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CONSULTING

Air Quality Study and Cumulative Effects Assessment in Support of an Application under Alternative Low-Carbon Fuels Regulation (O.Reg.79/15)

St Marys Cement Inc. (Canada), Bowmanville Facility

Report to: Ministry of the Environment, Conservation and Parks
Client Services and Permissions Branch
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Executive Summary

BCX Environmental Consulting (BCX) was retained by St. Marys Cement Inc. (Canada) (SMC) to prepare an Air Quality Study and Cumulative Effects Assessment (Study) in support of an application under the Alternative Low-Carbon Fuels (ALCF) Regulation (O.Reg. 79/15) for their cement plant located in Bowmanville, Ontario (Facility).

The SMC Facility is located at 410 Bowmanville Avenue South in Bowmanville, Ontario on the north shore of Lake Ontario and south of Highway 401. SMC is preparing an application to support the following:

- Thermal replacement of 30% of the conventional fuels (coal, petroleum coke) currently used at the Facility with ALCFs, which is an approximate increase from the current 100 tonnes of ALCFs used per day to 400 tonnes of ALCFs per day;
- Adding biomass, cellulosic and plastic materials derived from industrial and/or post-consumer sources, which cannot be recycled, are not considered hazardous and are not derived from animals or the processing and preparations of food, to the list of approved ALCFs at the Facility based on the recent demonstration project at the Facility;
- Installing new equipment at the Facility to accommodate the ALCFs; and
- Increasing the capacity of the current alternative fuels storage at the Facility using enclosed containers and buildings.

The purpose of this Study is to respond to stakeholder and public comments. Specifically, this Study quantifies future local air quality and determines if there will be any significant change in air quality in the community as a result of replacing up to 30% of conventional fuel with ALCF on a thermal basis.

The Study took a very conservative approach to provide the community with a high level of confidence in the Study conclusions. This means that the predicted cumulative concentrations and the predicted change in air quality are purposefully over-estimated.

Differing from the ALCF demonstration report which was to demonstrate compliance with the Ontario Ministry of the Environment, Conservation and Parks' (Ministry's) Point-Of-Impingement (POI) standards and to assess statistically significant changes under Ontario Regulation 419/05 (Reg. 419), this Study considers both stationary and mobile sources from the Facility, as well as cumulative impacts from major local sources.

The air emission sources from the Facility include both stationary and mobile air emissions from the cement plant, as well as stationary and mobile emissions from the quarry, the dock area and Canada Building Materials' (CBM's aggregate operations).

Emissions of an extensive suite of Contaminants of Potential Concern (CoPCs) from the kiln stack are estimated using the 2018 Ministry approved source testing data. Emissions of CoPCs from other sources are estimated using published emission factors (US Environmental Protection Agency and the Ministry), engineering estimates, mass balance, and manufacturer's performance specifications.

Cumulative effects are considered by using conservative background concentrations of each CoPC obtained from local ambient monitoring stations. In developing appropriate future background concentrations for the CoPCs, the planned Durham-York Energy Centre (DYEC) system optimization is considered. The modelled concentrations are added to the background concentrations and this result is compared to the applicable ambient air quality criteria.

Air dispersion modelling is completed using the US EPA AERMOD model (Version 16216r) as per requirements set out in the Air Dispersion Modelling Guideline of Ontario (ADMGO). Due to the height and the proximity of the kiln stack to Lake Ontario, shoreline effect factors are generated using the CALPUFF model (Version 7) to account for reduced air dispersion resulting from the temperature difference between water and land. These factors are incorporated in the AERMOD modelling input for the kiln stack to account for potential impact of shoreline effects.

The study concludes that:

- no significant cumulative local air quality impacts in the community are expected as a result of the proposed future use of ALCF. This is because using very conservative assumptions and conservative local background levels, all CoPCs are below their ambient air quality criteria at all sensitive receptors in the community except for benzene (annual) and BaP (24 hour and annual);

- with respect to benzene (annual) and BaP (24 hour and annual), the background levels locally and across the province are well above their respective ambient air quality criteria. The contribution from the plant to the cumulative concentration for these two CoPCs is small and on its own, the facility is well below the ambient air quality criteria;

- no significant change in local air quality in the community is expected as a result of the use of ALCF. This is because the predicted change in cumulative impacts is very small, even when the study purposefully over-estimates the emissions associated with the future use of ALCF; and

- The study findings are consistent with the “Alternative Fuel Demonstration Project Summary Report”, prepared by BCX, dated May 2019.

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1.0 INTRODUCTION

BCX Environmental Consulting (BCX) was retained by St. Marys Cement Inc. (Canada) (SMC) to prepare an Air Quality Study and Cumulative Effects Assessment (Study) in support of an application under the Alternative Low-Carbon Fuels (ALCF) Regulation (O.Reg. 79/15) for their cement plant located in Bowmanville, Ontario (Facility).

1.1 Project Background

The Facility is located at 410 Bowmanville Avenue South in Bowmanville, Ontario on the north shore of Lake Ontario and south of Highway 401 as shown in Figure 1-1 (Appendix A). A detailed site layout showing the current operations is presented in Figure 1-2 (Appendix A).

The Facility primarily produces Portland Cement by combing materials bearing calcium carbonate, silica, alumina and iron oxide at high temperatures to produce clinker. The clinker is either shipped as a product or is subsequently ground with finishing materials such as gypsum and limestone to produce cement on site.

In addition to the cement plant, the Facility includes a limestone quarry and a dock area to receive raw materials and conventional fuels and to ship products. The dock area is managed by Cargo Dockers Inc. CBM Aggregates, a Division of SMC, also operates a construction grade aggregate operation (crushing and storage) on site.

The cement plant and the limestone quarry are currently approved under Environmental Compliance Approvals (ECA Number 0469-9YUNKSK for air and ECA Number 7024-9XUK4C for waste). These approvals allow for the regular use of the following types of low carbon fuels (LCF) at a maximum rate of 96 tonnes per day:

- Woodwaste as defined in O.Reg. 347; and
- Woody biomass consisting of mainly of woodchips with some fragments of plastic, shingles, laminate, surface coatings obtained from industrial and post-consumer sources such as construction and demolition waste, which does not contain asbestos and hazardous waste as defined under O.Reg. 347 and contains:
    - (a) Less than 10% non-woody material such as plastic, shingles, laminate, surface coatings and other material;
    - (b) Less than 5% of treated wood;
    - (c) Less than or equal to 1% total halogen content; and
    - (d) Less than 25% moisture by weight.

In addition, the facility also has demonstration ECAs (ECA No. 4614-826K9W for air and ECA No.1255-7QVJ2N for waste). These approvals permit the facility to undertake time-limited demonstration projects to collect data to support the future use of ALCF defined as follows:

- Post-composting plastic polymers and woody residuals defined as "shredded and dried plastic film and other plastic materials and woody materials removed from finished compost"; and
- Plastic polymers, paper fibres and woody residuals derived from industrial and/or post consumer sources defined as "shredded plastic and other materials removed from post consumer recycling or from industrial manufacturing process".

1.1.1 2018 Alternative Fuel Demonstration Project

From September to December 2018, the Facility carried out an ALCF demonstration project to use residuals derived from industrial and/or post-consumer sources including plastic polymers, paper fibres and woody materials as alternative fuels under their demonstration approvals.

Per the ECAs, the results of the demonstration project are documented in the "Alternative Fuel Demonstration Project Summary Report, prepared by BCX, dated May 2019" and the "Alternative Fuel Demonstration Project Summary Waste Report, prepared by HDR Inc. (HDR), dated May 2019". The studies showed that:

- The allowable maximum alternative fuel consumption rate of approximately 30% thermal replacement can be readily achieved from an operational perspective;
- The Facility fully complied with their Operational Limits, their Performance Objectives, and with Ontario Regulation 419/05 (Reg. 419) while demonstrating any amount of ALCF;
- The data obtained from the source testing program demonstrated that relative to baseline conditions, there was no statistically significant difference in kiln stack emissions and Point -Of-Impingement (POI) concentrations of all contaminants as a result of the use of ALCF;
- The data obtained from the ambient monitoring program demonstrated that there was no statistically significant difference in ambient air concentrations of any contaminant as a result of the use of ALCF, relative to baseline conditions; and
- The demonstration project provides an extensive Ministry validated/reviewed data set to be used in the environmental studies to support an application for regular use of ALCFs.

1.2 Future Proposed Use of ALCF

SMC is preparing an application to support the following:

- Thermal replacement of 30% of the conventional fuels (coal, petroleum coke) currently used at the Facility with ALCFs, which is an approximate increase from the current 100 tonnes of ALCFs used per day to 400 tonnes of ALCFs per day;
- Adding biomass, cellulosic and plastic materials derived from industrial and/or post-consumer sources, which cannot be recycled, are not considered hazardous and are not derived from animals or the processing and preparations of food, to the list of approved ALCFs at the Facility based on the recent demonstration project at the Facility;

- Installing new equipment at the Facility to accommodate the ALCFs; and
- Increasing the capacity of the current alternative fuels storage at the Facility using enclosed containers and buildings.

ALCF will be delivered in enclosed trucks which will access the expanded/new fuel storage buildings via the existing delivery route for LCF. A detailed site layout showing the proposed ALCF storage buildings and ALCF delivery route is presented in Figure 1-3 (see Appendix A). Other than a reduction in conventional fuel consumption, there will be no changes to any other operations at the Facility.

1.3 Purpose of this Study

The purpose of this Study is to respond to stakeholder and public comments. Specifically, this Study should quantify future local air quality and determine if there will be any significant change in air quality in the community as a result of replacing up to 30% of conventional fuel with ALCF on a thermal basis.

This Study differs from the ALCF demonstration report which was to demonstrate compliance with the Ontario Ministry of the Environment, Conservation and Parks' (Ministry's) POI standards and to assess statistically significant changes under Reg. 419. The ALCF demonstration report does not specifically address ambient air quality in the community which is influenced by other sources such as local major industrial sources, transportation, residential heating and long-range transport (i.e. cumulative effects). The ALCF demonstration report, however, does provide site-specific Ministry approved emissions data to support this Study.

This study, therefore, assesses all significant air emission sources from existing and the proposed future operations at the Facility, and compares their impact to determine change in local air quality. Emission sources include both stationary and mobile air emissions from the cement plant, as well as stationary and mobile emissions from the quarry, the dock area and CBM's aggregate operations.

Cumulative effects are considered by using conservative background concentrations of each Compound of Potential Concern (CoPC) obtained from local ambient monitoring stations. The modelled concentrations are added to the background concentrations and this result is compared to the applicable ambient air quality criteria, which is a desirable concentration of a contaminant in air used to assess general air quality.

This Study takes a very conservative approach to provide the community with a high level of confidence in the Study conclusions. This means that the predicted cumulative concentrations and the predicted change in air quality are purposefully over-estimated.

The ALCF approval, if granted, does not replace the requirement for an ECA (Air) supported by a site-wide Emission Inventory and Dispersion Modelling (ESDM) Report under Reg. 419.

2.0 STUDY SCOPE

2.1 Study Area and Sensitive Receptors

A study area of 10km x 10km centred from the Bowmanville Facility's kiln stack is used to assess potential off-site impacts from the project on local air quality (see Figure 1-1 in Appendix A).

A tiered receptor grid as per Ministry's requirements in the ADMGO is used for the entire study area. In addition, the closest existing sensitive receptors representing the following five communities are selected for further study (see Figure 1-1):

R1: Residential subdivision north of Baseline Road;
R2: Residential community along Lake Ontario;
R3: Agricultural farmhouses north of the 401 and south of Baseline Road;
R4: Legal non-conforming home north of the plant and south of the 401 (zoned light industrial); and
R5: Residential subdivision north and east of the intersection of Baseline Road and Liberty Street South.

Two discrete receptors are also included for the two Durham-York Energy Centre (DYEC) ambient monitoring stations (Rundle Road and Courtice), located approximately 2.5km and 4.5km, respectively, west of the cement plant.

2.2 Compounds of Potential Concern (CoPCs) and Ambient Air Quality Criteria

For this Study, CoPCs are identified as total suspended particulate (PM), respirable particulate ($PM_{2.5}$); nitrogen dioxide (NO_2); sulphur dioxide (SO_2); hydrogen chloride (HCl) & chlorinated organics including dioxins and furans (D&Fs), non-chlorinated organics including polycyclic aromatic hydrocarbons (PAHs) and metals. These CoPCs were identified by the Ministry during the ECA application process and are conservatively based on the Ministry's experience with and requirements for a wide range of combustion/incineration activities.

The Ministry's Ambient Air Quality Criteria (AAQC) are used in this study as the reference levels for assessing ambient air quality in the community. AAQCs are described in the Ministry document "Ontario's Ambient Air Quality Criteria", dated December 2016. An AAQC is a desirable concentration of a contaminant in air, established to protect against adverse effects on health or the environment. AAQCs are commonly used in environmental assessments, special studies using ambient air monitoring data, assessments of general air quality in a community and annual reporting on air quality across the province. AAQCs are not regulatory standards for demonstrating environmental air compliance.

In the absence of provincial AAQCs for $PM_{2.5}$, the study used Canadian Ambient Air Quality Standards (CAAQS) as the reference levels. This is a very conservative approach because the study results (i.e. maximum concentrations plus background) are not developed to match the CAAQS basis. The CAAQS value for 24-hour $PM_{2.5}$ is based on a 3-year average of the annual 98th

percentile of the daily 24-hour average concentrations. The CAAQS value for annual $PM_{2.5}$ is based on a 3-year average of the annual average concentrations.

In the absence of AAQCs and CAAQs, screening levels based on the Ministry's review of air quality values of other jurisdictions (JSLs) are used as reference levels. This is very conservative because the Ministry's JSLs are based generally on the lowest effect level identified from a review of all corresponding air quality values available in other jurisdictions.

2.2.1 Benzo(a)pyrene (BaP) AAQCs

As presented in Table 2-1, BaP has both a 24-hr (0.00005 $\mu g/m^3$) and annual (0.00001 $\mu g/m^3$) AAQC. It is relevant to note that these AAQCs were introduced by the Ministry as a surrogate to assess all PAHs as a group. These BaP criteria are very low and are more than 20 times lower than the previous AAQC for BaP as an individual PAH. It is also relevant to note that very small changes in BaP concentrations can result in significant relative changes when compared to these criteria.

Table 2-1: Summary of Applicable Air Quality Criteria and Standards

Contaminant Name	CAS #	Averaging Period	Air Criteria ($\mu g/m^3$)	Source of Air Criteria
Particulate				
PM	PM	24 hr	120	AAQC
PM	PM	Annual	60	AAQC
$PM_{2.5}$	PM2.5	24 hr	27	CAAQS
$PM_{2.5}$	PM2.5	Annual	8.8	CAAQS
Combustion Gases				
Nitrogen Dioxide	10102-44-0	1 hr	400	AAQC
Nitrogen Dioxide	10102-44-0	24 hr	200	AAQC
Sulphur Dioxide	7446-09-5	1 hr	690	AAQC
Sulphur Dioxide	7446-09-5	24 hr	275	AAQC
Sulphur Dioxide	7446-09-5	Annual	55	AAQC
Carbon Monoxide	630-08-0	1 hr	36200	AAQC
Carbon Monoxide	630-08-0	8 hr	15700	AAQC
Ammonia & Hydrochloric Acid				
Ammonia	7664-41-7	24 hr	100	AAQC
Hydrochloric Acid	7647-01-0	24 hr	20	AAQC
Metals & Metal Oxides				
Aluminum	7429-90-5	24 hr	12	SL-JSL
Antimony	7440-36-0	24 hr	25	AAQC
Arsenic	7440-38-2	24 hr	0.3	AAQC
Barium	7440-39-3	24 hr	10	AAQC
Beryllium	7440-41-7	24 hr	0.01	AAQC
Boron	7440-42-8	24 hr	120	AAQC
Cadmium	7440-43-9	24 hr	0.025	AAQC
Cadmium	7440-43-9	Annual	0.005	AAQC
Calcium Oxide	1305-78-8	24 hr	10	AAQC
Chromium	7440-47-3	24 hr	0.5	AAQC
Cobalt	7440-48-4	24 hr	0.1	AAQC
Copper	7440-50-8	24 hr	50	AAQC
Iron	7439-89-6	24 hr	4	Standard
Ferric Oxide	1309-37-1	24 hr	25	AAQC
Lead	7439-92-1	24 hr	0.5	AAQC
Lead	7439-92-1	30 day	0.2	AAQC
Magnesium	7439-95-4	24 hr	72	SL-MD
Manganese	7439-96-5	24 hr	0.4	AAQC
Manganese in PM_{10}	7439-96-5	24 hr	0.2	AAQC
Manganese in $PM_{2.5}$	7439-96-5	24 hr	0.1	AAQC
Mercury	7439-97-6	24 hr	2	AAQC
Mercury (alkyl compounds)	7439-97-6	24 hr	0.5	AAQC
Molybdenum	7439-98-7	24 hr	120	AAQC
Nickel	7440-02-0	24 hr	0.2	AAQC
Nickel	7440-02-0	Annual	0.04	AAQC
Nickel in PM_{10}	7440-02-0	24 hr	0.1	AAQC
Nickel in PM_{10}	7440-02-0	Annual	0.02	AAQC
Phosphorus	7723-14-0	24 hr	0.5	SL-MD
Potassium	7440-09-7	24 hr	1	SL-JSL
Selenium	7782-49-2	24 hr	10	AAQC
Silver	7440-22-4	24 hr	1	AAQC
Strontium	7440-24-6	24 hr	120	AAQC
Thallium	7440-28-0	24 hr	0.5	SL-JSL
Tin	7440-31-5	24 hr	10	AAQC
Titanium	7440-32-6	24 hr	120	AAQC
Vanadium	7440-62-2	24 hr	2	AAQC
Zinc	7440-66-6	24 hr	120	AAQC
Volatile Organic Compounds				
Acetone (2-Propanone)	67-64-1	24 hr	11880	AAQC
Acrolein	107-02-8	24 hr	0.4	AAQC
Benzene	71-43-2	24 hr	2.3	AAQC
Benzene	71-43-2	Annual	0.45	AAQC
Bromodichloromethane	75-27-4	24 hr	350	SL-JSL
Bromoform	75-25-2	24 hr	55	AAQC
Bromomethane	74-83-9	24 hr	1350	AAQC
Methyl Ethyl Ketone (2-Butanone)	78-93-3	24 hr	1000	AAQC

Note: Using the CAAQS for $PM_{2.5}$ as reference levels for this study is conservative, because these criteria are based on the 98th percentile, averaged over three years.

Table 2-1: Summary of Applicable Air Quality Criteria and Standards (continued)

Contaminant Name	CAS #	Averaging Period	Air Criteria (µg/m^3)	Source of Air Criteria
Volatile Organic Compounds				
Carbon Tetrachloride	56-23-5	24 hr	2.4	AAQC
Chlorobenzene	108-90-7	1 hr	3500	AAQC
Chlorobenzene	108-90-7	10 min	4500	AAQC
Chloroethane	75-00-3	24 hr	5600	AAQC
Chloroform	67-66-3	24 hr	1	AAQC
Chloroform	67-66-3	Annual	0.2	AAQC
Chloromethane	74-87-3	24 hr	320	AAQC
Cumene	98-82-8	24 hr	400	AAQC
Dibromochloromethane	124-48-1	24 hr	0.2	SL-JSL
1,1-Dichloroethane	75-34-3	24 hr	165	AAQC
1,2-Dichloroethane	107-06-2	24 hr	2	AAQC
1,2-Dichloroethane	107-06-2	Annual	0.4	AAQC
1,1-Dichloroethylene	75-35-4	24 hr	10	AAQC
cis-1,2-Dichloroethylene	156-59-2	24 hr	105	AAQC
trans-1,2-Dichloroethylene	156-60-5	24 hr	105	AAQC
1,2-Dichloropropane	78-87-5	24 hr	2400	AAQC
Ethylbenzene	100-41-4	10 min	1900	AAQC
Ethylbenzene	100-41-4	24 hr	1000	AAQC
Ethylene Dibromide	106-93-4	24 hr	3	AAQC
Methylene Chloride (Dichloromethane)	75-09-2	24 hr	220	AAQC
Methylene Chloride (Dichloromethane)	75-09-2	Annual	44	AAQC
Styrene	100-42-5	24 hr	400	AAQC
1,1,1,2-Tetrachloroethane	630-20-6	24 hr	0.5	SL-JSL
1,1,2,2-Tetrachloroethane	79-34-5	24 hr	0.1	SL-JSL
Tetrachloroethylene	127-18-4	24 hr	360	AAQC
Toluene	108-88-3	24 hr	2000	AAQC
1,1,1-Trichloroethane	71-55-6	24 hr	115000	AAQC
1,1,2-Trichloroethane	79-00-5	24 hr	0.3	SL-JSL
Trichloroethylene	79-01-6	24 hr	12	AAQC
Trichloroethylene	79-01-6	Annual	2.3	AAQC
Vinyl Chloride (1,1-dichloroethene)	75-01-4	24 hr	1	AAQC
Vinyl Chloride (1,1-dichloroethene)	75-01-4	Annual	0.2	AAQC
Xylenes	1330-20-7	10 min	3000	AAQC
Xylenes	1330-20-7	24 hr	730	AAQC
Total D&F				
Dioxins, Furans and Dioxin-like PCBs	CDD	24 hr	0.0000001	AAQC
Polycyclic Aromatic Hydrocarbons (PAH)				
Benzo(a)pyrene	50-32-8	24 hr	0.00005	AAQC
Benzo(a)pyrene	50-32-8	Annual	0.00001	AAQC
2-Chloronaphthalene	91-58-7	24 hr	1	SL-JSL
1-Methylnaphthalene	90-12-0		35.5	SL-JSL
Naphthalene	91-20-3	24 hr	22.5	AAQC
Naphthalene	91-20-3	10 min	50	AAQC
Tetralin	119-64-2	24 hr	151.5	SL-JSL
Chloronated Organics				
1,2-Dichlorobenzene	95-50-1	1 hr	30500	AAQC
1,3-Dichlorobenzene	541-73-1	24 hr	50	SL-JSL
1,4-Dichlorobenzene	106-46-7	24 hr	95	AAQC
1,2,3-Trichlorobenzene	87-61-6	24 hr	135	SL-JSL
1,2,4-Trichlorobenzene	120-82-1	24 hr	400	AAQC
1,3,5-Trichlorobenzene	108-70-3	24 hr	3.6	SL-JSL
1,2,3,4-Tetrachlorobenzene	634-66-2	24 hr	600	SL-JSL
1,2,3,5+1,2,4,5-Tetrachlorobenzene	634-90-2 / 95-94-3	24 hr	0.1	De Minimus
Pentachlorobenzene	608-93-5	24 hr	80	SL-JSL
Hexachlorobenzene	118-74-1	24 hr	0.011	SL-JSL
2,3-Dichlorophenol	576-24-9	24 hr	0.1	De Minimus
2,4 + 2,5-Dichlorophenol	120-83-2 / 583-78-8	24 hr	0.1	De Minimus
2,6-Dichlorophenol	87-65-0	24 hr	19	SL-JSL
2,3,4-Trichlorophenol	15950-66-0	24 hr	0.1	De Minimus
2,4,5-Trichlorophenol	95-95-4	24 hr	220	SL-JSL
2,4,6-Trichlorophenol	88-06-2	24 hr	1.5	SL-JSL
3,4,5-Trichlorophenol	609-19-8	24 hr	0.1	De Minimus
2,3,4,6-Tetrachlorophenol	58-90-2	24 hr	0.75	SL-JSL
2,3,5,6-Tetrachlorophenol	935-95-5	24 hr	0.1	De Minimus
Pentachlorophenol	87-86-5	24 hr	20	AAQC

3.0 AMBIENT BACKGROUND

As described in Section 1.3 of this Study, cumulative effects are considered by adding background concentrations of each CoPC obtained from local ambient monitoring stations. Data from these local stations is used to account for impacts of major local industrial sources, transportation, residential heating and long-range transport on existing local air quality.

BCX understands that a local major source (i.e. DYEC) is planning to implement a system optimization which will increase the annual processing capacity from 140,000 tonnes per year to 160,000 tonnes per year (TPA). Since the optimization may change the ambient background for the future scenario, impacts of this optimization have been considered in the future ambient background.

The general methodology for the cumulative effect assessment is described in the formulas below. The methodology for estimating the existing and future ambient background is further described in this section.

Existing Air Quality = Modelled Impacts from Existing SMC Bowmanville Facility Operations + Existing Ambient Background

Future Air Quality = Modelled Impacts from Future SMC Bowmanville Facility Operations + Future Ambient Background

To be conservative, SMC's contribution is not subtracted from the ambient background data. Further, the existing and future ambient background concentrations are assumed to be constant. This assumption overestimates, in particular, the background for CoPCs with short-term averaging periods (e.g. $PM_{2.5}$, NO_2, SO_2, D&F, BaP, benzene, mercury and lead, etc.)

3.1 Existing Scenario

With respect to total suspended particulate (PM), fine particulate ($PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), metals, dioxins and furans (D&F) and BaP (surrogate for all PAHs), recent monitoring data (2017[1] and 2018) from the two nearby DYEC ambient stations (Rundle Road and Courtice Stations) are used to develop background levels for the existing scenario.

With respect to volatile organic compounds (VOCs), ambient monitoring data from SMC's 2018 demonstration project is used to develop the background concentrations for the existing scenario. Ambient monitoring for the SMC demonstration project took place between September and December 2018 at three locations (OPG, Cove and Beach). Wind roses of each station are

[1] DYEC's boilers were offline due to maintenance and repairs for approximately 40 days in 2017. This did not significantly change the ambient background levels.

reviewed and only data points that are true background (i.e. either upwind or downwind of the cement plant) or upwind samples were considered.

For the above CoPCs with an hourly or 24-hour criteria, the average of the 90th percentile of the data set for each station is used as the background concentrations. For the above CoPCs with an annual criterion, the average of each station's data set mean is used as the background concentrations.

With respect to carbon monoxide (CO), 1,2-dichlorobenzene, 1,2,4-trichlorobenzene, hexachlorobenzene and pentachlorophenol, background concentrations for each contaminant are taken from the *Technical Memorandum – Air Quality Impact of 160,000 TPA Waste at the DYEC* (Golder Associates Limited).

3.2 Future Scenario

To evaluate DYEC's planned system optimization, Golder Associates Limited (Golder) completed a modelling assessment in February 19, 2019 to assess compliance with all applicable Point-Of-Impingement (POI) standards. The assessment lists the modelled maximum POI concentrations for both the current and optimization scenarios. The following approach was taken to conservatively calculate background for the future scenario of this Study:

If the modelled POI concentration for the DYEC optimization scenario > the current DYEC scenario:

Future Ambient Background = *Existing Ambient Background +*
(Maximum POI Concentration for DYEC Optimization – Maximum POI Concentration for DYEC Current)

If the modelled POI concentration for the DYEC optimization scenario ≤ the current DYEC scenario:

Future Ambient Background = *Existing Ambient Background*

Table 3-1: Background Concentration Data

Contaminant	CAS No.	90th Percentile		Average		AAQC/ CAAQS	Averaging Period	Standard/ Guideline	% of AAQC	
		Existing	Future	Existing	Future				Existing	Future
Particulate										
PM	PM	-	-	3.50E+01	3.50E+01	60	Annual	AAQC	58.3%	58.3%
PM	PM	6.73E+01	6.73E+01	-	-	120	24 hr	AAQC	56.1%	56.1%
$PM_{2.5}$	PM2.5	-	-	6.34E+00	6.34E+00	8.8	Annual	CAAQS	72.1%	72.1%
$PM_{2.5}$	PM2.5	1.23E+01	1.23E+01	-	-	27	24 hr	CAAQS	45.5%	45.5%
Combustion Gases										
Nitrogen Dioxide	10102-44-0	2.01E+01	2.01E+01	-	-	200	24 hr	AAQC	10.0%	10.0%
Nitrogen Dioxide	10102-44-0	2.01E+01	2.17E+01	-	-	400	1 hr	AAQC	5.0%	5.4%
Sulphur Dioxide	7446-09-5	-	-	3.79E+00	3.79E+00	55	Annual	AAQC	6.9%	6.9%
Sulphur Dioxide	7446-09-5	8.82E+00	8.82E+00	-	-	275	24 hr	AAQC	3.2%	3.2%
Sulphur Dioxide	7446-09-5	8.82E+00	9.25E+00	-	-	690	1 hr	AAQC	1.3%	1.3%
Carbon Monoxide	630-08-0	1.27E+03	1.27E+03	-	-	15700	8 hr	AAQC	8.1%	8.1%
Carbon Monoxide	630-08-0	1.27E+03	1.27E+03	-	-	36200	1 hr	AAQC	3.5%	3.5%
Metals & Metal Oxides										
Aluminum	7429-90-5	3.55E-01	3.55E-01	-	-	12	24 hr	SL-JSL	3.0%	3.0%
Antimony	7440-36-0	3.55E-03	3.55E-03	-	-	25	24 hr	AAQC	0.01%	0.01%
Arsenic	7440-38-2	2.12E-03	2.12E-03	-	-	0.3	24 hr	AAQC	0.7%	0.7%
Barium	7440-39-3	1.48E-02	1.48E-02	-	-	10	24 hr	AAQC	0.1%	0.1%
Beryllium	7440-41-7	3.55E-04	3.55E-04	-	-	0.01	24 hr	AAQC	3.6%	3.6%
Boron	7440-42-8	1.23E-02	1.23E-02	-	-	120	24 hr	AAQC	0.01%	0.01%
Cadmium	7440-43-9	-	-	6.83E-04	6.83E-04	0.005	Annual	AAQC	13.7%	13.7%
Cadmium	7440-43-9	7.08E-04	7.08E-04	-	-	0.005	24 hr	AAQC	14.2%	14.2%
Chromium	7440-47-3	5.80E-03	5.80E-03	-	-	0.5	24 hr	AAQC	1.2%	1.2%
Cobalt	7440-48-4	7.07E-04	7.07E-04	-	-	0.1	24 hr	AAQC	0.7%	0.7%
Copper	7440-50-8	6.10E-02	6.10E-02	-	-	50	24 hr	AAQC	0.1%	0.1%
Iron	7439-89-6	7.85E-01	7.85E-01	-	-	4	24 hr	Standard	19.6%	19.6%
Ferric Oxide	1309-37-1	2.25E+00	2.25E+00	-	-	25	24 hr	AAQC	9.0%	9.0%
Lead	7439-92-1	4.45E-03	4.45E-03	-	-	0.2	30 Day	AAQC	2.2%	2.2%
Lead	7439-92-1	4.45E-03	4.45E-03	-	-	0.5	24 hr	AAQC	0.9%	0.9%
Magnesium	7439-95-4	4.73E-01	4.73E-01	-	-	72	24 hr	SL-MD	0.7%	0.7%
Manganese	7439-96-5	2.44E-02	2.44E-02	-	-	0.4	24 hr	AAQC	6.1%	6.1%
Manganese in PM_{10}	7439-96-5	2.44E-02	2.44E-02	-	-	0.2	24 hr	AAQC	12.2%	12.2%
Manganese in $PM_{2.5}$	7439-96-5	4.46E-03	4.46E-03	-	-	0.1	24 hr	AAQC	4.5%	4.5%
Mercury	7439-97-6	1.96E-05	1.96E-05	-	-	2	24 hr	AAQC	0.001%	0.001%
Mercury (alkyl compounds)	7439-97-6	1.96E-05	1.96E-05	-	-	0.5	24 hr	AAQC	0.004%	0.004%
Molybdenum	7439-98-7	3.01E-03	3.01E-03	-	-	120	24 hr	AAQC	0.003%	0.003%
Nickel	7440-02-0	-	-	1.18E-03	1.18E-03	0.04	Annual	AAQC	2.9%	2.9%
Nickel	7440-02-0	2.09E-03	2.09E-03	-	-	0.2	24 hr	AAQC	1.0%	1.0%
Nickel in PM_{10}	7440-02-0	-	-	1.18E-03	1.18E-03	0.02	Annual	AAQC	5.9%	5.9%
Nickel in PM_{10}	7440-02-0	2.09E-03	2.09E-03	-	-	0.1	24 hr	AAQC	2.1%	2.1%
Selenium	7782-49-2	3.53E-03	3.53E-03	-	-	10	24 hr	AAQC	0.04%	0.04%
Silver	7440-22-4	1.77E-03	1.77E-03	-	-	1	24 hr	AAQC	0.2%	0.2%
Strontium	7440-24-6	1.69E-02	1.69E-02	-	-	120	24 hr	AAQC	0.01%	0.01%
Thallium	7440-28-0	3.53E-03	3.53E-03	-	-	0.5	24 hr	SL-JSL	0.7%	0.7%
Tin	7440-31-5	3.54E-03	3.54E-03	-	-	10	24 hr	AAQC	0.04%	0.04%
Titanium	7440-32-6	1.81E-02	1.81E-02	-	-	120	24 hr	AAQC	0.02%	0.02%
Vanadium	7440-62-2	1.78E-03	1.78E-03	-	-	2	24 hr	AAQC	0.1%	0.1%
Zinc	7440-66-6	5.16E-02	5.16E-02	-	-	120	24 hr	AAQC	0.0%	0.0%
Volatile Organic Matter										
Acetone (2-Propanone)	67-64-1	6.50E+00	6.50E+00	-	-	11880	24 hr	AAQC	0.1%	0.1%
Benzene	71-43-2	-	-	4.84E-01	4.84E-01	0.45	Annual	AAQC	107.5%	107.5%
Benzene	71-43-2	6.27E-01	6.27E-01	-	-	2.3	24 hr	AAQC	27.3%	27.3%
Methyl Ethyl Ketone (2-Butanone)	78-93-3	8.96E-01	8.96E-01	-	-	1000	24 hr	AAQC	0.1%	0.1%
Carbon Tetrachloride	56-23-5	9.44E-01	9.44E-01	-	-	2.4	24 hr	AAQC	39.3%	39.3%
Chloromethane	74-87-3	1.16E+00	1.16E+00	-	-	320	24 hr	AAQC	0.4%	0.4%
1,2-Dichloroethane	107-06-2	-	-	9.05E-02	9.05E-02	0.4	Annual	AAQC	22.6%	22.6%
1,2-Dichloroethane	107-06-2	1.33E-01	1.33E-01	-	-	2	24 hr	AAQC	6.7%	6.7%
1,2-Dichloropropane	78-87-5	3.73E-01	3.73E-01	-	-	2400	24 hr	AAQC	0.02%	0.02%
Ethylbenzene	100-41-4	2.17E-01	2.17E-01	-	-	1000	24 hr	AAQC	0.02%	0.02%
Ethylbenzene	100-41-4	2.17E-01	2.17E-01	-	-	1900	10 Min	AAQC	0.01%	0.01%
Methylene Chloride (Dichloromethane)	75-09-2	-	-	5.00E-01	5.00E-01	44	Annual	AAQC	1.1%	1.1%
Methylene Chloride (Dichloromethane)	75-09-2	6.70E-01	6.70E-01	-	-	220	24 hr	AAQC	0.3%	0.3%
Toluene	108-88-3	7.88E-01	7.88E-01	-	-	2000	24 hr	AAQC	0.04%	0.04%
Xylenes	1330-20-7	2.60E+00	2.60E+00	-	-	730	24 hr	AAQC	0.4%	0.4%
Total D&F										
Dioxins, Furans and Dioxin-like PCBs	CDD	3.06E-08	3.06E-08	-	-	0.0000001	24 hr	AAQC	30.6%	30.6%
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)pyrene	50-32-8	-	-	3.46E-05	3.46E-05	0.00001	Annual	AAQC	345.5%	345.5%
Benzo(a)pyrene	50-32-8	6.74E-05	6.74E-05	-	-	0.00005	24 hr	AAQC	134.9%	134.9%
1-Methylnaphthalene	90-12-0	1.20E-02	1.20E-02	-	-	35.5	24 hr	SL-JSL	0.03%	0.03%
Naphthalene	91-20-3	4.52E-02	4.52E-02	-	-	22.5	24 hr	AAQC	0.2%	0.2%
Naphthalene	91-20-3	4.52E-02	4.52E-02	-	-	50	10 Min	AAQC	0.1%	0.1%
Tetralin	119-64-2	2.80E-03	2.80E-03	-	-	151.5	24 hr	SL-JSL	0.002%	0.002%
Chloronated Organics										
1,2-Dichlorobenzene	95-50-1	3.05E-02	3.05E-02	-	-	30500	1 hr	AAQC	0.0001%	0.0001%
1,2,4-Trichlorobenzene	120-82-1	5.00E-02	5.00E-02	-	-	400	24 hr	AAQC	0.01%	0.01%
Hexachlorobenzene	118-74-1	6.47E-05	6.47E-05	-	-	0.011	24 hr	SL-JSL	0.6%	0.6%
Pentachlorophenol	87-86-5	8.85E-04	8.85E-04	-	-	20	24 hr	AAQC	0.004%	0.004%

Note: DYEC's boilers were offline due to maintenance and repairs for approximately 40 days in 2017. This did not significantly change the ambient background levels.

4.0 EMISSIONS SCENARIOS AND EMISSION ESTIMATION METHODOLOGY

4.1 Emission Scenarios

This air quality study assesses the following two scenarios:

Scenario #	Description
1	Existing Operations
2	Future Operations

4.1.1 Existing Operations

The existing operations are summarized in Table 4-1. These operations include stationary emission sources from the cement plant, limestone quarry, the dock operations and CBM aggregates operations. In addition, onsite road dust, tailpipe emissions and wind erosion from open stockpiles are also included.

The existing operations consider both conventional fuels only and LCF substitution. Emissions for operations associated with the delivery and use of LCFs for the Existing scenario are estimated based on an LCF delivery and consumption rate of 96 tonnes per day, 330 days per year (assuming 1-month shutdown).

All emission sources/operations are conservatively assumed to occur at their maximum achievable rates, all the time.

4.1.2 Future Operations

The future operations are summarized in Table 4-1. The same operations for the existing scenario are assumed to occur in the future scenario with the addition of ALCF delivery and substitution.

The emissions for operations associated with the delivery and use of ALCF as defined in Section 1.2 of this report are estimated based on an ALCF consumption rate of 400 tonnes per day, 330 days per year (assuming 1-month shutdown). While normal ALCF delivery will match consumption, the Study very conservatively assumes an ALCF delivery rate of 1200 tonnes per day to reflect the possibility that additional fuel may be required to be stockpiled prior to a three-day long weekend.

No changes to other operations are expected for the Future Scenario.

Table 4-1: Emission Sources and Scenario Assumption Summary

Activity	Contaminants**	Schedule	Existing Scenario Assumptions	Future Scenario Assumptions
Cement Plant				
LCF/ALCF Delivery*	PM, $PM_{2.5}$, NO_2, SO_2, BaP, Benzene	24 hours per day 7 days per week 11 months per year	100 tonnes/day (LCF)	1200 tonnes/day (ALCF)
Raw Material Delivery/Transfer*	PM, $PM_{2.5}$, NO_2, SO_2, BaP, Benzene	24 hours per day 7 days per week 11 months per year	Based on a maximum clinker production rate of 229 tonne/hr, 5500 tonnes/day and 1,815,000 tonne/year	Same as Existing
Kiln Stack	PM, $PM_{2.5}$, NO_2, SO_2, HCl, NH_3, metals, VOCs, PAHs, D&Fs, etc.	24 hours per day 7 days per week All year round	Based on a maximum clinker production rate of 229 tonne/hr, 5500 tonnes/day and 1,815,000 tonne/year and an LCF consumption rate of 96 tonnes/day	Based on a maximum clinker production rate of 5500 tonnes/day and fuel consumption rate as described in Calculation Sheet 1B in Appendix D
Various Baghouses for Raw Material and Product Storage	PM, $PM_{2.5}$	24 hours per day 7 days per week All year round	Based on a maximum clinker production rate of 229 tonne/hr, 5500 tonnes/day and 1,815,000 tonne/year	Same as Existing
Product Shipping*	PM, $PM_{2.5}$, NO_2, SO_2, BaP, Benzene	24 hours per day 7 days per week 11 months per year	Based on a maximum clinker production rate of 229 tonne/hr, 5500 tonnes/day and 1,815,000 tonne/year	Same as Existing
Limestone Quarry				
Blasting	PM, $PM_{2.5}$, NO_2, SO_2, CO	12pm – 1pm 7 days per week	2 blasts per hour 2 blasts per day 100 blasts per year	Same as Existing
Drilling	PM, $PM_{2.5}$, NO_2, SO_2, CO	2 holes per hour 20 holes per day 5400 holes per year	2 holes per hour 20 holes per day 5400 holes per year	Same as Existing
Limestone Processing and Handling	PM, $PM_{2.5}$	24 hours per day 7 days per week 11 months per year	60000 tonnes/day blasted 1500 tonnes/day processed in the quarry	Same as Existing
Limestone Transfer to Cement Plant*	PM, $PM_{2.5}$, NO_2, SO_2, BaP, Benzene	24 hours per day 7 days per week 11 months per year	8500 tonnes/day brought aboveground to be processed for Cement Plant	Same as Existing
Dock Area				
Raw Material and Fuel Receiving at Dock*	PM, $PM_{2.5}$, NO_2, SO_2, BaP, Benzene	24 hours per day 7 days per week 11 months per year	Based on a maximum clinker production rate of 229 tonne/hr, 5500 tonnes/day and 1,815,000 tonne/year	Same as Existing
Raw Material and Fuel Transfer to Plant*	PM, $PM_{2.5}$, NO_2, SO_2, BaP, Benzene	24 hours per day 7 days per week 11 months per year	Based on a maximum clinker production rate of 229 tonne/hr, 5500 tonnes/day and 1,815,000 tonne/year	Same as Existing

Table 4-1: Emission Sources and Scenario Assumption Summary (continued)

Activity	Contaminants**	Schedule	Existing Scenario Assumptions	Future Scenario Assumptions
CBM Aggregates				
Aggregate Processing	PM, $PM_{2.5}$, NO_2, SO_2, BaP, Benzene	24 hours per day 7 days per week 11 months per year	Based on a processing rate of 65 tonnes/hr, 15000 tonnes/day and 450000 tonnes/year	Same as Existing
Aggregate Transfer*	PM, $PM_{2.5}$, NO_2, SO_2, BaP, Benzene	24 hours per day 7 days per week 11 months per year	Based on a processing rate of 65 tonnes/hr, 15000 tonnes/day and 450000 tonnes/year	Same as Existing
Aggregate Shipping*	PM, $PM_{2.5}$, NO_2, SO_2, BaP, Benzene	24 hours per day 7 days per week 11 months per year	Based on a processing rate of 65 tonnes/hr, 15000 tonnes/day and 450000 tonnes/year	Same as Existing

Note:
* Including mobile road dust and tailpipe emissions associated with these activities.
** Although transportation is not a major source of SO_2, SO_2 emissions from onsite traffic have been included for the cumulative impact assessment due to major source onsite (Kiln stack) and offsite (DYEC).

4.2 Emission Estimation Methodologies

Potential air emissions are calculated using the practices set out in the Ministry's guidance documents under Reg. 419.

Emissions of CoPCs from the kiln stack are estimated using the 2018 Ministry approved source testing data which measured emissions from the use of conventional fuel only, LCF substitution and ALCF substitution. Emissions of CoPC from other sources such as the limestone quarry, road dust and baghouses are estimated using published emission factors (US Environmental Protection Agency and the Ministry), engineering estimates, mass balance, and manufacturer's performance specifications. With the exception of road dust, tailpipe and wind erosion, these methodologies have all been reviewed and approved by the Ministry as part of Facility's ECAs.

4.2.1 Emissions from the Kiln Stack

<u>Existing Scenario</u>

The average of the 2018 source testing results for baseline and for LCF substitution (96 tonnes per day) is assumed to be a representative realistic maximum emission rate for each contaminant from the kiln stack. Details of this methodology is presented in Appendix D.

<u>Future Scenario</u>

With respect to total suspended particulate, $PM_{2.5}$, NO_2, SO_2, NH_3 and CO, kiln stack emissions are dominated by conditions of the kiln system and associated air pollution control equipment. These conditions are not expected to change for the future scenario. The average of the 2018 source testing results for baseline, LCF substitution and alternative fuel substitution is assumed to be the representative realistic maximum kiln stack emission rate for these CoPCs.

With respect to all other CoPCs, emission factors (g/tonne of fuel input) are derived from the 2018 source testing results for baseline, LCF substitution and ALCF substitution. Since the 2018 ALCF demonstration source test allowed for the use of only 12 tonnes of ALCF per hour, emission rates for the future scenario are scaled up to account for the requested ALCF substitution rate (16 tonnes per hour) using the derived emission factors. This is expected to be very conservative because the source testing and associated modelling exercises to date indicate that there is no statistically significant change as a result of the use of LCF/ALCF and conventional fuels. Details of this methodology is presented in Appendix D.

It is important to note that, although the 2018 demonstration projects showed decreases in kiln stack emissions for more than 50% of the CoPCs when LCF/ALCF were used, no decrease in kiln stack emissions is assumed for the future scenario.

4.2.2 Emissions from Other Stationary Sources

Emissions from other onsite stationary sources including material delivery, transfers, and storage are calculated using published emission factors, engineering estimates and mass balance estimates. These methods are used in the current ESDM reports supporting the Facility's ECAs.

4.2.3 Emissions from Wind Erosion

Emissions from wind erosion are calculated using the "fastest mile method" in US EPA AP-42, Section 13.2.4 Industrial Wind Erosion, November 2006. Details of this methodology is presented in Appendix D.

4.2.4 Road Dust Emissions from Vehicle Traveling on Unpaved Roads

Road dust emissions associated with vehicle travel on onsite unpaved roads are estimated using emission factors from US EPA AP-42 Section 13.2.2 Unpaved Roads, November 2006. Details of this methodology is presented in Appendix D.

4.2.5 Road Dust Emissions from Vehicle Traveling on Paved Roads

Road dust emissions associated with vehicle travel on paved roads are estimated using emission factors from US EPA AP-42 Section 13.2.1 Paved Roads, January 2011. Details of this methodology is presented in Appendix D.

4.2.6 Tailpipe Emissions from On-Road Vehicles

Tailpipe emissions including travelling exhaust, brake wear, tire wear and idling for on-road trucks associated with SMC's operations (raw material delivery and transfer trucks and cement shipping trucks) are obtained using US EPA's Motor Vehicle Simulator (MOVES 2014b). A summary of the MOVES input assumptions is presented in the table below. The tailpipe emission factors are presented in Appendix C. Details of tailpipe emission calculations are presented in Appendix D.

Parameter	Input Description
Scale/Geographic Bounds	Custom County Domain
Year	2019
Meteorological Data	Toronto Pearson International Airport
Vehicles	Short/Long-Haul Trucks
Fuel Type	Diesel
Road Type	Rural Unrestricted
Speed	< 2.5mph (idling), 7.5mph <= speed < 12.5mph (onsite travel)
Pollutants	PM_{10} (representing TSP), $PM_{2.5}$, NO_2, SO_2, Benzene, Benzo(a)pyrene

Note: Tailpipe emissions from transportation are not considered a significant source of SO_2 due to the stringent government sulphur limits on fuels. However, since there are major SO_2 sources (i.e., the cement kiln and the DYEC stacks), SO_2 emissions from onsite traffic were included in the study to assess cumulative effects.

4.2.7 Tailpipe Emissions for Non-Road Vehicles

The tailpipe emissions for non-road vehicles including quarry haul trucks and front-end loaders are considered for this study. Particulate, NO_2 and SO_2 emissions are estimated using US EPA tiered emission standards/factors from the document "Nonroad Compression-Ignition Engines: Exhaust Emission Standards", March 2016.

Emission standards/factors for benzene and BaP are not available and, therefore, emissions of benzene and BaP are estimated using speciation profiles from the MOVES document "Speciation Profiles and Toxic Emission Factors for Non-road Engines", November 2015. Specifically:

- Benzene emissions are calculated using the ratio of VOC/NMHC, applied to the non-methane hydrocarbons (NMHC) emission standard from the "Nonroad Compression-Ignition Engines: Exhaust Emission Standards" document; and
- BaP emissions are calculated using the ratio of BaP/PM, applied to the PM emission standard from the "Nonroad Compression-Ignition Engines: Exhaust Emission Standards" document.

Details of this methodology is presented in Appendix D.

5.0 AIR DISPERSION MODELLING

5.1 Model Selection and Use

Air dispersion modelling for this air quality study is undertaken using the Ministry's approved AERMOD model (version 16216r).

AERMOD is a Ministry approved steady-state Gaussian plume dispersion modelling system that can be used to assess pollutant concentrations from a wide variety of complex industrial settings including multiple stacks, fugitive emissions, building wake effects and roads. The AERMOD modelling system was developed by the AMS/EPA Regulatory Model Improvement Committee (AERMIC) and consists of two pre-processors (AERMET and AERMAP) and the dispersion model, AERMOD.

AERMET is a general-purpose meteorological pre-processor which uses surface and upper air meteorological conditions together with surface characteristics to calculate the boundary layer parameters needed by AERMOD. AERMAP is the terrain pre-processor used to calculate a representative terrain-influenced height associated with each receptor within the modelling domain.

The AERMOD model calculates maximum hourly concentrations using local meteorological data, which the model subsequently uses to predict off-site concentrations over other averaging periods such as 24-hour and annual.

5.2 General Settings

Dry and wet deposition, and dry and wet depletion of the plume have been disabled for AERMOD to produce the maximum ambient air concentration results.

5.3 Meteorology

The Ministry supplied site-specific meteorological data set used for the current ESDM report (2004-2008, AERMET Version 16216) is used for the modelling exercise.

5.4 Terrain

The terrain data used (cdem__030M in GeoTIFF format) Datum NAD83, UTM Zone 17, is downloaded from Ontario Digital Elevation Model Data on the Ministry's website.

5.5 Modelling Domain and Receptor Grid

The modeling domain is defined by a tiered receptor grid centred on the kiln stack and extending out approximately 5km in all directions. Grid spacing is determined according to the *Ministry Air Dispersion Modelling Guideline for Ontario (February 2017),* (ADMGO).

In addition, a set of 128 discrete sensitive receptors are also included in the Study. These receptors represent the following five communities (see Figure 1-1):

R1: Residential subdivision north of Baseline Road;
R2: Residential community along Lake Ontario;
R3: Agricultural farmhouses north of the 401 and south of Baseline Road;
R4: Legal non-conforming home north of the plant and south of the 401 (zoned light industrial); and
R5: Residential subdivision north and east of the intersection of Baseline Road and Liberty Street South.

Two discrete receptors are also included for the two Durham-York Energy Centre (DYEC) ambient monitoring stations (Rundle Road and Courtice), located approximately 2.5km and 4.5km, respectively, west of the cement plant.

5.6 Source Inputs

For this modelling assessment, point sources are used for primary stacks including the kiln stack. Volume sources were used for groups of baghouse dust collectors and fugitive emissions (e.g. material delivery, handling and storage). Line volume sources are used for onsite road dust and tailpipe emissions. Emissions from the limestone quarry below grade are modelled as two open pit sources, one for the material drop points and one for the remaining activities. The particle size distributions for the two open pit sources are provided in Appendix F.

5.7 Shoreline Effect Assessment

The Facility's kiln stack has a height of 105m above grade and is located within 600m from the shoreline of Lake Ontario. The temperature difference between water and land can result in reduced air dispersion. This shoreline effect is referred as shoreline fumigation in the ADMGO. As required by ADMGO, a shoreline effect screening assessment is completed for this source using the Screen3 model. The screening assessment concluded that the shoreline effects may occur. A shoreline effect assessment is, therefore, completed using the CALPUFF model (Version 7) to generate "shoreline effect factors" which are then incorporated in the AERMOD modelling input for the kiln stack to account for potential impact of shoreline effects. Details of the shoreline effect assessment is presented in Appendix E.

6.0 RESULTS

Through the public consultation process, the following contaminants are identified as being of particular concern (Key CoPCs):

Criteria Air Contaminants	Hydrochloric Acid (HCl) and Chlorinated Organics	Non-Chlorinated Organics and Metals
• $PM_{2.5}$ • NO_2 • SO_2	• HCl • D&F and Dioxin-Like PCBs • 1,1,2,2-Tetrachloroethane	• Benzene • BaP • Mercury • Lead

This section provides results for the key CoPCs for the following assessments in the five communities in the vicinity of the Facility:

(1) the assessment of cumulative effects, where modelling results are added to the ambient background where available and then compared to the applicable reference levels; and
(2) the assessment of change in local air quality as a result of the use of ALCF.

The study takes a very conservative approach to provide the community with a high level of confidence in the study conclusions. This means that the predicted future air quality and change in air quality are over-estimated**.**

The maximum modelled concentrations in the five communities for the existing and future scenarios for all CoPCs are presented in Appendix G.

6.1 Assessment of Cumulative Effects

This section presents a summary of the air dispersion modelling results for each CoPC by averaging period. As discussed in Section 3.0, where applicable, ambient background concentrations are added to the predicted off-site air concentrations to determine overall local air quality impacts as a result of the use of ALCF.

The study results for the key CoPCs at offsite sensitive receptors representing the five closest communities (i.e. R1 to R5) for both the existing and future scenarios, are presented in Table 6-1.

All CoPCs are below their respective reference levels at all sensitive receptors in each of the five communities (i.e. R1 to R5), without background added.

With the exception of benzene (annual) and BaP (24 hour and annual), all CoPCs are below their respective AAQCs/reference levels at all sensitive receptors in each of the five communities, with background added (i.e. cumulative results).

With respect to benzene (annual) and BaP (24 hour and annual), the exceedance of their AAQCs is a result of elevated background concentrations. Background concentrations for benzene (annual criterion) and benzo(a)pyrene (24-hour and annual criteria) measured at the local ambient monitoring stations are similar to background concentrations measured across the province (i.e. it is not a localized phenomenon). Relative to background concentrations, the contribution from SMC is small.

6.2 Assessment of Change in Local Air Quality

This section presents a summary of the conservatively estimated change in cumulative concentrations for each CoPC by averaging period. As discussed in Sections 3 and 4, the Study purposefully does not permit a reduction in cumulative concentrations as a result of the use of ALCF, so as to provide a worst-case change.

The predicted change for the key CoPCs at offsite sensitive receptors representing five closest communities (i.e. R1 to R5) between the existing and future scenarios, are presented in Table 6-2.

As presented in the table, for the more densely populated communities (i.e. R1, R2, R5), the predicted worst-case change in cumulative air quality is less than 3% of the applicable ambient air quality criteria. For agricultural lands north of the 401 (i.e. R3), the predicted worst-case change in cumulative air quality is less than 4.5% of the applicable ambient air quality criteria. For the legal non-conforming home on light industrial lands south of the 401 (i.e. R4), the predicted worst-case change in cumulative air quality is less than 6% of the applicable ambient air quality criteria.

Table 6-1 Assessment of Cumulative Effects from the Use of ALCF in the Communities

Contaminant	Averaging Period	Air Quality Criteria (µg/m^3)	Background Concentration (µg/m^3)	Background % of Criteria	R1		R2		R3		R4		R5	
					Max. Concentration (µg/m^3)	% of Criteria	Max. Concentration (µg/m^3)	% of Criteria	Max. Concentration (µg/m^3)	% of Criteria	Max. Concentration (µg/m^3)	% of Criteria	Max. Concentration (µg/m^3)	% of Criteria
Criteria Air Contaminants														
$PM_{2.5}$	24 hr	27	12.3	45.5%	16.6	61.6%	19.2	70.9%	19.5	72.2%	20.8	76.9%	14.8	54.9%
$PM_{2.5}$	Annual	8.8	6.3	72.1%	6.6	74.5%	7.4	84.0%	6.9	78.2%	7.3	83.0%	6.5	73.8%
Nitrogen Dioxide	1 hr	400	21.7	5.4%	154.2	38.6%	119.6	29.9%	204.6	51.2%	205.4	51.4%	100.0	25.0%
Nitrogen Dioxide	24 hr	200	20.1	10.0%	53.7	26.8%	47.0	23.5%	76.3	38.2%	83.9	41.9%	30.5	15.2%
Sulphur Dioxide	1 hr	690	9.2	1.3%	230.7	33.4%	101.0	14.6%	295.2	42.8%	321.7	46.6%	141.8	20.5%
Sulphur Dioxide	24 hr	275	8.8	3.2%	59.2	21.5%	42.2	15.4%	92.6	33.7%	102.3	37.2%	18.7	6.8%
Sulphur Dioxide	Annual	55	3.8	6.9%	4.8	8.8%	7.5	13.7%	5.6	10.2%	5.5	10.0%	4.6	8.4%
Hydrochloric Acid (HCl) & Chloronated Organics														
Hydrochloric Acid	24 hr	20	-	-	0.7	3.4%	0.4	2.2%	1.1	5.6%	1.3	6.3%	0.1	0.7%
Dioxins, Furans and Dioxin-like PCBs	24 hr	0.0000001	0.00000003	30.6%	0.00000003	31.6%	0.00000003	31.2%	0.00000003	32.3%	0.00000003	32.5%	0.00000003	30.8%
1,1,2,2-Tetrachloroethane	24 hr	0.1	-	-	0.0001	0.09%	0.0001	0.06%	0.0001	0.14%	0.0002	0.16%	0.00002	0.02%
Non-Chloronated Organics & Metals														
Benzene	24 hr	2.30	0.6	27.3%	0.75	32.8%	0.71	30.9%	0.84	36.5%	0.86	37.5%	0.65	28.3%
Benzene	Annual	0.45	0.5	107.5%	0.486	108.0%	0.491	109.2%	0.488	108.5%	0.487	108.3%	0.486	107.9%
Benzo(a)pyrene	24 hr	0.00005	0.00007	134.9%	0.000077	154.2%	0.000079	158.0%	0.000084	167.6%	0.000088	176.3%	0.000072	143.5%
Benzo(a)pyrene	Annual	0.00001	0.00003	345.5%	0.00004	350.1%	0.00004	370.0%	0.00004	359.2%	0.00004	371.8%	0.00003	348.9%
Mercury	24 hr	0.50	0.00002	0.004%	0.0003	0.06%	0.0002	0.04%	0.0005	0.1%	0.0005	0.1%	0.0001	0.016%
Lead	24 hr	0.50	0.004	0.9%	0.005	1.0%	0.006	1.2%	0.006	1.2%	0.006	1.2%	0.005	1.0%
Lead	30 day	0.20	0.004	2.2%	0.005	2.4%	0.005	2.5%	0.005	2.5%	0.005	2.5%	0.005	2.3%

Table 6-2 Assessment of Change in Air Quality from the Use of ALCF in the Communities

Contaminant	Averaging Period	Air Quality Criteria (µg/m³)	Existing Background Concentration (µg/m³)	Future Background Concentration (µg/m³)	Existing Background % of Criteria	Future Background % of Criteria	R1 Change in % of Criteria (Future - Existing)	R2 Change in % of Criteria (Future - Existing)	R3 Change in % of Criteria (Future - Existing)	R4 Change in % of Criteria (Future - Existing)	R5 Change in % of Criteria (Future - Existing)
Criteria Air Contaminants											
$PM_{2.5}$	24 hr	27	12.3	12.3	45.5%	45.5%	0.2%	0.1%	0.1%	0.1%	0.1%
$PM_{2.5}$	Annual	8.8	6.3	6.3	72.1%	72.1%	0.01%	0.03%	0.04%	0.08%	0.01%
Nitrogen Dioxide	1 hr	400	20.1	21.7	5.0%	5.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Nitrogen Dioxide	24 hr	200	20.1	20.1	10.0%	10.0%	0.002%	0.035%	0.002%	0.026%	0.019%
Sulphur Dioxide	1 hr	690	8.8	9.2	1.3%	1.3%	2.3%	1.0%	3.0%	3.3%	1.4%
Sulphur Dioxide	24 hr	275	8.8	8.8	3.2%	3.2%	1.3%	0.8%	2.2%	2.4%	0.2%
Sulphur Dioxide	Annual	55	3.8	3.8	6.9%	6.9%	0.1%	0.4%	0.2%	0.2%	0.1%
Hydrochloric Acid (HCl) & Chloronated Organics											
Hydrochloric Acid	24 hr	20	-	-	-	-	1.5%	1.0%	2.5%	2.8%	0.3%
Dioxins, Furans and Dioxin-like PCBs	24 hr	0.0000001	0.00000003	0.00000003	30.6%	30.6%	0.2%	0.1%	0.3%	0.4%	0.04%
1,1,2,2-Tetrachloroethane	24 hr	0.1	-	-	-	-	0.01%	0.01%	0.02%	0.02%	0.002%
Non-Chloronated Organics & Metals											
Benzene	24 hr	2.30	0.6	0.6	27.3%	27.3%	1.4%	0.9%	2.4%	2.7%	0.3%
Benzene	Annual	0.45	0.5	0.5	107.5%	107.5%	0.1%	0.4%	0.3%	0.2%	0.1%
Benzo(a)pyrene	24 hr	0.00005	0.00007	0.00007	134.9%	134.9%	2.8%	1.1%	4.5%	5.8%	0.7%
Benzo(a)pyrene	Annual	0.00001	0.00003	0.00003	345.5%	345.5%	0.3%	1.0%	0.6%	1.0%	0.3%
Mercury	24 hr	0.50	0.00002	0.00002	0.004%	0.004%	0.03%	0.02%	0.05%	0.06%	0.01%
Lead	24 hr	0.50	0.004	0.004	0.9%	0.9%	0.03%	0.002%	0.08%	0.09%	0.002%
Lead	30 day	0.20	0.004	0.004	2.2%	2.2%	0.03%	0.002%	0.08%	0.08%	0.002%

7.0 ODOURS

There will be no odours in the community from the use of ALCF because the ALCF will not contain putrescible materials and the delivery, storage and transfer of the ALCF will be entirely enclosed.

8.0 CONCLUSIONS

No significant cumulative local air quality impacts in the community are expected as a result of the proposed future use of ALCF. This is because using very conservative assumptions and conservative local background levels for this Study, all CoPCs are below their respective reference levels at all sensitive receptors in each of the five communities except for benzene (annual) and BaP (24 hour and annual). With respect to these two CoPCs, the background levels locally and across the province are well above their respective ambient air quality criteria. The contribution from the plant to the cumulative concentrations for these two CoPCs are small and on their own are well below the AAQCs.

No significant change in local air quality in the community is expected as a result of the use of ALCF. This is because the predicted change in cumulative impacts is very small, even when the study purposefully over-estimates the emissions associated with the future use of ALCF.

These conclusions are consistent with the "Alternative Fuel Demonstration Project Summary Report", prepared by BCX, dated May 2019.

9.0 REFERENCES

BCX Environmental Consulting. "Alternative Fuel Demonstration Project Summary Report." May 2019.

Canadian Council of Ministers of the Environment (CCME). "Canadian Ambient Air Quality Standards (CAAQs)." February 2017.

Golder Associates Limited. "Technical Memorandum - Air Quality Impact of 160,000 TPA Waste at Durham York Energy Centre." February 19, 2019.

HDR Inc. (HDR). "Alternative Fuel Demonstration Project Summary Waste Report." May 2019.

Ministry of the Environment, Conservation and Parks (Ministry). "Air Dispersion Modelling Guideline for Ontario, Version 3.0." February 2017.

Ministry of the Environment, Conservation and Parks (Ministry). "Ontario's Ambient Air Quality Criteria." December 2016.

Ministry of the Environment, Conservation and Parks (Ministry). "Procedure for Preparing an Emission Summary and Dispersion Modelling Report, Version 4.1." March 2018.

U.S. EPA. "Compilation of Air Pollutant Emission Factors (AP-42) Volume I: Appendix A, Miscellaneous Data & Conversion Factors." September 1985.

U.S. EPA. "Compilation of Air Pollutant Emission Factors (AP-42) Volume I: Chapter 11.19.2, Crushed Stone and Pulverized Mineral Processing." August 2004.

U.S. EPA. "Compilation of Air Pollutant Emission Factors (AP-42) Volume I: Chapter 13.2.1, Paved Roads." January 2011.

U.S. EPA. "Compilation of Air Pollutant Emission Factors (AP-42) Volume I: Chapter 13.2.2, Unpaved Roads." November 2006.

U.S. EPA. "Compilation of Air Pollutant Emission Factors (AP-42) Volume I: Chapter 13.2.4, Aggregate Handling and Storage Piles." November 2006.

U.S. EPA. "Compilation of Air Pollutant Emission Factors (AP-42) Volume I: Chapter 3.3, Gasoline and Diesel Industrial Engines." October 1996.

U.S. EPA. "MOVES2014a User Guide." November 2015.

U.S. EPA. "Speciation Profiles and Toxic Emission Factors for Non-road Engines." 2015.

Jacques-Whiteford, "Air Quality Assessment - Technical Study Report, Durham York Residual Waste Study." December 4, 2009.

Appendix A

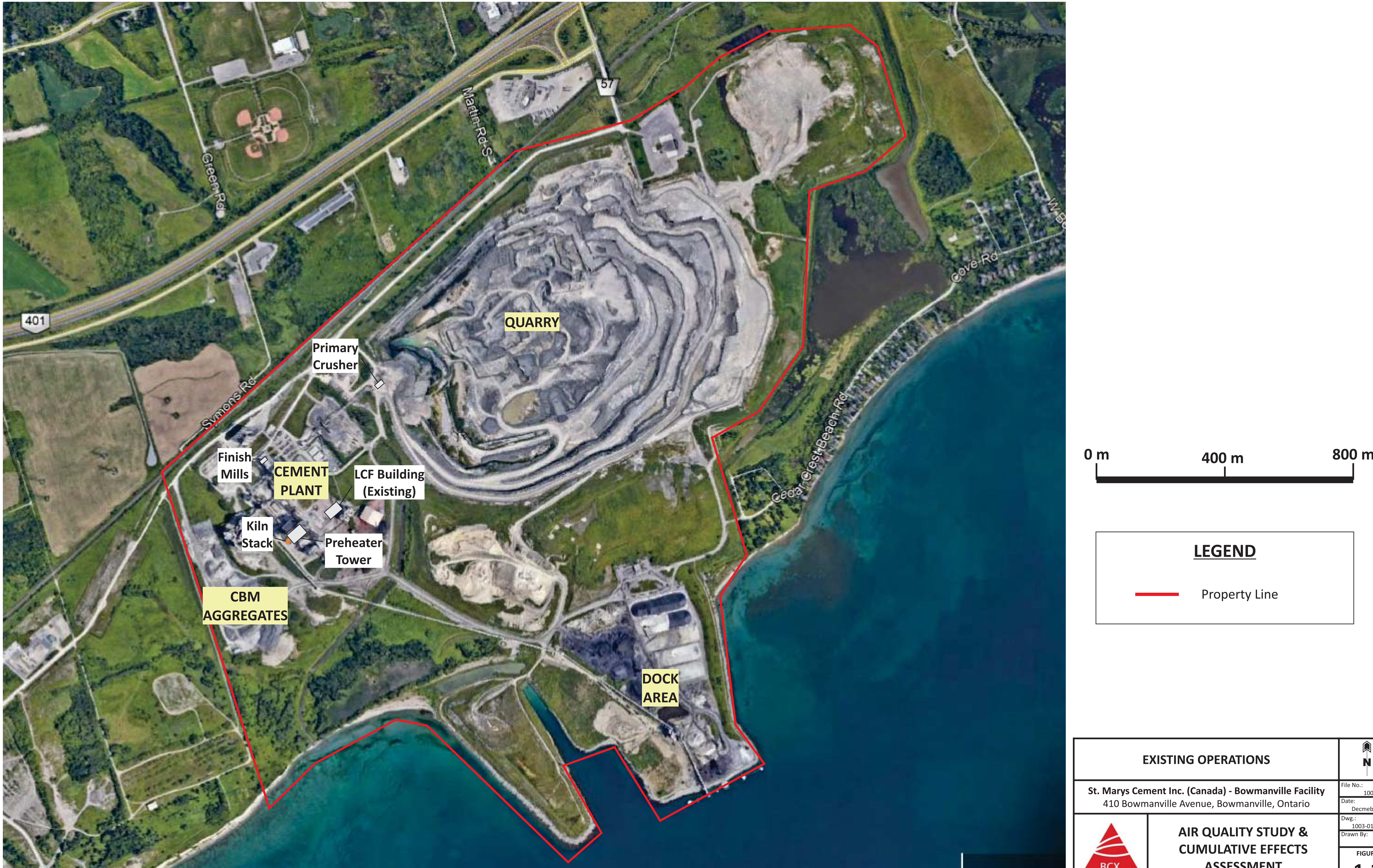
Figures

0 km 1.5 km 3 km

LEGEND

- Receptor
- Ambient Air Monitoring Station
- Property Line
- 10km x 10km Study Area

STUDY AREA AND RECEPTORS	N
St. Marys Cement Inc. (Canada) - Bowmanville Facility 410 Bowmanville Avenue, Bowmanville, Ontario	File No.: 1003-01.54 Date: December 2019
BCX — **AIR QUALITY STUDY & CUMULATIVE EFFECTS ASSESSMENT**	Dwg.: 1003-01.54_1-1 Drawn By: MO FIGURE **1-1**



EXISTING OPERATIONS

St. Marys Cement Inc. (Canada) - Bowmanville Facility
410 Bowmanville Avenue, Bowmanville, Ontario

BCX

AIR QUALITY STUDY & CUMULATIVE EFFECTS ASSESSMENT

File No.: 1003-01.54
Date: December 2019
Dwg.: 1003-01.54_1-2
Drawn By: MO

FIGURE 1-2

0 m 400 m 800 m

LEGEND

Property Line

Truck route

PROPOSED FUTURE OPERATIONS

St. Marys Cement Inc. (Canada) - Bowmanville Facility
410 Bowmanville Avenue, Bowmanville, Ontario

BCX

AIR QUALITY STUDY & CUMULATIVE EFFECTS ASSESSMENT

File No.: 1003-01.54
Date: December 2019
Dwg.: 1003-01.54_1-3
Drawn By: MO

N

FIGURE 1-3

Appendix B

Detailed Assumptions of Modelling Scenarios

Input Sheet

Delivery Rates				
Average Rates	Source ID	Material Rates (tonnes)		
		1 hr	24 hr	Annual
Cement Plant				
FEL delivery of Slag to Hopper	SGHOPPER-1	10	250	75020
FEL delivery of Gypsum to Hopper	SGHOPPER-2	10	250	75020
Delivery of Fuel to Fuel Hopper	FUELH-1	30	550	178600
Delivery of Ash to Stockpile	RAWPILES-1A	40	40	8930
Delivery of Sand to Stockpile	RAWPILES-2A	40	80	20850
Delivery of Iron to Stockpile	RAWPILES-3A	40	200	59550
Transfer to Raw Material Hopper	RAWSILO-10	20	75	20850
Delivery of Overburden to Stockpile	n/a	20	375	119100
Delivery of Gypsum/CKD to Stockpile	n/a	10	250	75020
Delivery of LCF (Existing) to ALCF Building	ALCF-1	20	100	33000
Delivery of ALCF (Future) to ALCF Building	ALCF-2	60	1200	132000
Material (Muck) Loading into Primary Crusher	QUARRY-3, PCRUSH-1	400	8500	2784400
Crushed Limestone from Crusher to Primary Stockpile	PPILE1A	300	7000	2310000
Cement Production	n/a	200	4000	1320000

Cargo Dockers Activities				
Activity	Source ID	Material Rates (tonnes)		
		1 hr	24 hr	Annual
Cargo Dockers - Transfer to Temporary Pile from Ship	CD-1A	40	250	75020
Cargo Dockers - Transfer to Shipping Truck	CD-4	40	250	75020

Quarry Activities				
Activity	Source ID	1 hr	24 hr	Annual
Number of Blasts	QUARRY-1	2	2	100
Amount Blasted (tonnes)		60000	60000	3037550
Average Bench Height		13.5		
Rock Density (tonnes/m^3)		2.7		
Mass of ANFO used (tonnes)		11	11	550
Drilling Rate (holes)	QUARRY-2	2	20	5400

CBM				
Activity	Source ID	Material Rates (tonnes)		
		1 hr	24 hr	Annual
Delivery of HL6 to CBM stockpiling area	CBM-2	80	100	25000
Delivery of 50mm (run) to CBM stockpiling area	CBM-3	40	500	150000
Delivery of 50mm (clear) to CBM stockpiling area	CBM-4	40	100	10000
Primary Crusher (Quarry)	QUARRY-4	65	1500	450000
Secondary Crusher (Quarry)	QUARRY-7	65	1500	450000
Quarry Drops	QUARRY-8	65	1500	450000
Shipment of materials offsite (CBM)	CBM-6	0	0	450000

Truck Trips	Source ID		Trip Distance - One Way (km)	Number of Trucks / Trips			Empty Truck Weight (tonnes)	Load Weight (tonnes)	Loaded Truck Weight (tonnes)	Road Type
	Road Dust	Tailpipe		1 hr	24 hr	Annual				
Cement Plant										
FEL feeding the raw material feed hopper	RAWSILO-10	RAWSILO-11	0.05	4	8	2085	17	10	27	Paved
FEL operating in CBM area	CBM-7	CBM-8	0.12	16	70	45000	17	10	27	Unpaved
FEL loading Haul Truck	QUARRY-10	QUARRY-11	0.12	40	850	278440	17	10	27	Unpaved
Cargo Dockers										
FEL moving materials	CD-2	CD-3	0.95	4	25	7502	17	10	27	Unpaved
Material Delivery and Shipping										
Iron & Sand Delivery - Paved Roads	R1-1	T1-1	1.74	1	10	2978	19	40	59	Paved
CBM Materials Shipping - Paved Roads	R1-2	T1-2	1.74	0	0	11250	19	40	59	Paved
Iron & Sand Delivery - Unpaved Roads	R2	T2	1.20	1	10	2978	19	40	59	Unpaved
CBM Materials Shipping - Unpaved Roads	R3	T3	1.28	0	0	11250	39.3	50	89.3	Unpaved
Ash Delivery - Paved Roads	R4-1	T4-1	1.28	1	1	224	19	40	59	Paved
LCF Delivery - Paved Roads (Existing)	R4-2	T4-2	1.28	1	5	1650	19	20	39	Paved
ALCF Delivery - Paved Roads (Future)	R4-3	T4-3	1.28	3	60	6600	19	20	39	Paved
Ash Delivery - Unpaved Roads	R5	T5	0.86	1	1	224	19	40	59	Unpaved
LCF Delivery - Unpaved Roads (Existing)	R6-1	T6-1	0.65	1	5	1650	19	20	39	Unpaved
ALCF Delivery - Unpaved Roads (Future)	R6-2	T6-2	0.65	3	60	6600	19	20	39	Unpaved
Overburden Delivery - Unpaved Roads	R7	T7	3.12	1	8	2382	39.3	50	89.3	Unpaved
Haul Truck to Primary Crusher - Unpaved Roads	R8	T8	1.77	8	170	55688	39.3	50	89.3	Unpaved
Fuel Delivery - Unpaved Roads	R9	T9	0.82	1	14	4465	19	40	59	Unpaved
CKD/Gypsum Delivery - Unpaved Roads	R10	T10	0.79	8	175	57750	19	40	59	Unpaved
Finished Cement Shipping - Paved Roads	R11	T11	1.66	8	175	57750	19	40	59	Unpaved

Appendix C

MOVES Emission Factors

MOVES Emission Factors

Year	Vehicle Type	Source Type ID	Contaminant	CAS Number	Idle (g/VMT)	Travel Onsite (g/VMT)
2019	Aggregate/Limestone truck	53	PM_{10}[1]	PM	3.75E+00	9.49E-01
2019	Aggregate/Limestone truck	53	$PM_{2.5}$	PM2.5	1.86E+00	3.39E-01
2019	Aggregate/Limestone truck	53	NO_2	10102-44-0	3.59E+01	5.99E+00
2019	Aggregate/Limestone truck	53	SO_2	7446-09-5	1.25E-01	2.26E-02
2019	Aggregate/Limestone truck	53	Benzene	71-43-2	6.80E-02	1.16E-02
2019	Aggregate/Limestone truck	53	Benzo(a)pyrene	50-32-8	3.00E-04	4.49E-05
2019	Aggregate/Limestone truck	53	CO	630-08-0	2.19E+01	5.03E+00

Notes:

1. It is assumed that total suspended particulate (PM) is equivalent to PM_{10}.

Appendix D

Key Emission Calculation Sheets

Calculation Sheet 1A - Kiln Stack Emissions - Existing

With respect to the kiln stack emissions for the existing scenario, the average of the 2019 source testing results for baseline, low carbon fuel substitution (96 tonne of woody material/day) and post baseline was assumed as the representative realistic maximum emission rate for each contaminant.

Contaminant	CAS Number	Emission Rate (g/s)				Emission Technique	Data Quality
		Conventional Fuel (Oct 2018)	Low Carbon Fuel (Dec 2018)	Post Baseline (Dec 2018)	Average		
Particulate							
PM	PM	2.02E+00	1.22E+00	4.12E+00	2.45E+00	V-ST	Above-Average
PM2.5	PM2.5	1.84E-01	2.12E-01	1.75E-01	1.90E-01	V-ST	Above-Average
Combustion Gases							
NO_2	10102-44-0	8.94E+01	9.36E+01	9.73E+01	9.34E+01	V-ST	Above-Average
SO_2	7446-09-5	1.37E+02	1.42E+02	1.14E+02	1.31E+02	V-ST	Above-Average
CO	630-08-0	1.19E+02	N.D.	7.49E+01	9.67E+01	V-ST	Above-Average
Ammonia & Hydrochloric Acid							
Ammonia	7664-41-7	5.95E+00	5.30E+00	4.06E+00	5.10E+00	V-ST	Above-Average
Hydrochloric Acid	7647-01-0	1.45E+00	1.10E+00	6.03E-01	1.05E+00	V-ST	Above-Average
Metals & Metal Oxides							
Aluminum	7429-90-5	6.07E-02	3.14E-02	1.47E-02	3.56E-02	V-ST	Above-Average
Antimony	7440-36-0	< 4.36E-04	< 5.38E-04	< 5.26E-04	5.00E-04	V-ST	Above-Average
Arsenic	7440-38-2	< 1.39E-04	< 1.44E-04	< 1.40E-04	1.41E-04	V-ST	Above-Average
Barium	7440-39-3	1.78E-03	1.31E-03	1.67E-03	1.59E-03	V-ST	Above-Average
Beryllium	7440-41-7	< 2.62E-05	< 3.23E-05	< 3.16E-05	3.00E-05	V-ST	Above-Average
Boron	7440-42-8	< 5.30E-03	< 5.38E-03	< 5.26E-03	5.31E-03	V-ST	Above-Average
Cadmium	7440-43-9	3.15E-05	< 3.32E-05	< 3.20E-05	3.22E-05	V-ST	Above-Average
Calcium Oxide	1305-78-8	9.69E-01	4.27E-01	1.16E-01	5.04E-01	V-ST	Above-Average
Chromium	7440-47-3	< 5.30E-04	< 5.38E-04	< 5.30E-04	5.33E-04	V-ST	Above-Average
Cobalt	7440-48-4	< 2.03E-04	< 3.58E-05	< 3.00E-05	8.96E-05	V-ST	Above-Average
Copper	7440-50-8	3.27E-04	< 3.06E-04	< 2.67E-04	3.00E-04	V-ST	Above-Average
Iron	7439-89-6	4.56E-02	2.59E-02	1.69E-02	2.95E-02	V-ST	Above-Average
Ferric Oxide	1309-37-1	1.30E-01	7.41E-02	4.83E-02	8.43E-02	V-ST	Above-Average
Lead	7439-92-1	1.19E-03	8.32E-04	1.80E-04	7.34E-04	V-ST	Above-Average
Magnesium	7439-95-4	3.01E-02	1.30E-02	1.09E-02	1.80E-02	V-ST	Above-Average
Manganese	7439-96-5	1.71E-03	8.02E-04	5.50E-04	1.02E-03	V-ST	Above-Average
Mercury	7439-97-6	4.03E-04	3.82E-04	< 1.73E-04	3.19E-04	V-ST	Above-Average
Molybdenum	7439-98-7	8.93E-04	8.71E-04	1.03E-03	9.31E-04	V-ST	Above-Average
Nickel	7440-02-0	5.18E-04	7.92E-04	3.21E-04	5.44E-04	V-ST	Above-Average
Phosphorus	7723-14-0	< 1.34E-02	< 1.65E-02	< 1.61E-02	1.53E-02	V-ST	Above-Average
Potassium	7440-09-7	1.07E-01	6.84E-02	< 2.10E-02	6.55E-02	V-ST	Above-Average
Selenium	7782-49-2	< 2.91E-04	< 3.59E-04	< 3.51E-04	3.34E-04	V-ST	Above-Average
Silver	7440-22-4	< 3.60E-04	< 4.31E-05	< 5.00E-05	1.51E-04	V-ST	Above-Average
Strontium	7440-24-6	1.39E-03	6.63E-04	2.20E-04	7.58E-04	V-ST	Above-Average
Thallium	7440-28-0	< 4.12E-05	< 4.31E-05	< 4.20E-05	4.21E-05	V-ST	Above-Average
Tin	7440-31-5	8.41E-03	6.93E-03	2.90E-03	6.08E-03	V-ST	Above-Average
Titanium	7440-32-6	3.68E-03	2.25E-03	1.51E-03	2.48E-03	V-ST	Above-Average
Vanadium	7440-62-2	< 1.02E-04	< 1.08E-04	< 1.05E-04	1.05E-04	V-ST	Above-Average
Zinc	7440-66-6	< 2.64E-03	< 1.98E-03	< 1.75E-03	2.12E-03	V-ST	Above-Average
Volatile Organic Compounds							
Acetone (2-Propanone)	67-64-1	9.82E-02	8.18E-02	8.06E-02	8.69E-02	V-ST	Above-Average
Acrolein	107-02-8	1.80E-02	1.72E-02	N.D.	1.76E-02	V-ST	Above-Average
Benzene	71-43-2	2.44E-01	2.68E-01	2.77E-01	2.63E-01	V-ST	Above-Average
Bromodichloromethane	75-27-4	< 1.66E-04	< 1.59E-04	< 1.57E-04	1.61E-04	V-ST	Above-Average
Bromoform	75-25-2	< 2.11E-04	< 2.02E-04	< 2.00E-04	2.04E-04	V-ST	Above-Average
Bromomethane	74-83-9	< 4.10E-03	< 4.62E-03	< 6.76E-03	5.16E-03	V-ST	Above-Average
Methyl Ethyl Ketone (2-Butanone)	78-93-3	< 5.43E-04	< 5.19E-04	< 5.14E-04	5.25E-04	V-ST	Above-Average
Carbon Tetrachloride	56-23-5	< 2.41E-04	< 2.31E-04	< 2.28E-04	2.33E-04	V-ST	Above-Average
Chlorobenzene	108-90-7	5.60E-03	8.18E-03	< 5.21E-03	6.33E-03	V-ST	Above-Average
Chloroethane	75-00-3	8.22E-03	7.03E-03	8.90E-03	8.05E-03	V-ST	Above-Average
Chloroform	67-66-3	< 1.66E-04	< 1.59E-04	< 1.57E-04	1.61E-04	V-ST	Above-Average
Chloromethane	74-87-3	7.31E-02	6.77E-02	1.02E-01	8.09E-02	V-ST	Above-Average
Cumene	98-82-8	< 6.41E-02	< 1.03E-02	< 1.43E-02	2.96E-02	V-ST	Above-Average
Dibromochloromethane	124-48-1	< 1.36E-04	< 1.30E-04	< 1.28E-04	1.31E-04	V-ST	Above-Average
1,1-Dichloroethane	75-34-3	< 1.81E-04	< 1.73E-04	< 1.71E-04	1.75E-04	V-ST	Above-Average
1,2-Dichloroethane	107-06-2	< 1.06E-04	< 1.01E-04	< 1.00E-04	1.02E-04	V-ST	Above-Average
1,1-Dichloroethylene	75-35-4	< 1.66E-04	< 1.59E-04	< 1.57E-04	1.61E-04	V-ST	Above-Average
cis-1,2-Dichloroethylene	156-59-2	< 1.51E-04	0.00E+00	< 1.43E-04	9.80E-05	V-ST	Above-Average
trans-1,2-Dichloroethylene	156-60-5	< 1.51E-04	< 1.44E-04	< 1.43E-04	1.46E-04	V-ST	Above-Average
1,2-Dichloropropane	78-87-5	< 1.66E-04	< 1.59E-04	< 1.57E-04	1.61E-04	V-ST	Above-Average
Ethylbenzene	100-41-4	3.23E-02	3.82E-02	3.98E-02	3.68E-02	V-ST	Above-Average
Ethylene Dibromide	106-93-4	< 1.51E-04	< 1.44E-04	< 1.43E-04	1.46E-04	V-ST	Above-Average
Methylene Chloride(Dichloromethane)	75-09-2	< 2.87E-04	< 2.74E-04	< 2.71E-04	2.77E-04	V-ST	Above-Average
Styrene	100-42-5	3.42E-02	4.69E-02	3.97E-02	4.03E-02	V-ST	Above-Average
1,1,1,2-Tetrachloroethane	630-20-6	< 1.51E-04	< 1.44E-04	< 1.43E-04	1.46E-04	V-ST	Above-Average
1,1,2,2-Tetrachloroethane	79-34-5	< 2.11E-04	< 2.02E-04	< 2.00E-04	2.04E-04	V-ST	Above-Average
Tetrachloroethylene	127-18-4	< 2.72E-04	< 2.59E-04	< 2.57E-04	2.63E-04	V-ST	Above-Average
Toluene	108-88-3	1.40E-01	1.54E-01	2.08E-01	1.67E-01	V-ST	Above-Average
1,1,1-Trichloroethane	71-55-6	< 2.11E-04	< 2.02E-04	< 2.00E-04	2.04E-04	V-ST	Above-Average
1,1,2-Trichloroethane	79-00-5	< 2.41E-04	< 2.31E-04	< 2.28E-04	2.33E-04	V-ST	Above-Average
Trichloroethylene	79-01-6	< 1.66E-04	< 1.59E-04	< 1.57E-04	1.61E-04	V-ST	Above-Average
Vinyl Chloride	75-01-4	< 1.96E-04	< 5.79E-04	< 1.85E-04	3.20E-04	V-ST	Above-Average
Xylene	1330-20-7	1.71E-01	2.04E-01	2.58E-01	2.11E-01	V-ST	Above-Average
Total D&F							
Dioxins, Furans and Dioxin-like PCBs	CDD	2.74E-09	2.33E-09	1.93E-09	2.33E-09	V-ST	Above-Average
Polycyclic Aromatic Hydrocarbons (PAHs)							
Benzo(a)pyrene	50-32-8	< 2.18E-05	< 2.14E-05	< 2.17E-05	2.16E-05	V-ST	Above-Average
2-Chloronaphthalene	91-58-7	3.94E-04	5.51E-04	3.65E-04	4.37E-04	V-ST	Above-Average
1-Methylnaphthalene	90-12-0	2.27E-02	2.66E-02	2.14E-02	2.36E-02	V-ST	Above-Average
Naphthalene	91-20-3	< 5.42E-02	< 5.72E-02	4.75E-02	5.30E-02	V-ST	Above-Average
Tetralin	119-64-2	< 1.41E-02	< 1.23E-02	1.19E-02	1.28E-02	V-ST	Above-Average
Chloronated Organics							
1,2-Dichlorobenzene	95-50-1	< 4.99E-04	4.46E-04	5.00E-04	4.82E-04	V-ST	Above-Average
1,3-Dichlorobenzene	541-73-1	1.54E-04	< 2.12E-04	2.54E-04	2.07E-04	V-ST	Above-Average
1,4-Dichlorobenzene	106-46-7	1.19E-04	< 1.87E-04	2.69E-04	1.92E-04	V-ST	Above-Average
1,2,3-Trichlorobenzene	87-61-6	1.31E-04	< 1.49E-04	1.94E-04	1.58E-04	V-ST	Above-Average
1,2,4-Trichlorobenzene	120-82-1	< 1.14E-04	1.53E-04	1.82E-04	1.50E-04	V-ST	Above-Average
1,3,5-Trichlorobenzene	108-70-3	< 2.39E-05	< 2.14E-05	< 2.17E-05	2.23E-05	V-ST	Above-Average
1,2,3,4-Tetrachlorobenzene	634-66-2	< 2.18E-05	2.14E-05	< 2.17E-05	2.16E-05	V-ST	Above-Average
1,2,3,5+1,2,4,5-Tetrachlorobenzene	634-90-2 / 95-94-3	< 2.18E-05	2.14E-05	< 2.17E-05	2.16E-05	V-ST	Above-Average
Pentachlorobenzene	608-93-5	< 2.18E-05	< 2.14E-05	2.20E-05	2.17E-05	V-ST	Above-Average
Hexachlorobenzene	118-74-1	2.18E-05	< 2.14E-05	< 2.17E-05	2.16E-05	V-ST	Above-Average
2,3-Dichlorophenol	576-24-9	< 2.18E-05	< 2.14E-05	< 6.52E-05	3.61E-05	V-ST	Above-Average
2,4 + 2,5-Dichlorophenol	120-83-2 / 583-78-8	< 2.18E-05	< 3.70E-05	< 7.48E-05	4.45E-05	V-ST	Above-Average
2,6-Dichlorophenol	87-65-0	< 2.18E-05	< 2.18E-05	< 6.52E-05	3.63E-05	V-ST	Above-Average
2,3,4-Trichlorophenol	15950-66-0	< 2.18E-05	< 2.14E-05	< 6.52E-05	3.61E-05	V-ST	Above-Average
2,4,5-Trichlorophenol	95-95-4	< 2.18E-05	2.14E-05	< 6.52E-05	3.61E-05	V-ST	Above-Average
2,4,6-Trichlorophenol	88-06-2	< 2.18E-05	< 2.14E-05	< 6.52E-05	3.61E-05	V-ST	Above-Average
3,4,5-Trichlorophenol	609-19-8	< 2.18E-05	2.14E-05	< 6.52E-05	3.61E-05	V-ST	Above-Average
2,3,4,6-Tetrachlorophenol	58-90-2	2.18E-05	< 2.14E-05	< 6.50E-05	3.60E-05	V-ST	Above-Average
2,3,5,6-Tetrachlorophenol	935-95-5	< 2.18E-05	< 2.14E-05	< 6.50E-05	3.60E-05	V-ST	Above-Average
Pentachlorophenol	87-86-5	< 2.18E-05	< 2.14E-05	< 6.52E-05	3.61E-05	V-ST	Above-Average

- Stack test performed in October and December 2018 by Rowan Williams Davies and Irwin Inc. (RWDI)
- Calcium and ferric oxide calculated from metals with molecular weight conversion

Calculation Sheet 1B - Kiln Stack Emissions - Future

With respect to the kiln stack emissions for the future scenario, emission factors (g/tonne of fuel input) were first derived from the 2018 source testing results for baseline, low carbon fuel substitution and alternative fuel substitution (demonstration trial 2). Emission rates of the future scenario were then estimated using these emission factors and the proposed fuel consumption rates.

With respect to total suspended particulate, PM2.5, NO2, SO2, NH3 and CO, kiln stack emissions are dominated by conditions of the kiln system and associated air pollution control equipment. These conditions are not expected to change for the future scenario. The average of the 2018 source testing results for baseline, LCF substitution and alternative fuel substitution is assumed to be the representative realistic maximum kiln stack emission rate for these CoPCs.

With respect to all other CoPCs, the methodology is detailed below.

Existing ER of CF only (g/s) = EF_{CF} x Fuel Consumption $_{CF,AE}$ (tonne/day) x (day/24hr) x (1hr/3600s)

EF_{CF} (g/tonne) = Existing ER of CF only (g/s) x (3600s/hr) x (24hr/day)/Fuel Consumption $_{CF,AE}$

Existing ER of LCF (g/s) = EF_{CF} (g/tonne) x Fuel Consumption$_{CF,B}$ (tonne/day) x (1day/24hr) x (1hr/3600) + EF_{LCF} (g/tonne) x Fuel Consumption$_{LCF,\ B}$ (tonne/day) x (1day/24hr) x (1hr/3600)

EF_{LCF} = [Existing ER of LCF (g/s) - EF_{CF} (g/tonne) x Fuel Consumption$_{CF,BE}$ (tonne/day) x (1day/24hr) x (1hr/3600)] / [Fuel Consumption$_{LCF,\ BE}$ (tonne/day) x (1day/24hr) x (1hr/3600)]

Existing ER of ALCF (g/s) = EF_{CF} (g/tonne) x Fuel Consumption$_{CF,C}$ (tonne/day) x (1day/24hr) x (1hr/3600) + EF_{ALCF} (g/tonne) x Fuel Consumption$_{ALCF,\ C}$ (tonne/day) x (1day/24hr) x (1hr/3600)

EF_{ALCF} = [Existing ER of ALCF (g/s) - EF_{CF} (g/tonne) x Fuel Consumption$_{CF,CE}$ (tonne/day) x (1day/24hr) x (1hr/3600)] / [Fuel Consumption$_{ALCF,\ CE}$ (tonne/day) x (1day/24hr) x (1hr/3600)]

Future ER of CF only (g/s) = EF_{CF} x Fuel Consumption $_{CF,AF}$ (tonne/day) x (day/24hr) x (1hr/3600s)

Future ER of LCF (g/s) = EF_{CF} (g/tonne) x Fuel Consumption$_{CF,BF}$ (tonne/day) x (1day/24hr) x (1hr/3600) + EF_{LCF} (g/tonne) x Fuel Consumption$_{LCF,\ BF}$ (tonne/day) x (1day/24hr) x (1hr/3600)

Future ER of ALCF (g/s) = EF_{CF} (g/tonne) x Fuel Consumption$_{CF,CF}$ (tonne/day) x (1day/24hr) x (1hr/3600) + EF_{ALCF} (g/tonne) x Fuel Consumption$_{ALCF,\ CF}$ (tonne/day) x (1day/24hr) x (1hr/3600)

Future ER (g/s) = Maximum of the above three ER (g/s)

Scenario	E. Source Testing Existing Fuel Consumption (tonnes/day)			F. Future Fuel Consumption (tonnes/day)		
	Conventional Fuel	Low Carbon Fuel	Alternative Low Carbon Fuel	Conventional Fuel	Low Carbon Fuel	Alternative Low Carbon Fuel
Conventional Fuel Only	608	0	0	613	0	0
Conventional Fuel + Low Carbon Fuel	530	96	0	430	400	0
Conventional Fuel + Alternative Low Carbon Fuel	490	0	287	430	0	400

Scenario Coding Example: BE - Conventional Fuel + LCF (Woody), Existing

Contaminant	CAS Number	Existing Emission Rates (g/s)			Emission Factors (g/tonne)			Emission Rate (Future) (g/s)	Emission Technique	Data Quality
		Conventional Fuel (Average of Oct&Dec 2018)	Low Carbon Fuel (Dec 2018)	Alternative Low Carbon Fuel (Dec 2018)	Conventional Fuel (EF_{CF})	Low Carbon Fuel (EF_{LCF})	Alternative Low Carbon Fuel (EF_{ALCF})			
Particulate										
PM	PM	3.07E+00	1.22E+00	4.17E+00	-	-	-	2.88E+00	V-ST	Above-Average
PM10	PM10	4.24E-01	5.08E-01	5.08E-01	-	-	-	4.66E-01	V-ST	Above-Average
PM2.5	PM2.5	1.80E-01	2.12E-01	2.12E-01	-	-	-	1.96E-01	V-ST	Above-Average
Combustion Gases										
NO2	10102-44-0	9.33E+01	9.36E+01	8.67E+01	-	-	-	9.34E+01	V-ST	Above-Average
SO2	7446-09-5	1.26E+02	1.42E+02	1.69E+02	-	-	-	1.41E+02	V-ST	Above-Average
CO	630-08-0	9.67E+01	N.D.	1.00E+02	-	-	-	9.79E+01	V-ST	Above-Average
Ammonia & Hydrochloric Acid										
Ammonia	7664-41-7	5.01E+00	5.30E+00	5.22E+00	-	-	-	5.13E+00	V-ST	Above-Average
Hydrochloric Acid	7647-01-0	1.03E+00	1.10E+00	1.67E+00	1.46E+02	1.85E+02	2.54E+02	1.90E+00	V-ST	Above-Average
Metals & Metal Oxides										
Aluminum	7429-90-5	3.77E-02	3.14E-02	2.11E-02	5.36E+00			3.80E-02	V-ST	Above-Average
Antimony	7440-36-0	< 4.81E-04	< 5.38E-04	< 5.07E-04	6.84E-02	1.07E-01	3.59E-02	8.35E-04	V-ST	Above-Average
Arsenic	7440-38-2	< 1.40E-04	< 1.44E-04	< 1.35E-04	1.98E-02	2.02E-02	6.80E-03	1.92E-04	V-ST	Above-Average
Barium	7440-39-3	1.73E-03	1.31E-03	1.91E-03	2.45E-01		1.56E-01	1.94E-03	V-ST	Above-Average
Beryllium	7440-41-7	< 2.89E-05	< 3.23E-05	< 3.00E-05	4.11E-03	6.40E-03	2.02E-03	5.01E-05	V-ST	Above-Average
Boron	7440-42-8	< 5.28E-03	< 5.38E-03	< 5.07E-03	7.50E-01	7.00E-01	2.45E-01	6.97E-03	V-ST	Above-Average
Cadmium	7440-43-9	3.18E-05	< 3.32E-05	< 3.00E-05	4.51E-03	4.97E-03	1.33E-03	4.55E-05	V-ST	Above-Average
Calcium Oxide	1305-78-8	5.43E-01	4.27E-01	2.20E-01	7.71E+01			5.47E-01	V-ST	Above-Average
Chromium	7440-47-3	< 5.30E-04	< 5.38E-04	< 5.07E-04	7.53E-02	6.84E-02	2.40E-02	6.91E-04	V-ST	Above-Average
Cobalt	7440-48-4	< 1.17E-04	< 3.58E-05	< 3.20E-05	1.66E-02			1.17E-04	V-ST	Above-Average
Copper	7440-50-8	2.97E-04	< 3.06E-04	< 3.73E-04	4.22E-02	4.24E-02	4.02E-02	4.06E-04	V-ST	Above-Average
Iron	7439-89-6	3.13E-02	2.59E-02	2.36E-02	4.44E+00			3.15E-02	V-ST	Above-Average
Ferric Oxide	1309-37-1	8.94E-02	7.41E-02	6.75E-02	1.27E+01			9.01E-02	V-ST	Above-Average
Lead	7439-92-1	6.85E-04	8.32E-04	3.00E-04	9.73E-02	2.11E-01		1.46E-03	V-ST	Above-Average
Magnesium	7439-95-4	2.05E-02	1.30E-02	1.80E-02	2.91E+00		4.45E-01	2.07E-02	V-ST	Above-Average
Manganese	7439-96-5	1.13E-03	8.02E-04	2.37E-03	1.61E-01		4.39E-01	2.83E-03	V-ST	Above-Average
Mercury	7439-97-6	2.88E-04	3.82E-04	< 3.06E-04	4.09E-02	1.18E-01	2.22E-02	7.49E-04	V-ST	Above-Average
Molybdenum	7439-98-7	9.62E-04	8.71E-04	8.08E-04	1.37E-01	2.96E-02	9.97E-03	9.69E-04	V-ST	Above-Average
Nickel	7440-02-0	4.20E-04	7.92E-04	4.17E-04	5.96E-02	3.84E-01	2.38E-02	2.07E-03	V-ST	Above-Average
Phosphorus	7723-14-0	< 1.48E-02	< 1.65E-02	< 1.55E-02	2.10E+00	3.28E+00	1.09E+00	2.56E-02	V-ST	Above-Average
Potassium	7440-09-7	6.40E-02	6.84E-02	< 2.66E-02	9.09E+00	1.13E+01		9.78E-02	V-ST	Above-Average
Selenium	7782-49-2	< 3.21E-04	< 3.59E-04	< 3.38E-04	4.56E-02	7.13E-02	2.39E-02	5.57E-04	V-ST	Above-Average
Silver	7440-22-4	< 2.05E-04	< 4.31E-05	< 4.60E-05	2.91E-02			2.07E-04	V-ST	Above-Average
Strontium	7440-24-6	8.05E-04	6.63E-04	4.98E-04	1.14E-01			8.12E-04	V-ST	Above-Average
Thallium	7440-28-0	< 4.16E-05	< 4.31E-05	< 4.10E-05	5.91E-03	6.15E-03	2.25E-03	5.79E-05	V-ST	Above-Average
Tin	7440-31-5	5.66E-03	6.93E-03	3.34E-03	8.04E-01	1.80E+00		1.23E-02	V-ST	Above-Average
Titanium	7440-32-6	2.60E-03	2.25E-03	1.85E-03	3.69E-01			2.62E-03	V-ST	Above-Average
Vanadium	7440-62-2	< 1.04E-04	< 1.08E-04	< 1.01E-04	1.47E-02	1.60E-02	5.29E-03	1.47E-04	V-ST	Above-Average
Zinc	7440-66-6	< 2.20E-03	< 1.98E-03	< 2.82E-03	3.12E-01	5.99E-02	3.16E-01	3.02E-03	V-ST	Above-Average
Volatile Organic Compounds										
Acetone (2-Propanone)	67-64-1	8.94E-02	8.18E-02	1.23E-01	1.27E+01	3.52E+00	1.53E+01	1.34E-01	V-ST	Above-Average
Acrolein	107-02-8	1.80E-02	1.72E-02	1.72E-02	2.56E+00	1.36E+00	8.11E-01	1.90E-02	V-ST	Above-Average
Benzene	71-43-2	2.61E-01	2.68E-01	2.48E-01	3.70E+01	3.72E+01	1.15E+01	3.56E-01	V-ST	Above-Average
Bromodichloromethane	75-27-4	< 1.62E-04	< 1.59E-04	< 1.56E-04	2.30E-02	1.64E-02	7.78E-03	1.90E-04	V-ST	Above-Average
Bromoform	75-25-2	< 2.06E-04	< 2.02E-04	< 1.99E-04	2.92E-02	2.06E-02	1.00E-02	2.41E-04	V-ST	Above-Average
Bromomethane	74-83-9	< 5.43E-03	< 4.62E-03	< 1.11E-02	7.72E-01		2.02E+00	1.32E-02	V-ST	Above-Average
Methyl Ethyl Ketone (2-Butanone)	78-93-3	< 5.29E-04	< 5.19E-04	< 5.11E-04	7.51E-02	5.25E-02	2.56E-02	6.17E-04	V-ST	Above-Average
Carbon Tetrachloride	56-23-5	< 2.35E-04	< 2.31E-04	< 2.27E-04	3.33E-02	2.39E-02	1.14E-02	2.77E-04	V-ST	Above-Average
Chlorobenzene	108-90-7	5.41E-03	8.18E-03	< 8.25E-03	7.68E-01	3.12E+00	1.17E+00	1.83E-02	V-ST	Above-Average
Chloroethane	75-00-3	8.56E-03	7.03E-03	8.90E-03	1.22E+00		6.02E-01	8.84E-03	V-ST	Above-Average
Chloroform	67-66-3	< 1.62E-04	< 1.59E-04	< 1.56E-04	2.30E-02	1.64E-02	7.78E-03	1.90E-04	V-ST	Above-Average
Chloromethane	74-87-3	8.76E-02	6.77E-02	9.12E-02	1.24E+01		6.21E+00	9.07E-02	V-ST	Above-Average
Cumene	98-82-8	< 3.92E-02	< 1.03E-02	< 1.11E-02	5.57E+00			3.95E-02	V-ST	Above-Average
Dibromochloromethane	124-48-1	< 1.32E-04	< 1.30E-04	< 1.28E-04	1.88E-02	1.34E-02	6.51E-03	1.56E-04	V-ST	Above-Average
1,1-Dichloroethane	75-34-3	< 1.76E-04	< 1.73E-04	< 1.70E-04	2.50E-02	1.76E-02	8.48E-03	2.06E-04	V-ST	Above-Average
1,2-Dichloroethane	107-06-2	< 1.03E-04	< 1.01E-04	< 9.90E-05	1.46E-02	1.01E-02	4.81E-03	1.20E-04	V-ST	Above-Average
1,1-Dichloroethylene	75-35-4	< 1.62E-04	< 1.59E-04	< 1.56E-04	2.30E-02	1.64E-02	7.78E-03	1.90E-04	V-ST	Above-Average
cis-1,2-Dichloroethylene	156-59-2	< 1.47E-04	0.00E+00	< 1.42E-04	2.09E-02		7.08E-03	1.48E-04	V-ST	Above-Average
trans-1,2-Dichloroethylene	156-60-5	< 1.47E-04	< 1.44E-04	< 1.42E-04	2.09E-02	1.43E-02	7.08E-03	1.70E-04	V-ST	Above-Average
1,2-Dichloropropane	78-87-5	< 1.62E-04	< 1.59E-04	< 1.56E-04	2.30E-02	1.64E-02	7.78E-03	1.90E-04	V-ST	Above-Average
Ethylbenzene	100-41-4	3.61E-02	3.82E-02	3.73E-02	5.12E+00	6.10E+00	2.48E+00	5.37E-02	V-ST	Above-Average
Ethylene Dibromide	106-93-4	< 1.47E-04	< 1.44E-04	< 1.42E-04	2.09E-02	1.43E-02	7.08E-03	1.70E-04	V-ST	Above-Average
Methylene Chloride(Dichloromethane)	75-09-2	< 2.79E-04	< 2.74E-04	< 2.70E-04	3.96E-02	2.77E-02	1.36E-02	3.26E-04	V-ST	Above-Average
Styrene	100-42-5	3.70E-02	4.69E-02	2.93E-02	5.25E+00	1.32E+01		8.73E-02	V-ST	Above-Average
1,1,1,2-Tetrachloroethane	630-20-6	< 1.47E-04	< 1.44E-04	< 1.42E-04	2.09E-02	1.43E-02	7.08E-03	1.70E-04	V-ST	Above-Average
1,1,2,2-Tetrachloroethane	79-34-5	< 2.06E-04	< 2.02E-04	< 1.99E-04	2.92E-02	2.06E-02	1.00E-02	2.41E-04	V-ST	Above-Average
Tetrachloroethylene	127-18-4	< 2.65E-04	< 2.59E-04	< 2.56E-04	3.76E-02	2.56E-02	1.29E-02	3.06E-04	V-ST	Above-Average
Toluene	71-55-6	< 2.06E-04	< 2.02E-04	< 1.99E-04	2.92E-02	2.06E-02	1.00E-02	2.41E-04	V-ST	Above-Average
1,1,1-Trichloroethane	79-00-5	< 2.35E-04	< 2.31E-04	< 2.27E-04	3.33E-02	2.39E-02	1.14E-02	2.77E-04	V-ST	Above-Average
1,1,2-Trichloroethane	79-01-6	< 1.62E-04	< 1.59E-04	< 1.56E-04	2.30E-02	1.64E-02	7.78E-03	1.90E-04	V-ST	Above-Average
Trichloroethylene	108-88-3	1.74E-01	1.54E-01	1.61E-01	2.47E+01	2.27E+00	6.25E+00	1.75E-01	V-ST	Above-Average
Vinyl Chloride	75-01-4	< 1.91E-04	< 5.79E-04	< 7.03E-04	2.71E-02	3.72E-01	1.65E-01	1.86E-03	V-ST	Above-Average
Xylene	1330-20-7	2.15E-01	2.04E-01	2.17E-01	3.05E+01	1.49E+01	1.31E+01	2.21E-01	V-ST	Above-Average

Calculation Sheet 1B - Kiln Stack Emissions - Future

With respect to the kiln stack emissions for the future scenario, emission factors (g/tonne of fuel input) were first derived from the 2018 source testing results for baseline, low carbon fuel substitution and alternative fuel substitution (demonstration trial 2). Emission rates of the future scenario were then estimated using these emission factors and the proposed fuel consumption rates.

With respect to total suspended particulate, PM2.5, NO2, SO2, NH3 and CO, kiln stack emissions are dominated by conditions of the kiln system and associated air pollution control equipment. These conditions are not expected to change for the future scenario. The average of the 2018 source testing results for baseline, LCF substitution and alternative fuel substitution is assumed to be the representative realistic maximum kiln stack emission rate for these CoPCs.

With respect to all other CoPCs, the methodology is detailed below.

Existing ER of CF only (g/s) = EF_{CF} **x Fuel Consumption** $_{CF,AE}$ **(tonne/day) x (day/24hr) x (1hr/3600s)**

EF_{CF} **(g/tonne) =** **Existing ER of CF only (g/s) x (3600s/hr) x (24hr/day)/Fuel Consumption** $_{CF,AE}$

Existing ER of LCF (g/s) = EF_{CF} **(g/tonne) x Fuel Consumption**$_{CF,B}$ **(tonne/day) x (1day/24hr) x (1hr/3600) +** EF_{LCF} **(g/tonne) x Fuel Consumption**$_{LCF,B}$ **(tonne/day) x (1day/24hr) x (1hr/3600)**

$$EF_{LCF} = \frac{\text{Existing ER of LCF (g/s)} - EF_{CF}\text{ (g/tonne) x Fuel Consumption}_{CF,BE}\text{ (tonne/day) x (1day/24hr) x (1hr/3600)}}{\text{Fuel Consumption}_{LCF,BE}\text{ (tonne/day) x (1day/24hr) x (1hr/3600)}}$$

Existing ER of ALCF (g/s) = EF_{CF} **(g/tonne) x Fuel Consumption**$_{CF,C}$ **(tonne/day) x (1day/24hr) x (1hr/3600) +** EF_{ALCF} **(g/tonne) x Fuel Consumption**$_{ALCF,C}$ **(tonne/day) x (1day/24hr) x (1hr/3600)**

$$EF_{ALCF} = \frac{\text{Existing ER of ALCF (g/s)} - EF_{CF}\text{ (g/tonne) x Fuel Consumption}_{CF,CE}\text{ (tonne/day) x (1day/24hr) x (1hr/3600)}}{\text{Fuel Consumption}_{ALCF,CE}\text{ (tonne/day) x (1day/24hr) x (1hr/3600)}}$$

Future ER of CF only (g/s) = EF_{CF} **x Fuel Consumption** $_{CF,AF}$ **(tonne/day) x (day/24hr) x (1hr/3600s)**

Future ER of LCF (g/s) = EF_{CF} **(g/tonne) x Fuel Consumption**$_{CF,BF}$ **(tonne/day) x (1day/24hr) x (1hr/3600) +** EF_{LCF} **(g/tonne) x Fuel Consumption**$_{LCF,BF}$ **(tonne/day) x (1day/24hr) x (1hr/3600)**

Future ER of ALCF (g/s) = EF_{CF} **(g/tonne) x Fuel Consumption**$_{CF,CF}$ **(tonne/day) x (1day/24hr) x (1hr/3600) +** EF_{ALCF} **(g/tonne) x Fuel Consumption**$_{ALCF,CF}$ **(tonne/day) x (1day/24hr) x (1hr/3600)**

Future ER (g/s) = Maximum of the above three ER (g/s)

Scenario	E. Source Testing Existing Fuel Consumption (tonnes/day)			F. Future Fuel Consumption (tonnes/day)		
	Conventional Fuel	Low Carbon Fuel	Alternative Low Carbon Fuel	Conventional Fuel	Low Carbon Fuel	Alternative Low Carbon Fuel
Conventional Fuel Only	608	0	0	613	0	0
Conventional Fuel + Low Carbon Fuel	530	96	0	430	400	0
Conventional Fuel + Alternative Low Carbon Fuel	490	0	287	430	0	400

Scenario Coding Example: BE - Conventional Fuel + LCF (Woody), Existing

Contaminant	CAS Number	Existing Emission Rates (g/s)			Emission Factors (g/tonne)			Emission Rate (Future) (g/s)	Emission Technique	Data Quality
		Conventional Fuel (Average of Oct&Dec 2018)	Low Carbon Fuel (Dec 2018)	Alternative Low Carbon Fuel (Dec 2018)	Conventional Fuel (EF_{CF})	Low Carbon Fuel (EF_{LCF})	Alternative Low Carbon Fuel (EF_{ALCF})			
Total D&F										
Dioxins, Furans and Dioxin-like PCBs	CDD	2.34E-09	2.33E-09	1.89E-09	3.32E-07	2.65E-07	2.46E-09	2.88E-09	V-ST	Above-Average
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)pyrene	50-32-8	< 2.17E-05	< 2.14E-05	< 2.17E-05	3.09E-03	2.17E-03	1.26E-03	2.54E-05	V-ST	Above-Average
2-Chloronaphthalene	91-58-7	3.80E-04	5.51E-04	2.99E-04	5.39E-02	1.98E-01		1.19E-03	V-ST	Above-Average
1-Methylnaphthalene	90-12-0	2.20E-02	2.66E-02	2.19E-02	3.13E+00	6.66E+00	1.24E+00	4.64E-02	V-ST	Above-Average
Naphthalene	91-20-3	5.08E-02	< 5.72E-02	4.94E-02	7.23E+00	1.15E+01	2.53E+00	8.94E-02	V-ST	Above-Average
Tetralin	119-64-2	1.30E-02	< 1.23E-02	1.34E-02	1.85E+00	8.71E-01	8.76E-01	1.33E-02	V-ST	Above-Average
Chloronated Organics										
1,2-Dichlorobenzene	95-50-1	4.99E-04	4.46E-04	3.59E-04	7.10E-02	9.58E-03		5.04E-04	V-ST	Above-Average
1,3-Dichlorobenzene	541-73-1	2.04E-04	< 2.12E-04	1.70E-04	2.90E-02	3.07E-02	1.68E-03	2.87E-04	V-ST	Above-Average
1,4-Dichlorobenzene	106-46-7	1.94E-04	< 1.87E-04	1.99E-04	2.76E-02	1.61E-02	1.28E-02	2.12E-04	V-ST	Above-Average
1,2,3-Trichlorobenzene	87-61-6	1.62E-04	< 1.49E-04	1.00E-04	2.31E-02	6.79E-03		1.64E-04	V-ST	Above-Average
1,2,4-Trichlorobenzene	120-82-1	1.48E-04	1.53E-04	1.14E-04	2.10E-02	2.15E-02		2.04E-04	V-ST	Above-Average
1,3,5-Trichlorobenzene	108-70-3	< 2.28E-05	< 2.14E-05	< 2.17E-05	3.24E-03	1.37E-03	1.00E-03	2.30E-05	V-ST	Above-Average
1,2,3,4-Tetrachlorobenzene	634-66-2	< 2.17E-05	2.14E-05	< 2.17E-05	3.09E-03	2.22E-03	1.26E-03	2.56E-05	V-ST	Above-Average
1,2,3,5+1,2,4,5-Tetrachlorobenzene	634-90-2 / 95-94-3	< 2.17E-05	2.14E-05	< 2.17E-05	3.09E-03	2.22E-03	1.26E-03	2.56E-05	V-ST	Above-Average
Pentachlorobenzene	608-93-5	2.19E-05	< 2.14E-05	2.17E-05	3.11E-03	2.10E-03	1.23E-03	2.52E-05	V-ST	Above-Average
Hexachlorobenzene	118-74-1	2.17E-05	< 2.14E-05	< 2.17E-05	3.09E-03	2.17E-03	1.26E-03	2.54E-05	V-ST	Above-Average
2,3-Dichlorophenol	576-24-9	< 4.35E-05	< 2.14E-05	< 2.17E-05	6.18E-03			4.38E-05	V-ST	Above-Average
2,4 + 2,5-Dichlorophenol	120-83-2 / 583-78-8	< 4.83E-05	< 3.70E-05	< 3.49E-05	6.86E-03			4.87E-05	V-ST	Above-Average
2,6-Dichlorophenol	87-65-0	< 4.35E-05	< 2.18E-05	< 2.17E-05	6.18E-03			4.38E-05	V-ST	Above-Average
2,3,4-Trichlorophenol	15950-66-0	< 4.35E-05	< 2.14E-05	< 2.17E-05	6.18E-03			4.38E-05	V-ST	Above-Average
2,4,5-Trichlorophenol	95-95-4	< 4.35E-05	2.14E-05	< 2.17E-05	6.18E-03			4.38E-05	V-ST	Above-Average
2,4,6-Trichlorophenol	88-06-2	< 4.35E-05	< 2.14E-05	< 2.17E-05	6.18E-03			4.38E-05	V-ST	Above-Average
3,4,5-Trichlorophenol	609-19-8	< 4.35E-05	2.14E-05	< 2.17E-05	6.18E-03			4.38E-05	V-ST	Above-Average
2,3,4,6-Tetrachlorophenol	58-90-2	4.34E-05	< 2.14E-05	< 2.17E-05	6.16E-03			4.37E-05	V-ST	Above-Average
2,3,5,6-Tetrachlorophenol	935-95-5	< 4.34E-05	< 2.14E-05	< 2.17E-05	6.16E-03			4.37E-05	V-ST	Above-Average
Pentachlorophenol	87-86-5	< 4.35E-05	< 2.14E-05	< 2.17E-05	6.18E-03			4.38E-05	V-ST	Above-Average

- Stack test performed in October and December 2018 by Rowan Williams Davies and Irwin Inc. (RWDI)
- Calcium and ferric oxide calculated from metals with molecular weight conversion
- Blank cell for emission factor indicates that higher emissions are expected when conventional fuel only is used.

Calculation Sheet 7A - Stockpile Information for Wind Erosion Calculation

Source ID	Source Description	Pile #	Type of Pile	Height of Pile (m)	Base Diameter (m)	Base Radius (m)	Angle of Repose	Top Radius (m)	Lateral Area (m^2)	Top Area (m^2)	Total Exposed Surface Area (m^2)
RAWPILES-1B	Wind Erosion from the Ash Stockpile	1	Conical	2	20	10	11.3	n/a	n/a	n/a	320.38
RAWPILES-2B	Wind Erosion from the Sand Stockpile	1	Conical	2	20	10	11.3	n/a	n/a	n/a	320.38
RAWPILES-3B	Wind Erosion from the Iron Stockpile	1	Conical	2	20	10	11.3	n/a	n/a	n/a	320.38
CBM-5	Wind erosion of CBM Stockpiles	1	Oval with Flattop	4	60	30	33.7	24.0	1223.3	1809.6	3032.89
CBM-5	Wind erosion of CBM Stockpiles	2	Conical	3	20	10	16.7	n/a	n/a	n/a	327.99
CBM-5	Wind erosion of CBM Stockpiles	3	Oval with Flattop	5	45	23	39.8	16.5	956.9	855.3	1812.23
CBM-5	Wind erosion of CBM Stockpiles	4	Oval with Flattop	12	60	30	22.5	1.0	3056.5	3.1	3059.68
CBM-5	Wind erosion of CBM Stockpiles	5	Oval with Flattop	7	150	75	81.9	74.0	3309.9	17203.4	20513.31
CBM-5	Wind erosion of CBM Stockpiles	6	Oval with Flattop	5	55	28	55.0	24.0	987.5	1809.6	2797.02
CBM-5	Wind erosion of CBM Stockpiles	7	Oval with Flattop	4	38	19	31.6	12.5	755.3	490.9	1246.15
CBM-5	Wind erosion of CBM Stockpiles	8	Oval with Flattop	4	54	27	29.7	20.0	1190.4	1256.6	2447.07
CBM-5	Wind erosion of CBM Stockpiles	9	Oval with Flattop	4	44	22	29.7	15.0	937.1	706.9	1644.01
CBM-5	Wind erosion of CBM Stockpiles	10	Oval with Flattop	5	56	28	42.3	22.5	1179.3	1590.4	2769.69
CBM-5	Wind erosion of CBM Stockpiles	11	Oval with Flattop	8	100	50	48.8	43.0	3105.8	5808.8	8914.59
QUARRY-9	Wind erosion of Quarry stockpiles	1	Oval with Flattop	10	500	250	45.0	240.0	21770.1	180955.7	202725.86
PPILE1B	Wind Erosion of Primary Stockpile #1	1	Conical	18	60	30	31.0	n/a	n/a	n/a	3297.33
PPILE1C	Wind Erosion of Primary Stockpile #2	2	Conical	18	60	30	31.0	n/a	n/a	n/a	3297.33
CD-1B	Wind Erosion of Temporary Pile	1	Conical	8	40	20	21.8	n/a	n/a	n/a	1353.44

Calculation Sheet - Wind Erosion

The number of disturbances per year was determined by subtracting the number of days with rainfall >0.2 mm from the number of days per year. The precipitation data was taken from the Canadian Climate Normals from 1981-2010 at Bowmanville Mostert Station. For conical piles, distribution of disturbed area is 40%, 48% and 12% for U_s/U_R ratios of 0.2, 0.6, 0.9 and 1.1, respectively. For oval stockpiles with flattops, distribution of disturbed area is 28%, 54%, 14% and 4% for U_s/U_R ratios of 0.2, 0.6, 0.9 and 1.1, respectively. The fastest mile is estimated to be 1.18 to 1.27 times the highest wind speed (Australian NPI, 2012). An average of the range (1.225) was applied to the highest hourly windspeed from the Ministry-approved Bowmanville site specific meteorological data.

Emissions (g/s) = Affected Area of Pile (m^2) x Erosion Potential (g/m^2) x Conversion for Averaging Period (Daily or Annual)

Affected Area of Pile (m^2) = Total Exposed Surface Area (m^2) x Disturbed (%)

Erosion Potential (g/m^2) (If Friction Velocity > Threshold Friction Velocity) = 58 x [Friction Velocity (m/s) - Threshold Friction Velociy (m/s)] ^{2} + 25 x [Friction Velocity (m/s) - Threshold Friction Velociy (m/s)]

Industrial Wind Erosion, U.S. EPA AP-42, November 2006																		24 hr - Emission Rate (g/s)			Annual - Emission Rate (g/s)		
Source	Source Description	Material	Pile Number	Disturbances per Year, N	Height to Base Ratio	U_s/U_r ratio	Disturbed (%)	Affected Area of Pile, A (m^2)	Total Exposed Surface Area, S (m^2)	Fastest Mile, U^+_x (m/s)	x, Anemometer Height (m)	Surface Roughness Height (m)	Fastest Mile, U^+_{10} (m/s)	Friction Velocity, U^* (m/s)	Surface Wind Speed , U^+_s (m/s)	Threshold Friction Velocity, U_t^* (m/s)	Erosion Potential, Pi (g/m^2) [(6)]	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Cement Plant																							
RAWPILES-1B	Wind Erosion from the Ash Stockpile	Ash	1	242.3	0.10	0.2	40%	128.2	320.4	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	48%	153.8						1.47	16.68	3.03	0.00E+00						
						0.9	12%	38.4						1.47	25.03	3.03	0.00E+00						
						1.1	n/a	n/a						1.47	30.59	3.03	0.00E+00						
RAWPILES-2B	Wind Erosion from the Sand Stockpile	Sand	1	242.3	0.10	0.2	40%	128.2	320.4	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	48%	153.8						1.47	16.68	3.03	0.00E+00						
						0.9	12%	38.4						1.47	25.03	3.03	0.00E+00						
						1.1	n/a	n/a						1.47	30.59	3.03	0.00E+00						
RAWPILES-3B	Wind Erosion from the Iron Stockpile	Iron	1	242.3	0.10	0.2	40%	128.2	320.4	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	48%	153.8						1.47	16.68	3.03	0.00E+00						
						0.9	12%	38.4						1.47	25.03	3.03	0.00E+00						
						1.1	n/a	n/a						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	1	242.3	0.07	0.2	28%	849.2	3032.9	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	1637.8						1.47	16.68	3.03	0.00E+00						
						0.9	14%	424.6						1.47	25.03	3.03	0.00E+00						
						1.1	4%	121.3						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	2	242.3	0.15	0.2	40%	131.2	328.0	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	48%	157.4						1.47	16.68	3.03	0.00E+00						
						0.9	12%	39.4						1.47	25.03	3.03	0.00E+00						
						1.1	n/a	n/a						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	3	242.3	0.11	0.2	28%	507.4	1812.2	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	978.6						1.47	16.68	3.03	0.00E+00						
						0.9	14%	253.7						1.47	25.03	3.03	0.00E+00						
						1.1	4%	72.5						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	4	242.3	0.20	0.2	28%	856.7	3059.7	27.8	10.0	0.005	27.8	0.56	5.56	3.03	0.00E+00	9.87E-04	4.94E-04	7.41E-05	2.71E-06	1.35E-06	2.03E-07
						0.6	54%	1652.2						1.67	16.68	3.03	0.00E+00						
						0.9	14%	428.4						2.50	25.03	3.03	0.00E+00						
						1.1	4%	122.4						3.06	30.59	3.03	6.97E-01						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	5	242.3	0.05	0.2	28%	5743.7	20513.3	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	11077.2						1.47	16.68	3.03	0.00E+00						
						0.9	14%	2871.9						1.47	25.03	3.03	0.00E+00						
						1.1	4%	820.5						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	6	242.3	0.09	0.2	28%	783.2	2797.0	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	1510.4						1.47	16.68	3.03	0.00E+00						
						0.9	14%	391.6						1.47	25.03	3.03	0.00E+00						
						1.1	4%	111.9						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	7	242.3	0.11	0.2	28%	348.9	1246.2	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	672.9						1.47	16.68	3.03	0.00E+00						
						0.9	14%	174.5						1.47	25.03	3.03	0.00E+00						
						1.1	4%	49.8						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	8	242.3	0.07	0.2	28%	685.2	2447.1	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	1321.4						1.47	16.68	3.03	0.00E+00						
						0.9	14%	342.6						1.47	25.03	3.03	0.00E+00						
						1.1	4%	97.9						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	9	242.3	0.09	0.2	28%	460.3	1644.0	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	887.8						1.47	16.68	3.03	0.00E+00						
						0.9	14%	230.2						1.47	25.03	3.03	0.00E+00						
						1.1	4%	65.8						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	10	242.3	0.09	0.2	28%	775.5	2769.7	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	1495.6						1.47	16.68	3.03	0.00E+00						
						0.9	14%	387.8						1.47	25.03	3.03	0.00E+00						
						1.1	4%	110.8						1.47	30.59	3.03	0.00E+00						
CBM-5	Wind erosion of CBM Stockpiles	Limestone	11	242.3	0.08	0.2	28%	2496.1	8914.6	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	4813.9						1.47	16.68	3.03	0.00E+00						
						0.9	14%	1248.0						1.47	25.03	3.03	0.00E+00						
						1.1	4%	356.6						1.47	30.59	3.03	0.00E+00						
QUARRY-9	Wind erosion of Quarry stockpiles	Limestone	1	242.3	0.02	0.2	28%	56763.2	202725.9	27.8	10.0	0.005	27.8	1.47	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	54%	109472.0						1.47	16.68	3.03	0.00E+00						
						0.9	14%	28381.6						1.47	25.03	3.03	0.00E+00						
						1.1	4%	8109.0						1.47	30.59	3.03	0.00E+00						
PPILE1B	Wind Erosion of Primary Stockpile #1	Limestone	1	242.3	0.30	0.2	40%	1318.9	3297.3	27.8	10.0	0.005	27.8	0.56	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	48%	1582.7						1.67	16.68	3.03	0.00E+00						
						0.9	12%	395.7						2.50	25.03	3.03	0.00E+00						
						1.1	n/a	n/a						n/a	n/a	n/a	n/a						
PPILE1C	Wind Erosion of Primary Stockpile #2	Limestone	2	242.3	0.30	0.2	40%	1318.9	3297.3	27.8	10.0	0.005	27.8	0.56	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	48%	1582.7						1.67	16.68	3.03	0.00E+00						
						0.9	12%	395.7						2.50	25.03	3.03	0.00E+00						
						1.1	n/a	n/a						n/a	n/a	n/a	n/a						
Cargo Dockers																							
CD-1B	Wind Erosion of Temporary Pile	Raw Materials, Solid Fuels, Salt	1	242.3	0.20	0.2	40%	541.4	1353.4	27.8	10.0	0.005	27.8	0.56	5.56	3.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
						0.6	48%	649.7						1.67	16.68	3.03	0.00E+00						
						0.9	12%	162.4						2.50	25.03	3.03	0.00E+00						
						1.1	n/a	n/a						n/a	n/a	n/a	n/a						

Calculation Sheet - Road Dust, Unpaved

Unpaved Road Emission Factor (g/VMT) = k x [(Silt Content,s/12)^a] x [Mean Vehicle Weight, W/3)^b] x (281.9 g/VKT)/(1 lb/VWT)

Controlled Emissions (g/s) = Unpaved Road Emission Factor (g/VKT) x Trip Distance (km) x (1-Control Efficiency [%]) x (1 day/24 hr) x (1 hr/3600 s)

Source I.D.	Activity	Contaminant	CAS No.	Averaging Period	Round Trip Distance (km)	Number of Trips	Empty Truck Weight (tonne)	Load Weight (tonne)	Loaded Truck Weight (tonne)	Mean Vehicle Weight (tonne)	Silt Content of Unpaved Road, s (%)	k	a	b	Emission Factor (g/VKT)	Additional Control Efficiency (%)	Controlled Emissions (g/s)	Estimation Technique
Cement Plant																		
CBM-7	Road dust from FEL operating in CBM area	PM	PM	24 hr	0.24	70	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	1.27E-02	EF
CBM-7	Road dust from FEL operating in CBM area	PM	PM	Annual	0.24	45000	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	2.24E-02	EF
CBM-7	Road dust from FEL operating in CBM area	$PM_{2.5}$	PM2.5	24 hr	0.24	70	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	3.62E-04	EF
CBM-7	Road dust from FEL operating in CBM area	$PM_{2.5}$	PM2.5	Annual	0.24	45000	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	6.37E-04	EF
QUARRY-10	Road dust from FEL loading Haul Truck - Unpaved Roads	PM	PM	24 hr	0.24	850	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	1.54E-01	EF
QUARRY-10	Road dust from FEL loading Haul Truck - Unpaved Roads	PM	PM	Annual	0.24	278440	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	1.39E-01	EF
QUARRY-10	Road dust from FEL loading Haul Truck - Unpaved Roads	$PM_{2.5}$	PM2.5	24 hr	0.24	850	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	4.39E-03	EF
QUARRY-10	Road dust from FEL loading Haul Truck - Unpaved Roads	$PM_{2.5}$	PM2.5	Annual	0.24	278440	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	3.94E-03	EF
Cargo Dockers																		
CD-2	Road dust from FEL moving materials into trucks	PM	PM	24 hr	1.90	25	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	3.60E-02	EF
CD-2	Road dust from FEL moving materials into trucks	PM	PM	Annual	1.90	7502	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	2.96E-02	EF
CD-2	Road dust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	24 hr	1.90	25	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	1.02E-03	EF
CD-2	Road dust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	Annual	1.90	7502	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	8.41E-04	EF
CD-2	Road dust from FEL moving materials into trucks	PM	PM	24 hr	1.90	25	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	3.60E-02	EF
CD-2	Road dust from FEL moving materials into trucks	PM	PM	Annual	1.90	7502	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	2.96E-02	EF
CD-2	Road dust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	24 hr	1.90	25	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	1.02E-03	EF
CD-2	Road dust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	Annual	1.90	7502	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	8.41E-04	EF
CD-2	Road dust from FEL moving materials into trucks	PM	PM	24 hr	1.90	25	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	3.60E-02	EF
CD-2	Road dust from FEL moving materials into trucks	PM	PM	Annual	1.90	7502	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	2.96E-02	EF
CD-2	Road dust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	24 hr	1.90	25	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	1.02E-03	EF
CD-2	Road dust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	Annual	1.90	7502	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	8.41E-04	EF
CD-2	Road dust from FEL moving materials into trucks	PM	PM	24 hr	1.90	25	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	3.60E-02	EF
CD-2	Road dust from FEL moving materials into trucks	PM	PM	Annual	1.90	7502	17	10	27	22	8.3	4.9	0.7	0.45	2615.8	98%	2.96E-02	EF
CD-2	Road dust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	24 hr	1.90	25	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	1.02E-03	EF
CD-2	Road dust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	Annual	1.90	7502	17	10	27	22	8.3	0.15	0.9	0.45	74.4	98%	8.41E-04	EF
Material Delivery and Shipping																		
R2	Iron & Sand Delivery - Unpaved Roads	PM	PM	24 hr	2.40	10	19	40	59	39	8.3	4.9	0.7	0.45	3384.5	98%	2.35E-02	EF
R2	Iron & Sand Delivery - Unpaved Roads	PM	PM	Annual	2.40	2978	19	40	59	39	8.3	4.9	0.7	0.45	3384.5	98%	1.92E-02	EF
R2	Iron & Sand Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	24 hr	2.40	10	19	40	59	39	8.3	0.15	0.9	0.45	96.2	98%	6.68E-04	EF
R2	Iron & Sand Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	Annual	2.40	2978	19	40	59	39	8.3	0.15	0.9	0.45	96.2	98%	5.45E-04	EF
R3	CBM Materials Shipping - Unpaved Roads	PM	PM	24 hr	2.56	0	39	50	89	64.3	8.3	4.9	0.7	0.45	4238.5	98%	0.00E+00	EF
R3	CBM Materials Shipping - Unpaved Roads	PM	PM	Annual	2.56	11250	39	50	89	64.3	8.3	4.9	0.7	0.45	4238.5	98%	9.68E-02	EF
R3	CBM Materials Shipping - Unpaved Roads	$PM_{2.5}$	PM2.5	24 hr	2.56	0	39	50	89	64.3	8.3	0.15	0.9	0.45	120.5	98%	0.00E+00	EF
R3	CBM Materials Shipping - Unpaved Roads	$PM_{2.5}$	PM2.5	Annual	2.56	11250	39	50	89	64.3	8.3	0.15	0.9	0.45	120.5	98%	2.75E-03	EF
R5	Ash Delivery - Unpaved Roads	PM	PM	24 hr	1.72	1	19	40	59	39	8.3	4.9	0.7	0.45	3384.5	98%	1.68E-03	EF
R5	Ash Delivery - Unpaved Roads	PM	PM	Annual	1.72	224	19	40	59	39	8.3	4.9	0.7	0.45	3384.5	98%	1.03E-03	EF
R5	Ash Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	24 hr	1.72	1	19	40	59	39	8.3	0.15	0.9	0.45	96.2	98%	4.79E-05	EF
R5	Ash Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	Annual	1.72	224	19	40	59	39	8.3	0.15	0.9	0.45	96.2	98%	2.94E-05	EF
R6-1	LCF Delivery - Unpaved Roads (Existing)	PM	PM	24 hr	1.31	5	19	20	39	29	8.3	4.9	0.7	0.45	2962.1	98%	5.60E-03	EF
R6-1	LCF Delivery - Unpaved Roads (Existing)	PM	PM	Annual	1.31	1650	19	20	39	29	8.3	4.9	0.7	0.45	2962.1	98%	5.06E-03	EF
R6-1	LCF Delivery - Unpaved Roads (Existing)	$PM_{2.5}$	PM2.5	24 hr	1.31	5	19	20	39	29	8.3	0.15	0.9	0.45	84.2	98%	1.59E-04	EF
R6-1	LCF Delivery - Unpaved Roads (Existing)	$PM_{2.5}$	PM2.5	Annual	1.31	1650	19	20	39	29	8.3	0.15	0.9	0.45	84.2	98%	1.44E-04	EF
R6-2	ALCF Delivery - Unpaved Roads (Future)	PM	PM	24 hr	1.31	60	19	20	39	29	8.3	4.9	0.7	0.45	2962.1	98%	6.72E-02	EF
R6-2	ALCF Delivery - Unpaved Roads (Future)	PM	PM	Annual	1.31	6600	19	20	39	29	8.3	4.9	0.7	0.45	2962.1	98%	2.03E-02	EF
R6-2	ALCF Delivery - Unpaved Roads (Future)	$PM_{2.5}$	PM2.5	24 hr	1.31	60	19	20	39	29	8.3	0.15	0.9	0.45	84.2	98%	1.91E-03	EF
R6-2	ALCF Delivery - Unpaved Roads (Future)	$PM_{2.5}$	PM2.5	Annual	1.31	6600	19	20	39	29	8.3	0.15	0.9	0.45	84.2	98%	5.76E-04	EF
R6-2A	ALCF Delivery - Unpaved Roads (Future) - Alternative Route	PM	PM	24 hr	2.61	60	19	20	39	29	8.3	4.9	0.7	0.45	2962.1	98%	1.34E-01	EF
R6-2A	ALCF Delivery - Unpaved Roads (Future) - Alternative Route	PM	PM	Annual	2.61	6600	19	20	39	29	8.3	4.9	0.7	0.45	2962.1	98%	4.05E-02	EF
R6-2A	ALCF Delivery - Unpaved Roads (Future) - Alternative Route	$PM_{2.5}$	PM2.5	24 hr	2.61	60	19	20	39	29	8.3	0.15	0.9	0.45	84.2	98%	3.82E-03	EF
R6-2A	ALCF Delivery - Unpaved Roads (Future) - Alternative Route	$PM_{2.5}$	PM2.5	Annual	2.61	6600	19	20	39	29	8.3	0.15	0.9	0.45	84.2	98%	1.15E-03	EF
R7	Overburden Delivery - Unpaved Roads	PM	PM	24 hr	6.23	8	39	50	89	64.3	8.3	4.9	0.7	0.45	4238.5	98%	6.11E-02	EF
R7	Overburden Delivery - Unpaved Roads	PM	PM	Annual	6.23	2382	39	50	89	64.3	8.3	4.9	0.7	0.45	4238.5	98%	4.99E-02	EF
R7	Overburden Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	24 hr	6.23	8	39	50	89	64.3	8.3	0.15	0.9	0.45	120.5	98%	1.74E-03	EF
R7	Overburden Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	Annual	6.23	2382	39	50	89	64.3	8.3	0.15	0.9	0.45	120.5	98%	1.42E-03	EF
R8	Haul Truck to Primary Crusher - Unpaved Roads	PM	PM	24 hr	3.54	170	39	50	89	64.3	8.3	4.9	0.7	0.45	4238.5	98%	7.38E-01	EF
R8	Haul Truck to Primary Crusher - Unpaved Roads	PM	PM	Annual	3.54	55688	39	50	89	64.3	8.3	4.9	0.7	0.45	4238.5	98%	6.62E-01	EF
R8	Haul Truck to Primary Crusher - Unpaved Roads	$PM_{2.5}$	PM2.5	24 hr	3.54	170	39	50	89	64.3	8.3	0.15	0.9	0.45	120.5	98%	2.10E-02	EF
R8	Haul Truck to Primary Crusher - Unpaved Roads	$PM_{2.5}$	PM2.5	Annual	3.54	55688	39	50	89	64.3	8.3	0.15	0.9	0.45	120.5	98%	1.88E-02	EF
R9	Fuel Delivery - Unpaved Roads	PM	PM	24 hr	1.64	14	19	40	59	39	8.3	4.9	0.7	0.45	3384.5	98%	2.21E-02	EF
R9	Fuel Delivery - Unpaved Roads	PM	PM	Annual	1.64	4465	19	40	59	39	8.3	4.9	0.7	0.45	3384.5	98%	1.97E-02	EF
R9	Fuel Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	24 hr	1.64	14	19	40	59	39	8.3	0.15	0.9	0.45	96.2	98%	6.29E-04	EF
R9	Fuel Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	Annual	1.64	4465	19	40	59	39	8.3	0.15	0.9	0.45	96.2	98%	5.59E-04	EF
R10	CKD/Gypsum Delivery - Unpaved Roads	PM	PM	24 hr	1.57	175	19	40	59	39	8.3	4.9	0.7	0.45	3384.5	98%	2.69E-01	EF
R10	CKD/Gypsum Delivery - Unpaved Roads	PM	PM	Annual	1.57	57750	19	40	59	39	8.3	4.9	0.7	0.45	3384.5	98%	2.44E-01	EF
R10	CKD/Gypsum Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	24 hr	1.57	175	19	40	59	39	8.3	0.15	0.9	0.45	96.2	98%	7.66E-03	EF
R10	CKD/Gypsum Delivery - Unpaved Roads	$PM_{2.5}$	PM2.5	Annual	1.57	57750	19	40	59	39	8.3	0.15	0.9	0.45	96.2	98%	6.93E-03	EF

Notes:
- This emission factor calculation and constant values for unpaved road dust are from the US EPA AP42 document titled "13.2.2 Unpaved Roads".
- A 98% control efficiency was assumed because the roadways are watered regularly.

Calculation Sheet - Road Dust, Paved

Road Dust Emission Rate [g/s] = E [g/VMT] x Number of Vehicles x Distance Travelled [miles] / Averaging Period Converted to seconds [years to seconds/days to seconds/hours to seconds]

Paved Road Emission Factor E (g/VMT) = k * ((sL)^0.91 * (W)^1.02)

sL	<500	50-5000	5000-10000	>10000
Roadway Average Daily Traffic (ADT)	0.6	0.2	0.06	0.03

Source I.D.	Activity	Contaminant	CAS No.	Averaging Period	Particle Size Multiplier (k)	Round Trip Distance (km)	Average Daily Traffic (ADT)	Number of Trips	Empty Truck Weight (tonne)	Load Weight (tonne)	Loaded Truck Weight (tonne)	Mean Vehicle Weight (W) (tonne)	Emission Factor (g/VKT)	Uncontrolled Emission Rate (g/s)	Additional Control Efficiency (%)	Controlled Emission Rate (g/s)	Data Quality	Estimation Technique
Cement Plant																		
RAWSILO-10	Road dust from FEL transferring sand to feed hopper	PM	PM	24 hr	5.24	0.10	<500	8	17	10	27	22	85.1	7.88E-04	50%	3.94E-04	A	EF
RAWSILO-10	Road dust from FEL transferring sand to feed hopper	PM	PM	Annual	5.24	0.10	<500	2085	17	10	27	22	85.1	5.63E-04	50%	2.81E-04	A	EF
RAWSILO-10	Road dust from FEL transferring sand to feed hopper	$PM_{2.5}$	PM2.5	24 hr	0.25	0.10	<500	8	17	10	27	22	4.1	3.76E-05	50%	1.88E-05	D	EF
RAWSILO-10	Road dust from FEL transferring sand to feed hopper	$PM_{2.5}$	PM2.5	Annual	0.25	0.10	<500	2085	17	10	27	22	4.1	2.68E-05	50%	1.34E-05	D	EF
Material Delivery and Shipping																		
R1-1	Iron & Sand Delivery - Paved Roads	PM	PM	24 hr	5.24	3.48	<500	10	19	40	59	39	152.6	6.15E-02	50%	3.07E-02	A	EF
R1-1	Iron & Sand Delivery - Paved Roads	PM	PM	Annual	5.24	3.48	<500	2978	19	40	59	39	152.6	5.01E-02	50%	2.51E-02	A	EF
R1-1	Iron & Sand Delivery - Paved Roads	$PM_{2.5}$	PM2.5	24 hr	0.25	3.48	<500	10	19	40	59	39	7.3	2.93E-03	50%	1.47E-03	D	EF
R1-1	Iron & Sand Delivery - Paved Roads	$PM_{2.5}$	PM2.5	Annual	0.25	3.48	<500	2978	19	40	59	39	7.3	2.39E-03	50%	1.20E-03	D	EF
R1-2	CBM Materials Shipping - Paved Roads	PM	PM	Annual	5.24	3.48	<500	11250	19	40	59	39	152.6	1.89E-01	50%	9.47E-02	A	EF
R1-2	CBM Materials Shipping - Paved Roads	$PM_{2.5}$	PM2.5	Annual	0.25	3.48	<500	11250	19	40	59	39	7.3	9.04E-03	50%	4.52E-03	D	EF
R4-1	Ash Delivery - Paved Roads	PM	PM	24 hr	5.24	2.56	<500	1	19	40	59	39	152.6	4.52E-03	50%	2.26E-03	A	EF
R4-1	Ash Delivery - Paved Roads	PM	PM	Annual	5.24	2.56	<500	224	19	40	59	39	152.6	2.77E-03	50%	1.39E-03	A	EF
R4-1	Ash Delivery - Paved Roads	$PM_{2.5}$	PM2.5	24 hr	0.25	2.56	<500	1	19	40	59	39	7.3	2.16E-04	50%	1.08E-04	D	EF
R4-1	Ash Delivery - Paved Roads	$PM_{2.5}$	PM2.5	Annual	0.25	2.56	<500	224	19	40	59	39	7.3	1.32E-04	50%	6.62E-05	D	EF
R4-2	LCF Delivery - Paved Roads (Existing)	PM	PM	24 hr	5.24	2.56	<500	5	19	20	39	29	112.8	1.67E-02	50%	8.35E-03	A	EF
R4-2	LCF Delivery - Paved Roads (Existing)	PM	PM	Annual	5.24	2.56	<500	1650	19	20	39	29	112.8	1.51E-02	50%	7.55E-03	A	EF
R4-2	LCF Delivery - Paved Roads (Existing)	$PM_{2.5}$	PM2.5	24 hr	0.25	2.56	<500	5	19	20	39	29	5.4	7.97E-04	50%	3.99E-04	D	EF
R4-2	LCF Delivery - Paved Roads (Existing)	$PM_{2.5}$	PM2.5	Annual	0.25	2.56	<500	1650	19	20	39	29	5.4	7.21E-04	50%	3.60E-04	D	EF
R4-3	ALCF Delivery - Paved Roads (Future)	PM	PM	24 hr	5.24	2.56	<500	60	19	20	39	29	112.8	2.01E-01	50%	1.00E-01	A	EF
R4-3	ALCF Delivery - Paved Roads (Future)	PM	PM	Annual	5.24	2.56	<500	6600	19	20	39	29	112.8	6.04E-02	50%	3.02E-02	A	EF
R4-3	ALCF Delivery - Paved Roads (Future)	$PM_{2.5}$	PM2.5	24 hr	0.25	2.56	<500	60	19	20	39	29	5.4	9.57E-03	50%	4.78E-03	D	EF
R4-3	ALCF Delivery - Paved Roads (Future)	$PM_{2.5}$	PM2.5	Annual	0.25	2.56	<500	6600	19	20	39	29	5.4	2.88E-03	50%	1.44E-03	D	EF
R4-3A	ALCF Delivery - Paved Roads (Future) - Alternative Route	PM	PM	24 hr	5.24	3.50	<500	60	19	20	39	29	112.8	2.74E-01	50%	1.37E-01	A	EF
R4-3A	ALCF Delivery - Paved Roads (Future) - Alternative Route	PM	PM	Annual	5.24	3.50	<500	6600	19	20	39	29	112.8	8.25E-02	50%	4.13E-02	A	EF
R4-3A	ALCF Delivery - Paved Roads (Future) - Alternative Route	$PM_{2.5}$	PM2.5	24 hr	0.25	3.50	<500	60	19	20	39	29	5.4	1.31E-02	50%	6.53E-03	D	EF
R4-3A	ALCF Delivery - Paved Roads (Future) - Alternative Route	$PM_{2.5}$	PM2.5	Annual	0.25	3.50	<500	6600	19	20	39	29	5.4	3.94E-03	50%	1.97E-03	D	EF
R11	Finished Cement Shipping - Paved Roads	PM	PM	24 hr	5.24	3.32	<500	175	19	40	59	39	152.6	1.03E+00	50%	5.13E-01	A	EF
R11	Finished Cement Shipping - Paved Roads	PM	PM	Annual	5.24	3.32	<500	57750	19	40	59	39	152.6	9.28E-01	50%	4.64E-01	A	EF
R11	Finished Cement Shipping - Paved Roads	$PM_{2.5}$	PM2.5	24 hr	0.25	3.32	<500	175	19	40	59	39	7.3	4.90E-02	50%	2.45E-02	D	EF
R11	Finished Cement Shipping - Paved Roads	$PM_{2.5}$	PM2.5	Annual	0.25	3.32	<500	57750	19	40	59	39	7.3	4.43E-02	50%	2.21E-02	D	EF

Notes:
- This emission factor calculation and constant values for paved road dust are from the US EPA AP42 document titled "13.2.1 Paved Roads".
- A 50% control efficiency was assumed because the paved roads are vaccuumed/swept regularly.

Calculation Sheet - Tailpipe Emissions - On-Road Vehicles

Tailpipe Travelling Emission Rate [g/s] = Number of Vehicles x Distance Travelled per Vehicles [km] x 0.621 [miles/ km] x Travelling Emission Factor [g/VKT] / Averaging Period Converted to Seconds [years to seconds/days to seconds/hours to seconds]

Source ID	Source Description	Contaminant	CAS No.	Averaging Period	Round Trip Distance (km)	Idling Time (h)	Idling "Sped" (km/hr)	Number of Trucks during Averaging Period	Travelling Emission Factor (g/VKT)	Emission Rate (g/s)	Data Quality	Estimation Technique
					Material Delivery and Shipping							
T1-1	Iron & Sand Delivery - Tailpipe	PM	PM	24 hr	3.48	n/a	n/a	10	5.90E-01	2.38E-04	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	PM	PM	24 hr	3.48	n/a	n/a	0	5.90E-01	0.00E+00	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	PM	PM	24 hr	2.40	n/a	n/a	10	5.90E-01	1.64E-04	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	PM	PM	24 hr	2.56	n/a	n/a	0	5.90E-01	0.00E+00	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	PM	PM	24 hr	2.56	n/a	n/a	1	5.90E-01	1.75E-05	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	PM	PM	24 hr	2.56	n/a	n/a	5	5.90E-01	8.74E-05	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	PM	PM	24 hr	2.56	n/a	n/a	60	5.90E-01	1.05E-03	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	PM	PM	24 hr	3.50	n/a	n/a	60	5.90E-01	1.43E-03	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	PM	PM	24 hr	1.72	n/a	n/a	1	5.90E-01	1.17E-05	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	PM	PM	24 hr	1.31	n/a	n/a	5	5.90E-01	4.46E-05	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	PM	PM	24 hr	1.31	n/a	n/a	60	5.90E-01	5.35E-04	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	PM	PM	24 hr	2.61	n/a	n/a	60	5.90E-01	1.07E-03	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	PM	PM	24 hr	6.23	n/a	n/a	8	5.90E-01	3.40E-04	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	PM	PM	24 hr	3.54	n/a	n/a	170	5.90E-01	4.11E-03	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	PM	PM	24 hr	1.64	n/a	n/a	14	5.90E-01	1.54E-04	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	PM	PM	24 hr	1.57	n/a	n/a	175	5.90E-01	1.88E-03	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	PM	PM	24 hr	3.32	n/a	n/a	175	5.90E-01	3.97E-03	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	PM	PM	24 hr	n/a	0.20	4.02	175	2.33E+00	3.80E-03	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	PM	PM	Annual	3.48	n/a	n/a	2978	5.90E-01	1.94E-04	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	PM	PM	Annual	3.48	n/a	n/a	11250	5.90E-01	7.32E-04	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	PM	PM	Annual	2.40	n/a	n/a	2978	5.90E-01	1.34E-04	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	PM	PM	Annual	2.56	n/a	n/a	11250	5.90E-01	5.39E-04	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	PM	PM	Annual	2.56	n/a	n/a	224	5.90E-01	1.07E-05	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	PM	PM	Annual	2.56	n/a	n/a	1650	5.90E-01	7.90E-05	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	PM	PM	Annual	2.56	n/a	n/a	6600	5.90E-01	3.16E-04	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	PM	PM	Annual	3.50	n/a	n/a	6600	5.90E-01	4.32E-04	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	PM	PM	Annual	1.72	n/a	n/a	224	5.90E-01	7.21E-06	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	PM	PM	Annual	1.31	n/a	n/a	1650	5.90E-01	4.03E-05	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	PM	PM	Annual	1.31	n/a	n/a	6600	5.90E-01	1.61E-04	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	PM	PM	Annual	2.61	n/a	n/a	6600	5.90E-01	3.23E-04	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	PM	PM	Annual	6.23	n/a	n/a	2382	5.90E-01	2.78E-04	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	PM	PM	Annual	3.54	n/a	n/a	55688	5.90E-01	3.69E-03	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	PM	PM	Annual	1.64	n/a	n/a	4465	5.90E-01	1.37E-04	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	PM	PM	Annual	1.57	n/a	n/a	57750	5.90E-01	1.70E-03	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	PM	PM	Annual	3.32	n/a	n/a	57750	5.90E-01	3.59E-03	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	PM	PM	Annual	n/a	0.20	4.02	57750	2.33E+00	3.44E-03	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	3.48	n/a	n/a	10	2.11E-01	8.49E-05	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	3.48	n/a	n/a	0	2.11E-01	0.00E+00	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	2.40	n/a	n/a	10	2.11E-01	5.85E-05	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	2.56	n/a	n/a	0	2.11E-01	0.00E+00	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	2.56	n/a	n/a	1	2.11E-01	6.24E-06	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	$PM_{2.5}$	PM2.5	24 hr	2.56	n/a	n/a	5	2.11E-01	3.12E-05	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	$PM_{2.5}$	PM2.5	24 hr	2.56	n/a	n/a	60	2.11E-01	3.75E-04	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	$PM_{2.5}$	PM2.5	24 hr	3.50	n/a	n/a	60	2.11E-01	5.12E-04	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	1.72	n/a	n/a	1	2.11E-01	4.19E-06	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	$PM_{2.5}$	PM2.5	24 hr	1.31	n/a	n/a	5	2.11E-01	1.59E-05	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	$PM_{2.5}$	PM2.5	24 hr	1.31	n/a	n/a	60	2.11E-01	1.91E-04	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	$PM_{2.5}$	PM2.5	24 hr	2.61	n/a	n/a	60	2.11E-01	3.82E-04	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	6.23	n/a	n/a	8	2.11E-01	1.22E-04	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	3.54	n/a	n/a	170	2.11E-01	1.47E-03	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	1.64	n/a	n/a	14	2.11E-01	5.50E-05	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	1.57	n/a	n/a	175	2.11E-01	6.71E-04	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	$PM_{2.5}$	PM2.5	24 hr	3.32	n/a	n/a	175	2.11E-01	1.42E-03	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	$PM_{2.5}$	PM2.5	24 hr	n/a	0.20	4.02	175	1.15E+00	1.88E-03	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	$PM_{2.5}$	PM2.5	Annual	3.48	n/a	n/a	2978	2.11E-01	6.92E-05	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	$PM_{2.5}$	PM2.5	Annual	3.48	n/a	n/a	11250	2.11E-01	2.62E-04	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	$PM_{2.5}$	PM2.5	Annual	2.40	n/a	n/a	2978	2.11E-01	4.78E-05	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	$PM_{2.5}$	PM2.5	Annual	2.56	n/a	n/a	11250	2.11E-01	1.92E-04	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	$PM_{2.5}$	PM2.5	Annual	2.56	n/a	n/a	224	2.11E-01	3.83E-06	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	$PM_{2.5}$	PM2.5	Annual	2.56	n/a	n/a	1650	2.11E-01	2.82E-05	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	$PM_{2.5}$	PM2.5	Annual	2.56	n/a	n/a	6600	2.11E-01	1.13E-04	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	$PM_{2.5}$	PM2.5	Annual	3.50	n/a	n/a	6600	2.11E-01	1.54E-04	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	$PM_{2.5}$	PM2.5	Annual	1.72	n/a	n/a	224	2.11E-01	2.57E-06	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	$PM_{2.5}$	PM2.5	Annual	1.31	n/a	n/a	1650	2.11E-01	1.44E-05	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	$PM_{2.5}$	PM2.5	Annual	1.31	n/a	n/a	6600	2.11E-01	5.76E-05	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	$PM_{2.5}$	PM2.5	Annual	2.61	n/a	n/a	6600	2.11E-01	1.15E-04	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	$PM_{2.5}$	PM2.5	Annual	6.23	n/a	n/a	2382	2.11E-01	9.92E-05	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	$PM_{2.5}$	PM2.5	Annual	3.54	n/a	n/a	55688	2.11E-01	1.32E-03	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	$PM_{2.5}$	PM2.5	Annual	1.64	n/a	n/a	4465	2.11E-01	4.90E-05	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	$PM_{2.5}$	PM2.5	Annual	1.57	n/a	n/a	57750	2.11E-01	6.07E-04	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	$PM_{2.5}$	PM2.5	Annual	3.32	n/a	n/a	57750	2.11E-01	1.28E-03	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	$PM_{2.5}$	PM2.5	Annual	n/a	0.20	4.02	57750	1.15E+00	1.70E-03	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	NO_2	10102-44-0	1 hr	3.48	n/a	n/a	1	3.72E+00	3.60E-03	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	NO_2	10102-44-0	1 hr	3.48	n/a	n/a	0	3.72E+00	0.00E+00	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	NO_2	10102-44-0	1 hr	2.40	n/a	n/a	1	3.72E+00	2.48E-03	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	NO_2	10102-44-0	1 hr	2.56	n/a	n/a	0	3.72E+00	0.00E+00	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	NO_2	10102-44-0	1 hr	2.56	n/a	n/a	1	3.72E+00	2.65E-03	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	NO_2	10102-44-0	1 hr	2.56	n/a	n/a	1	3.72E+00	2.65E-03	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	NO_2	10102-44-0	1 hr	2.56	n/a	n/a	3	3.72E+00	7.95E-03	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	NO_2	10102-44-0	1 hr	3.50	n/a	n/a	3	3.72E+00	1.09E-02	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	NO_2	10102-44-0	1 hr	1.72	n/a	n/a	1	3.72E+00	1.78E-03	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	NO_2	10102-44-0	1 hr	1.31	n/a	n/a	1	3.72E+00	1.35E-03	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	NO_2	10102-44-0	1 hr	1.31	n/a	n/a	3	3.72E+00	4.06E-03	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	NO_2	10102-44-0	1 hr	2.61	n/a	n/a	3	3.72E+00	8.11E-03	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	NO_2	10102-44-0	1 hr	6.23	n/a	n/a	1	3.72E+00	6.45E-03	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	NO_2	10102-44-0	1 hr	3.54	n/a	n/a	8	3.72E+00	2.93E-02	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	NO_2	10102-44-0	1 hr	1.64	n/a	n/a	1	3.72E+00	1.27E-03	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	NO_2	10102-44-0	1 hr	1.57	n/a	n/a	8	3.72E+00	1.22E-02	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	NO_2	10102-44-0	1 hr	3.32	n/a	n/a	8	3.72E+00	2.58E-02	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	NO_2	10102-44-0	1 hr	n/a	0.20	4.02	8	2.23E+01	3.74E-02	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	NO_2	10102-44-0	24 hr	3.48	n/a	n/a	10	3.72E+00	1.50E-03	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	NO_2	10102-44-0	24 hr	3.48	n/a	n/a	0	3.72E+00	0.00E+00	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	NO_2	10102-44-0	24 hr	2.40	n/a	n/a	10	3.72E+00	1.03E-03	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	NO_2	10102-44-0	24 hr	2.56	n/a	n/a	0	3.72E+00	0.00E+00	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	NO_2	10102-44-0	24 hr	2.56	n/a	n/a	1	3.72E+00	1.10E-04	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	NO_2	10102-44-0	24 hr	2.56	n/a	n/a	5	3.72E+00	5.52E-04	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	NO_2	10102-44-0	24 hr	2.56	n/a	n/a	60	3.72E+00	6.62E-03	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	NO_2	10102-44-0	24 hr	3.50	n/a	n/a	60	3.72E+00	9.05E-03	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	NO_2	10102-44-0	24 hr	1.72	n/a	n/a	1	3.72E+00	7.42E-05	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	NO_2	10102-44-0	24 hr	1.31	n/a	n/a	5	3.72E+00	2.82E-04	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	NO_2	10102-44-0	24 hr	1.31	n/a	n/a	60	3.72E+00	3.38E-03	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	NO_2	10102-44-0	24 hr	2.61	n/a	n/a	60	3.72E+00	6.76E-03	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	NO_2	10102-44-0	24 hr	6.23	n/a	n/a	8	3.72E+00	2.15E-03	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	NO_2	10102-44-0	24 hr	3.54	n/a	n/a	170	3.72E+00	2.59E-02	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	NO_2	10102-44-0	24 hr	1.64	n/a	n/a	14	3.72E+00	9.73E-04	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	NO_2	10102-44-0	24 hr	1.57	n/a	n/a	175	3.72E+00	1.19E-02	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	NO_2	10102-44-0	24 hr	3.32	n/a	n/a	175	3.72E+00	2.51E-02	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	NO_2	10102-44-0	24 hr	n/a	0.20	4.02	175	2.23E+01	3.63E-02	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	SO_2	7446-09-5	1 hr	3.48	n/a	n/a	1	1.40E-02	1.36E-05	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	SO_2	7446-09-5	1 hr	3.48	n/a	n/a	0	1.40E-02	0.00E+00	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	SO_2	7446-09-5	1 hr	2.40	n/a	n/a	1	1.40E-02	9.37E-06	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	SO_2	7446-09-5	1 hr	2.56	n/a	n/a	0	1.40E-02	0.00E+00	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	SO_2	7446-09-5	1 hr	2.56	n/a	n/a	1	1.40E-02	9.99E-06	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	SO_2	7446-09-5	1 hr	2.56	n/a	n/a	1	1.40E-02	9.99E-06	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	SO_2	7446-09-5	1 hr	2.56	n/a	n/a	3	1.40E-02	3.00E-05	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	SO_2	7446-09-5	1 hr	3.50	n/a	n/a	3	1.40E-02	4.09E-05	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	SO_2	7446-09-5	1 hr	1.72	n/a	n/a	1	1.40E-02	6.71E-06	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	SO_2	7446-09-5	1 hr	1.31	n/a	n/a	1	1.40E-02	5.10E-06	Above Average	MOVES EF

Source ID	Source Description	Contaminant	CAS No.	Averaging Period	Round Trip Distance (km)	Idling Time (h)	Idling "Sped" (km/hr)	Number of Trucks during Averaging Period	Travelling Emission Factor (g/VKT)	Emission Rate (g/s)	Data Quality	Estimation Technique
T6-2	ALCF Delivery - Tailpipe (Future)	SO_2	7446-09-5	1 hr	1.31	n/a	n/a	3	1.40E-02	1.53E-05	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	SO_2	7446-09-5	1 hr	2.61	n/a	n/a	3	1.40E-02	3.06E-05	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	SO_2	7446-09-5	1 hr	6.23	n/a	n/a	1	1.40E-02	2.43E-05	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	SO_2	7446-09-5	1 hr	3.54	n/a	n/a	8	1.40E-02	1.11E-04	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	SO_2	7446-09-5	1 hr	1.64	n/a	n/a	1	1.40E-02	4.80E-06	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	SO_2	7446-09-5	1 hr	1.57	n/a	n/a	8	1.40E-02	4.60E-05	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	SO_2	7446-09-5	1 hr	3.32	n/a	n/a	8	1.40E-02	9.73E-05	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	SO_2	7446-09-5	1 hr	n/a	0.20	4.02	8	7.75E-02	1.30E-04	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	SO_2	7446-09-5	24 hr	3.48	n/a	n/a	10	1.40E-02	5.66E-06	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	SO_2	7446-09-5	24 hr	3.48	n/a	n/a	0	1.40E-02	0.00E+00	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	SO_2	7446-09-5	24 hr	2.40	n/a	n/a	10	1.40E-02	3.90E-06	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	SO_2	7446-09-5	24 hr	2.56	n/a	n/a	0	1.40E-02	0.00E+00	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	SO_2	7446-09-5	24 hr	2.56	n/a	n/a	1	1.40E-02	4.16E-07	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	SO_2	7446-09-5	24 hr	2.56	n/a	n/a	5	1.40E-02	2.08E-06	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	SO_2	7446-09-5	24 hr	2.56	n/a	n/a	60	1.40E-02	2.50E-05	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	SO_2	7446-09-5	24 hr	3.50	n/a	n/a	60	1.40E-02	3.41E-05	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	SO_2	7446-09-5	24 hr	1.72	n/a	n/a	1	1.40E-02	2.80E-07	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	SO_2	7446-09-5	24 hr	1.31	n/a	n/a	5	1.40E-02	1.06E-06	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	SO_2	7446-09-5	24 hr	1.31	n/a	n/a	60	1.40E-02	1.27E-05	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	SO_2	7446-09-5	24 hr	2.61	n/a	n/a	60	1.40E-02	2.55E-05	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	SO_2	7446-09-5	24 hr	6.23	n/a	n/a	8	1.40E-02	8.11E-06	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	SO_2	7446-09-5	24 hr	3.54	n/a	n/a	170	1.40E-02	9.79E-05	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	SO_2	7446-09-5	24 hr	1.64	n/a	n/a	14	1.40E-02	3.67E-06	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	SO_2	7446-09-5	24 hr	1.57	n/a	n/a	175	1.40E-02	4.47E-05	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	SO_2	7446-09-5	24 hr	3.32	n/a	n/a	175	1.40E-02	9.46E-05	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	SO_2	7446-09-5	24 hr	n/a	0.20	4.02	175	7.75E-02	1.26E-04	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	SO_2	7446-09-5	Annual	3.48	n/a	n/a	2978	1.40E-02	4.62E-06	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	SO_2	7446-09-5	Annual	3.48	n/a	n/a	11250	1.40E-02	1.74E-05	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	SO_2	7446-09-5	Annual	2.40	n/a	n/a	2978	1.40E-02	3.18E-06	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	SO_2	7446-09-5	Annual	2.56	n/a	n/a	11250	1.40E-02	1.28E-05	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	SO_2	7446-09-5	Annual	2.56	n/a	n/a	224	1.40E-02	2.55E-07	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	SO_2	7446-09-5	Annual	2.56	n/a	n/a	1650	1.40E-02	1.88E-06	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	SO_2	7446-09-5	Annual	2.56	n/a	n/a	6600	1.40E-02	7.53E-06	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	SO_2	7446-09-5	Annual	3.50	n/a	n/a	6600	1.40E-02	1.03E-05	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	SO_2	7446-09-5	Annual	1.72	n/a	n/a	224	1.40E-02	1.72E-07	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	SO_2	7446-09-5	Annual	1.31	n/a	n/a	1650	1.40E-02	9.61E-07	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	SO_2	7446-09-5	Annual	1.31	n/a	n/a	6600	1.40E-02	3.84E-06	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	SO_2	7446-09-5	Annual	2.61	n/a	n/a	6600	1.40E-02	7.69E-06	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	SO_2	7446-09-5	Annual	6.23	n/a	n/a	2382	1.40E-02	6.61E-06	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	SO_2	7446-09-5	Annual	3.54	n/a	n/a	55688	1.40E-02	8.78E-05	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	SO_2	7446-09-5	Annual	1.64	n/a	n/a	4465	1.40E-02	3.26E-06	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	SO_2	7446-09-5	Annual	1.57	n/a	n/a	57750	1.40E-02	4.04E-05	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	SO_2	7446-09-5	Annual	3.32	n/a	n/a	57750	1.40E-02	8.55E-05	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	SO_2	7446-09-5	Annual	n/a	0.20	4.02	57750	7.75E-02	1.14E-04	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	Benzene	71-43-2	24 hr	3.48	n/a	n/a	10	7.19E-03	2.90E-06	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	Benzene	71-43-2	24 hr	3.48	n/a	n/a	0	7.19E-03	0.00E+00	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	Benzene	71-43-2	24 hr	2.40	n/a	n/a	10	7.19E-03	2.00E-06	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	Benzene	71-43-2	24 hr	2.56	n/a	n/a	0	7.19E-03	0.00E+00	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	Benzene	71-43-2	24 hr	2.56	n/a	n/a	1	7.19E-03	2.13E-07	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	Benzene	71-43-2	24 hr	2.56	n/a	n/a	5	7.19E-03	1.07E-06	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	Benzene	71-43-2	24 hr	2.56	n/a	n/a	60	7.19E-03	1.28E-05	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	Benzene	71-43-2	24 hr	3.50	n/a	n/a	60	7.19E-03	1.75E-05	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	Benzene	71-43-2	24 hr	1.72	n/a	n/a	1	7.19E-03	1.43E-07	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	Benzene	71-43-2	24 hr	1.31	n/a	n/a	5	7.19E-03	5.44E-07	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	Benzene	71-43-2	24 hr	1.31	n/a	n/a	60	7.19E-03	6.53E-06	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	Benzene	71-43-2	24 hr	2.61	n/a	n/a	60	7.19E-03	1.31E-05	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	Benzene	71-43-2	24 hr	6.23	n/a	n/a	8	7.19E-03	4.15E-06	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	Benzene	71-43-2	24 hr	3.54	n/a	n/a	170	7.19E-03	5.01E-05	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	Benzene	71-43-2	24 hr	1.64	n/a	n/a	14	7.19E-03	1.88E-06	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	Benzene	71-43-2	24 hr	1.57	n/a	n/a	175	7.19E-03	2.29E-05	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	Benzene	71-43-2	24 hr	3.32	n/a	n/a	175	7.19E-03	4.84E-05	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	Benzene	71-43-2	24 hr	n/a	0.20	4.02	175	4.23E-02	6.89E-05	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	Benzene	71-43-2	Annual	3.48	n/a	n/a	2978	7.19E-03	2.36E-06	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	Benzene	71-43-2	Annual	3.48	n/a	n/a	11250	7.19E-03	8.93E-06	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	Benzene	71-43-2	Annual	2.40	n/a	n/a	2978	7.19E-03	1.63E-06	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	Benzene	71-43-2	Annual	2.56	n/a	n/a	11250	7.19E-03	6.57E-06	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	Benzene	71-43-2	Annual	2.56	n/a	n/a	224	7.19E-03	1.31E-07	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	Benzene	71-43-2	Annual	2.56	n/a	n/a	1650	7.19E-03	9.63E-07	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	Benzene	71-43-2	Annual	2.56	n/a	n/a	6600	7.19E-03	3.85E-06	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	Benzene	71-43-2	Annual	3.50	n/a	n/a	6600	7.19E-03	5.26E-06	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	Benzene	71-43-2	Annual	1.72	n/a	n/a	224	7.19E-03	8.79E-08	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	Benzene	71-43-2	Annual	1.31	n/a	n/a	1650	7.19E-03	4.92E-07	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	Benzene	71-43-2	Annual	1.31	n/a	n/a	6600	7.19E-03	1.97E-06	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	Benzene	71-43-2	Annual	2.61	n/a	n/a	6600	7.19E-03	3.93E-06	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	Benzene	71-43-2	Annual	6.23	n/a	n/a	2382	7.19E-03	3.39E-06	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	Benzene	71-43-2	Annual	3.54	n/a	n/a	55688	7.19E-03	4.50E-05	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	Benzene	71-43-2	Annual	1.64	n/a	n/a	4465	7.19E-03	1.67E-06	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	Benzene	71-43-2	Annual	1.57	n/a	n/a	2382	7.19E-03	8.54E-07	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	Benzene	71-43-2	Annual	3.32	n/a	n/a	55688	7.19E-03	4.22E-05	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	Benzene	71-43-2	Annual	n/a	0.20	4.02	55688	4.23E-02	6.00E-05	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	3.48	n/a	n/a	10	2.79E-05	1.12E-08	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	3.48	n/a	n/a	0	2.79E-05	0.00E+00	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	2.40	n/a	n/a	10	2.79E-05	7.75E-09	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	2.56	n/a	n/a	0	2.79E-05	0.00E+00	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	2.56	n/a	n/a	1	2.79E-05	8.26E-10	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	Benzo(a)pyrene	50-32-8	24 hr	2.56	n/a	n/a	5	2.79E-05	4.13E-09	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	Benzo(a)pyrene	50-32-8	24 hr	2.56	n/a	n/a	60	2.79E-05	4.96E-08	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	Benzo(a)pyrene	50-32-8	24 hr	3.50	n/a	n/a	60	2.79E-05	6.77E-08	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	1.72	n/a	n/a	1	2.79E-05	5.55E-10	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	Benzo(a)pyrene	50-32-8	24 hr	1.31	n/a	n/a	5	2.79E-05	2.11E-09	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	Benzo(a)pyrene	50-32-8	24 hr	1.31	n/a	n/a	60	2.79E-05	2.53E-08	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	Benzo(a)pyrene	50-32-8	24 hr	2.61	n/a	n/a	60	2.79E-05	5.06E-08	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	6.23	n/a	n/a	8	2.79E-05	1.61E-08	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	3.54	n/a	n/a	170	2.79E-05	1.94E-07	Above Average	MOVES EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	Benzo(a)pyrene	50-32-8	24 hr	0.24	n/a	n/a	850	1.87E-04	4.40E-07	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	1.64	n/a	n/a	14	2.79E-05	7.29E-09	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	1.57	n/a	n/a	175	2.79E-05	8.88E-08	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	Benzo(a)pyrene	50-32-8	24 hr	3.32	n/a	n/a	175	2.79E-05	1.88E-07	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	Benzo(a)pyrene	50-32-8	24 hr	n/a	0.20	4.02	175	1.87E-04	3.04E-07	Above Average	MOVES EF
T1-1	Iron & Sand Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	3.48	n/a	n/a	2978	2.79E-05	9.17E-09	Above Average	MOVES EF
T1-2	CBM Materials Shipping - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	3.48	n/a	n/a	11250	2.79E-05	3.46E-08	Above Average	MOVES EF
T2	Iron & Sand Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	2.40	n/a	n/a	2978	2.79E-05	6.32E-09	Above Average	MOVES EF
T3	CBM Materials Shipping - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	2.56	n/a	n/a	11250	2.79E-05	2.55E-08	Above Average	MOVES EF
T4-1	Ash Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	2.56	n/a	n/a	224	2.79E-05	5.07E-10	Above Average	MOVES EF
T4-2	LCF Delivery - Tailpipe (Existing)	Benzo(a)pyrene	50-32-8	Annual	2.56	n/a	n/a	1650	2.79E-05	3.74E-09	Above Average	MOVES EF
T4-3	ALCF Delivery - Tailpipe (Future)	Benzo(a)pyrene	50-32-8	Annual	2.56	n/a	n/a	6600	2.79E-05	1.49E-08	Above Average	MOVES EF
T4-3A	ALCF Delivery - Tailpipe (Future) - Alternative	Benzo(a)pyrene	50-32-8	Annual	3.50	n/a	n/a	6600	2.79E-05	2.04E-08	Above Average	MOVES EF
T5	Ash Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	1.72	n/a	n/a	224	2.79E-05	3.41E-10	Above Average	MOVES EF
T6-1	LCF Delivery - Tailpipe (Existing)	Benzo(a)pyrene	50-32-8	Annual	1.31	n/a	n/a	1650	2.79E-05	1.91E-09	Above Average	MOVES EF
T6-2	ALCF Delivery - Tailpipe (Future)	Benzo(a)pyrene	50-32-8	Annual	1.31	n/a	n/a	6600	2.79E-05	7.63E-09	Above Average	MOVES EF
T6-2A	ALCF Delivery - Tailpipe (Future) - Alternative	Benzo(a)pyrene	50-32-8	Annual	2.61	n/a	n/a	6600	2.79E-05	1.53E-08	Above Average	MOVES EF
T7	Overburden Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	6.23	n/a	n/a	2382	2.79E-05	1.31E-08	Above Average	MOVES EF
T8	Haul Truck to Primary Crusher - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	3.54	n/a	n/a	55688	2.79E-05	1.74E-07	Above Average	MOVES EF
T9	Fuel Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	1.64	n/a	n/a	4465	2.79E-05	6.48E-09	Above Average	MOVES EF
T10	CKD/Gypsum Delivery - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	1.57	n/a	n/a	57750	2.79E-05	8.03E-08	Above Average	MOVES EF
T11	Finished Cement Shipping - Tailpipe	Benzo(a)pyrene	50-32-8	Annual	3.32	n/a	n/a	57750	2.79E-05	1.70E-07	Above Average	MOVES EF
I11	Finished Cement Shipping - Idling	Benzo(a)pyrene	50-32-8	Annual	n/a	0.20	4.02	57750	1.87E-04	2.75E-07	Above Average	MOVES EF

Calculation Sheet - Tailpipe Emissions - Off-Road Vehicles

Assumes FEL operates at an average speed of 10 km/hr and runs on a 192 HP engine

FEL Emission Rate [g/s] = Number of Vehicles x Distance Travelled per Vehicle [km] x Operating Time per Trip [hr] x Tier 4 Emission Factor [g/HP-hr] x 192 HP engine / Averaging Period Converted to Seconds

Source ID	Source Description	Contaminant	CAS No.	Averaging Period	Round Trip Distance (km)	Number of Trips during Averaging Period	Operating Time per Trip (hr)	Power (hp)	Tier 4 Emission Factor (g/hp-hr)	Emission Rate (g/s)	Data Quality	Estimation Technique
Cement Plant												
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	PM	PM	24 hr	0.10	8	0.010	200.0	0.015	2.78E-06	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	PM	PM	24 hr	0.24	70	0.024	200.0	0.015	5.83E-05	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	PM	PM	24 hr	0.24	850	0.024	200.0	0.015	7.08E-04	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	PM	PM	Annual	0.10	2085	0.010	200.0	0.015	1.98E-06	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	PM	PM	Annual	0.24	45000	0.024	200.0	0.015	1.03E-04	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	PM	PM	Annual	0.24	278440	0.024	200.0	0.015	6.36E-04	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	$PM_{2.5}$	PM2.5	24 hr	0.10	8	0.010	200.0	0.015	2.78E-06	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	$PM_{2.5}$	PM2.5	24 hr	0.24	70	0.024	200.0	0.015	5.83E-05	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	$PM_{2.5}$	PM2.5	24 hr	0.24	850	0.024	200.0	0.015	7.08E-04	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	$PM_{2.5}$	PM2.5	Annual	0.10	2085	0.010	200.0	0.015	1.98E-06	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	$PM_{2.5}$	PM2.5	Annual	0.24	45000	0.024	200.0	0.015	1.03E-04	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	$PM_{2.5}$	PM2.5	Annual	0.24	278440	0.024	200.0	0.015	6.36E-04	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	NO_2	10102-44-0	1 hr	0.10	4	0.010	200.0	0.300	6.67E-04	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	NO_2	10102-44-0	1 hr	0.24	16	0.024	200.0	0.300	6.40E-03	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	NO_2	10102-44-0	1 hr	0.24	40	0.024	200.0	0.300	1.60E-02	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	NO_2	10102-44-0	24 hr	0.10	8	0.010	200.0	0.300	5.56E-05	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	NO_2	10102-44-0	24 hr	0.24	70	0.024	200.0	0.300	1.17E-03	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	NO_2	10102-44-0	24 hr	0.24	850	0.024	200.0	0.300	1.42E-02	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	SO_2	7446-09-5	1 hr	0.10	4	0.010	200.0	0.930	2.07E-03	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	SO_2	7446-09-5	1 hr	0.24	16	0.024	200.0	0.930	1.98E-02	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	SO_2	7446-09-5	1 hr	0.24	40	0.024	200.0	0.930	4.96E-02	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	SO_2	7446-09-5	24 hr	0.10	8	0.010	200.0	0.930	1.72E-04	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	SO_2	7446-09-5	24 hr	0.24	70	0.024	200.0	0.930	3.62E-03	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	SO_2	7446-09-5	24 hr	0.24	850	0.024	200.0	0.930	4.39E-02	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	SO_2	7446-09-5	Annual	0.10	2085	0.010	200.0	0.930	1.23E-04	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	SO_2	7446-09-5	Annual	0.24	45000	0.024	200.0	0.930	6.37E-03	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	SO_2	7446-09-5	Annual	0.24	278440	0.024	200.0	0.930	3.94E-02	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	Benzene	71-43-2	24 hr	0.10	8	0.010	200.0	0.002	4.42E-07	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	Benzene	71-43-2	24 hr	0.24	70	0.024	200.0	0.002	9.29E-06	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	Benzene	71-43-2	24 hr	0.24	850	0.024	200.0	0.002	1.13E-04	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	Benzene	71-43-2	Annual	0.10	2085	0.010	200.0	0.002	3.16E-07	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	Benzene	71-43-2	Annual	0.24	45000	0.024	200.0	0.002	1.64E-05	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	Benzene	71-43-2	Annual	0.24	278440	0.024	200.0	0.002	1.01E-04	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	Benzo(a)pyrene	50-32-8	24 hr	0.10	8	0.010	200.0	4.95E-08	9.17E-12	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	Benzo(a)pyrene	50-32-8	24 hr	0.24	70	0.024	200.0	4.95E-08	1.93E-10	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	Benzo(a)pyrene	50-32-8	24 hr	0.24	850	0.024	200.0	4.95E-08	2.34E-09	A	EF
RAWSILO-11	Tailpipe exhaust from FEL transferring sand to feed hopper	Benzo(a)pyrene	50-32-8	Annual	0.10	2085	0.010	200.0	4.95E-08	6.55E-12	A	EF
CBM-8	Tailpipe exhaust from FEL operating in CBM area	Benzo(a)pyrene	50-32-8	Annual	0.24	45000	0.024	200.0	4.95E-08	3.39E-10	A	EF
QUARRY-11	Tailpipe exhaust from FEL loading Haul Truck	Benzo(a)pyrene	50-32-8	Annual	0.24	278440	0.024	200.0	4.95E-08	2.10E-09	A	EF
Cargo Dockers												
CD-3	Tailpipe exhaust from FEL moving materials into trucks	PM	PM	24 hr	1.90	25	0.19	200.0	0.015	1.65E-04	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	PM	PM	Annual	1.90	7502	0.19	200.0	0.015	1.36E-04	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	24 hr	1.90	25	0.19	200.0	0.015	1.65E-04	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	$PM_{2.5}$	PM2.5	Annual	1.90	7502	0.19	200.0	0.015	1.36E-04	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	NO_2	10102-44-0	1 hr	1.90	4	0.19	200.0	0.300	1.27E-02	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	NO_2	10102-44-0	24 hr	1.90	25	0.19	200.0	0.300	3.30E-03	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	SO_2	7446-09-5	1 hr	1.90	4	0.19	200.0	0.930	3.93E-02	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	SO_2	7446-09-5	24 hr	1.90	25	0.19	200.0	0.930	1.02E-02	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	SO_2	7446-09-5	Annual	1.90	7502	0.19	200.0	0.930	8.41E-03	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	Benzene	71-43-2	24 hr	1.90	25	0.19	200.0	0.002	2.63E-05	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	Benzene	71-43-2	Annual	1.90	7502	0.19	200.0	0.002	2.16E-05	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	Benzo(a)pyrene	50-32-8	24 hr	1.90	25	0.19	200.0	0.000	5.44E-10	A	EF
CD-3	Tailpipe exhaust from FEL moving materials into trucks	Benzo(a)pyrene	50-32-8	Annual	1.90	7502	0.19	200.0	0.000	4.47E-10	A	EF

Appendix E

Shoreline Effect Assessment

Appendix E
Shoreline Effects Assessment

The Facility's kiln stack has a height of 105m above grade and is located within 600m from the shoreline of Lake Ontario. The temperature difference between water and land can result in reduced air dispersion. This shoreline effect is referred as shoreline Effects in the ADMGO. As required by ADMGO, a shoreline effect screening assessment is completed for this source using the Screen3 model. The screening assessment concluded that the shoreline effects may occur. A shoreline effect assessment is, therefore, completed using the CALPUFF model (Version 7).

As described in Section 5 of this report, the Facility is currently approved in AERMOD. The site-wide emission modelling for this study is, therefore, completed using AERMOD (Version 16216r). CALPUFF modelling is only completed for the kiln stack to generate "shoreline effects factors" which are then incorporated in the AERMOD modelling input for the kiln stack to account for potential impact of shoreline effects.

CALPUFF is an advanced non-steady-state meteorological and air quality modeling system. The model has been adopted by the Newfoundland and Labrador Department of Environment and Conservation (NL DOEC) in its "Guideline for Plume Dispersion Modelling" as the preferred model. CALPUFF is a US EPA guided model for assessing long-range transport of pollutants and in many other jurisdictions is used on a case-by-case basis for complex terrain and shore-line settings.

The methodology is described below.

E.1 CALMET SET UP

CALMET is the meteorological pre-processor for CALPUFF which establishes the 3-Dimensional meteorological field by taking into consideration local weather, terrain and land use information.

E.1.1. CALMET Modelling Domain, Terrain and Land Use Data

A modelling domain of 10km x 10km is set up for this study to be consistent with the domain size/study area for the site wide AERMOD assessment. A fine resolution of 200m is selected for the grid setting to capture the shoreline of Lake Ontario. The modelling domain and grid setting are shown in Figure E-1.

Terrain data (CDED 1-Deg) is downloaded from WebGIS. Land Use data (USQS CTG format) for the modelling domain is developed by BCX using the most recent aerial (Google Earth) image.

E.1.2 Surface, Upper Air, Precipitation and Overwater Data

The meso-scale weather forecasting model WRF-NMM was used to generate 5-year (2014-2018) input data files for CALMET (i.e., surface, upper air, precipitation and overwater data). 17 prognostic surface and upper air stations are generated for the meteorological grid, as well as one precipitation and one overwater station. The locations of these prognostic stations are shown in Figure E-1 (yellow dots).

Figure E-1 – Modelling Domain, Grid Spacing and Prognostic Weather Stations

E.1.3 WRF-NMM output validation

The WRF-NMM model predictions of wind speed and temperature are validated by comparing outputs with real field measurements at three weather stations (i.e. Toronto Pearson Airport, Peterborough and Trenton Airport). The validation assessment shows that the WRF-NMM model predictions are generally consistent with real field measurements.

E.2 CALPUFF SET UP

Critical inputs for CALPUFF include emission source input, building downwash, receptor locations, the 3-dimensional meteorological field (aka CALMET output, see Section 2.2), and dispersion coefficients. The assumptions for these critical inputs are presented in the sections below.

E.2.1 Source Data and Building Downwash

Source data (i.e. the kiln stack) including physical source parameters and building downwash input in this air quality study are used for this study.

E.2.2 Receptors

The receptors for this study include: a nested grid as per ADMGO spacing requirements covering the entire modelling domain and property line receptors extracted from the current ESDM report.

E.2.3 Dispersion Coefficient

Dispersion coefficients are calculated using values based on stability classes (PG).

E.3 CALPUFF RUNS for Shoreline Effects Factors

In order to assess the potential impact of shoreline Effects on the modelling results, 48 CALPUFF model runs are completed to obtain unit emission dispersion factors (with and without shoreline effects) for each hour. For each of the 48 model runs, the kiln stack emission rate is assumed to be 1g/s for the active hour and zero for the remaining hours. The shoreline effects factor for each hour is calculated as the ratio of maximum hourly POI concentration (with Effects)/maximum hourly POI concentration (without shoreline effects). The model runs and the hourly shoreline effects factors are summarized below.

Active Hour	With Shoreline Effects (Coastal Line Active)	Without Shoreline Effects (Coastal Line Inactive)	Shoreline Effects Factor
1	H1F	H1NF	1
2	H2F	H2NF	1
3	H3F	H3NF	1
4	H4F	H4NF	1
5	H5F	H5NF	1
6	H6F	H6NF	1
7	H7F	H7NF	1
8	H8F	H8NF	0.9965
9	H9F	H9NF	1
10	H10F	H10NF	0.9824
11	H11F	H11NF	0.9876
12	H12F	H12NF	1
13	H13F	H13NF	1
14	H14F	H14NF	1
15	H15F	H15NF	1.0106
16	H16F	H16NF	1
17	H17F	H17NF	0.9960
18	H18F	H18NF	0.9965
19	H19F	H19NF	1
20	H20F	H20NF	1
21	H21F	H21NF	1
22	H22F	H22NF	1
23	H23F	H23NF	1
24	H24F	H24NF	1

To account for potential impacts of shoreline effects in the site wide AERMOD modelling assessment, a very conservative hourly shoreline effects factor of 1.1 are applied as the corresponding diurnal hourly variable emission factor for the kiln stack source in the AERMOD input file.

Appendix F

AERMOD Supporting Files

Particle Size Distribution

Source_ID	Particle_Diameter	Mass Fraction	Particle_Density
	[microns]	[0 to 1]	[g/cm^3]
QUARRY	1.25	0.0306	1.51
QUARRY	6.25	0.2755	1.51
QUARRY	20	0.6939	1.51
QUARRYD	1.25	0.0663	1.51
QUARRYD	3.75	0.1838	1.51
QUARRYD	7.5	0.1875	1.51
QUARRYD	12.5	0.1625	1.51
QUARRYD	22.5	0.3250	1.51
QUARRYD	37	0.0750	1.51

Appendix G

Maximum Modelled Concentrations for Existing and Future Scenarios

Maximum Modelled Concentration Table

Contaminant Name	CAS #	Total Facility Emission Rate (g/s)		Maximum Concentration at any Receptor (µg/m³)		Background Concentration (µg/m³)		Maximum Concentration at any Receptor (incl. Background) (µg/m³)		Averaging Period Emission Rate	Averaging Period POI Concentration	Air Criteria (µg/m³)	Source of Air Criteria	Limiting Effect	Percentage of Ministry POI Limit at any Receptor (Facility Only) (%)		% Change	Percentage of Ministry POI Limit at any Receptor (incl. Background) (%)		% Change
		Existing	Future	Existing	Future	Existing	Future	Existing	Future						Existing	Future		Existing	Future	
Particulate																				
PM	PM	1.04E+01	1.10E+01	4.11E+01	4.38E+01	6.73E+01	6.73E+01	1.08E+02	1.11E+02	24 hr	24 hr	120	AAQC	Visibility	34.2%	36.5%	2.3%	90.3%	92.5%	2.3%
PM	PM	1.04E+01	1.10E+01	6.66E+00	6.81E+00	3.50E+01	3.50E+01	4.17E+01	4.18E+01	Annual	Annual	60	AAQC	Visibility	11.1%	11.4%	0.3%	69.4%	69.7%	0.3%
PM2.5	PM2.5	2.67E+00	2.68E+00	8.44E+00	8.46E+00	1.23E+01	1.23E+01	2.07E+01	2.08E+01	24 hr	24 hr	27	CAAQS	See note #8	31.2%	31.3%	<0.1%	76.8%	76.9%	<0.1%
PM2.5	PM2.5	2.67E+00	2.68E+00	1.05E+00	1.05E+00	6.34E+00	6.34E+00	7.39E+00	7.40E+00	Annual	Annual	8.8	CAAQS	See note #8	11.9%	11.9%	<0.1%	84.0%	84.0%	<0.1%
Combustion Gases																				
Nitrogen Dioxide	10102-44-0	9.49E+01	9.49E+01	1.84E+02	1.84E+02	2.01E+01	2.17E+01	2.04E+02	2.05E+02	1 hr	1 hr	400	AAQC	Health	45.9%	45.9%	<0.1%	51.0%	51.4%	0.4%
Nitrogen Dioxide	10102-44-0	9.49E+01	9.49E+01	6.38E+01	6.38E+01	2.01E+01	2.01E+01	8.38E+01	8.39E+01	24 hr	24 hr	200	AAQC	Health	31.9%	31.9%	<0.1%	41.9%	41.9%	<0.1%
Sulphur Dioxide	7446-09-5	1.31E+02	1.41E+02	2.90E+02	3.12E+02	8.82E+00	9.25E+00	2.99E+02	3.22E+02	1 hr	1 hr	690	AAQC	Health & Vegetation	42.1%	45.3%	3.2%	43.4%	46.6%	3.3%
Sulphur Dioxide	7446-09-5	1.31E+02	1.41E+02	8.69E+01	9.35E+01	8.82E+00	8.82E+00	9.57E+01	1.02E+02	24 hr	24 hr	275	AAQC	Health & Vegetation	31.6%	34.0%	2.4%	34.8%	37.2%	2.4%
Sulphur Dioxide	7446-09-5	1.31E+02	1.41E+02	3.54E+00	3.74E+00	3.79E+00	3.79E+00	7.33E+00	7.53E+00	Annual	Annual	55	AAQC	Health & Vegetation	6.4%	6.8%	0.4%	13.3%	13.7%	0.4%
Carbon Monoxide	630-08-0	9.74E+01	9.87E+01	2.14E+02	2.17E+02	1.27E+03	1.27E+03	1.49E+03	1.49E+03	1 hr	1 hr	36200	AAQC	Health	0.6%	0.6%	<0.1%	4.1%	4.1%	<0.1%
Carbon Monoxide	630-08-0	9.74E+01	9.87E+01	1.20E+02	1.21E+02	1.27E+03	1.27E+03	1.39E+03	1.40E+03	1 hr	8 hr	15700	AAQC	Health	0.8%	0.8%	<0.1%	8.9%	8.9%	<0.1%
Ammonia & Hydrochloric Acid																				
Ammonia	7664-41-7	5.10E+00	5.13E+00	3.37E+00	3.39E+00	-	-	-	-	24 hr	24 hr	100	AAQC	Health	3.4%	3.4%	<0.1%	-	-	-
Hydrochloric Acid	7647-01-0	1.05E+00	1.90E+00	6.95E-01	1.26E+00	-	-	-	-	24 hr	24 hr	20	AAQC	Health	3.5%	6.3%	2.8%	-	-	-
Metals & Metal Oxides																				
Aluminum	7429-90-5	3.56E-02	3.80E-02	2.35E-02	2.51E-02	3.55E-01	3.55E-01	3.78E-01	3.80E-01	24 hr	24 hr	12	SL-JSL	Health	0.2%	0.2%	<0.1%	3.2%	3.2%	<0.1%
Aluminum Oxide	1344-28-1	6.73E-02	7.18E-02	4.45E-02	4.75E-02	6.70E-01	6.70E-01	7.15E-01	7.18E-01	24 hr	24 hr	120	AAQC	Particulate	<0.1%	<0.1%	<0.1%	0.6%	0.6%	<0.1%
Antimony	7440-36-0	5.22E-04	8.56E-04	3.60E-04	5.80E-04	3.55E-03	3.55E-03	3.91E-03	4.13E-03	24 hr	24 hr	25	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Arsenic	7440-38-2	2.20E-04	2.71E-04	2.60E-04	2.60E-04	2.12E-03	2.12E-03	2.38E-03	2.38E-03	24 hr	24 hr	0.3	AAQC	Health	<0.1%	<0.1%	<0.1%	0.8%	0.8%	<0.1%
Barium	7440-39-3	4.24E-03	4.60E-03	8.46E-03	8.46E-03	1.48E-02	1.48E-02	2.32E-02	2.32E-02	24 hr	24 hr	10	AAQC	Health	<0.1%	<0.1%	<0.1%	0.2%	0.2%	<0.1%
Beryllium	7440-41-7	3.48E-05	5.49E-05	3.00E-05	4.00E-05	3.55E-04	3.55E-04	3.85E-04	3.95E-04	24 hr	24 hr	0.01	AAQC	Health	0.3%	0.4%	0.1%	3.9%	4.0%	0.1%
Boron	7440-42-8	5.31E-03	6.97E-03	3.51E-03	4.61E-03	1.23E-02	1.23E-02	1.58E-02	1.69E-02	24 hr	24 hr	120	AAQC	Particulate	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Cadmium	7440-43-9	4.29E-05	5.62E-05	4.00E-05	5.00E-05	7.08E-04	7.08E-04	7.48E-04	7.58E-04	24 hr	24 hr	0.025	AAQC	Health	0.2%	0.2%	<0.1%	3.0%	3.0%	<0.1%
Cadmium	7440-43-9	4.29E-05	5.62E-05	3.84E-06	4.09E-06	6.83E-04	6.83E-04	6.86E-04	6.87E-04	Annual	Annual	0.005	AAQC	Health	<0.1%	<0.1%	<0.1%	13.7%	13.7%	<0.1%
Calcium Oxide	1305-78-8	5.04E-01	5.47E-01	3.33E-01	3.62E-01	-	-	-	-	24 hr	24 hr	10	AAQC	Corrosion	3.3%	3.6%	0.3%	-	-	-
Chromium	7440-47-3	1.01E-03	1.17E-03	1.64E-03	1.64E-03	5.80E-03	5.80E-03	7.44E-03	7.44E-03	24 hr	24 hr	0.5	AAQC	Health	0.3%	0.3%	<0.1%	1.5%	1.5%	<0.1%
Cobalt	7440-48-4	2.30E-04	2.57E-04	7.00E-04	7.00E-04	7.07E-04	7.07E-04	1.41E-03	1.41E-03	24 hr	24 hr	0.1	AAQC	Health	0.7%	0.7%	<0.1%	1.4%	1.4%	<0.1%
Copper	7440-50-8	3.00E-04	4.06E-04	1.98E-04	2.69E-04	6.10E-02	6.10E-02	6.12E-02	6.13E-02	24 hr	24 hr	50	AAQC	Health	<0.1%	<0.1%	<0.1%	0.1%	0.1%	<0.1%
Iron	7439-89-6	2.95E-02	3.15E-02	1.95E-02	2.08E-02	7.85E-01	7.85E-01	8.05E-01	8.06E-01	24 hr	24 hr	4	Standard	Health	0.5%	0.5%	<0.1%	20.1%	20.2%	<0.1%
Ferric Oxide	1309-37-1	4.49E-01	4.55E-01	1.21E+00	1.21E+00	2.25E+00	2.25E+00	3.46E+00	3.46E+00	24 hr	24 hr	25	AAQC	Soiling	4.9%	4.9%	<0.1%	13.8%	13.8%	<0.1%
Lead	7439-92-1	1.08E-03	1.81E-03	1.33E-03	1.45E-03	4.45E-03	4.45E-03	5.78E-03	5.90E-03	24 hr	24 hr	0.5	AAQC	Health	0.3%	0.3%	<0.1%	1.2%	1.2%	<0.1%
Lead	7439-92-1	1.08E-03	1.81E-03	5.13E-04	5.59E-04	4.45E-03	4.45E-03	4.96E-03	5.01E-03	24 hr	30 day	0.2	AAQC	Health	0.3%	0.3%	<0.1%	2.5%	2.5%	<0.1%
Magnesium	7439-95-4	1.80E-02	2.07E-02	1.19E-02	1.37E-02	4.73E-01	4.73E-01	4.85E-01	4.86E-01	24 hr	24 hr	72	SL-MD	Health	<0.1%	<0.1%	<0.1%	0.7%	0.7%	<0.1%
Magnesium Oxide	1309-48-4	2.98E-02	3.43E-02	1.97E-02	2.27E-02	7.84E-01	7.84E-01	8.04E-01	8.07E-01	24 hr	24 hr	120	AAQC	Particulate	<0.1%	<0.1%	<0.1%	0.7%	0.7%	<0.1%
Manganese	7439-96-5	1.02E-02	1.20E-02	3.04E-02	3.04E-02	2.44E-02	2.44E-02	5.48E-02	5.48E-02	24 hr	24 hr	0.4	AAQC	Health	7.6%	7.6%	<0.1%	13.7%	13.7%	<0.1%
Manganese in PM10	7439-96-5	1.02E-02	1.20E-02	2.53E-02	2.53E-02	2.44E-02	2.44E-02	4.98E-02	4.98E-02	24 hr	24 hr	0.2	AAQC	Health	12.7%	12.7%	<0.1%	24.9%	24.9%	<0.1%
Manganese in PM2.5	7439-96-5	1.02E-02	1.20E-02	1.36E-02	1.36E-02	2.44E-02	2.44E-02	3.81E-02	3.81E-02	24 hr	24 hr	0.1	AAQC	Health	13.6%	13.6%	<0.1%	38.1%	38.1%	<0.1%
Mercury	7439-97-6	3.36E-04	7.66E-04	2.30E-04	5.20E-04	1.96E-05	1.96E-05	2.50E-04	5.40E-04	24 hr	24 hr	2	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Mercury (alkyl compounds)	7439-97-6	3.36E-04	7.66E-04	2.22E-04	5.07E-04	1.96E-05	1.96E-05	2.42E-04	5.26E-04	24 hr	24 hr	0.5	AAQC	Health	<0.1%	0.1%	<0.1%	<0.1%	0.1%	<0.1%
Molybdenum	7439-98-7	9.31E-04	9.69E-04	6.16E-04	6.41E-04	3.01E-03	3.01E-03	3.62E-03	3.65E-03	24 hr	24 hr	120	AAQC	Particulate	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Nickel	7440-02-0	3.86E-03	5.39E-03	1.78E-02	1.78E-02	2.09E-03	2.09E-03	1.99E-02	1.99E-02	24 hr	24 hr	0.2	AAQC	Health	8.9%	8.9%	<0.1%	9.9%	9.9%	<0.1%
Nickel	7440-02-0	3.86E-03	5.39E-03	1.30E-03	1.33E-03	1.18E-03	1.18E-03	2.48E-03	2.51E-03	Annual	Annual	0.04	AAQC	Health	3.3%	3.3%	<0.1%	6.2%	6.3%	<0.1%
Nickel in PM10	7440-02-0	3.86E-03	5.39E-03	1.49E-02	1.49E-02	2.09E-03	2.09E-03	1.70E-02	1.70E-02	24 hr	24 hr	0.1	AAQC	Health	14.9%	14.9%	<0.1%	17.0%	17.0%	<0.1%
Nickel in PM10	7440-02-0	3.86E-03	5.39E-03	1.09E-03	1.12E-03	1.18E-03	1.18E-03	2.27E-03	2.30E-03	Annual	Annual	0.02	AAQC	Health	5.5%	5.6%	0.1%	11.3%	11.5%	0.2%
Phosphorus	7723-14-0	1.53E-02	2.56E-02	1.01E-02	1.69E-02	-	-	-	-	24 hr	24 hr	0.5	SL-MD	Health	2.0%	3.4%	1.4%	-	-	-
Potassium	7440-09-7	6.55E-02	9.78E-02	4.33E-02	6.47E-02	-	-	-	-	24 hr	24 hr	1	SL-JSL	Health	4.3%	6.5%	2.1%	-	-	-
Selenium	7782-49-2	3.66E-04	5.89E-04	2.70E-04	4.20E-04	3.53E-03	3.53E-03	3.80E-03	3.95E-03	24 hr	24 hr	10	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Silver	7440-22-4	1.88E-04	2.44E-04	1.50E-04	1.90E-04	1.77E-03	1.77E-03	1.92E-03	1.96E-03	24 hr	24 hr	1	AAQC	Health	<0.1%	<0.1%	<0.1%	0.2%	0.2%	<0.1%
Strontium	7440-24-6	7.58E-04	8.12E-04	5.01E-04	5.36E-04	1.69E-02	1.69E-02	1.74E-02	1.75E-02	24 hr	24 hr	120	AAQC	Particulate	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Thallium	7440-28-0	4.21E-05	5.79E-05	2.78E-05	3.83E-05	3.53E-03	3.53E-03	3.56E-03	3.57E-03	24 hr	24 hr	0.5	SL-JSL	Health	<0.1%	<0.1%	<0.1%	0.7%	0.7%	<0.1%
Tin	7440-31-5	6.22E-03	1.25E-02	4.21E-03	8.33E-03	3.54E-03	3.54E-03	7.75E-03	1.19E-02	24 hr	24 hr	10	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	0.1%	<0.1%
Titanium	7440-32-6	2.48E-03	2.62E-03	1.64E-03	1.73E-03	1.81E-02	1.81E-02	1.97E-02	1.98E-02	24 hr	24 hr	120	AAQC	Particulate	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Vanadium	7440-62-2	7.84E-04	8.27E-04	2.14E-03	2.14E-03	1.78E-03	1.78E-03	3.92E-03	3.92E-03	24 hr	24 hr	2	AAQC	Health	0.1%	0.1%	<0.1%	0.2%	0.2%	<0.1%
Zinc	7440-66-6	2.12E-03	3.02E-03	1.40E-03	1.99E-03	5.16E-02	5.16E-02	5.30E-02	5.36E-02	24 hr	24 hr	120	AAQC	Particulate	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Volatile Organic Compounds																				
Acetone (2-Propanone)	67-64-1	8.69E-02	1.34E-01	5.74E-02	8.87E-02	6.50E+00	6.50E+00	6.56E+00	6.59E+00	24 hr	24 hr	11880	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Acrolein	107-02-8	1.76E-02	1.90E-02	1.16E-02	1.26E-02	-	-	-	-	24 hr	24 hr	0.4	AAQC	Health	2.9%	3.1%	0.2%	-	-	-
Benzene	71-43-2	2.63E-01	3.57E-01	1.75E-01	2.36E-01	6.27E-01	6.27E-01	8.02E-01	8.64E-01	24 hr	24 hr	2.3	AAQC	Health	7.6%	10.3%	2.7%	34.9%	37.5%	2.7%
Benzene	71-43-2	2.63E-01	3.57E-01	5.98E-03	7.87E-03	4.84E-01	4.84E-01	4.90E-01	4.91E-01	Annual	Annual	0.45	AAQC	Health	1.3%	1.7%	0.4%	108.8%	109.2%	0.4%
Bromodichloromethane	75-27-4	1.61E-04	1.90E-04	1.06E-04	1.26E-04	0.00E+00	0.00E+00	1.06E-04	1.26E-04	24 hr	24 hr	350	SL-JSL	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Bromoform	75-25-2	2.04E-04	2.41E-04	1.35E-04	1.59E-04	0.00E+00	0.00E+00	1.35E-04	1.59E-04	24 hr	24 hr	55	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Bromomethane	74-83-9	5.16E-03	1.32E-02	3.41E-03	8.73E-03	0.00E+00	0.00E+00	3.41E-03	8.73E-03	24 hr	24 hr	1350	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Methyl Ethyl Ketone (2-Butano	78-93-3	5.25E-04	6.17E-04	3.47E-04	4.08E-04	8.96E-01	8.96E-01	8.96E-01	8.96E-01	24 hr	24 hr	1000	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Carbon Tetrachloride	56-23-5	2.33E-04	2.77E-04	1.54E-04	1.83E-04	9.44E-01	9.44E-01	9.44E-01	9.44E-01	24 hr	24 hr	2.4	AAQC	Health	<0.1%	<0.1%	<0.1%	39.3%	39.3%	<0.1%
Chlorobenzene	108-90-7	6.33E-03	1.83E-02	1.40E-02	4.04E-02	0.00E+00	0.00E+00	1.40E-02	4.04E-02	1 hr	1 hr	3500	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Chlorobenzene	108-90-7	6.33E-03	1.83E-02	2.31E-02	6.68E-02	0.00E+00	0.00E+00	2.31E-02	6.68E-02	1 hr	10 min	4500	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Chloroethane	75-00-3	8.05E-03	8.84E-03	5.32E-03	5.85E-03	0.00E+00	0.00E+00	5.32E-03	5.85E-03	24 hr	24 hr	5600	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Chloroform	67-66-3	1.61E-04	1.90E-04	1.06E-04	1.26E-04	0.00E+00	0.00E+00	1.06E-04	1.26E-04	24 hr	24 hr	1	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%

Contaminant Name	CAS #	Total Facility Emission Rate (g/s)		Maximum Concentration at any Receptor (μg/m³)		Background Concentration (μg/m³)		Maximum Concentration at any Receptor (incl. Background) (μg/m³)		Averaging Period Emission Rate	Averaging Period POI Concentration	Air Criteria (μg/m³)	Source of Air Criteria	Limiting Effect	Percentage of Ministry POI Limit at any Receptor (Facility Only) (%)		% Change	Percentage of Ministry POI Limit at any Receptor (incl. Background) (%)		% Change
		Existing	Future	Existing	Future	Existing	Future	Existing	Future						Existing	Future		Existing	Future	
Chloroform	67-66-3	1.61E-04	1.90E-04	3.25E-06	3.84E-06	0.00E+00	0.00E+00	3.25E-06	3.84E-06	Annual	Annual	0.2	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Chloromethane	74-87-3	8.09E-02	9.07E-02	5.35E-02	5.99E-02	1.16E+00	1.16E+00	1.21E+00	1.22E+00	24 hr	24 hr	320	AAQC	Health	<0.1%	<0.1%	<0.1%	0.4%	0.4%	<0.1%
Cumene	98-82-8	2.96E-02	3.95E-02	1.95E-02	2.61E-02	0.00E+00	0.00E+00	1.95E-02	2.61E-02	24 hr	24 hr	400	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Dibromochloromethane	124-48-1	1.31E-04	1.56E-04	8.68E-05	1.03E-04	0.00E+00	0.00E+00	8.68E-05	1.03E-04	24 hr	24 hr	0.2	SL-JSL	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
1,1-Dichloroethane	75-34-3	1.75E-04	2.06E-04	1.16E-04	1.36E-04	0.00E+00	0.00E+00	1.16E-04	1.36E-04	24 hr	24 hr	165	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
1,2-Dichloroethane	107-06-2	1.02E-04	1.20E-04	6.76E-05	7.90E-05	1.33E-01	1.33E-01	1.34E-01	1.34E-01	24 hr	24 hr	2	AAQC	Health	<0.1%	<0.1%	<0.1%	6.7%	6.7%	<0.1%
1,2-Dichloroethane	107-06-2	1.02E-04	1.20E-04	2.07E-06	2.42E-06	9.05E-02	9.05E-02	9.05E-02	9.05E-02	Annual	Annual	0.4	AAQC	Health	<0.1%	<0.1%	<0.1%	22.6%	22.6%	<0.1%
1,1-Dichloroethylene	75-35-4	1.61E-04	1.90E-04	1.06E-04	1.26E-04	-	-	-	-	24 hr	24 hr	10	AAQC	Health	<0.1%	<0.1%	<0.1%	-	-	-
cis-1,2-Dichloroethylene	156-59-2	9.80E-05	1.48E-04	6.48E-05	9.80E-05	0.00E+00	0.00E+00	6.48E-05	9.80E-05	24 hr	24 hr	105	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
trans-1,2-Dichloroethylene	156-60-5	1.46E-04	1.70E-04	9.65E-05	1.12E-04	0.00E+00	0.00E+00	9.65E-05	1.12E-04	24 hr	24 hr	105	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
1,2-Dichloropropane	78-87-5	1.61E-04	1.90E-04	1.06E-04	1.26E-04	3.73E-01	3.73E-01	3.73E-01	3.73E-01	24 hr	24 hr	2400	AAQC	Odour	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Ethylbenzene	100-41-4	3.68E-02	5.37E-02	1.34E-01	1.96E-01	2.17E-01	2.17E-01	3.51E-01	4.13E-01	1 hr	10 min	1900	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Ethylbenzene	100-41-4	3.68E-02	5.37E-02	2.43E-02	3.55E-02	2.17E-01	2.17E-01	2.41E-01	2.52E-01	24 hr	24 hr	1000	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Ethylene Dibromide	106-93-4	1.46E-04	1.70E-04	9.65E-05	1.12E-04	0.00E+00	0.00E+00	9.65E-05	1.12E-04	24 hr	24 hr	3	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Methylene Chloride(Dichlorom	75-09-2	2.77E-04	3.26E-04	1.83E-04	2.15E-04	6.70E-01	6.70E-01	6.70E-01	6.70E-01	24 hr	24 hr	220	AAQC	Health	<0.1%	<0.1%	<0.1%	0.3%	0.3%	<0.1%
Methylene Chloride(Dichlorom	75-09-2	2.77E-04	3.26E-04	5.61E-06	6.58E-06	5.00E-01	5.00E-01	5.00E-01	5.00E-01	Annual	Annual	44	AAQC	Health	<0.1%	<0.1%	<0.1%	1.1%	1.1%	<0.1%
Styrene	100-42-5	4.03E-02	8.73E-02	2.66E-02	5.77E-02	0.00E+00	0.00E+00	2.66E-02	5.77E-02	24 hr	24 hr	400	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
1,1,1,2-Tetrachloroethane	630-20-6	1.46E-04	1.70E-04	9.65E-05	1.12E-04	0.00E+00	0.00E+00	9.65E-05	1.12E-04	24 hr	24 hr	0.5	SL-JSL	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
1,1,2,2-Tetrachloroethane	79-34-5	2.04E-04	2.41E-04	1.35E-04	1.59E-04	0.00E+00	0.00E+00	1.35E-04	1.59E-04	24 hr	24 hr	0.1	SL-JSL	Health	0.1%	0.2%	<0.1%	0.1%	0.2%	<0.1%
Tetrachloroethylene	127-18-4	2.63E-04	3.06E-04	1.74E-04	2.02E-04	0.00E+00	0.00E+00	1.74E-04	2.02E-04	24 hr	24 hr	360	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Toluene	108-88-3	1.67E-01	1.75E-01	1.11E-01	1.16E-01	7.88E-01	7.88E-01	8.98E-01	9.04E-01	24 hr	24 hr	2000	AAQC	Odour	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
1,1,1-Trichloroethane	71-55-6	2.04E-04	2.41E-04	1.35E-04	1.59E-04	0.00E+00	0.00E+00	1.35E-04	1.59E-04	24 hr	24 hr	115000	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
1,1,2-Trichloroethane	79-00-5	2.33E-04	2.77E-04	1.54E-04	1.83E-04	0.00E+00	0.00E+00	1.54E-04	1.83E-04	24 hr	24 hr	0.3	SL-JSL	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Trichloroethylene	79-01-6	1.61E-04	1.90E-04	1.06E-04	1.26E-04	0.00E+00	0.00E+00	1.06E-04	1.26E-04	24 hr	24 hr	12	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Trichloroethylene	79-01-6	1.61E-04	1.90E-04	3.25E-06	3.84E-06	0.00E+00	0.00E+00	3.25E-06	3.84E-06	Annual	Annual	2.3	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Vinyl Chloride	75-01-4	3.20E-04	1.86E-03	2.12E-04	1.23E-03	0.00E+00	0.00E+00	2.12E-04	1.23E-03	24 hr	24 hr	1	AAQC	Health	<0.1%	0.1%	0.1%	<0.1%	0.1%	0.1%
Vinyl Chloride	75-01-4	3.20E-04	1.86E-03	6.47E-06	3.75E-05	0.00E+00	0.00E+00	6.47E-06	3.75E-05	Annual	Annual	0.2	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Xylene	1330-20-7	2.11E-01	2.21E-01	7.71E-01	8.07E-01	2.60E+00	2.60E+00	3.37E+00	3.41E+00	1 hr	10 min	3000	AAQC	Health	<0.1%	<0.1%	<0.1%	0.1%	0.1%	<0.1%
Xylene	1330-20-7	2.11E-01	2.21E-01	1.39E-01	1.46E-01	2.60E+00	2.60E+00	2.74E+00	2.75E+00	24 hr	24 hr	730	AAQC	Health	<0.1%	<0.1%	<0.1%	0.4%	0.4%	<0.1%
Total D&F																				
Dioxins, Furans and Dioxin-like	CDD	2.33E-09	2.88E-09	1.54E-09	1.90E-09	3.06E-08	3.06E-08	3.21E-08	3.25E-08	24 hr	24 hr	0.0000001	AAQC	Health	1.5%	1.9%	0.4%	32.1%	32.5%	0.4%
Polycyclic Aromatic Hydrocarbons (PAHs)																				
Benzo(a)pyrene	50-32-8	2.26E-05	2.65E-05	1.78E-05	2.07E-05	6.74E-05	6.74E-05	8.52E-05	8.81E-05	24 hr	24 hr	0.00005	AAQC	Health	35.6%	41.4%	5.8%	170.5%	176.3%	5.8%
Benzo(a)pyrene	50-32-8	2.26E-05	2.65E-05	2.53E-06	2.63E-06	3.46E-05	3.46E-05	3.71E-05	3.72E-05	Annual	Annual	0.00001	AAQC	Health	25.3%	26.3%	1.0%	370.8%	371.8%	1.0%
2-Chloronaphthalene	91-58-7	4.37E-04	1.19E-03	2.89E-04	7.84E-04	-	-	-	-	24 hr	24 hr	1	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
1-Methylnaphthalene	90-12-0	2.36E-02	4.64E-02	1.56E-02	3.07E-02	1.21E-04	1.21E-04	1.57E-02	3.08E-02	24 hr	24 hr	35.5	SL-JSL	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Naphthalene	91-20-3	5.30E-02	8.94E-02	3.50E-02	5.91E-02	1.21E-04	1.21E-04	3.51E-02	5.92E-02	24 hr	24 hr	22.5	AAQC	Health	0.2%	0.3%	0.1%	0.2%	0.3%	0.1%
Naphthalene	91-20-3	5.30E-02	8.94E-02	1.41E-01	2.38E-01	1.21E-04	1.21E-04	1.41E-01	2.38E-01	24 hr	10 min	50	AAQC	Health	0.3%	0.5%	0.2%	0.3%	0.5%	0.2%
Tetralin	119-64-2	1.28E-02	1.33E-02	8.45E-03	8.77E-03	2.80E-03	2.80E-03	1.13E-02	1.16E-02	24 hr	24 hr	151.5	SL-JSL	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Chloronated Organics																				
1,2-Dichlorobenzene	95-50-1	4.82E-04	5.04E-04	1.07E-03	1.11E-03	3.05E-02	3.05E-02	3.16E-02	3.16E-02	1 hr	1 hr	30500	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
1,3-Dichlorobenzene	541-73-1	2.07E-04	2.87E-04	1.37E-04	1.89E-04	-	-	-	-	24 hr	24 hr	50	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
1,4-Dichlorobenzene	106-46-7	1.92E-04	2.12E-04	1.27E-04	1.40E-04	-	-	-	-	24 hr	24 hr	95	AAQC	Health	<0.1%	<0.1%	<0.1%	-	-	-
1,2,3-Trichlorobenzene	87-61-6	1.58E-04	1.64E-04	1.04E-04	1.08E-04	-	-	-	-	24 hr	24 hr	135	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
1,2,4-Trichlorobenzene	120-82-1	1.50E-04	2.04E-04	9.90E-05	1.35E-04	5.00E-02	5.00E-02	5.01E-02	5.01E-02	24 hr	24 hr	400	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
1,3,5-Trichlorobenzene	108-70-3	2.23E-05	2.30E-05	1.48E-05	1.52E-05	-	-	-	-	24 hr	24 hr	3.6	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
1,2,3,4-Tetrachlorobenzene	634-66-2	2.16E-05	2.56E-05	1.43E-05	1.69E-05	-	-	-	-	24 hr	24 hr	600	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
1,2,3,5+1,2,4,5-Tetrachlorober	634-90-2 / 95-94-	2.16E-05	2.56E-05	1.43E-05	1.69E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
Pentachlorobenzene	608-93-5	2.17E-05	2.52E-05	1.44E-05	1.66E-05	-	-	-	-	24 hr	24 hr	80	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
Hexachlorobenzene	118-74-1	2.16E-05	2.54E-05	1.43E-05	1.68E-05	6.47E-05	6.47E-05	7.89E-05	8.14E-05	24 hr	24 hr	0.011	SL-JSL	Health	0.1%	0.2%	<0.1%	0.7%	0.7%	<0.1%
2-Chlorophenol	95-57-8	1.02E-03	2.36E-03	6.76E-04	1.56E-03	-	-	-	-	24 hr	24 hr	18	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
3-Chlorophenol (m-Chloropher	108-43-0	1.85E-04	6.57E-04	1.22E-04	4.34E-04	-	-	-	-	24 hr	24 hr	15	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
4-Chlorophenol (p-Chlorophen	106-48-9	1.81E-04	6.23E-04	1.20E-04	4.12E-04	-	-	-	-	24 hr	24 hr	15	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
2,3-Dichlorophenol	576-24-9	3.61E-05	4.38E-05	2.39E-05	2.90E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
2,4 + 2,5-Dichlorophenol	120-83-2 / 583-78-	4.45E-05	4.87E-05	2.94E-05	3.22E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
2,6-Dichlorophenol	87-65-0	3.63E-05	4.38E-05	2.40E-05	2.90E-05	-	-	-	-	24 hr	24 hr	19	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
3,4-Dichlorophenol	95-77-2	3.61E-05	4.38E-05	2.39E-05	2.90E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
3,5-Dichlorophenol	591-35-5	3.61E-05	4.38E-05	2.39E-05	2.90E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
2,3,4-Trichlorophenol	15950-66-0	3.61E-05	4.38E-05	2.39E-05	2.90E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
2,3,5-Trichlorophenol	933-78-8	3.61E-05	4.37E-05	2.38E-05	2.89E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
2,3,6-Trichlorophenol	933-75-5	3.61E-05	4.38E-05	2.39E-05	2.90E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
2,4,5-Trichlorophenol	95-95-4	3.61E-05	4.38E-05	2.39E-05	2.90E-05	-	-	-	-	24 hr	24 hr	220	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
2,4,6-Trichlorophenol	88-06-2	3.61E-05	4.38E-05	2.39E-05	2.90E-05	-	-	-	-	24 hr	24 hr	1.5	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
3,4,5-Trichlorophenol	609-19-8	3.61E-05	4.38E-05	2.39E-05	2.90E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
2,3,4,5-Tetrachlorophenol	4901-51-3	3.60E-05	4.37E-05	2.38E-05	2.89E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
2,3,4,6-Tetrachlorophenol	58-90-2	3.60E-05	4.37E-05	2.38E-05	2.89E-05	-	-	-	-	24 hr	24 hr	0.75	SL-JSL	Health	<0.1%	<0.1%	<0.1%	-	-	-
2,3,5,6-Tetrachlorophenol	935-95-5	3.60E-05	4.37E-05	2.38E-05	2.89E-05	-	-	-	-	24 hr	24 hr	0.1	De Minimus	-	<0.1%	<0.1%	<0.1%	-	-	-
Pentachlorophenol	87-86-5	3.61E-05	4.38E-05	2.39E-05	2.90E-05	8.85E-04	8.85E-04	9.08E-04	9.14E-04	24 hr	24 hr	20	AAQC	Health	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%

[shaded] - Indicates that kiln stack concentration was below detection limit. The detection limit was used to calculate the kiln stack emission rate.

AAQC - Ambient Air Quality Criteria; CAAQS - Canadian Ambient Air Quality Standards; SL-JSL - Jurisdictional Screening Level; SL-MD - Ministry-derived Screening Level; Standard - Schedule 3 Standard under O.Reg. 419; De Minimus - Ministry Screening Concentration (per Section 7.1 of Guideline A-10)