Annual Ambient Air Quality Monitoring Report for the Durham York Energy Centre – May to December 2013

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 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 (MOE, 2010). The air monitoring plan was also developed to satisfy the conditions of the Environmental Compliance Approval and the environmental mitigation and commitments set out in the Environmental Assessment (Jacques Whitford, 2009). The predominantly downwind station is located along Rundle Road, south of Baseline Road. The predominantly upwind station is sited at the Courtice Water Pollution Control Plant (WPCP). Since the start of monitoring in May 2013, the two stations have measured the following air contaminants:

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

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 MOE 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 May to December 2013 – an 8-month period. In order to calculate annual average concentrations suitable for comparison to MOE annual criteria, MOE requires that a minimum of 9 months of data out the 12 months in a year be available. Since the length of the measurement period in 2013 was less than 9-months, the period (i.e. 8-month) averages presented in this report were not compared to available MOE annual criteria.

The 2013 monitoring collected background air quality levels (i.e. air quality without the DYEC operating). The DYEC was under construction in 2013, with commissioning of the facility currently anticipated to start in July 2014. Based on this schedule, 14-months of background air quality data will be collected prior to the start of the facility operations. As the MOE requires quarterly and annual reports to be submitted based on calendar quarters/years, a separate report will be issued summarizing the data collected over the 14-months of background data collection. At this time, sufficient data will have been collected to compare annual average levels to applicable annual criteria.

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 and 24-hour averaging periods. As noted above, since the monitoring period was less than minimum length required to calculate annual averages, the period (8-month)averages presented in this report were not explicitly compared with the applicable annual criteria;

2. The 98th percentiles of the measured daily average $PM_{2.5}$ levels during the 2013 monitoring period were 21.5 µg/m^3 at the Courtice WPCP station and 21.7 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 2013 measurements are not directly comparable;

3. The maximum measured concentrations of TSP and all metals with MOE 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 MOE Ambient Air Quality Criteria, were well below their applicable 24-hour criteria (presented in Table 2-4) at both stations with the exception of four (4) 24-hour average benzo(a)pyrene (B(a)P) measurements. Three (3) samples collected at the Rundle Road Station (on June 21, August 20, and December 18, 2013) exceeded the Ontario 24-hour B(a)P AAQC by levels varying from 3% to 720%. One (1) measurement of B(a)P at the Courtice WPCP Station (collected on August 20, 2013) exceeded the MOE Ambient Air Quality Criteria by 30%, However, all four samples were well below the MOE 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 MOE 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. All monitored contaminants were below their applicable MOE criteria during the 2013 monitoring period with the exception of four (4) 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
MOE	Ontario Ministry of the Environment
SO_2	Sulphur Dioxide
NO_x	Nitrogen Oxides
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
Si	Silver
Tl	Thallium
Sn	Tin
V	Vanadium
Zn	Zinc

Miscellaneous	
°C	temperature in degrees Celsius
N/A	not available
%	percent
ppm (part per million)	mg/L, µg/mL, ng/µL
ppb (part per billion)	µg/L, ng/mL, pg/µL
ppt (part per trillion)	ng/L, pg/mL, fg/µL
min	minimum
max	maximum
$\mu g/m^3$	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). Since May 2013, the two stations have measured the following air contaminants:

- Sulphur Dioxide (SO_2);
- Nitrogen Oxides (NO_X);
- Particulate Matter smaller than 2.5 microns ($PM_{2.5}$);
- 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 since May 2013 were prepared by Stantec and submitted to the Region. This Annual Report summarizes the results of the ambient air monitoring over the portion of the calendar year that the monitoring station was operating - from May to December 2013.

1.2 LOCATIONS OF AMBIENT AIR QUALITY MONITORING STATIONS

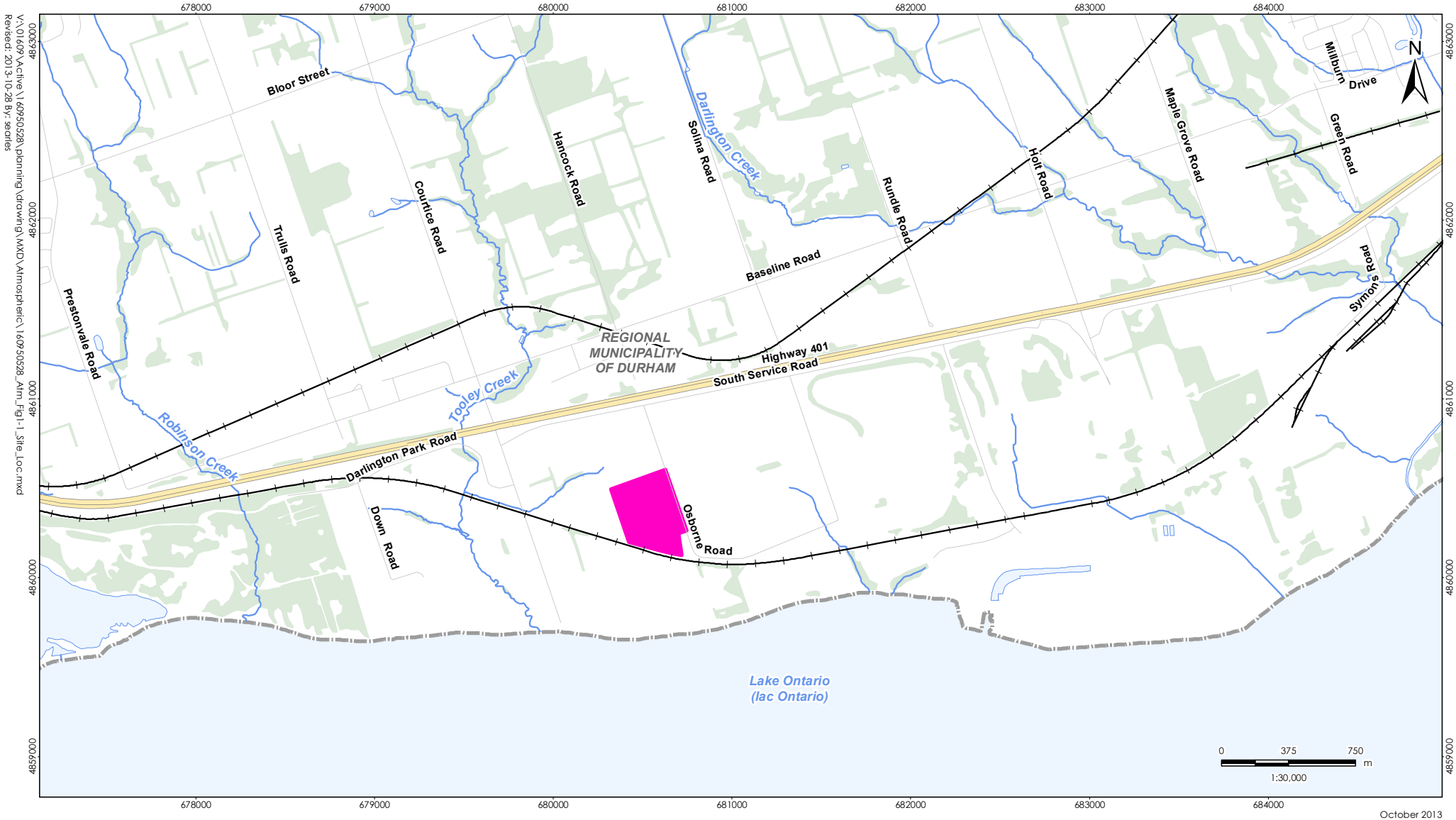
The selection of sites for the monitoring stations was done in consultation with the Ontario Ministry of Environment (MOE) and Durham/York representatives based on the results of air quality modelling done in support of the environmental assessment for the project, the locations of nearby sensitive receptors, and general MOE 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. The monitoring station measures all the air contaminants listed in Section 1.1 and meteorological data. 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. This monitoring station measures the air contaminants presented in Section1.1, as well as meteorological data, 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 2014 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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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.

Legend

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

Client/Project

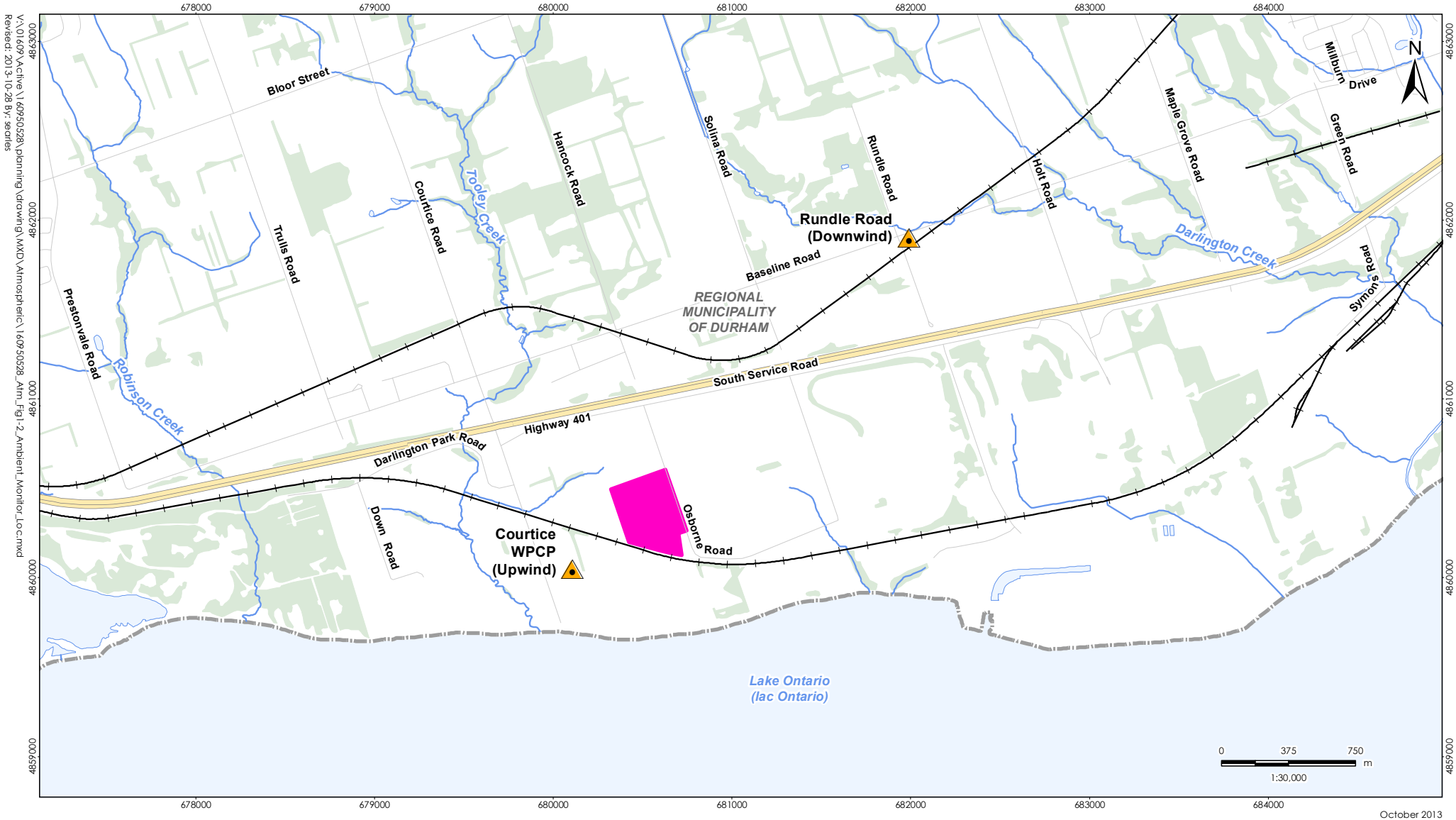
The Region of Durham
Durham York Energy Centre

Figure No.

1-1

Title

Site Location Plan



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October 2013
160950528

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Legend

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

Notes

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

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

1-2

Title

Locations of Ambient Monitoring Stations

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

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

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:

- Nitrogen Oxides (NO_X);
- Sulphur Dioxide (SO_2);
- Particulate Matter smaller than 2.5 microns ($PM_{2.5}$);
- 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. Further oxidation and combination with water in the atmosphere forms what is known as "acid rain".

Nitrogen oxides are emitted from a variety of combustion sources including vehicles, industrial heaters and boilers, and residential gas-fired furnaces and hot water boilers. Generally for combustion, 5 to 10% of the initial total emissions of NO_X are NO_2 with the remaining 90-95% being NO. The conversion of the majority of NO occurs after 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. Rationales for the choice of contaminants being monitored is provided in the Ambient Air Quality Monitoring Plan

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 is provided in the Ambient Air Quality Monitoring Plan.

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.

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 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 is the limits reported in O.Reg.419/05 (Schedules 3 and 6). These are compliance based standards used through the province of Ontario. However, not all chemicals have O.Reg.419/05 criteria, or in some instances updated health-based standards were used in the human health risk assessment (HHRA) conducted in support of the Environmental Assessment (July 31, 2009) - December 10, 2009). These health-based values, which were reported in Table 7-2 (Summary of Inhalation TRVs and Inhalation Benchmarks Selected for CACs) and Table 7-3 (Inhalation TRVs and Inhalation Benchmarks for Selected COPCs) of the HHRA (Stantec, 2009) were used as the second set of standards.

The currently applicable Canada-Wide Standard (CWS) for $PM_{2.5}$ 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. 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.

A summary of the relevant 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/m³)	24-Hour (µg/m³)	Other time Period (µg/m³)	1-Hour (µg/m³)	24-Hour (µg/m³)	Annual (µg/m³)
Sulphur dioxide	7446095	690	275	55 [A]; annual	690	275	29
Nitrogen oxides [B]	10102-44-0	400	200		400	200	60
Contaminant	**CAS**	**Canada-Wide Standard**			**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)**	**Other time Period (µg/m³)**
$PM_{2.5}$	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	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

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

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)
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/m³) [F] 1 (pg TEQ/m³) [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. O. Reg. 419 24 Hour Guideline
E. Application of the air standard for dioxins, furans, and dioxin-like PCBs requires the calculation of the total toxicity equivalent (TEQ) concentration contributed by all dioxin-like compounds in the mixture. TEQ is calculated using the methodology as per the 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. The monitors were set up in April 2013, and monitoring started in May 2013.

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

In April 2013, two manually operated, hi-volume air samplers were 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 MOE 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 (ACC) 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 (a minimum of weekly). 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/ Valley Environmental Services Inc. (Valley) during the station visits in 2013 is presented in Table A-1 in Appendix A.

Diagnostic tests were performed remotely on the continuous monitoring equipment and station parameters on a routine basis during week days to check for anomalous data and assess whether the equipment was functioning normally. Any issues identified were investigated and rectified. If required, Valley was notified to dispatch a trained technician to address the issue.

3.3 DATA ACQUISITION /ARCHIVING

Continuous station data is maintained in the data loggers, and data was viewed and collected via the automated data acquisition systems and cell phone modems.

- On a routine 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 (see Section 3.6.2 for further discussion of this protocol);
- 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 MOE 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 MOE 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 of monthly (or after any motor maintenance) during the sampling period. The calibration frequency exceeded the MOE Operations Manual requirement of quarterly calibrations.

3.5 MINISTRY OF THE ENVIRONMENT MONITOR PERFORMANCE AND SITE AUDIT

One Ministry of the Environment (MOE) audit was conducted in 2013 and occurred on July 31. The continuous $PM_{2.5}$, SO_2, and $NO_X/NO_2/NO$ monitors at both the Courtice WPCP and Rundle Road Stations were audited. All monitors passed the MOE performance and site audits, and calibrations met all current MOE criteria.

3.6 INSTRUMENTATION ISSUES

A few instrumentation issues were encountered during 2013. Two instrumentation issues that occurred during the initial shake-down period and into the first two months (May-June) of the monitoring are discussed in detail in the following sub-sections. Monitoring in the months following the May-June period has seen few instrumentation issues and acceptable data recovery rates for all parameters. Other than the instrumentation issues discussed below, issues with the monitors were generally associated with; a power outage, adverse effects on instrumentation due to an ice storm, ice build-up on a monitor 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 2013 monitoring period is presented in Tables A-3 and A-4 in Appendix A.

3.6.1 $PM_{2.5}$ Instrumentation Issue

The ambient monitoring station shelters at the Courtice and Rundle Road locations were installed by Stantec Consulting Limited and Valley Environmental on April 3, 2013 and the instrumentation was installed on April 11, 2013 Almost immediately upon start of operation, the Thermo-Fisher Sharpe $PM_{2.5}$ instruments at both stations exhibited operational issues in which the instruments would cease operation and display a "flow fault" error on their digital readouts. This occurred several times over the period April 22 to 29 and culminated on April 29th with the Rundle station instrument failing completely and the Courtice Station continuing to exhibit the "flow fault" error. On April 29th, both instruments were removed from the stations and hand-delivered to CD NOVA. CD NOVA examined the instruments but was not able to diagnose or repair the problems, which necessitated both instruments being shipped back to the manufacturer in the United States.

Thermo-Fisher in the US determined that the instrument at the Rundle Road station had a mother board failure and replaced it under warranty. Thermo-Fisher was however, unable to determine an issue with the unit at Courtice. Thermo-Fisher re-installed the software in both units as a potential operational solution. The Courtice Station instrument was received back from CD NOVA on June 11 and re-installed at the site. However, the instrument continued to exhibit the "flow-fault" error even though the software had been re-installed on the unit by the manufacturer.

Valley Environmental contacted the Ministry of Environment (MOE) the week of June 11th and learned that the MOE, who has been operating several of these instruments for an extended period of time were also experiencing this issue with some of their units. The MOE had been in contact with Environment Canada (also an operator of these units) who were also experiencing the same issue and believed that the issue was due to the units being unusually sensitive to fluctuations in electrical power supply. When the Rundle Road unit was received back from CD NOVA and re-installed on June 19/20, 2013, Valley Environmental also attached both the units to un-interruptible power supplies to provide constant, un-fluctuating power to the instruments. Following a warm-up/stabilization period, both units were ready to again collect data on June 26, 2013. After this solution was implemented, this issue has not been seen again.

Since implementation of these actions in June 2013, quarterly data recovery rates for $PM_{2.5}$ for the remainder of 2013 ranged from 96.3% to 99.9%, which are all well above the recovery rate required by the MOE.

3.6.2 Data Logger Memory Issue

The second instrumentation issue encountered in the May-June period occurred for the Rundle Road station, in which an anomalous data logger issue was encountered in which data for almost the entire month of June was found to be missing from the downloaded data logger file. Data from the stations was remotely downloaded on a routine basis from each station during the monitoring period with software configured to append the data to a file for each station located on a PC in the Stantec office. Following the month of June, it was found that the PC file did not contain any data for this month, although the data logger was checked frequently during the month and the software appeared to remotely download the data correctly from the data logger. The data was not recoverable from the data logger.

To address this issue, Stantec and Valley Environmental implemented the following remedial actions:

- The station data logger files are now backed-up by Stantec on a weekly basis to separate computer directories to ensure that any data logger/software download issues will not overwrite any data already stored in the PC files.
- An additional quality record was added to the Stantec Quality Plan for the project in February 2014. Stantec has Implemented use of an electronic log sheet to track monitoring station data logger access by project personnel. The form includes a field to record the project folder location that the data logger files are saved into on a weekly basis.
- Valley Environmental has updated their standard procedures so that in addition to down loading all the data (as was done previously), they are now also manually checking the integrity/continuity of all the data (hour by hour) before proceeding with any work on the data logger.

For the remainder of 2013 (July-December 2013) after this issue occurred, data recovery from both the Rundle Road and Courtice Station data loggers was 100%.

3.7 INSTRUMENTATION RECOVERY RATES

Data recovery rates for each continuous monitor at the two monitoring stations during the 2013 sampling period (May to December 2013) are presented in Tables 3-4 and 3-5. The data recovery rates for all contaminants at both stations met or exceeded MOE requirements for data validity.

Table 3-4 Summary of Data Recovery Rates for the Courtice WPCP Station (Upwind) –2013 Monitoring Period

Parameter	Valid Measurement Hours	Data Recovery Rate (%)
SO_2	5698	97%
NO_X	5779	98%
$PM_{2.5}$	4392	75%
Temperature	5854	99.6%
Rainfall	5854	99.6%
Relative Humidity	5854	99.6%
Pressure	5729	97%
Wind Speed/Direction	5880	100%
TSP/Metals	40 [A]	98%
PAHs	21 [A]	100%
Dioxins and Furans	10 [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) – 2013 Monitoring Period

Parameter	Valid Measurement Hours	Data Recovery Rate (%)
SO_2	5003	85%
NO_X	4892	83%
$PM_{2.5}$	4415	75%
Temperature	5169	88%
Rainfall	5169	88%
Relative Humidity	5169	88%
Wind Speed/Direction	4567	78%
TSP/Metals	39 [A]	95%
PAHs	21 [A]	100%
Dioxins and Furans	9 [A]	90%

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 May - December 2013 is presented in Table 4-1.

Table 4-1 Summary of Hourly Meteorological Measurements –2013 Monitoring Period

Parameter		Courtice WPCP (Upwind)	Rundle Road (Downwind)	Units
Temperature	Max	30.3	32.8	C
	Min	-19.1	-20.0	C
	Mean	11.7	10.8	C
	Standard Deviation	9.2	9.9	C
Rainfall	Max	21.9	19.8	mm
	Min	0.0	0.0	mm
	Mean	0.08	0.08	mm
	Standard Deviation	0.60	0.56	mm
Relative Humidity	Max	100.0	100.0	%
	Min	25.8	20.7	%
	Mean	76.6	77.7	%
	Standard Deviation	14.4	15.5	%
Pressure [A]	Max	30.4	-	in Hg
	Min	28.8	-	in Hg
	Mean	29.7	-	in Hg
	Standard Deviation	0.2	-	in Hg
Wind Speed [B]	Max	46.1	50.8	km/hr
	Min	0.1	0.0	km/hr
	Mean	10.7	9.2	km/hr
	Standard Deviation	6.5	6.0	km/hr

Notes:

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

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

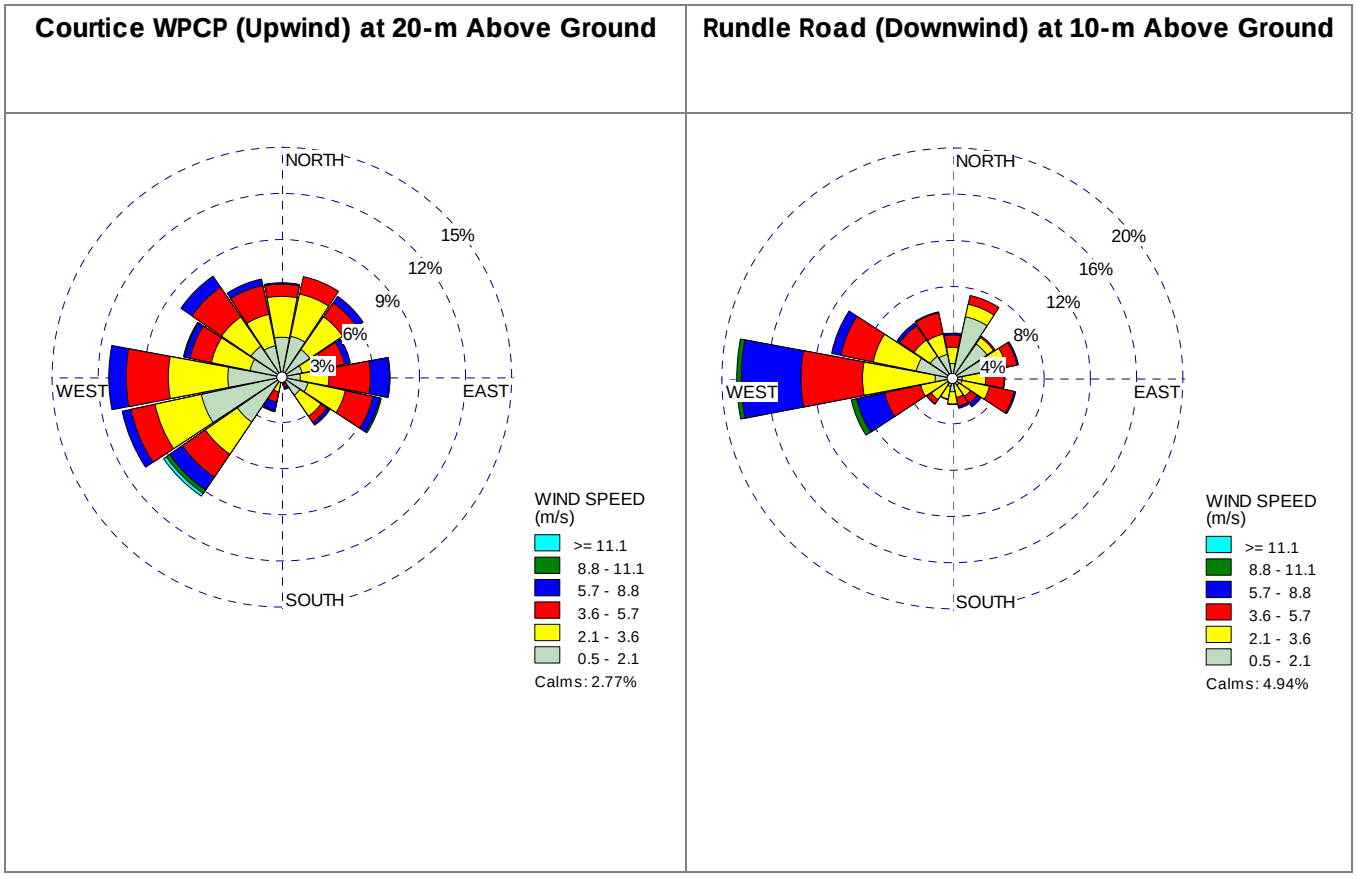
Summary of Ambient Measurements
May 14, 2014

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 eight-month monitoring period in 2013 at the Courtice WPCP Station occurred predominantly from west to 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 Station. Higher wind speeds occurred from the west at the Rundle Station relative to all other directions.

Figure 4-1 Wind Roses for the 2013 Monitoring Period



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 of the relevant Ontario ambient air quality criteria (AAQC) or health-based standard for each contaminant (if any occurred). All monitored contaminants were below their applicable hourly or 24-hour average criteria during the period between May and December, 2013. In order to calculate annual average concentrations suitable for comparison to MOE annual criteria, MOE requires that a minimum of 9 months of data out the 12 months in year be available. Since the length of the measurement period in 2013 was less than 9-months, the period (i.e. 8-month) averages presented in this report were not compared to available MOE annual criteria.

Nitric oxide (NO) has no regulatory criteria as discussed in Section 4.2.2 below. The hourly and 24-hour AAQC for NO_X are based on health effects of NO_2, therefore the AAQCs were compared to measured NO_2 concentrations in this report (MOE, 2012a). However, as per the current April 2012 version of O.Reg. 419 Summary of Standards and Guidelines (MOE, 2012b), the Schedule 3 criteria for NOx 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 - 2013 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	157.2	56.3	65.3	24.8
				Minimum	0.0	0.0	0.0	0.0
				Mean	4.4	1.6	1.2	0.4
				Standard Deviation	8.3	3.0	2.7	1.0
				# of Exceedances	0	0	0	0
	24	275	100	Maximum	36.8	13.8	10.4	3.9
				Minimum	0.0	0.0	0.0	0.0
				Mean	4.4	1.6	1.2	0.4
				Standard Deviation	5.6	2.0	1.2	0.4
				# of Exceedances	0	0	0	0
	Annual	55 / 29 [B]	20 / 11 [B]	Mean (Period)	4.4	1.6	1.2	0.4
				# of Exceedances	N/A [A]	N/A [A]	N/A [A]	N/A [A]
$PM_{2.5}$	24	30 [C]	NA	Maximum	27.0	-	50.6	-
				Minimum	1.8	-	0.6	-
				Mean	8.6	-	8.4	-
				98th Percentile [D]	21.5	-	21.7	-
				Standard Deviation	4.7	-	6.2	-
				# of Exceedances	N/A [G]	-	N/A [G]	-

Table 4-2 Summary of Ambient CAC Monitoring Data - 2013 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 [E]	200 [E]	Maximum	93.8	48.0	78.3	39.3
				Minimum	0.0	0.0	0.0	0.0
				Mean	12.6	6.4	12.8	6.5
				Standard Deviation	14.0	7.1	10.0	5.1
				# of Exceedances	0	0	0	0
	24	200 [E]	100 [E]	Maximum	54.5	26.8	50.4	24.7
				Minimum	0.5	0.3	0.4	0.2
				Mean	12.6	6.4	12.9	6.6
				Standard Deviation	8.0	4.1	6.9	3.5
				# of Exceedances	0	0	0	0
NO [F]	1	NA	NA	Maximum	148.1	111.1	53.5	40.7
				Minimum	0.0	0.0	0.0	0.0
				Mean	4.1	3.2	3.9	3.0
				Standard Deviation	8.2	6.4	3.8	2.9
				# of Exceedances	N/A	N/A	N/A	N/A
	24	NA	NA	Maximum	30.4	22.9	14.1	10.6
				Minimum	0.0	0.0	0.6	0.5
				Mean	4.1	3.2	3.9	3.0
				Standard Deviation	3.8	3.0	1.8	1.4
				# of Exceedances	N/A	N/A	N/A	N/A

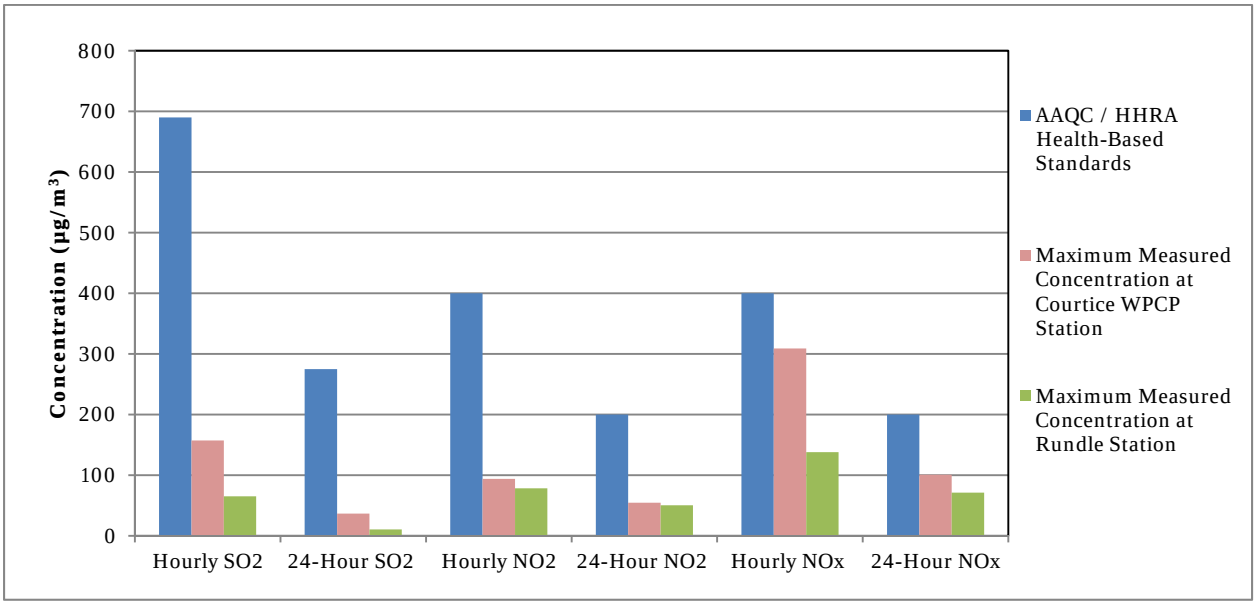
Table 4-2 Summary of Ambient CAC Monitoring Data - 2013 Monitoring Period

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 [E]	200 [E]	Maximum	309.0	151.3	138.1	68.5
				Minimum	0.0	0.0	0.0	0.0
				Mean	18.7	9.6	15.8	8.0
				Standard Deviation	24.0	12.2	13.8	7.0
				# of Exceedances	0	0	0	0
	24	200 [E]	100 [E]	Maximum	100.8	49.6	71.2	34.9
				Minimum	0.3	0.1	0.7	0.3
				Mean	18.7	9.5	15.9	8.1
				Standard Deviation	12.9	6.6	8.5	4.3
				# of Exceedances	0	0	0	0

Notes:

A. As the length of the measurement period in 2013 was less than 9-months, the period (i.e. 8-months) averages presented in this report were not compared to available MOE annual criteria.
B. Annual AAQC / Annual HHRA.
C. 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.
D. The 98th percentile of the daily average $PM_{2.5}$ measurements in the period.
E. 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.
F. NO has no regulatory criteria.
G. 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 8-month period covered by this report.

Figure 4-2 Comparison of NO_2 / NO_X and SO_2 Ambient Monitoring Data to Applicable Criteria –2013 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 is 29 µg/m³. As the monitoring period in the 2013 calendar year was only 8-months (May to December), which is less than the minimum 9-months of data required by MOE to calculate annual averages, the period averages presented in this report were not compared to the annual criteria.

The maximum hourly and 24-hour average concentrations measured at the Courtice WPCP station during the 2013 monitoring period were 157 and 37 µg/m³, respectively, which are 23% and 13% of the applicable ambient 1-hour and 24-hour air quality criteria. The average concentration for the period (May to December 2013) measured at the Courtice WPCP station was 4 µg/m³.

Summary of Ambient Measurements
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The maximum hourly and 24-hour average concentrations measured at the Rundle Road station during 2013 were 65 and 10 µg/m^3, respectively, which are 10% and 4% of the applicable ambient 1-hour and 24-hour air quality criteria. The average concentration for the period (May to December 2013) at the Rundle Road station was 1 µg/m^3.

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 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 southwesterly winds directions in which Highway 401 and a CN railway are upwind of the station.

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Stantec

Legend

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

Concentration (ug/m3) 50-160 20-50 10-20 1-10 0-1

Notes

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Figure No.

4-3

Title

Pollution Roses of Measured Hourly Average SO_2 Concentrations - 2013 Monitoring Period

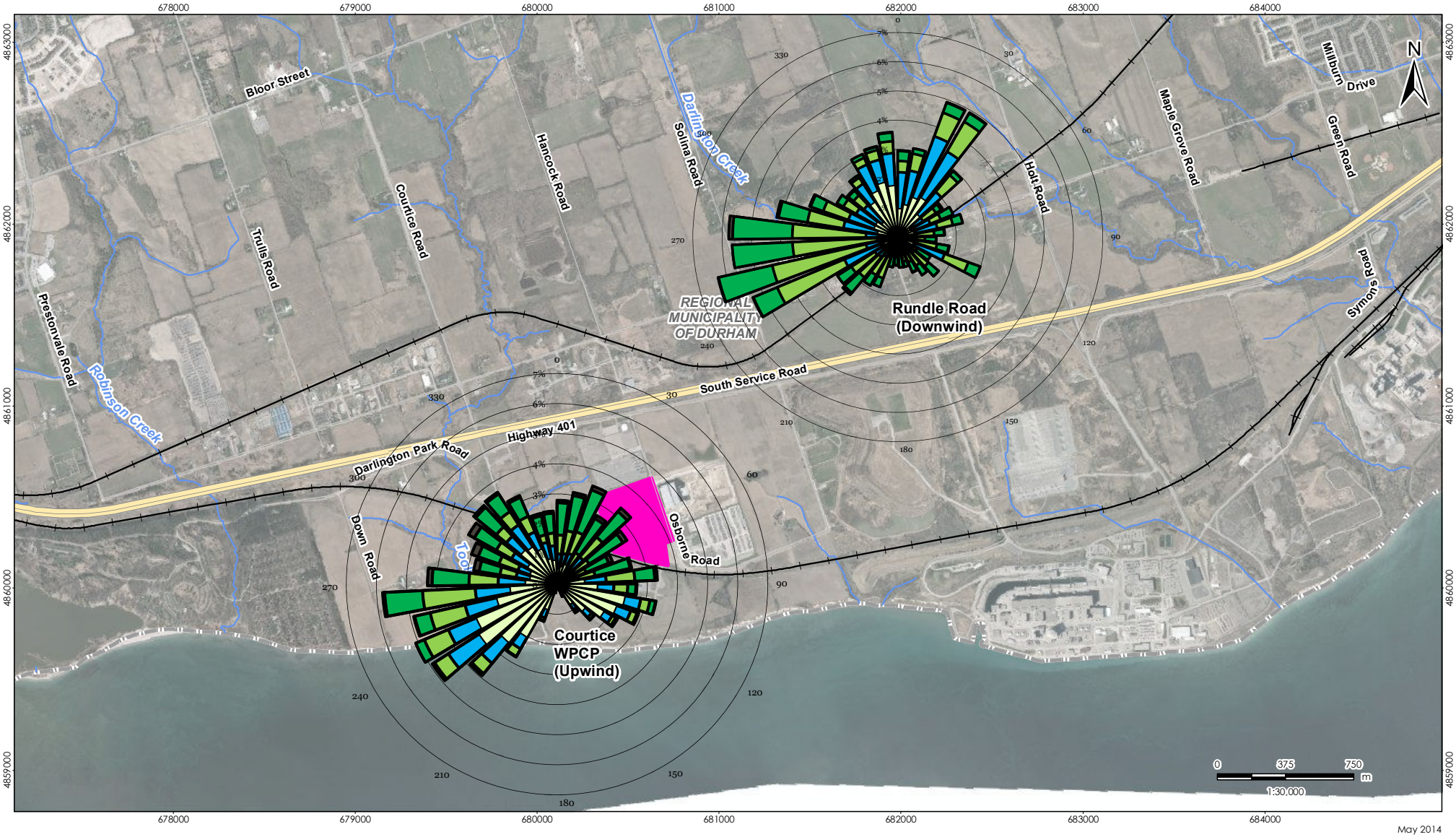
4.2.2 Nitrogen Dioxide (NO_2)

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 (MOE, 2012a). However, as per the current April 2012 version of O. Reg. 419 Summary of Standards and Guidelines (MOE, 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/m^3 and 200 µg/m^3 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 and 24-hour average NO_2 concentrations measured at the Courtice WPCP station during 2013 (May to December) were 94 and 55 µg/m^3, respectively which are 23% and 27% 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 78 and 50 µg/m^3, which are 20% and 25% 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 northeasterly winds - a direction in which the Courtice WPCP and the DYEC construction site were upwind of the station. At the Rundle Road Station, higher hourly average NO_2 concentrations were measured for winds blowing from westerly and northeasterly directions, for which Baseline Road and Rundle Road are upwind of the station.



May 2014
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- Railway
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- Highway
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Concentration (ug/m3) 50-100 20-50 10-20 5-10 0-5

Notes

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Figure No.

4-4

Title

Pollution Roses of Measured Hourly Average NO_2 Concentrations - 2013 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/m^3 and 200 µg/m^3 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 309 µg/m^3, which is 77% of the 1-hour ambient criteria. The 24-hour average NO_X concentration measured at this station was 101 µg/m^3, which is 50% of the applicable ambient 24-hour air quality criteria. At the Rundle Road Station, the maximum hourly and 24-hour average concentrations measured in 2013 were 138 and 71 µg/m^3, which are 35% and 36% 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. Review of the ratios of measured NO_x to NO_2 during the hours when the highest NO_x levels were measured, suggest that the measurements were likely due to a nearby source in the Courtice WPCP or the DYEC construction site. Elevated NO_X concentrations were also measured for north/northwesterly winds, for which Highway 401 is 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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Stantec

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- Railway
- Road
- Highway
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Concentration (ug/m3) 100-310 | 50-100 | 20-50 | 10-20 | 0-10

Notes

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Figure No.

4-5

Title

Pollution Roses of Measured Hourly Average NO_x Concentrations – 2013 Monitoring Period

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

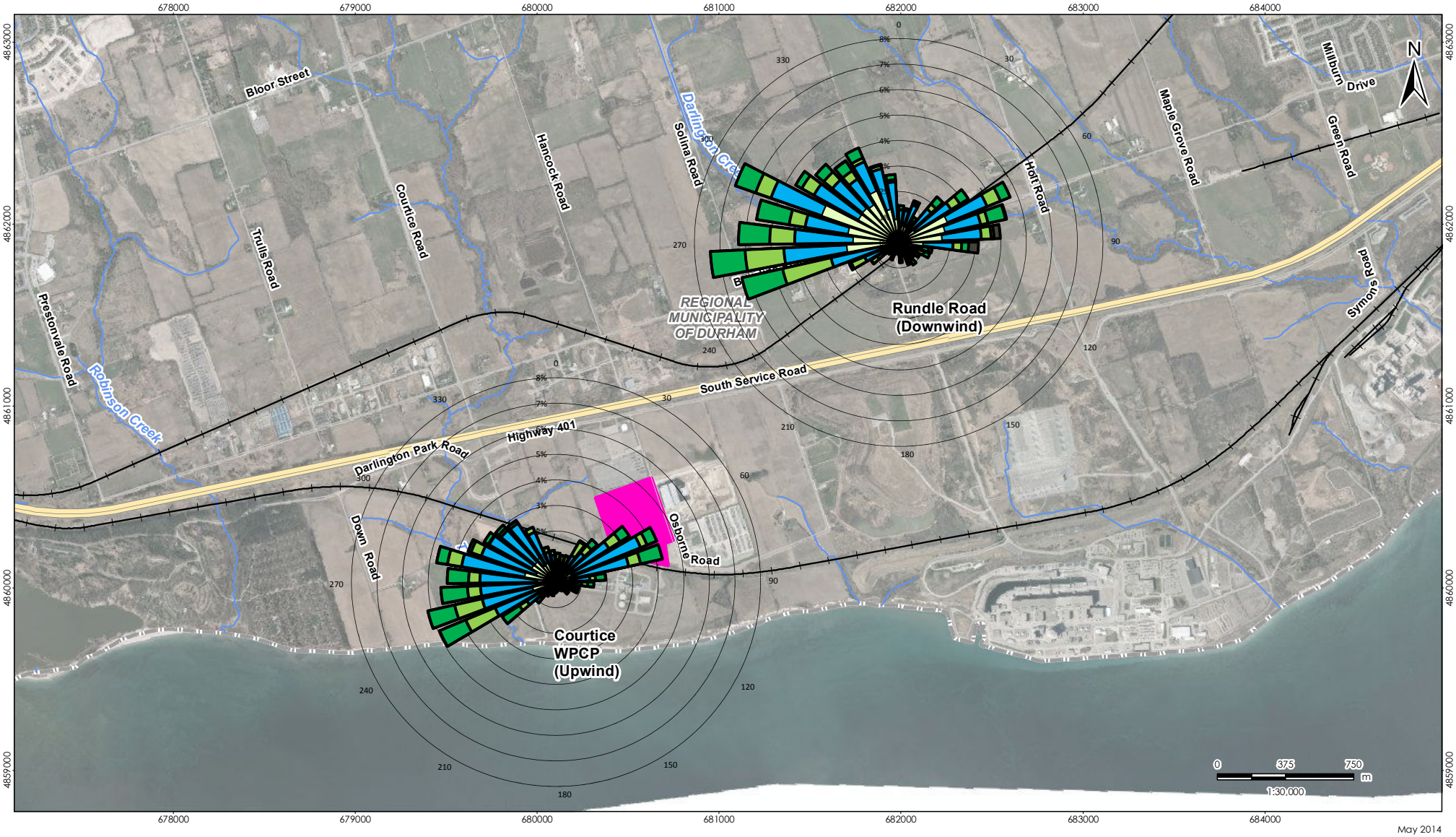
Time history plots of the measured 24-hour average $PM_{2.5}$ concentrations over the measurement period are presented in Appendix E, Figures E1 and E2.

The maximum 24-hour average $PM_{2.5}$ concentration measured at the Courtice WPCP station over the monitoring period was 27 µg/m^3. The maximum measured 24-hour average $PM_{2.5}$ concentration at the Rundle Road station was 51 µg/m^3. The 98th percentiles of the daily average $PM_{2.5}$ concentrations measured over the monitoring period were 21.5 µg/m^3 at the Courtice WPCP Station and 21.7 µg/m^3 at the Rundle Road Station. A comparison to the CWS for $PM_{2.5}$ requires averaging the 98th percentile daily average levels in each of three consecutive years. As the measurement period in 2013 (8-months) was less than the minimum length required to calculate a 98th percentile annual level (MOE requires a minimum of 9-months of data), the period 98th percentile $PM_{2.5}$ data were not explicitly compared to the current CWS criteria of 30 µg/m^3 in Table 4-2. However, since the 98th percentiles for the 8-month period were low compared to the current CWS criteria, this suggests that the 98th percentile of an annual monitoring period would likely also be below the CWS criteria.

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 southwesterly winds, with elevated $PM_{2.5}$ concentrations (relative to other directions) also measured for winds blowing from east to northeasterly directions. The Courtice WPCP and the DYEC construction site were upwind of this monitoring station for east to northeasterly winds, while an agricultural area is located upwind of the monitoring station for southwesterly 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.



May 2014
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Revised: 2014-05-15 By: bcowper

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- Highway
- Watercourse

Concentration (ug/m3) 30-55 15-30 10-15 5-10 0-5

Notes

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Figure No.

4-6

Title

Pollution Roses of Measured 24-Hour Average $PM_{2.5}$ Concentrations – 2013 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 MOE air quality criteria during the 2013 monitoring period were well below their applicable 24-hour criteria (shown in Table 4-3 below) at both stations.

Table 4-3 Summary of Measured Ambient TSP/Metals Concentrations – 2013 Monitoring Period

Contaminant	Units	MOE (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
Particulate	µg/m³	120	120	62	5	25 / 21 [A]	0	78	6	31 / 26 [A]	0
Total Mercury (Hg)	µg/m³	2		3.12E-05	3.75E-06	1.19E-05	0	5.14E-05	4.12E-06	1.21E-05	0
Aluminum (Al)	µg/m³	4.8	-	3.34E-01	1.23E-02	9.80E-02	0	4.54E-01	1.10E-02	1.31E-01	-
Antimony (Sb)	µg/m³	25	25	2.69E-03	1.88E-03	2.16E-03	0	2.86E-03	2.03E-03	2.25E-03	0
Arsenic (As)	µg/m³	0.3	0.3	3.79E-03	1.13E-03	1.36E-03	0	1.76E-03	1.22E-03	1.35E-03	0
Barium (Ba)	µg/m³	10	10	1.58E-02	1.52E-03	5.72E-03	0	1.61E-02	1.18E-03	6.44E-03	0
Beryllium (Be)	µg/m³	0.01	0.01	2.69E-04	1.88E-04	2.16E-04	0	2.86E-04	2.03E-04	2.25E-04	0
Bismuth (Bi)	µg/m³	-	-	1.66E-03	1.13E-03	1.30E-03	-	1.76E-03	1.22E-03	1.35E-03	-
Boron (B)	µg/m³	120	-	1.13E-02	1.13E-03	2.04E-03	0	1.45E-02	1.22E-03	2.31E-03	-
Cadmium (Cd)	µg/m³	0.025	0.025	5.59E-04	3.75E-04	4.34E-04	0	8.99E-04	4.06E-04	4.64E-04	0
Chromium (Cr)	µg/m³	0.5	-	3.82E-03	9.38E-04	1.68E-03	0	1.78E-02	1.05E-03	2.90E-03	-
Cobalt (Co)	µg/m³	0.1	0.1	5.59E-04	3.75E-04	4.34E-04	0	5.95E-04	4.06E-04	4.51E-04	0
Copper (Cu)	µg/m³	50	-	7.68E-02	9.21E-03	2.95E-02	0	2.36E-01	2.92E-02	1.00E-01	-
Iron (Fe)	µg/m³	4	-	9.90E-01	6.23E-02	3.43E-01	0	1.31E+00	4.47E-02	4.89E-01	-
Lead (Pb)	µg/m³	0.5	0.5	6.47E-03	5.97E-04	2.48E-03	0	6.80E-03	6.18E-04	2.78E-03	0
Magnesium (Mg)	µg/m³	-	-	5.71E-01	2.89E-02	1.58E-01	-	6.76E-01	2.98E-02	1.98E-01	-
Manganese (Mn)	µg/m³	0.4	-	3.31E-02	2.01E-03	1.03E-02	0	1.02E-01	2.15E-03	1.74E-02	-

Table 4-3 Summary of Measured Ambient TSP/Metals Concentrations – 2013 Monitoring Period

Contaminant	Units	MOE (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
Molybdenum (Mo)	µg/m³	120	-	1.65E-03	5.63E-04	8.10E-04	0	3.79E-03	6.50E-04	2.29E-03	-
Nickel (Ni)	µg/m³	0.2	-	4.35E-03	5.63E-04	1.31E-03	0	4.67E-03	6.18E-04	1.73E-03	-
Phosphorus (P)	µg/m³	-	-	1.45E-01	4.69E-03	3.35E-02	-	1.59E-01	5.35E-03	4.32E-02	-
Selenium (Se)	µg/m³	10	10	2.69E-03	1.88E-03	2.16E-03	0	2.86E-03	2.03E-03	2.25E-03	0
Silver (Ag)	µg/m³	1	1	1.89E-03	3.99E-04	8.65E-04	0	2.33E-03	4.20E-04	9.03E-04	0
Strontium (Sr)	µg/m³	120	-	1.10E-02	8.34E-04	3.73E-03	0	1.95E-02	8.77E-04	5.18E-03	0
Thallium (Tl)	µg/m³	-	-	2.69E-03	1.88E-03	2.16E-03	-	2.86E-03	2.03E-03	2.25E-03	-
Tin (Sn)	µg/m³	10	10	4.79E-03	1.88E-03	2.23E-03	0	2.86E-03	2.03E-03	2.25E-03	0
Titanium (Ti)	µg/m³	120	-	1.73E-02	1.72E-03	5.90E-03	0	2.40E-02	2.10E-03	7.88E-03	0
Vanadium (V)	µg/m³	2	1	1.92E-03	3.99E-04	9.54E-04	0	3.22E-03	4.20E-04	1.15E-03	0
Zinc (Zn)	µg/m³	120	-	6.50E-02	8.04E-03	2.45E-02	0	7.43E-02	9.74E-03	3.07E-02	0
Zirconium (Zr)	µg/m³	20	-	1.39E-03	1.99E-04	8.46E-04	0	1.48E-03	2.10E-04	8.50E-04	0
Total Uranium (U)	µg/m³	1.5	-	1.24E-04	8.44E-05	9.76E-05	0	1.32E-04	9.13E-05	1.02E-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.

The maximum measured concentrations of all PAHs with MOE air quality criteria, with the exception of four (4) benzo(a)pyrene (B(a)P) measurements, 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 2010-2012, 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 2012 (for three stations reported in Ontario – Windsor, Toronto and Hamilton) all had maximum levels above the AAQC (varying between 716% -2920% 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 MOE AAQC. In 2010, all of these stations, including the Burnt Island station, measured B(a)P levels above the AAQC.

Three (3) samples collected at the Rundle Road Station on June 21, August 20, and December 18, 2013 exceeded the Ontario 24-hour B(a)P AAQC varying between 3% and 720%. One (1) measurement of B(a)P at the Courtice WPCP Station collected on August 20, 2013 exceeded the MOE Ambient Air Quality Criteria by 30%, However, all four samples were well below the MOE 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).

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 MOE 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 – 2013 Monitoring Period

Contaminant	Units	MOE 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	6.48E-02	6.35E-03	1.89E-02	1 0 0	4.13E-01	6.00E-03	4.14E-02	3 0 0
1-Methylnaphthalene	ng/m³	12000	-	2.72E+01	9.67E-01	7.51E+00	0	2.66E+01	1.36E+00	7.56E+00	0
2-Methylnaphthalene	ng/m³	10000	-	5.43E+01	1.75E+00	1.42E+01	0	4.54E+01	2.19E+00	1.36E+01	0
Acenaphthene	ng/m³	-	-	3.87E+01	1.44E-01	7.60E+00	-	1.89E+01	1.11E-01	6.07E+00	-
Acenaphthylene	ng/m³	3500	-	1.06E+00	1.11E-01	3.03E-01	0	1.63E+00	7.77E-02	2.95E-01	0
Anthracene	ng/m³	200	-	1.31E+01	1.11E-01	9.20E-01	0	1.50E+00	1.10E-01	5.05E-01	0
Benzo(a)anthracene	ng/m³	-	-	1.60E-01	8.25E-02	1.26E-01	-	5.34E-01	7.77E-02	1.50E-01	-
Benzo(a)fluorene	ng/m³	-	-	3.20E-01	1.65E-01	2.53E-01	-	5.94E-01	1.55E-01	2.77E-01	-
Benzo(b)fluoranthene	ng/m³	-	-	3.74E-01	8.25E-02	1.37E-01	-	9.50E-01	7.77E-02	1.76E-01	-
Benzo(b)fluorene	ng/m³	-	-	3.20E-01	1.65E-01	2.53E-01	-	4.68E-01	1.55E-01	2.63E-01	-
Benzo(e)pyrene	ng/m³	-	-	3.20E-01	1.65E-01	2.53E-01	-	4.68E-01	1.55E-01	2.63E-01	-
Benzo(g,h,i)perylene	ng/m³	-	-	3.56E-01	8.25E-02	1.38E-01	-	5.64E-01	7.77E-02	1.51E-01	-
Benzo(k)fluoranthene	ng/m³	-	-	4.31E-01	8.25E-02	1.47E-01	-	3.26E-01	7.77E-02	1.40E-01	-
Biphenyl	ng/m³	-	-	1.49E+01	3.02E-01	3.95E+00	-	7.35E+00	8.72E-01	3.33E+00	-
Chrysene	ng/m³	-	-	1.60E-01	8.25E-02	1.26E-01	-	9.20E-01	7.77E-02	1.68E-01	-
Dibenz(a,h) anthracene [D]	ng/m³	-	-	2.67E-01	8.25E-02	1.34E-01	-	2.34E-01	7.77E-02	1.31E-01	-
Dibenzo(a,c) anthracene + Picene [E]	ng/m³	-	-	3.20E-01	2.39E-02	2.44E-01	-	3.64E-01	2.21E-01	2.72E-01	-
Fluoranthene	ng/m³	-	-	4.46E+00	1.51E-01	1.28E+00	-	7.67E+00	3.11E-01	2.38E+00	-

Table 4-4 Summary of Measured Ambient PAH Concentrations – 2013 Monitoring Period

Contaminant	Units	MOE 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
Indeno (1,2,3-cd)pyrene	ng/m^3	-	-	3.56E-01	8.25E-02	1.38E-01	-	4.75E-01	7.77E-02	1.54E-01	-
Naphthalene	ng/m^3	22500	22500	1.43E+02	5.04E+00	3.91E+01	0	9.41E+01	9.78E+00	3.27E+01	0
o-Terphenyl	ng/m^3	-	-	3.20E-01	1.65E-01	2.53E-01	-	4.68E-01	1.55E-01	2.63E-01	-
Perylene	ng/m^3	-	-	3.20E-01	1.65E-01	2.53E-01	-	4.68E-01	1.55E-01	2.63E-01	-
Phenanthrene	ng/m^3	-	-	3.39E+01	6.65E-01	7.88E+00	-	2.94E+01	1.24E+00	9.22E+00	-
Pyrene	ng/m^3	-	-	1.66E+00	1.11E-01	5.11E-01	-	3.18E+00	1.56E-01	1.12E+00	-
Tetralin	ng/m^3	-	-	5.80E+00	6.95E-01	2.35E+00	-	5.05E+00	6.52E-01	2.37E+00	-
Total PAH [F]	ng/m^3	-	-	3.27E+02	1.28E+01	8.79E+01	-	1.65E+02	1.96E+01	8.18E+01	-

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. Dibenzo(a,c)anthracene was not reported for July, August, September1, and September 13 samples. Based on laboratory analyses, dibenzo(a,c)anthracene co-elutes with dibenz(a,h)anthracene.

E. Dibenzo(a,c) anthracene + Picene was reported for samples taken after September 13, 2013. Based on laboratory analyses, picene elutes after dibenz(a,h)anthracene.

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

Table 4-5 Source Contribution Analysis – 2013 B(a)P Exceendances

Date	Station	% above the MOE B(a)P Criterion	Wind Direction	Potential Source Contributions
June 21, 2013	Rundle Road	3%	Northeast	Land use in this upwind direction is primarily agricultural. A potential source could be agricultural activities.
August 20, 2013	Rundle Road	30%	West	Land use in this direction is primarily agricultural at Courtice and a mix of agricultural and commercial at Rundle. Give the similarity in the measured levels at both stations, this suggests that the elevated B(a)P levels may have been a result of regional conditions rather than a local source.
	Courtice WPCP	30%	West	
Dec 18, 2013	Rundle Road	720%	West	Review of the continuous monitoring data for other contaminants at the Rundle Road Station, which showed elevated levels of particulate and nitrogen oxides during a portion of the 24-hour sampling period (along with consistently westerly winds). This suggests that the elevated B(a)P measurement may have been due to a nearby business or residence with a poorly controlled 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 2013 monitoring period.

Table 4-6 Summary of Measured Ambient Dioxin and Furan Concentrations – 2013 Monitoring Period

Contaminant	Units	MOE 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			2.54E-02	4.70E-03	7.94E-03		1.06E-02	3.89E-03	6.27E-03	
1,2,3,7,8-Penta CDD	pg/m³			1.01E-02	4.70E-03	6.30E-03		9.02E-03	4.86E-03	6.32E-03	
1,2,3,4,7,8-Hexa CDD	pg/m³			7.21E-03	5.24E-03	6.06E-03		7.82E-03	4.53E-03	6.17E-03	
1,2,3,6,7,8-Hexa CDD	pg/m³			2.42E-02	4.45E-03	8.13E-03		1.56E-02	4.38E-03	7.27E-03	
1,2,3,7,8,9-Hexa CDD	pg/m³			2.72E-02	4.61E-03	8.11E-03		1.90E-02	4.54E-03	9.00E-03	
1,2,3,4,6,7,8-Hepta CDD	pg/m³			1.60E-01	2.54E-02	7.97E-02		1.66E-01	6.54E-03	8.22E-02	
Octa CDD	pg/m³			6.37E-01	1.65E-01	3.14E-01		1.92E+00	4.98E-02	5.29E-01	
Total Tetra CDD	pg/m³			2.54E-02	4.97E-03	9.18E-03		2.73E-02	4.45E-03	1.02E-02	
Total Penta CDD	pg/m³			5.14E-02	5.80E-03	1.45E-02		2.35E-02	5.64E-03	1.05E-02	
Total Hexa CDD	pg/m³			2.05E-01	6.48E-03	5.31E-02		8.79E-02	6.78E-03	3.94E-02	
Total Hepta CDD	pg/m³			3.50E-01	2.54E-02	1.61E-01		3.97E-01	6.54E-03	1.64E-01	
2,3,7,8-Tetra CDF **	pg/m³			2.42E-02	4.70E-03	8.22E-03		2.18E-02	4.55E-03	9.13E-03	
1,2,3,7,8-Penta CDF	pg/m³	-	-	7.66E-03	4.85E-03	5.91E-03	N/A	7.82E-03	4.38E-03	5.88E-03	N/A
2,3,4,7,8-Penta CDF	pg/m³			1.51E-02	4.70E-03	6.75E-03		8.00E-03	4.21E-03	5.86E-03	
1,2,3,4,7,8-Hexa CDF	pg/m³			6.34E-03	4.77E-03	5.84E-03		2.18E-02	4.97E-03	8.48E-03	
1,2,3,6,7,8-Hexa CDF	pg/m³			1.51E-02	4.07E-03	6.07E-03		9.38E-03	3.73E-03	5.79E-03	
2,3,4,6,7,8-Hexa CDF	pg/m³			3.63E-02	4.92E-03	1.06E-02		2.91E-02	4.38E-03	9.27E-03	
1,2,3,7,8,9-Hexa CDF	pg/m³			7.33E-03	5.32E-03	6.39E-03		1.56E-02	4.70E-03	7.52E-03	
1,2,3,4,6,7,8-Hepta CDF	pg/m³			5.14E-02	4.45E-03	1.60E-02		3.45E-02	4.25E-03	1.64E-02	
1,2,3,4,7,8,9-Hepta CDF	pg/m³			1.57E-02	4.96E-03	7.41E-03		1.82E-02	5.02E-03	7.84E-03	
Octa CDF	pg/m³			4.70E-02	6.99E-03	2.52E-02		1.05E-01	5.01E-03	3.21E-02	
Total Tetra CDF	pg/m³			2.42E-02	4.96E-03	1.03E-02		1.75E-02	6.10E-03	9.83E-03	
Total Penta CDF	pg/m³			7.85E-02	4.77E-03	1.31E-02		1.60E-02	4.38E-03	6.97E-03	
Total Hexa CDF	pg/m³			1.12E-01	4.77E-03	1.80E-02		4.73E-02	4.86E-03	1.72E-02	
Total Hepta CDF	pg/m³			9.08E-02	5.08E-03	2.42E-02		5.63E-02	4.86E-03	2.19E-02	
TOTAL TOXIC EQUIVALENCY [A]	pg TEQ/m³	0.1 [B] 1 [C]	-	0.036	0.019	0.024	0 0	0.029	0.016	0.022	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 2013 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 and 24-hour averaging periods. As noted above, since the monitoring period was less than minimum length required to calculate annual averages, the period (8-month)averages presented in this report were not explicitly compared with the applicable annual criteria;

2. The 98th percentiles of the measured daily average $PM_{2.5}$ levels during the 2013 monitoring period were 21.5 µg/m^3 at the Courtice WPCP station and 21.7 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 2013 measurements are not directly comparable;

3. The maximum measured concentrations of TSP and all metals with MOE 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 MOE Ambient Air Quality Criteria, were well below their applicable 24-hour criteria (presented in Table 2-4) at both stations with the exception of four (4) 24-hour average benzo(a)pyrene (B(a)P) measurements. Three (3) samples collected at the Rundle Road Station (on June 21, August 20, and December 18, 2013) exceeded the Ontario 24-hour B(a)P AAQC by levels varying from 3% to 720%. One (1) measurement of B(a)P at the Courtice WPCP Station (collected on August 20, 2013) exceeded the MOE Ambient Air Quality Criteria by 30%, However, all four samples were well below the MOE 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 MOE to be included in each annual report, is provided in Section 4.4.

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

6. The maximum measured toxic equivalent dioxin and furan concentration was well below the applicable criteria presented in Table 2.4; and,

7. All monitored contaminants were below their applicable MOE criteria during the 2013 monitoring period with the exception of four (4) benzo(a)pyrene measurements. All measured levels of all monitored contaminants were below their applicable HHRA health-based standards.

6.0 REFERENCES

Canadian Council of Ministers of the Environment (CCME), (2000). Canada-Wide Standards for Particulate Matter and Ozone, June 5-6, 2000.

Canadian Council of Ministers of the Environment, (2007). Guidance Document on Achievement Determination Canada-wide Standards for Particulate Matter and Ozone, Revised, PN 1391 978-1-896997-74-2 PDF, 2007.

Jacques Whitford, (2009). Final Environmental Assessment, December 4, 2009.

Ministry of the Environment Operations Division Technical Support Section, (2008). Operations Manual for Air Quality Monitoring in Ontario, March 2008 (PIBS 6687e).

Ontario Minister of the Environment (MOE), (2010). Environmental Assessment Act, Section 9. Notice of Approval to Proceed with the Undertaking. Re: The Amended Environmental Assessment for Durham and York Residual Waste Study (EA File No: 04-EA-02-08).

Ontario Ministry of the Environment (MOE), (2012a). Ontario's Ambient Air Quality Criteria, Standards Development Branch , April 2012 (PIBS # 6570e01).

Ontario Ministry of the Environment (MOE), (2012b). Summary of Standards and Guidelines to Support Ontario Regulation 419: Air Pollution – Local Air Quality, April 2012 (PIBs 6569e01).

Ontario Regulation 419/05: Air Pollution – Local Air Quality.

Stantec Consulting Ltd. (2009). Final Environmental Assessment, Appendix C12: Site Specific Human Health and Ecological Risk Assessment Technical Study Report, December 4, 2009.

Stantec Consulting Ltd., (2012). Ambient Air Quality Monitoring Plan, Durham York Residual Waste Study, May 8, 2012.

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	2013 Schedule Dates
SO_2	Teledyne Monitor Labs	Change particulate filter	Monthly	Done during monthly calibration	Monthly calibration schedules in 2013 for both monitoring stations: April 25 May 17 June 26 July 31 September 4 September 25 October 22 (Courtice WPCP)/October 24 (Rundle Road) November 26 December 20
		Exchange chemical – external zero air scrubber	3 months	Done during monthly calibration	
		Replace perm tube	6 months	Perm tubes were checked and do not need replacement yet. To be replaced in 2014.	
		Replace Pump diaphragm	Annual	Rundle - replaced. Courtice - not replaced yet.	Rundle Road Station - December 20, 2013
		Clean sample chamber, windows and filters	As required	To be checked during annual maintenance	
		Replace critical flow orifice and filters	As required	Done during monthly calibration	
NOx	API Model 200E	Change particulate filter	Monthly	Done during monthly calibration	Monthly calibration schedules in 2013 for both monitoring stations: April 25 May 17 June 26 July 31 September 4 September 25 October 22 (Courtice WPCP)/October 24 (Rundle Road) November 26 December 20
		Exchange chemical – external zero air scrubber	3 months	Done during monthly calibration	
		Replace chemical – external dryer	3 months	Done during monthly calibration	
		Chemical change – ozone filter	3 months	Done during monthly calibration	
		Clean reaction cell window (annually or as necessary)	Annually	To be cleaned at annual maintenance	
		Change particulate DFU filter	Annually	To be replaced at annual maintenance	
		Replace reaction cell O-rings & sintered filters	Annually or as required	To be checked during annual maintenance	
		Rebuild pump head	Annually	To be done at annual maintenance	
		Replace inline exhaust scrubber	Annually	To be replaced at annual maintenance	
		Replace NO2 converter	When RCEL pressures exceeds 10 in Hg	When required	
		Replace inline exhaust scrubber	Annually	To be replaced at annual maintenance	
		Replace NO2 converter	Every 3 years or if conversion < 96%	Conversion checked every 6 months	NO2 converter checked on September 25, 2013
$PM_{2.5}$	Thermo Sharp 5030	Replace filter tape	Upon 10% remaining	As required	
		Replace SHARP zeroing filters	6 months	Replaced in September 2013	Replaced on September 25, 2013
		Clean PM2.5 inlet	Monthly	Done during monthly calibration	Monthly calibration schedules in 2013 for both monitoring stations: April 25 May 17 June 26 July 31 September 4 September 25 October 22 (Courtice WPCP)/October 24 (Rundle Road) November 26 December 20
		Clean cyclone	Monthly	Done during monthly calibration	
		Clean air inlet system	Annually	To be cleaned at annual maintenance	
		Rebuild vacuum pump	12-18 months	To be done at annual maintenance	
		Clean ambient temp/RH shield and assembly	Annually	To be cleaned at annual maintenance	

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	2013 Schedule Dates
TSP/metals	TE-5170	Ensure all gaskets sealing properly	Weekly	Checked at weekly site visit	
		Power cord checks for damage/cracks	Weekly	Checked at weekly site visit	
		Inspect screen and remove foreign deposits	Weekly	Checked at weekly site visit	
		Inspect holder frame gasket	Every sample	Checked at weekly site visit	
		Replace motor brushes	Every 500 hours	Rundle Road Station - to be replaced in 2014 Courtice WPCP Station – to be replaced in 2014	
		Check elapsed time meter	Weekly	Checked at weekly site visit	
		Check flow recorder pen/tubing	Weekly	Checked at weekly site visit	
		Ensure all gaskets sealing properly	Weekly	Checked at weekly site visit	
PAH and D/F	TE-1000	Ensure all gaskets sealing properly	Weekly	Checked at weekly site visit	
		Power cord checks for damage/cracks	Weekly	Checked at weekly site visit	
		Clean any dirt around module and filter holder	Weekly	Checked at weekly site visit	
		Inspect dual sampling module gaskets	Every sample	Checked at weekly site visit	
		Inspect and replace motor flange gasket and motor cushion	Routinely, minimum annually	To be replaced at annual maintenance	
		Replace motor brushes	Every 400 hours	Rundle Road Station - to be replaced in 2014 Courtice WPCP Station – to be replaced in 2014	
Wind Speed and Direction (Rundle Road Station only)	Met One 034B	Physical inspection of equipment for signs of damage/erratic behavior	Weekly	Checked at weekly site visit	
		Replace wind speed sensor bearings and calibrate	Annually	To be replaced at annual maintenance	
		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	
Temperature	CS 107 (Rundle)/ HMP 60 (Courtice)	Check radiation shield free from debris	Weekly	Checked at weekly site visit	
Rainfall	TE525M	Inspect funnel and bucket mechanism for debris	Weekly	Checked at weekly site visit and cleaned as required	
Relative Humidity	CS HMP60	Change INTERCAP® Sensor	On out of spec calibration	As required	
		Sensor cleaning	As required	As required	
		Inspect/replace filter if blocked	Monthly	Done during monthly calibration	Refer to monthly calibration dates above
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	Checked at weekly site visit and at monthly calibration	
		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	Checked at weekly site visit and at monthly calibration	
		Replace zero and span calibration cylinders when pressure is below 1,500 kPa (215 psig)		Checked - all cylinders at 1000 psig or better	
		Ensure shelters and gates are locked upon departure	Weekly	Checked at weekly site visit	

Table A-2 Summary of Equipment Calibration

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule	Schedule / Comments	2013 Schedule Dates
SO2	API Model 100E	Verify test functions	Weekly	Checked weekly	
		Evaluate Zero/Span check	Weekly	Checked daily	
		Zero/span external check	Monthly	Checked monthly	Monthly calibration schedules in 2013 for both monitoring stations: April 25 May 17 June 26 July 31 September 4 September 25 October 22 (Courtice WPCP)/October 24 (Rundle Road) November 26 December 20
		Zero/span calibration	3 months	Calibrated monthly	
		Flow check	6 months	Checked monthly	
		Pneumatic leak check	Annually or after repairs	Done when flow drops or checked annually	
		Calibrate UV lamp output	Prior to zero/span cal	Done prior to zero/span cal	
		PMT sensor hardware cal	On PMT/preamp changes or slope changes as specified	Done when instrument slope is outside of acceptable range	
NOX	API Model 200E	Verify test functions	Weekly	Checked weekly	
		Evaluate Zero/Span check	Weekly	Checked daily	
		Zero/span external check	Monthly	Checked monthly	Monthly calibration schedules in 2013 for both monitoring stations: April 25 May 17 June 26 July 31 September 4 September 25 October 22 (Courtice WPCP)/October 24 (Rundle Road) November 26 December 20
		Zero/span calibration	3 months	Calibrated monthly	
		Pneumatic sub-system check	Annually or after repairs	Checked after repairs	
		PMT sensor hardware cal	On PMT/preamp changes or slope changes as specified	Done when slope exceeds the acceptable range	

Table A-2 Summary of Equipment Calibration

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule	Schedule / Comments	2013 Schedule Dates
PM2.5	Thermo Sharp 5030	Ambient temperature	Audit monthly, calibrate annually	Audit monthly. Full annual audit to be done in 2014.	Monthly audit schedules in 2013 for both monitoring stations: April 25 May 17 June 26 July 31 September 4 September 25 October 22 (Courtice WPCP)/October 24 (Rundle Road) November 26 December 20
		Ambient pressure	Audit monthly, calibrate annually	Audit monthly. Full annual audit to be done in 2014.	
		Flow	Audit monthly, calibrate annually	Audit monthly. Full annual audit to be done in 2014.	
		Leak check	Monthly	Leak check is not possible on this make/model.	
		Analog output	Annually	Done annually	
		Proportional Counter	Audit annually	Done annually	
		Nephelometer zero	Audit quarterly	Done monthly	
TSP/metals	TE-5170	Flow calibration	Upon installation, monthly, or after any motor maintenance	Calibrated monthly and after motor maintenance.	Monthly calibration schedules in 2013 for both monitoring stations: April 29 May 30 June 28 July 29 September 5 September 27 October 30 December 4 December 27

Table A-2 Summary of Equipment Calibration

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule	Schedule / Comments	2013 Schedule Dates
PAH and D/F	TE-1000	Flow calibration	Upon installation, monthly, or after any motor maintenance	Calibrated monthly and after motor maintenance.	Monthly calibration schedules in 2013 for both monitoring stations: April 29 May 30 June 28 July 29 September 5 September 27 October 30 December 4 December 27
Wind Speed and Direction	Met One 034B	Wind speed calibration	Annually	To be done in May 2014	
		Potentiometer calibration	Annually	To be done in May 2014	
Temperature	HMP 60	External calibration	Annually	To be done in May 2014	
Rainfall	TE525M	Field Calibration. Factory calibration if field calibration not passed.	Annually	To be done in May 2014	
Relative Humidity	CS HMP60	Calibration (annually)	Annually	To be done in May 2014	
Atmospheric Pressure	CS106	Re-calibration (2-years)	2-years	To be done at 2 years	
Data Acquisition	CS CR1000	Calibration every three years	3- years	To be done at 3 years	

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

Parameter	Issues	Time Frame	Remedial Action
SO_2	Thermocouple failure causing internal daily calibration to not perform properly.	May 30, 2013	Replaced thermocouple with new unit from supplier.
	The hydrocarbon kicker in the unit failed.	November 26 – 29, 2013	A new hydrocarbon kicker was installed on November 29 and the instrument was recalibrated.
NO_X	Calibration light was off.	July 11, 2013	Reset unit.
	Ozone flow warning light was on. Power was out and then back on.	July 16, 2013	Reset unit.
$PM_{2.5}$	Vacuum pumps tripping off and monitor going off-line.	April 13 to June 20, 2013	Monitor was shipped back to the supplier for repair. The manufacturer re-installed the software in the unit. The monitor was re-installed on June 11th, with the vacuum pump connected to an uninterruptible power supply (UPS) on June 20th.
	A spider web was found in the nephelometer chamber, causing the unit to not zero.	December 17 – December 20, 2013	Unit was removed on December 17, cleaned and re-installed on December 20. Zero offset was applied to data for the period the data was affected.
TSP/Metals Hi-Vol.	TSP Hi-vol did not run full cycle and timer was not at correct day/time. Likely due to power outage.	July 15-16, 2013	Reset timer. Hi-vol operated properly for the next sampling day.
PAH/ D/F Hi-Vol	PAH Hi-vol did not start at the correct time. Likely due to a power outage.	Jul 4, 2013	Reset timer. Hi-vol operated properly for the next sampling day. The hi-vol operated for approximately 22 hours for the sample collected on July 3. This sample was sent to the laboratory for analysis.
Other	Power outage for a short duration during site visit.	July 11, 2013	Contacted WPCP personnel to increase power supply at the station.

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

Parameter	Issues	Time Frame	Remedial Action
SO_2	Monitor off-line due to power outage.	May 31, 2013	Replaced back-up power.
	Ruptured pump diaphragm in the unit.	December 17 - 20, 2013	Unit was removed, repaired and reinstalled on December 20.
	Monitor non-operational during power outage following ice storm.	December 21 – 23, 2013	Checked equipment after power outage. Equipment operated normally after power was restored.
NO_X	Monitor off-line due to power outage.	May 31, 2013	Replaced back-up power.
	Calibration light was off.	July 4, 2013	Reset unit.
	Fault light on.	July 16, 2013	Reset unit.
	Monitor non-operational due to a leak in the system causing low ozone level.	October 17 - 24, 2013	Repaired and reinstalled unit on October 24.
	NOx monitor non-operational during power outage following ice storm.	December 21 – 22, 2013 December 23 – 25, 2013	Checked equipment after power outage. Equipment operated normally after power was restored.
$PM_{2.5}$	Vacuum pumps tripping off, monitor going off-line, and circuit board failure.	April 22 to June 20, 2013	Monitor was shipped back to the manufacturer for repair. The manufacturer replaced the circuit board and re-installed the software in the unit. The monitor was re-installed on June 20, with the vacuum pump connected to an uninterruptible power supply (UPS).
	Ants inside pod causing UPS to trip.	June 26, 2013	Installed ant traps and applied insect spray to remove ants.
	Monitor non-operational during power outage following ice storm.	December 23, 2013	Checked equipment after power outage. Equipment operated normally after power was restored

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

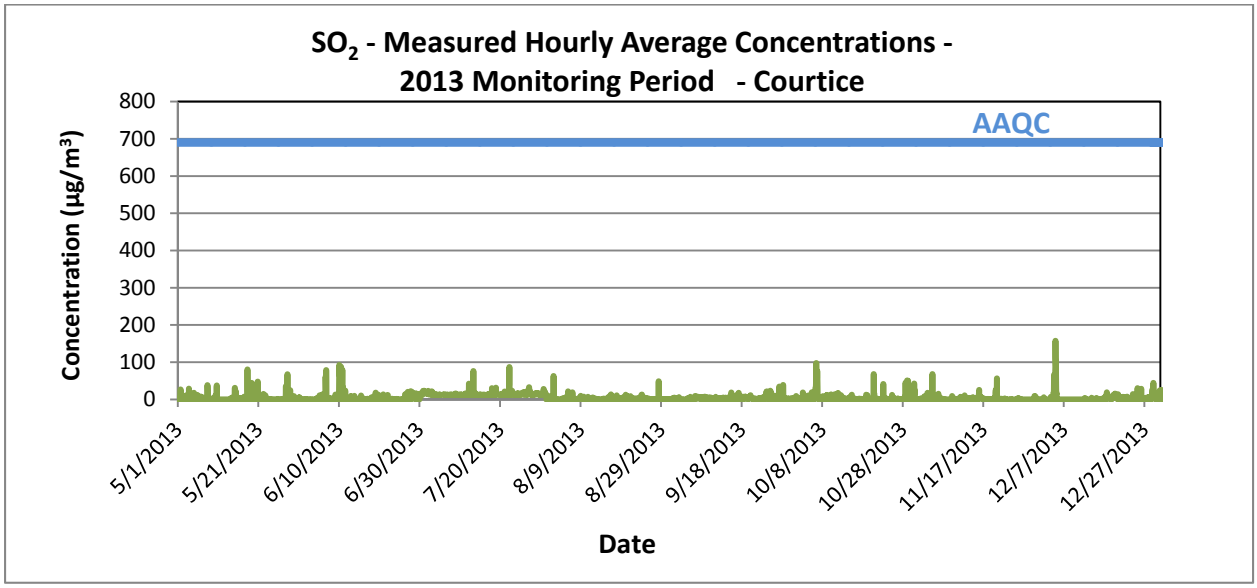
Parameter	Issues	Time Frame	Remedial Action
TSP/Metals Hi-Vol.	TSP Hi-vol did not run full cycle. Power outage due to water collecting inside sealed plug connection.	August 12, 2013	Dried out plug connection and resealed it.
	TSP hi-vol did not start at the correct time due to power outage during the ice storm affecting the unit's timer.	Dec 24, 2013	Although the sample was not collected at the scheduled time, the collected sample was a 24-hour sample and was sent to the lab for analysis. Checked equipment and re-set timer for next run.
	TSP hi-vol failed in mid-sample due to worn motor brushes.	Dec 30, 2013	Replaced motor brushes and re-calibrated unit.
PAH/ D/F Hi-Vol	Elapsed timer not working.	June 12-20, 2013	Replaced elapsed timer.
Met tower	Wind head was not functioning properly due to an internal problem.	May 10 – 31 2013	Wind head was sent back to supplier to repair and was re-installed on May 31.
	Rain bucket was plugged.	June 20, 2013	Cleaned out rain bucket.
	The anemometer froze due to ice accumulation in the ice storm and extreme cold.	Dec 22 to Dec 26, 2013	Checked equipment. Equipment functioned properly after the weather turned warmer.
Rain Gauge	Rain gauge was plugged.	July 4, 2013	Cleared debris from rain gauge and re-installed rain gauge.

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

Parameter	Issues	Time Frame	Remedial Action
Data Logger	Unexpected loss of data records	May 31 – June 30, 2013	Data for this period missing from datalogger download file due to the datalogger resetting and skipping a portion of the data. Corrective Action - routine file back-up to second location to avoid any file overwriting implemented to avoid this issue in the future, and an electronic log sheet to track monitoring station data logger access by project personnel. In addition, prior to performing any work/maintenance on the datalogger, the integrity/continuity of all the data is manually checked.
Other – Laboratory	The PAH /D/F sample collected on July 3, 2013 was not analyzed due to an accident at the laboratory.	July 3, 2013	Contacted laboratory personnel to identify cause and whether there was archived sample to re-run the analyses. However, there was not sufficient archive to re-analyze the sample.

Appendix B SO_2 PLOTS

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



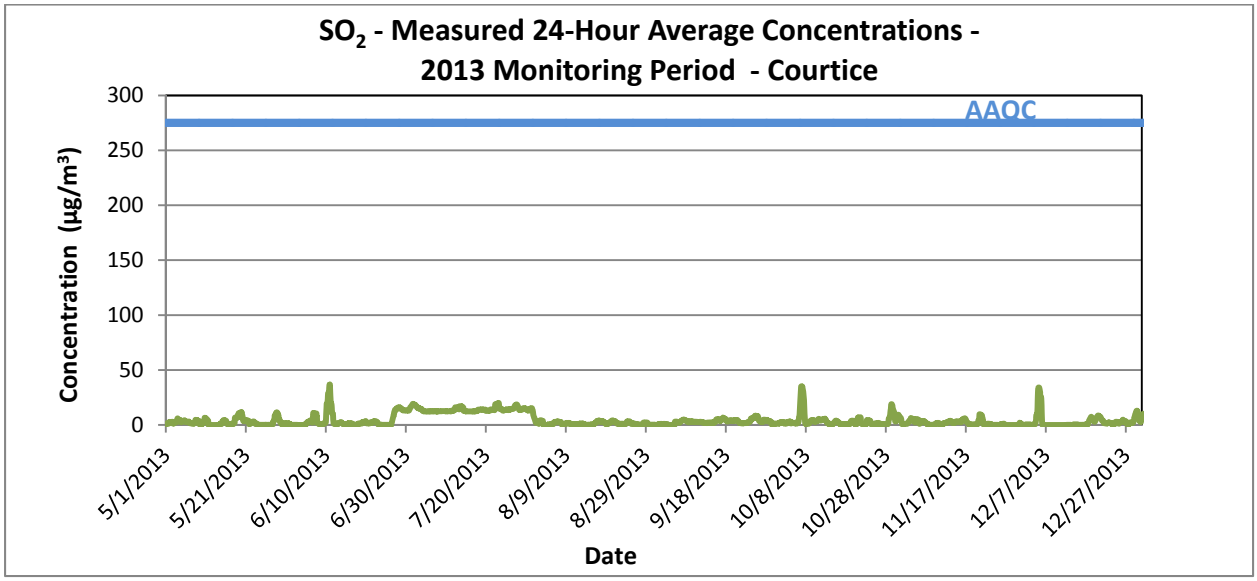
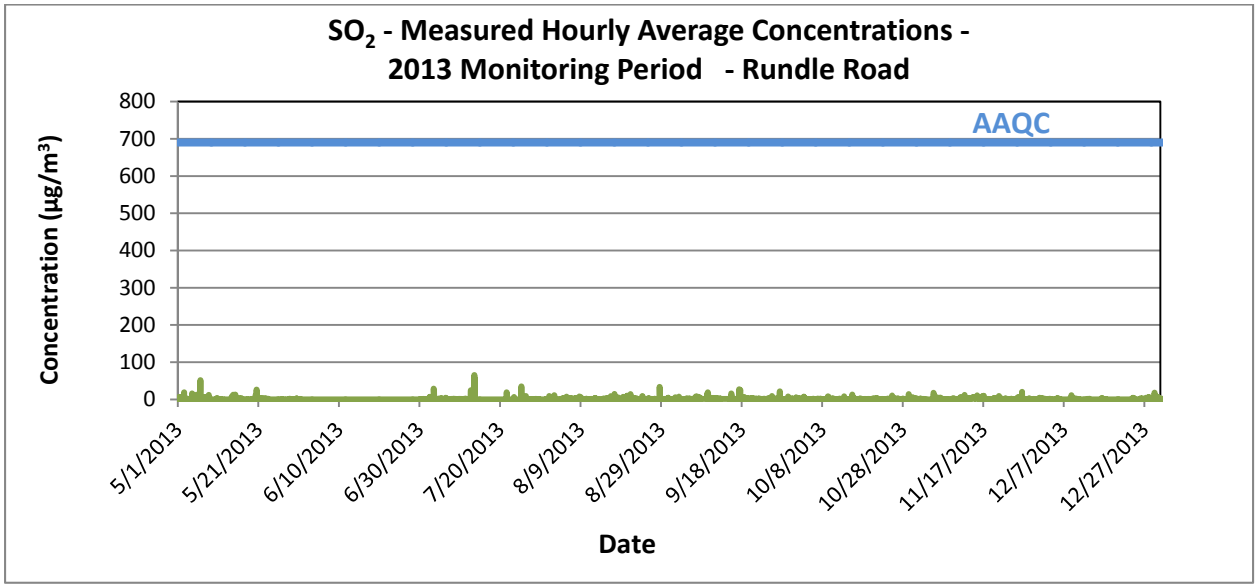


Figure B-2 Time History Plots of Measured Hourly Average and 24-Hour Average SO_2 Concentrations – Rundle Road Station



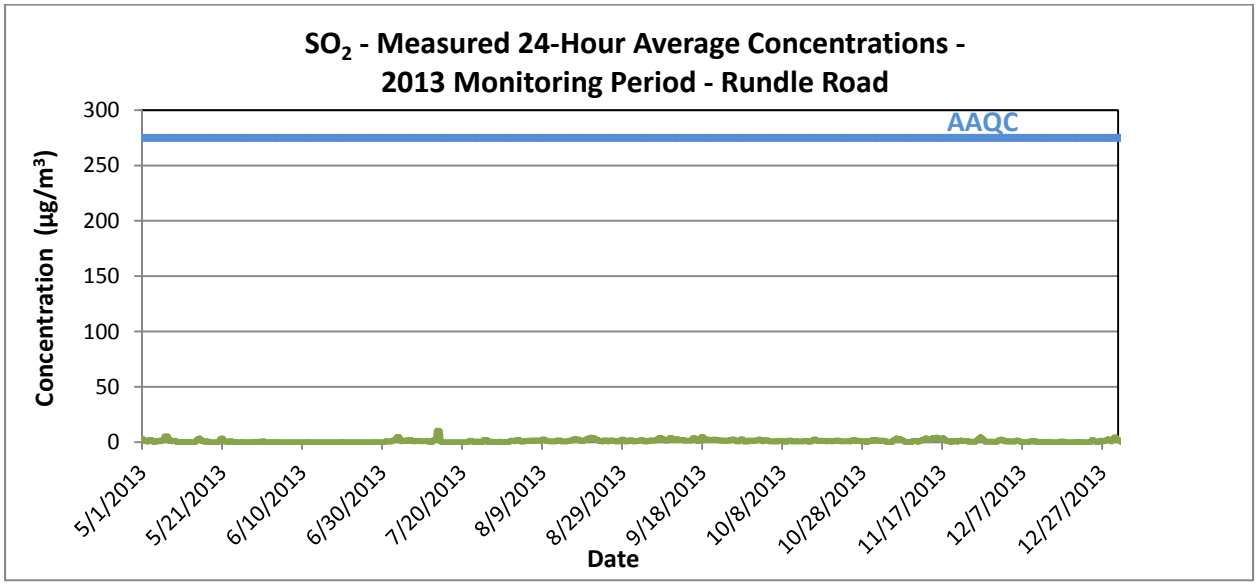


Figure B-3 Measured Hourly Average SO_2 Concentrations vs. Wind Direction – Courtice WPCP Station

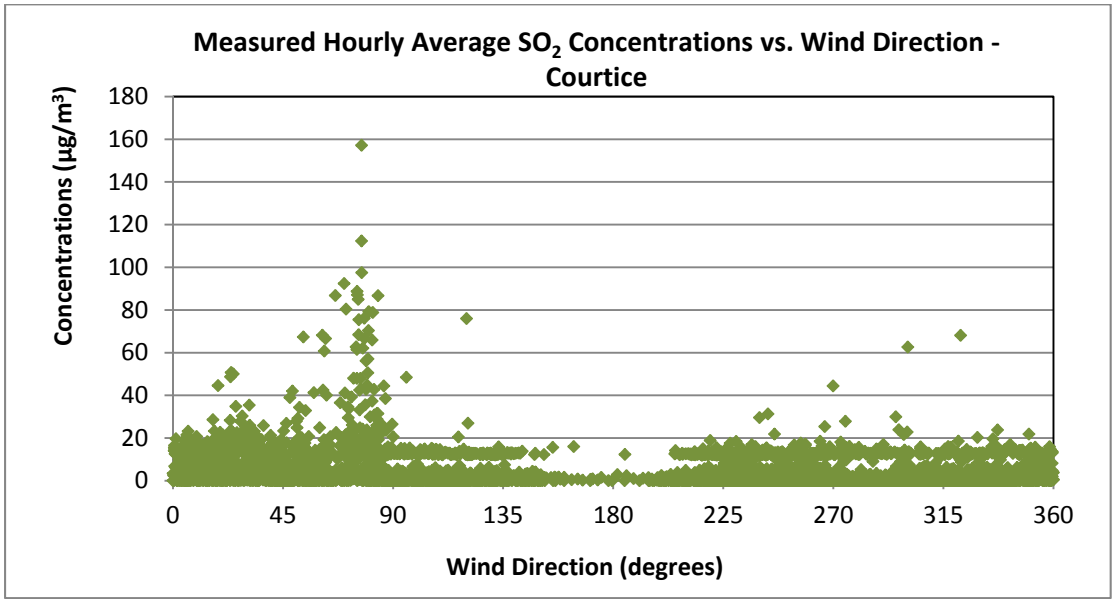
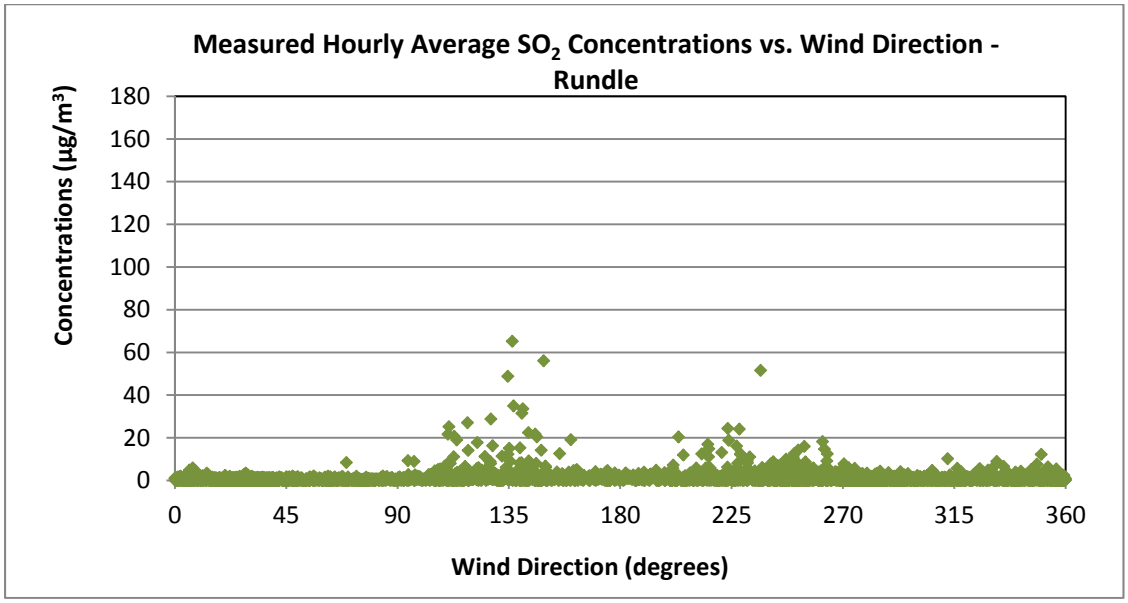
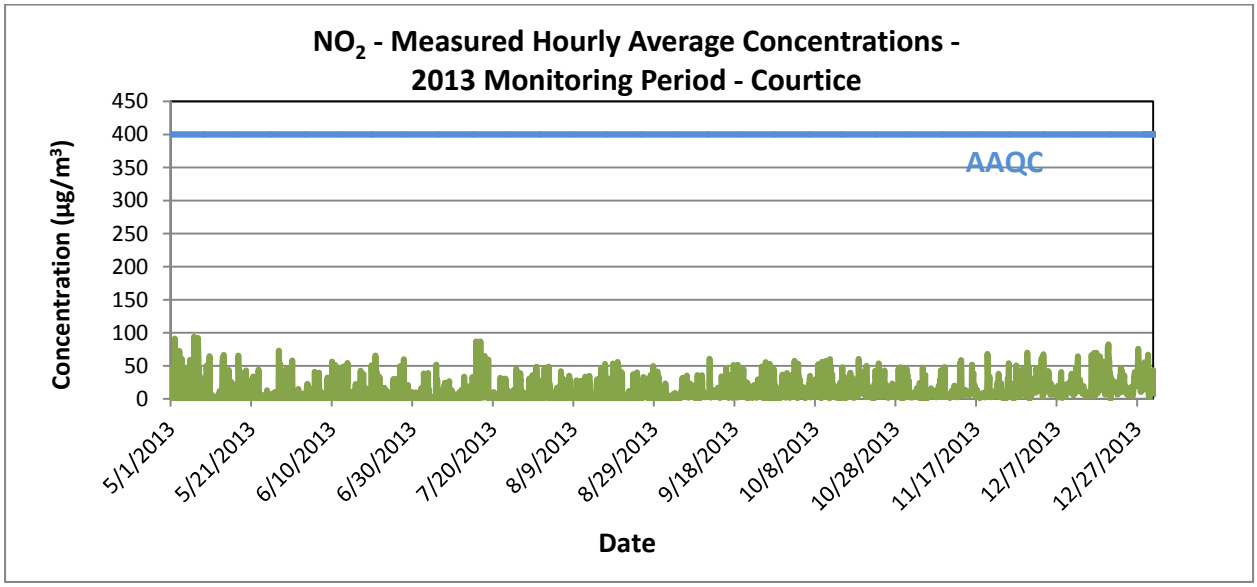


Figure B-4 Measured Hourly Average SO_2 Concentrations vs. Wind Direction - Rundle Road Station



Appendix C NO_2 PLOTS

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



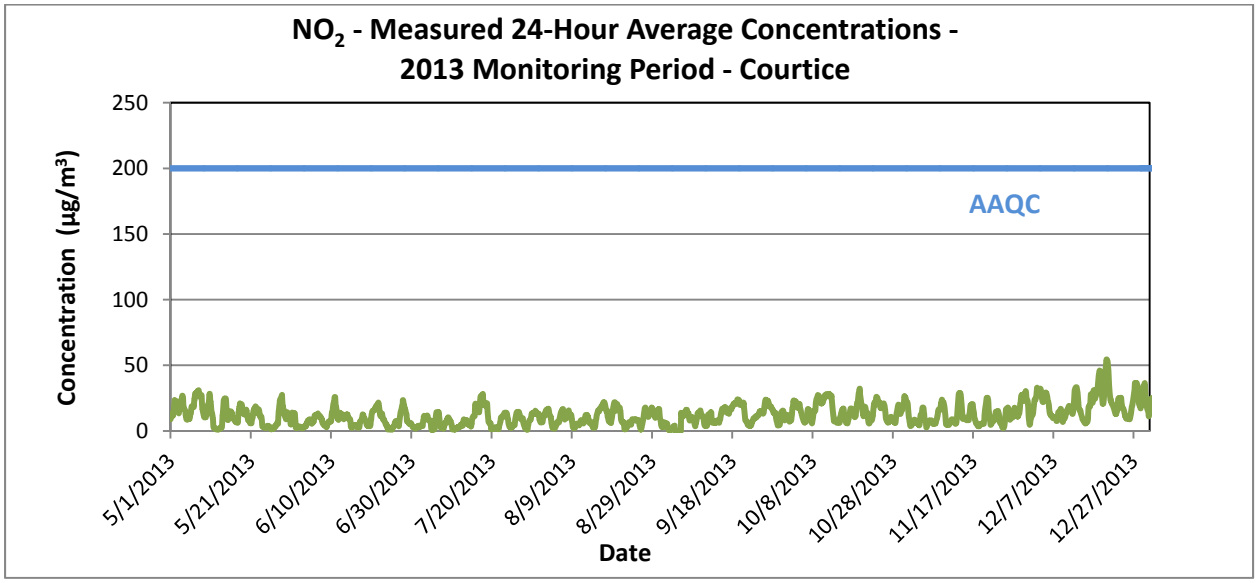
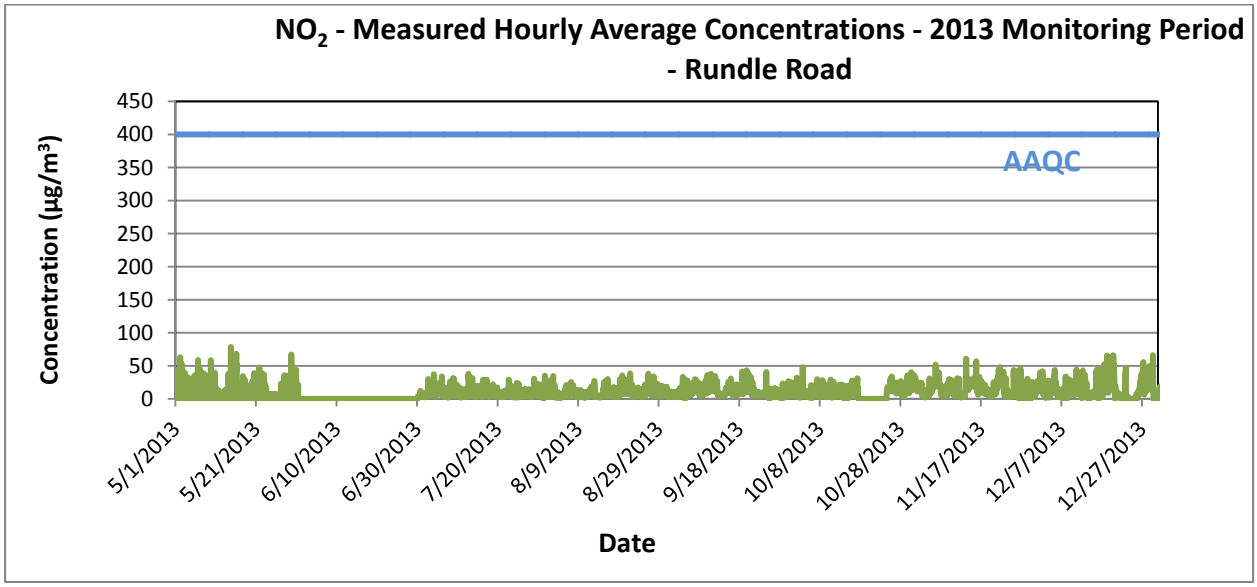


Figure C-2 Time History Plots of Measured Hourly Average and 24-Hour Average NO_2 Concentrations – Rundle Road Station



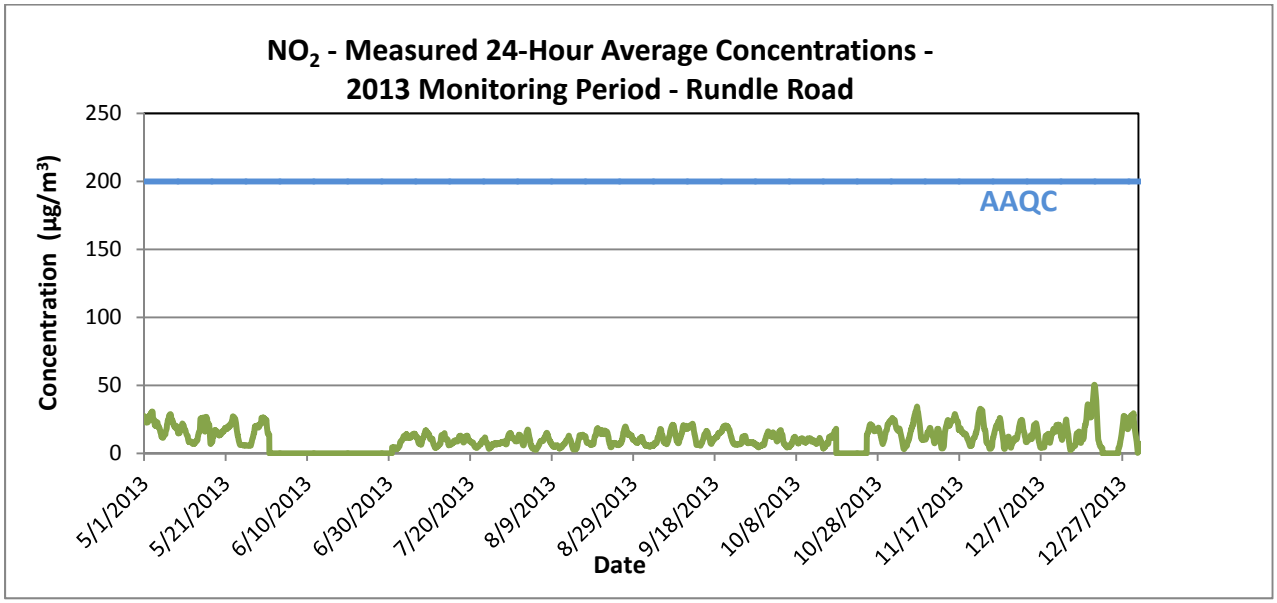


Figure C-3 Measured Hourly Average NO_2 Concentrations vs. Wind Direction – Courtice WPCP Station

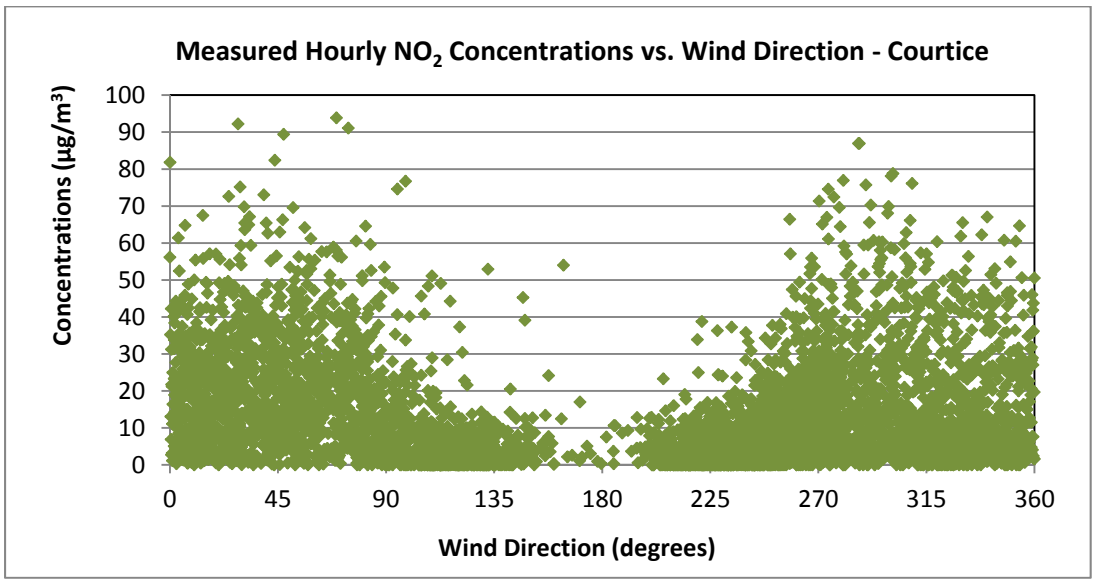
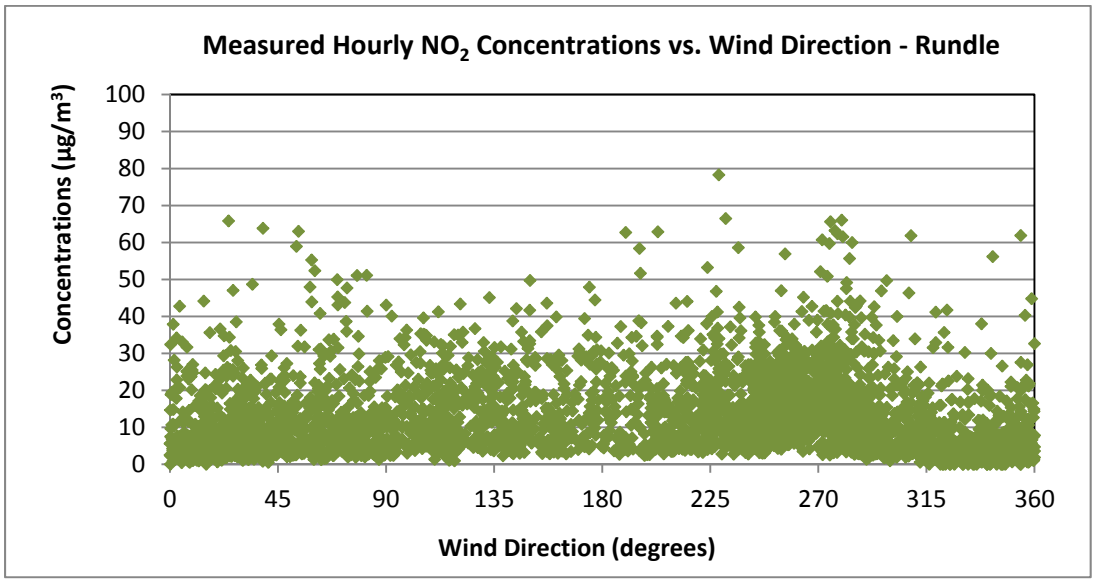
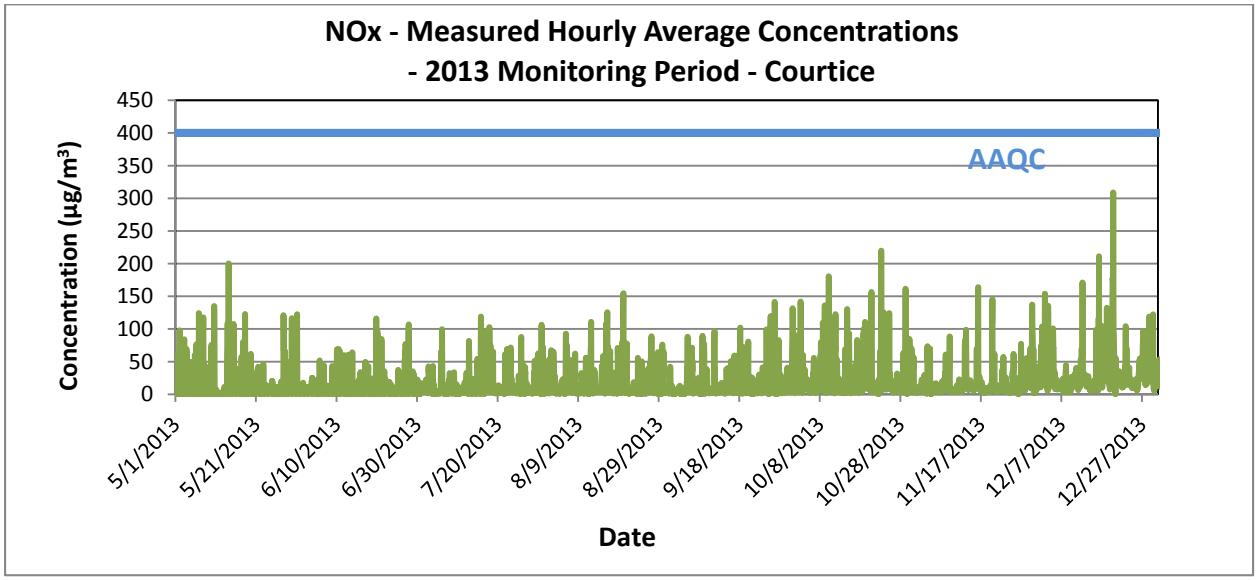


Figure C-4 Measured Hourly Average NO_2 Concentrations vs. Wind Direction - Rundle Road Station



Appendix D NO_X PLOTS

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



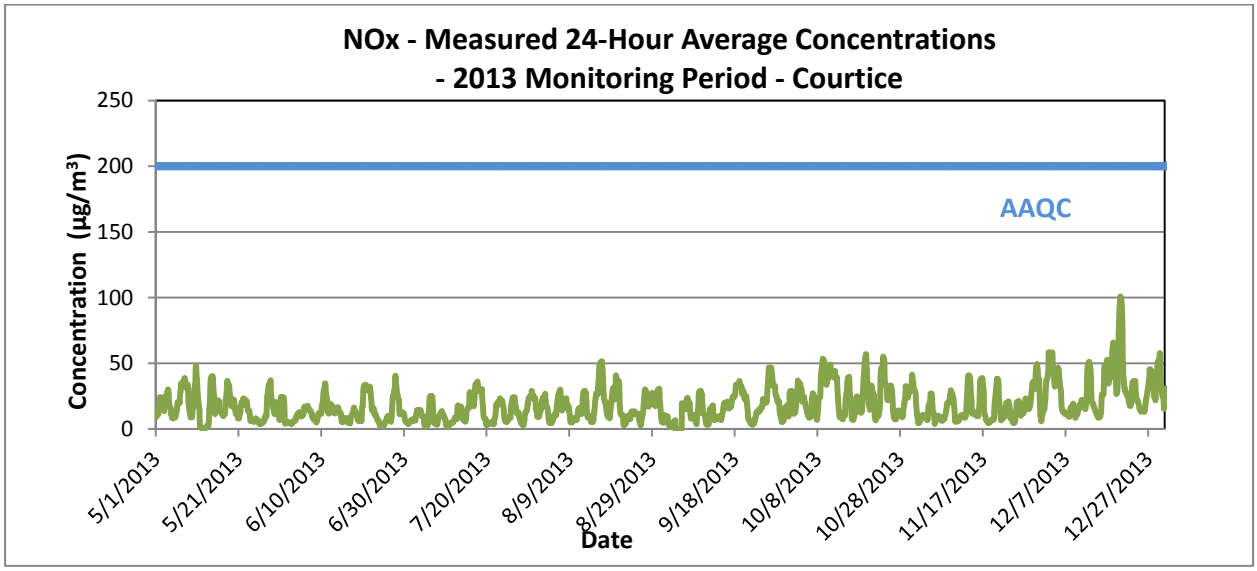
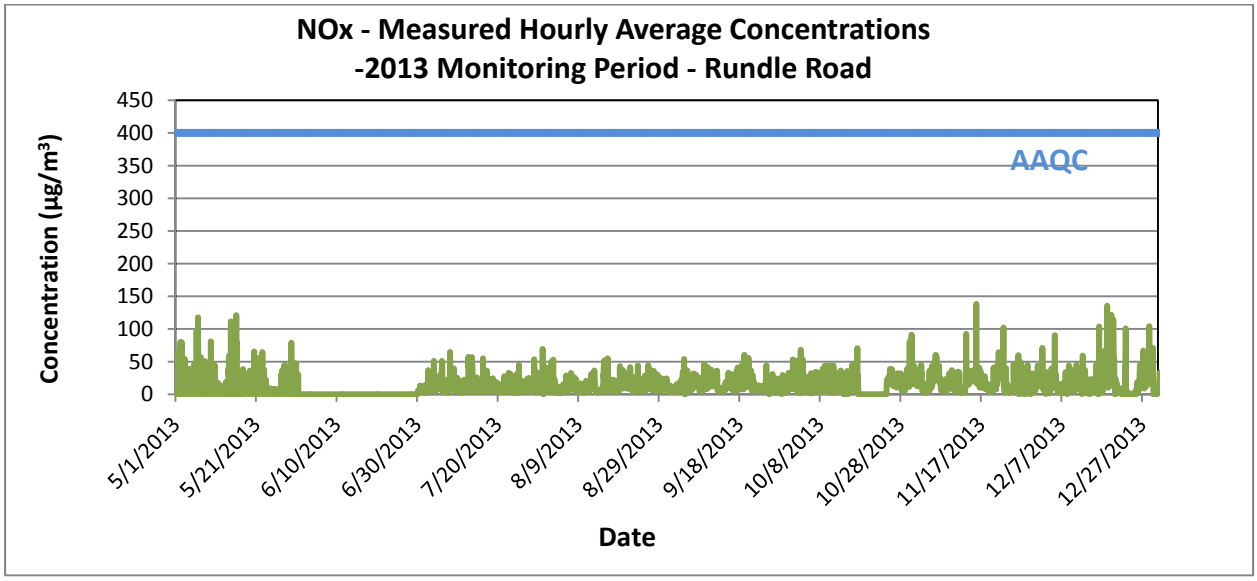


Figure D-2 Time History Plots of Measured Hourly Average and 24-Hour Average NO_x Concentrations – Rundle Road Station



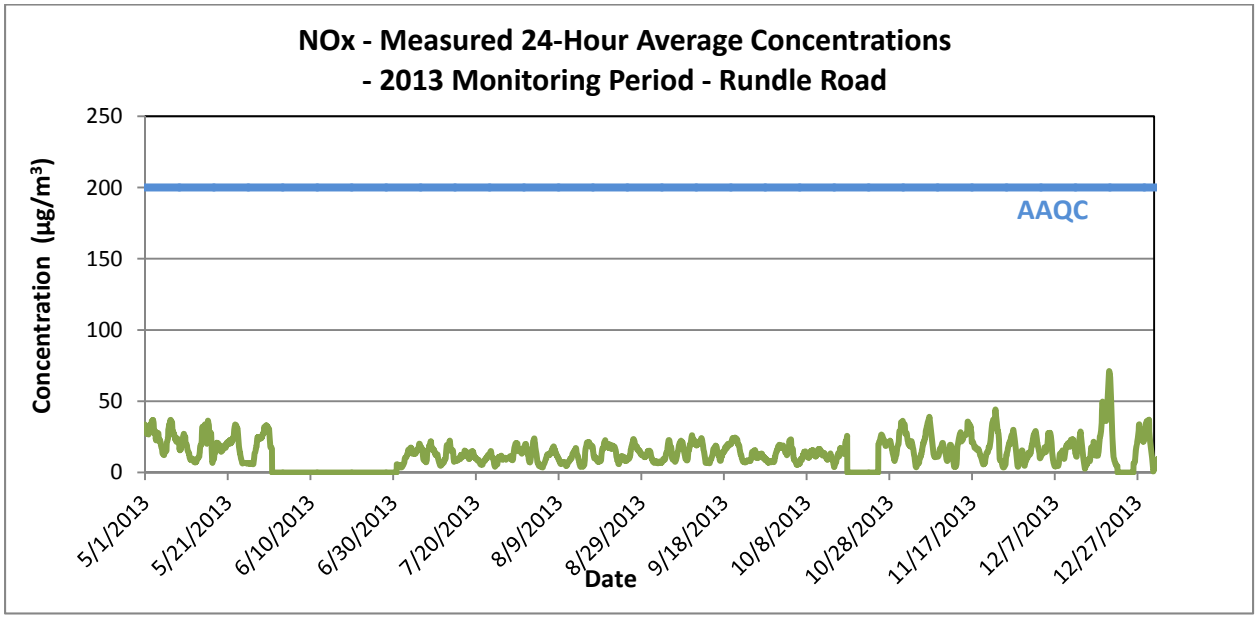


Figure D-3 Measured Hourly NO_X Concentrations vs. Wind Direction – Courtice WPCP Station

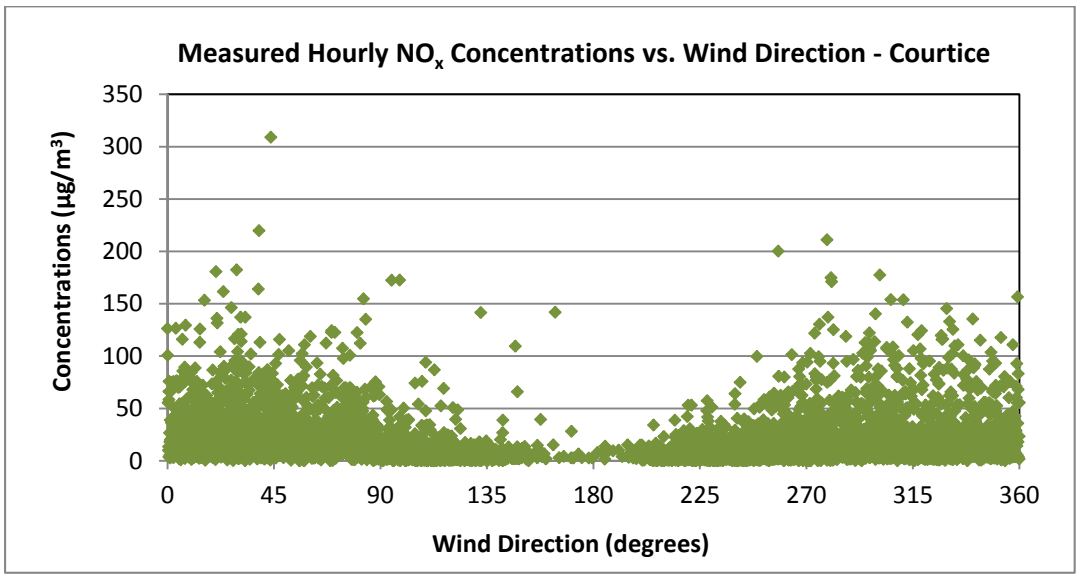
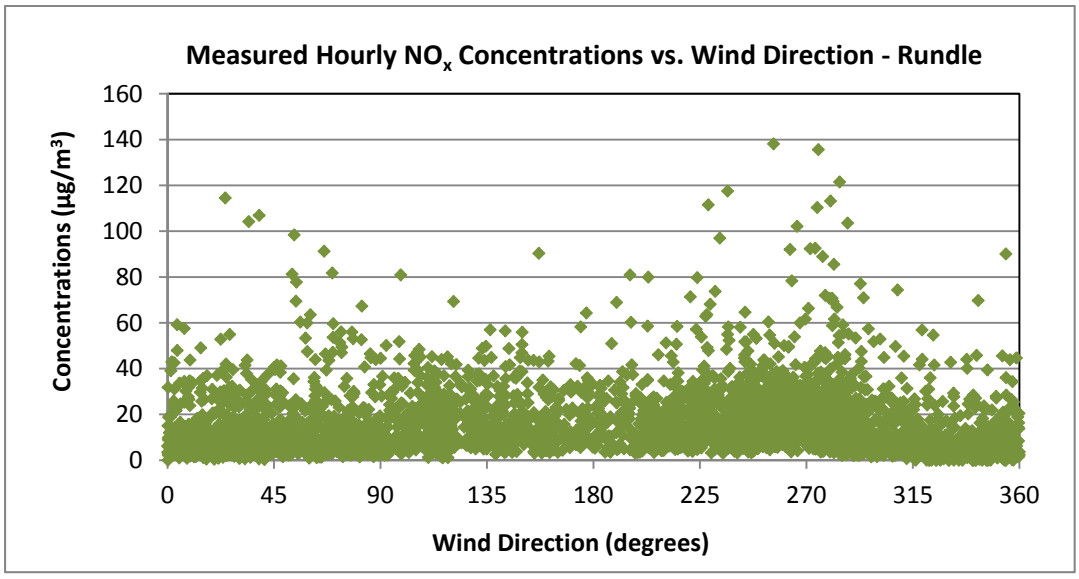


Figure D-4 Measured Hourly NO_X Concentrations vs. Wind Direction - Rundle Road Station



Appendix E $PM_{2.5}$ PLOT

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

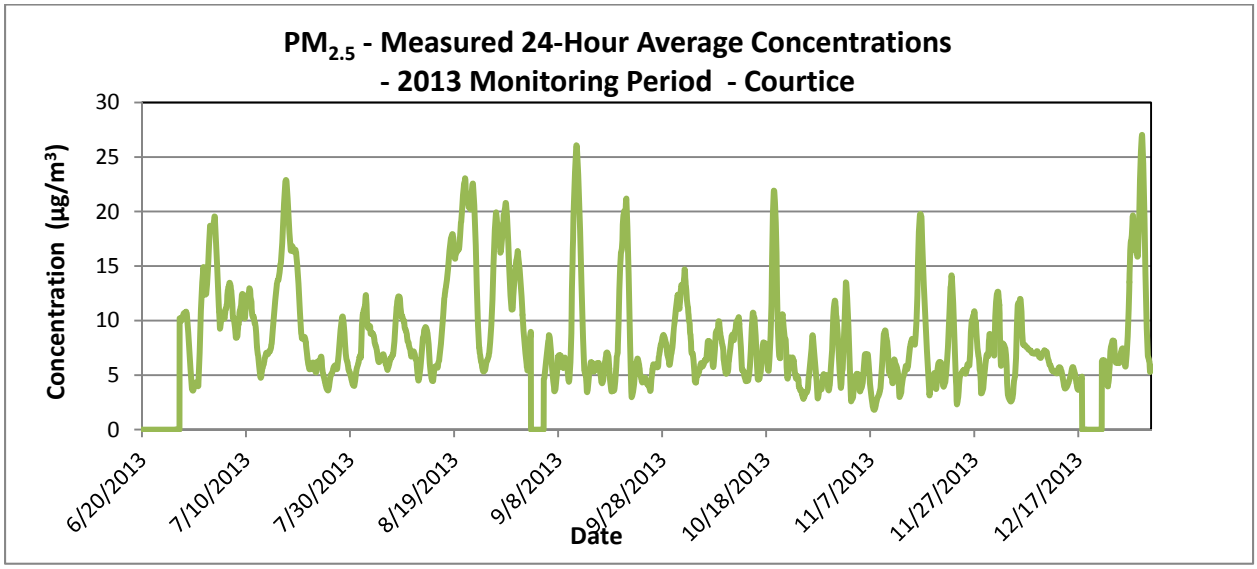


Figure E-2 Time History Plot of Measured 24-Hour Average $PM_{2.5}$ Concentrations – Rundle Road Station

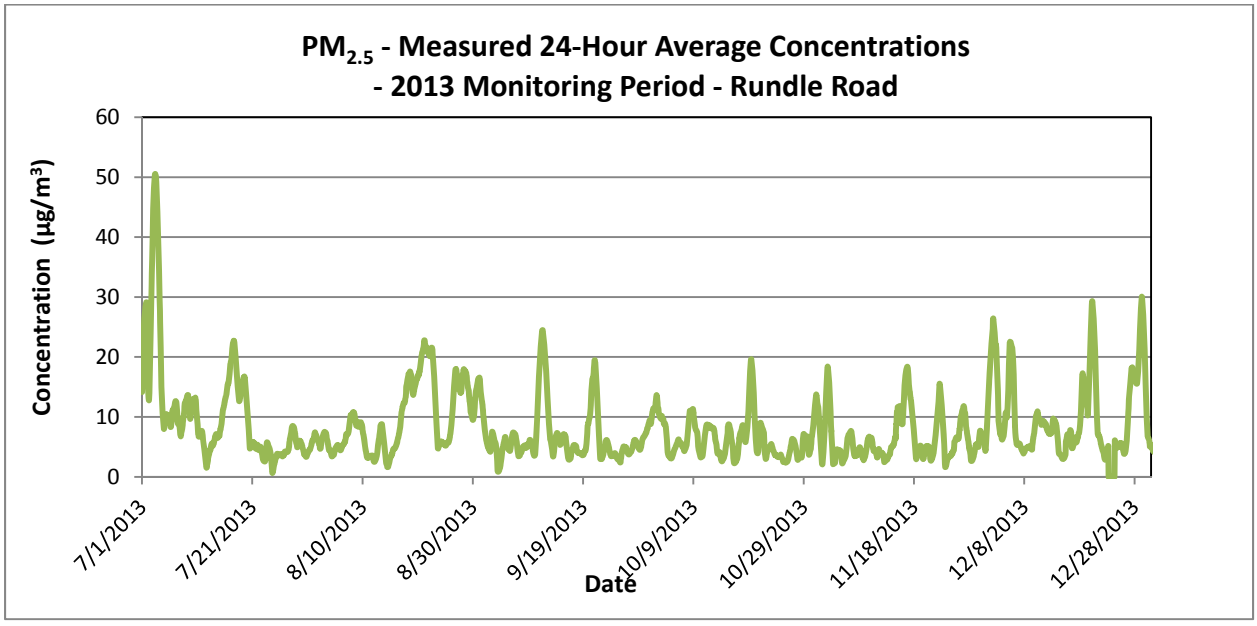


Figure E-3 Measured 24-Hour Average $PM_{2.5}$ Concentrations vs. Measured 24-Hour Vector Averaged Wind Direction Courtice WPCP Station

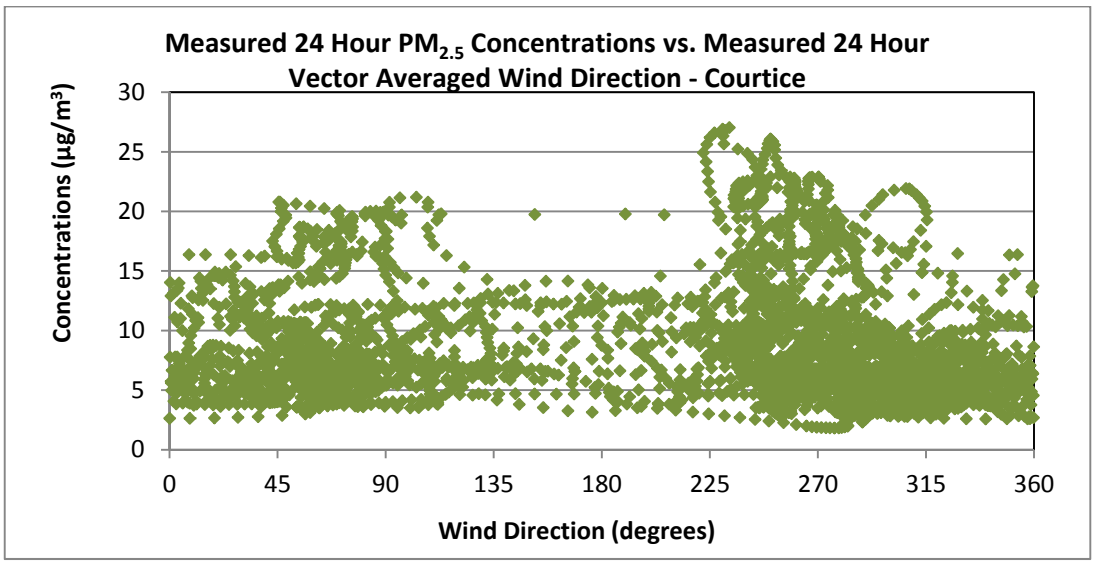


Figure E-4 Measured 24-Hour Average $PM_{2.5}$ Concentrations vs. Measured 24-Hour Vector Averaged Wind Direction – Rundle Road Station