submitted to the Region. This Annual Report summarizes the results of the ambient air monitoring from January to December 2014.

Operation of the non-continuous monitors was temporarily discontinued from June 28, 2014 onwards as per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012), which calls for collection of continuous parameters only during commissioning of the Facility. When the EFW facility is fully operational, monitoring of non-continuous monitors will resume (as specified in the Ambient Monitoring Plan).

1.2 LOCATIONS OF AMBIENT AIR QUALITY MONITORING STATIONS

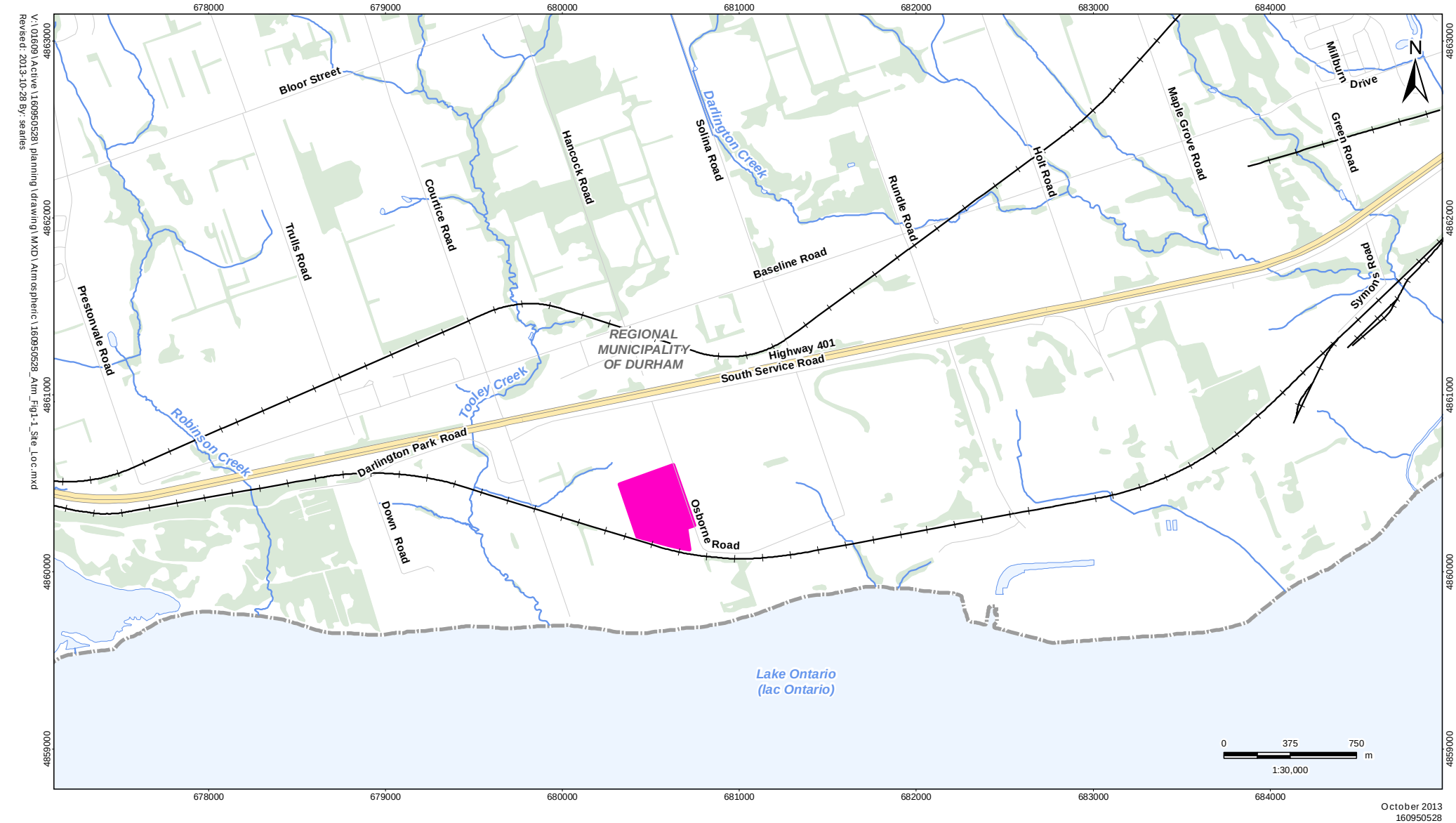
The selection of sites for the monitoring stations was done in consultation with the Ontario Ministry of Environment and Climate Change (MOECC) and Durham/York representatives based on the results of air quality modelling done in support of the environmental assessment for the project, the locations 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 Monitoring Plan.

The selected predominantly downwind location is sited northeast of the DYEC in the vicinity of residential receptors downwind of the DYEC in this direction, and falls in the area where maximum annual concentrations are predicted to occur. The downwind station is located along Rundle Road, south of Baseline Road. Its location is shown in **Figure 1-2**. All the air contaminants listed in Section 1.1 and meteorological data are measured at the monitoring station. This station is referred to as the Rundle Road Station.

The predominantly upwind station is sited at the Courtice Water Pollution Control Plant (WPCP), located to the southwest of the DYEC in order to measure background air quality in the predominantly upwind direction. The location is presented in **Figure 1-2**. The air contaminants presented in Section1.1, as well as meteorological data are measured at this station, with the exception of wind speed and wind direction, which are measured by and available from the Courtice Water Pollution Control Plant.

A third fence line station, which will measure metals and total particulate matter will be installed prior to full operation of the DYEC in 2015 and run for a one-year period.

Photographs of the Rundle Road and Courtice WPCP ambient air quality monitoring stations are shown in **Figures 1-3 and 1-4** respectively.



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October 2013
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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

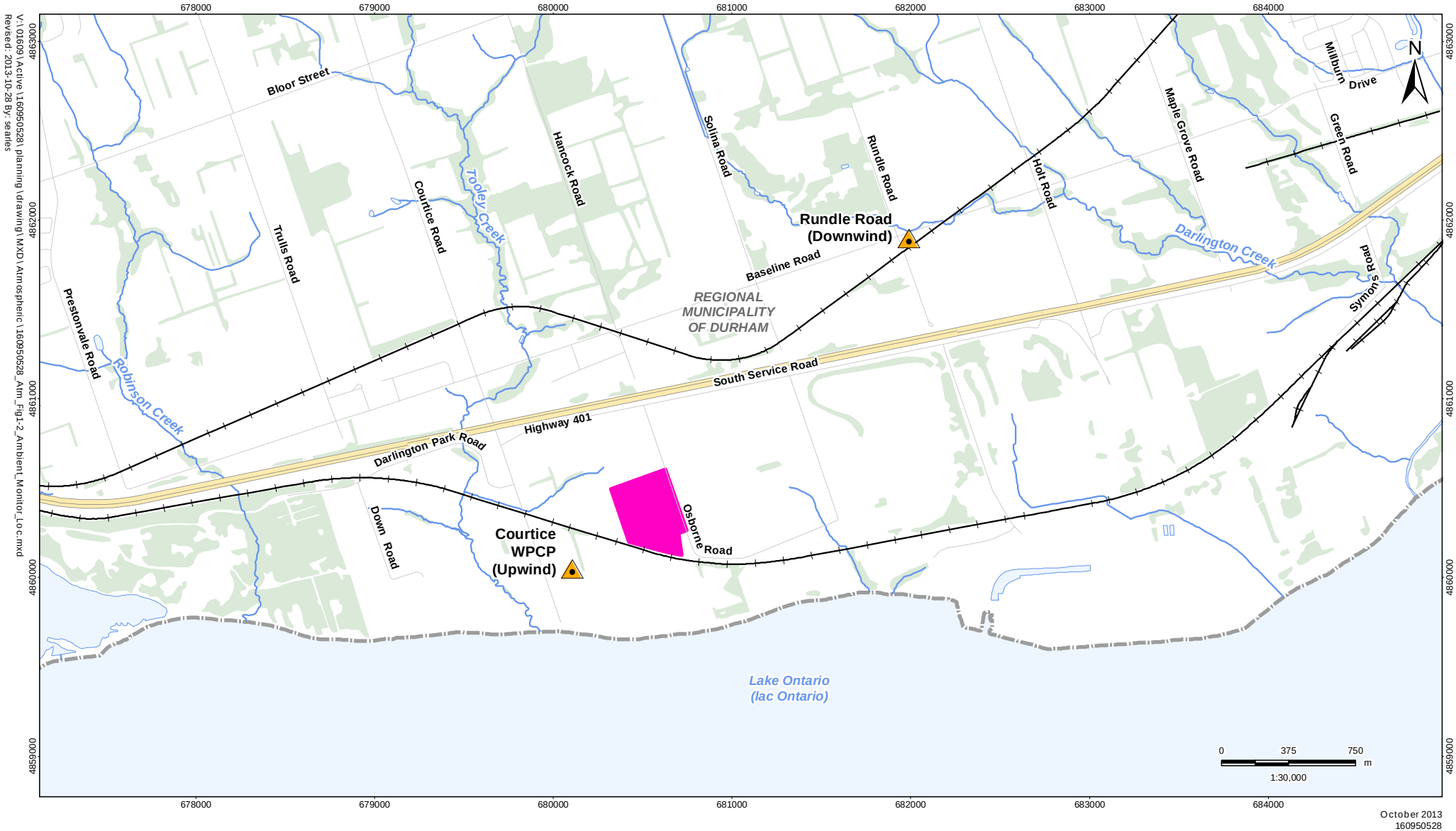
The Region of Durham
Durham York Energy Centre

Figure No.

1-1

Title

Site Location Plan



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Revised: 2013-10-28 By: searles

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Stantec

Legend

- Station Location
- Durham York Energy Centre Site
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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

2.0 KEY COMPONENTS ASSESSED

2.1 METEOROLOGY

The following meteorological parameters are measured at the Rundle Road and Courtice WPCP monitoring stations.

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 @ 20-m	Wind Speed and Direction @10-m
Ambient Temperature @ 2-m	Ambient Temperature @ 2-m
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:

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

Operation of the non-continuous monitors was temporarily discontinued from June 28, 2014 onwards as per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012), which calls for collection of continuous parameters only during commissioning of the Facility. When the EFW facility is fully operational, monitoring of non-continuous monitors will resume (as specified in the Ambient Monitoring Plan). Therefore, the following contaminants were not measured from July to December 2014:

- Total Suspended Particulate (TSP) matter and metals;
- Polycyclic Aromatic Hydrocarbons (PAHs); and,
- Dioxins and Furans (D/Fs).

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 and irritating. 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 NOX are NO_2 with the remaining 90-95% being NO. The conversion of the majority of NO occurs after emission 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.

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 the 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 Smaller than 2.5 Microns ($PM_{2.5}$)

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, etc.).

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 with regard to 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 PAHs

2.2.6 Dioxins and Furans

Dioxins and furans refer to a family of toxic substances that all share a similar chemical structure. Dioxins and furans all 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 of 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
- 1,2,3,4,7,8,9-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 ambient air quality standards were used for comparison to the air quality data as specified in the Ambient Air Monitoring Plan (Stantec, 2012). The first set of standards are the limits as reported in O.Reg.419/05 (Schedules 3 and 6). These are compliance based standards used throughout the province of Ontario. However, not all chemicals have O.Reg.419/05 criteria, and in some instances updated health-based standards were used in the human health risk assessment (HHRA) that was 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 standards.

The applicable Canada-Wide Standard (CWS) for $PM_{2.5}$ in 2014 of 30 µg/m^3 for a daily averaging period (average of the 98th percentile daily average level in each of 3 consecutive years), is noted in **Table 2-2** (CCME, 2000). New Canadian Ambient Air Quality Standards (CAAQS) are being proposed as objectives to replace the existing CWS. The proposed CAAQS for $PM_{2.5}$ would be 28 µg/m^3 by 2015 and 27 µg/m^3 by 2020 (CCME, 2012).

A summary of the relevant ambient air quality criteria is presented in **Tables 2-2 to 2-4** for CACs, metals and PAHs/dioxins and furans respectively.

Table 2-2 Summary of Air Quality Criteria for CACs

Contaminant	CAS	O. Reg 419/05 – Schedule 3/AAQC			HHRA Health-Based Standards		
		1-Hour (µg/m^3)	24-Hour (µg/m^3)	Other time Period (µg/m^3)	1-Hour (µg/m^3)	24-Hour (µg/m^3)	Annual (µg/m^3)
Nitrogen oxides [B]	10102-44-0	400	200		400	200	60
Sulphur dioxide	7446095	690	275	55 [A]; annual	690	275	29
Contaminant	**CAS**	**Canada-Wide Standard**			**HHRA Health-Based Standards**		
		1-Hour (µg/m^3)	24-Hour (µg/m^3)	Other time Period (µg/m^3)	1-Hour (µg/m^3)	24-Hour (µg/m^3)	Other time Period (µg/m^3)
$PM_{2.5}$	N/A		30 [C]			30	

Notes:

A. Ontario Ambient Air Quality Criteria

B. The Schedule 3 standards for NO_X are 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 April 2012 version of O. Reg. 419 Summary of Standards and Guidelines, the standard was also compared to the monitored NO_X.

C. CCME (2000), Canada-Wide Standards for Respirable Particulate Matter and Ozone, effective by 2010. The Respirable Particulate Matter Objective is referenced to the 98th percentile averaged over 3 consecutive years.

Table 2-3 Summary of Air Quality Criteria for Metals

Contaminant	CAS	O. Reg 419/05 – Schedule 3/AAQC			HHRA Health-Based Standards		
		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 Matter	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]
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

Table 2-3 Summary of Air Quality Criteria for Metals

Contaminant	CAS	O. Reg 419/05 – Schedule 3/AAQC			HHRA Health-Based Standards		
		1-Hour (µg/m³)	24-Hour (µg/m³)	Other time Period (µg/m³)	1-Hour (µg/m³)	24-Hour (µg/m³)	Annual (µg/m³)
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	O. Reg 419/05 – Schedule 3/AAQC			HHRA Health-Based Standards			
		1-Hour (ng/m³)	24-Hour (ng/m³)	Other time Period (ng/m³)	1-Hour (ng/m³)	24-Hour (ng/m³)	Annual (ng/m³)	Toxic Equivalency Factor Annual [A, G] (ng/m³)⁻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]	

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

Contaminant	CAS	O. Reg 419/05 – Schedule 3/AAQC			HHRA Health-Based Standards			
		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] $(ng/m^3)^{-1}$
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
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 Schedule 6 Upper Risk Thresholds
D. Future O. Reg. 419 Standard that will be in effect in 2016
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 O. Reg.419 Summary of Standards and Guidelines, and the corresponding WHO_{2005} toxic equivalency factors (TEFs).
F. Ontario Ambient Air Quality Criteria
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) are 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

Table 3-1 Summary of Continuous Ambient Air Quality Monitors

Contaminant	Monitor	Principle of Operation	Range	Time Interval
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, hi-volume air samplers are installed at each of the Courtice WPCP (upwind) and Rundle Road (downwind) monitoring stations to collect metals in total suspended particulates (TSP), polycyclic aromatic hydrocarbons (PAHs) and dioxins and furans. Monitoring for metals/TSP, PAHs and dioxins and furans are conducted per the methodology and analyses described in the Ambient Air Monitoring Plan (Stantec 2012) as presented in **Table 3-2**. The sampling schedule corresponded with the Ontario MOECC province-wide ambient sampling schedule. 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 analyzed 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 / Furans				24 hour sample taken every 24 days

The predominantly downwind Rundle Road station measures horizontal wind speed, wind direction, atmospheric temperature, relative humidity and rainfall. The predominantly upwind Courtice station measures atmospheric temperature, relative humidity, rainfall and barometric pressure. Wind speed and wind direction data at the upwind location are available from the Courtice Water Pollution Control Plant. The meteorological sensors at the Rundle Road station are mounted on an external 10-m aluminum tower and are logged using a digital data acquisition system (DAS). The meteorological equipment includes the following:

Table 3-3 Summary of Meteorological Equipment

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

A Campbell Scientific CRX1000 station data acquisition system is used to collect continuous instrument monitoring data and status codes from the ambient air quality monitors. Continuous station data is 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

Monitoring station visits were conducted on a regular basis. During the station visits, the integrity and proper operation of the sampling and monitoring equipment and of the data acquisition systems, to ensure the collection of valid and complete data were verified, as well as the continued safe and secure environment at the station.

Station visits 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 2014 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 investigated and rectified. If required, Valley Environmental was notified to dispatch a trained technician to address the issue.

3.3 DATA ACQUISITION/ARCHIVING

Continuous station data are maintained in the data loggers, and 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 was 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 ;
- All 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.

Details of the data editing are presented in the quarterly reports.

3.4 INSTRUMENTATION CALIBRATION

Continuous Monitors

All samplers were calibrated when they were installed in the field before their first use. On-going performance checks and external calibrations of the continuous monitors were performed monthly and met the recommended calibration schedule listed in the MOECC Operations Manual. 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.

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

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 requirement of quarterly calibrations.

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

Five MOECC audits were conducted in 2014. These were done on January 10, March 26, June 9, August 21 and December 3 for the continuous monitors ($PM_{2.5}$, SO_2, and $NO_X/NO_2/NO$) at both the Courtice WPCP and Rundle Road Stations. MOECC audits of the non-continuous hi-volume air samplers at both monitoring stations were conducted on June 9, 2014. All monitors passed the MOECC performance and site audits, and calibrations met all current MOECC criteria.

3.6 INSTRUMENTATION ISSUES

A few instrumentation issues were encountered during 2014. Issues with the monitors were generally associated with power outages, ice build-up on a monitor, UV lamp replacement and 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 2014 monitoring period is presented in **Tables A-3 and A-4** in **Appendix A**.

3.7 DATA RECOVERY RATES

Data recovery rates for each continuous monitor at the two monitoring stations during the 2014 sampling period (January to December 2014) are presented in **Tables 3-4 and 3-5**. The data recovery rates for all contaminants at both stations met or exceeded MOECC requirements for data validity.

Table 3-4 Summary of Data Recovery Rates for the Courtice WPCP Station (Upwind) –2014 Monitoring Period

Parameter	Valid Measurement Hours	Data Recovery Rate (%)
SO_2	8712	99.5%
NO_X	8718	99.5%
$PM_{2.5}$	8630	98.5%
Temperature	8758	100.0%
Rainfall	8158	93.1%
Relative Humidity	8758	100.0%
Pressure	8758	100.0%
Wind Speed/Direction	8717	99.5%
TSP/Metals	28 [A]	93%
PAHs	15 [A]	100%
Dioxins and Furans	8 [A]	100%

Note:

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

Table 3-5 Summary of Data Recovery Rates for the Rundle Road Station (Downwind) – 2014 Monitoring Period

Parameter	Valid Measurement Hours	Data Recovery Rate (%)
SO_2	8626	98.5%
NO_X	8712	99.5%
$PM_{2.5}$	8718	99.5%
Temperature	8751	99.9%
Rainfall	8751	99.9%
Relative Humidity	8751	99.9%
Pressure	8758	100.0%
Wind Speed/Direction	8751	99.9%
TSP/Metals	30 [A]	100%
PAHs	15 [A]	100%
Dioxins and Furans	8 [A]	100%

Note:

A. a – Number of filters/24-hour average samples.

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 2014 is presented in **Table 4-1**.

Table 4-1 Summary of Hourly Meteorological Measurements –2014 Monitoring Period

Parameter		Courtice WPCP (Upwind)	Rundle Road (Downwind)	Units
Temperature	Max	25.8	26.6	C
	Min	-24.8	-25.7	C
	Mean	6.8	6.6	C
	Standard Deviation	10.5	10.9	C
Rainfall	Max	14.9	13.7	mm
	Min	0.0	0.0	mm
	Mean	0.08	0.09	mm
	Standard Deviation	0.52	0.55	mm
Relative Humidity	Max	100.0	100.0	%
	Min	25.1	26.7	%
	Mean	72.9	75.4	%
	Standard Deviation	13.8	15.3	%
Pressure [A]	Max	30.5	-	in Hg
	Min	28.9	-	in Hg
	Mean	29.7	-	in Hg
	Standard Deviation	0.2	-	in Hg
Wind Speed [B]	Max	58.6	45.2	km/hr
	Min	0.2	0.0	km/hr
	Mean	12.5	11.1	km/hr
	Standard Deviation	7.7	7.1	km/hr

Notes:

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

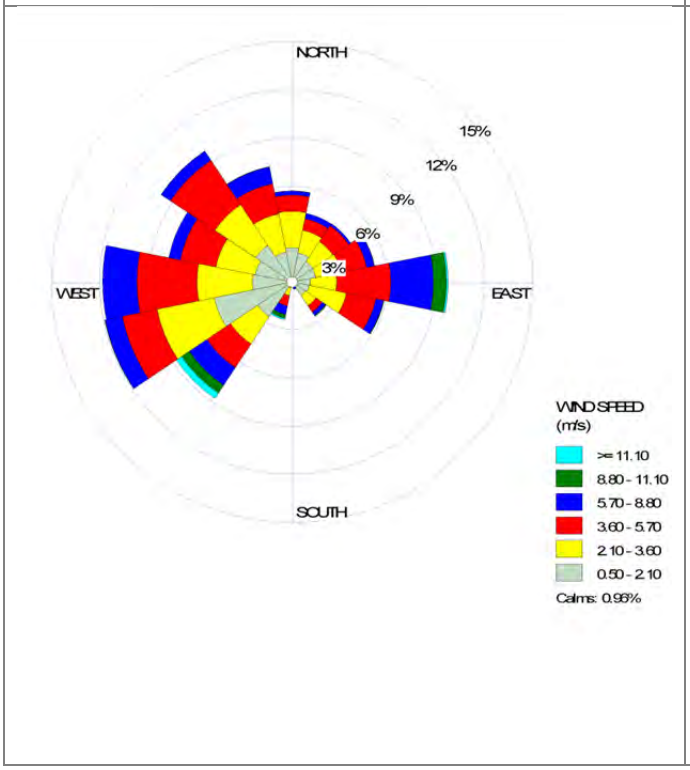
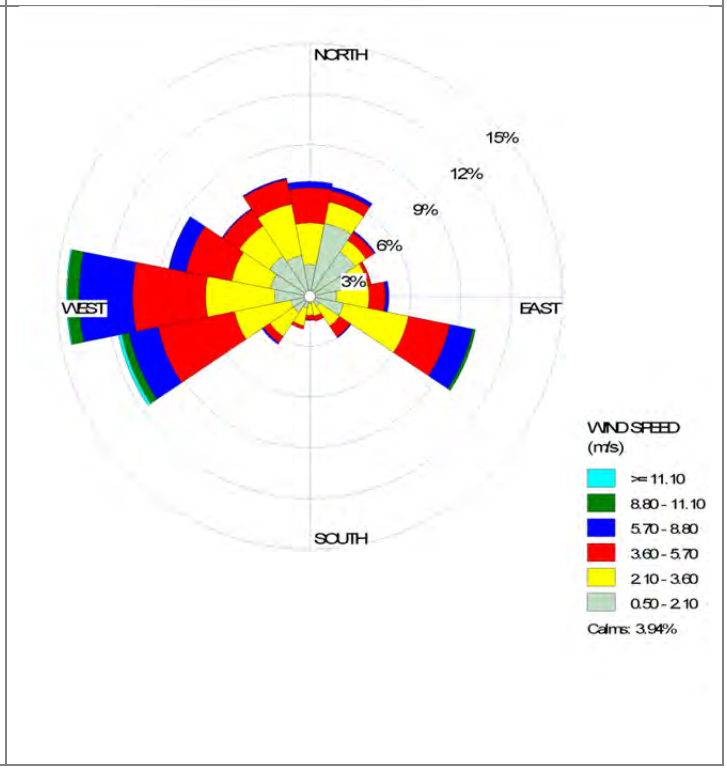
B. Wind speed at the Courtice WPCP Station is measured at 20-m and at the Rundle Road Station at 10-m.

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 2014 at the Courtice WPCP Station occurred predominantly from west to west-southwesterly directions. Winds blew infrequently from the south. At the Rundle Road Station, the predominant wind direction was winds blowing from westerly 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 2014 Monitoring Period (Jan-Dec 2014)

Courtice WPCP (Upwind) at 20-m Above Ground	Rundle Road (Downwind) at 10-m Above Ground
	

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** is the number of exceedances (if any occurred) of the relevant Ontario ambient air quality criteria (AAQC) or health-based standard for each contaminant. All monitored contaminants were below their applicable hourly, 24-hour and annual average criteria during 2014.

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, 2012a). However, as per the April 2012 version of O.Reg. 419 Summary of Standards and Guidelines (MOECC, 2012b), the Schedule 3 criteria for NO_X were 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 - 2014 Monitoring Period

Pollutant	Averaging Period	AAQC / HHRA Health-Based Standards			Courtice WPCP (Upwind)		Rundle Road (Downwind)	
		µg/m³	ppb		Concentration (µg/m³)	Concentration (ppbv)	Concentration (µg/m³)	Concentration (ppbv)
SO_2	1	690	250	Maximum	120.7	43.3	91.6	34.1
				Minimum	0.0	0.0	0.0	0.0
				Mean	4.0	1.5	1.8	0.7
				Standard Deviation	6.0	2.2	3.3	1.2
				# of Exceedances	0	0	0	0
	24	275	100	Maximum	43.7	15.6	11.2	4.2
				Minimum	0.0	0.0	0.0	0.0
				Mean	4.0	1.5	1.8	0.7
				Standard Deviation	3.6	1.3	1.6	0.6
				# of Exceedances	0	0	0	0
	Annual	55 / 29 [A]	20 / 11 [A]	Mean (Period)	4.0	1.5	1.8	0.7
				# of Exceedances	0	0	0	0
$PM_{2.5}$	24	30 [B]	NA	Maximum	43.2	-	41.3	-
				Minimum	0.2	-	0.2	-
				Mean	8.6	-	8.5	-
				98th Percentile [C]	22.3	-	21.1	-
				Standard Deviation	5.6	-	5.2	-
				# of Exceedances	N/A	-	N/A	-

Table 4-2 Summary of Ambient CAC Monitoring Data - 2014 Monitoring Period

Pollutant	Averaging Period	AAQC / HHRA Health-Based Standards			Courtice WPCP (Upwind)		Rundle Road (Downwind)	
		µg/m³	ppb		Concentration (µg/m³)	Concentration (ppbv)	Concentration (µg/m³)	Concentration (ppbv)
NO_2	1	400 [D]	200 [D]	Maximum	108.6	52.7	117.4	62.2
				Minimum	0.0	0.0	0.0	0.0
				Mean	16.1	8.0	12.2	6.1
				Standard Deviation	15.7	7.6	11.8	5.8
				# of Exceedances	0	0	0	0
	24	200 [D]	100 [D]	Maximum	68.8	31.7	60.4	28.0
				Minimum	0.1	0.1	0.0	0.0
				Mean	16.1	8.0	12.2	6.1
				Standard Deviation	9.7	4.6	8.1	3.9
				# of Exceedances	0	0	0	0
	Annual	60	30	Mean	16.1	8.0	12.2	6.1
				# of Exceedances	0	0	0	0

Table 4-2 Summary of Ambient CAC Monitoring Data - 2014 Monitoring Period

Pollutant	Averaging Period	AAQC / HHRA Health-Based Standards			Courtice WPCP (Upwind)		Rundle Road (Downwind)	
		µg/m³	ppb		Concentration (µg/m³)	Concentration (ppbv)	Concentration (µg/m³)	Concentration (ppbv)
NO [E]	1	NA	NA	Maximum	108.3	79.1	53.5	38.2
				Minimum	0.2	0.1	0.0	0.0
				Mean	5.1	3.9	3.0	2.3
				Standard Deviation	7.5	5.7	3.8	2.9
				# of Exceedances	NA	NA	NA	NA
	24	NA	NA	Maximum	30.3	21.7	15.8	11.2
				Minimum	0.6	0.5	0.0	0.0
				Mean	5.1	3.9	3.0	2.3
				Standard Deviation	3.9	2.9	1.7	1.3
				# of Exceedances	NA	NA	NA	NA

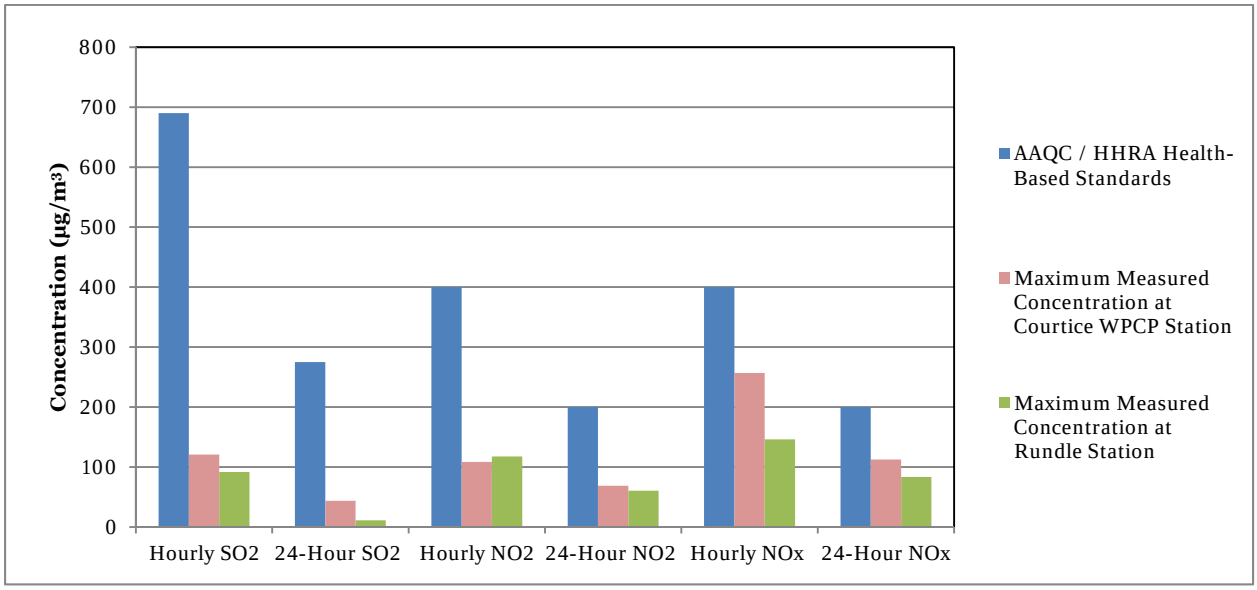
Table 4-2 Summary of Ambient CAC Monitoring Data - 2014 Monitoring Period

Pollutant	Averaging Period	AAQC / HHRA Health-Based Standards			Courtice WPCP (Upwind)		Rundle Road (Downwind)	
		µg/m³	ppb		Concentration (µg/m³)	Concentration (ppbv)	Concentration (µg/m³)	Concentration (ppbv)
NO_X	1	400 [D]	200 [D]	Maximum	256.7	122.2	146.2	70.0
				Minimum	0.0	0.0	0.0	0.0
				Mean	21.7	10.8	15.6	7.8
				Standard Deviation	24.7	12.0	15.4	7.6
				# of Exceedances	0	0	0	0
	24	200 [D]	100 [D]	Maximum	112.5	52.1	83.4	38.6
				Minimum	2.6	1.4	0.0	0.0
				Mean	21.7	10.8	15.5	7.8
				Standard Deviation	14.6	7.0	9.7	4.7
				# of Exceedances	0	0	0	0
	Annual	60	30	Mean	21.7	10.8	15.6	7.8
				# of Exceedances	0	0	0	0

Notes:

A. Annual AAQC / Annual HHRA.
B. Canada-Wide Standards 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.
C. The 98th percentile of the daily average $PM_{2.5}$ measurements in the period.
D. As per current version (April 2012) of Reg 419 Summary of Standards and Guidelines, the air standard for NO_X is compared to a monitored NO_X concentration, although the Reg419 Schedule 3 standard for NO_X is based on health effects of NO_2.
E. NO has no regulatory criteria.
F. Daily $PM_{2.5}$ concentrations were not compared to the Canada Wide 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.

Figure 4-2 Comparison of NO_2 / NO_X and SO_2 Ambient Monitoring Data to Applicable Criteria –2014 Monitoring Period



Detailed discussion for each measured contaminant is presented in the following sections.

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 690 µg/m³ and 275 µg/m³ are shown as blue lines on each plot. As shown in these figures, measured ambient SO_2 concentrations at both stations were well below the criteria. The annual Ontario AAQC for SO_2 is 55 µg/m³, and the annual HHRA criterion is 29 µg/m³.

The maximum hourly, 24-hour, annual average concentrations measured at the Courtice WPCP station during the 2014 monitoring period were 120.7, 43.7 and 4.0 µg/m³, respectively, which are 17.5%, 15.9% and 13.9% 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 2014 were 91.6, 11.2 and 1.8 µg/m³, respectively, which are 13.3%, 4.1% and 6.3% 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). Plots of the measured hourly average SO_2 concentrations versus wind direction are presented in **Appendix B, Figures B3 and B4**.

For the Courtice WPCP Station, the maximum measured concentration occurred for north-northeasterly winds – a direction in which Highway 401 and the St. Mary's Cement Plant are upwind of the monitoring station. For the Rundle Road station, the measured hourly average concentrations were higher for southeasterly winds as well as for westerly to southwesterly winds directions. Highway 401 and a CN railway are upwind of the Rundle station for southwesterly to southeasterly wind directions.

April 2015
160950528

Stantec

Legend

- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

Concentration (ug/m³)

- 50 - 175
- 10 -50
- 5 - 10
- 1 - 5
- 0 - 1

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.
3. Orthoimagery © First Base Solutions, 2013.

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

4-3

Title

Pollution Roses of Measured Hourly Average SO_2 Concentrations - 2014 Monitoring Period

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 form 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 form of NO_X, the AAQC were compared to measured NO_2 concentrations (MOECC, 2012a). However, as per the current April 2012 version of O. Reg. 419 Summary of Standards and Guidelines (MOECC, 2012b), the NOx Schedule 3 criteria were 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 the hourly and 24-hour averages, the Ontario AAQCs of 400 µg/m³ and 200 µg/m³ are shown as blue lines on the time history plots. 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 2014 were 108.6, 68.8 and 16.1 µg/m³, respectively which are 27.2%, 34.4% and 26.8% of the applicable ambient 1-hour and 24-hour air quality criteria. At the Rundle Road Station, the maximum measured hourly and 24-hour average concentrations were 117.4, 60.4 and 12.2 µg/m³, which are 29.4%, 30.2% and 20.4% of the applicable air quality criteria.

Pollution roses of hourly NO_2 concentrations are presented in **Figure 4-4**. Plots of measured hourly average NO_2 concentrations versus measured wind direction are presented in **Appendix C, Figures C3 and C4**. The maximum measured hourly average concentration for the Courtice WPCP Station occurred for northwesterly winds - a direction in which the CN railway, Highway 401 and an agricultural area are upwind of the station. At the Rundle Road Station, higher hourly average NO_2 concentrations were measured for winds blowing from northwesterly directions, for which Rundle Road and some commercial businesses are upwind of the station.

April 2015
160950528

Stantec

Legend

- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

Concentration (ug/m³)

- 70 - 145
- 20 - 70
- 10 - 20
- 5 - 10
- 0 - 5

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
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The Region of Durham
Durham York Energy Centre

Figure No.

4-4

Title

Pollution Roses of Measured Hourly Average NO_2 Concentrations - 2014 Monitoring Period

4.2.3 Nitrogen Oxides (NO_X)

Time history plots of the hourly and 24-hour average NO_x concentrations over the measurement period are presented in **Appendix D, Figures D1 and D2**. For the hourly and 24-hour averages, the Ontario Schedule 3 criteria of 400 µg/m³ and 200 µg/m³ are shown as blue lines on each time history plot. As indicated in the section above, although the criteria were compared to the measured NO_X 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 station were below the criteria during the monitoring period. The measured concentrations at the Rundle Road station were also well below the criteria.

As presented in **Table 4-2**, the maximum hourly average NO_X concentration measured at the Courtice WPCP station was 256.7 µg/m³, which is 64.2% of the 1-hour ambient criteria. The 24-hour and annual average NO_X concentrations measured at this station were 112.5 µg/m³ and 21.7 µg/m³, which are 56.3% and 36.2% of the applicable ambient air quality criteria. At the Rundle Road Station, the maximum hourly, 24-hour and annual average concentrations measured in 2014 were 146.2, 83.4 and 15.6 µg/m³, which are 36.6%, 41.7% and 25.9% 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**. Wind direction plots for NO_X are presented in **Appendix D Figures D3 and D4**. The maximum measured hourly average NO_X concentration for the Courtice WPCP Station occurred for winds blowing from the northeast, in which direction the Courtice WPCP and the DYEC construction site were upwind. Elevated NO_X concentrations were also measured for westerly to northerly winds, for which the CN railway, agricultural lands and Highway 401 are upwind.

At the Rundle Road Station, the maximum measured hourly average NO_x concentration occurred for westerly winds. In this direction, Rundle Road and some commercial businesses are situated upwind of the monitoring station.

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Revised: 2015-04-14 By: bcowper

Stantec

Legend

- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

Concentration (ug/m³)

- 100 - 260
- 50 - 100
- 20 - 50
- 10 - 20
- 0 - 10

Notes

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The Region of Durham
Durham York Energy Centre

Figure No.

4-5

Title

Pollution Roses of Measured Hourly Average NO_x Concentrations – 2014 Monitoring Period

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

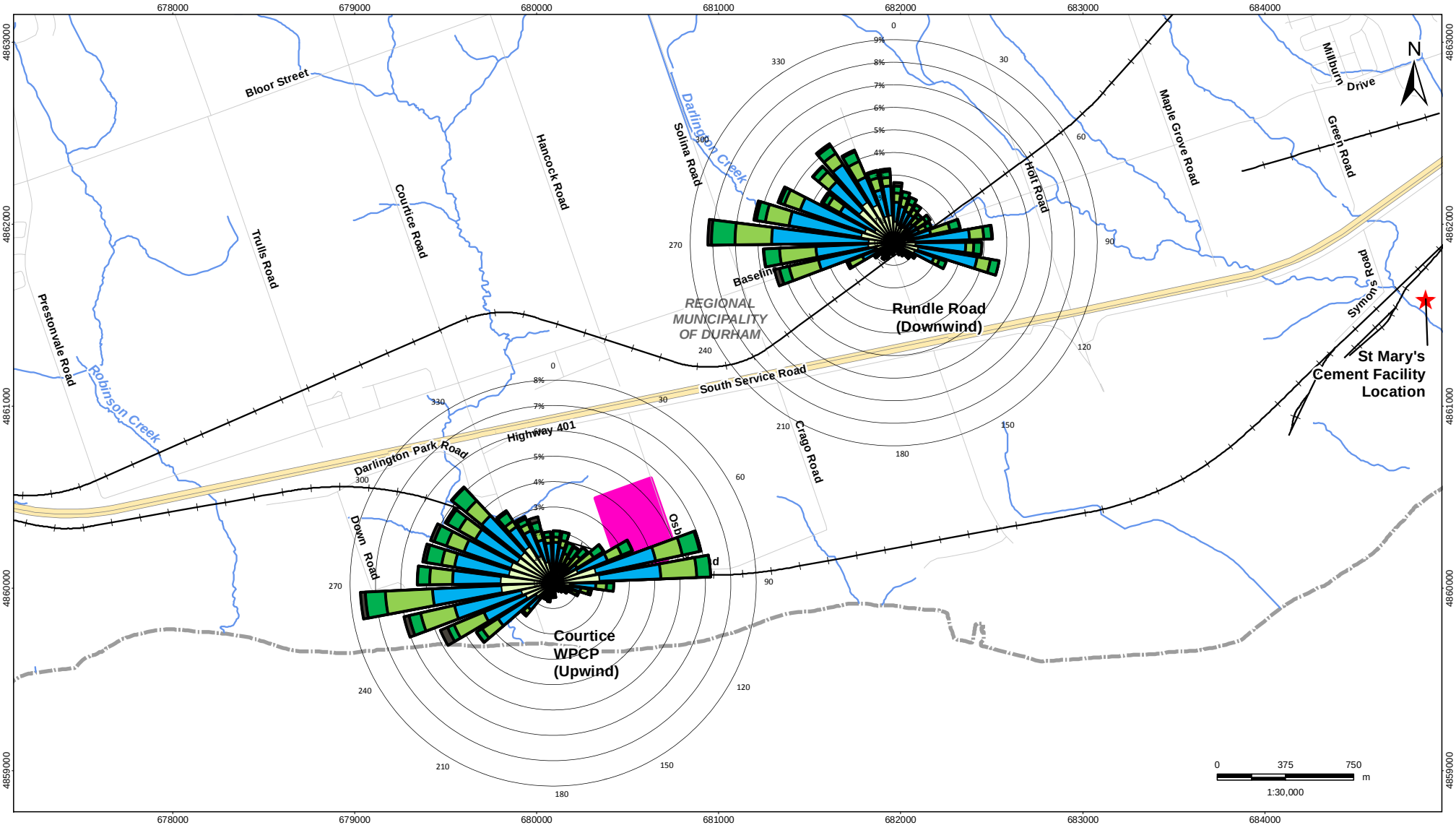
Time history plots of the measured 24-hour average $PM_{2.5}$ concentrations over the measurement period are presented in **Appendix E, Figures E1 and E2**.

The maximum 24-hour average $PM_{2.5}$ concentration measured at the Courtice WPCP station over the monitoring period was 43.2 µg/m³. The maximum measured 24-hour average $PM_{2.5}$ concentration at the Rundle Road station was 41.3 µg/m³. The 98th percentiles of the daily average $PM_{2.5}$ concentrations measured over the monitoring period were 22.3 µg/m³ at the Courtice WPCP Station and 21.1 µg/m³ at the Rundle Road Station. For the period considered in this report (12 months), the 98th percentile of this annual monitoring period is below the CWS criteria. However, a comparison to the CWS for $PM_{2.5}$ requires averaging the 98th percentile daily average levels in at least two of three consecutive years and as a result, the period 98th percentile $PM_{2.5}$ data were not explicitly compared to the current CWS criteria in **Table 4-2**.

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. 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**.

The maximum measured $PM_{2.5}$ concentration at the Courtice WPCP Station occurred for easterly winds, with elevated $PM_{2.5}$ concentrations (relative to other directions) also measured for winds blowing from southwesterly to northwesterly directions. The Courtice WPCP (the water pollution control plant) and the DYEC construction site were upwind of this monitoring station for easterly winds, while an agricultural area, the CN railway and Highway 401 are located upwind of the monitoring station for southwesterly to northwesterly winds.

At the Rundle Road Station, the maximum measured 24-hour average $PM_{2.5}$ concentration occurred for easterly winds – for this wind direction the St. Mary's Cement Facility is located upwind of the Rundle Road station. Elevated $PM_{2.5}$ concentrations (relative to other directions) were also measured for winds blowing from the southwesterly to northwesterly directions for which some commercial businesses and Highway 401 are upwind.



May 2015
160950528

Stantec

Legend

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

Concentration (ug/m³)

- 25 - 45
- 15 -25
- 10 - 15
- 5 - 10
- 0 - 5

Notes

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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 – 2014 Monitoring Period

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 4-3**.

The maximum measured concentrations of TSP and all metals with MOECC air quality criteria during the 2014 non-continuous contaminants monitoring period (January 2014 – June 2014) were well below their applicable 24-hour criteria (shown in **Table 4-3** below) at both stations. As discussed in Section 1.1, operation of the non-continuous monitors was temporarily discontinued on June 28, 2014 as per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012).

Table 4-3 Summary of Measured Ambient TSP/Metals Concentrations – 2014 Monitoring Period

Contaminant	Units	MOECC Criteria (Daily Average)	HHRA Health Based Standard (Daily Average)	Courtice WPCP (Upwind)				Rundle Road (Downwind)			
				Max	Min	Period Arithmetic Mean	No. of Exceedances	Max	Min	Period Arithmetic Mean	No. of Exceedances
Particulate	µg/m³	120	120	57	4	25 / 21 [A]	0	59	8	25 / 23 [A]	0
Total Mercury (Hg)	µg/m³	2	2	2.15E-05	4.56E-06	9.48E-06	0	2.94E-05	5.89E-07	8.80E-06	0
Aluminum (Al)	µg/m³	4.8	-	3.57E-01	1.57E-02	1.18E-01	0	2.90E-01	1.39E-02	1.12E-01	0
Antimony (Sb)	µg/m³	25	25	3.91E-03	2.12E-03	2.87E-03	0	3.41E-03	1.96E-03	2.81E-03	0
Arsenic (As)	µg/m³	0.3	0.3	2.35E-03	1.27E-03	1.73E-03	0	2.05E-03	1.18E-03	1.69E-03	0
Barium (Ba)	µg/m³	10	10	1.90E-02	1.36E-03	6.02E-03	0	1.18E-02	1.57E-03	5.54E-03	0
Beryllium (Be)	µg/m³	0.01	0.01	3.91E-04	2.12E-04	2.87E-04	0	3.41E-04	1.96E-04	2.81E-04	0
Bismuth (Bi)	µg/m³	-	-	2.35E-03	1.27E-03	1.73E-03	-	2.05E-03	1.18E-03	1.69E-03	-
Boron (B)	µg/m³	120	-	5.61E-03	1.27E-03	2.05E-03	0	4.43E-03	1.18E-03	1.91E-03	0
Cadmium (Cd)	µg/m³	0.025	0.025	1.18E-03	4.25E-04	6.02E-04	0	6.83E-04	3.92E-04	5.64E-04	0
Chromium (Cr)	µg/m³	0.5	-	6.29E-03	1.06E-03	1.97E-03	0	4.75E-03	9.80E-04	1.74E-03	0
Cobalt (Co)	µg/m³	0.1	0.1	7.83E-04	4.25E-04	5.76E-04	0	6.83E-04	3.92E-04	5.64E-04	0
Copper (Cu)	µg/m³	50	-	5.95E-02	8.92E-03	3.31E-02	0	1.93E-01	7.90E-03	5.79E-02	0
Iron (Fe)	µg/m³	4	-	9.26E-01	5.54E-02	3.79E-01	0	9.30E-01	6.77E-02	3.97E-01	0
Lead (Pb)	µg/m³	0.5	0.5	5.50E-03	6.37E-04	1.88E-03	0	7.34E-03	6.63E-04	2.17E-03	0
Magnesium (Mg)	µg/m³	-	-	4.13E-01	1.57E-02	1.81E-01	-	2.97E-01	1.39E-02	1.68E-01	-
Manganese (Mn)	µg/m³	0.4	-	3.08E-02	1.60E-03	1.25E-02	0	2.60E-02	1.79E-03	1.17E-02	0

Table 4-3 Summary of Measured Ambient TSP/Metals Concentrations – 2014 Monitoring Period

Contaminant	Units	MOECC Criteria (Daily Average)	HHRA Health Based Standard (Daily Average)	Courtice WPCP (Upwind)				Rundle Road (Downwind)			
				Max	Min	Period Arithmetic Mean	No. of Exceedances	Max	Min	Period Arithmetic Mean	No. of Exceedances
Molybdenum (Mo)	µg/m³	120	-	2.36E-03	6.37E-04	9.24E-04	0	2.76E-03	5.88E-04	1.15E-03	0
Nickel (Ni)	µg/m³	0.2	-	2.78E-03	6.37E-04	1.06E-03	0	4.58E-03	5.88E-04	1.23E-03	0
Phosphorus (P)	µg/m³	-	-	1.05E-01	5.31E-03	3.10E-02	-	1.85E-01	5.04E-03	3.47E-02	-
Selenium (Se)	µg/m³	10	10	3.91E-03	2.12E-03	2.87E-03	0	3.41E-03	1.96E-03	2.81E-03	0
Silver (Ag)	µg/m³	1	1	1.96E-03	1.06E-03	1.44E-03	0	1.71E-03	9.80E-04	1.41E-03	0
Strontium (Sr)	µg/m³	120	-	1.34E-02	7.51E-04	5.03E-03	0	1.09E-02	7.91E-04	4.79E-03	0
Thallium (Tl)	µg/m³	-	-	3.91E-03	2.12E-03	2.87E-03	-	3.41E-03	1.96E-03	2.81E-03	-
Tin (Sn)	µg/m³	10	10	3.91E-03	2.12E-03	2.87E-03	0	3.41E-03	1.96E-03	2.81E-03	0
Titanium (Ti)	µg/m³	120	-	2.26E-02	2.12E-03	6.84E-03	0	1.71E-02	2.02E-03	6.67E-03	0
Vanadium (V)	µg/m³	2	1	1.96E-03	1.06E-03	1.44E-03	0	1.71E-03	9.80E-04	1.41E-03	0
Zinc (Zn)	µg/m³	120	-	1.14E-01	8.78E-03	2.20E-02	0	1.24E-01	6.24E-03	2.14E-02	0
Zirconium (Zr)	µg/m³	20	-	1.96E-03	1.06E-03	1.44E-03	0	1.71E-03	9.80E-04	1.41E-03	0
Total Uranium (U)	µg/m³	1.5	-	1.76E-04	9.56E-05	1.31E-04	0	1.54E-04	8.82E-05	1.27E-04	0

Note:
A. Period geometric mean is 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 4-4**. In this summary both individual PAHs as well as a total PAH concentration are reported. PAHs were monitored from January to June 2014.

The maximum measured concentrations of all PAHs with MOECC air quality criteria, with the exception of seven (7) benzo(a)pyrene (B(a)P) measurements out of a total of thirty (30) samples, were well below their applicable 24-hour criteria (presented in **Table 4-4**) at both stations.

The current Ontario 24-hour B(a)P AAQC was introduced in 2011 and levels above this recently enacted 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.

Four (4) samples collected at the Rundle Road Station on January 14, February 8, February 28 and March 24, 2014 exceeded the Ontario 24-hour B(a)P AAQC by levels varying between 34% and 476%. Three (3) measurements of B(a)P at the Courtice WPCP Station collected on February 4, March 24 and June 28, 2014 exceeded the MOECC Ambient Air Quality Criteria by levels varying between 19% and 165%. However, all seven samples were well below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419 24-hour average guideline, and the HHRA health based standard (as shown in **Table 4-4**).

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. A summary/analysis 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 4-5**.

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.

Table 4-4 Summary of Measured Ambient PAH Concentrations – 2014 Monitoring Period

Contaminant	Units	MOECC Daily Average Criteria	HHRA Health Based Daily Average Standard	Courtice WPCP (Upwind)				Rundle Road (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	1.32E-01	8.11E-03	3.12E-02	3 0 0	2.88E-01	6.60E-03	4.97E-02	4 0 0
1-Methylnaphthalene	ng/m³	12000	-	8.17E+00	1.64E+00	4.06E+00	0	1.08E+01	1.60E+00	4.14E+00	0
2-Methylnaphthalene	ng/m³	10000	-	1.39E+01	2.75E+00	7.36E+00	0	1.87E+01	2.52E+00	7.50E+00	0
Acenaphthene	ng/m³	-	-	1.18E+01	3.28E-01	3.38E+00	-	8.10E+00	1.53E-01	2.04E+00	-
Acenaphthylene	ng/m³	3500	-	3.84E-01	1.09E-01	1.85E-01	0	2.04E+00	1.04E-01	4.51E-01	0
Anthracene	ng/m³	200	-	1.12E+00	7.73E-02	2.32E-01	0	7.41E-01	7.69E-02	2.60E-01	0
Benzo(a)anthracene	ng/m³	-	-	1.70E-01	7.73E-02	1.37E-01	-	1.54E-01	7.69E-02	1.36E-01	-
Benzo(a)fluorene	ng/m³	-	-	3.41E-01	1.55E-01	2.75E-01	-	3.09E-01	1.54E-01	2.72E-01	-
Benzo(b)fluoranthene	ng/m³	-	-	5.91E-01	7.73E-02	1.79E-01	-	6.84E-01	7.69E-02	1.91E-01	-
Benzo(b)fluorene	ng/m³	-	-	3.41E-01	1.55E-01	2.75E-01	-	3.09E-01	1.54E-01	2.72E-01	-
Benzo(e)pyrene	ng/m³	-	-	3.41E-01	1.55E-01	2.75E-01	-	3.09E-01	1.54E-01	2.72E-01	-
Benzo(g,h,i)perylene	ng/m³	-	-	3.42E-01	7.73E-02	1.51E-01	-	3.13E-01	7.69E-02	1.59E-01	-
Benzo(k)fluoranthene	ng/m³	-	-	2.48E-01	7.73E-02	1.46E-01	-	1.54E-01	7.69E-02	1.36E-01	-
Biphenyl	ng/m³	-	-	4.47E+00	8.56E-01	2.21E+00	-	5.84E+00	1.02E+00	2.07E+00	-
Chrysene	ng/m³	-	-	5.32E-01	7.73E-02	1.63E-01	-	6.55E-01	7.69E-02	1.84E-01	-
Dibenz(a,h) anthracene	ng/m³	-	-	4.85E-01	7.73E-02	1.60E-01	-	2.40E-01	7.69E-02	1.44E-01	-

Table 4-4 Summary of Measured Ambient PAH Concentrations – 2014 Monitoring Period

Contaminant	Units	MOECC Daily Average Criteria	HHRA Health Based Daily Average Standard	Courtice WPCP (Upwind)				Rundle Road (Downwind)			
				Max	Min	Period Arithmetic Mean	No. of Exceedances	Max	Min	Period Arithmetic Mean	No. of Exceedances
Dibenzo(a,c) anthracene + Picene	ng/m³	-	-	3.41E-01	1.43E-01	2.65E-01		3.09E-01	1.54E-01	2.72E-01	-
Fluoranthene	ng/m³	-	-	3.99E+00	1.53E-01	9.45E-01	-	3.52E+00	3.63E-01	1.14E+00	-
Indeno (1,2,3-cd)pyrene	ng/m³	-	-	4.85E-01	7.73E-02	1.60E-01	-	2.85E-01	7.69E-02	1.56E-01	-
Naphthalene	ng/m³	22500	22500	3.87E+01	9.26E+00	2.14E+01	0	9.26E+01	1.02E+01	2.53E+01	0
o-Terphenyl	ng/m³	-	-	3.41E-01	1.55E-01	2.75E-01	-	3.09E-01	1.54E-01	2.72E-01	-
Perylene	ng/m³	-	-	3.41E-01	1.55E-01	2.75E-01	-	3.09E-01	1.54E-01	2.72E-01	-
Phenanthrene	ng/m³	-	-	1.42E+01	1.01E+00	4.35E+00	-	1.30E+01	1.38E+00	4.24E+00	-
Pyrene	ng/m³	-	-	2.54E+00	7.73E-02	4.68E-01	-	1.88E+00	1.47E-01	5.77E-01	-
Tetralin	ng/m³	-	-	2.53E+01	1.01E+00	3.73E+00	-	3.99E+00	6.46E-01	1.91E+00	-
Total PAH [D]	ng/m³	-	-	95.0	21.3	51.1	-	153.9	23.1	52.4	-

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 Schedule 6 Upper Risk Thresholds

C. O. Reg. 419 24 Hour Guideline

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

Table 4-5 Source Contribution Analysis – 2014 B(a)P Exceedances

Date	Station	% above the MOECC B(a)P Criterion	Wind Direction	Potential Source Contributions
January 14, 2014	Rundle Road	42%	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.
February 4, 2014	Courtice WPCP	165%	North	Land use in this direction is primarily agricultural with Highway 401and a CN rail line also located to the north. Potential sources could be agricultural activities or transportation emissions.
February 8, 2014	Rundle Road	476%	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.
February 28, 2014	Rundle Road	34%	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.
March 24, 2014	Courtice WPCP	19%	West/ Northwest	Land use in this direction is primarily agricultural at Courtice and a mix of agricultural and commercial at Rundle. Potential sources could be agricultural activities or a nearby business or residence with a poorly controlled combustion source operating.
March 24, 2014	Rundle Road	102%	West/ Northwest	
June 28, 2014	Courtice WPCP	47%	East	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.

4.5 AMBIENT DIOXIN AND FURAN CONCENTRATIONS

A summary of the maximum, minimum, and arithmetic mean daily average ambient D/F concentrations are presented in **Table 4-6**. 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 4-6**) for the entire 2014 monitoring period (January to June 2014).

Table 4-6 Summary of Measured Ambient Dioxin and Furan Concentrations – 2014 Monitoring Period

Contaminant	Units	MOECC Criteria	HHRA Health Based Standard	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			1.09E-02	5.91E-03	7.60E-03		3.75E-02	5.38E-03	1.04E-02	
1,2,3,7,8-Penta CDD	pg/m³			1.18E-02	5.85E-03	7.49E-03		1.27E-02	5.92E-03	7.61E-03	
1,2,3,4,7,8-Hexa CDD	pg/m³			1.38E-02	6.13E-03	7.58E-03		8.73E-03	6.13E-03	6.67E-03	
1,2,3,6,7,8-Hexa CDD	pg/m³			1.55E-02	6.37E-03	9.96E-03		2.63E-02	6.13E-03	9.32E-03	
1,2,3,7,8,9-Hexa CDD	pg/m³			2.48E-02	5.66E-03	1.38E-02		3.63E-02	5.44E-03	1.31E-02	
1,2,3,4,6,7,8-Hepta CDD	pg/m³			1.38E-01	1.71E-02	7.49E-02		2.53E-01	6.06E-03	9.00E-02	
Octa CDD	pg/m³			6.72E-01	7.73E-02	3.54E-01		5.17E-01	5.25E-02	2.82E-01	
Total Tetra CDD	pg/m³			3.07E-02	5.99E-03	1.51E-02		3.20E-02	6.13E-03	1.53E-02	
Total Penta CDD	pg/m³			2.78E-02	5.85E-03	1.50E-02		2.62E-02	5.92E-03	1.51E-02	
Total Hexa CDD	pg/m³			9.95E-02	7.85E-03	4.13E-02		1.60E-01	7.51E-03	5.02E-02	
Total Hepta CDD	pg/m³			3.34E-01	1.71E-02	1.45E-01		2.53E-01	1.53E-02	1.46E-01	
2,3,7,8-Tetra CDF **	pg/m³			4.19E-02	5.71E-03	1.32E-02		5.10E-02	5.89E-03	1.51E-02	
1,2,3,7,8-Penta CDF	pg/m³	-	-	1.66E-02	5.66E-03	8.28E-03	N/A	1.23E-02	4.94E-03	7.49E-03	N/A
2,3,4,7,8-Penta CDF	pg/m³			1.81E-02	5.66E-03	8.40E-03		1.54E-02	4.94E-03	7.87E-03	
1,2,3,4,7,8-Hexa CDF	pg/m³			2.60E-02	5.99E-03	1.07E-02		2.06E-02	6.03E-03	8.93E-03	
1,2,3,6,7,8-Hexa CDF	pg/m³			1.66E-02	5.38E-03	8.38E-03		6.44E-03	5.30E-03	5.78E-03	
2,3,4,6,7,8-Hexa CDF	pg/m³			1.55E-02	5.89E-03	7.59E-03		6.64E-03	5.82E-03	6.27E-03	
1,2,3,7,8,9-Hexa CDF	pg/m³			1.65E-02	5.91E-03	8.18E-03		6.87E-03	5.67E-03	6.31E-03	
1,2,3,4,6,7,8-Hepta CDF	pg/m³			2.98E-02	5.28E-03	1.48E-02		3.34E-02	5.49E-03	1.42E-02	
1,2,3,4,7,8,9-Hepta CDF	pg/m³			1.75E-02	5.16E-03	7.82E-03		7.29E-03	5.82E-03	6.62E-03	
Octa CDF	pg/m³			6.04E-02	1.36E-02	2.63E-02		3.69E-02	6.19E-03	2.11E-02	
Total Tetra CDF	pg/m³			1.54E-01	5.71E-03	2.92E-02		1.84E-01	5.89E-03	3.74E-02	
Total Penta CDF	pg/m³			4.93E-02	5.66E-03	1.58E-02		6.84E-02	5.89E-03	1.57E-02	
Total Hexa CDF	pg/m³			6.65E-02	5.99E-03	2.52E-02		3.39E-02	5.89E-03	1.15E-02	
Total Hepta CDF	pg/m³			5.90E-02	5.56E-03	2.50E-02		3.34E-02	5.92E-03	1.71E-02	
TOTAL TOXIC EQUIVALENCY [A]	pg TEQ/m³	0.1 [B] 1 [C]	-	0.038	0.019	0.027	0 0	0.065	0.020	0.029	0 0

Note:
A. Total Toxicity Equivalent (TEQ) concentration contributed by all dioxins, furans and dioxin-like PCBs calculated as per O. Reg. 419 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.
B. Ontario Ambient Air Quality Criteria.
C. O. Reg. 419 Schedule 6 Upper Risk Thresholds
* CDD - Chloro Dibenzo-p-Dioxin, ** CDF - Chloro Dibenzo-p-Furan

5.0 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 2014 monitoring period. The following observations and conclusions were made from a review of the measured ambient air quality monitoring data:

1. Measured levels 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 standards 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 2014 monitoring period were 22.3 µg/m³ at the Courtice WPCP station and 21.1 µg/m³ at the Rundle Road station. The Canada Wide Standard (CWS) of 30 µg/m³ is based on the average of the 98th percentile levels in each of three consecutive years. Due to the different averaging periods, the CWS and the 2014 measurements are not directly comparable;

3. The maximum measured concentrations of TSP and all metals with MOECC air quality criteria were well below their applicable criteria (presented in **Table 2-3** in this report);

4. The maximum measured concentrations of all PAHs with MOECC Ambient Air Quality Criteria, were well below their applicable 24-hour criteria (presented in **Table 2-4**) at both stations with the exception of seven (7) 24-hour average benzo(a)pyrene (B(a)P) measurements. Out of fifteen (15) samples collected at the Rundle Road Station, four (4) samples on January 14, February 8, February 28 and March 24, 2014 exceeded the Ontario 24-hour B(a)P AAQC by levels varying between 34% and 476%. Out of fifteen (15) B(a)P measurements collected at the Courtice WPCP Station, three (3) measurements of B(a)P on February 4, March 24 and June 28, 2014 exceeded the MOECC Ambient Air Quality Criteria by levels varying between 19% and 165%. However, all seven samples were well below the MOECC Schedule 6 Upper Risk Threshold, the MOE O. Reg. 419 24-hour average guideline, and the HHRA health based standard (as shown in **Table 4-4**). 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

5. The maximum measured toxic equivalent dioxin and furan concentration was well below the applicable criteria presented in **Table 2-4**; and,

6. In summary, all monitored contaminants were below their applicable MOECC criteria during the 2014 monitoring period with the exception of seven (7) benzo(a)pyrene measurements. All measured levels of all monitored contaminants were below their applicable HHRA health-based standards.

6.0 REFERENCES

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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	2014 Schedule Dates	
					Courtice	Rundle
SO_2	Teledyne Monitor Labs	Change particulate filter	Monthly	During monthly calibration	See note 1	See note 2
		Replace critical flow orifice and filters	As required	During monthly calibration	See note 1	See note 2
		Exchange chemical – external zero air scrubber	3 months	During monthly calibration	See note 1	See note 2
		Replace perm tube	As required	During annual maintenance	August 15	July 30
		Replace Pump diaphragm	Annual	During annual maintenance,	August 15	December 20, 2013
		Clean sample chamber, windows and filters	As required	During annual maintenance,	August 15	July 30
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	During monthly calibration	See note 1	See note 2
		Replace chemical – external dryer	3 months	During monthly calibration	See note 1	See note 2
		Chemical change – ozone filter	Annually	During annual maintenance,	See note 1	See note 2
		Clean reaction cell window (annually or as necessary)	Annually	During annual maintenance,	August 15	July 30
		Change particulate DFU filter	Annually	During annual maintenance,	August 15	July 30
		Replace reaction cell O-rings & sintered filters	Annually or as required	During annual maintenance,	August 15	July 30
		Rebuild pump head	When RCEL pressures exceeds 10 in Hg	At annual maintenance,	August 15	July 30
		Replace inline exhaust scrubber	Annually	During annual maintenance,	August 15	July 30
		Replace inline exhaust scrubber	Annually	During annual maintenance,	August 15	July 30
		Replace NO2 converter	Every 3 years or if conversion < 96%	Conversion checked every 6 months,	Convertor at 98%	Convertor at 98%
$PM_{2.5}$	Thermo Sharp 5030	Replace filter tape	Upon 10% remaining	As required	Not required	Not required
		Replace SHARP zeroing filters	6 months		February 2014 and September 2014	February 2014 and September 2014
		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,	August 15	July 30
		Rebuild vacuum pump	12-18 months	During annual maintenance,	August 15	July 30
		Clean ambient temp/RH shield and assembly	Annually	During annual maintenance,	August 15	July 30
TSP/metals	TE-5170	Ensure all gaskets sealing properly	Weekly	Check at weekly site visit	Weekly	Weekly
		Power cord checks for damage/cracks	Weekly	Check at weekly site visit	Weekly	Weekly
		Inspect screen and remove foreign deposits	Weekly	Check at weekly site visit	Weekly	Weekly
		Inspect holder frame gasket	Every sample	Check at weekly site visit	Weekly	Weekly
		Replace motor brushes	Every 500 hours	Replace as needed	Replaced February 7 and July 3	Replaced January 9 and May 22
		Check elapsed time meter	Weekly	Check at weekly site visit	Weekly	Weekly
		Check flow recorder pen/tubing	Weekly	Check at weekly site visit	Weekly	Weekly
		Ensure all gaskets sealing properly	Weekly	Check at weekly site visit	Weekly	Weekly
PAH and D/F	TE-1000	Ensure all gaskets sealing properly	Weekly	Check at weekly site visit	Weekly	Weekly
		Power cord checks for damage/cracks	Weekly	Check at weekly site visit	Weekly	Weekly
		Clean any dirt around module and filter holder	Weekly	Check at weekly site visit	Weekly	Weekly
		Inspect dual sampling module gaskets	Every sample	Check at weekly site visit	Weekly	Weekly
		Inspect and replace motor flange gasket and motor cushion	Routinely, minimum annually		Not required in 2014. Replaced in Q2 2015	Not required in 2014. Replaced in Q2 2015
		Replace motor brushes	Every 400 hours	Replaced as needed	Replaced March 5	Replaced February 7
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		Annual maintenance done in March 2015. The wind head has been replaced with a new spare and is at the factory for calibration and overhaul.
		Replace wind vane potentiometer and bearings	24-months	To be replaced at 2 years		
		Complete factory overhaul	24-36 months	To be replaced at 2 to 3 years		

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	2014 Schedule Dates	
Temperature	CS 107 (Rundle)/ HMP 60 (Courtice)	Check radiation shield free from debris	Weekly	Checked at weekly site visit	Weekly	Weekly
Rainfall	TE525M	Inspect funnel and bucket mechanism for debris	Weekly	During weekly site visit	Weekly	Weekly
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
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	SO2 replaced January 21, 2015, Nox replaced November 18, 2014	SO2 replaced January 21, 2015, Nox replaced November 18, 2014
		Ensure shelters and gates are locked upon departure	Weekly	Check at weekly site visit	Weekly	Weekly

1. Courtice monthly calibration and maintenance dates in 2014: January 21, February 25, March 26, April 25, June 9, July 3, July 30, August 15, September 23, October 23, November 25, December 30
2. Rundle monthly calibration and maintenance dates in 2014: January 21, February 25, March 26, April 25, June 9, July 3, July 30, August 15, September 23, October 23, November 25, December 30

Table A-2 Summary of Equipment Calibration

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule	Schedule / Comments	2014 Schedule Dates	
					Courtice	Rundle
SO2	API Model 100E	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
		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	August 15	July 30
		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	August 15	July 30
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	August 15	July 30
		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
PM2.5	Thermo Sharp 5030	Ambient temperature	Audit monthly, calibrate annually	Audit monthly.	See note 1, full calibration done July 30, 2014	See note 2, full calibration done July 30, 2014
		Ambient pressure	Audit monthly, calibrate annually	Audit monthly.	See note 1, full calibration done July 30, 2014	See note 2, full calibration done July 30, 2014
		Flow	Audit monthly, calibrate annually	Audit monthly.	See note 1, full calibration done July 30, 2014	See note 2, full calibration done July 30, 2014
		Leak check	Monthly	Leak check is not possible on this make/model.	N/A	N/A
		Analog output	Annually	Done annually	Checked at monthly calibrations.	Checked at monthly calibrations.
		Proportional Counter	Audit annually	Done annually	Checked at monthly calibrations.	Checked at monthly calibrations.
		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.	February 3 February 7 February 19 February 25 March 5 March 11 April 3 April 25 May 27 June 19	January 9 February 3 February 25 March 5 April 3 April 25 May 22 May 27 June 19

Table A-2 Summary of Equipment Calibration

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule	Schedule / Comments	2014 Schedule Dates	
					Courtice	Rundle
PAH and D/F	TE-1000	Flow calibration	Upon installation, monthly, or after any motor maintenance	Calibrated monthly and after motor maintenance.	February 3 February 25 March 5 April 3 April 16 April 25 May 22 May 27 June 9 June 13	February 7 February 25 March 5 April 3 April 25 May 27 June 9 June 13
Wind Speed and Direction	Met One 034B	Wind speed calibration	Annually		N/A	July 30 2014
		Potentiometer calibration	Annually		N/A	July 30 2014
Temperature	HMP 60	External calibration	Annually		July 30 2014	July 30 2014
Rainfall	TE525M	Field Calibration. Factory calibration if field calibration not passed.	Annually		July 30 2014	July 30 2014
Relative Humidity	CS HMP60	Calibration (annually)	Annually		July 30 2014	July 30 2014
Atmospheric Pressure	CS106	Re-calibration (2-years)	2-years	To be done at 2 years	Not required in 2014	Not required in 2014
Data Acquisition	CS CR1000	Calibration every three years	3- years	To be done at 3 years	Not required in 2014	Not required in 2014

1. Courtice monthly calibration and maintenance dates in 2014: January 21, February 25, March 26, April 25, June 9, July 3, July 30, August 15, September 23, October 23, November 25, December 30
2. Rundle monthly calibration and maintenance dates in 2014: January 21, February 25, March 26, April 25, June 9, July 3, July 30, August 15, September 23, October 23, November 25, December 30

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

Parameter	Issues	Time Frame	Remedial Action
SO_2	UV Lamp warning message.	November 7- 25, 2014	UV lamp adjusted. No data adjustments required as lamp did not require re-calibration.
	Auto-calibrations were higher than normal	November 3 - 21, 2014	Issue related to UV lamp adjustment noted above.
NO_X	Sample flow warning message noted (likely due to a momentary power loss to the pump)	May 27, 2014	All data was intact. Cleared error message.
	Pump rebuild required due to reaction cell pressure rise.	September 23, 2014	Pump was rebuilt during routine calibrations.
	RCELL/Sample flow/Ozone flow warning messages	November 7, 2014	Error messages were diagnosed as due to a momentary power outage to unit. All data was intact. Cleared message. No data adjustments required.
	Auto-calibrations were lower than normal	November 15 - 21, 2014	Issue was caused by damage to the pump line causing low flow. The pump line was replaced. No data adjustments required.
$PM_{2.5}$	A cable from the monitor to the data logger came loose.	Jan 11 to Jan 12, 2014	Re-connected and secured cable. Data during this period was downloaded directly from the monitor.
	Zero offset on $PM_{2.5}$ monitor required adjustment.	Jan 12 to Jan 17, 2014	Offset adjustment carried out. Data during this period was downloaded directly from the monitor.
	Snow/ice accumulated in the head of the monitor and later melted, causing water build-up.	Mar 20 to Mar 24	Removed unit to dry out. Unit was cleaned, checked and re-installed. Visual checks of the monitor heads for snow/ice accumulation implemented on a weekly basis.

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

Parameter	Issues	Time Frame	Remedial Action
TSP/Metals Hi-Vol.	TSP hi-vol failed due to a motor brush not being secured properly during maintenance.	Feb 16, 2014	Secured motor brush and re-calibrated unit.
	TSP hi-vol motor did not turn on for one sample run.	May 23, 2014	Inspect all electrical connections, check on/off switches. Always test on/off switches for future runs.
PAH/ D/F Hi-Vol	Motor failed at the end of a run due to misaligned motor brush.	April 8, 2014	Secured motor brush and recalibrated unit.
	Motor would not turn on due to motor brush issue.	May 22, 2014	Secured motor brush and recalibrated unit.
	7 day timer switch that feeds power to the rest of the system at startup failed	June 27, 2014	Replaced 7-day timer assembly with a new one. The sample ran on schedule and no data was lost.
Rain gauge	Top of the rain gauge was missing. Suspected to have been blown away by strong winds.	Jan 10, to Feb 3, 2014	Several attempts were made to locate the rain gauge top in the nearby field after the snow melted, however, it was not found. A new top was ordered, re-installed, and secured.
Data logger	Unable to connect remotely for data download.	November 10 - 12, 2014	Data logger reset.

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

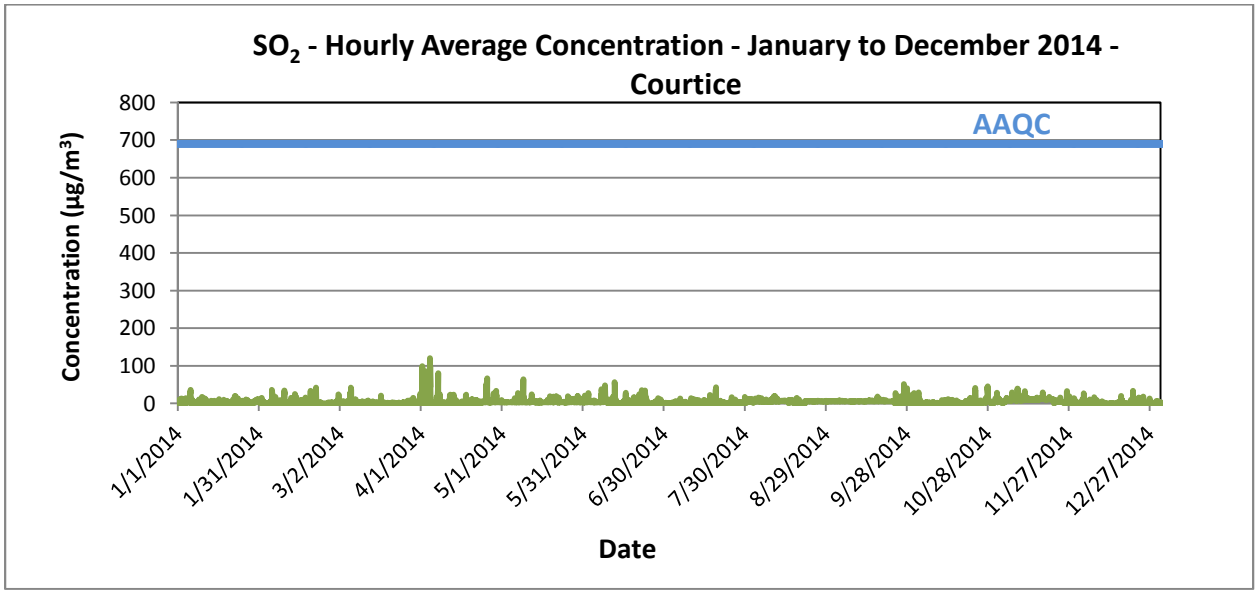
Parameter	Issues	Time Frame	Remedial Action
SO_2	The permeation tube oven's evacuation orifice was plugged, resulting in a negative bias to SO_2 measurements.	July 3, 2014 to July 12, 2014	Orifice replaced and chamber purged with zero air for 7 days before recalibrating. Charcoal filter replaced. Zero offset applied to measurement data.
	Auto calibrations were not turned on after manual calibration.	July 3, 2014 to July 12, 2014	Auto calibration turned on.
	SO_2 pump failed	August 31, 2014 to September 3, 2014	Pump was replaced with a spare pump on the morning of September 3, 2014. A replacement pump was ordered (under warranty) and was installed on Sept 23, 2014.
	UV Lamp Warning message.	November 12 - 21, 2014	UV lamp adjusted. No data adjustments required as lamp did not require re-calibration.
	Auto-calibrations were lower than usual	November 6 - 21, 2014	Issue related to UV lamp adjustment noted above.
	UV Lamp Warning message	December 11, 2014	UV lamp adjusted. No data adjustments required as lamp did not require re-calibration.
	System automatically reset due to power loss.	December 23, 2014	No action required.

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

Parameter	Issues	Time Frame	Remedial Action
NO_X	Sample pressure warning message noted. (likely due to a momentary power loss to the pump)	May 22, 2014	All data was intact. Cleared error message.
	Auto calibrations were not turned on after manual calibration.	July 3, 2014 to July 12, 2014	Auto calibration turned on.
	Zero offset noted when substitute unit installed during routine maintenance of permanent unit.	July 3, 2014 to July 30, 2014	Substitute monitor removed and the permanent unit re-installed after completion of routine maintenance. Zero offset applied to measurement data during this period.
	Pump rebuild required due to reaction cell pressure rise.	Sep 23, 2014	Pump was rebuilt during routine calibrations. Reaction cell pressure within acceptable range.
	System automatically reset due to power loss.	December 23, 2014	No action required.
$PM_{2.5}$			
TSP/Metals Hi-Vol.	Unit blown over by strong winds.	Mar 17, 2014	Unit secured with tie-downs. As a precautionary measure, all other hi-vols were secured as well.
PAH/ D/F Hi-Vol	PAH / D/F hi-vol did not start due to a power trip.	Jan 11, 2014	Reset power and set hi-vol to run on Jan 14 to replace missed sample.
Other – Modem	Modem connection off-line	January 17, 2014	Re-started modem.
General	Data logger did not allow remote connecting and downloading.	Sept 7, 2014- Sept 9, 2014	Logger rebooted. All data stored in logger was intact – issue only affected remote communication via cell modem.
	Unable to connect remotely for data download.	November 6, 2014	Data logger reset on the same day.

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



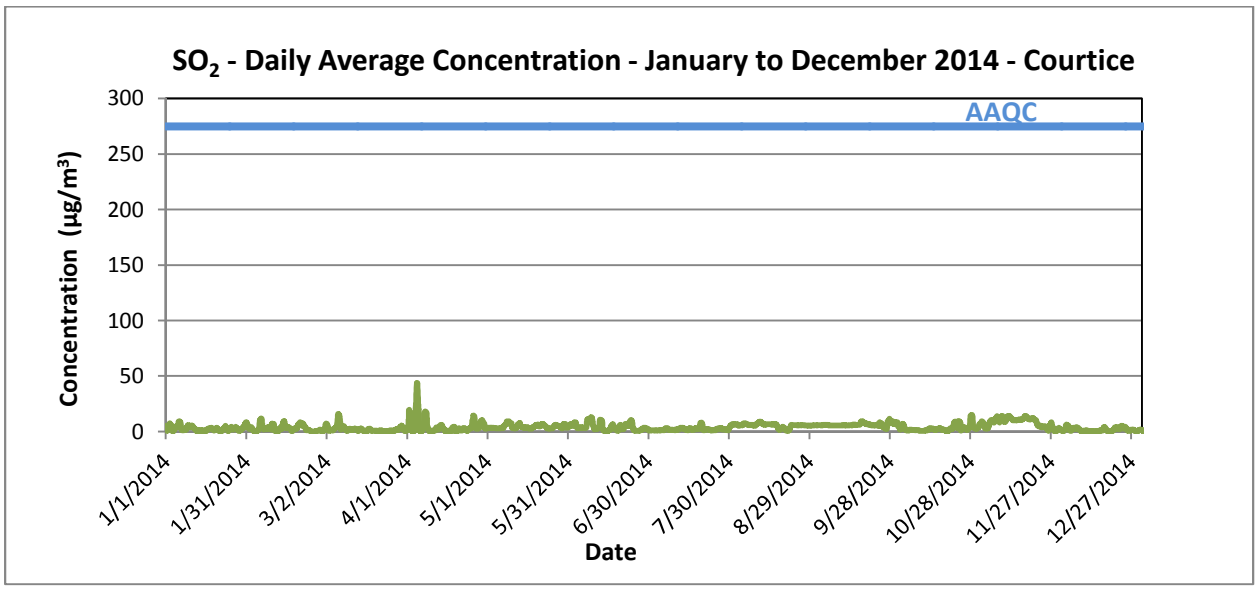
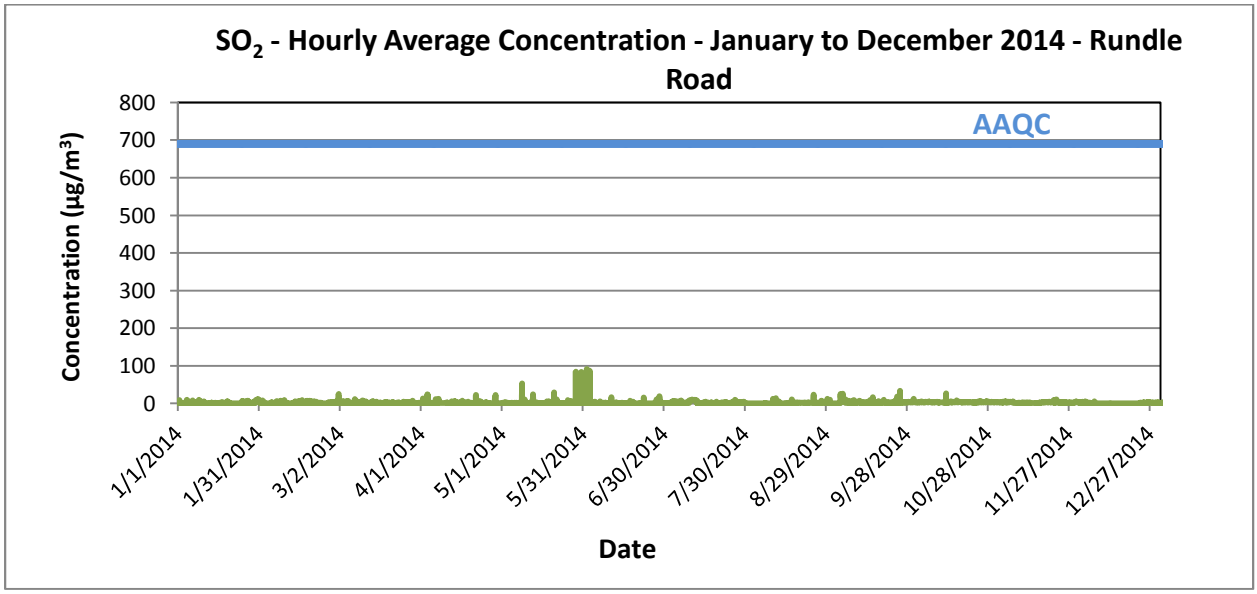


Figure B-2 Time History Plots of Measured Hourly Average and 24-Hour Average SO_2 Concentrations – Rundle Road Station



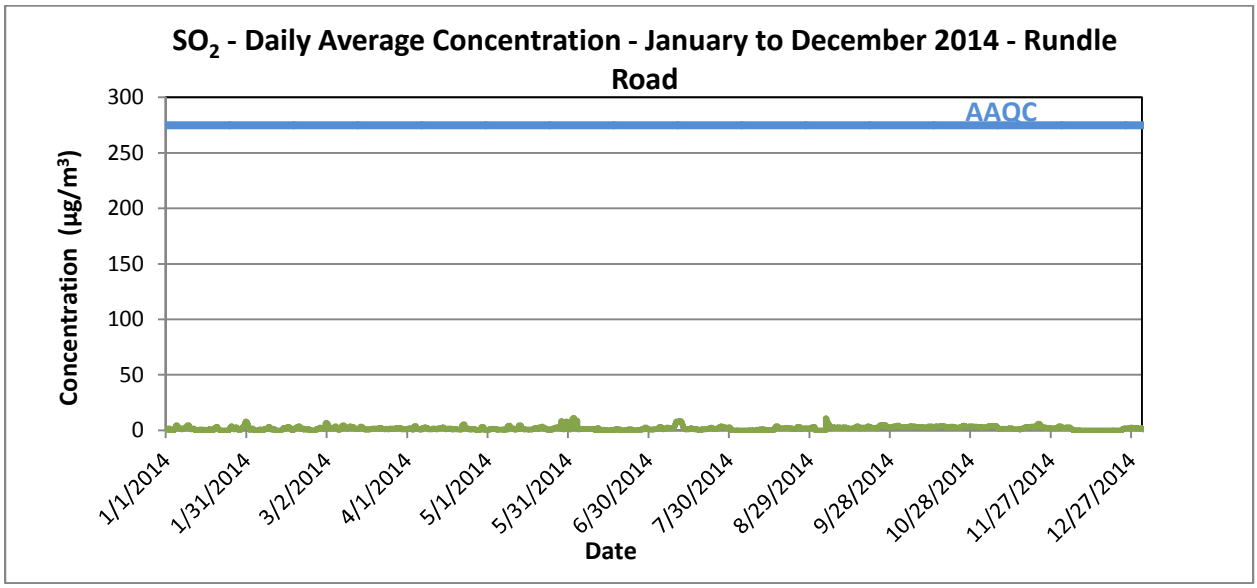


Figure B-3 Measured Hourly Average SO_2 Concentrations vs. Wind Direction – Courtice WPCP Station

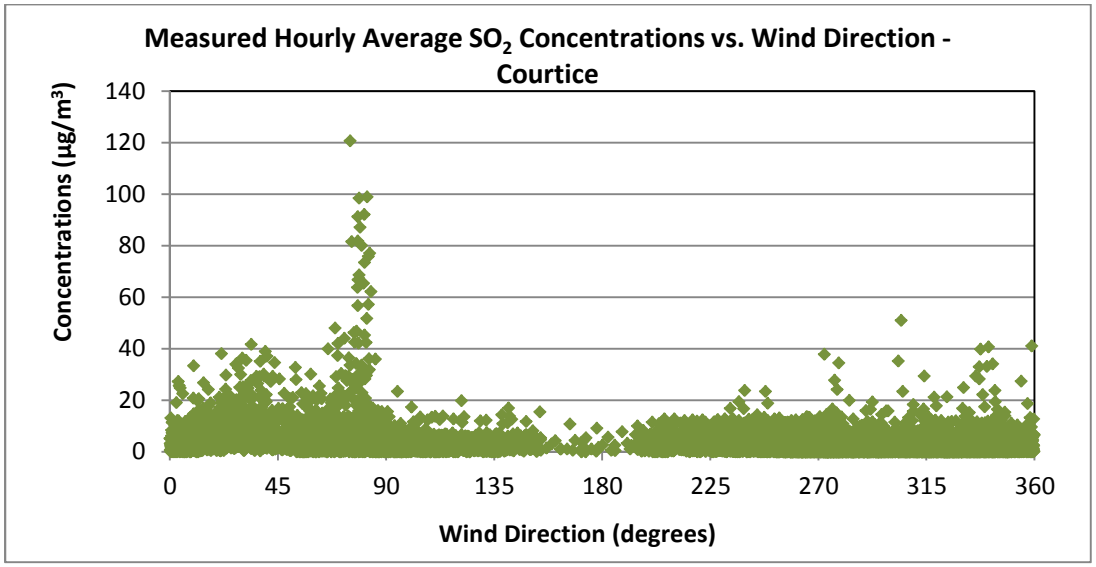
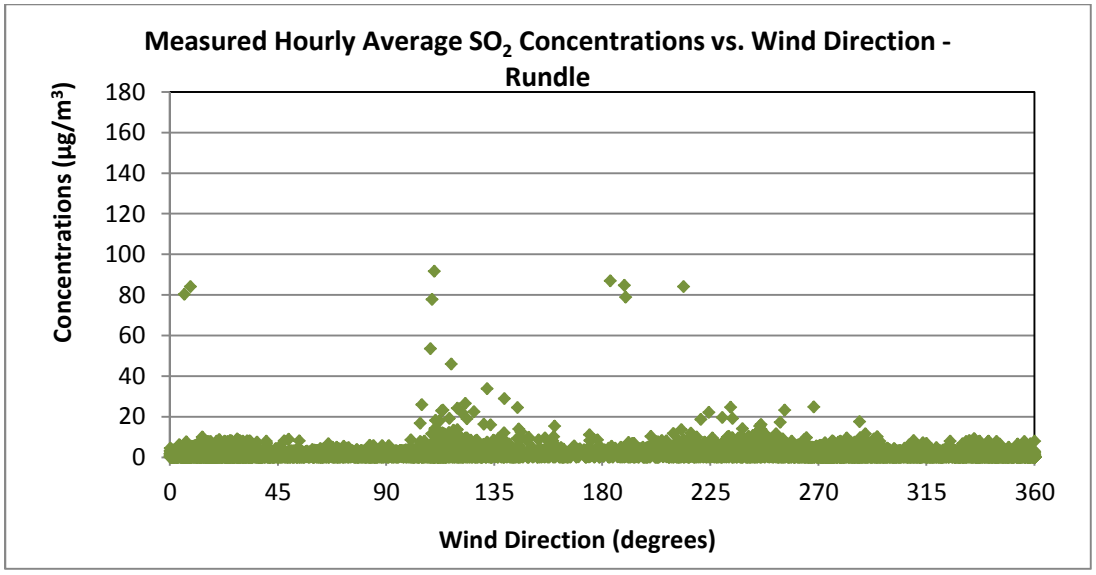
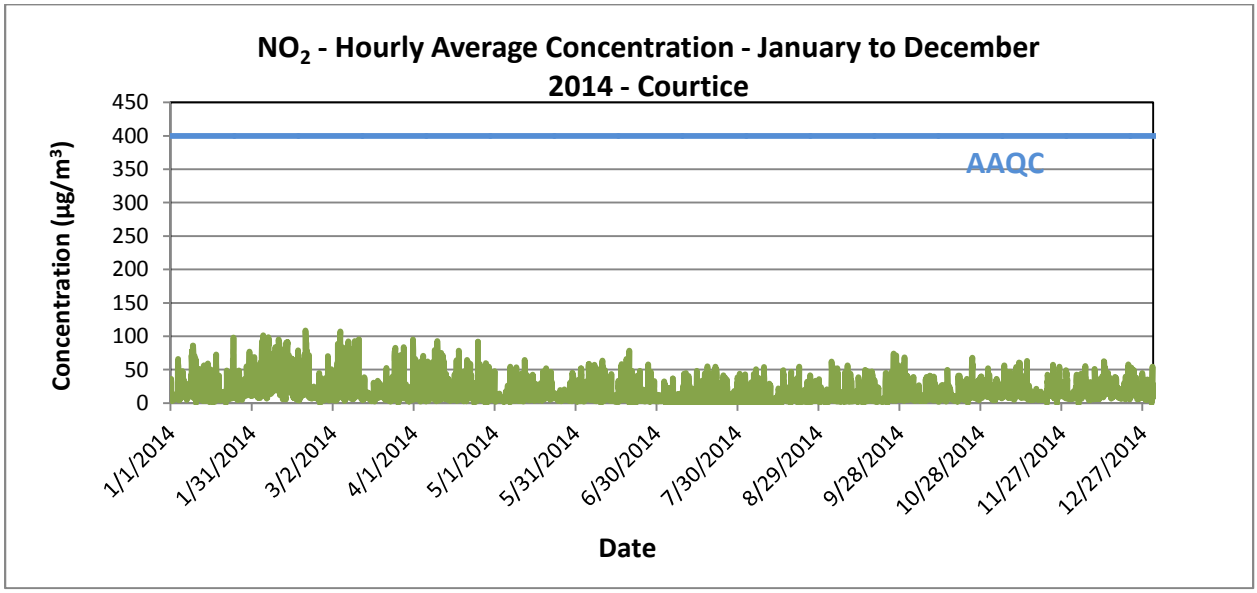


Figure B-4 Measured Hourly Average SO_2 Concentrations vs. Wind Direction - Rundle Road Station



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



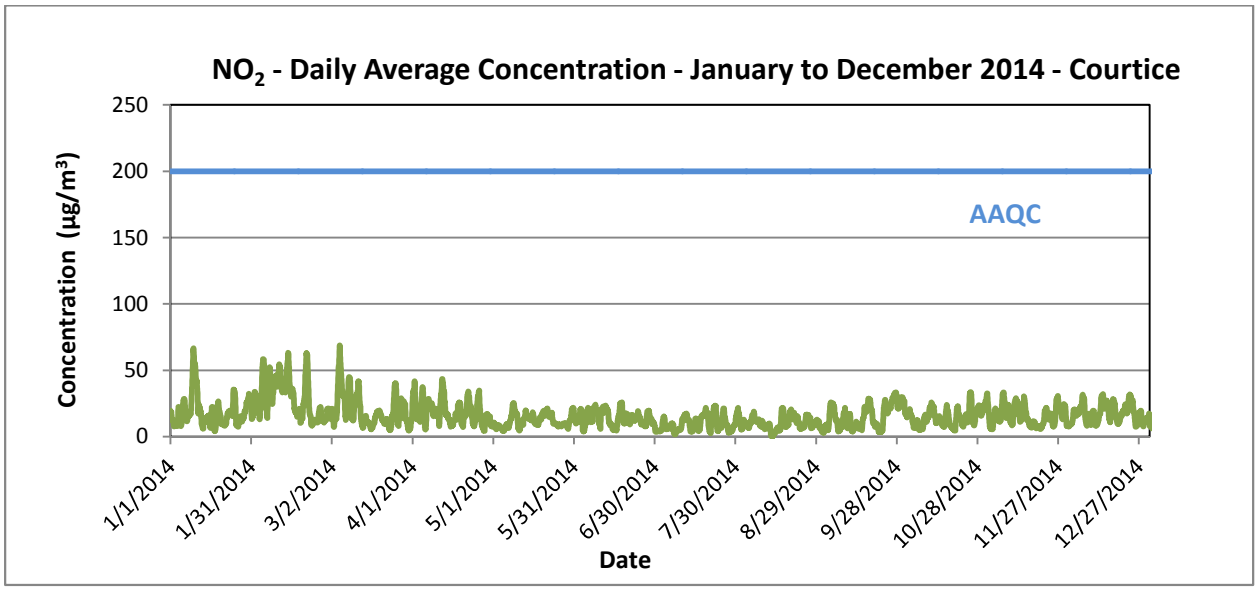
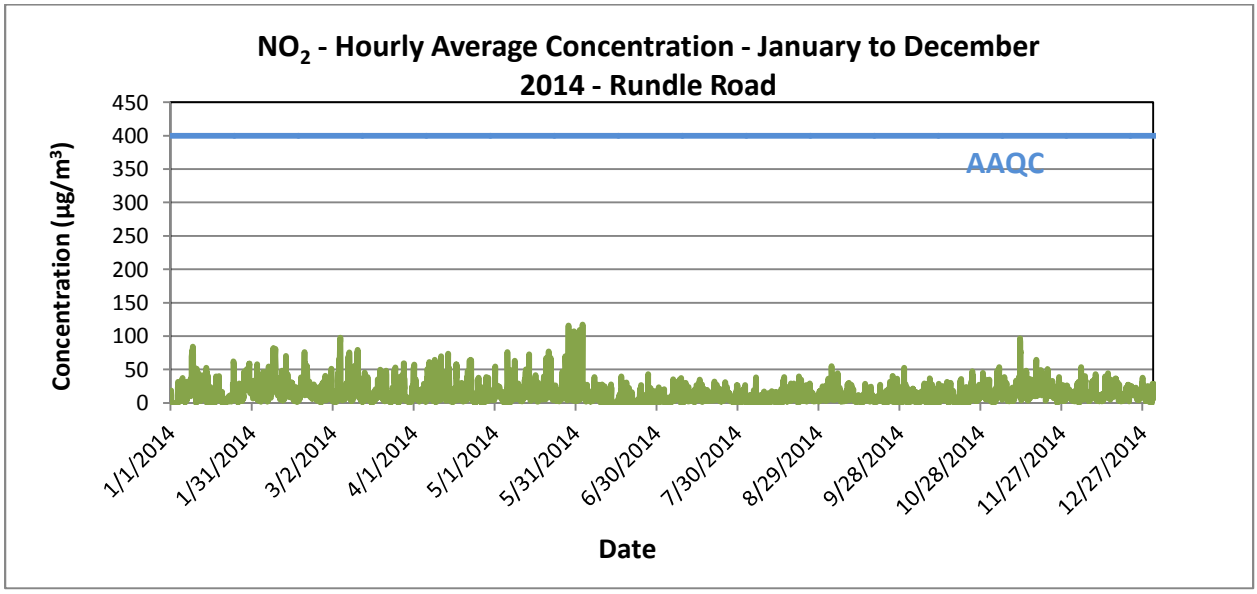


Figure C-2 Time History Plots of Measured Hourly Average and 24-Hour Average NO_2 Concentrations – Rundle Road Station



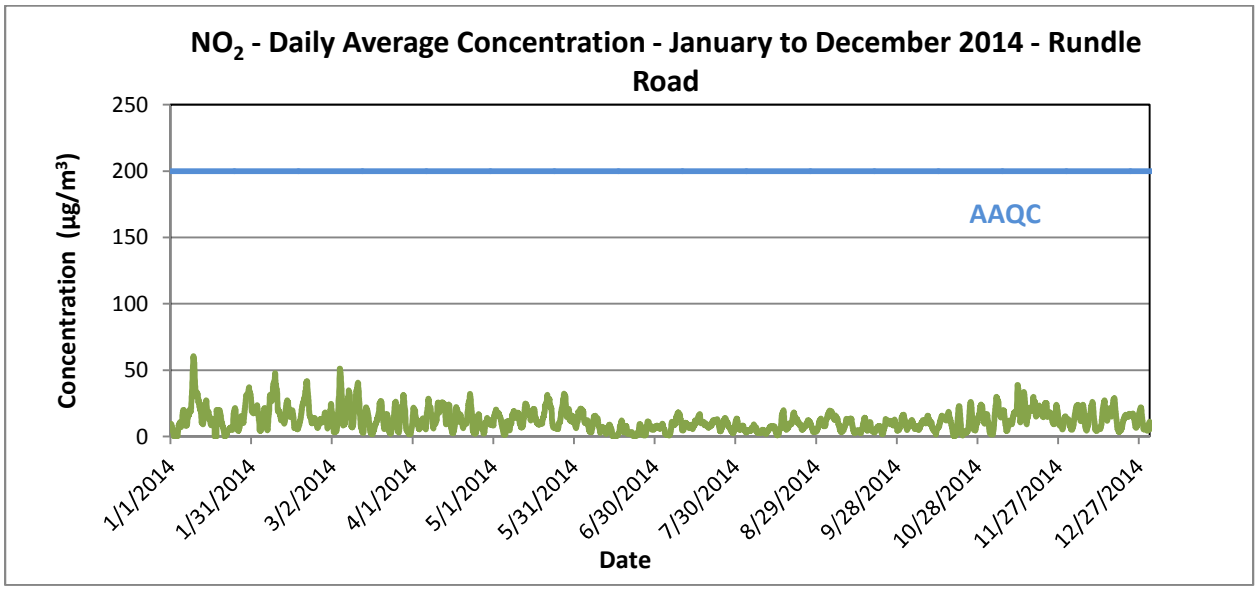


Figure C-3 Measured Hourly Average NO_2 Concentrations vs. Wind Direction – Courtice WPCP Station

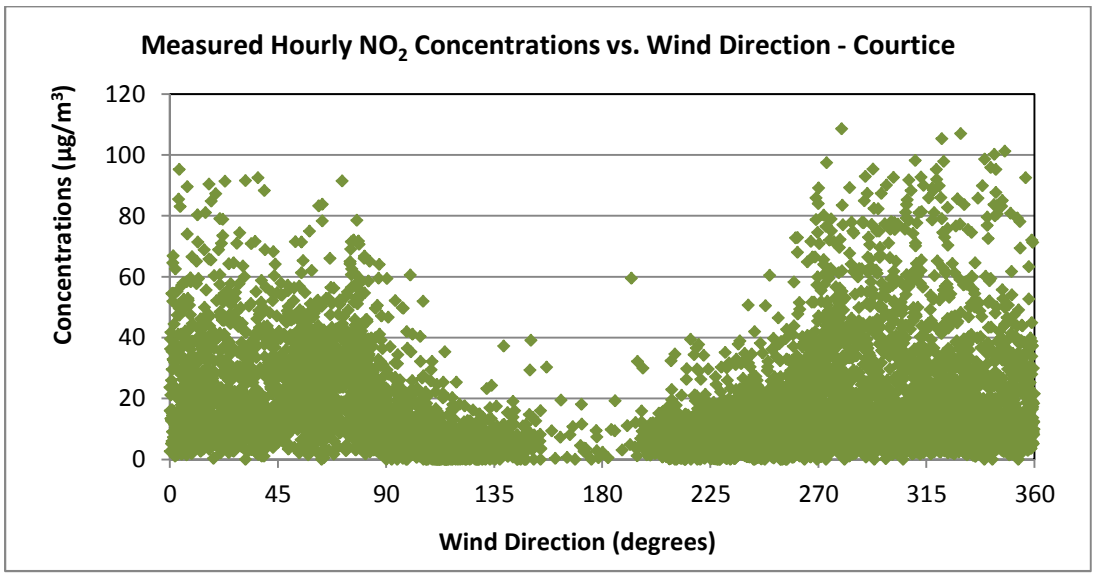
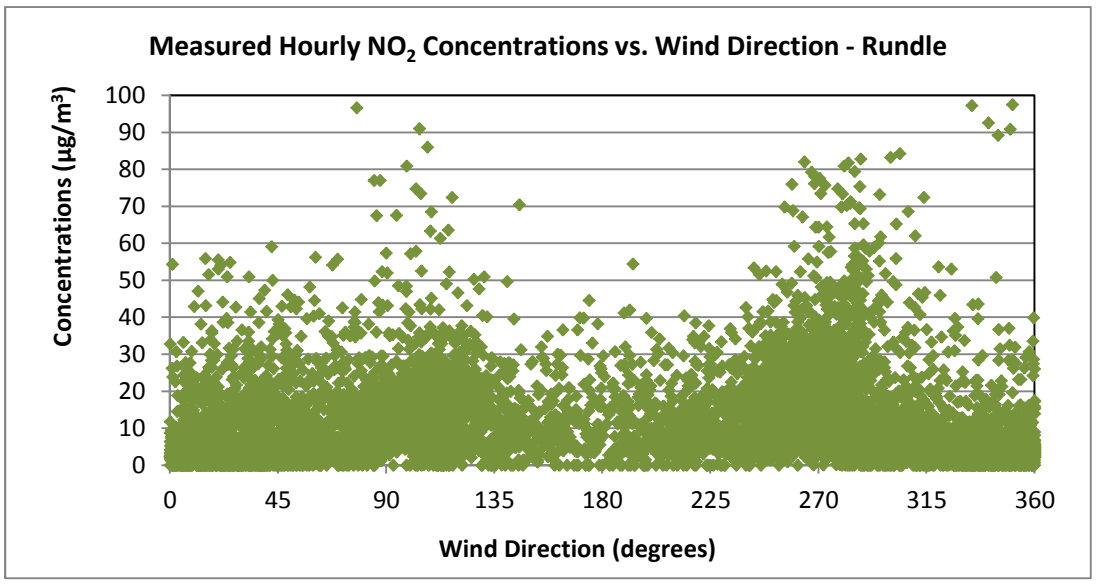
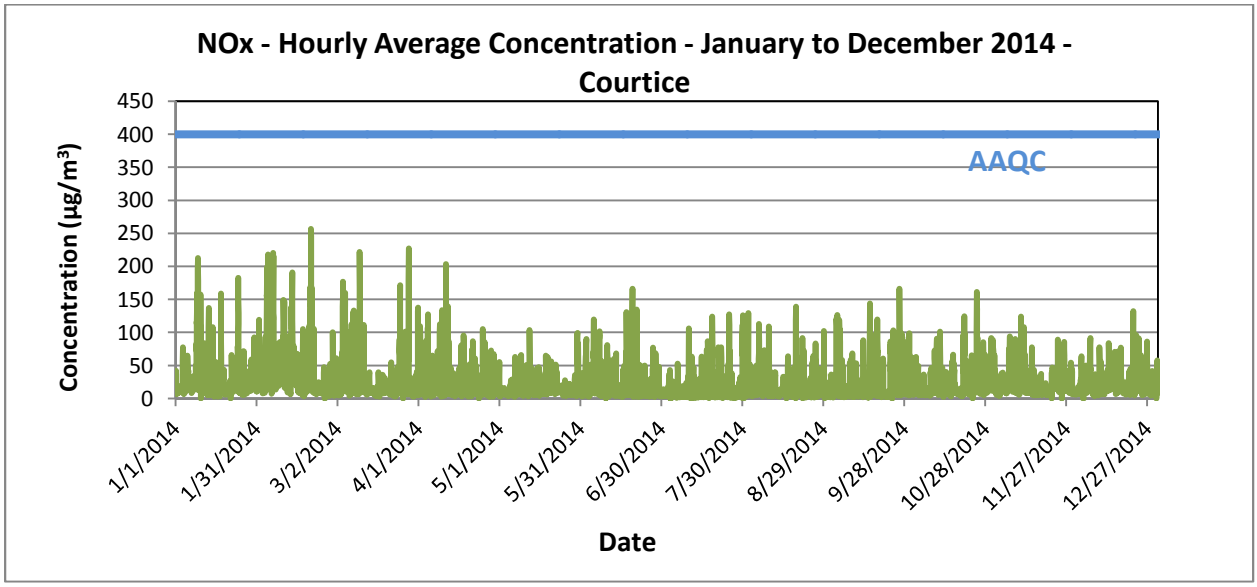


Figure C-4 Measured Hourly Average NO_2 Concentrations vs. Wind Direction - Rundle Road Station



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



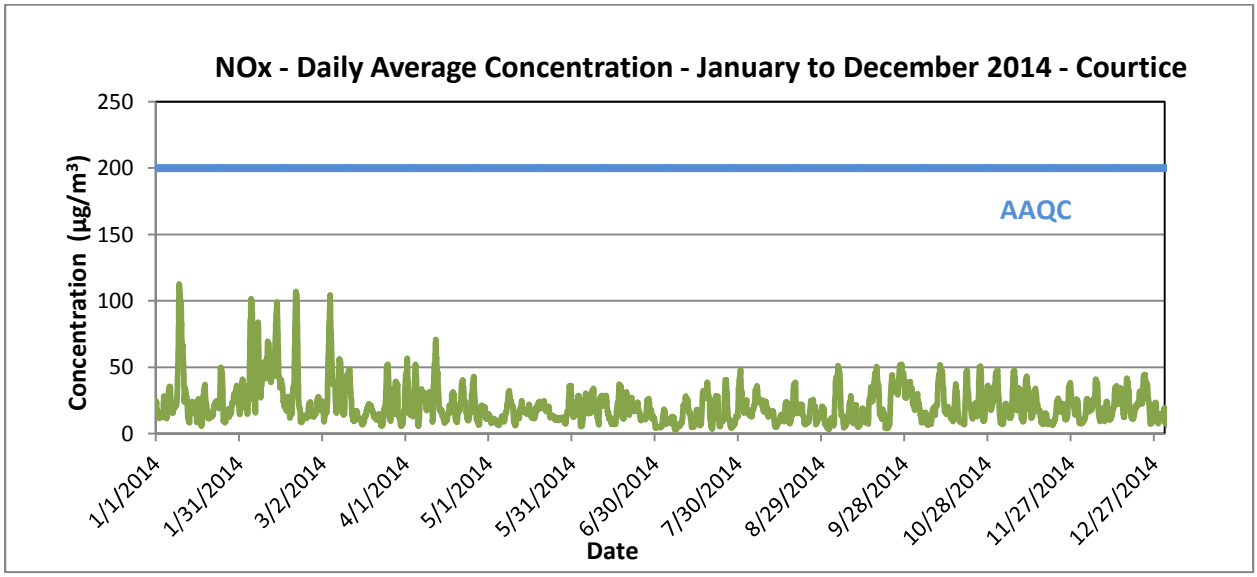
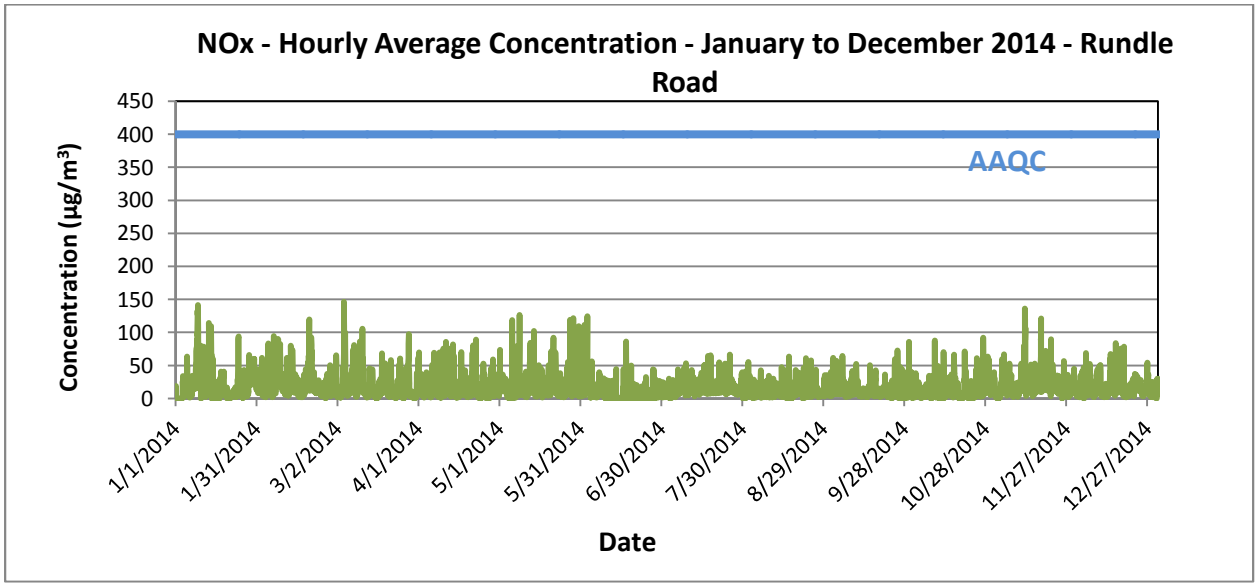


Figure D-2 Time History Plots of Measured Hourly Average and 24-Hour Average NO_X Concentrations – Rundle Road Station



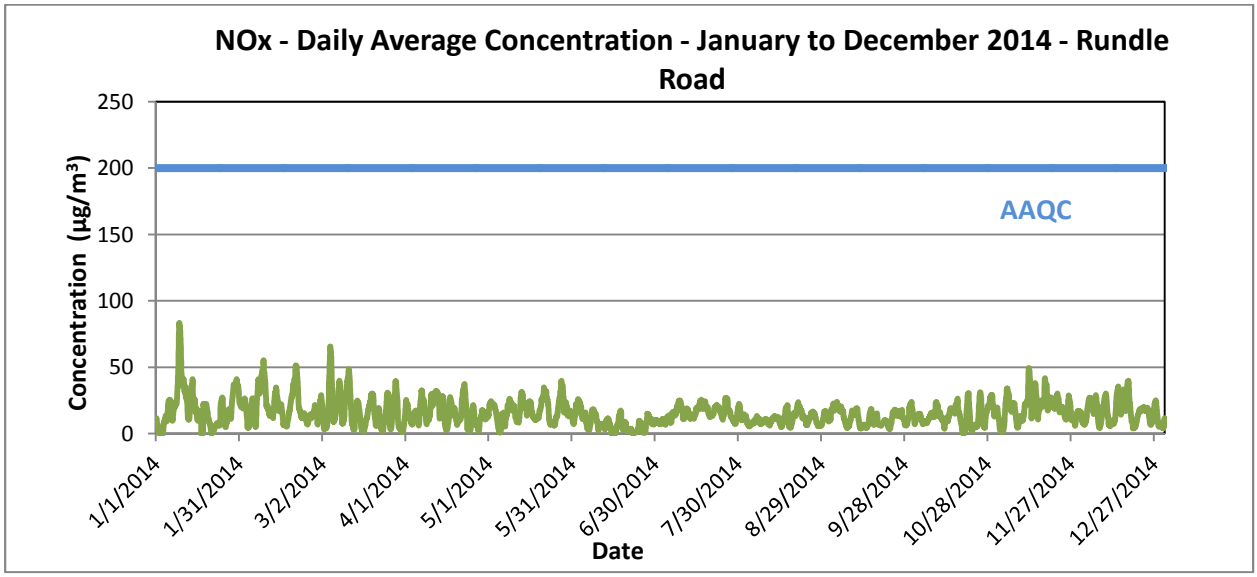


Figure D-3 Measured Hourly NOx Concentrations vs. Wind Direction – Courtice WPCP Station

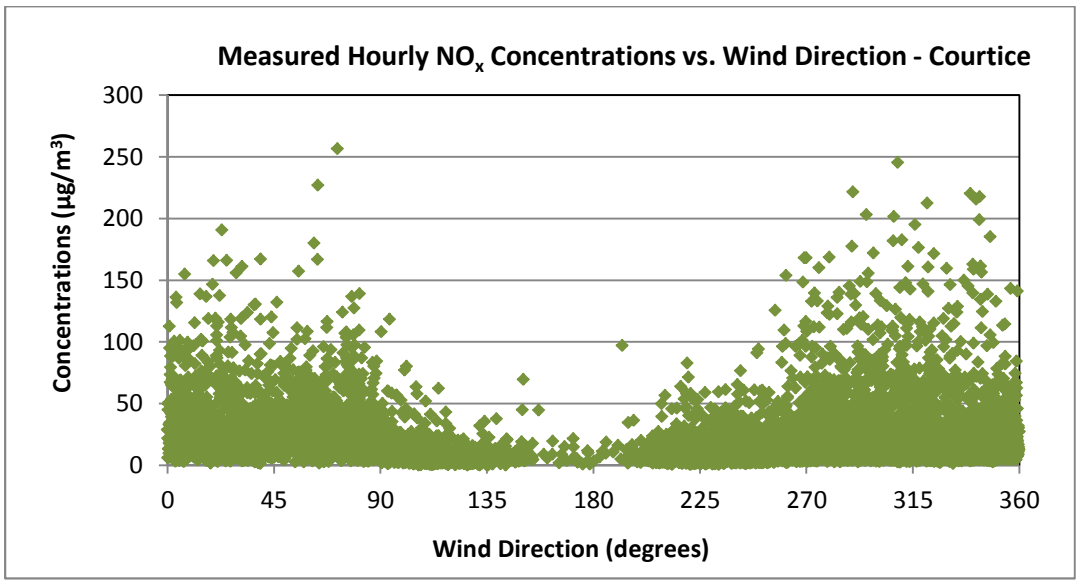
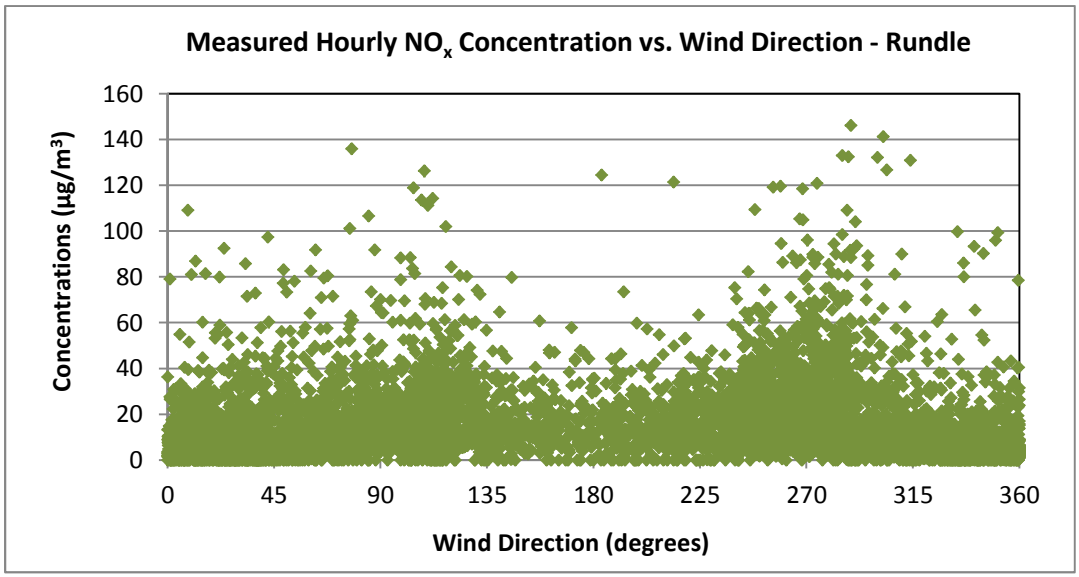


Figure D-4 Measured Hourly NOx Concentrations vs. Wind Direction - Rundle Road Station



Appendix E $PM_{2.5}$ PLOT

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

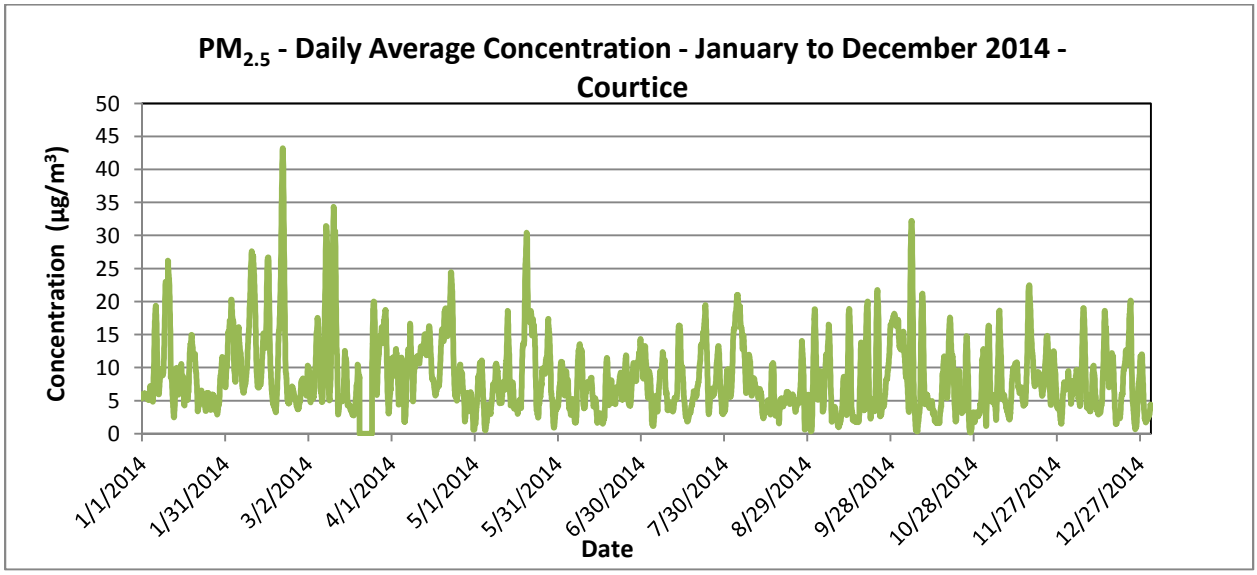


Figure E-2 Time History Plot of Measured 24-Hour Average $PM_{2.5}$ Concentrations – Rundle Road Station

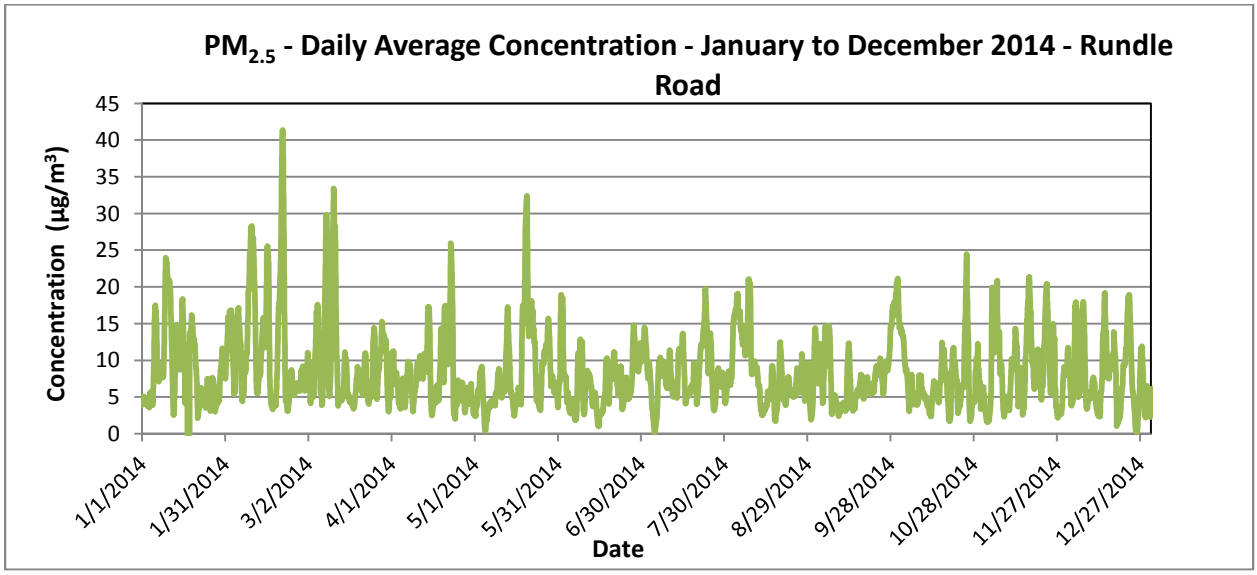


Figure E-3 Measured 24-Hour Average $PM_{2.5}$ Concentrations vs. Measured 24-Hour Vector Averaged Wind Direction Courtice WPCP Station

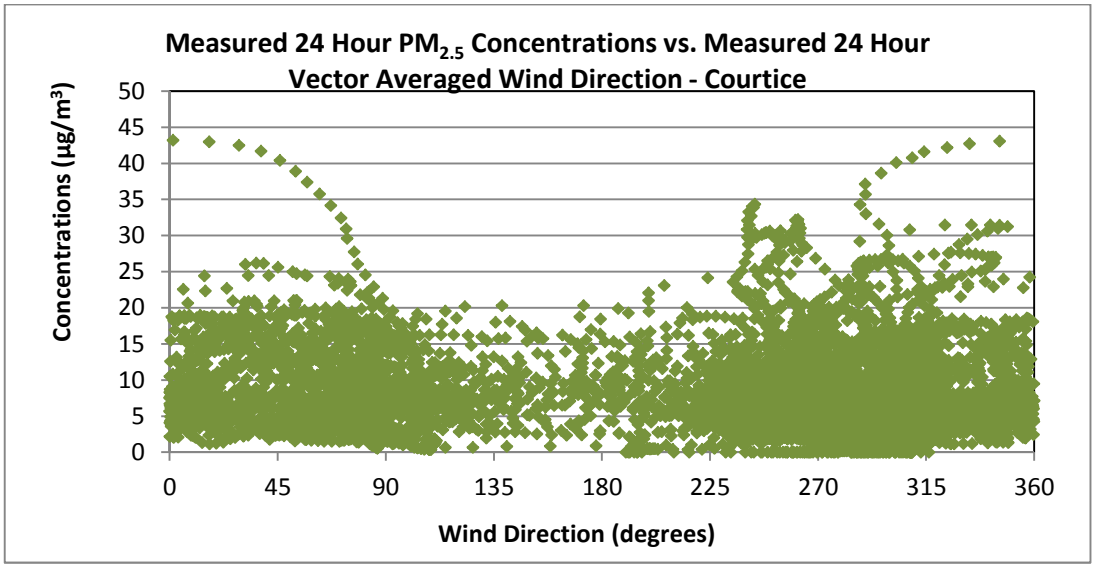


Figure E-4 Measured 24-Hour Average $PM_{2.5}$ Concentrations vs. Measured 24-Hour Vector Averaged Wind Direction – Rundle Road Station