BURNSIDE

Air Quality Study
Brantford Pit Expansion
Brant County, ON

Lafarge Canada
6509 Airport Road
Mississauga, ON
L4V 1S7

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R.J. Burnside & Associates Limited

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July 31, 2020

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Executive Summary

Lafarge Canada Inc. (Lafarge) would like to extend its operation of the existing Brantford Pit onto the adjacent property at 1044 Colborne Street West (formerly known as Highway 53) in Brantford, Ontario.

The Air Quality Study (AQS) is conducted to support the application for a Category 1 Class “A” license (pit below water) under the Aggregate Resources Act and a County of Brant Official Plan and Zoning By-law Amendment under Planning Act to permit this expansion.

The objective of the study is to assess the potential impact on the existing environment due to the Brantford Pit expansion. Multiple operating scenarios were analyzed to determine the worst-case conditions. Predicted ground level concentrations were compared to the applicable criteria and discussed in this study. The results of the dispersion modelling show that predicted particulate and nitrogen oxides off-property concentrations generated from the operation of the proposed Brantford Pit expansion will be below the applicable criteria at all times. Cumulative off-property concentrations were predicted to be below the applicable criteria at all surrounding sensitive receptor locations; therefore, no adverse effect is expected due to the proposed expansion.

The following dust mitigation measures and best management practices are recommended to be implemented at the proposed Brantford Pit expansion site:

- Paved portion of the road at the Site entry/exit should be cleaned periodically to minimize mud tracking onto Colborne Street West and reduce dust generation.
- Reduced speeds should be enforced on-site, and signs posted at the Site entrance.
- Watering of on-site unpaved roads (up to 1.5 L/m2 per hour) when visible dust is observed behind the trucks. Other commercial dust suppressants can be considered, if required.
- Regular washing of extraction, processing and transport equipment.
- Wetting material prior to processing or loading on very dry days.
- Monitor on-site dust through visual site inspections and apply additional water when needed.
- Installing berms around excavation area to reduce windblown dust onto neighboring properties.
- Re-vegetating disturbed areas as soon as possible to minimize dust from these areas.
- During very dry and windy conditions resulting in dust plumes travelling off-site, activities at the Site should be temporarily suspended.

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1.0 Introduction

Lafarge Canada Inc. (Lafarge) would like to extend its operation of the existing Brantford Pit onto the adjacent property at 1044 Colborne Street West (formerly known as Highway 53) in Brantford, Ontario (Site).

The Air Quality Study (AQS) is conducted to support the application for a Category 1 Class “A” license (pit below water) under the Aggregate Resources Act and a County of Brant Official Plan and Zoning By-law Amendment under Planning Act to permit this expansion.

The objective of this study is to assess the potential impact onto the existing environment due to the Brantford Pit expansion. Multiple operating scenarios were analyzed to determine the worst-case conditions. Predicted ground level concentrations were compared to the applicable criteria and discussed in this study.

1.1 Study Area

The proposed Site is located at 1044 Colborne Street West, 7 km west of Brantford in the County of Brant as shown in Figure 1.

The Site is approximately 20 hectares (49.1 acres) and is located on the west side of the existing Lafarge Brantford Pit, ARA license #5515. The Site currently is used as a farmland.

The Site is surrounded by agricultural lands to the south, west, and north. An existing pit is adjacent on the east side. An area zoned for general commercial operation is located on the east side just south of Colborne Street West.

Figure 1: Site Location

1.2 Sensitive Receptors

The air quality effects due to the proposed extraction of aggregates on the surrounding environment were predicted at selected sensitive receptors. Sensitive receptors are described by MECP as:

- A childcare facility.
- A health care facility.
- A senior citizens' residence or long-term care facility.
- An educational facility.
- A dwelling.

Residential dwellings are located northwest, northeast, and east of the Site. Six residential properties were selected as representative sensitive receptors surrounding the Site. All sensitive receptors are summarized in Table 1 and shown in Figure 2.

Table 1: Sensitive Receptors

ID	Address	UTM, m	
		Easting	Northing
R1	1030 Colborne Street West, Brantford	552839	4774685
R2	1037 Colborne Street West, Brantford	552799	4774756
R3	1052 Colborne Street West, Brantford	552570	4774624
R4	1059 Colborne Street West, Brantford	552412	4774653
R5	35 MacGregor Avenue, Brantford	553346	4774474
R6	1012 Colborne Street West, Brantford	553211	4774767

Figure 2: Site Plan and Sensitive Receptors

1.3 Potential Pollutants

Aggregate extraction related contaminants are emitted due to on-site vehicle movement, processing equipment and fuel combustion. The most relevant pollutants are generated dust and products of combustion. Typical dust is comprised of the following size particles:

- Total Suspended Particulate Matter (TSP) – Particulate Matter (PM) with a diameter of less than 44 microns.
- PM10 – particles with diameter of 10 □m or less, mainly generated through vehicle movement, combustion, and windblown dust from open land.

- PM2.5 – particles with diameter of less than 2.5 □m.

The combustion emissions from on-site vehicles and equipment were included as part of this assessment. Nitrogen dioxide (NO_2) and particulate matter (TSP, PM10, and PM2.5) are the main pollutants released from motor vehicles and equipment engines.

2.0 Existing Ambient Conditions

2.1 Climate

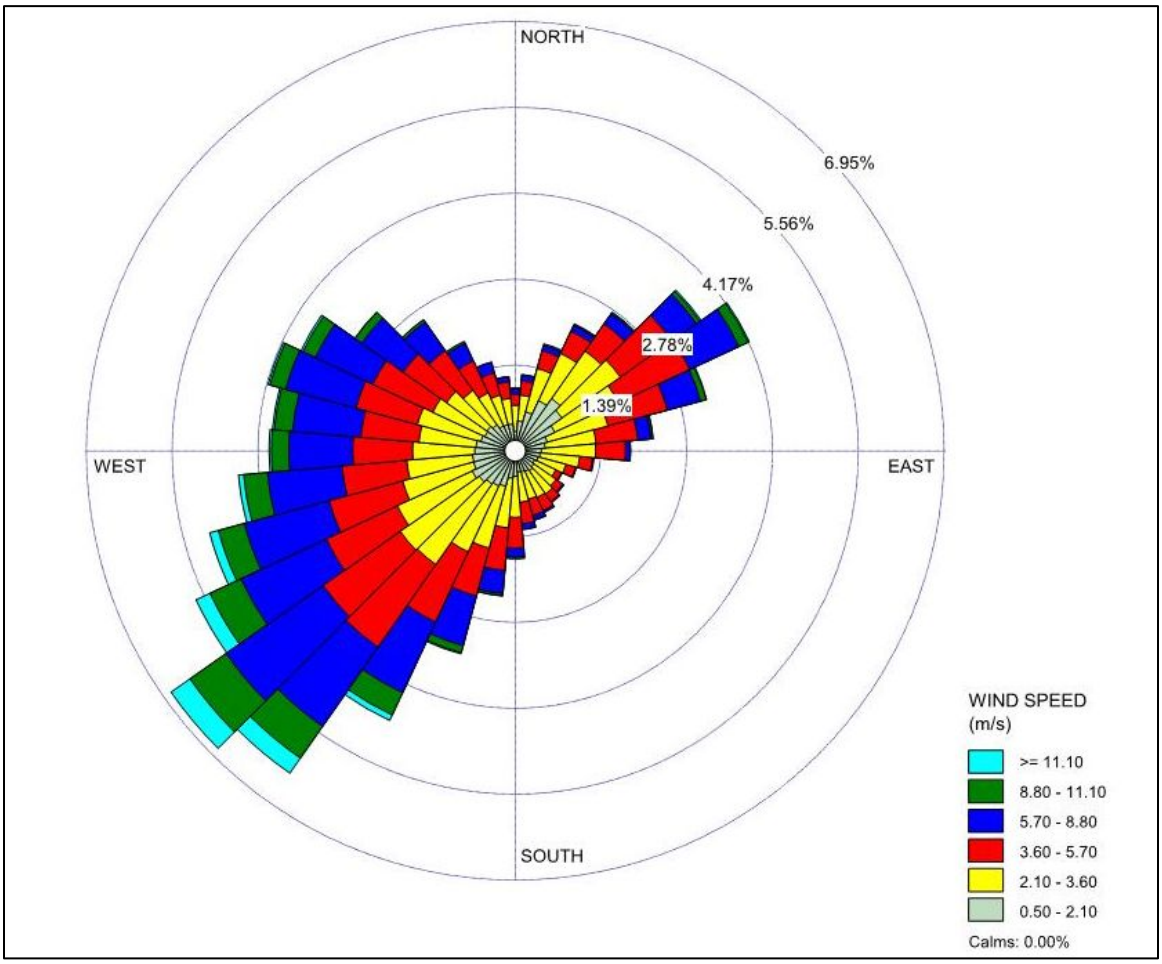
The ambient air monitoring station in Brantford was used to assess the climate in the vicinity of the Site. The Site is located within the County of Brant approximately 7 km west of Brantford. The area's climate is cold and temperate. Local climate conditions were obtained from Environment and Climate Change Canada's (ECCC) Brantford MOE meteorological station (Station ID 6140954, Latitude 43°08'00.000" N, Longitude 80°14'00.000" W). According to the Canadian Climate Normals (calendar years 1981 to 2010) for this station, the mean annual temperature is estimated at 8.1°C. The warmest month of the year is July with an average temperature of 21.3°C and the coldest month is January with an average temperature of -6.0°C. The Brantford MOE meteorological station recorded a total average annual precipitation of 867 mm, 770 mm of which was rain. Precipitation is distributed throughout the year, with most of the rain occurring between May and November. The maximum mean monthly rainfall is 95.0 mm and occurs in July. Climate normals for the Brantford MOE station are summarized in Table 2.

Table 2: Brantford MOE Meteorological Station Climate Normals (1981-2010)

Meteorological Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Avg. Temp. (°C)	-6	-4.3	0.3	7	13.5	18.7	21.3	20.2	16	9.3	3.8	-2.5	8.1
Daily Max. Temp. (°C)	-1.6	0.3	5.1	12.4	19.3	24.6	27.2	25.8	21.7	14.5	7.9	1.4	13.2
Daily Min. Temp. (°C)	-10.4	-8.9	-4.5	1.5	7.5	12.7	15.4	14.5	10.1	3.9	-0.3	-6.3	3
Rainfall (mm)	27.6	30.4	43.5	65.3	81.1	75.9	95	75	86.6	70.1	78.3	40.8	770
Snowfall (cm)	27.1	21.9	15.6	3.6	0	0	0	0	0	0	6.1	24.2	98.4
Precipitation (mm)	54.7	51.5	59.1	68.9	81.1	75.9	95	75	86.6	70.1	84.4	65.1	867

Air dispersion modelling is based on the most recent meteorological data. The MECP provided the meteorological data set (Station ID 61409) to be used in this study. This data set covers calendar years 2014 to 2018. Based on the provided data, the average wind speed at the station is 4.05 m/s. The dominant wind direction is southwest. A wind rose depicting the relative frequency of wind directions including wind speeds is provided in Figure 3.

Figure 3: Wind Rose



2.2 Air Quality

The MECP and National Air Pollution Surveillance (NAPS) stations in close proximity to the Site were reviewed to ensure the most representative background concentration would be selected. The nearest MECP station in Brantford was selected to fully characterize the background concentrations in the vicinity of the Site. The station information and the five most recent years of data are summarized in Table 3. The location of the selected station is shown in Figure 1. The Site is surrounded by agricultural lands on the south, west, and north sides. An existing pit is adjacent on the east side. An area zoned for general commercial operation is located on the east side just south of Colborne Street West.

Table 3: Ambient Monitoring Stations Summary

Contaminant	Station ID	Station Location	Year
PM2.5	MECP 21005	324 Grand River Avenue, Brantford	2013-2017
NO_2	MECP 21005	324 Grand River Avenue, Brantford	2013-2017

A summary of the 90th percentile, maximum and average background concentration values from the monitoring station is provided in Table 4. Averaging periods of background concentrations match the averaging periods of the applicable air quality criteria as summarized in Table 5.

Table 4: Background Data Summary

Contaminant	CAS#	Averaging period	90th Percentile * ($\mu g/m^3$)	Max ($\mu g/m^3$)	Average ($\mu g/m^3$)
NO_2	11104-93-1	1 hr	20.68	99.64	9.41
		24 hr	17.47	52.41	9.22
		Annual	-	10.33	9.22
PM2.5	-	24 hr	14.08	30.33	8.14
		Annual	-	9.21	8.14
PM10	-	24 hr	26.08	56.17	15.07
TSP	-	24 hr	46.94	101.11	27.13
		Annual	-	30.69	27.13
Notes: * 5 annual values are insufficient to calculate an annual 90th percentile value.					

MECP monitoring stations only record background concentrations of PM2.5. Since PM10 and TSP background concentrations were not available, values were calculated based on monitored PM2.5 concentrations. Mean ratios of PM2.5/PM10=0.54±0.14, and PM2.5/TSP=0.30±0.11 derived by Lall, et al[1] were used to calculate 90th percentile, maximum and average concentrations of PM10 and TSP.

2.3 Air Quality Assessment Criteria

Ontario regulates contaminants released into the environment in order to limit and reduce concentrations of harmful substances in the atmosphere and to protect the environment and human health. As part of this regulation, MECP has developed a number of sources of criteria as described below.

Ambient air criteria for contaminants associated with aggregate extraction operations were taken from Ontario's Ambient Air Quality Criteria[2] (AAQC) developed by the MECP. The AAQC limit concentrations for contaminants in air based on protection against adverse effects on public health or the environment. The Canadian Ambient Air Quality Standards[3] (CAAQS) were used for PM2.5. The CAAQS coming into effect in

[1] Lall R., Kendall M., Ito K., Thurston G.D. (2004) Estimation of Historical Annual PM2.5 Exposures for Health Effects Assessment. Atmospheric Environment, Vol. 38, Issue 31.
[2] Ministry of the Environment and Climate Change (2012) Ontario's Ambient Air Quality Criteria. PIBS # 6570e01.
[3] Environment Canada and Climate Change (2013) Canadian Ambient Air Quality Standards.

2025 were used for NO_2. CAAQS 2025 will supersede Canadian National Ambient Air Quality Objectives[4] (NAAQOs) for a maximum desired NO_2 level.

Table 5: Representative Contaminants and Air Quality Criteria

Contaminant	CAS#	Averaging Period	AAQC[1] (μg/m³)	CAAQS[2] 2020 (μg/m³)	CAAQS 2025 (μg/m³)	Limiting Effect
Nitrogen Dioxide	10102-44-0	1 hr	400	113 (60 ppb)	79 (42 ppb)	Health
		24 hr	200			Health
		Annual		32 (17 ppb)	23 (12 ppb)	Health
PM2.5	-	24 hr	30	27		Health
		Annual		8.8		Health
PM10	-	24 hr	50			Health
TSP	-	24 hr	120			Visibility
		Annual	60			Visibility

Notes:
[1] Ontario's Ambient Air Quality Criteria
[2] Canadian Ambient Air Quality Standards

NO_x is the sum of nitrogen dioxide (NO_2) and nitric oxide (NO). Emissions of NO_x consist mainly of NO; however, NO is converted to NO_2 in the ambient air. NO_2 has an adverse effect at much lower concentrations than NO according to Ontario's Ambient Air Quality Criteria publication. Therefore, AAQC is based on the NO_2. As a conservative assumption for this assessment, it was assumed that all NO is converted to NO_2.

3.0 Air Quality Assessment

3.1 Methodology

The purpose of the AQS is to assess the potential impact on air quality due to the proposed expansion of the Brantford Pit. The aggregate extraction at the Site will happen in phases. In order to account for the worst-case scenario, all three extraction phases were considered in the assessment. The Site will operate during each phase as following:

- Phase 1 (south part of the Site) layout shown in Figure 4:
  - Overburden removal from Phase 2 area;
  - Perimeter berm construction;
  - Above water aggregate extraction activities within Phase 1 area;
  - Below water aggregate extraction activities within Phase 1 area;
  - Aggregate processing activities within Phase 1 area; and

[4] Canadian Council of Ministers of the Environment (1999) Canadian Environmental Quality Guidelines. Canadian National Ambient Air Quality Objectives: Process and Status.

  - Below water aggregate extraction activities at the existing Brantford Pit site (only during the above water extraction within Phase 1 area).
- Phase 2 layout shown in Figure 5:
  - Overburden removal from Phase 3 area;
  - Above water aggregate extraction activities within Phase 2 area;
  - Below water aggregate extraction activities within Phase 2 area;
  - Aggregate processing activities within Phase 2 area; and
  - Below water aggregate extraction activities at the existing Brantford Pit site (only during above water extraction within Phase 2 area).
- Phase 3 layout shown in Figure 6:
  - Above water aggregate extraction activities within Phase 3 area;
  - Below water aggregate extraction activities within Phase 3 area; and
  - Aggregate processing activities within Phase 2 area.

The maximum ground level concentrations were predicted for all contaminants of interest for the three phases. Extraction above the water table level was determined to represent the worst-case scenario as concentrations resulting from the extraction below water level are expected to be much lower due to much higher moisture content in the extracted material.

Extraction activities might happen at the existing Brantford Pit site simultaneously with Phase 1 and Phase 2 above water extraction at the proposed expansion site. Any extraction activities at the existing pit will happen below water; therefore, moisture content in the extracted material will be very high. Considering most of the existing site is vegetated or underwater, while the rest of the area remains undisturbed, this source was deemed to be negligible.

The resulting modelled concentrations from the proposed Brantford Pit expansion site, with and without the background concentration, were compared to the applicable criteria.

The background concentrations were assumed to remain the same in the future. Based on data collected at the MECP ambient monitoring stations, concentrations of the key pollutants such as NO_2, and PM2.5 decreased over the 10 years by 30% and 12%, respectively (MECP, 2018[5]). Assuming this trend will continue in the future, using current background values to assess potential future impact is a conservative approach.

[5] Ministry of the Environment and Climate Change (2018). Air Quality in Ontario, 2016 Report.

Figure 4: Phase 1 Site Layout

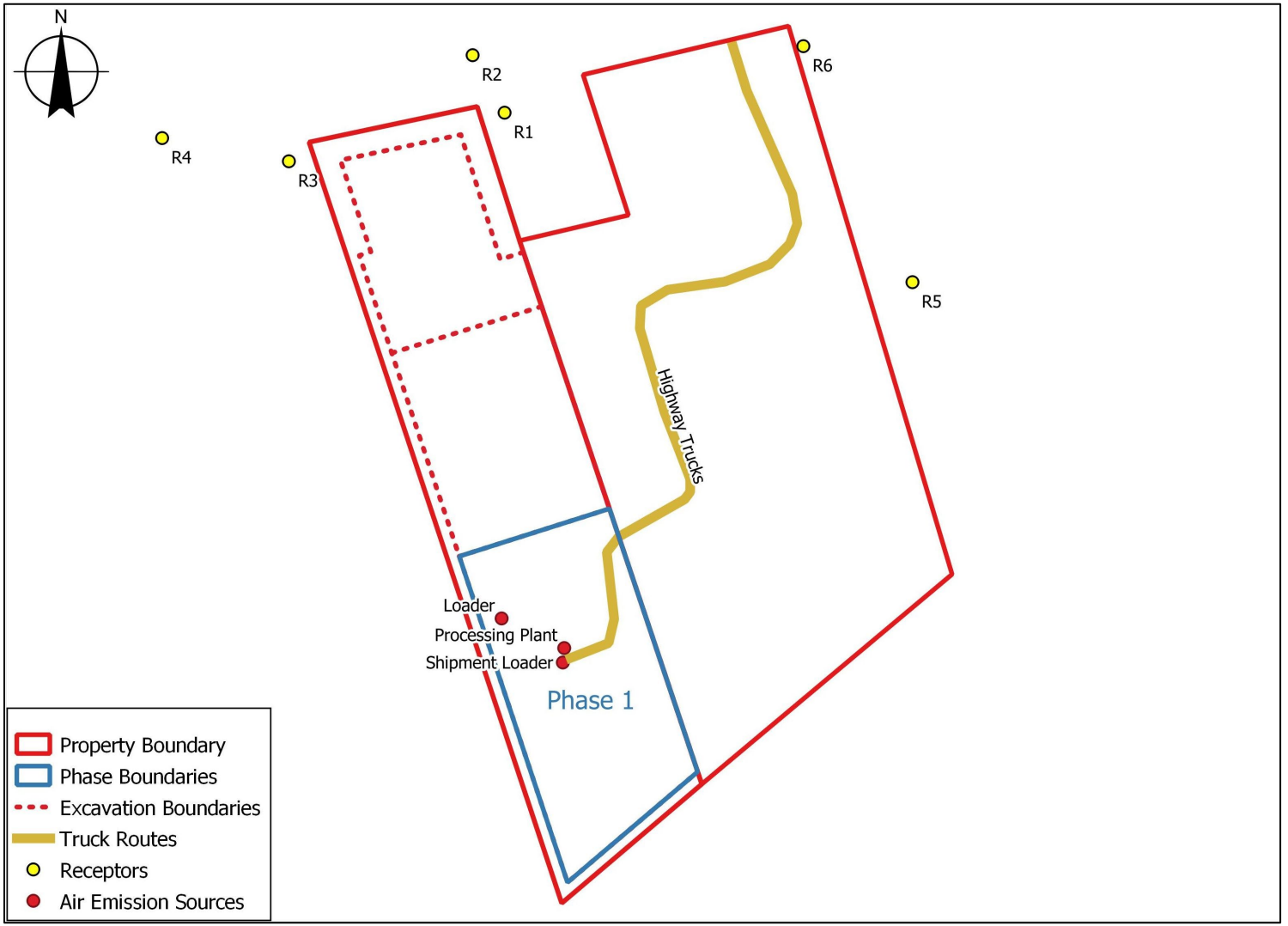


Figure 5: Phase 2 Site Layout

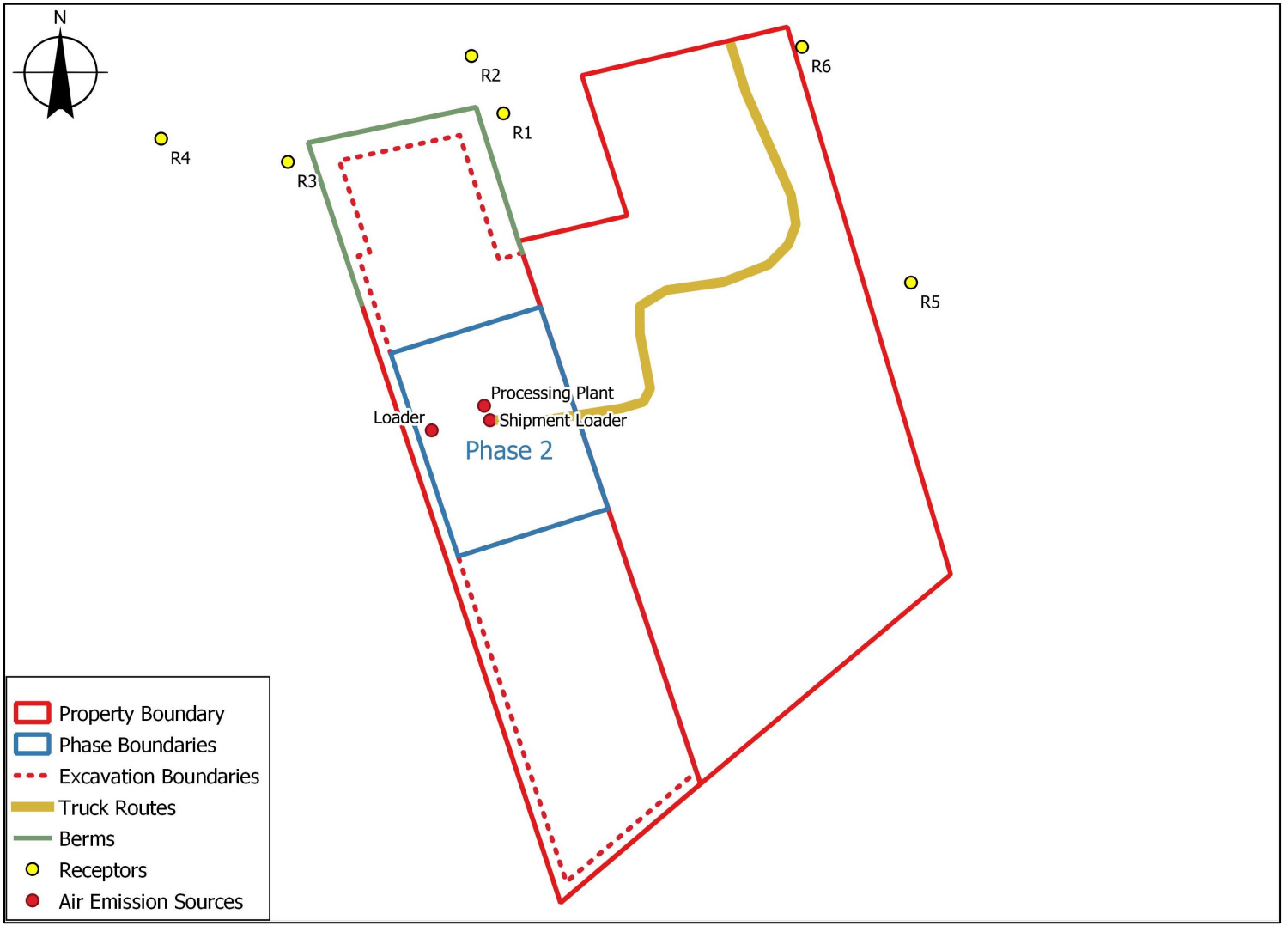
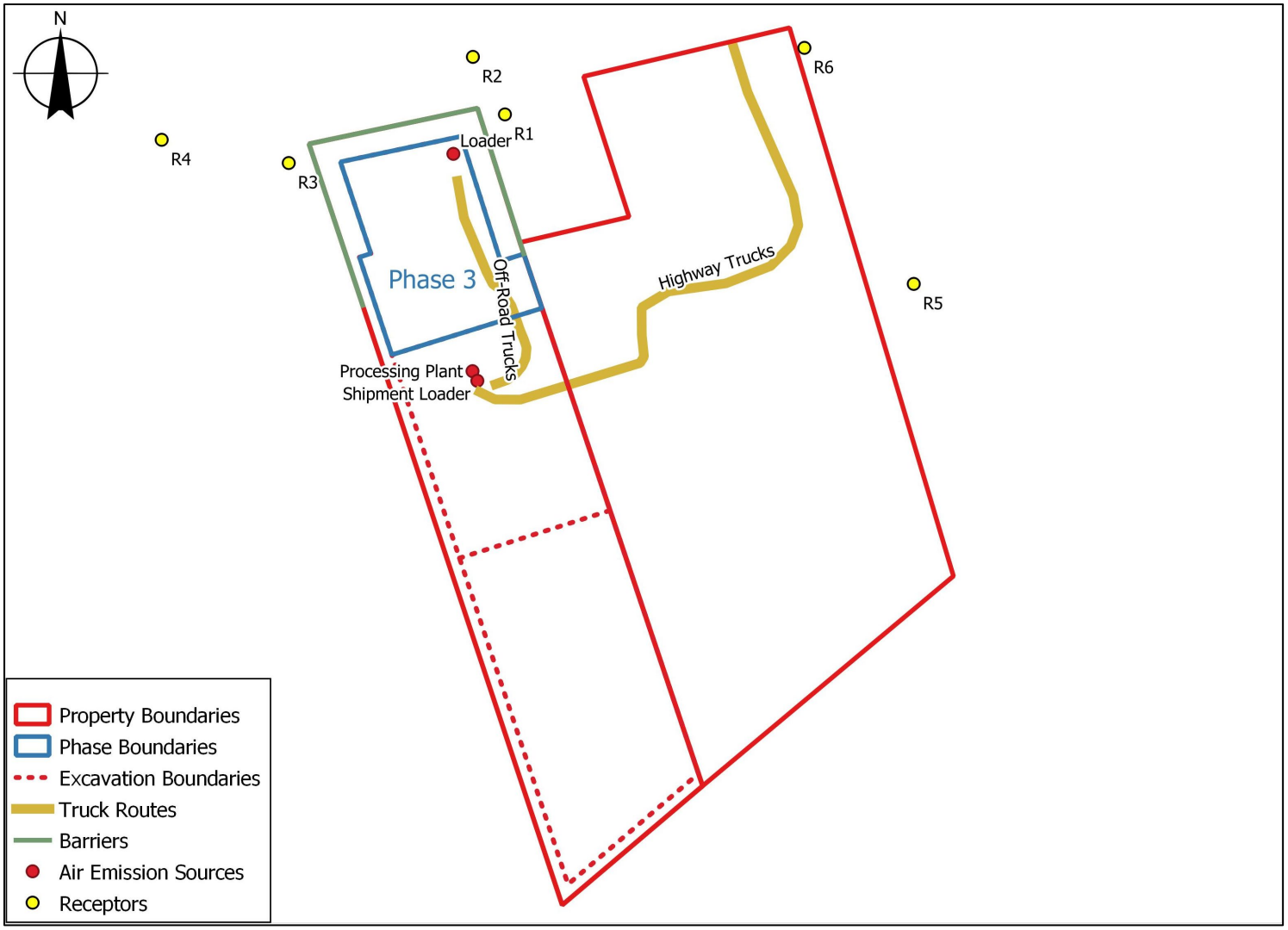


Figure 6: Phase 3 Site Layout


N
R2
R6
R1
Loader
R4
R3
Phase 3
Off-Road Trucks
Highway Trucks
R5
Processing Plant
Shipment Loader
Property Boundaries
Phase Boundaries
Excavation Boundaries
Truck Routes
Barriers
Air Emission Sources
Receptors

3.2 Emission Calculations

Emission calculations for on-site sources and activities were calculated using methods most suitable for each type of source as described below. All the on-site sources are summarized in Appendix A, Table A-01.

On-Site Non-Road Dust

Particulate emissions from on-site material handling and storage piles were calculated based on the maximum amount of aggregate extraction per day using emission factors from the US EPA developed for mineral products industry[6] and aggregate handling and storage piles [7]. Typical parameters for aggregate extraction operation were taken from the same publication. Detailed calculations are provided in Appendix B, Table B-01.

On-Site Road Vehicle Emissions

Transportation related emissions are associated with fuel combustion, brake wear, tire wear, as well as re-suspended road dust.

Emission factors for fuel combustion, break wear and tire wear were estimated using Motor Vehicle Emission Simulator (MOVES) developed by the US EPA Office of Transportation and Air Quality (OTAQ). This emission modeling system estimates emissions for mobile sources covering a broad range of pollutants.

Vehicles traveling on gravel roads cause dust to be transported into the air. Road dust emissions were calculated using US EPA methodology for unpaved[8] and roads. A control efficiency of 95% was assumed for the unpaved on-site roads, which is up 1.5 L of water per 1 m^2 surface in 1 hour[9].

MOVES software does not provide an emission factor for TSP. An exhaust emission factor for PM10 was used for TSP as, according to the US EPA, based on emissions test results, more than 97% of tailpipe particulate matter is PM10 or less.

The total emission factors for particulate matter were a sum of tail pipe and road dust emission factors. On-site road emission calculations are provided in Appendix B, Table B-02.

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[6] US EPA, AP 42, Fifth Edition Compilation of Air Pollutant Emissions Factors, Volume 1: Stationary Point and Area Sources, Chapter 11 - Mineral Products Industry.
[7] US EPA, AP 42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Chapter 13, Section 2.4 Aggregate Handling and Storage Piles.
[8] US EPA TTN CHIEF, AP-42, Fifth Edition, Volume I, Chapter 13, 13.2.2, Draft Section – March 22, 2006.
[9] RWDI presentation at “Fugitive, Dust, Best Management Practices” A&WMA Nuisance Conference, June 21, 2017, page 14.

On-Site Non-Road Vehicle Emissions

Various off-road equipment will operate at the Site, like processing plant (crusher, screener), dragline, excavators, extraction and shipment loaders. It is possible for most of the vehicles to be on-site at the same time and be in use within the same hour; however, only one of dragline or excavator will be operating at a time. All of the equipment is assumed to be operating at 100% capacity, 12 hours per day. Shipment loaders will be the only ones that will operate 13 hours per day at 50% capacity due to noise restrictions.

All the engines are assumed to meet US EPA Tier 4 emission standards by 2025. The emission factors were retrieved from the table[10] at the bottom of the page of Appendix B, Table B-03.

3.3 Air Dispersion Modelling

Dispersion modelling was completed in accordance with the MECP's "Air Dispersion Modelling Guideline for Ontario" (ADMGO)[11]. Since standards and criteria applicable to this assessment are based on 1 hour, 24 hours, and annual periods, the modelled impact of contaminant emissions is assessed as 1 hour, 24 hour, and annual maximum concentrations. The appropriate model to assess the maximum impact is the US EPA AERMOD model.

Meteorological Data

MECP site specific meteorological data preprocessed for AERMOD v19191 was used for this assessment. The meteorological data covers the dates from January 1, 2014 to December 31, 2018. The hourly data includes many factors which affect the dispersion of air contaminants including wind speed, wind direction, temperature, ceiling height, and atmospheric stability.

Terrain Data

Terrain elevation contour data was downloaded from Ontario Digital Elevation Model data set and processed using the AERMOD terrain processor AERMAP. AERMAP determines base terrain elevation using the DEM data for all sources, receptors and buildings, and provides the user with a suitable input file for use with AERMOD.

[10] This table is constructed from the information at https://www.dieselnet.com/standards/us/nonroad.php
[11] MECP (2017) Air Dispersion Modelling Guideline for Ontario (Guideline A-11).

Deposition

Dry and wet depletion algorithms were utilized in the models for the particulates. These methods account for gravitational settling and deposition of particles. The particle size distribution and density were taken from Burnside's reference files for a typical bulk material and are summarized in Table 6.

Table 6: Typical Particle Size Distribution Used for Particulate Deposition

Particle Density, g/cm^3	Particle Diameter, microns	Mass Fraction
2.5	25.0	0.21
	17.5	0.12
	12.5	0.13
	8.0	0.15
	5.0	0.10
	3.25	0.06
	1.75	0.13
	0.50	0.10

Site Operation Levels

The proposed expansion will not operate at full capacity year-round. Typically, it will be closed during winter months (December to February); however, occasionally there will be some activity during these months. Conservatively, it was assumed that the pit will operate at 5% of the regular activity levels. The complete list of activity levels is shown in Table 7.

Table 7: Monthly Operation Levels

Month	Shipping	Production
January	5%	5%
February	5%	5%
March	5%	25%
April	25%	50%
May	25%	50%
June	50%	100%
July	100%	100%
August	100%	100%
September	100%	100%
October	50%	50%
November	50%	25%
December	5%	5%

All the sources included in the modelling are summarized in Appendix A, Table A-02 for all three phases.

4.0 Modelling Results

The impact of the proposed Brantford Pit expansion was assessed based on predicted Maximum Ground Level Concentration (concentration) in the vicinity of the Site and existing background concentrations as monitored at the nearest MECP station.

Predicted maximum concentrations at each sensitive receptor for all three phases (as described in Section 3.0) are summarized in Table 8 through Table 11.

The results are presented by contaminant and phase and include background concentration (90th percentile), maximum concentration at each sensitive receptor, cumulative concentration, cumulative impact as percentage of the criteria and number of days per year the criterion will be exceeding at the sensitive receptor.

Table 8 shows results for the smallest particulate matter, PM2.5. Cumulative concentrations for 24-hour averaging period are predicted to remain below criteria for PM2.5 at all sensitive receptors during each of the three extraction phases; therefore, no adverse impact is expected from the proposed activities.

The average annual background concentration for PM2.5 is 92% of criterion without any contribution from the Site activities. Predicted cumulative annual concentrations for PM2.5 do not exceed criterion most of the time at the receptors, except during Phase 3 activities at receptor R1. The contribution of PM2.5 from the Site at receptor R1 is only 16% to the cumulative annual concentration; however, even this small fraction results in concentration slightly above criterion.

According to Air Quality in Ontario 2017 Report, fine particulate matter decreased 11% from 2008 to 2017. Considering the general trend in Ontario, average annual background concentrations and small contribution due to the activities at the Site it is reasonable to expect that cumulative PM2.5 concentrations will be below their annual criteria in the vicinity of the Site most of the time.

Results summarized for PM10 (Table 9) indicate that 24-hour averaging cumulative concentration will not exceed criterion at any sensitive receptor location after removing outliers.

The dispersion model does not consider the effects of the berm that will be constructed around Phase 3 area and will separate the Site from the surrounding environment. The maximum off-property concentration during Phase 3 activities is expected to be lower due to the berm as well as the vegetation on the berm.

Maximum cumulative TSP concentrations at all sensitive receptors are predicted to remain below criterion for 24-hour averaging period during all three phases of operation. Cumulative annual off-property concentrations are always predicted to be below criterion at any location.

Maximum NO_2 off-property concentration predicted from the Site activities are below criteria for all averaging periods. Maximum cumulative NO_2 concentration predicted to be below criteria at all sensitive receptors; therefore, no negative impact is expected.

Table 8: Maximum Predicted Concentrations – PM2.5

Phase	Receptor ID	24-hour Concentrations					Annual Concentrations			
		Background (µg/m³)	Max POI Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Impact (%)	Exceedances (days/year)	Background (µg/m³)	Max POI Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Impact (%)
Phase 1	R1	14.1	1.32	15.4	57%	0	8.1	0.08	8.2	93%
	R2		1.18	15.3	57%	0		0.06	8.2	93%
	R3		1.36	15.4	57%	0		0.05	8.2	93%
	R4		1.15	15.2	56%	0		0.04	8.2	93%
	R5		1.96	16.0	59%	0		0.26	8.4	95%
	R6		1.51	15.6	58%	0		0.19	8.3	95%
Phase 2	R1		2.62	16.7	62%	0		0.21	8.3	95%
	R2		2.12	16.2	60%	0		0.14	8.3	94%
	R3		2.82	16.9	63%	0		0.12	8.3	94%
	R4		1.65	15.7	58%	0		0.08	8.2	93%
	R5		2.46	16.5	61%	0		0.29	8.4	96%
	R6		3.11	17.2	64%	0		0.31	8.4	96%
Phase 3	R1		11.34	25.4	94%	0		1.57	9.7	110%
	R2		6.6	20.7	77%	0		0.63	8.8	100%
	R3		6.51	20.6	76%	0		0.48	8.6	98%
	R4		1.86	15.9	59%	0		0.15	8.3	94%
	R5		2.3	16.4	61%	0		0.24	8.4	95%
	R6		3.34	17.4	65%	0		0.39	8.5	97%

Background – 90th percentile of MECP measured values for 24 hours and average values for annual background.
Criteria: 27 µg/m³, 24-hour
8.8 µg/m³, annual

Table 9: Maximum Predicted Concentrations – PM10

Phase	Receptor ID	24-hour Concentrations				
		Background (µg/m³)	Max POI Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Impact (%)	Exceedances (days/year)
Phase 1	R1	26.1	3.81	29.9	60%	0
	R2		3.02	29.1	58%	0
	R3		3.94	30.0	60%	0
	R4		2.76	28.8	58%	0
	R5		6.13	32.2	64%	0
	R6		10.29	36.4	73%	0
Phase 2	R1		6.34	32.4	65%	0
	R2		5.46	31.5	63%	0
	R3		7.32	33.4	67%	0
	R4		3.77	29.9	60%	0
	R5		8.29	34.4	69%	0
	R6		14.04	40.1	80%	0
Phase 3	R1		21.26[12]	47.3	95%	0
	R2		15.05	41.1	82%	0
	R3		14.89	41.0	82%	0
	R4		14.48	40.6	81%	0
	R5		8.12	34.2	68%	0
	R6		11.84	37.9	76%	0

Background – 90th percentile of MECP measured values.
Criterion: 50 µg/m³, 24-hour

[12] After removing outliers.

Table 10: Maximum Predicted Concentrations – TSP

Phase	Receptor ID	24-hour Concentrations					Annual Concentrations			
		Background (µg/m³)	Max POI Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Impact (%)	Exceedances (days/year)	Background (µg/m³)	Max POI Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Impact (%)
Phase 1	R1	46.9	13.59	60.5	50%	0	27.1	1.09	28.2	47%
	R2		10.67	57.6	48%	0		0.79	27.9	47%
	R3		10.16	57.1	48%	0		0.57	27.7	46%
	R4		6.79	53.7	45%	0		0.39	27.5	46%
	R5		19.96	66.9	56%	0		3.47	30.6	51%
	R6		37.38	84.3	70%	0		4.72	31.8	53%
Phase 2	R1		14.77	61.7	51%	0		1.63	28.8	48%
	R2		12.42	59.4	49%	0		1.11	28.2	47%
	R3		16.45	63.4	53%	0		0.86	28.0	47%
	R4		7.21	54.2	45%	0		0.52	27.6	46%
	R5		23.73	70.7	59%	0		3.25	30.4	51%
	R6		44.8	91.7	76%	0		5.20	32.3	54%
Phase 3	R1		47.4	94.3	79%	0		5.26	32.4	54%
	R2		25.44	72.4	60%	0		2.44	29.6	49%
	R3		27.15	74.1	62%	0		1.74	28.9	48%
	R4		8.87	55.8	47%	0		0.7	27.8	46%
	R5		26.13	73.1	61%	0		2.81	29.9	50%
	R6		42.21	89.2	74%	0		5.17	32.3	54%

Background – 90th percentile of MECP measured values for 24 hours and average values for annual background.

Criteria 120 µg/m³, 24-hour
60 µg/m³, annual

Table 11: Maximum Predicted Concentrations – NO_2

Phase	Receptor ID	1-hour Concentrations					24-hour Concentrations					Annual Concentrations			
		Background (µg/m³)	Max POI Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Impact (%)	Exceedances (days/year)	Background (µg/m³)	Max POI Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Impact (%)	Exceedances (days/year)	Background (µg/m³)	Max POI Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Impact (%)
Phase 1	R1	20.7	7.37	28.1	36%	0	17.5	1.50	19.0	9%	0	9.2	0.08	9.3	16%
	R2		7.44	28.1	36%	0		1.35	18.8	9%	0		0.06	9.3	15%
	R3		7.97	28.7	36%	0		1.78	19.2	10%	0		0.05	9.3	15%
	R4		8.10	28.8	36%	0		1.74	19.2	10%	0		0.04	9.3	15%
	R5		8.04	28.7	36%	0		2.16	19.6	10%	0		0.22	9.4	16%
	R6		7.90	28.6	36%	0		1.48	18.9	9%	0		0.14	9.4	16%
Phase 2	R1		8.04	28.7	36%	0		2.56	20.0	10%	0		0.16	9.4	16%
	R2		8	28.7	36%	0		1.77	19.2	10%	0		0.12	9.3	16%
	R3		9.38	30.1	38%	0		2.67	20.1	10%	0		0.09	9.3	16%
	R4		7.94	28.6	36%	0		1.35	18.8	9%	0		0.06	9.3	15%
	R5		9.03	29.7	38%	0		2.51	20.0	10%	0		0.21	9.4	16%
	R6		8.55	29.2	37%	0		2.66	20.1	10%	0		0.22	9.4	16%
Phase 3	R1		24.63	45.3	57%	0		9.97	27.4	14%	0		1.09	10.3	17%
	R2		15.61	36.3	46%	0		6.84	24.3	12%	0		0.4	9.6	16%
	R3		8.41	29.1	37%	0		2.31	19.8	10%	0		0.18	9.4	16%
	R4		4.73	25.4	32%	0		1.26	18.7	9%	0		0.09	9.3	16%
	R5		5.36	26.0	33%	0		1.53	19.0	9%	0		0.19	9.4	16%
	R6		5.52	26.2	33%	0		1.8	19.3	10%	0		0.26	9.5	16%

Background – 90th percentile of MECP measured values for 1 hour and 24 hours and average values for annual background.

Criteria	79	µg/m³, 1-hour
	200	µg/m³, 24-hour
	23	µg/m³, annual

5.0 Conclusions and Recommendations

This Air Quality Study evaluated the impacts of the proposed Brantford Pit expansion on the surrounding environment. The results of the dispersion modelling show that predicted particulate and nitrogen oxides off-property concentrations generated from the operation of the proposed Brantford Pit expansion will be below the applicable criteria at all times. Cumulative off-property concentrations were predicted to be below the applicable criteria at all surrounding sensitive receptor locations for all contaminants except for annual PM2.5 concentration at receptor R1. The exceedance is mainly due to the elevated background concentration and the contribution from the activities at the Site is only 16%. Considering the Site's worst case contribution is small and the general trend of decrease in PM2.5 concentrations in Ontario, it is reasonable to expect that cumulative PM2.5 concentrations will be below their annual criteria in the vicinity of the Site for the majority of the time during operations; therefore, no adverse effect is expected due to the proposed expansion. The following dust mitigation measures and best management practices are recommended to be implemented at the proposed Brantford pit expansion site:

- Paved portion of the road at the Site entry/exit should be cleaned periodically to minimize mud tracking onto Colborne Street West and reduce dust generation.
- Reduced speeds should be enforced on-site, and signs posted at the Site entrance.
- Watering of on-site unpaved roads (up to 1.5 L/m2 per hour) when visible dust is observed behind the trucks. Other commercial dust suppressants can be considered if required.
- Regular washing of extraction, processing and transport equipment.
- Wetting material prior to processing or loading on very dry days.
- Monitor on-site dust through visual site inspections and apply additional water when needed.
- Installing berms around excavation area to reduce windblown dust onto neighboring properties.
- Re-vegetating disturbed areas as soon as possible to minimize dust from these areas.
- During very dry and windy conditions resulting in dust plumes travelling off-site, activities at the Site should be temporarily suspended.

Biographies

Harvey Watson, P.Eng.

Harvey has over 15 years of experience in the Air and Noise Approvals industry. Normally, Harvey is initially retained to address a specific environmental air or noise related project. Subsequently, he is recalled for every similar or potentially related project and so has built a strong client base of repeat clients. Harvey's clients have found that they receive great service at a reasonable cost and rarely look elsewhere for services that he can provide. Harvey specializes in intricate and complicated spreadsheets, so he can handle the most complex challenges but always looks for the most practical solution to problems which minimizes the client costs and difficulties. Harvey has undertaken projects for a wide range of municipal, industrial, and commercial clients with businesses including various municipal governments, commercial food franchises, automotive refinishing, chemical refining, flexible packaging printing, railcar cleaning and repair, agricultural pharmaceuticals, automotive parts manufacturing, industrial transformer refurbishing, mining consumable manufacturing, paint additive manufacturing, consumer chemical mixing and packaging, industrial ink manufacturing, commercial sign manufacturing, aircraft landing gear heat treating, and aggregate pits.

Harvey has successfully completed more than 150 applications for Ontario Environmental Compliance (ECA) Approvals and Environmental Activities and Sector Registry (EASR) registrations which include air, noise, and vibration aspects. All the applications resulted in the Ministry of the Environment, Conservation and Parks (MECP) issuing an approval. Harvey also assisted numerous clients with other environmental compliance requirements such as National Pollutant Release Inventory (NPRI), Ministry of Energy Reporting of Energy Consumption and Water Use, Provincial Stewardship reporting, Toronto ChemTRAC, Oakville Fine Particulate Matter, Saskatchewan Environmental Protection Plans, and Alberta Industrial Approval Applications.

In addition, Harvey has been involved in various projects including site specific odour sampling and modelling.

Kristina Zeromskiene, Ph.D., LEL

Kristina is a licensed engineering professional in air and noise disciplines. Kristina has over 10 years of experience with environmental assessments, industrial approvals, and emission inventories for the waste management, manufacturing, power generation, transportation, and variety of other sectors. Kristina has completed multiple air quality assessments and obtained approvals for industrial and commercial facilities and is very knowledgeable in Ontario regulations and guidelines. Kristina has performed process and non-process related emission inventories, dispersion modelling, data analysis and has worked with a variety of surface and upper-air meteorological data sets. Kristina has advance skills in dispersion modelling using atmospheric dispersion modelling systems like AERMOD and CALRoads. Kristina has prepared, reviewed and assisted multiple clients in emission assessments and reporting to federal, provincial and municipal governments.

Kristina is likewise experienced in industry and transportation related noise assessments. Kristina is proficient with software package for environmental noise projects Predictor as well as Ministry of the Environment, Conservation and Parks (MECP) computer program for road and rail traffic noise assessment STAMSON. Kristina has completed noise impact assessments and peer reviews for road improvements, commercial/industrial and residential developments and aggregate extraction activities in Ontario.

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Appendix A

Emission Source Identification

Table A-01:
Sources and Contaminants Identification Table
(2019-12)

Source ID	Source Description	General Location	Contaminants	Significant? Yes/No	Rate / Rationale
BLDZ	Bulldozer	Overburden removal - entire site	PM	No	Moist material, less dust than extraction, short duration
SCR	Screener	Processing plant area	NO_2, PM	No	Accounted under Processing Plant
CRU	Crusher	Processing plant area	NO_2, PM	No	Accounted under Processing Plant
STK	Stockpile	Various	PM	No	Accounted under Processing Plant & Material Handling
WF	Working Face	Working face area	PM	No	Accounted under Material Handling
CONV	Conveyor Transfers	Processing plant area	PM	No	Accounted under Processing Plant
TRCK_1	Onsite highway trucks	Truck route - Phase 1 area	NO_2, PM	Yes	
TRCK_2	Onsite highway trucks	Truck route - Phase 2 area	NO_2, PM	Yes	
TRCK_3A	Onsite highway trucks	Truck route - Phase 3 area (above water table)	NO_2, PM	Yes	
TRCK_3B	Onsite highway trucks	Truck route - Phase 3 area (below water table)	NO_2, PM	No	Below water extraction, not the worst case scenario
TRCKO_3A	Onsite off-road trucks	Truck route - Phase 3 (above water table)	NO_2, PM	Yes	
TRCKO_3B	Onsite off-road trucks	Truck route - Phase 3 (below water table)	NO_2, PM	No	Below water extraction, not the worst case scenario
DRGL	Dragline	Working face area	NO_2, PM	No	Only 1 dragline or excavator operates at a time
EXVT	Excavator	Working face area	NO_2, PM	No	Only during below water extraction
LOAD_1	Extraction Loader	Working face - Phase 1 area	NO_2, PM	Yes	PM accounted under Material Handling
LOAD_2	Extraction Loader	Working face - Phase 2 area	NO_2, PM	Yes	PM accounted under Material Handling
LOAD_3	Extraction Loader	Working face - Phase 3 area	NO_2, PM	Yes	PM accounted under Material Handling
LOAD_SH1	Shipment Loader	Processing plant area	NO_2, PM	Yes	PM accounted under Processing Plant
LOAD_SH2	Shipment Loader	Processing plant area	NO_2, PM	Yes	PM accounted under Processing Plant
LOAD_SH3	Shipment Loader	Processing plant area	NO_2, PM	Yes	PM accounted under Processing Plant
PP_1	Processing Plant	Phase 1 area	NO_2, PM	Yes	
PP_2	Processing Plant	Phase 2 area	NO_2, PM	Yes	
PP_3	Processing Plant	Phase 3 area	NO_2, PM	Yes	
MH_1	Material Handling	Phase 1 area	PM	Yes	
MH_2	Material Handling	Phase 2 area	PM	Yes	
MH_3	Material Handling	Phase 3 area	PM	Yes	

Modelled Source ID	Source ID	Source Description	Modelled Source Type
LOAD_1	LOAD_1	Extraction Loader - Phase 1 Area	POINT
LOAD_2	LOAD_2	Extraction Loader - Phase 2 Area	POINT
LOAD_3	LOAD_3	Extraction Loader - Phase 3 Area	POINT
MH_1	MH_1	Material Handling - Phase 1 Area	OPEN PIT
	STK	Stockpile	
	WF	Working Face	
	CONV	Conveyor Transfers	
	LOAD_1	Extraction Loader	
MH_2	MH_2	Material Handling - Phase 2 Area	OPEN PIT
	STK	Stockpile	
	WF	Working Face	
	CONV	Conveyor Transfers	
	LOAD_2	Extraction Loader	
MH_3	MH_3	Material Handling - Phase 3 Area	OPEN PIT
	STK	Stockpile	
	WF	Working Face	
	CONV	Conveyor Transfers	
	LOAD_3	Extraction Loader	
PP_1	PP_1	Processing Plant - Phase 1 Area	OPEN PIT/POINT*
	SCR	Screener	
	CRU	Crusher	
	LOAD_SH1	Shipment Loader	
PP_2	PP_2	Processing Plant - Phase 2 Area	OPEN PIT/POINT*
	SCR	Screener	
	CRU	Crusher	
	LOAD_SH2	Shipment Loader	
PP_3	PP_3	Processing Plant - Phase 3 Area	OPEN PIT/POINT*
	SCR	Screener	
	CRU	Crusher	
	LOAD_SH3	Shipment Loader	
TRCK_1	TRCK_1	Onsite highway trucks - Phase 1 Area	LINE VOLUME
TRCK_2	TRCK_2	Onsite highway trucks - Phase 2 Area	LINE VOLUME
TRCK_3A	TRCK_3A	Onsite highway trucks - Phase 3 Area	LINE VOLUME
TRCKO_3A	TRCKO_3A	Onsite off-road trucks - Phase 3 Area	LINE VOLUME

* Activities at the Processing plant were modelled as OPEN PIT for particulate, engines were modelled as POINT source for NO_2

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Appendix B

Emission Calculations

Processing Plant - Screening & Crushing

5,000 tonnes/day Daily throughput

Contaminant	Emission Factor (kg/tonne)		Emission Rate (g/s)	
	Screening (controlled)	Crushing (controlled)	Screening	Crushing
TSP	0.0011	0.0006	0.06	0.03
PM10	0.00037	0.00027	0.02	0.02
PM2.5	0.000025	0.00005	0.00145	0.003

Source:
U.S. EPA Fifth Edition, Volume I Chapter 11, section 11.19.2, Crushed Stone Processing and Pulverized Mineral Processing, Table 11.19-2-1
Control factors available in "Pits and quarries reporting guide - Canada.ca.pdf"

Processing Plant - Conveyor Transfers

5,000 tonnes/day Daily throughput

Contaminant	Emission Factors (kg/tonne)	Emission Rate (g/s)
	Conveyor Transfer Point (controlled)	Conveyor Transfer Point
TSP	0.00007	0.0041
PM10	2.30E-05	0.0013
PM2.5	6.50E-06	3.76E-04

Source:
U.S. EPA Fifth Edition, Volume I Chapter 11, section 11.19.2, Crushed Stone Processing and Pulverized Mineral Processing, Table 11.19-2-1
Control factors available in "Pits and quarries reporting guide - Canada.ca.pdf"

Material Handling - Working Face

The quantity of particulate emissions generated by either type of drop operation, per mass of material transferred

k =	see table below	Particle Size Multiplier (dimensionless)
U =	3.48	Mean wind speed (m/s)
M =	5	Material moisture content (%)
Transfer points:	1.00	
Daily Turnover:	5,000.0	tonnes/day

Contaminant	Particle Size Multiplier	Emission Factor (kg PM / Mg of Material)	Emission Rate	
			kg PM/day	g/s
TSP	0.74	5.958E-04	3.0E+00	3.448E-02
PM10	0.35	2.818E-04	1.4E+00	1.631E-02
PM2.5	0.053	4.267E-05	2.1E-01	2.469E-03

Source:
Emissions calculated using "USEPA TTN CHIEF, AP-42, Fifth Edition, Volume I, Chapter 13, Equation 13.2.4.(1)

Wind Erosion from Stockpiles

J =	see table below	Particulate Aerodynamic Factor
s =	6.9	Material silt content (%)
P =	135.6	Average number of days during the year with at least 0.254 mm of precipitation
I =	26	Percentage of time in the year with unobstructed wind speed >19.3 km/h in percent (%)
D =	12	Stockpile Diameter, m
H =	6	Stockpile Height, m
A =	273	Stockpile Exposed Surface Area, m2

Contaminant	Particulate Aerodynamic Factor	Emission Factor (kg/m2)	Emission Rate (g/s)
TSP	1	5.43E-01	1.48E-01
PM10	0.5	2.71E-01	7.41E-02
PM2.5	0.2	1.09E-01	2.97E-02

Source:
Control factors available in "Pits and quarries reporting guide - Canada.ca.pdf", Equation 8.11

Road description: Unpaved - Gravel

Truck Type	Max Hourly Traffic (trucks/h)	Max Daily Traffic (trucks/day)	Average Vehicle Weight (tons)	Mean vehicle speed (mph)
Off-Road Truck	20	250	30	19
Highway Truck	20	250	30	16

s: Surface material silt content: 4.8 % AP42,c13.2.2, Table 13.2.2-1
M: Surface material moisture content: 6.5 % AP42,c13.2.2, Table 13.2.2-3

Constant	PM2.5	PM10	PM-30
k (lb/VMT)	0.15	1.5	4.9
a	0.9	0.9	0.7
b	0.45	0.45	0.45
Quality Rating	B	B	B

Source: AP42,c13.2.2, Table 13.2.2-2

Daily Road Dust Particulate Emissions

Road Segment	Segment Length (m)	# of Trips per Day	# of Trucks per Day	Mean Vehicle Weight (tons) (ton)	VKT (km)	VMT (mi)	Emission Factors (lb/VMT)			Emission Factors (g/s) (13-h day)		
							PM2.5	PM10	TSP	PM2.5	PM10	TSP
Phase 1	1007	500	250	30.0	503.4	312.8	0.185	1.853	7.272	0.304	3.044	11.943
Phase 2	773	500	250	30.0	386.4	240.1	0.185	1.853	7.272	0.234	2.337	9.168
Phase 3 - Hwy	748	500	250	30.0	374.2	232.5	0.185	1.853	7.272	0.226	2.262	8.877
Phase 3 - Off	293	500	250	30.0	146.5	91.1	0.185	1.853	7.272	0.089	0.886	3.476

VKT - Vehicle Kilometres Travelled
VMT - Vehicle Miles Travelled
AW - Extraction above water table
BW - Extraction below water table

Source:
Emissions calculated using "USEPA TTN CHIEF, AP-42, Fifth Edition, Volume I, Chapter 13, 13.2.2, Draft Section - March 22, 2006
Equation 1a: E = k x (s/12)^a x (W/3)^b

Hourly Engine non-Particulate Emissions:

Road Segment	Segment Length (m)	# of Trips per Hour	# of Trucks per Hour	Mean Vehicle Weight (ton)	VKT (km)	VMT (mi)	Emission Rate (g/h)	Emission Rate (g/s) (1-h Max)
							NO2	NO2
Phase 1	1007	40	20	30.0	40.3	25.0	14.99	0.0042
Phase 2	773	40	20	30.0	30.9	19.2	11.50	0.0032
Phase 3 - Hwy	748	40	20	30.0	29.9	18.6	11.14	0.0031
Phase 3 - Off	293	40	20	30.0	11.7	7.3	5.32	0.0015

Daily Engine Particulate Emissions:

Road Segment	Segment Length (m)	# of Trips per Day	# of Trucks per Day	Mean Vehicle Weight (tons)	VKT (km)	VMT (mi)	Daily Emission Rate (g/day) (g/day)			Emission Rate (g/s) (13-h Average)		
							PM2.5	PM10	TSP	PM2.5	PM10	TSP
Phase 1	1007	500	250	30.0	503.4	312.8	44.17	119.96	119.96	0.00051	0.00139	0.00139
Phase 2	773	500	250	30.0	386.4	240.1	33.91	92.09	92.09	0.00039	0.00107	0.00107
Phase 3 - Hwy	748	500	250	30.0	374.2	232.5	32.83	89.17	89.17	0.00038	0.00103	0.00103
Phase 3 - Off	293	500	250	30.0	146.5	91.1	16.08	45.97	45.97	0.00019	0.00053	0.00053

Total Daily Particulate Emissions:

Road Segment	Segment Length (m)	# of Trips per Day	# of Trucks per Day	Mean Vehicle Weight (tons) (ton)	VKT (km)	VMT (mi)	BMPP Reduction			Emission Rates (g/s) (13-h Average)		
							PM2.5	PM10	TSP	PM2.5	PM10	TSP
Phase 1	1007	500	250	30.0	503.4	312.8	0.95	0.95	0.95	0.016	0.154	0.599
Phase 2	773	500	250	30.0	386.4	240.1	0.95	0.95	0.95	0.012	0.118	0.459
Phase 3 - Hwy	748	500	250	30.0	374.2	232.5	0.95	0.95	0.95	0.012	0.114	0.445
Phase 3 - Off	748	500	250	30.0	374.2	232.5	0.95	0.95	0.95	0.005	0.045	0.174

Hourly Engine non-Particulate Emissions:

Equipment Type	Gross Power Rating (hp)	Gross Power Rating (kW)	# units	Hourly Load Factor	Hours of Operation	NOx (g/kW-h)	NOx (g/h)	NOx (g/s)
Crusher	355	265	1	100%	1	0.4	105.89	0.03
Dragline	316	236	1	0%	1	0.4	0.00	0.00
Excavator	316	236	1	0%	1	0.4	0.00	0.00
Loader Extraction	350	261	2	100%	1	0.4	208.80	0.06
Loader Shipment	350	261	2	50%	1	0.4	104.40	0.03
Screener	132	98	1	100%	1	0.4	39.37	0.01
Material Handling				100%	1			
Processing Plant				100%	1			0.04

All equipment assumed to meet Tier 4 for NOx emissions by 2025.
One dragline or excavator operates at a time, either operate during below water extraction only
Processing Plant includes Crusher and Screener

Daily Engine Particulate Emissions:

Equipment Type	Gross Power Rating (hp)	Gross Power Rating (kW)	# units	Daily Load Factor	Hours of Operation	PM2.5 (g/kW-h)	PM10 (g/kW-h)	TSP (g/kW-h)	PM2.5 (g/day)	PM10 (g/day)	TSP (g/day)	PM2.5 (g/s)	PM10 (g/s)	TSP (g/s)
Crusher	355	265	1	100%	12	0.2	0.2	0.2	635.34	635.34	635.34	0.007	0.007	0.007
Dragline	316	236	1	0%	12	0.2	0.2	0.2	0.00	0.00	0.00	0.000	0.000	0.000
Excavator	316	236	1	0%	12	0.2	0.2	0.2	0.00	0.00	0.00	0.000	0.000	0.000
Loader Extraction	350	261	2	100%	12	0.2	0.2	0.2	1252.78	1252.78	1252.78	0.014	0.014	0.014
Loader Shipment	350	261	2	50%	13	0.2	0.2	0.2	678.59	678.59	678.59	0.008	0.008	0.008
Screener	132	98	1	100%	12	0.2	0.2	0.2	236.24	236.24	236.24	0.003	0.003	0.003
Material Handling				100%	12							0.014	0.014	0.014
Processing Plant				100%	12							0.018	0.018	0.018

One dragline or excavator operates at a time, either operate during below water extraction only
Processing Plant includes Crusher and Screener

https://www.dieselnet.com/standards/us/nonroad.php

EPA Tier 1-3 Nonroad Diesel Engine Emission Standards, g/kWh (g/bhp·hr)

Engine Power	Tier	Year	CO	HC	NMHC + NOx	NOx	PM
kW < 8 (hp < 11)	Tier 1	2000	8.0 (6.0)	-	10.5 (7.8)	-	1.0 (0.75)
	Tier 2	2005	8.0 (6.0)	-	7.5 (5.6)	-	0.8 (0.6)
8 ≤ kW < 19 (11 ≤ hp < 25)	Tier 1	2000	6.6 (4.9)	-	9.5 (7.1)	-	0.8 (0.6)
	Tier 2	2005	6.6 (4.9)	-	7.5 (5.6)	-	0.8 (0.6)
19≤ kW < 37 (25 ≤ hp < 50)	Tier 1	1999	5.5 (4.1)	-	9.5 (7.1)	-	0.8 (0.6)
	Tier 2	2004	5.5 (4.1)	-	7.5 (5.6)	-	0.6 (0.45)
37 ≤ kW < 75 (50 ≤ hp < 100)	Tier 1	1998	-	-	-	9.2 (6.9)	-
	Tier 2	2004	5.0 (3.7)	-	7.5 (5.6)	-	0.4 (0.3)
	Tier 3	2008	5.0 (3.7)	-	4.7 (3.5)	-	-†
75 ≤ kW < 130 (100 ≤ hp < 175)	Tier 1	1997	-	-	-	9.2 (6.9)	-
	Tier 2	2003	5.0 (3.7)	-	6.6 (4.9)	-	0.3 (0.22)
	Tier 3	2007	5.0 (3.7)	-	4.0 (3.0)	-	-†
130 ≤ kW < 225 (175 ≤ hp < 300)	Tier 1	1996	11.4 (8.5)	1.3 (1.0)	-	9.2 (6.9)	0.54 (0.4)
	Tier 2	2003	3.5 (2.6)	-	6.6 (4.9)	-	0.2 (0.15)
	Tier 3	2006	3.5 (2.6)	-	4.0 (3.0)	-	-†
225 ≤ kW < 450 (300 ≤ hp < 600)	Tier 1	1996	11.4 (8.5)	1.3 (1.0)	-	9.2 (6.9)	0.54 (0.4)
	Tier 2	2001	3.5 (2.6)	-	6.4 (4.8)	-	0.2 (0.15)
	Tier 3	2006	3.5 (2.6)	-	4.0 (3.0)	-	-†
450 ≤ kW < 560 (600 ≤ hp < 750)	Tier 1	1996	11.4 (8.5)	1.3 (1.0)	-	9.2 (6.9)	0.54 (0.4)
	Tier 2	2002	3.5 (2.6)	-	6.4 (4.8)	-	0.2 (0.15)
	Tier 3	2006	3.5 (2.6)	-	4.0 (3.0)	-	-†
kW ≥ 560 (hp ≥ 750)	Tier 1	2000	11.4 (8.5)	1.3 (1.0)	-	9.2 (6.9)	0.54 (0.4)
	Tier 2	2006	3.5 (2.6)	-	6.4 (4.8)	-	0.2 (0.15

† Not adopted, engines must meet Tier 2 PM standard.

Tier 4 Emission Standards—Engines up to 560 kW, g/kWh (g/bhp-hr)

Engine Power	Year	CO	NMHC	NMHC+ NOx	NOx	PM
kW < 8 (hp < 11)	2008	8.0 (6.0)	-	7.5 (5.6)	-	0.4a (0.3)
8 ≤ kW < 19 (11 ≤ hp < 25)	2008	6.6 (4.9)	-	7.5 (5.6)	-	0.4 (0.3)
19 ≤ kW < 37 (25 ≤ hp < 50)	2008	5.5 (4.1)	-	7.5 (5.6)	-	0.3 (0.22)
	2013	5.5 (4.1)	-	4.7 (3.5)	-	0.03 (0.022)
37 ≤ kW < 56 (50 ≤ hp < 75)	2008	5.0 (3.7)	-	4.7 (3.5)	-	0.3b (0.22)
	2013	5.0 (3.7)	-	4.7 (3.5)	-	0.03 (0.022)
56 ≤ kW < 130 (75 ≤ hp < 175)	2012-2014c	5.0 (3.7)	0.19 (0.14)	-	0.40 (0.30)	0.02 (0.015)
130 ≤ kW ≤ 560 (175 ≤ hp ≤ 750)	2011-2014d	3.5 (2.6)	0.19 (0.14)	-	0.40 (0.30)	0.02 (0.015)

a - hand-startable, air-cooled, DI engines may be certified to Tier 2 standards through 2009 and to an optional PM standard of 0.6 g/kWh starting in 2010
b - 0.4 g/kWh (Tier 2) if manufacturer complies with the 0.03 g/kWh standard from 2012
c - PM/CO: full compliance from 2012; NOx/HC: Option 1 (if banked Tier 2 credits used)—50% engines must comply in 2012-2013; Option 2 (if no Tier 2 credits claimed)—25% engines must comply in 2012-2014, with full compliance from 2014.12.31
d - PM/CO: full compliance from 2011; NOx/HC: 50% engines must comply in 2011-2013

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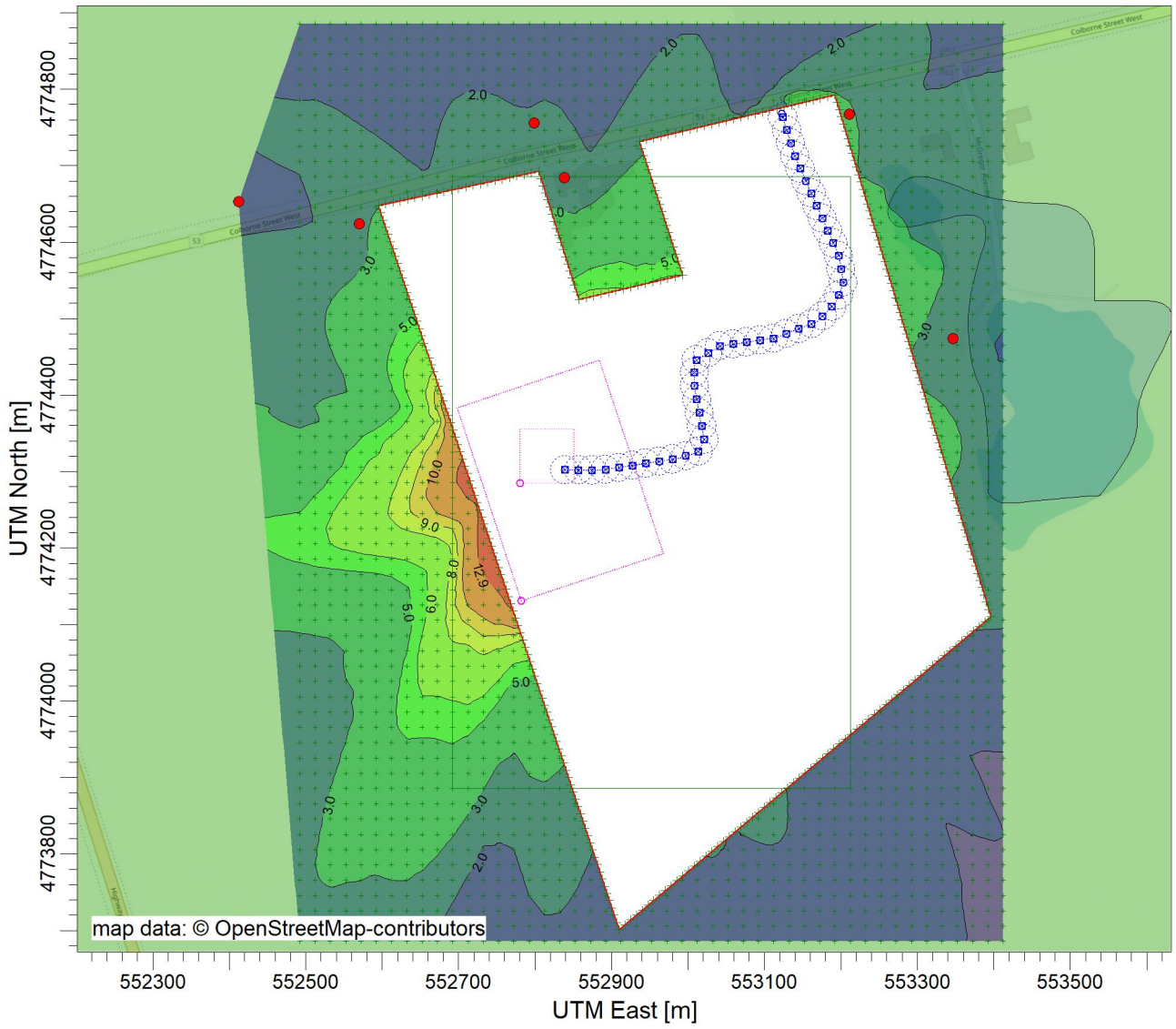
Appendix C

Sample Modelling Results

PROJECT TITLE:

Figure C-01: PM2.5 24-Hour Averaging Concentration Contour Plot
Phase 2



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

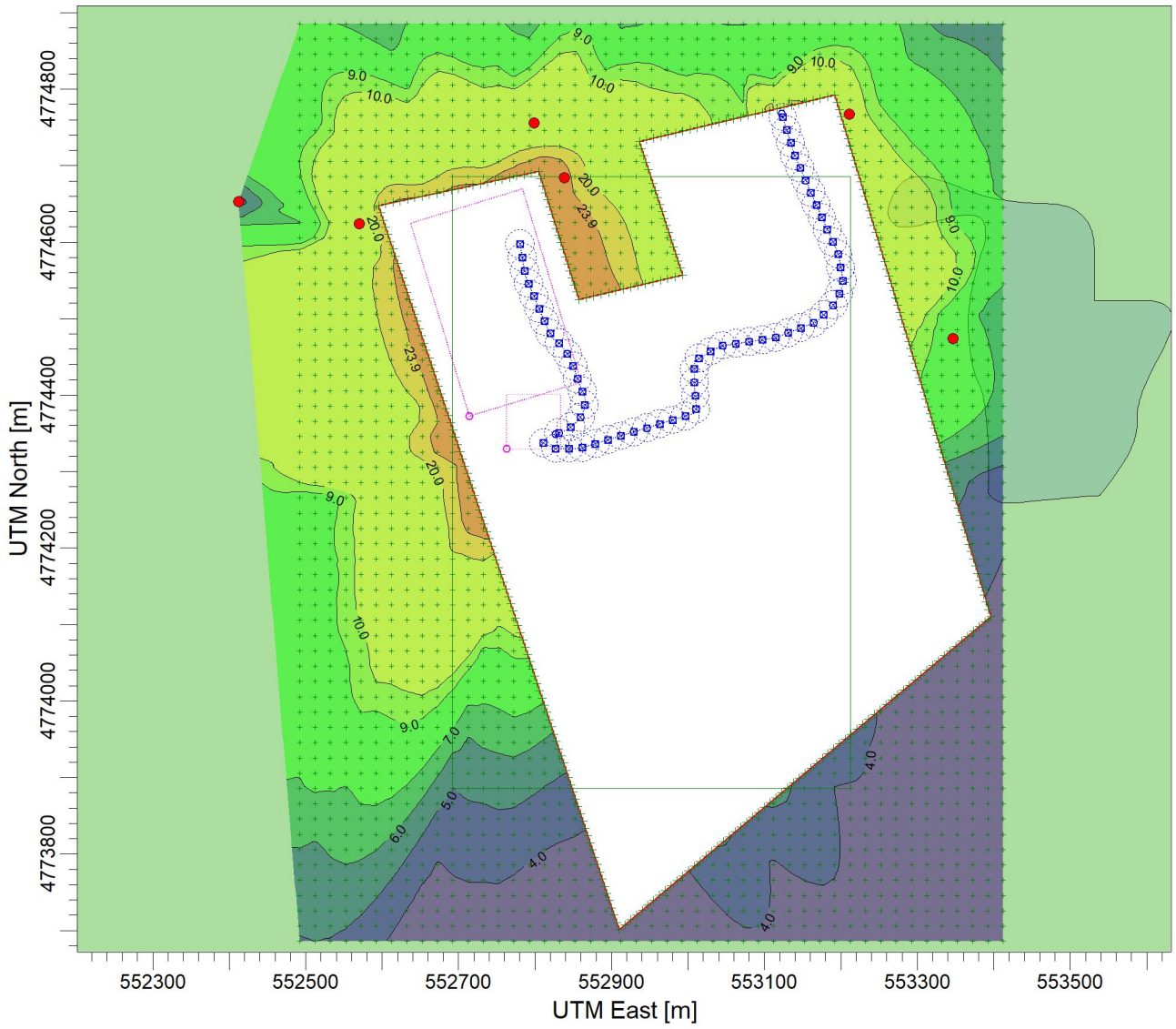
Max: 16.4 [ug/m^3] at (552742.95, 4774202.90)

0.8 1.0 2.0 3.0 5.0 6.0 8.0 9.0 10.0 12.9

COMMENTS: Background concentration - 14 ug/m3 Criterion - 27 ug/m3 Contour line 12.9 ug/m3 shows exceedance area for cumulative concentrattion.	SOURCES: **3**	COMPANY NAME: **R.J. Burnside & Associates Limited**	
	RECEPTORS: **1993**	MODELER: **KZ**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:9,000 0 0.3 km	
	MAX: **16.4 ug/m^3**	DATE: **7/13/2020**	PROJECT NO.: **300043727.0000**

PROJECT TITLE:

Figure C-02: PM10 24-Hour Averaging Concentration Contour Plot
Phase 3



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

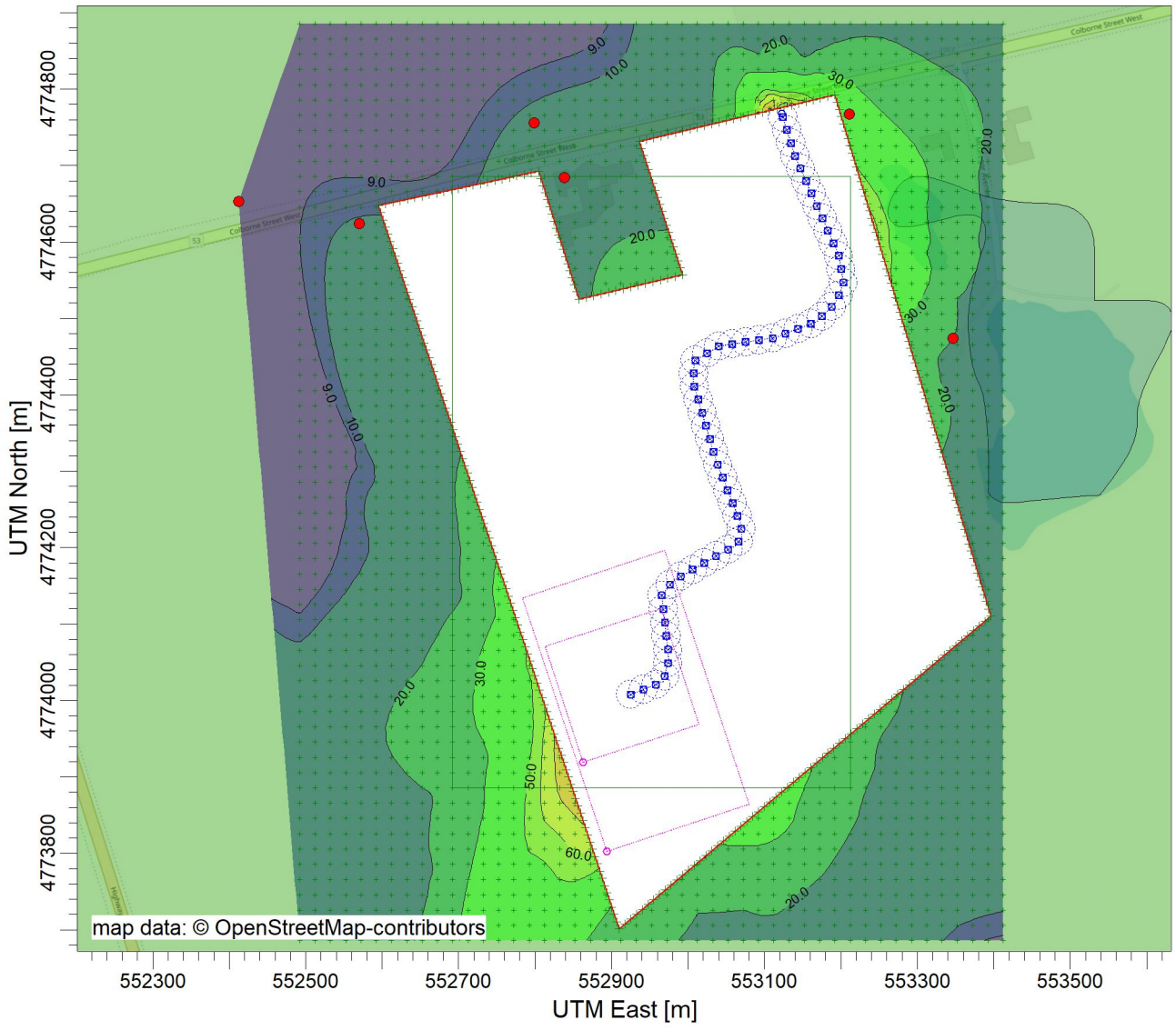
Max: 37.1 [ug/m^3] at (552857.23, 4774525.27)

2.5 4.0 5.0 6.0 7.0 9.0 10.0 20.0 23.9 37.1

COMMENTS: Background concentration - 26 ug/m3 Criterion - 50 ug/m3 Contour line 23.9 ug/m3 shows exceedance area for cumulative concentrattion.	SOURCES: **4**	COMPANY NAME: **R.J. Burnside & Associates Limited**	
	RECEPTORS: **1993**	MODELER: **KZ**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:9,000 0 0.3 km	
	MAX: **37.1 ug/m^3**	DATE: **7/13/2020**	PROJECT NO.: **300043727.0000**

PROJECT TITLE:

Figure C-03: TSP 24-Hour Averaging Concentration Contour Plot
Phase 1



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

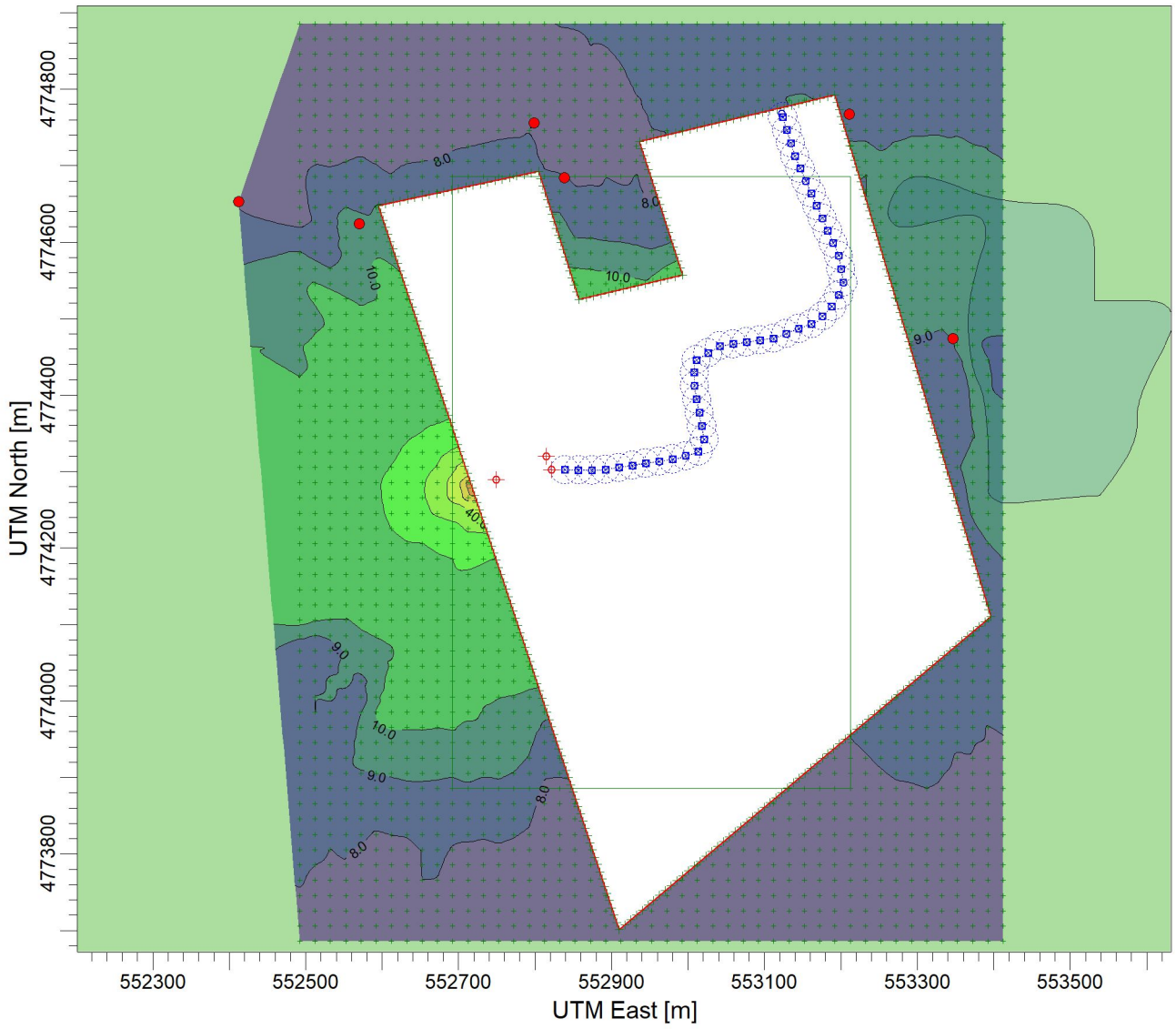
Max: 96.0 [ug/m^3] at (553106.85, 4774772.11)

6.1 9.0 10.0 20.0 30.0 50.0 60.0 73.0 90.0 96.0

COMMENTS: Background concentration - 47 ug/m3 Criterion - 120 ug/m3 Contour line 73.0 ug/m3 shows exceedance area for cumulative concentrattion.	SOURCES: **3**	COMPANY NAME: **R.J. Burnside & Associates Limited**	
	RECEPTORS: **1993**	MODELER: **KZ**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:9,000 0 0.3 km	
	MAX: **96.0 ug/m^3**	DATE: **7/13/2020**	PROJECT NO.: **300043727.0000**

PROJECT TITLE:

Figure C-04: NO2 1-Hour Averaging Concentration Contour Plot
Phase 2



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 67.0 [ug/m^3] at (552717.79, 4774278.63)

7.0 8.0 9.0 10.0 20.0 30.0 40.0 50.0 58.3 67.0

COMMENTS: Background concentration - 21 ug/m3 Criterion - 79 ug/m3 (42 ppb) Contour line 58.3 ug/m3 shows exceedance area for cumulative concentrattion.	SOURCES: **4**	COMPANY NAME: **R.J. Burnside & Associates Limited**	
	RECEPTORS: **1993**	MODELER: **KZ**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:9,000 0 0.3 km	
	MAX: **67.0 ug/m^3**	DATE: **7/13/2020**	PROJECT NO.: **300043727.0000**

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Appendix D

MECP Approval to Use Site-specific Meteorological Data

Ministry of the Environment, Conservation and Parks

Environmental Monitoring and Reporting Branch

125 Resources Road
Etobicoke ON M9P 3V6
Tel.: 416 235-6300
Fax: 416 235-6235

Ministère de l'Environnement, de la Protection de la nature et des Parcs
Direction de la Surveillance Environnmentale

125, chemin Resources
Etobicoke ON M9P 3V6
Tél. : 416 235-6300
Téléc. : 416 235-6235

Ontario

May 24, 2019
Carol Siemiginowski, Land Manager
Lafarge Canada Inc.
6509 Airport Road
Mississauga, Ontario
L4V 1S7

Dear Madam/Sir:

Re: Request for Approval under Paragraph 3 of section 13(1) of Regulation 419/05
For use of Site-specific Meteorological Data:
Lafarge Canada Inc. - Brantford (located at 1044 Colborne Street West, Brantford, Ontario)

In accordance with the application for approval under s.13(1) of Regulation 419/05 for use of site-specific meteorological data, I am approving the use of site-specific data for the above-referenced site as requested by Lafarge Canada Inc. in the application dated February 25, 2019.

The site-specific meteorological data referenced as the Brantford airport data is a reasonable reflection of the meteorological conditions for the proposed modelling assessment.

A fully-processed 5-year (2014 to 2018) meteorological data set has been prepared by the Ministry of the Environment, Conservation and Parks with wind-sector dependent land use specific to the site identified in the application, upper air data from the U.S. National Weather Service's Buffalo station and surface data from the Environment and Climate Change Canada's Brantford airport station, with missing data filled with those from the Hamilton airport station.

This fully-processed site-specific meteorological data was prepared in response to a request submitted under O. Reg. 419/05 and is approved for use at this specific facility until such time as there are significant land use changes in vicinity of the facility.

This meteorological dataset was prepared using the AERMET 16216 meteorological pre-processor computer program. It is to be used in conjunction with the corresponding version of AERMOD to model discharges from the above-referenced facility. You are reminded that this dataset must be reprocessed when the Ministry adopts a newer version of AERMET. The Ministry can provide reprocessed meteorological data upon request.

Should you have any comments or questions relating to the above site specific meteorological dataset, please send an e-mail to MetDataENE@ontario.ca within 30 days of the date of this correspondence with details, so that this dataset can be modified, if necessary.

Yours truly,

Yvonne Hall
Director, Section 13, O. Reg. 419/05

cc: District Manager, Guelph District Office
Director, Section 9, Environmental Protection Act
Environmental Assessment and Permissions Branch
R.J. Burnside & Associates Limited

R.J. Burnside & Associates Limited