2016 Annual Ambient Air Quality Monitoring Report for the Durham York Energy Centre (Crago Road Station)

Durham York Energy Centre

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Sign-off Sheet

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Executive Summary

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

The 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. An ambient air quality monitoring and reporting program was also a requirement laid out in the Provincial Minister's Notice of Approval to Proceed with the Undertaking, detailed in Condition 11 of the Notice of Approval (MOECC, 2010). The air monitoring plan was also developed to satisfy the conditions of the Environmental Compliance Approval and the environmental mitigation and commitments set out in the Environmental Assessment (Jacques Whitford, 2009). The Ambient Monitoring Plan included two monitoring stations referred to as the Courtice Water Pollution Control Plant (WPCP) Station and the Rundle Road Station (as well as a temporary fence line monitor). Subsequently, the Region decided to add a third ambient air monitoring station located near the corner of Crago and Osborne Roads (referred to as the Crago Road station), which was installed in October/November 2014. The Crago Road station is not part of the Ambient Monitoring Plan; however, it is operated following the same protocols as the other two stations. Since the Crago Road station was not part of the Provincial Minister's Notice of Approval, results of the Crago Road station are reported separately from the Courtice WPCP and Rundle Road stations.

The Crago Road station is equipped to measure concentrations of several air contaminants either continuously or at scheduled intervals (non-continuously) as outlined below:

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

Meteorological data is also measured at the station. The predominantly downwind Crago Road station measures horizontal wind speed, wind direction, atmospheric temperature, relative humidity, and rainfall.

Monitoring of non-continuous air quality parameters commenced once the EFW facility became fully operational on February 1, 2016. The first sampling day for non-continuous monitors was February 6, 2016.

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

This annual report provides a summary of the ambient air quality data collected at the Crago Road station for the period January to December 2016 and follows the same annual reporting requirements as for the Courtice WPCP and Rundle Road monitoring stations (Stantec, 2012).

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

1. Measured concentrations of NO_2, SO_2 and $PM_{2.5}$ were below the applicable O. Reg. 419/05 Standards and/or human health risk assessment (HHRA) health-based criteria presented in **Table 2-1** of this report for hourly, 24-hour and annual averaging periods.

2. The 98th percentile of the measured daily average $PM_{2.5}$ levels during the 2016 monitoring period was 22.6 µg/m^3 at the Crago Road station. The annual average $PM_{2.5}$ concentration measured at the Crago Road station over the monitoring period was 6.6 µg/m^3. As detailed below, these values for the 2016 measurements should not be used for direct comparison against the Canadian Ambient Air Quality Standard.

3. The 24-hour and annual $PM_{2.5}$ Canadian Ambient Air Quality Standards (CAAQS) criteria both require a three-calendar year average for comparison, with the data considered valid if an annual 98th percentile value is available for at least two of the three calendar years. Using the measured $PM_{2.5}$ data for calendar years 2015 and 2016, the average annual 98th percentile daily average and annual average $PM_{2.5}$ levels were below the CAAQS criteria.

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

5. The maximum measured concentrations of PAHs with MOECC Ambient Air Quality Criteria were below their applicable 24-hour criteria (presented in **Table 2-3**) with the exception of four (4) benzo(a)pyrene (B(a)P) measurements. Out of twenty-eight (28) PAH samples collected at the Crago Road Station, four (4) samples exceeded the Ontario 24-hour B(a)P AAQC of 0.05 ng/m^3 by 12% to 62%. However, all four samples were well below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419/05 24-hour average guideline, and the HHRA health based criteria (as shown in **Table 2-3**).

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. Discussion of the meteorology and potential sources for these events, which is required by the MOECC to be included in each annual report, is provided in Section 4.4.

6. The maximum toxic equivalent dioxin and furan concentration measured over this period was well below the applicable criteria presented in **Table 2-3**.

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

Abbreviations

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

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

1.0 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

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

An Ambient Air Quality Monitoring Plan – Durham York Residual Waste Study (Ambient Monitoring Plan) was developed in 2011-2012 and included two monitoring stations referred to as the Courtice Water Pollution Control Plant (WPCP) Station and the Rundle Road Station (as well as a temporary Fence Line Station). The plan developed for these stations was based on the Regional Council's mandate to provide ambient air quality monitoring in the area of the DYEC for a three-year period.

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

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

At the request of the Regional Municipality of Durham (the Region), a third ambient air monitoring station located near the corner of Crago and Osborne Roads was installed in October/November 2014. This station, which is not part of the original Ambient Monitoring Plan, is operated following the same protocols as the other two stations (Courtice WPCP and Rundle Road Stations) already in operation.

The Crago Road Station is equipped to measure concentrations of several air contaminants either continuously or at scheduled intervals (non-continuously) as outlined below:

- Contaminants monitored continuously:
    - Sulphur Dioxide (SO_2)
    - Nitrogen Oxides (NO_X), and
    - Particulate Matter smaller than 2.5 microns ($PM_{2.5}$).

- Contaminants monitored non-continuously:
  - 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 this station for 2016 were prepared by Stantec and submitted to the Regional Municipality of Durham. This Annual Report summarizes the results of the ambient air monitoring from January to December 2016.

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

1.2 LOCATION OF THE AMBIENT AIR QUALITY MONITORING STATION

The selection of the site for the monitoring station was accomplished in consultation with Regional Municipality of Durham representatives, with consideration of the location of the existing monitoring stations and general MOECC siting criteria. The final location of the monitoring station was influenced by the availability of electrical power, accessibility of each location, and security.

The Crago Road Station is sited east of the DYEC near the Darlington Hydro Upper and Lower Soccer Fields on the east side of Crago Road, north of Osborne Road. Its location is shown in **Figure 1-2** and **Figure 1-3**. The air contaminants listed in Section 1.1 and meteorological data are measured at this monitoring station.

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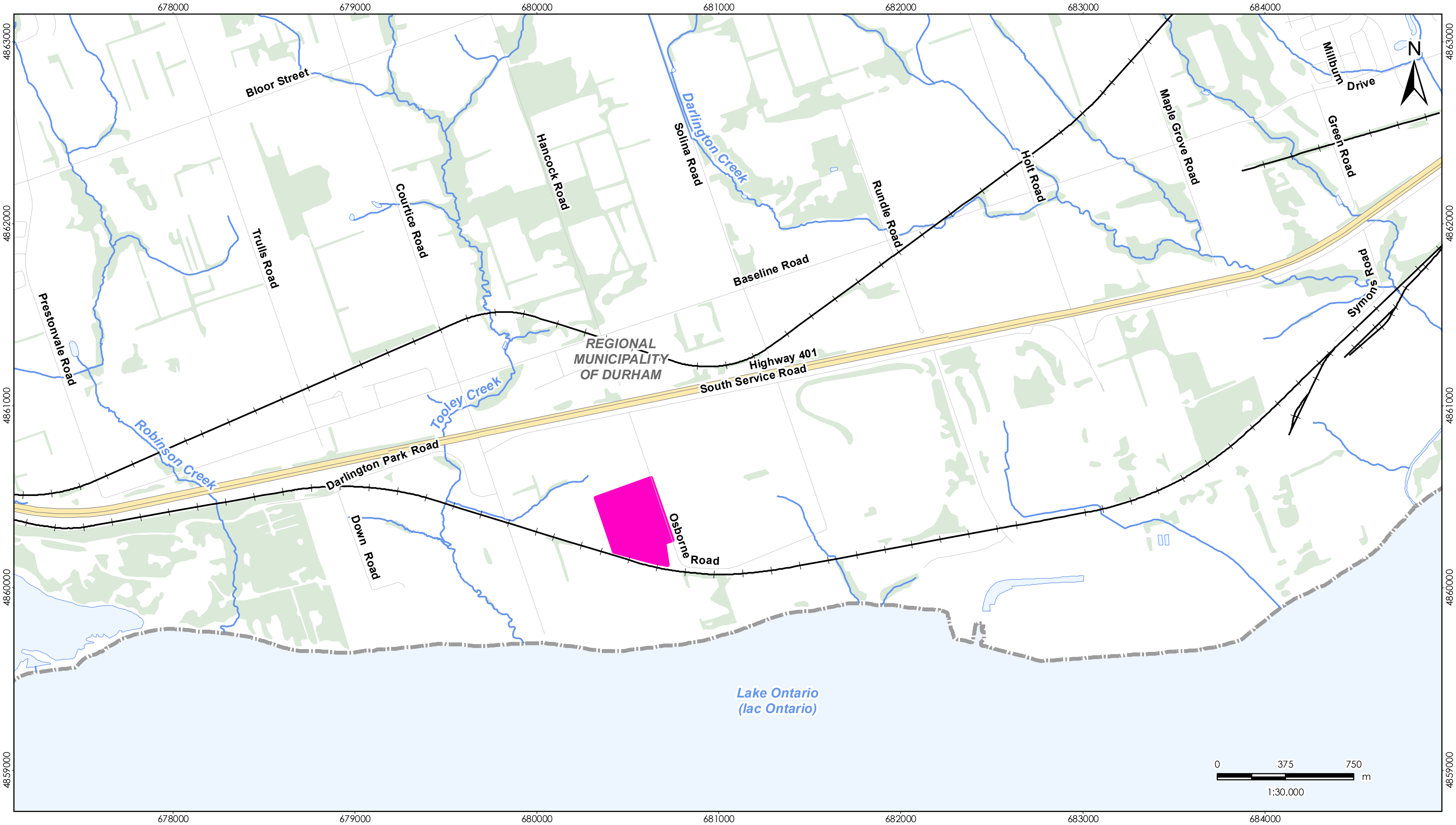


October 2013
160950528

Stantec

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.

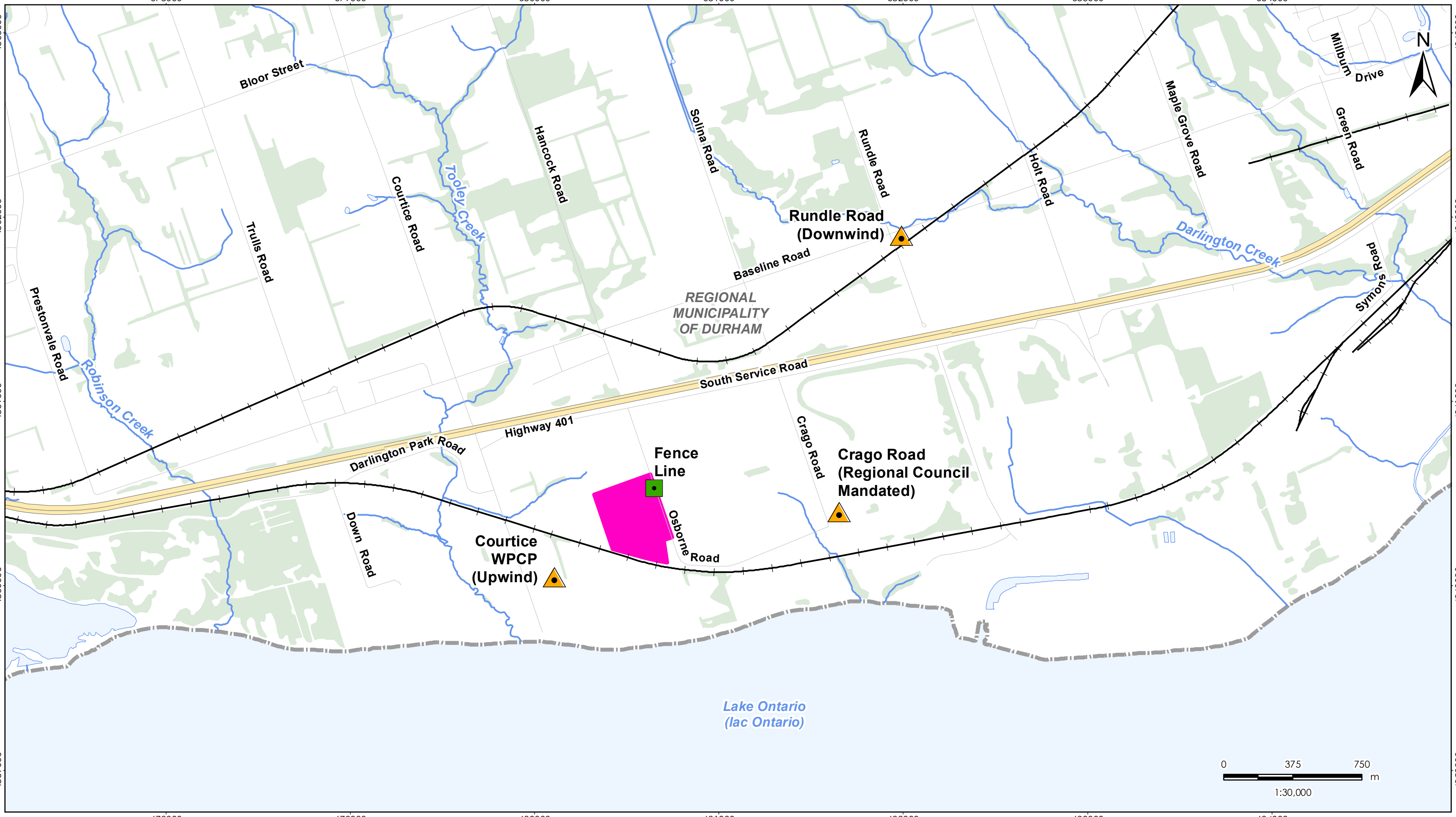
1-1

Title

Site Location Plan

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.



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Stantec

Legend

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

Notes

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

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

1-2

Title

Locations of Ambient Monitoring Stations

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

2.0 KEY COMPONENTS ASSESSED

2.1 METEOROLOGY

The following meteorological parameters are measured at the Crago Road monitoring station:

- Wind Speed and Direction at a height of 10 m
- Ambient Temperature at a height of 2 m
- Relative Humidity, and
- Rainfall

2.2 AIR QUALITY CONTAMINANTS OF CONCERN

The ambient air quality monitoring program for the Crago Road Station includes the following air contaminants specified in the Ambient Monitoring Plan (Stantec 2012):

- Continuously monitored criteria air contaminants (CACs)
    - Sulphur Dioxide (SO_2)
    - Nitrogen Oxides (NO_X), and
    - Particulate Matter smaller than 2.5 microns ($PM_{2.5}$).

- Non-continuously monitored
    - Metals in Total Suspended Particulate (TSP) matter
    - Polycyclic Aromatic Hydrocarbons (PAHs), and
    - Dioxins and Furans.

Rationales for the choice of air contaminants being monitored are provided in the Ambient Monitoring Plan (Stantec, 2012).

Non-continuous measurements started once the EFW commenced commercial operation on February 1, 2016. The first sampling day was February 6, 2016.

2.2.1 Nitrogen Oxides (NO_X)

Nitrogen oxides (NO_X) are produced in most combustion processes, and are almost entirely made up of nitric oxide (NO) and nitrogen dioxide (NO_2). Together, they are often referred to as NO_X. NO_2 is an orange to reddish gas that is corrosive with an irritating odour. Most NO_2 in the atmosphere is formed by the oxidation of NO, which is emitted directly by combustion processes, particularly those at high temperature and pressure. NO is a colourless gas. The levels of NO and NO_2, and the ratio of the two gases, together with the presence of hydrocarbons and sunlight, are the most important factors in the formation of ground-level ozone (O_3). Further oxidation and mixing 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 its release to the atmosphere. The rate of conversion depends on the oxidizing potential of the atmosphere at the time of release. For example, if the ambient concentration of O_3 is high at the time of release, the conversion might be expected to be higher than if the ambient concentration of O_3 was low at that time.

2.2.2 Sulphur Dioxide (SO_2)

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

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

2.2.3 Particulate Matter

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

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

2.2.4 Metals

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

- weathering of the rocks, mining/construction activities, etc. can release metals into air as particulate matter.

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

Metals:

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

2.2.5 Polycyclic Aromatic Hydrocarbons (PAH)

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

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

Polycyclic Aromatic Hydrocarbons:

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

2.2.6 Dioxins and Furans

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

Concentrations of the following dioxins and furans are measured:

Dioxins and Furans:

- 2,3,7,8-Tetra CDD
- 1,2,3,7,8-Penta CDD
- 1,2,3,4,7,8-Hexa CDD
- 1,2,3,6,7,8-Hexa CDD
- 1,2,3,7,8,9-Hexa CDD
- 1,2,3,4,6,7,8-Hepta CDD
- Octa CDD
- Total Tetra CDD
- Total Penta CDD
- Total Hexa CDD
- Total Hepta CDD
- 2,3,7,8-Tetra CDF
- 1,2,3,7,8-Penta CDF
- 2,3,4,7,8-Penta CDF
- 1,2,3,4,7,8-Hexa CDF
- 1,2,3,6,7,8-Hexa CDF
- 2,3,4,6,7,8-Hexa CDF
- 1,2,3,7,8,9-Hexa CDF
- 1,2,3,4,6,7,8-Hepta CDF
- 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 criteria were used for comparison to the air quality data as specified in the Ambient Monitoring Plan (Stantec, 2012); one based on regulatory limits, and the second developed in the human health risk assessment (HHRA) completed as part of the Environmental Assessment of the DYEC. The regulatory criteria include:

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

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

The previously applicable 24-hour Canada-Wide Standard (CWS) for $PM_{2.5}$ of 30 µg/m^3 (98th percentile averaged over three consecutive years) has been superseded by the new Canadian Ambient Air Quality Standard (CAAQS) of 28 µg/m^3 (98th percentile averaged over three consecutive years) and an annual objective of 10 µg/m^3, as noted in **Table 2-1**. The proposed CAAQS 24-hour objective for 2020 is 27 µg/m^3.

Summaries of the relevant ambient air quality criteria are presented in **Table 2-1** to **Table 2-3**.

Table 2-1 Summary of Air Quality Criteria for CACs

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

Notes:

A. The Schedule 3 Standard for NO_X is based on health effects of NO_2, as NO_2 has adverse health effects at much lower concentrations than NO. Therefore, the standard was compared to NO_2 in this report. However, as per the current December 2016 version of the ACB List, the standard was also compared to the monitored NO_X.

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

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

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

Table 2-2 Summary of Air Quality Criteria for Metals

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

Table 2-2 Summary of Air Quality Criteria for Metals

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

Notes:

A. Annual Average
B. Carcinogenic Annual Average

Table 2-3 Summary of Air Quality Criteria for PAHs and D/Fs

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

Table 2-3 Summary of Air Quality Criteria for PAHs and D/Fs

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

Notes:

A. Carcinogenic Annual Average. Units in $(ng/m^3)^{-1}$.
B. Ontario Ambient Air Quality Criteria - The criteria for benzo(a)pyrene (B(a)P) is for B(a)P as a surrogate for PAHs.
C. O. Reg. 419/05 Schedule 6 Upper Risk Thresholds
D. O. Reg. 419/05 24 Hour Guideline
E. Application of the air standard for dioxins, furans, and dioxin-like PCBs requires the calculation of the total toxicity equivalent (TEQ) concentration contributed by all dioxin-like compounds in the mixture. TEQ is calculated using the methodology as per the current December 2016 version of the ACB List and the corresponding WHO2005 toxic equivalency factors (I-TEFs).
F. 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 site includes both continuous and non-continuous monitors to sample air contaminant concentrations. Monitoring for respirable particulate matter ($PM_{2.5}$), nitrogen oxides (NO_X) and sulphur dioxide (SO_2) are conducted on a continuous basis. A summary of the continuous monitors and a brief description of their principle of operation are provided in **Table 3-1** below.

Table 3-1 Summary of Continuous Ambient Air Quality Monitors

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

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

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

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

Horizontal wind speed, wind direction, atmospheric temperature, relative humidity, and rainfall are measured at the predominantly downwind Crago Road Station. The meteorological sensors at the Crago Road Station are mounted on an external 10 m aluminum tower. The meteorological equipment at the Crago Road Station is summarized in **Table 3-3**.

Table 3-3 Summary of Meteorological Equipment

Parameter	Equipment
Wind Speed/Wind Direction	Met One Instruments Inc. Model 034B
Temperature / Relative Humidity	Campbell Scientific Model HMP 60
Rainfall	Texas Electronic TE525M

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

3.2 MONITORING STATION VISITS AND REGULAR MAINTENANCE ACTIVITIES

Visits to the monitoring station were conducted by the air quality team (composed of employees from Stantec and Valley Environmental Services (Valley Environmental)) for routine maintenance, setup of the non-continuous monitoring runs, and on an as-needed basis to verify the correct operation of the monitoring equipment as prescribed by the Ambient Monitoring Plan (Stantec, 2012). During the station visits, the integrity and proper operation of the monitoring equipment and the data acquisition systems were checked and verified. These checks were done to ensure the collection of valid and complete data, and to confirm the continued safe and secure environment at the station. Station visits in 2016 were documented in the site logbook, and visual checks of the equipment were documented during each site visit in an Ambient Pod Checklist. A list of the regular and major preventative maintenance activities performed by Stantec and/or Valley Environmental during the station visits in 2016 is presented in **Table A-1** in **Appendix A**.

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

3.3 DATA ACQUISITION/ARCHIVING

Data from the continuous monitors at the station are maintained in the data logger. These data were viewed and collected via the automated data acquisition system and cell phone modem. The data review and storage schedule was as follows:

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

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

3.4 INSTRUMENTATION CALIBRATION

Continuous Monitors

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

Non-Continuous Monitors

The high volume air samplers were calibrated at a minimum monthly (or after any motor maintenance) during their sampling period in 2016. The calibration frequency exceeded the MOECC Operations Manual (MOECC, 2008) requirement of quarterly calibrations.

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

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

The Crago Road Station is not part of the ambient monitoring network required by MOECC as described in the Ambient Monitoring Plan (Stantec, 2012) therefore the MOECC does not conduct performance or site audits of the equipment.

3.6 INSTRUMENTATION ISSUES

A few instrumentation issues were encountered during 2016. The most significant of these were power outages at the station and a malfunction of the datalogger leading to a loss of one week of air quality and meteorological data. There were also some minor equipment issues that commonly occur when operating instrumentation continuously for extended periods of time.

A summary of operational issues and the resolution for each measurement parameter during the 2016 monitoring period is presented in **Table A-3** in **Appendix A**.

3.7 DATA RECOVERY RATES

Data recovery rates for each continuous monitor at the station during the 2016 sampling period (January to December 2016) are presented in **Table 3-4**. The data recovery rates for the measured air contaminants met or exceeded MOECC requirements of 75% for data validity on an annual basis (MOECC, 2008).

Table 3-4 Summary of Data Recovery Rates for the Crago Road Station (Downwind) – 2016 Monitoring Period

Parameter	Valid Measurement Hours	Data Recovery Rate (%)
SO_2	8587	98% [A]
NO_X	8584	98% [A]
$PM_{2.5}$	8593	98% [A]
Temperature	8631	98% [A]
Rainfall	8631	98% [A]
Relative Humidity	8631	98% [A]
Wind Speed/Direction	8621	98% [A]
TSP/Metals	55 [B]	100%
PAHs	28 [B]	100%
Dioxins and Furans	20 [B,C]	100%

Note:

A. Includes instrumentation issues summarized in Appendix Table A3 and monthly calibrations.
B. Number of filters/24-hour average samples.
C. Includes additional dioxins and furans sampling requested by the Regional Municipality of Durham.

3.8 FIELD CONDITION OBSERVATIONS

During 2016, activities near the Crago Road station were observed that had the potential to affect ambient air quality. These observations were noted by Stantec and Valley Environmental personnel during field visits and by Regional Municipality of Durham personnel located at the DYEC.

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

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

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

Other activities around the monitoring station that had the potential to affect local air quality included:

- Construction of a new access road to the station on August 9, 2016. This activity included building a culvert and new gravel access roadway to the monitoring station.
- Hydro crews working on the perimeter of the new South Service Road construction area in December 2016.
- A fire on the roof of the DYEC on December 11, 2016 lasting from approximately 10:00 – 12:00.

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

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

4.0 SUMMARY OF AMBIENT MEASUREMENTS

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

4.1 METEOROLOGICAL DATA

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

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

Parameter [A]		Crago Road Station (Downwind)	Units
Temperature	Maximum	31.4	C
	Minimum	-26.9	C
	Mean	8.9	C
	Standard Deviation	10.1	C
Rainfall	Maximum	13.6	mm
	Minimum	0.0	mm
	Mean	0.06	mm
	Standard Deviation	0.40	mm
Relative Humidity	Maximum	98.7	%
	Minimum	19.0	%
	Mean	71.2	%
	Standard Deviation	15.8	%
Wind Speed [B]	Maximum	46.5	km/hr
	Minimum	0.0	km/hr
	Mean	12.2	km/hr
	Standard Deviation	7.3	km/hr

Notes:

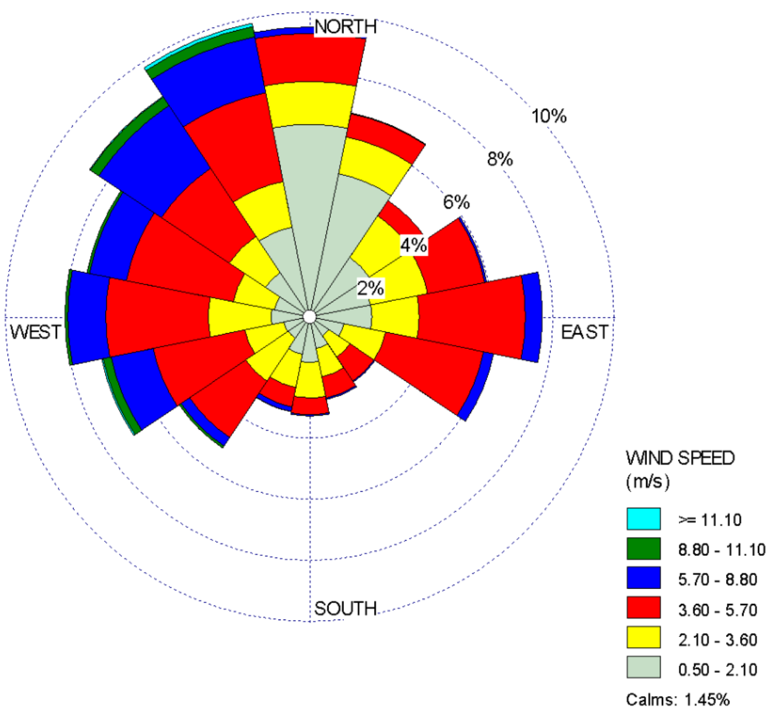
A. Pressure is not measured at the Crago Road Station.

B. Wind speed at the Crago Road Station is measured at a height of 10 m.

A wind rose showing the directionality and speed for 2016 at this location is presented in **Figure 4-1**. The length of the radial barbs gives the total percent frequency of winds blowing from the indicated direction, while portions of the barbs of different widths indicate the frequency associated with each wind speed category.

In 2016, winds at the Crago Road Station occurred predominantly from northerly to westerly directions, with some winds from easterly directions. Winds blew infrequently from the south.

Figure 4-1 Wind Rose for the 2016 Monitoring Period



4.2 CAC AMBIENT AIR QUALITY MEASUREMENTS

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

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

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

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

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

Pollutant	Averaging Period	Regulatory and HHRA Health-Based Criteria			Crago Road Station (Downwind)	
		ppb	µg/m³		Concentration (ppb)	Concentration (µg/m³)
SO_2	1	250	690	Maximum	41.3	116.2
				Minimum	0	0
				Mean	0.9	2.5
				Standard Deviation	2.2	6.3
				# of Exceedances	0	0
	24	100	275	Maximum	24.7	69.5
				Minimum	0	0
				Mean	0.9	2.5
				Standard Deviation	1.5	4.2
				# of Exceedances	0	0
	Annual	20 / 11 [A]	55 / 29 [A]	Mean (Period)	0.9	2.5
				# of Exceedances	0	0
$PM_{2.5}$	24	N/A	28 [B, G]	Maximum	-	96
				Minimum	-	0.2
				Mean	-	6.6
				98^{th} Percentile [C]	-	22.6
				Standard Deviation	-	6.3
				# of Exceedances	-	N/A
	Annual	N/A	10 [D, H]	Mean (Period)	-	6.6
				# of Exceedances	-	N/A

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

Pollutant	Averaging Period	Regulatory and HHRA Health-Based Criteria			Crago Road Station (Downwind)	
		ppb	µg/m³		Concentration (ppb)	Concentration (µg/m³)
NO_2	1	200 [E]	400 [E]	Maximum	56.5	108.3
				Minimum	0	0
				Mean	5.5	10.9
				Standard Deviation	6.3	12.8
				# of Exceedances	0	0
	24	100 [E]	200 [E]	Maximum	20.9	43.3
				Minimum	0	0
				Mean	5.5	10.9
				Standard Deviation	3.6	7.4
				# of Exceedances	0	0
	Annual	30	60	Mean	5.5	10.9
				# of Exceedances	0	0
NO [F]	1	NA	NA	Maximum	78.4	103.5
				Minimum	0	0
				Mean	1.7	2.2
				Standard Deviation	3.8	4.9
				# of Exceedances	0	0
	24	NA	NA	Maximum	16.9	21.9
				Minimum	0	0
				Mean	1.6	2.1
				Standard Deviation	1.9	2.4
				# of Exceedances	0	0

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

Pollutant	Averaging Period	Regulatory and HHRA Health-Based Criteria			Crago Road Station (Downwind)	
		ppb	µg/m³		Concentration (ppb)	Concentration (µg/m³)
NO_X	1	200 [E]	400 [E]	Maximum	107.2	216.9
				Minimum	0	0
				Mean	7	14
				Standard Deviation	9	18
				# of Exceedances	0	0
	24	100 [E]	200 [E]	Maximum	35.7	71.3
				Minimum	0	0
				Mean	7	14
				Standard Deviation	5.1	10.4
				# of Exceedances	0	0
	Annual	30	60	Mean	7	14
				# of Exceedances	0	0

Notes:

A. Annual AAQC / Annual HHRA.

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

C. The 98th percentile of the daily average $PM_{2.5}$ measurements in the period.

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

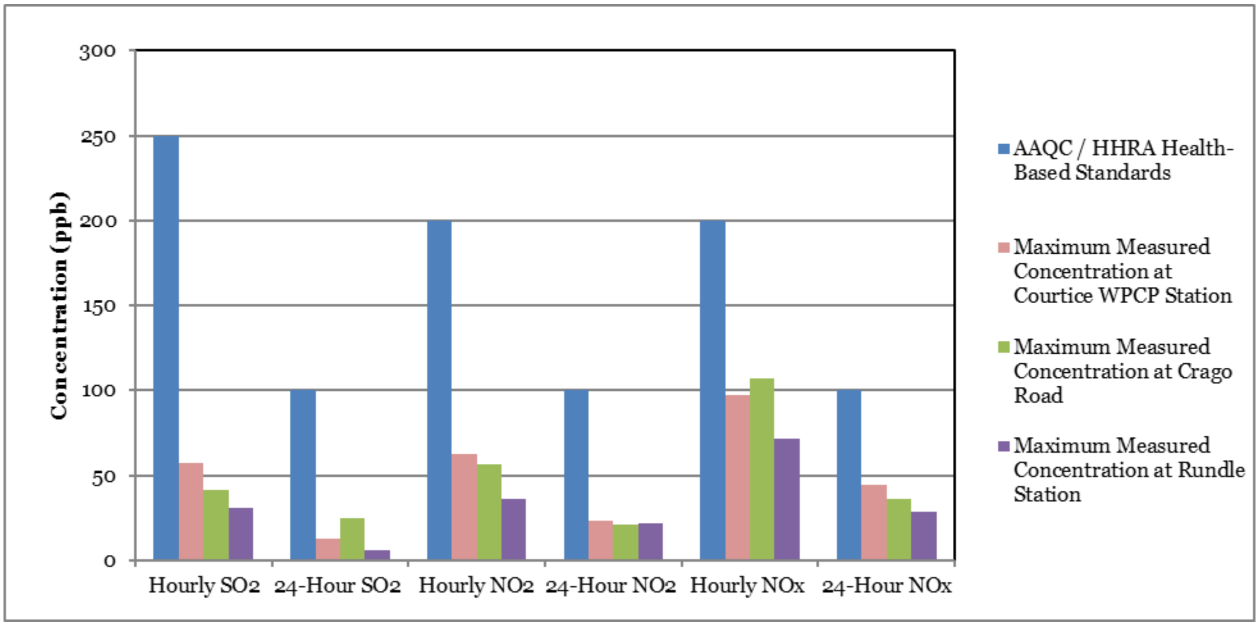
E. As per the current December 2016 version of the ACB List, the air Standard for NO_X is compared to a monitored NO_X concentration, although the Reg. 419/05 Schedule 3 Standard for NO_X is based on health effects of NO_2.

F. NO has no regulatory criteria.

G. Daily $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires averaging the 98th percentile concentrations over three consecutive years, as compared to the 12-month period covered by this report.

H. Annual $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires a three-year average of the annual average concentrations over three consecutive years, as compared to the 12-month period covered by this report.

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



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

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

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

Pollutant	Averaging Period (hr)		Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_2	1	Maximum Concentration (ppb)	41.3	29.6	31.8	16.3
		Wind Direction	East	East	East	East
		Courtice WPCP / Rundle Road Station Concentrations During Same Period (ppb)	22.6 / 0.5	16.5 / 0.9	13.1/0.5	9.6 / 0.0
		Potential Emission Sources	St. Mary's Cement, CN Railroad, Ontario Hydro	St. Mary's Cement, CN Railroad, Ontario Hydro	St. Mary's Cement, CN Railroad, Ontario Hydro	St. Mary's Cement, CN Railroad, Ontario Hydro
NO_2	1	Concentration (ppb)	41.7	56.5	34.5	31.4
		Wind Direction	Northwest	North-northwest	North-northeast	Northwest
		Courtice WPCP / Rundle Road Station Concentrations During Same Period (ppb)	39.0 / 34.9	41.5 / 9.3	22.7 / 7.9	26.6 / 26.1
		Oshawa MOECC Station Concentration During Same Period (ppb)	27	5	9	12
		Potential Emission Sources	Regional sources, Highway 401, and agricultural activities	Highway 401 and agricultural activities	Highway 401, agricultural activities, and Highway 418 construction	Highway 401, agricultural activities, and Highway 418 construction

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

Pollutant	Averaging Period (hr)		Quarter 1	Quarter 2	Quarter 3	Quarter 4
NOx	1	Concentration (ppb)	107.2	63.7	61.9	68.2
		Wind Direction	Southwest	North-northwest	North	North
		Courtice WPCP / Rundle Road Station Concentrations During Same Period (ppb)	4.6 /10.5	71.7 / 30.2	49.7 /15.9	43.7 / 20.0
		Potential Emission Sources	CN railroad	Highway 401 and agricultural activities	Highway 401, agricultural activities, and Highway 418 construction	Highway 401, agricultural activities, and Highway 418 construction
$PM_{2.5}$	24	Concentration (µg/m^3)	29.6	25.5	20.0	96.0
		Wind Direction	West-southwest	North-northeast	East	West
		Courtice WPCP / Rundle Road Station Concentrations During Same Period (µg/m^3)	21.2 / 42.7	8.8 / 7.8	16.8 / 14.1	8.1 / 5.6
		Oshawa MOECC Station Concentration During Same Period (µg/m^3)	16.8	4.2	10.5	5.5
		Potential Emission Sources	Agricultural activities and CN railroad	Highway 401 and agricultural activities	St. Mary's Cement and Ontario Hydro	DYEC and agricultural activities

4.2.1 Sulphur Dioxide (SO_2)

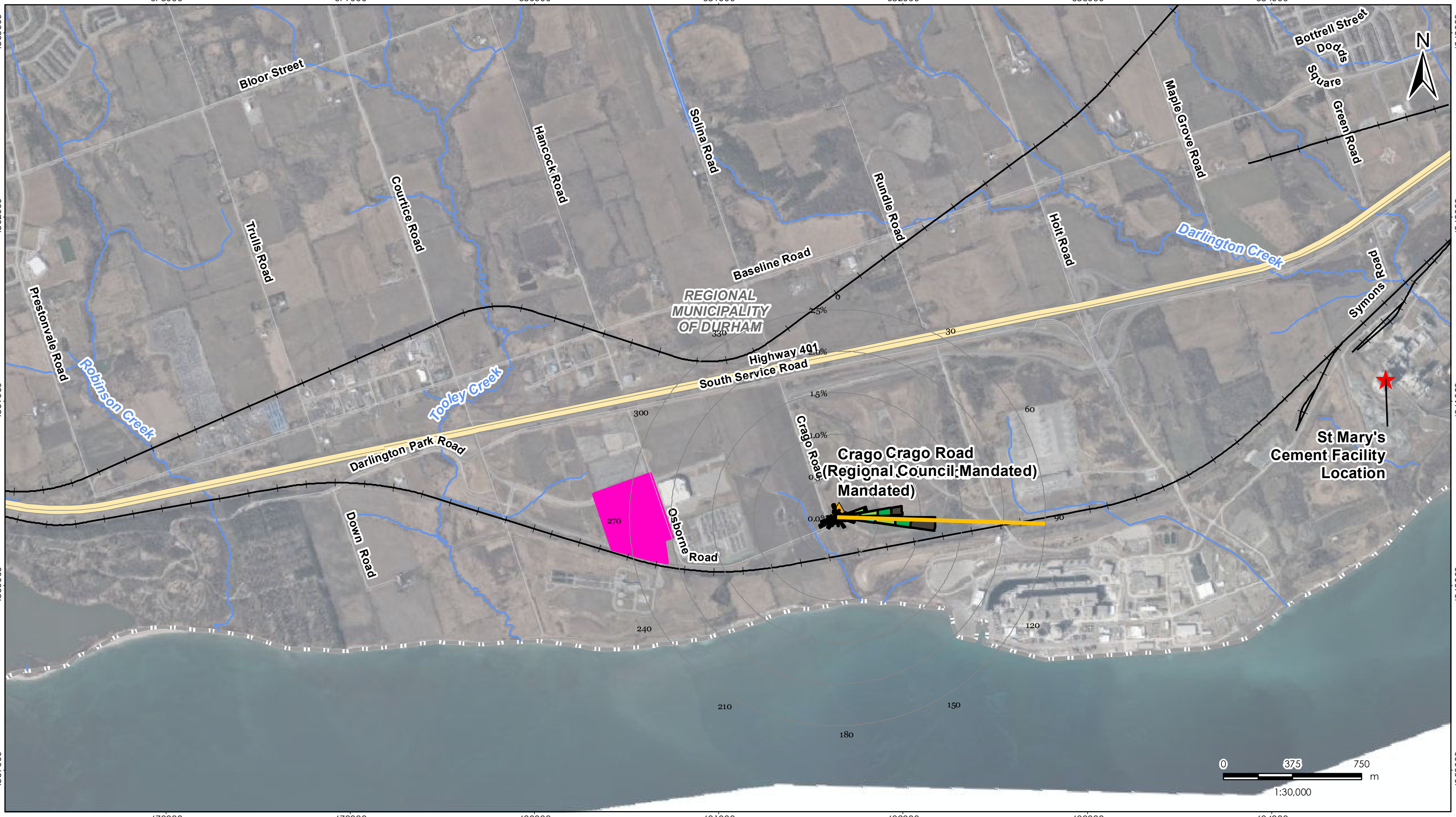
Time history plots of the hourly and 24-hour average SO_2 concentrations over the measurement period are presented in **Appendix B, Figure B1**. For hourly and 24-hour averages, the Ontario AAQCs of 250 ppb and 100 ppb (690 µg/m^3 and 275 µg/m^3) are shown with blue lines on the respective plot. The annual Ontario AAQC for SO_2 is 20 ppb (55 µg/m^3), and the annual HHRA criterion is 11 ppb (29 µg/m^3). As shown in these figures, measured ambient SO_2 concentrations were well below the Ontario AAQCs.

The maximum hourly, 24-hour and annual average concentrations measured at the Crago Road Station during the 2016 monitoring period were 41.3, 24.7, and 0.9 ppb (116.2, 69.5, and 2.5 µg/m^3), respectively, which are 17%, 25%, and 4.5% of the applicable 1-hour, 24-hour, and annual ambient air quality criteria.

A pollution rose of hourly average SO_2 concentrations measured at the Crago Road Station is presented in **Figure 4-3**. A pollution rose plot presents measured hourly average contaminant concentrations versus measured wind direction (over 10˚ wind sectors). In this figure, concentrations less than 2 ppb, which account for about 94% of the measurements at the station, were removed from the plot to allow the distribution of maximum levels to be more clearly visible in the figure. A plot of the measured hourly average SO_2 concentrations versus wind direction is presented in **Appendix B, Figure B2**.

For the Crago Road Station, higher measured concentrations occurred for winds blowing from easterly directions. The maximum measured concentration at this station occurred from the east – a direction in which the Darlington Nuclear Generating Station and St. Mary's Cement are upwind of the monitoring station.

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



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February 2017
160950528

Stantec

Legend

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

Concentration (ppb)

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

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
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3. Orthoimagery © First Base Solutions, 2013.
4. Concentrations less than 2 ppb, which account for 94% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

4-3

Title

Pollution Rose of Measured Hourly Average SO_2 Concentrations - 2016 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 species of NO_X, the AAQC were compared to measured NO_2 concentrations (MOECC, 2012). However, as per the current ACB List (MOECC, 2016), the NO_X Schedule 3 Standards were also compared to the monitored NO_X concentrations (see Section 4.2.3 below).

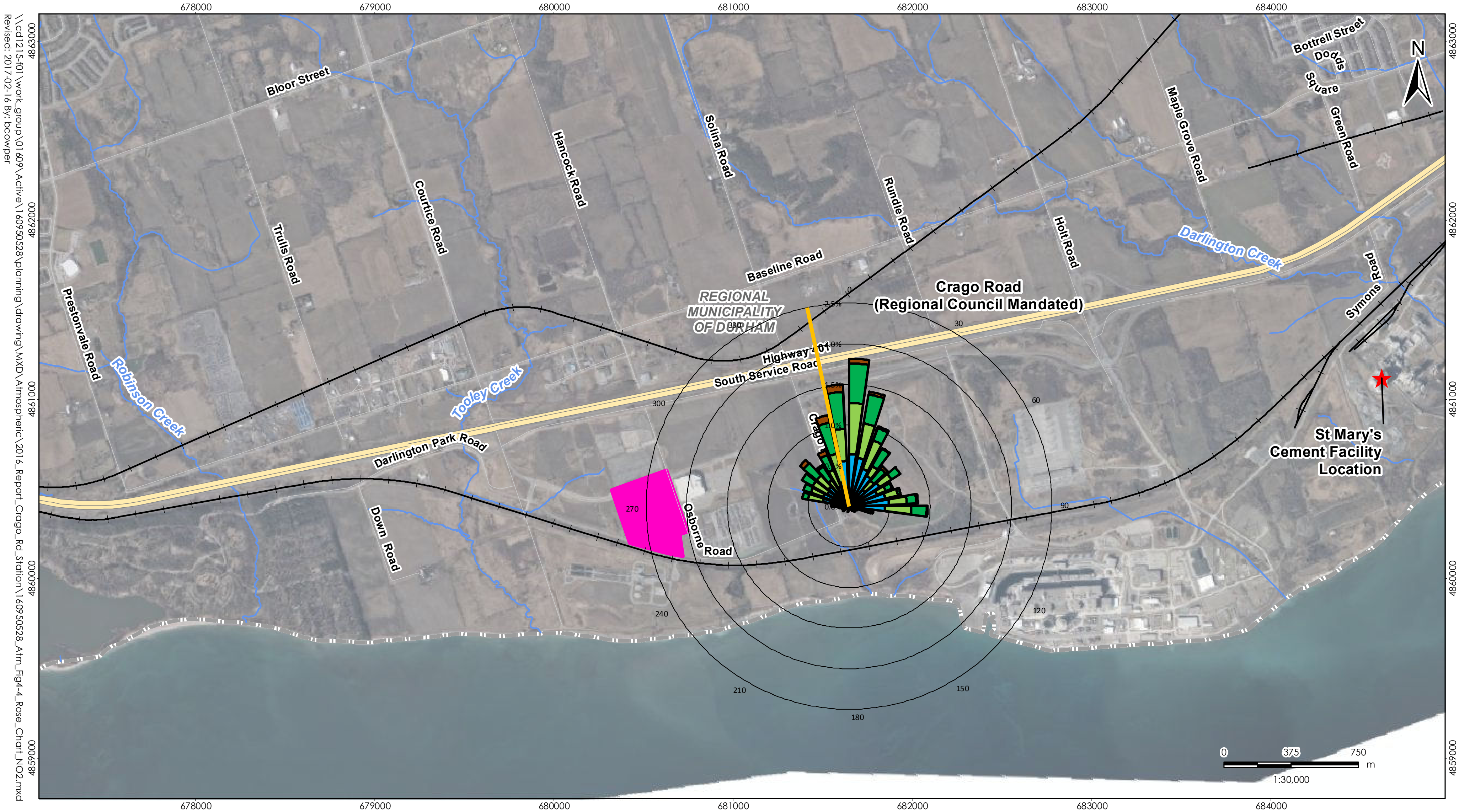
Time history plots of the hourly and 24-hour average NO_2 concentrations over the measurement period are presented in **Appendix C, Figure C1**. For hourly and 24-hour averages, the Ontario AAQCs of 200 ppb and 100 ppb (400 µg/m^3 and 200 µg/m^3) are shown as blue lines on their respective time history plots in Appendix C. Measured ambient NO_2 concentrations were well below the Ontario AAQCs.

The maximum hourly, 24-hour and annual average NO_2 concentrations measured at the Crago Road Station during 2016 were 56.5, 20.9, and 5.5 ppb (108.3, 43.3, and 10.9 µg/m^3) respectively, which are 28%, 21%, and 18% of the applicable ambient 1-hour, 24-hour, and annual air quality criteria.

A pollution rose of hourly NO_2 concentrations is presented in **Figure 4-4**. Concentrations less than 10 ppb which account for approximately 82% of measurements were removed from the plot to allow higher concentrations to be more clearly visible. A plot of measured hourly average NO_2 concentrations versus measured wind direction is presented in **Appendix C, Figure C2**.

Higher measured hourly concentrations for the Crago Road Station occurred most frequently from northerly directions. The maximum measured hourly average NO_2 concentration for the Crago Road Station occurred for a north-northwesterly wind - a direction in which the CN railway, Highway 401, Highway 418 construction, and the Darlington Hydro Upper and Lower Soccer Fields are upwind of the station.

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



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Revised: 2017-02-16 By: bcowper

February 2017
160950528

Stantec

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
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3. Orthoimagery © First Base Solutions, 2013.
4. Concentrations less than 10 ppb, which account for 82% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

Legend

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

Concentration (ppb)

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

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

4-4

Title

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

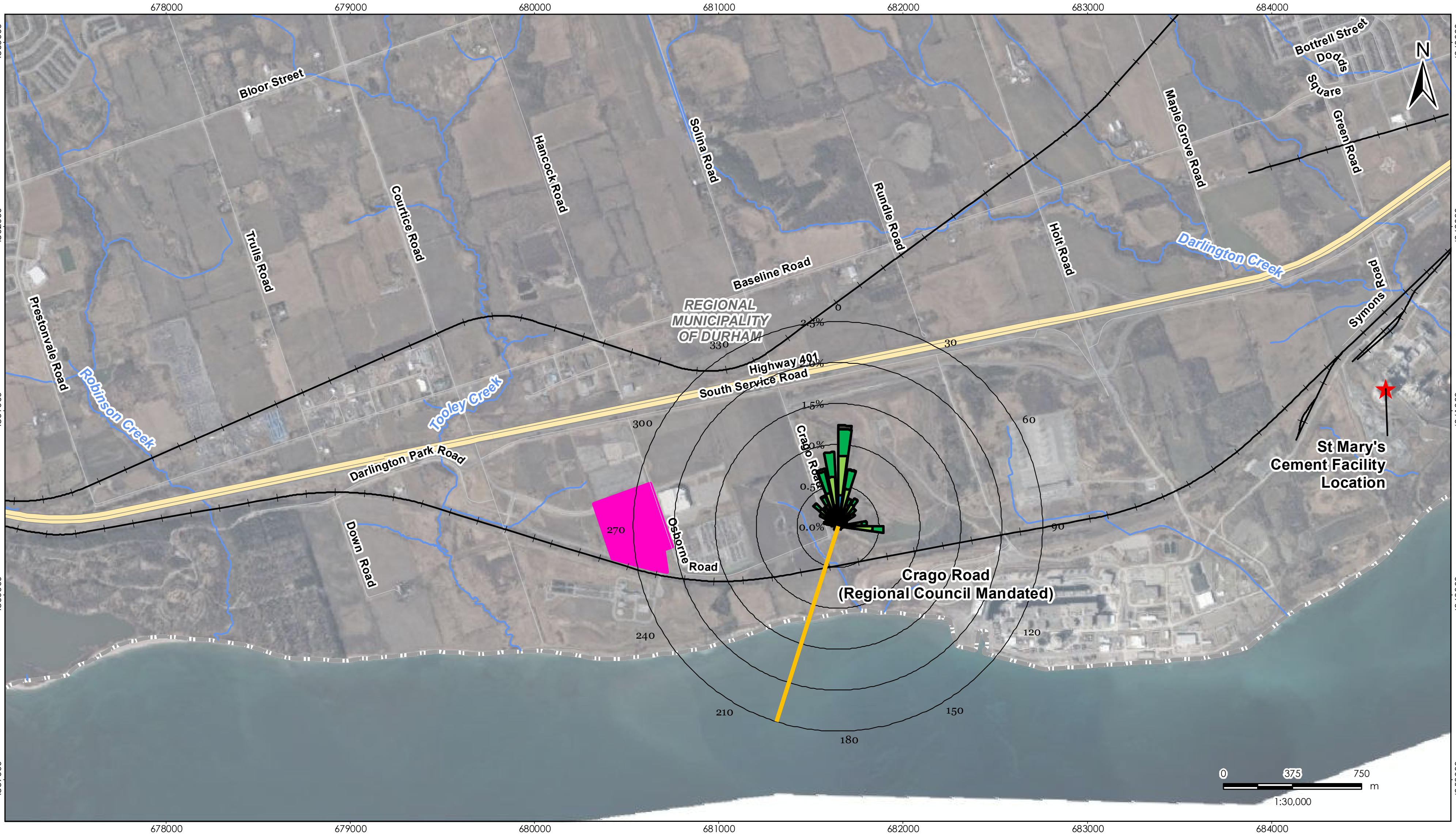
4.2.3 Nitrogen Oxides (NO_X)

Time history plots of hourly and 24-hour average NO_x concentrations over the measurement period are presented in **Appendix D, Figure D1**. For hourly and 24-hour averages in **Appendix D**, the O. Reg. 419/05 Schedule 3 Standards of 200 ppb and 100 ppb (400 µg/m^3 and 200 µg/m^3) are shown as blue lines on the corresponding time history plots. As indicated in the section above, although the criteria were compared to the measured NO_X concentrations in this report, the standards for NO_X are based on health effects of NO_2. As shown in these figures, the maximum measured ambient hourly and 24-hour average NO_X concentrations at the Crago Road Station were below the criteria during the monitoring period.

As presented in **Table 4-2**, the maximum hourly average NO_X concentration measured at the Crago Road Station was 107.2 ppb (216.9 µg/m^3), which is 54% of the 1-hour ambient criteria. The measured maximum 24-hour and annual average NO_X concentrations were 35.7 ppb and 7.0 ppb (75.1 µg/m^3 and 12.6 µg/m^3), respectively, which are 36% and 23% of the Ontario AAQCs.

A pollution rose of hourly average NO_X concentrations for the Crago Road Station is presented in **Figure 4-5**. The pollution rose in this figure presents measured concentrations above 20 ppb to allow higher levels to be more easily visible (concentrations less than 20 ppb accounted for 91% of the NOx measurements). A plot of wind direction versus measured NO_X concentrations is presented in **Appendix D, Figure D2**. Higher measured hourly average NO_X concentrations for the Crago Road Station typically occurred for winds blowing from northerly directions. The maximum measured concentration was for a wind blowing from the south-southwest, for which the CN railway is upwind.

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



February 2017
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Revised: 2017-02-16 By: bcowper

Stantec

Legend

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

Concentration (ppb)

- 60 - 110
- 35 - 60
- 25 - 35
- 20 - 25
- Direction of Maximum Measured Concentration

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthoimagery © First Base Solutions, 2013.
4. Concentrations less than 20 ppb, which account for 91% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

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Durham York Energy Centre

Figure No.

4-5

Title

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

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

A time history plot of the measured 24-hour average $PM_{2.5}$ concentrations over the measurement period is presented in **Appendix E, Figure E1**.

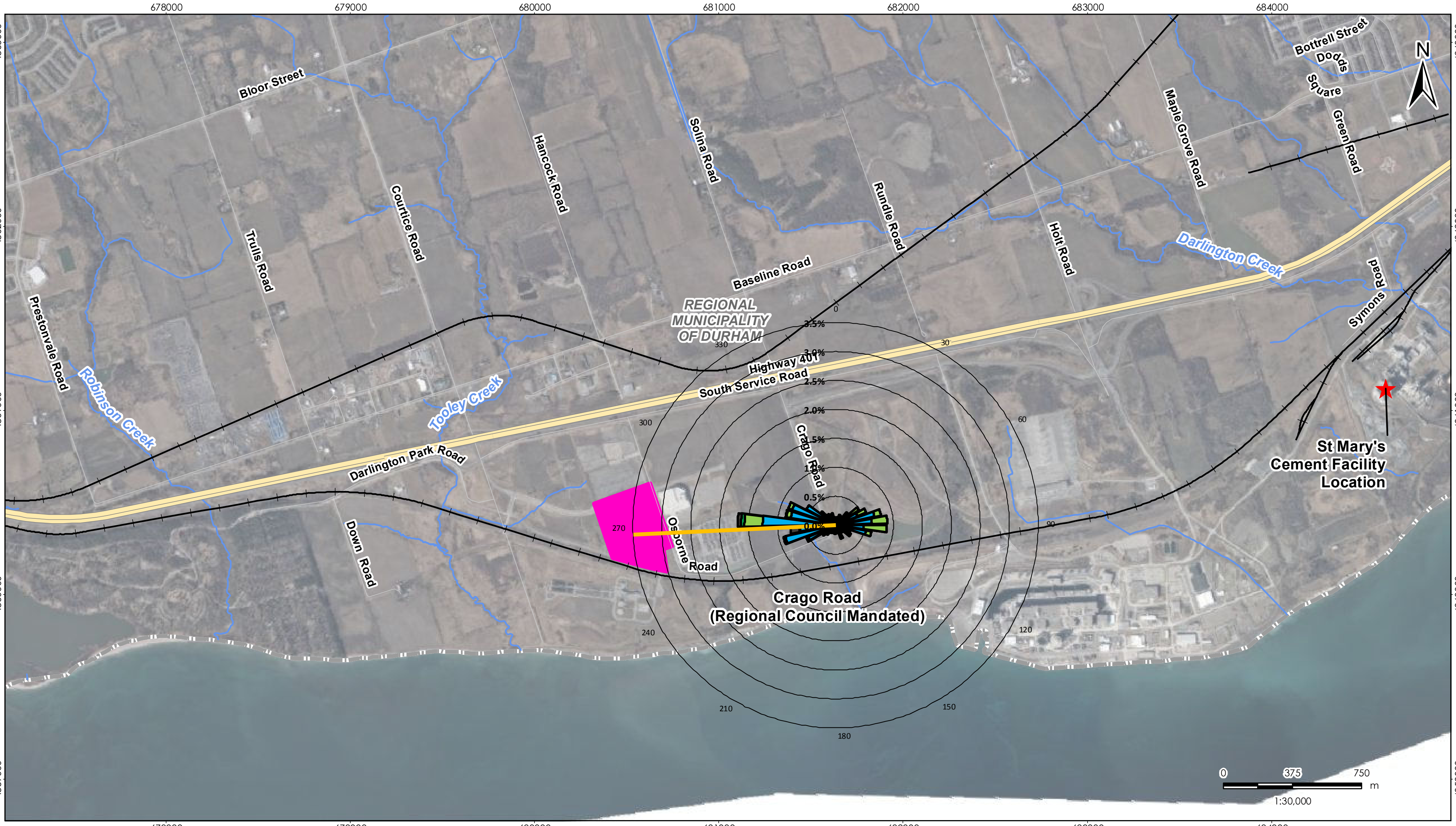
The maximum 24-hour average $PM_{2.5}$ concentration measured at the Crago Road Station over the monitoring period was 96.0 µg/m^3. In 2016, the 98th percentile of the measured daily average $PM_{2.5}$ concentrations was 22.6 µg/m^3. This value was lower than the 98th percentile daily average measurements at the Courtice WPCP and Rundle Road stations (21.6 and 32.9 µg/m^3 respectively). As detailed below, this value for the 98th percentile should not be used for comparison against the Canadian Ambient Air Quality Standard.

A pollution rose showing measured 24-hour average ambient $PM_{2.5}$ concentrations versus wind direction is shown in **Figure 4-6**. Concentrations less than 10 µg/m^3, which accounted for approximately 84% of measurements, were not included in this figure to more clearly show the distribution of higher concentration levels. A plot of measured 24-hour average ambient $PM_{2.5}$ concentrations versus measured 24-hour average wind direction is presented in **Appendix E, Figure E-2**.

Higher measured $PM_{2.5}$ concentrations at the Crago Road Station occurred for westerly and easterly winds, with the maximum measured concentration occurring from the west. The CN railway, agricultural fields, the DYEC, and local traffic were located upwind of the monitoring station. During the time of the maximum measured $PM_{2.5}$ concentration, representatives from the Region confirmed that opacity readings for the DYEC boilers were 0%.

The 24-hour and annual $PM_{2.5}$ CAAQS criteria both require a three-calendar year average for comparison, with the data considered valid if an annual 98th percentile value is available for at least two of the required three calendar years. A preliminary comparison of the calculated two-year average of the annual 98th percentile of the daily 24-hour average concentrations and the two-year average of the annual average concentrations to their respective CAAQS criteria using data for calendar years 2015 to 2016 is shown in **Table 4-4**. The measured ambient $PM_{2.5}$ levels were below their respective CAAQS standards.

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



February 2017
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Revised: 2017-02-16 By: bcowper

Stantec

Legend

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

Concentration (µg/m³)

- 70 - 100
- 40 - 70
- 20 - 40
- 10 - 20
- Direction of Maximum Measured Concentration

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthoimagery © First Base Solutions, 2013.
4. Concentrations less than 10µg/m³, which account for 84% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

4-6

Title

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

Table 4-4 Comparison of Ambient $PM_{2.5}$ Levels to the CAAQS Using 2015 to 2016 Measurement Data

Pollutant	Averaging Period	CAAQS (µg/m³)	Crago Road Station $PM_{2.5}$ Concentration (µg/m³) (Predominantly Downwind)
			2015 – 2016
$PM_{2.5}$	24-hour	28 [A]	22.6
	Annual	10 [B]	7.0

Notes:

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

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

4.3 AMBIENT TSP / METALS CONCENTRATIONS

A summary of the maximum, minimum, and mean measured ambient TSP and metals concentrations (for a daily averaging period) are presented in **Table 4-3**. The maximum measured concentrations of TSP and metals with MOECC air quality criteria during the 2016 monitoring period (February to December 2016) were below their applicable 24-hour criteria.

Table 4-3 Summary of Measured Ambient TSP/Metals Concentrations

Contaminant	Units	MOECC Standard	HHRA Health Based Criteria	Results			
				Maximum	Minimum	Period Arithmetic Mean	No. of Exceedances
Particulate	µg/m³	120	120	102.16	8.94	29.7/26.1 [B]	0
Total Mercury (Hg)	µg/m³	2	2	2.5E-05	4.8E-06 [A]	9.70E-06	0
Aluminum (Al)	µg/m³	4.8	-	7.8E-01	3.2E-02	1.53E-01	0
Antimony (Sb)	µg/m³	25	25	3.5E-03 [A]	2.4E-03 [A]	3.14E-03	0
Arsenic (As)	µg/m³	0.3	0.3	3.7E-03	1.5E-03 [A]	1.92E-03	0
Barium (Ba)	µg/m³	10	10	1.9E-02	2.8E-03	7.95E-03	0
Beryllium (Be)	µg/m³	0.01	0.01	3.5E-04 [A]	2.4E-04 [A]	3.14E-04	0
Bismuth (Bi)	µg/m³	-	-	2.1E-03 [A]	1.5E-03 [A]	1.89E-03	-
Boron (B)	µg/m³	120	-	6.7E-03	1.5E-03 [A]	2.17E-03	0
Cadmium (Cd)	µg/m³	0.025	0.025	1.3E-03	4.8E-04 [A]	6.41E-04	0
Chromium (Cr)	µg/m³	0.5	-	5.9E-03	1.2E-03 [A]	1.99E-03	0
Cobalt (Co)	µg/m³	0.1	0.1	7.0E-04 [A]	4.8E-04 [A]	6.29E-04	0

Table 4-3 Summary of Measured Ambient TSP/Metals Concentrations

Contaminant	Units	MOECC Standard	HHRA Health Based Criteria	Results			
				Maximum	Minimum	Period Arithmetic Mean	No. of Exceedances
Copper (Cu)	µg/m³	50	-	6.6E-02	1.1E-02	2.83E-02	0
Iron (Fe)	µg/m³	4	-	1.6E+00	8.3E-02	4.04E-01	0
Lead (Pb)	µg/m³	0.5	0.5	6.3E-03	7.9E-04 [A]	2.22E-03	0
Magnesium (Mg)	µg/m³	-	-	1.1E+00	5.6E-02	2.29E-01	-
Manganese (Mn)	µg/m³	0.4	-	5.5E-02	2.8E-03	1.36E-02	0
Molybdenum (Mo)	µg/m³	120	-	2.5E-03	7.3E-04 [A]	1.09E-03	0
Nickel (Ni)	µg/m³	0.2	-	2.6E-03	7.3E-04 [A]	1.01E-03	0
Phosphorus (P)	µg/m³	-	-	1.2E-01	6.1E-03 [A]	3.70E-02	-
Selenium (Se)	µg/m³	10	10	3.5E-03 [A]	2.4E-03 [A]	3.14E-03	0
Silver (Ag)	µg/m³	1	1	1.8E-03 [A]	1.2E-03 [A]	1.57E-03	0
Strontium (Sr)	µg/m³	120	-	1.7E-02	1.4E-03	5.48E-03	0
Thallium (Tl)	µg/m³	-	-	3.5E-03 [A]	2.4E-03 [A]	3.14E-03	-
Tin (Sn)	µg/m³	10	10	3.5E-03 [A]	2.4E-03 [A]	3.14E-03	0
Titanium (Ti)	µg/m³	120	-	3.7E-02	2.4E-03 [A]	9.17E-03	0
Vanadium (V)	µg/m³	2	1	1.8E-03 [A]	1.2E-03 [A]	1.57E-03	0
Zinc (Zn)	µg/m³	120	-	6.7E-02	7.6E-03	2.43E-02	0
Zirconium (Zr)	µg/m³	20	-	1.8E-03 [A]	1.2E-03 [A]	1.57E-03	0
Total Uranium (U)	µg/m³	1.5	-	1.6E-04 [A]	1.1E-04 [A]	1.41E-04	0

Note:

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

4.4 AMBIENT PAH CONCENTRATIONS

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

The maximum measured concentrations of all PAHs with MOECC air quality criteria were well below their applicable 24-hour criteria, with the exception of four (4) measurements of benzo(a)pyrene (B(a)P) out of a total of 28 measurements.

B(a)P 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 (including being present in soil and water).

The current Ontario 24-hour B(a)P AAQC was introduced in 2011 and levels above this AAQC are commonly measured throughout Ontario. B(a)P measurement data available from the National Air Pollutant Surveillance (NAPS) network for Ontario in 2013 (for Simcoe, Toronto, and Hamilton), all had maximum levels above the AAQC (varying between 136% -6,220% of the criteria). Available NAPS data for Ontario in 2012 (for Windsor, Toronto, and Hamilton) showed maximum B(a)P levels at these stations that varied between 716% -2,920% of the criteria. In 2011, NAPS data available for seven Ontario stations (Windsor, Toronto, Etobicoke, Hamilton, Simcoe, Pt. Petrie, and Burnt Island) showed exceedances at six of the seven stations, with only the remote Burnt Island Ontario station reporting a maximum level below the MOECC AAQC. In 2010, all of these stations, including the Burnt Island station, measured B(a)P levels above the AAQC.

The four (4) B(a)P samples collected on February 18, April 18, September 21, and November 8 2016, exceeded the Ontario AAQC of 0.05 ng/m^3 by 12% to 62%. The samples were however, well below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419/05 24-hour average guideline, and the HHRA health based criteria.

A summary of the wind directions and potential source contributions for these measurements (as required by the MOECC for inclusion in annual reports) is presented in **Table 4-5**.

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

Table 4-4 Summary of Measured Ambient PAH Concentrations

Contaminant	Units	Regulatory Criteria	HHRA Health Based Criteria	Results			
				Maximum	Minimum	Period Arithmetic Mean	No. of Exceedances
Benzo(a)pyrene	ng/m^3	0.05 [A]	1	8.12E-02	5.60E-03	3.15E-02	4
		5 [B]					0
		1.1 [C]					0
1-Methylnaphthalene	ng/m^3	12,000	-	1.44E+01	1.32E+00	4.81E+00	0
2-Methylnaphthalene	ng/m^3	10,000	-	2.77E+01	2.01E+00	8.10E+00	0
Acenaphthene	ng/m^3	-	-	1.73E+01	2.73E-01	3.80E+00	-
Acenaphthylene	ng/m^3	3500	-	4.07E-01	6.65E-02 [F]	1.40E-01	0
Anthracene	ng/m^3	200	-	8.92E-01	6.75E-02 [F]	2.81E-01	0

Table 4-4 Summary of Measured Ambient PAH Concentrations

Contaminant	Units	Regulatory Criteria	HHRA Health Based Criteria	Results			
				Maximum	Minimum	Period Arithmetic Mean	No. of Exceedances
Benzo(a)anthracene	ng/m³	-	-	2.41E-01	6.28E-02 [A]	9.49E-02	-
Benzo(a)fluorene	ng/m³	-	-	2.22E-01 [F]	1.26E-01 [F]	1.80E-01	-
Benzo(b)fluoranthene	ng/m³	-	-	5.89E-01	6.28E-02 [F]	1.25E-01	-
Benzo(b)fluorene	ng/m³	-	-	2.22E-01 [F]	1.26E-01 [F]	1.80E-01	-
Benzo(e)pyrene	ng/m³	-	-	2.22E-01 [F]	1.26E-01 [F]	1.80E-01	-
Benzo(g,h,i)perylene	ng/m³	-	-	6.78E-01	6.28E-02 [F]	1.16E-01	-
Benzo(k)fluoranthene	ng/m³	-	-	3.55E-01	6.28E-02 [F]	9.91E-02	-
Biphenyl	ng/m³	-	-	7.57E+00	7.14E-01 [F]	2.46E+00	-
Chrysene	ng/m³	-	-	4.56E-01	6.28E-02 [F]	1.06E-01	-
Dibenz(a,h)anthracene [D]	ng/m³	-	-	7.03E-01	6.28E-02 [F]	1.12E-01	-
Dibenzo(a,c)anthracene + Picene	ng/m³	-	-	7.54E-01	6.92E-02 [F]	2.32E-01	-
Fluoranthene	ng/m³	-	-	3.29E+00	9.92E-02 [F]	1.26E+00	-
Indeno (1,2,3-cd)pyrene	ng/m³	-	-	7.11E-01	6.28E-02 [F]	1.12E-01	-
Naphthalene	ng/m³	22,500	22,500	6.72E+01	6.98E+00	2.04E+01	0
o-Terphenyl	ng/m³	-	-	2.22E-01 [F]	1.26E-01 [F]	1.80E-01	-
Perylene	ng/m³	-	-	2.22E-01 [F]	1.26E-01 [F]	1.80E-01	-
Phenanthrene	ng/m³	-	-	1.96E+01	7.30E-01	6.29E+00	-
Pyrene	ng/m³	-	-	1.36E+00	9.77E-02 [F]	5.86E-01	-
Tetralin	ng/m³	-	-	4.95E+00	7.90E-01	1.66E+00	-
Total PAH [E]	ng/m³	-	-	128	15.8	5.17E+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. 419/05 Schedule 6 Upper Risk Thresholds.
C. O. Reg. 419/05 24 Hour Guideline
D. Based on laboratory analyses, dibenzo(a,c)anthracene co-elutes with dibenz(a,h)anthracene. Picene elutes after dibenz(a,h)anthracene
E. The reported total PAH is the sum of all analyzed PAH species.
F. Measured concentration was less than the laboratory method detection limit.

Table 4-5 Source Contribution Analysis – 2016 B(a)P Exceedances

Date	% above the MOECC B(a)P Criterion	Wind Direction	Potential Source Contributions
18-Feb-16	12%	Northwest	Land use in this direction is primarily agricultural with Highway 401 also located to the north. Potential sources could be agricultural or transportation activities.
18-Apr-16	62%	Northwest	Land use in this direction is primarily agricultural with Highway 401 also located to the north. Potential sources could be agricultural or transportation activities.
21-Sep-16	23%	Northwest	Land use in this direction is primarily agricultural with Highway 401 also located to the north. Potential sources could be agricultural or transportation activities.
8-Nov-16	38%	Northeast	Land use in this direction is primarily agricultural with Highway 401 also located to the north. Potential sources could be agricultural or transportation activities.

4.5 AMBIENT DIOXIN AND FURAN CONCENTRATIONS

A summary of the maximum and minimum, and arithmetic mean daily average ambient dioxin and furan concentrations are presented in **Table 4-6** for the measurements collected in 2016. 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 concentration at the Crago Road Station was below the applicable 24-hour criteria AAQC of 0.1 pg TEQ/m^3 (as shown in **Table 4-6**) for the 2016 monitoring period (January to December 2016).

Table 4-6 Summary of Measured Ambient Dioxin and Furan Concentrations

Contaminant	Units	Regulatory Criteria	HHRA Health Based Criteria	Crago Road (Predominatly Downwind)			
				Maximum	Minimum	Arithmetic Mean	No. of Exceedances
2,3,7,8-Tetra CDD *	pg/m³	-	-	7.45E-03 A	2.54E-03 A	4.34E-03	N/A
1,2,3,7,8-Penta CDD	pg/m³			8.07E-03	3.15E-03 A	4.64E-03	
1,2,3,4,7,8-Hexa CDD	pg/m³			1.57E-02	3.59E-03 A	5.53E-03	
1,2,3,6,7,8-Hexa CDD	pg/m³			2.04E-02	3.89E-03 A	5.93E-03	
1,2,3,7,8,9-Hexa CDD	pg/m³			2.53E-02	3.89E-03 A	8.82E-03	
1,2,3,4,6,7,8-Hepta CDD	pg/m³			2.31E-01	4.36E-03 A	5.97E-02	
Octa CDD	pg/m³			4.77E-01	4.33E-02	2.03E-01	
Total Tetra CDD	pg/m³			3.58E-02	2.54E-03 A	1.06E-02	
Total Penta CDD	pg/m³			6.78E-02	3.52E-03 A	1.13E-02	
Total Hexa CDD	pg/m³			1.79E-01	4.36E-03 A	4.15E-02	
Total Hepta CDD	pg/m³			4.29E-01	1.26E-02	1.31E-01	
2,3,7,8-Tetra CDF **	pg/m³			3.62E-02	4.03E-03 A	7.65E-03	
1,2,3,7,8-Penta CDF	pg/m³			1.94E-02	3.30E-03 A	5.49E-03	
2,3,4,7,8-Penta CDF	pg/m³			1.97E-02	3.30E-03 A	5.80E-03	
1,2,3,4,7,8-Hexa CDF	pg/m³			4.82E-02	3.15E-03 A	8.75E-03	
1,2,3,6,7,8-Hexa CDF	pg/m³			1.83E-02	2.59E-03 A	5.61E-03	
2,3,4,6,7,8-Hexa CDF	pg/m³			2.69E-02	2.73E-03 A	6.07E-03	
1,2,3,7,8,9-Hexa CDF	pg/m³			1.52E-02	3.02E-03 A	5.08E-03	
1,2,3,4,6,7,8-Hepta CDF	pg/m³			1.25E-01	3.76E-03 A	1.66E-02	
1,2,3,4,7,8,9-Hepta CDF	pg/m³			1.67E-02	3.02E-03 A	5.70E-03	

Table 4-6 Summary of Measured Ambient Dioxin and Furan Concentrations

Contaminant	Units	Regulatory Criteria	HHRA Health Based Criteria	Crago Road (Predominatly Downwind)			
				Maximum	Minimum	Arithmetic Mean	No. of Exceedances
Octa CDF	pg/m³			1.20E-01	4.08E-03 [A]	1.71E-02	
Total Tetra CDF	pg/m³			1.93E-01	4.08E-03 [A]	1.84E-02	
Total Penta CDF	pg/m³			1.63E-01	3.30E-03 [A]	1.62E-02	
Total Hexa CDF	pg/m³			2.06E-01	3.15E-03 [A]	2.27E-02	
Total Hepta CDF	pg/m³			2.04E-01	4.08E-03 [A]	2.32E-02	
TOTAL TOXIC EQUIVALENCY [B]	pg TEQ/m³	0.1 [C] 1 [D]	-	0.038	0.011	1.71E-02	0 0

Notes:

A. Measured concentration was less than the laboratory method detection limit.
B. Total Toxicity Equivalent (TEQ) concentration contributed by all dioxins, furans calculated as per O. Reg. 419/05methodology using corresponding WHO_{2005} toxic equivalency factors (I-TEFs) and a value of half the minimum detection limit (MDL) substituted for concentrations less than the MDL.
C. Ontario Ambient Air Quality Criteria
D. O. Reg. 419/05 Schedule 6 Upper Risk Thresholds
* CDD - Chloro Dibenzo-p-Dioxin, ** CDF - Chloro Dibenzo-p-Furan

5.0 AMBIENT AIR QUALITY TRENDS

Ambient air quality measurements from the Crago Road Station have been collected since November 2014. The MOECC requires that a minimum of 9 months of data out of the 12 months in a year (a minimum 75% data recovery rate) be available for calculation of annual averages. Since the length of the measurement period in 2014 was less than 9-months, the 2014 period averages were not compared to available MOECC annual criteria, nor are they directly comparable to the 2015 to 2016 annual averages.

5.1 CRITERIA AIR CONTAMINANT (CAC) COMPARISONS

A summary of the maximum, minimum, and arithmetic mean CAC concentrations, along with the number of exceedances of the relevant Ontario Ambient Air Quality Criteria (AAQC) or health-based criteria or each contaminant (if any occurred) at the Crago Road Station from 2015 to 2016 are presented in **Table 5-1** below. Also presented is the percentage of the applicable criteria for the maximum measured value in each year.

Plots of annual variations in measured hourly, 24-hour and annual average SO_2, NO_2 and $PM_{2.5}$ concentrations are presented in Figures 5-1 to 5-3, respectively.

The following observations were made from comparing the 2015 and 2016 CAC data:

- Since in 2014 only two-months of measurements were collected, the data from 2014 are not directly comparable to the 2015 and 2016 data.
- The concentrations of the monitored CACs were below their applicable hourly, 24-hour and annual average criteria for 2015 and 2016 years. The measured hourly and 24-hour average CAC concentrations in 2014 were below the applicable criteria. Since only two-months of data were collected in 2014, the data are not comparable to annual criteria.
- The 98th percentile daily average $PM_{2.5}$ concentrations were similar in 2015 and 2016 (22.7 and 22.6 µg/m^3, respectively), and were slightly higher than measurements taken at MOECC's Oshawa Station (20.5 and 17.1 µg/m^3, respectively).
- The maximum measured annual average $PM_{2.5}$ concentration stayed relatively consistent between 2015 and 2016.
- The maximum measured hourly average NO_2 concentration increased in 2016 relative to 2015 while the maximum measured 24-hour average NO_2 concentration decreased.
- The maximum measured hourly average SO_2 concentration decreased in 2016 relative to 2015 while the maximum measured 24-hour average SO_2 concentration increased.

It should be noted that since the monitoring period in 2014 was different versus 2015 and 2016 (two-months in 2014 versus 12-months in 2015 and 2016), the data from 2014 are not fully comparable to measurements from 2015 and 2016.

Table 5-1 Comparison of Measured Ambient CAC Concentrations (2014 - 2016)

Pollutant	Averaging Period	AAQC / HHRA Criteria	Units		Measurement			% of Criteria		
					2014	2015	2016	2014	2015	2016
SO_2	1	250	ppb	Maximum	16.3	120.5	41.3	6.52	48.2	16.5
				Minimum	0.0	0.0	0.0			
				# of Exceedances	0	0	0			
	24	100	ppb	Maximum	5.3	19.9	24.7	5.3	19.9	24.7
				Minimum	0.4	0.0	0.0			
				# of Exceedances	0	0	0			
	Annual	20 / 11 [A]	ppb	Mean (Period)	1.9	1.1	0.9	9.5	5.5	4.5
				# of Exceedances	N/A [B]	0	0			
$PM_{2.5}$	24	28 [C]	µg/m³	Maximum	9.1	45.8	96.0	-		
				Minimum	0.2	0.4	0.2			
				Mean	3.7	7.3	6.6			
				98^{th} Percentile [D]	9.1	22.7	22.6			
				# of Exceedances	N/A [E]	N/A [E]	N/A [E]			
	Annual	10 [F]	µg/m³	Mean (Period)	3.7	7.3	6.6	-		
				# of Exceedances	N/A [G]	N/A [G]	N/A [G]			
NO_2	1	200 [H]	ppb	Maximum	30.2	44	56.5	15.1	22.0	28.3
				Minimum	0.0	0.0	0.0			
				# of Exceedances	0	0	0			
	24	100 [H]	ppb	Maximum	14.3	22.3	20.9	14.3	22.3	20.9
				Minimum	0.8	0.0	0.0			
				# of Exceedances	0	0	0			
	Annual	30	ppb	Mean	6.9	4.7	5.5	23.0	15.7	18.3
				# of Exceedances	N/A [B]	0	0			

Table 5-1 Comparison of Measured Ambient CAC Concentrations (2014 - 2016)

Pollutant	Averaging Period	AAQC / HHRA Criteria	Units		Measurement			% of Criteria		
					2014	2015	2016	2014	2015	2016
NO [I]	1	NA	ppb	Maximum	33.1	75	78.4	-		
				Minimum	0	0	0.0			
				# of Exceedances	N/A	N/A	N/A			
	24	NA	ppb	Maximum	11.5	15.1	16.9			
				Minimum	0.1	0	0.0			
				# of Exceedances	N/A	N/A	N/A			
NO_X	1	200 [H]	ppb	Maximum	57.9	83.1	107.2	29.0	41.6	53.6
				Minimum	0.0	0.0	0.0			
				# of Exceedances	0	0	0			
	24	100 [H]	ppb	Maximum	25.4	35.8	35.7	25.4	35.8	35.7
				Minimum	2.4	0.0	0.0			
				# of Exceedances	0	0	0			
	Annual	30	ppb	Mean	9.3	6.2	7.0	31.0	20.7	23.3
				# of Exceedances	N/A [B]	0	0			

Notes:

A. Annual AAQC / Annual HHRA criteria

B. As the length of the measurement period in 2014 was less than 9-months, the period (i.e. 2-month) averages presented in this report were not compared to available MOECC annual criteria.

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

D. The 98th percentile of the daily average $PM_{2.5}$ measurements in the period.

E. Daily $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires averaging the 98th percentile concentrations over three consecutive years, as compared to the two-month period covered in 2014 and the 12-month periods covered in 2015 and 2016

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

G. Annual $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires the three-year average of the annual average concentrations compared to the 12-month period considered in this report for 2015 and 2016 and the two-month period for 2014.

Figure 5-1 Maximum 1-hour, 24-hour, and Annual Average SO_2 Concentrations Measured at the Crago Road Station Between 2014-2016

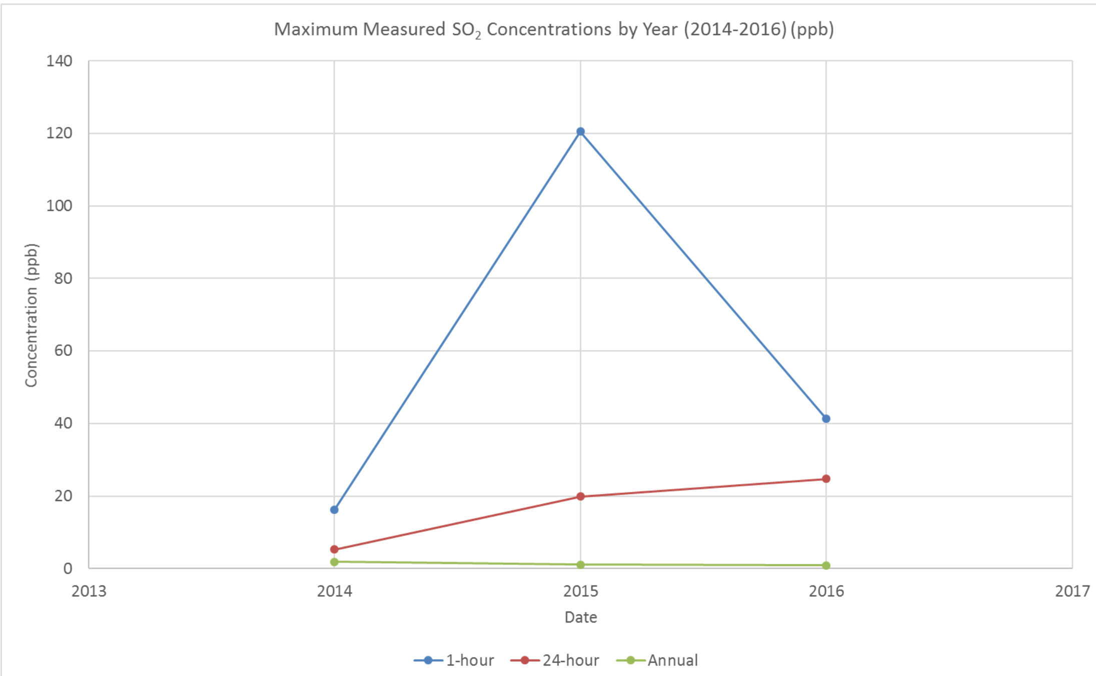


Figure 5-2 Maximum 1-hour, 24-hour, and Annual Average NO_2 Concentrations Measured at the Crago Road Station Between 2014-2016

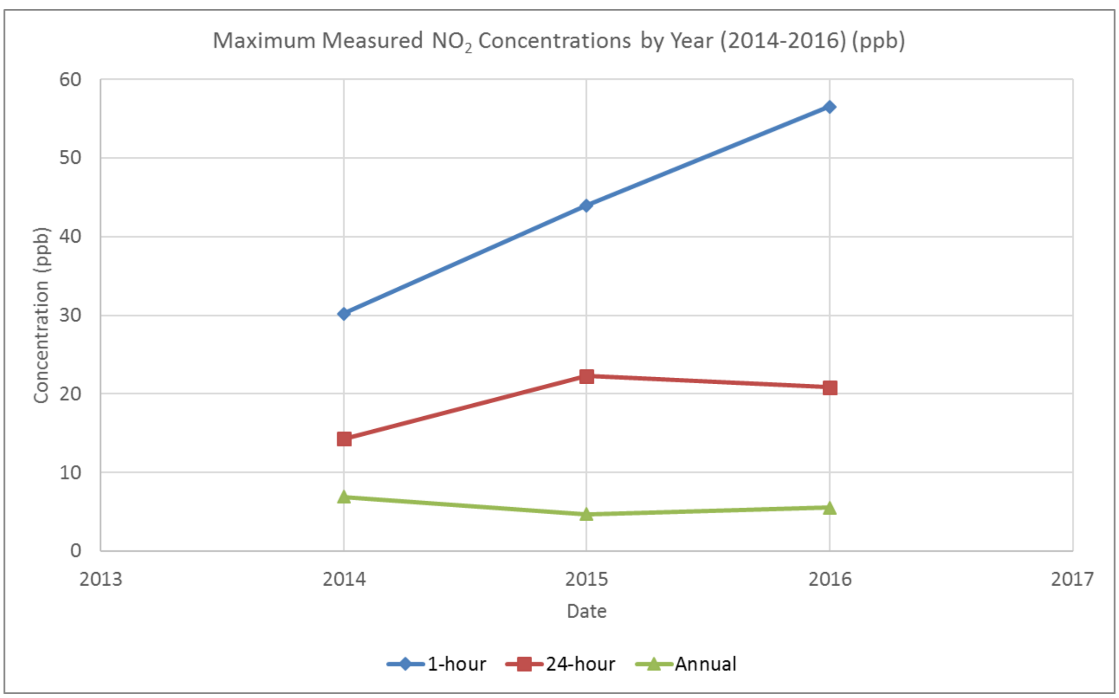
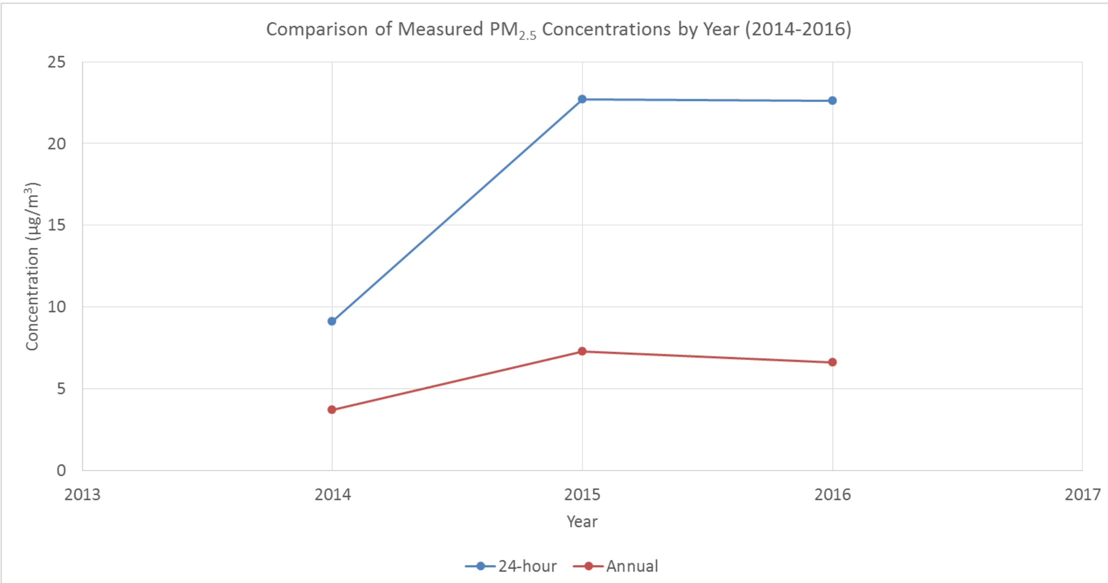


Figure 5-3 Maximum 98th Percentile 24-hour and Annual Average $PM_{2.5}$ Concentrations Measured at the Crago Road Station Between 2014-2016



5.2 DIOXIN AND FURAN COMPARISONS

The maximum ambient toxic equivalent dioxin and furan concentrations measured at Crago Road in 2015 and 2016 are presented in **Table 5-2**.

Table 5-2 Comparison of Maximum Measured Dioxin and Furan Concentrations (2015-2016)

Year	Measurement Period in each Year	pg TEQ/m^3
2015	October–December	0.034
2016	January-December	0.038

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

It should be noted that since the monitoring periods in 2015 and 2016 were different (as shown in **Table 5-2**), the data between each year is not directly comparable. Caution should be exercised in comparing the data as the measurement periods were different and cover different periods of each year (with different meteorological conditions).

5.3 TSP AND PAH COMPARISONS

Ambient PAH and TSP measurements at the Crago Road Station commenced in January and February of 2016, respectively. Therefore, there is currently no information to compare air quality trends in other years with the 2016 measurement data. Air quality trends will be discussed in future annual reports as additional data becomes available.

6.0 CONCLUSIONS

This report provides a summary of the ambient air quality data collected at the Crago Road Station for the 2016 monitoring period. The following observations and conclusions were made from a review of the measured ambient air quality monitoring data:

1. Measured concentrations of NO_2, SO_2, and $PM_{2.5}$ were below the applicable O. Reg. 419/05 criteria and/or human health risk assessment (HHRA) health-based criteria presented in **Table 2-1** of this report for hourly, 24-hour and annual averaging periods.

2. The 24-hour and annual $PM_{2.5}$ Canadian Ambient Air Quality Standards (CAAQS) criteria both require a 3-calendar year average for comparison, with the data considered valid if an annual 98th percentile value is available for at least two of the three calendar years. Using the measured $PM_{2.5}$ data for calendar years 2015 and 2016, the average annual 98th percentile daily average and annual average $PM_{2.5}$ levels were below the CAAQS criteria.

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

4. The maximum measured concentrations of PAHs with MOECC Ambient Air Quality Criteria were below their applicable 24-hour criteria (presented in **Table 2-3**) with the noted exception of four (4) benzo(a)pyrene (B(a)P) measurements. Out of twenty-eight (28) samples collected at the Crago Road Station, the four (4) samples exceeded the Ontario 24-hour B(a)P AAQC by levels varying between 12% and 62% above the AAQC criteria. However, all four samples were well below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419/05 24-hour average guideline, and the HHRA health based criteria (as shown in **Table 2-3**).

5. The maximum measured toxic equivalent dioxin and furan concentration was below the applicable Standards presented in **Table 2-3**.

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

7.0 REFERENCES

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

Table A-1 Summary of Preventative Maintenance
Crago Road Station

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule (to meet MOE and Ambient Monitoring Plan requirements)	Target date	Schedule / Comments
SO_2	Teledyne Monitor Labs	Change particulate filter	Monthly	Every month	See Note 1
		Exchange chemical – external zero air scrubber	3 months	Every 3 month	Completed in February, May 12, August 17, October 13
		Replace perm tube	8 months		Replaced April 15
		Replace Pump diaphragm	8 months	Oct-16	Replaced July 21
		Clean sample chamber, windows and filters	As required		Completed October 18
		Replace critical flow orifice and filters	As required	Annually	Completed October 18
		Yearly maintenance	Annually	Oct-16	Completed October 20
NOx	API Model 200E	Change particulate filter	Monthly	Every month	See Note 1
		Exchange chemical – external zero air scrubber	3 months	Every 3 month	Completed in February, May 12, August 17, October 20
		Replace chemical – external dryer	3 months	Every 3 month	Completed in February, May 12, August 17, October 20
		Chemical change – ozone filter	3 months	Every 3 month	Completed in February, May 12, August 17, October 20
		Clean reaction cell window (annually or as necessary)	Annually	Oct-16	Completed October 20
		Change particulate DFU filter	Annually	Oct-16	Completed October 20
		Replace reaction cell O-rings & sintered filters	Annually or as required	Oct-16	Completed October 20
		Rebuild pump head	When RCEL pressures exceeds 10 in Hg	Oct-16	Completed May 12
		Replace inline exhaust scrubber	Annually	Oct-16	Completed October 20
		Replace inline exhaust scrubber	Annually	Oct-16	Completed October 20
		Yearly maintenance	Annually	Oct-16	Completed October 20
		Replace NO2 converter	Every 3 years or if conversion < 96%		Completed in 2015
$PM_{2.5}$	Thermo Sharp 5030	Replace filter tape	Upon 10% remaining		Completed May 12
		Replace SHARP zeroing filters	6 months	Apr-16	Replaced March 11
		Clean PM2.5 inlet	Monthly	Every month	See Note 1
		Clean cyclone	Monthly	Every month	See Note 1
		Clean air inlet system	Annually	Oct-16	Completed May 12
		Rebuild vacuum pump	12-18 months	Oct 16 to Apr 2017	
		Clean ambient temp/RH shield and assembly	Annually	Oct-16	Completed October 18

Table A-1 Summary of Preventative Maintenance
Crago Road Station

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule (to meet MOE and Ambient Monitoring Plan requirements)	Target date	Schedule / Comments
TSP/metals	TE-5170	Ensure all gaskets sealing properly	Weekly	Monitoring resumed in February 2016. Maintenance performed weekly.	
		Power cord checks for damage/cracks	Weekly		
		Inspect screen and remove foreign deposits	Weekly		
		Inspect holder frame gasket	Every sample		
		Replace motor brushes	Every 500 hours		Replaced June 14 and October 17
		Check elapsed time meter	Weekly	Monitoring resumed in February 2016. Maintenance performed weekly. Resealed on July 29.	
		Check flow recorder pen/tubing	Weekly		
		Ensure all gaskets sealing properly	Weekly		
PAH and D/F	TE-1000	Ensure all gaskets sealing properly	Weekly	Monitoring resumed in February 2016. Maintenance performed weekly.	
		Power cord checks for damage/cracks	Weekly		
		Clean any dirt around module and filter holder	Weekly		
		Inspect dual sampling module gaskets	Every sample		
		Inspect and replace motor flange gasket and motor cushion	Routinely, minimum annually		Replaced October 25
		Replace motor brushes	Every 400 hours		Replaced April 29 and November 9
Wind Speed and Direction (Rundle Road Station only)	Met One 034B	Physical inspection of equipment for signs of damage/erratic behavior	Weekly	Every week	Maintenance Performed Weekly.
		Replace wind speed sensor bearings and calibrate	Annually	Oct-16	Completed September 16
		Replace wind vane potentiometer and bearings	24-months	Oct-17	Completed in 2015
		Complete factory overhaul	24-36 months	Oct 2017 to Oct 2018	Completed in 2015
Temperature	HMP 60	Check radiation shield free from debris	Weekly	Every week	Maintenance Performed Weekly
		Annually	During annual maintenance		Completed September 16
Rainfall	TE525M	Inspect funnel and bucket mechanism for debris	Weekly	Every week	Maintenance Performed Weekly
		Annually	During annual maintenance		Completed September 16
Relative Humidity	CS HMP60	Change INTERCAP® Sensor	On out of spec calibration		Not Required
		Sensor cleaning	As required		See Note 1
		Inspect/replace filter if blocked	Monthly	Every month	See Note 1
		Annually	During annual maintenance		Completed September 16

Table A-1 Summary of Preventative Maintenance
Crago Road Station

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule (to meet MOE and Ambient Monitoring Plan requirements)	Target date	Schedule / Comments
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	Every week	See Notes 1 and 3.
		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	Every week	See Note 1
		Replace zero and span calibration cylinders when pressure is below 1,500 kPa (215 psig)			SO2 Bottle Replaced September 9. Replaced again October 20.
		Check data logger / equipment connection cables to ensure cables are not loose	Monthly	Monthly	See Note 1
		Ensure all debris and litter are cleaned up upon departure	Every site visit	Every site visit	Maintenance Performed During Each Site Visit.
		Ensure shelters and gates are locked upon departure	Every site visit	Every site visit	Maintenance Performed During Each Site Visit.
Other comments					See Notes 2 through 5

Notes

1. Monthly Calibrations Completed March 11, April 15, May 12, June 13, July 21, August 17, September 23, October 13, November 11, December 12
2. Checked all wire connections March 24, wind velocity frozen from overnight ice storm. Left to melt as too dangerous to climb to wind head.
3. Repaired leak on Sharp inlet March 15.
4. Data logger failed Dec 21, replaced data logger with spare and sent data logger to manufacturer for repair and to download any data.
5. Spare NOX analyzer installed November 11 to allow for additional maintenance on original analyzer. Original NOX analyzer reinstalled November 28.

Table A-2 Summary of Equipment Calibration

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule	Schedule / Comments	2016 Schedule Dates
SO_2	Teledyne API Model 1100	Verify test functions	Weekly	Checked weekly	Checked weekly
		Evaluate Zero/Span check	Weekly	Checked daily	Checked weekly
		Zero/span external check	Monthly	Checked monthly	See note 1
		Zero/span calibration	3 months	Calibrated monthly	See note 1
		Flow check	6 months	Checked monthly	See note 1
		Pneumatic leak check	Annually or after repairs	Done when flow drops or checked annually	N/A
		Calibrate UV lamp output	Prior to zero/span cal	Done prior to zero/span cal	See note 1
		PMT sensor hardware cal	On PMT/preamp changes or slope changes as specified	Done when instrument slope is outside of acceptable range	N/A
NOx	API Model 200E	Verify test functions	Weekly	Checked weekly	Checked weekly
		Evaluate Zero/Span check	Weekly	Checked daily	Checked weekly
		Zero/span external check	Monthly	Checked monthly	See Note 1
		Zero/span calibration	3 months	Calibrated monthly	See Note 1
		Pneumatic sub-system check	Annually or after repairs	Checked after repairs	See Note 1
		PMT sensor hardware cal	On PMT/preamp changes or slope changes as specified	Done when slope exceeds the acceptable range	See Note 1
$PM_{2.5}$	Thermo Sharp 5030	Ambient temperature	Audit monthly, calibrate annually	Audit monthly.	See Note 1
		Ambient pressure	Audit monthly, calibrate annually	Audit monthly.	See Note 1
		Flow	Audit monthly, calibrate annually	Audit monthly.	See Note 1
		Leak check	Monthly	See note 4	See note 3
		Analog output	Annually	Done annually	See note 1
		Proportional Counter	Audit annually	Done annually	See note 1
		Nephelometer zero	Audit quarterly	Done monthly	Checked at monthly calibrations. Adjusted when required.

Table A-2 Summary of Equipment Calibration

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule	Schedule / Comments	2016 Schedule Dates
TSP/metals	TE-5170	Flow calibration	Upon installation, monthly, or after any motor maintenance	Calibrated monthly and after motor maintenance.	Monitoring resumed in February 2016. Flows calibrated on the following dates: 04-Feb-16 25-Feb-16 07-Apr-16 19-Apr-16 17-May-16 27-May-16 27-Jun-16 25-Jul-16 29-Aug-16 12-Sep-16 28-Sep-16 28-Oct-16 28-Nov-16
PAH and D/F	TE-1000	Flow calibration	Upon installation, monthly, or after any motor maintenance	Calibrated monthly and after motor maintenance.	Monitoring resumed in February 2016. Flows calibrated on the following dates: 21-Jan-16 19-Feb-16 01-Apr-16 29-Apr-16 27-May-16 27-Jun-16 25-Jul-16 29-Aug-16 28-Sep-16 28-Oct-16 28-Nov-16
Wind Speed and Direction	Met One 034B	Wind speed calibration	Annually	Annually	16-Sep
		Potentiometer calibration	Annually	Annually	16-Sep

Table A-2 Summary of Equipment Calibration

Parameter	Equipment Make/Model	Description of Maintenance Activities	Required Schedule	Schedule / Comments	2016 Schedule Dates
Temperature	HMP 60	External calibration	Annually	Annually	16-Sep
Rainfall	TE525M	Field Calibration. Factory calibration if field calibration not passed.	Annually	Annually	16-Sep
Relative Humidity	CS HMP60	Calibration (annually)	Annually	Annually	16-Sep
Data Acquisition	CS CR1000	Calibration every three years	3- years	To be done at 3 years	See Note 4

Notes:

1. Monthly Calibrations Completed March 11, April 15, May 12, June 13, July 21, August 17, September 23, October 13, November 11, and December 12.

2. Although a leak check is not formally possible with this model, the MOECC introduced a methodology using a leak checker designed for the Sharp 5030i which has been implemented. The procedure is only performed when data is suspect.

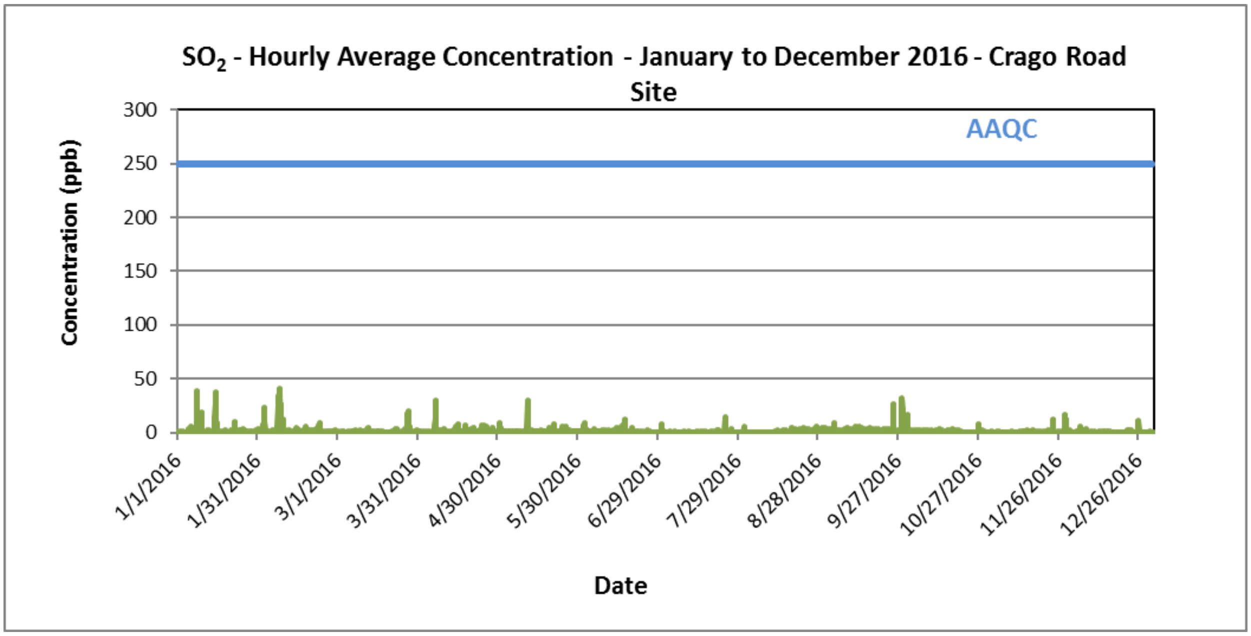
3. Data logger failed Dec 21, replaced data logger with spare and sent data logger to manufacturer for repair and to download any data.

Table A-3 Summary of Instrument Issues at the Crago Road Station (Predominately Downwind)

Parameter	Issues	Time Frame	Remedial Action
SO_2	Data logger was reset during maintenance - data was not recorded for 3 hours.	16-Sept-16, 9:30 AM – 12:30 PM	Maintenance activity - no action required. Three hours of data invalidated.
	Power outage.	27-Nov-16 11:00 AM – 5:30 PM	Reviewed and invalidated 7 hours of data.
NO_X	Data logger was reset during maintenance - data was not recorded for 3 hours.	16-Sept-16, 9:30 AM – 12:30 PM	Maintenance activity - no action required. Three hours of data invalidated.
	Power outage.	27-Nov-16 11:00 AM – 5:30 PM	Reviewed and invalidated 7 hours of data.
$PM_{2.5}$	Water leak around Sharp sample mast into equipment shelter	14,15-Mar-16	Sample mast re-sealed. All data intact.
	Analogue output to data logger issue.	5,12-15,21,22-Aug-16	Data was downloaded directly from the analyzer. Valley Environmental Services calibrated and adjusted the instrument HVPS. All data intact.
	Power outage.	27-Nov-16 11:00 AM – 5:30 PM	Reviewed and invalidated 7 hours of data.
Other	Modem Connection Issue	25-29-Jan-16	Reset modem. All data intact.
	Water leak into equipment enclosure around the Thermo Sharp inlet tube.	13-19-May-16	Thermo Sharp inlet through roof was re-sealed. All data intact.
	Data logger was reset during maintenance – data was not recorded from met station.	16-Sept-16, 9:30 AM – 12:30 PM	Maintenance activity - no action required. Three hours of data invalidated.
	Power outage.	27-Nov-16 11:00 AM – 5:30 PM	Reviewed and invalidated 7 hours of meteorological data.
	Unable to access data logger.	15-Dec-16, 10:00 AM to 21-Dec-16, 2:00 PM	Data logger replaced with spare unit and sent to manufacturer for repair. Data in the logger memory could not be retrieved by the manufacturer. All continuous data during this timeframe were invalidated.
TSP/Metals Hi-Vol.	Elapsed timer output did not agree with chart recorder.	4-Apr-16 and 18-May-16	In both cases, the chart recorder showed complete (24-hour) runs, and was used to calculate the sampling duration. The measurements were comparable to those at the other stations and were therefore deemed valid.
PAH/ D/F Hi-Vol	-	-	-

Appendix B SO_2 PLOTS

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



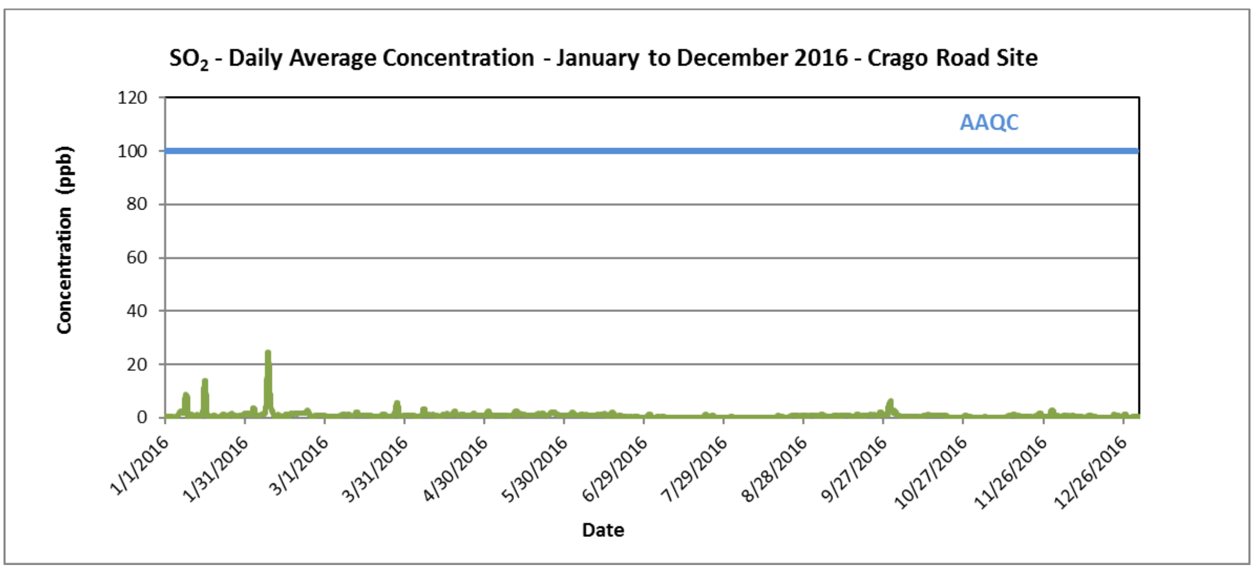
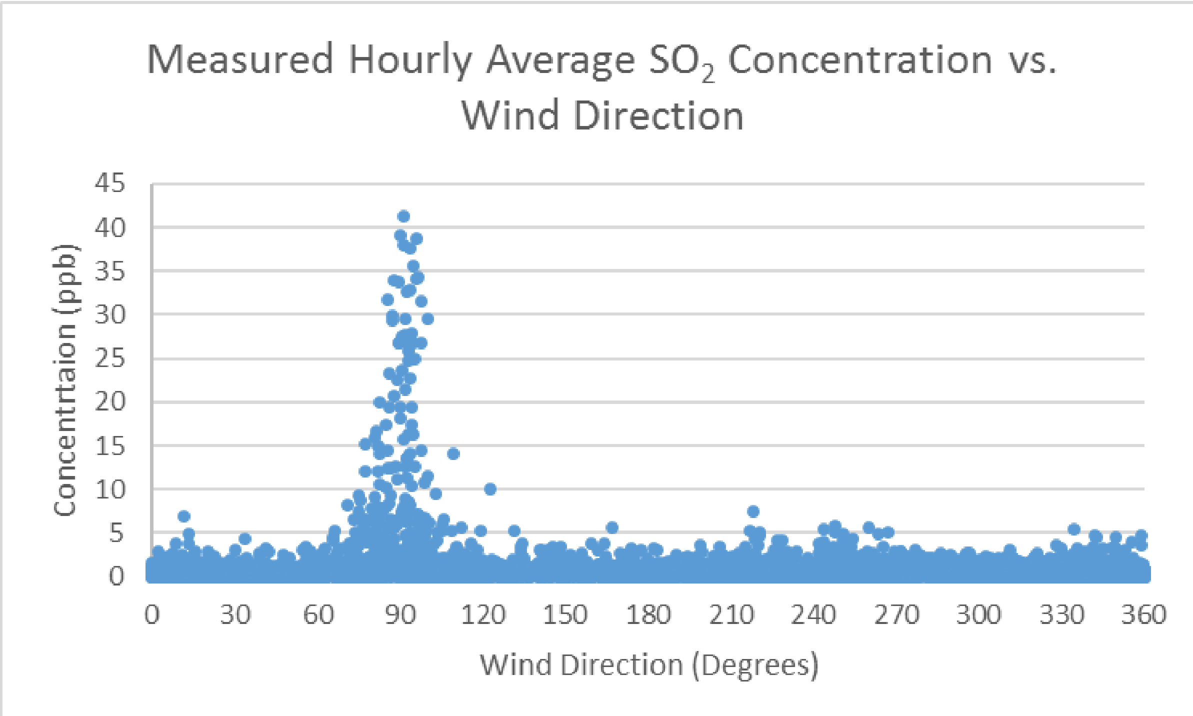
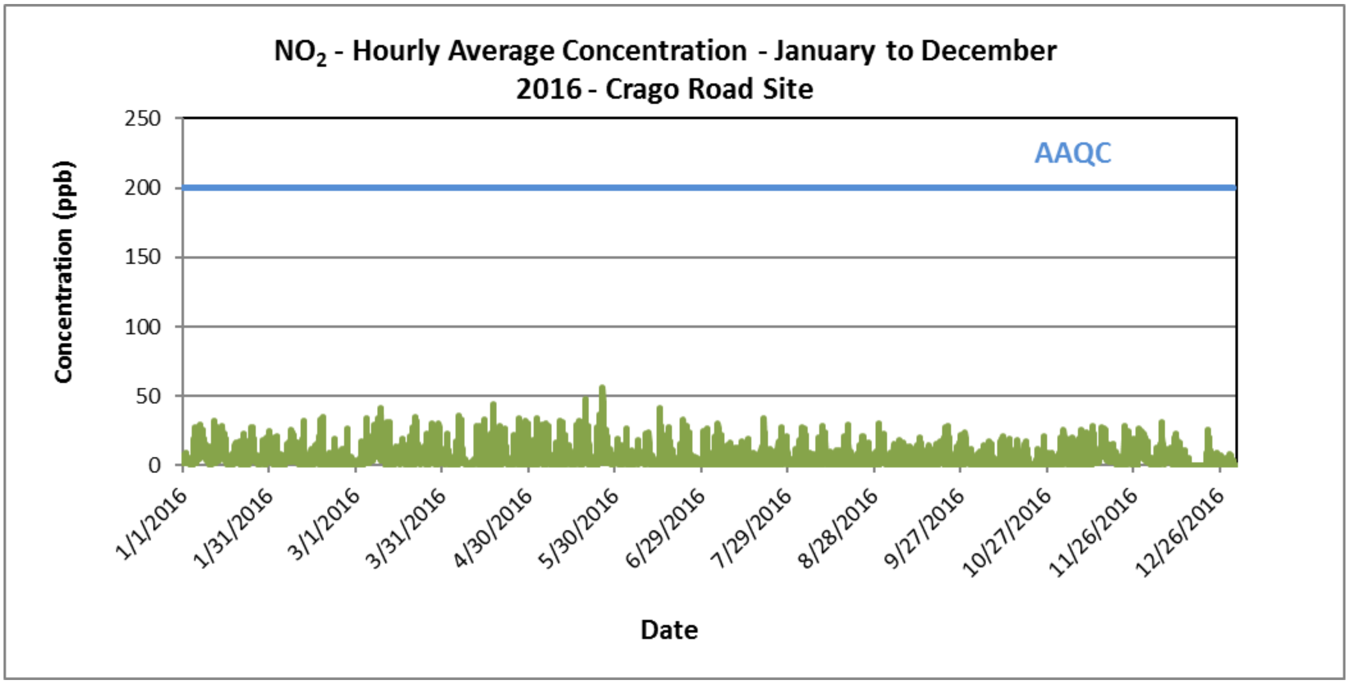


Figure B-2 Measured Hourly Average SO_2 Concentrations vs. Wind Direction – Crago Road Station



Appendix C NO$_2$ PLOTS

Figure C-1 Time History Plots of Measured Hourly Average and 24-Hour Average NO_2 Concentrations – Crago Road Station



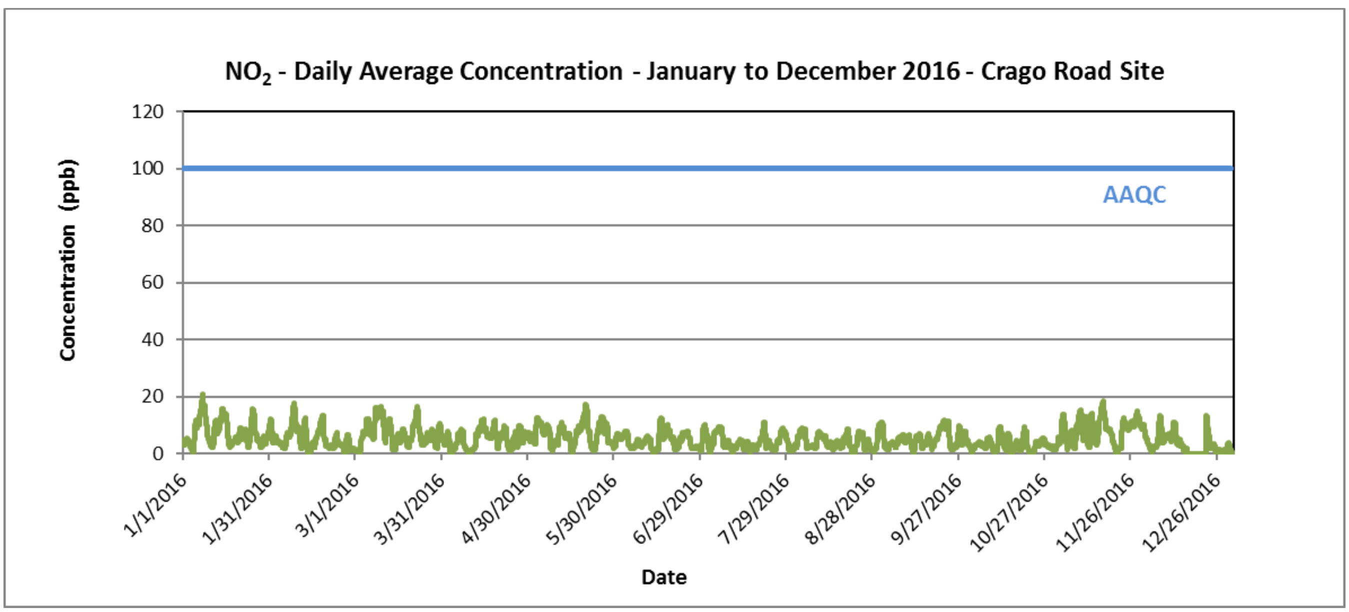
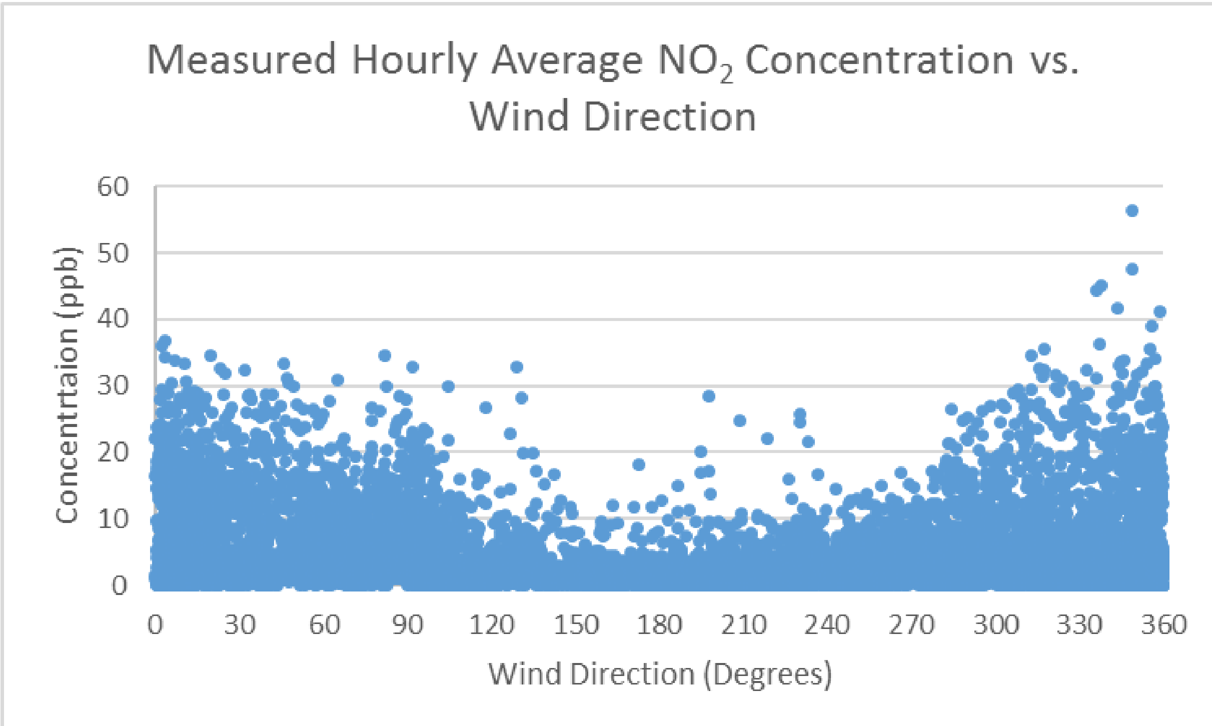
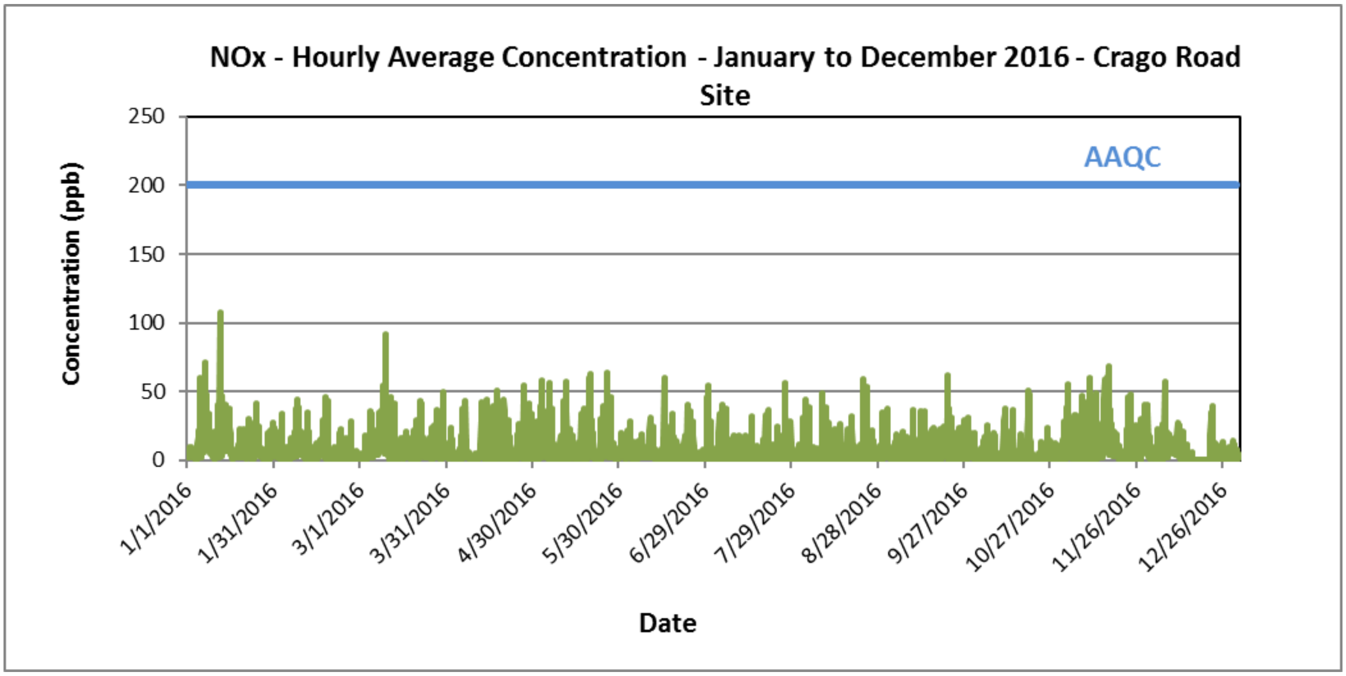


Figure C-2 Measured Hourly Average NO_2 Concentrations vs. Wind Direction – Crago Road Station



Appendix D NO_X PLOTS

Figure D-1 Time History Plots of Measured Hourly Average and 24-Hour Average NO_X Concentrations– Crago Road Station



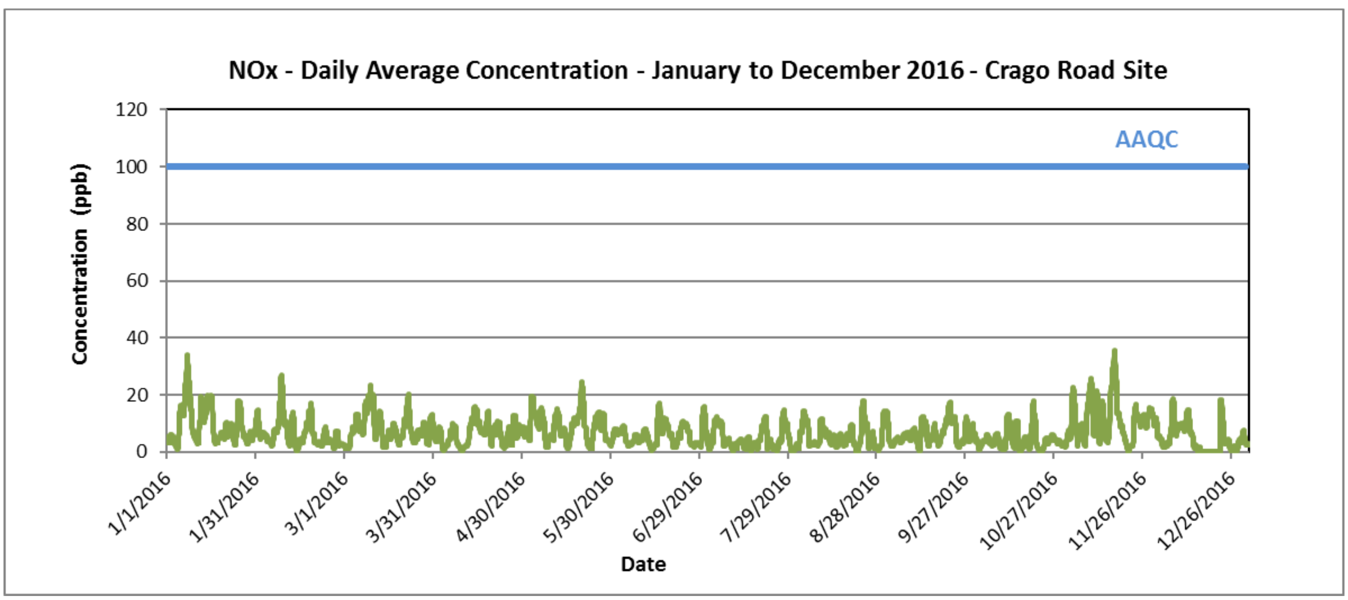
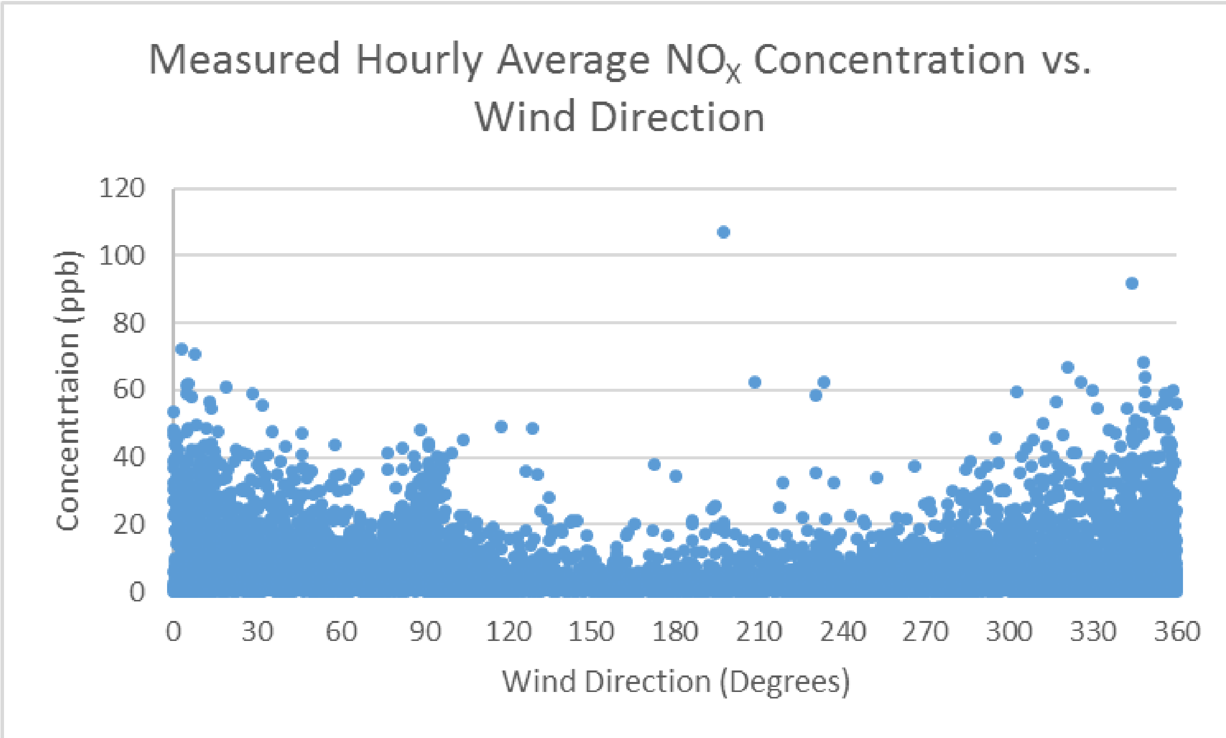


Figure D-2 Measured Hourly NO_X Concentrations vs. Wind Direction – Crago Road Station



Appendix E $PM_{2.5}$ PLOT

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

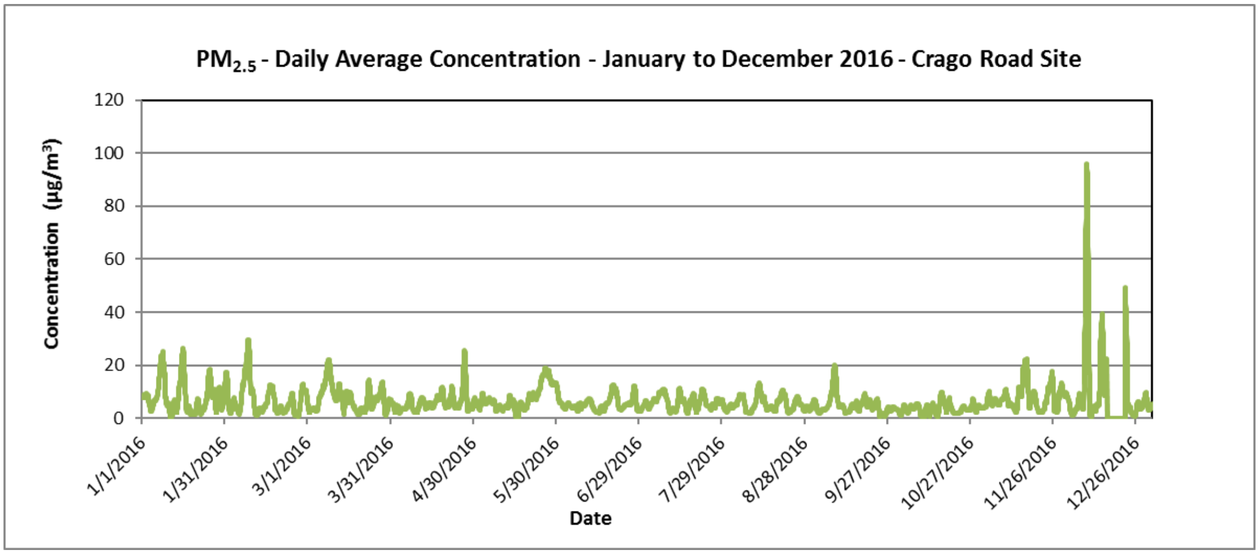


Figure E-2 Measured 24-Hour Average $PM_{2.5}$ Concentrations vs. Measured 24-Hour Vector Averaged Wind Direction - Crago Road Station