Emission Summary and Dispersion Modelling Report for a Wastewater Treatment Facility

In Support of an REA Application

July 22, 2022

Prepared for:

Ontario Clean Water Agency

In Association With:

The Town of Petawawa

CAMBIUM INC.
866.217.7900
cambium-inc.com

Peterborough | Barrie | Oshawa | Kingston

Version Control

Revision	Date	Revision Description	Prepared By:	Submitted To:
Draft	October 22, 2021	Emission Summary and Dispersion Modelling Report for Review	Cambium Inc.	The Town of Petawawa
Final	July 22, 2022	Operator changed to OCWA. Site-specific meteorological data	Cambium Inc.	The Town of Petawawa

Ontario

Ministry of the Environment, Conservation and Parks

Emission Summary and Dispersion Modelling Report Checklist

Company Name

The Corporation of the Town of Petawawa

Company Address

Unit Number	Street Number	Street Name	PO Box
	1111	Victoria Street	

City/Town	Province	Postal Code
Petawawa	Ontario	K8H 2E6

Location of Facility

560 Abbie Lane, Petawawa, Ontario

The attached Emission Summary and Dispersion Modeling Report was prepared in accordance with s. 26 of O. Reg. 419/05 and the guidance in the MECP document "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009 and "Air Dispersion Modelling Guideline for Ontario" dated March 2009 and the minimum required information identified in the check-list on the reverse of this sheet has been submitted.

Company Contact

Company Contact

The Corporation of the Town of Petawawa

Company Contact Name

Last Name	First Name	Middle Initial
Unrau	David	

Title	Telephone Number
Director of Public Works	613-687-5536

Signature: David Unrau, P. Eng

Digitally signed by David Unrau, P. Eng
DN: cn=David Unrau, P. Eng, o=Town of Petawawa, ou=Director of Public Works, email=dunrau@petawawa.ca, c=CA
Date: 2022.08.17 13:58:52 -04'00'

Date (yyyy/mm/dd): 2022/08/17

Technical Contact

Technical Contact

Cambium Inc.

Technical Contact Name

Last Name	First Name	Middle Initial
Bachynski	Sadie	

Representing	Telephone Number
The Corporation of the Town of Petawawa	705-772-2016

Signature

Date (yyyy/mm/dd): 2022/08/17

* This checklist is taken from the document titled "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009.

Emission Summary and Dispersion Modelling Report Checklist

	Required Information	Submitted	Explanation/Reference
-	**Executive Summary and Emission Summary Table**	-	-
-	1.1 Overview of ESDM Report	☑ Yes	
-	1.2 Emission Summary Table	☑ Yes	
1.0	**Introduction and Facility Description**	-	-
–	1.1 Purpose and Scope of ESDM Report (when report only represents a portion of facility)	☑ Yes	
-	1.2 Description of Processes and NAICS code(s)	☑ Yes	
-	1.3 Description of Products and Raw Materials	☑ Yes	
-	1.4 Process Flow Diagram	☑ Yes	
-	1.5 Operating Schedule	☑ Yes	
2.0	**Initial Identification of Sources and Contaminants**	-	-
-	2.1 Sources and Contaminants Identification Table	☑ Yes	
3.0	**Assessment of the Significance of Contaminants and Sources**	–	–
–	3.1 Identification of Negligible Contaminants and Sources	☑ Yes	
-	3.2 Rationale for Assessment	☑ Yes	
4.0	**Operating Conditions, Emission Rate Estimating and Data Quality**	–	–
—	4.1 Description of operating conditions, for each significant contaminant that results in the maximum POI concentration for that contaminant	☑ Yes	
–	4.2 Explanation of Method used to calculate the emission rate for each contaminant	☑ Yes	
-	4.3 Sample calculation for each method	☑ Yes	
-	4.4 Assessment of Data Quality for each emission rate	☑ Yes	
5.0	**Source Summary Table and Property Plan**	-	-
-	5.1 Source Summary Table	☑ Yes	
-	5.2 Site Plan (scalable)	☑ Yes	
6.0	**Dispersion Modelling**	.	.
-	6.1 Dispersion Modelling Input Summary Table	☑ Yes	
-	6.2 Land Use Zoning Designation Plan	☑ Yes	
-	6.3 Dispersion Modelling Input and Output Files	☑ Yes	
7.0	**Emission Summary Table and Conclusions**	-	-
-	7.1 Emission Summary Table	☑ Yes	
-	7.2 Assessment of Contaminants with no MECP POI Limits	☑ Yes	
-	7.3 Conclusions	☑ Yes	
-	**Appendices** (Provide supporting information or details such as…)	-	-
	See Attached	☑ Yes	
		☐ Yes	
		☐ Yes	

Executive Summary

The Ontario Clean Water Agency operates a wastewater treatment facility (the Facility) located at 560 Abbie Lane, Petawawa, Ontario in an area zoned for Industrial use. The current processes at the Facility consist of the treatment of municipal wastewater using primary treatment, secondary treatment, Sequencing Batch Reactivator technology, ultra-violet (UV) disinfection, and a sludge thickening process. The activities of the Facility are currently approved under the amended Environmental Compliance Approval #A-500-3113268754 (September 2021). The North American Industrial Classification System (NAICS) code that best applies to this Facility is 221320 – sewage treatment facilities.

The Facility is proposing to add a combined heat and power (CHP) system and required auxiliary equipment to utilize the biogas produced from the treatment process. The modelling and calculations completed by Cambium Inc. (Cambium) demonstrate that the predicted point of impingement (POI) concentrations of process contaminants emitted by the proposed Facility do not exceed the Ministry of the Environment, Conservation and Parks (the Ministry) prescribed limits at any of the required points of reception modelled. Therefore, we understand the proposed Facility can operate in compliance with Ontario Regulation 419/05: *Air Pollution – Local Air Quality* (O. Reg. 419/05).

Cambium has prepared this Emission Summary and Dispersion Modelling (ESDM) Report to support an application for a Renewable Energy Approval (REA) consistent with section 26 of O. Reg. 419/05 for the operations of the proposed Facility. This ESDM report follows the guidance provided in *Guideline A-10: Procedure for Preparing an ESDM Report* (The ESDM Procedure Document) (MOECC, 2019a).

Cambium has assessed compliance of the Facility using section 20 standards of O. Reg. 419/05 and the applicable limits listed in the *Air Contaminants Benchmarks List (ACBv2)* (MOECC, 2019b). We have modelled the impact of the contaminant emissions with the United States Environmental Protection Agency (USEPA) AERMOD dispersion model for the applicable time averaged maximum POI concentrations.

Cambium has found the significant sources of contaminant emissions from the proposed Facility include the exhaust points of the emergency flare, the biogas upgrade system vent, and the CHP units. The sources and contaminants we have considered negligible consistent with section 8 of O. Reg. 419/05 include all wastewater treatment activities including clarifiers and other exposed activities used for the treatment or detention of sewage. Cambium has only considered odour emissions from these sources.

The proposed Facility is expected to emit several contaminants with guidelines or screening levels in the *ACBv2* including products of combustion, volatile compounds, and particulate contaminant groups. Cambium has not identified any significant contaminants released by the proposed Facility that are not found in the ACBv2.

Cambium calculated the emission rates of all contaminants at the operating conditions that would result in their maximum rate of emission, which is consistent with section 11 of O. Reg. 419/05. This scenario is when all process gas is flared during maintenance activities. Our data quality assessment of the calculations follows the criteria defined in The ESDM Procedure Document. The predicted POI concentrations from the approved dispersion model is presented in the following Emission Summary Table consistent with section 26 of O. Reg. 419/05.

Table A: Emissions Summary Table

Contaminant	CAS Number	Total Facility Emission Rate (g/s)	Standard	Averaging Period	Limiting Effect	Schedule	Max POI Concentration (µg/m³)	Percentage of Ministry POI Limit (%)	Air Dispersion Model Used
Ammonia	7664-41-7	6.76E-03	1000	24 hour	URT	URT	1.97E-01	0.02%	AERMOD 19191
Ammonia	7664-41-7	6.76E-03	100	24 hour	Health	Standard	1.97E-01	0.20%	AERMOD 19191
Benzene	71-43-2	1.43E-07	4.5	annual	Health	AAV	2.33E-07	0.00%	AERMOD 19191
Benzene	71-43-2	1.43E-07	0.45	annual	Health	Standard	2.33E-07	0.00%	AERMOD 19191
Butane	106-97-8	8.16E-06	3600	24 hour	Health	SL-JSL	2.38E-04	0.00%	AERMOD 19191
Carbon dioxide	124-38-9	2.09E+02	255800	24 hour	Health	SL-PA	6.11E+03	2.39%	AERMOD 19191
Carbon monoxide	630-08-0	1.68E+00	6000	30 minute	Health	Standard	1.46E+02	2.43%	AERMOD 19191
Cyclohexane	110-82-7	4.99E-08	6100	24 hour	Health	Standard	1.46E-06	0.00%	AERMOD 19191
Cyclohexane	110-82-7	4.99E-08	61000	24 hour	URT	URT	1.46E-06	0.00%	AERMOD 19191
Decamethylcyclopentasiloxane	541-02-6	3.92E-05	500	24 hour	Health	SL-JSL	1.15E-03	0.00%	AERMOD 19191
Decamethyltetrasiloxane	141-62-8	3.68E-07	0.5	24 hour	Health	SL-JSL	1.08E-05	0.00%	AERMOD 19191
Dodecamethylpentasiloxane	141-63-9	4.56E-07	0.75	24 hour	Health	SL-PA	1.33E-05	0.00%	AERMOD 19191
Ethane	74-84-0	4.43E-04	14500	24 hour	Health	SL-JSL	1.30E-02	0.00%	AERMOD 19191
Ethyl benzene	100-41-4	1.94E-07	1000	24 hour	Health	Standard	5.66E-06	0.00%	AERMOD 19191
Ethyl benzene	100-41-4	1.94E-07	10000	24 hour	URT	URT	5.66E-06	0.00%	AERMOD 19191
Ethyl benzene	100-41-4	1.94E-07	1900	10 minute	Odour	Guideline	2.29E-05	0.00%	AERMOD 19191
Heptane, n-	142-82-5	1.37E-06	11000	24 hour	Health	Standard	4.01E-05	0.00%	AERMOD 19191
Hexamethylcyclotrisiloxane	541-05-9	6.09E-06	25	24 hour	Health	SL-JSL	1.78E-04	0.00%	AERMOD 19191
Hexamethyldisiloxane	107-46-0	1.93E-07	1200	24 hour	Health	SL-JSL	5.63E-06	0.00%	AERMOD 19191
Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	2.36E-07	25000	24 hour	URT	URT	6.89E-06	0.00%	AERMOD 19191
Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	2.36E-07	7500	24 hour	Health	Standard	6.89E-06	0.00%	AERMOD 19191
Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	2.36E-07	25000	24 hour	URT	URT	6.89E-06	0.00%	AERMOD 19191
Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	2.36E-07	2500	24 hour	Health	Standard	6.89E-06	0.00%	AERMOD 19191
Hydrogen sulphide	7783-06-4	1.09E-02	13	10 minute	Odour	Standard	1.29E+00	9.91%	AERMOD 19191
Hydrogen sulphide	7783-06-4	1.09E-02	7	24 hour	Health	Standard	3.18E-01	4.54%	AERMOD 19191

Table A: Emissions Summary Table

Contaminant	CAS Number	Total Facility Emission Rate (g/s)	Standard	Averaging Period	Limiting Effect	Schedule	Max POI Concentration (µg/m³)	Percentage of Ministry POI Limit (%)	Air Dispersion Model Used
Hydrogen sulphide	7783-06-4	1.09E-02	70	24 hour	URT	URT	3.18E-01	0.45%	AERMOD 19191
Isooctane	540-84-1	6.77E-08	1750	24 hour	Health	SL-JSL	1.98E-06	0.00%	AERMOD 19191
Methane	74-82-8	9.56E-01	37330	24 hour	Health	SL-PA	2.79E+01	0.07%	AERMOD 19191
Methyl ethyl ketone (2-Butanone)	78-93-3	2.30E-07	10000	24 hour	URT	URT	6.73E-06	0.00%	AERMOD 19191
Methyl ethyl ketone (2-Butanone)	78-93-3	2.30E-07	1000	24 hour	Health	Standard	6.73E-06	0.00%	AERMOD 19191
Methyl isobutyl ketone	108-10-1	5.94E-08	1200	24 hour	Odour	Guideline	1.74E-06	0.00%	AERMOD 19191
Mixed Odour	NA (odour)	2.63E+03	1	10 minute	Odour	N/A	0.467 @ 140 m setback	46.65% @ 140 m setback	AERMOD 19191
Nitrogen oxides	10102-44-0	8.95E-01	200	24 hour	Health	Standard	2.61E+01	13.07%	AERMOD 19191
Nitrogen oxides	10102-44-0	8.95E-01	400	1 hour	Health	Standard	6.41E+01	16.03%	AERMOD 19191
Octamethylcyclotetrasiloxane	556-67-2	6.76E-06	500	24 hour	Health	SL-JSL	1.98E-04	0.00%	AERMOD 19191
Octamethyltrisiloxane	107-51-7	2.80E-07	204	24 hour	Health	SL-PA	8.19E-06	0.00%	AERMOD 19191
Propane	74-98-6	3.10E-05	215000	24 hour	Health	SL-JSL	9.04E-04	0.00%	AERMOD 19191
Propylene	115-07-1	6.64E-06	4000	24 hour	Health	Standard	1.94E-04	0.00%	AERMOD 19191
Propylene	115-07-1	6.64E-06	40000	24 hour	URT	URT	1.94E-04	0.00%	AERMOD 19191
Silicon dioxide	7631-86-9	2.12E-03	5	24 hour	Health	SL-MD	6.18E-02	1.24%	AERMOD 19191
Sulphur dioxide	7446-09-5	1.00E+00	100	1 hour	Health & Vegetation	Standard	7.18E+01	71.83%	AERMOD 19191
Sulphur dioxide	7446-09-5	1.00E+00	10	annual	Health & Vegetation	Standard	1.64E+00	16.38%	AERMOD 19191
Suspended particulate matter (< 44 µm diameter)	NA (tsp)	2.10E+00	120	24 hour	Visibility	Standard	6.14E+01	51.18%	AERMOD 19191
Tetrahydrofuran	109-99-9	6.58E-07	93000	24 hour	Odour	Guideline	1.92E-05	0.00%	AERMOD 19191
Toluene	108-88-3	1.26E-05	2000	24 hour	Odour	Guideline	3.68E-04	0.00%	AERMOD 19191
Xylenes	1330-20-7	2.57E-07	730	24 hour	Health	Standard	7.50E-06	0.00%	AERMOD 19191
Xylenes	1330-20-7	2.57E-07	3000	10 minute	Odour	Guideline	3.04E-05	0.00%	AERMOD 19191
Xylenes	1330-20-7	2.57E-07	7300	24 hour	URT	URT	7.50E-06	0.00%	AERMOD 19191

Table of Contents

1.0 Introduction and Facility Description 1
1.1 Purpose and Scope of ESDM Report 1
1.2 Description of Processes and NAICS Code 2
1.3 Description of Products and Raw material 2
1.4 Process Flow Diagram 5
1.5 Operating Schedule 5
1.6 Facility Production Limit 5
2.0 Initial Identification of Sources and Contaminants 5
2.1 Source and Contaminants Identification Table 6
3.0 Assessment of the Significance of Contaminants and Sources 6
3.1 Identification of Negligible Contaminants and Sources 7
3.2 Rationale for Assessment 7
4.0 Operating Conditions, Emission Estimating, and Data Quality 8
4.1 Description of Operating Conditions 8
4.2 Explanation of the Methods Used to Calculate Emission Rates 9
4.3 Sample Calculations 9
4.4 Assessment of Data Quality 9
5.0 Source Summary and Site Plan 10
5.1 Source Summary Table 10
5.2 Site Plan 10
6.0 Dispersion Modelling 10
6.1 Dispersion Modelling Input Summary Table 11
6.2 Coordinate System 12
6.3 Meteorology and Land Use Data 12
6.4 Terrain 12
6.5 Receptors 12
6.6 Building Downwash 13

6.7 Averaging Time and Conversions 14
6.8 Dispersion Modelling Options 15
6.9 Dispersion Modelling Input and Output Files 15
7.0 Emission Summary Table and Conclusions 15
7.1 Emission Summary Table 16
7.2 Assessment of Contaminants with no POI Limits 16
7.3 Odour Impacts 16
7.4 Conclusions 16
8.0 References 19

List of Appended Figures

Figure 1 – Site Location Plan
Figure 2 – Land Use Zoning Designation Plan
Figure 3 – Site Plan and Roof Layout
Figure 4 – Process Flow Diagram
Figure 5 – Three (3) Kilometre Satellite Image

List of Appended Tables

Table 1 – Sources and Contaminants Identification Table
Table 2 – Source Summary Tables
Table 3 – Dispersion Modelling Input Summary Table
Table 4 – Emission Summary Table

List of Appendices

Appendix A – Supporting Calculations
Appendix B – Assessment for Negligibility
Appendix C – Equipment Specifications
Appendix D – Dispersion Modelling Data and Electronic Files (on CD)
Appendix E – Proposed Process Flow Diagrams

1.0 Introduction and Facility Description

An environmental approval is required for a facility discharging a contaminant into any part of the natural environment, other than water. Businesses discharging to the air require an Emission Summary and Dispersion Modelling (ESDM) Report to demonstrate regulatory compliance, which is monitored though these environmental approvals.

Cambium Inc. (Cambium) has prepared this ESDM Report following the requirements of section 26 of Ontario Regulation 419/05: *Air Pollution – Local Air Quality* (O. Reg.419/05). Additionally, we have followed the guidance in *Guideline A-10: Procedure for Preparing an ESDM Report* (The ESDM Procedure Document) (MOECC, 2019a) as appropriate. The structure of this report corresponds with each of the items listed in the *ESDM Report Checklist* (MOECC, 2017a) attached to this report.

This introductory section provides a description of the facility as required by sub paragraph 1 of section 26(1) of O. Reg. 419/05.

1.1 Purpose and Scope of ESDM Report

The Ontario Clean Water Agency operates a wastewater treatment facility (the Facility) located at 560 Abbie Lane, Petawawa, Ontario in an area zoned for Industrial use with Residential areas adjacent. The Facility is proposing to add a combined heat and power (CHP) system and required auxiliary equipment to utilize the biogas produced from the treatment process.

All activities require an EASR unless they fall under the operations defined in section (2) subsection (2) of O. Reg. 1/17. The activities in this section for sewage treatment facilities apply to the Facility. Therefore, this ESDM Report was prepared to support a Renewable Energy Approval (REA), as required for the operations as proposed, which includes all sources of air emissions at the Facility.

Cambium has presented the location of the Facility on Figure 1 – Site Location Plan, and the land use designation of the Site and surrounding area on Figure 2 – Land Use Zoning Designation Plan. The location of the discharge points for each source is illustrated on

Figure 3 – Site Plan and Roof Layout, denoted by their corresponding assigned source identification codes.

1.2 Description of Processes and NAICS Code

The main processes at the proposed Facility consists of the treatment of wastewater and the preparation of biogas generated from the treatment process to supply 200 kWh of electricity to the local grid and for sale gas.

The Facility's wastewater treatment process involves primary, secondary, followed by ultraviolet (UV) treatment. Primary treatment includes chemical addition, screening, grit removal, pre-aeration, scum removal (skimming) and sedimentation (clarification). Secondary wastewater treatment is accomplished using a Sequencing Batch Reactor (SBR) activated sludge process. The water is then treated using an UV system before being eventually discharged into the Ottawa River.

The first thickened activated sludge from the wastewater treatment, along with sorted curbside collections and septage received by truck as part of the proposed expansion, are sent for anaerobic digestion in a two-stage process. Digested sludge is dewatered and hauled off the property by truck. The biogas collected from the digestion process, rather than wasted and used for site boilers, will be sent through a hydrogen sulfide removal and upgrade system before being used in the CHP units or stored as sale gas.

The North American Industry Classification System (NAICS) industry code that best applies to the Facility 221320 – sewage treatment facilities, which is part of NAICS subsector code 221 – Utilities.

1.3 Description of Products and Raw material

The Facility will produce treated wastewater, biogas, and digested sludge from municipal wastewater, sorted curbside collections, and septage. Air emissions are produced from the release of gases during treatment and the exhausts of the emergency flare, CHP units, and biogas upgrade system.

The Facility operates the following significant equipment:

Grit Removal and Pre-Aeration:

- Two aerated grit removal/pre-aeration tanks with a total volume of 153 m^3 with two blowers.

Primary Treatment:

- A chemical storage/feed system including a 25 m^3 bulk alum storage tank and dosing pumps.
- A polymer storage/feed system, including a polymer tank, mixer, pumps and piping and appurtenances located in the main control building.
- Two primary sedimentation clarifiers having a total volume of 1,580 m^3 and surface area of 147 m^2 complete with sludge scraper mechanism, scum collection system, piping, and by-pass channels.
- A primary effluent low lift pumping station consisting of an inlet chamber and two inclined channels each equipped with a screw pump and each capable of lifting 202 L/s to an elevated height of 6.1 m and an outlet chamber.

Secondary Treatment:

- A sequencing batch reactor (SBR) system consisting of four basins arranged in parallel, each having approximate dimensions of 28 x 9.0 x 5.5 m, complete with a pre-react zone and five blowers.
- An alum storage/feed system located in the sludge thickening building.

Disinfection:

- An UV disinfection system within the disinfection building.

Digestion:

- One activated sludge holding tank with approximate dimensions of 9.0 x 22 x 5.5 m.
- One rotary drum thickener with a capacity of 10 L/s complete with a polymer system.

- One 100 m^3 thickened waste activated sludge holding chamber.
- Two anaerobic primary digesters, each with a fixed cover, sludge mixing and sludge circulation and heating equipment approximately 12.2 x 6.4 m with a working sludge volume of 810 m^3 and 13 x 7.8 m with a working sludge volume of 1,075 m^3.
- Two anaerobic secondary digesters, each with a floating cover, supernatant withdrawal equipment and gas collection equipment and digested sludge transfer pumps approximately 12.2 x 5.8 m with a working sludge volume of 740 m^3 and 13 x 7.5 m with a working sludge volume of 1,030 m^3.
- Two digested sludge holding tanks, each 24.7 x 8.8 m with a 4,200 m^3 working volume.

Proposed Equipment:

- Buffer Storage Tank (to hold primary sludge and thickened waste activated sludge).
- Thickening Building, including the following:
  - Chemical Dosing Systems (Polymer and Chemicals to Digester)
  - Septage Receiving System
  - Slurry Receiving System
  - Thickeners
- Digester Retrofits to Digesters # 3 and 4, including:
  - Membrane Covers
  - Mixers
  - Heat Exchanger
- Biogas Treatment:
  - H_2S removal system
  - Emergency Flare

- Biogas Conditioning Skid
- Combined Heat and Power (CHP) system

- Dewatering Building, including the following:
  - Dewatering Units
  - Dewatered Cake Loading Conveyors

The required material usages and process information are detailed in Appendix A – Supporting Calculations and Appendix B – Assessment for Negligibility. Table 1 – Sources and Contaminants Identification Table lists the individual sources of emissions at the Facility. Refer to Appendix C for the associated equipment specifications for the proposed CHP units.

1.4 Process Flow Diagram

Refer to Figure 4 – Process Flow Diagram for a graphical representation of the operational processes at the Facility.

1.5 Operating Schedule

The Facility is capable of operating 24 hours per day, seven (7) days a week, 356 days a year.

1.6 Facility Production Limit

The production quantities of the Facility are indirectly related to the air emissions because of the product variety and changing demand. Cambium has estimated the emission rates for each process from their maximum relevant usage rate, which are detailed in Appendix A – Supporting Calculations and on Figure 4 – Process Flow Diagram.

2.0 Initial Identification of Sources and Contaminants

The following section provides an initial identification of all sources and contaminants emitted at the Facility, as required by sub paragraphs 2 through 5 of section 26(1) of O. Reg. 419/05.

2.1 Source and Contaminants Identification Table

All the emission sources and their corresponding contaminants expected for the Facility are tabulated in Table 1 – Sources and Contaminants Identification Table. This table provides the information required to satisfy sub paragraphs 2 through 5 of section 26(1) of O. Reg. 419/05. The source identification codes for the significant sources defined in Table 1 have their discharge points depicted in Figure 3 – Site Plan and Roof Layout. All the significant sources of air emissions at the Facility are outlined below.

- **EG01** – Exhaust of the CHP system that will process up to 112 m^3/h of preconditioned biogas.
- **SC01** –Vent for the membrane biogas upgrade system used to extract sale gas from the preconditioned biogas.
- **FL01** – Exhaust of the emergency flare used to breakdown excess biogas not used by the CHP system or stored as sale gas.
- **PT01, ST01, DB01, TB01** – Fugitive releases of the clarifiers, sequence batch reactors, dewatering building, and thickening building respectively. Cambium has assumed only odour emissions are significant for these sources.

3.0 Assessment of the Significance of Contaminants and Sources

In this section, Cambium's justification for each source and contaminant identified as negligible in Table 1 – Sources and Contaminants Identification Table has been detailed as required by sub paragraph 5 of subsection 26(1) of O. Reg. 419/05. Identifying negligible contaminants and sources allows a more detailed analysis of emissions and POI concentrations for facilities with many sources and contaminants to review.

Consistent with section 8 of O. Reg. 419/05, emission rate calculations and dispersion modelling are not required for emissions from negligible sources, or for the emission of negligible contaminants from significant sources.

3.1 Identification of Negligible Contaminants and Sources

Cambium has selected sources and contaminants from the Facility that are expected to discharge in negligible amounts by following the guidance in The ESDM Procedure Document, and the sources described in Ontario Regulation 524/98 (Environmental Compliance Approvals – Exemptions from Section 9 of the Act). We have deemed sources and contaminants negligible if they met the screening guidance provided in these documents, they are not expected to be the main contributor to the POI concentration, and if the nature of the contaminant(s) were not concerning.

Table 1 – Sources and Contaminants Identification Table lists each negligible source and contaminant. Cambium has identified some contaminants from sources that were considered significant as negligible. Each negligible contaminant from a significant source is tabulated in Table 1. An explanation regarding the determination for each negligible source or contaminant is also included in Table 1, as required by sub paragraph 5 of subsection 26(1) of O. Reg. 419/05. For detailed explanations, refer to Appendix B – Assessment for Negligibility. Cambium has considered the remaining sources and contaminants significant and have therefore included them in the dispersion modelling for the Site.

3.2 Rationale for Assessment

As previously mentioned, Cambium's rationale for identifying each source or contaminant as being negligible is tabulated in Table 1. The technical information required to substantiate the justifications that each of the identified sources or contaminants is negligible are presented in Appendix B – Assessment for Negligibility.

All lagoons, clarifiers or ponds used for the treatment or detention of sewage emissions were assumed to be negligible except for odours. Any odours originating from the transport of material to or from the Site were assumed to be adequately represented by the emissions from the thickening and dewatering building where the sludge remains for the longest period.

There is general ventilation from buildings that only discharges uncontaminated air from the workspaces or air from the workspace that include contaminants that come from commercial

office supplies and building maintenance products, supplies, and activities. Cambium has considered these types of ventilation sources as negligible and did not identify them as sources at the Facility. Cambium has declared HVAC combustion sources at the Facility as insignificant following the guidance in Appendix B, Table B-3 of The ESDM Procedure Document. This analysis is detailed in Appendix B – Assessment for Negligibility.

4.0 Operating Conditions, Emission Estimating, and Data Quality

This section details the operating conditions used to estimate the site-wide emissions and details the data quality assessment of emissions. Descriptions for each contaminant assessed for the Facility has been included, as required by sub paragraph 6 and 7 of section 26(1) of O. Reg. 419/05. Cambium did not perform emission rate calculations and dispersion modelling for emissions from negligible sources or for the emission of negligible contaminants from significant sources as per section 8 of O. Reg. 419/05.

4.1 Description of Operating Conditions

As identified in Section 1.2 of this report, the NAICS code that best applies to the Facility is 221320 – sewage treatment facilities. This subsector is not listed in Schedule 4 or Schedule 5 of O. Reg. 419/05, and as of February 2020 is subject to section 20 of O. Reg. 419/05. Cambium has modeled the impact of contaminant emissions using the United States Environmental Protection Agency (USEPA) AERMOD model as the applicable time averaged maximum POI concentration for each contaminant and compared them to Schedule 3 standards of O. Reg. 419/05. The Schedule 3 standards are outlined in the *Air Contaminants Benchmarks List (ACBv2)* (MOECC, 2019b).

Section 10 of O. Reg. 419/05 states that an acceptable operating condition for a facility is a scenario that would result in the highest possible concentration of the relevant contaminant at the POI. Cambium has defined the operating scenario for the Facility, which corresponds to the maximum concentration at the POI, as when all significant sources are operating simultaneously at their individual maximum rates of production. The derivation of the

maximum rates of production for each contaminant of a significant source is detailed in Appendix A – Supporting Calculations. The maximum rate of production corresponds to the maximum emission rate during the averaging period that corresponds to each contaminant. This scenario is during maintenance when all process gas may be vented to the flare.

4.2 Explanation of the Methods Used to Calculate Emission Rates

Cambium has calculated the maximum emission rates for each significant contaminant emitted from a significant source, consistent with requirements of The ESDM Procedure Document, and using the estimation technique documented in Table 2 – Source Summary Tables.

4.3 Sample Calculations

Cambium's technical rational and the sample calculations required to substantiate the emission rates presented in Table 2 – Source Summary Tables are documented in Appendix A – Supporting Calculations.

4.4 Assessment of Data Quality

A data quality assessment of the emission estimates for each significant contaminant from the Facility is required by sub paragraph 7iii of section 26 (1) of O. Reg. 419/05.

The data quality of each emission rate estimate is documented in Table 2 – Source Summary Tables. Cambium's evaluation of the data quality for each source listed in Table 2 is detailed in Appendix A – Supporting Calculations. We have applied conservative assumptions that correspond to the operating scenario where all significant sources are emitting at their individual maximum rates. Assuming these maximum emission rates listed in Table 2, the rates are likely an overestimate of the actual emission quantities. We expect that the resulting calculated concentration at each POI will be greater than the actual concentrations because of applying these assumptions.

5.0 Source Summary and Site Plan

This section details the table and the site plan required by sub paragraphs 8 and 9 of section 26(1) of O. Reg. 419/05.

5.1 Source Summary Table

The emission rate estimates for each source of significant contaminants is tabulated in Table 2 – Source Summary Tables, consistent with the requirements of sub paragraph 8 of section 26(1) of O. Reg. 419/05.

5.2 Site Plan

The locations of the significant emission sources listed in Table 2 – Source Summary Tables are presented on Figure 3 – Site Plan and Roof Layout, denoted by their corresponding source identification value. The location of the property-line is also identified on Figure 3. Cambium has referenced the position of each source using the Universal Transverse Mercator (UTM) coordinates system under the Source Coordinates column in Table 2.

The Facility includes multiple single tiered buildings. The building heights and locations are detailed on Figure 3.

6.0 Dispersion Modelling

How the dispersion modelling was completed for the Facility to predict the maximum POI concentrations is described in this section, as required by sub paragraphs 10 to 13 of section 26(1) of O. Reg. 419/05. The Facility is subject to section 20 of O. Reg. 419/05, and as such, Cambium carried out the assessment of compliance with Schedule 3 standards using the USEPA, AERMOD atmospheric dispersion model.

The dispersion modelling completed for the Site conforms to Guideline A-11: *Air Dispersion Modelling Guideline for Ontario* (ADMGO) (MOECC, 2017b). A general description and summary of the input data for the dispersion model is provided in Table 3 – Dispersion Modelling Input Summary Table.

The Ministry has identified the AERMOD modelling system as one (1) of the approved dispersion models under O. Reg. 419/05. The software currently includes the Plume Rise Model Enhancement (PRIME) algorithms for assessing the effects of buildings on air dispersion.

The AERMOD modelling system is made up of the AERMOD dispersion model, the AERMET meteorological pre-processor, and the AERMAP terrain pre-processor.

Cambium used the following approved dispersion model and pre-processors in the assessment:

- AERMOD version 19191 dispersion model;
- AERMAP version 18081 meteorological pre-processor; and
- BPIP version 04274 building downwash pre-processor.

Cambium did not use AERMET in this assessment as we used a pre-processed Ministry meteorological dataset.

6.1 Dispersion Modelling Input Summary Table

Cambium's methodology used for the approved dispersion model is summarized in Table 3 – Dispersion Modelling Input Summary Table. This table meets both the requirements of sections 26(1)11 and 8 to 17 of O. Reg. 419/05, and follows the format provided in The ESDM Procedure Document.

Cambium has defined the source types as directed in Section 4.5 of the ADMGO and has classified the significant sources at the Facility as either point, or volume sources. We determined the parameters required for each source according to the procedures in ADMGO. The locations of the sources and the property line are shown on Figure 3 – Site Plan and Roof Layout.

6.2 Coordinate System

Cambium used the UTM coordinate system to specify model object sources, buildings, and receptors, consistent with Section 5.2.2 of the ADMGO. We defined all coordinates in the North American Datum of 1983 (NAD83).

6.3 Meteorology and Land Use Data

In this assessment, Cambium used the currently approved version of AERMOD with preprocessed surface and profile files created by the Ministry for the updated AERMET algorithm. In accordance with the application for approval under s.13 of O. Reg. 419/05 for use of site-specific meteorological data the prepared 2016-2020 dataset for the site was used.

Cambium has characterized the land use surrounding the Facility as "rural" because less than 50% of the area surrounding the Facility includes multi-family dwellings, industrial, and commercial use. The zoning of the surrounding area is depicted on Figure 2 – Land Use Zoning Designation Plan, and the land use detailed on Figure 5 – Three (3) Kilometre Satellite Image.

6.4 Terrain

Cambium obtained the terrain data for this assessment from the Ministry's *Map: Regional Meteorological and Terrain Data for Air Dispersion Modelling* in GeoTIFF format (MOECC, 2019c). The GeoTIFF file used was cdem_dem_031F.

6.5 Receptors

Cambium chose receptors based on recommendations provided in Section 7.1 of the ADMGO, which is consistent with section 14 of O. Reg. 419/05. We selected a grid of nested receptors centered over the emission sources as follows:

1. 20 m spacing, within an area of 200 m by 200 m
2. 50 m spacing, within an area surrounding the area described in (1) with a boundary at 500 m by 500 m outside the boundary of the area described in (1)

3. 100 m spacing, within an area surrounding the area described in (2) with a boundary at 1000 m by 1000 m outside the boundary of the area described in (1)
4. 200 m spacing, within an area surrounding the area described in (3) with a boundary at 2000 m by 2000 m outside the boundary of the area described in (1)
5. 500 m spacing, within an area surrounding the area described in (4) with a boundary at 5000 m by 5000 m outside the boundary of the area described in (1)

Receptors were also placed every 10 m along the property line, in addition to using the nested receptor grid. For the evaluation of odour, receptors were considered within the property.

There are no childcare facilities, health care facilities, senior's residences, long-term care facilities or any educational facilities located at the Facility; furthermore, the Facility does not share a building with another business. Cambium did not assess the impact of same structure contamination with the absence of these sensitive receptors.

6.6 Building Downwash

Cambium accounted for building wake effects in this assessment using the USEPA's Building Profile Input Program (BPIP-PRIME), another pre-processor to AERMOD. The inputs into this pre-processor include the coordinates and heights of the buildings and stacks. The output data from BPIP is used in the AERMOD building wake effect calculations.

The PRIME plume rise algorithms include vertical wind shear calculations, which are important for buoyant releases from short stacks (i.e., stacks at release heights within the recirculation zones of buildings). The PRIME algorithm also allows for the wind speed deficit induced by the building to change with respect to the distance from the building. These factors improve the accuracy of predicted concentrations within building wake zones that form in the lee of buildings.

The BPIP input file is provided in Appendix D – Dispersion Modelling Data and Electronic Files (on CD).

6.7 Averaging Time and Conversions

The shortest time scale that AERMOD predicts is a 1-hour average value. Schedule 3 standards of O. Reg. 419/05 apply to this application, which are based on varying averaging times. Any case where a standard had an averaging period that differed from the model prediction capabilities, the appropriate averaging period was converted to using the Ministry's recommended factors, as documented in the ADMGO.

Please refer to Table 2 – Source Summary Tables for the averaging period associated with each contaminant.

6.8 Dispersion Modelling Options

The options used in the AERMOD dispersion model are summarized in the table below.

Options Used in AERMOD

Modelling Parameter	Description	Used in the Assessment?
DFAULT	Specified that regulatory default options will be used	Yes
CONC	Specifies that concentration values will be calculated	Yes
DDPLETE	Specified that dry deposition will be calculated	No
WDPLETE	Specified that wet deposition will be calculated	No
FLAT	Specifies that the non-default option of assuming flat terrain will be used	No, the model will use elevated terrain data files as detailed in the AERMAP output
NOSTD	Specified that the non-default option of no stack tip downwash will be used	No
RELEASE	Specifies that capped and horizontal stack releases will be used	No
AVERTIME	Time averaging periods calculated	1-hour,24-hour, 30 days, and annual
URBANOPT	Allows the model to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions	No
URBANROUGHNESS	Specifies the urban roughness length (m)	No
FLAGPOLE	Specifies that receptor heights above local ground level are allowed on the receptors	No

6.9 Dispersion Modelling Input and Output Files

The dispersion model input data is summarized in Table 3 – Dispersion Modelling Input Summary Table . Cambium has provided electronic copies of all the input and output files for the AERMOD model in Appendix D on compact disc (CD).

7.0 Emission Summary Table and Conclusions

This section contains the table required by sub paragraph 14 of section 26(1) of O. Reg. 419/05. Cambium has also provided an interpretation of the results as required by The ESDM Procedure Document.

7.1 Emission Summary Table

Cambium calculated a POI concentration for each significant contaminant using the emission rates listed in Table 2 – Source Summary Tables. We have provided the output from the approved dispersion model in Appendix D. The modelling results provided in Table 4 – Emission Summary Table conforms to The ESDM Procedure Document.

Cambium compared the POI concentrations listed in Table 4 against the ACBv2. All predicted POI concentrations do not exceed the corresponding limits in ACBv2.

7.2 Assessment of Contaminants with no POI Limits

It is a requirement of sub paragraph 14 subsection viii of section 26(1) O. Reg. 419/05 to indicate the likelihood, nature, and location of any adverse effect if a contaminant is not listed in Schedules 2 and 3. Cambium has determined this indication is redundant, as all emitted contaminants are within these Schedule designations.

There are no significant ‘Contaminants with No Ministry POI Limits’ emitted at the Facility.

7.3 Odour Impacts

The setback required to detect odours has been determined to be less than 140 m, which is well within the property boundary. The nearest sensitive receptor is 200 m to the north-west where, based on the calculations and modelling, a maximum of 0.15 odour units (OU) is expected under the worst-case operating conditions described in this report. Therefore, odour emissions are not expected to result in a negative impact as the detection concentration for 50% of a given population is equal to 1 OU.

7.4 Conclusions

Cambium prepared this ESDM Report to conform to section 26 of O. Reg. 419/05. In addition, we followed the guidance in The ESDM Procedure Document as applicable. The Facility is subject to section 20 of O. Reg. 419/05, therefore we carried out the assessment of compliance with Schedule 3 standards using the USEPA, AERMOD atmospheric dispersion model.

Cambium has documented the emission rate estimates for each significant contaminant in Table 2 – Source Summary Tables. Inherent conservatism has been built into the emissions estimates by choosing maximum production capacity, simultaneous operation, and prudent parameters for use in the calculations. Therefore, we expect the actual emissions to be less than the modelled predictions for the Site.

A POI concentration for each significant contaminant emitted from the Facility was calculated using the conservative emission rates, and the output from the AERMOD model. The modelling results are presented in Table 4 – Emission Summary Table. The POI concentrations listed in Table 4 were then compared with ACBv2. The predicted POI concentrations for all assessed contaminants listed in the Emissions Summary Table are less than O. Reg. 419/05 corresponding limits.

Cambium has demonstrated in this ESDM Report that the Facility operated by Ontario Clean Water Agency can readily comply with Section 20 of O. Reg. 419/05. Cambium therefore recommends that a Renewable Energy Approval for air be issued for the Facility.

Respectfully submitted,

Cambium Inc.

Sadie Bachynski, P.Eng.
Senior Project Manager

Cody Given, EIT.
Technologist

P:\11700 to 11799\11757-003 JDM Designworks - Air & Noise - Petawawa STP\Deliverables\REPORT - AIR\Final\2022-07-22-RPT-Petawawa REA ESDM.docx

Qualifications and Limitations

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

Reliance on Materials and Information

The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work or reports.

Facts, conditions, information and circumstances may vary with time and locations and Cambium's work is based on a review of such matters as they existed at the particular time and location indicated in its reports. No assurance is made by Cambium that the facts, conditions, information, circumstances or any underlying assumptions made by Cambium in connection with the work performed will not change after the work is completed and a report is submitted. If any such changes occur or additional information is obtained, Cambium should be advised and requested to consider if the changes or additional information affect its findings or results.

When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

Reliance

Cambium's services, work and reports may be relied on by the client and its corporate directors and officers, employees, and professional advisors. Cambium is not responsible for the use of its work or reports by any other party, or for the reliance on, or for any decision which is made by any party using the services or work performed by or a report prepared by Cambium without Cambium's express written consent. Any party that relies on services or work performed by Cambium or a report prepared by Cambium without Cambium's express written consent, does so at its own risk. No report of Cambium may be disclosed or referred to in any public document without Cambium's express prior written consent. Cambium specifically disclaims any liability or responsibility to any such party for any loss, damage, expense, fine, penalty or other such thing which may arise or result from the use of any information, recommendation or other matter arising from the services, work or reports provided by Cambium.

Limitation of Liability

Potential liability to the client arising out of the report is limited to the amount of Cambium's professional liability insurance coverage. Cambium shall only be liable for direct damages to the extent caused by Cambium's negligence and/or breach of contract. Cambium shall not be liable for consequential damages.

Personal Liability

The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.

8.0 References

Environmental Monitoring and Reporting Branch. (2020, December). Technical Bulletin: Modelling Open Flares under O. Reg. 419/05.

MOECC. (2017a). *Emission Summary and Dispersion Modelling Report Checklist.* Queen's Printer for Ontario.

MOECC. (2017b). *Guideline A-11: Air Dispersion Modelling Guideline for Ontario.* Ontario Ministry of the Environment and Climate Change.

MOECC. (2019a). *Guideline A-10: Procedure for Preparing an Emission Summary and Dispersion Modelling Report.* Ontario Ministry of the Environment and Climate Change.

MOECC. (2019b). *Air Contaminants Benchmarks List: standards, guidelines and screening levels for assessing point of impingement concentrations of air contaminants.* Ministry of the Environment and Climate Change.

MOECC. (2019c). *Map: Regional Meteorological and Terrain Data for Air Dispersion Modelling.* Ministry of the Environment and Climate Change.

US EPA. (1991). Chapter 13.5 (Industrial Flares). In *AP 42.*

US EPA. (2000). Chapter 3.1 (Stationary Gas Turbines). In *AP 42.*

Appended Figures

EMISSION SUMMARY AND DISPERSION MODELLING REPORT

TOWN OF PETAWAWA
560 Abbie Lane
Petawawa, Ontario

LEGEND

- Building
- Major Road
- Minor Road
- Watercourse, Permanent
- Contour 5m Interval (Major)
- Contour 5m Interval (Minor)
- Unevaluated Wetlands
- Water Area
- Provincial Park
- Wooded Area
- Building
- Site (approximate)

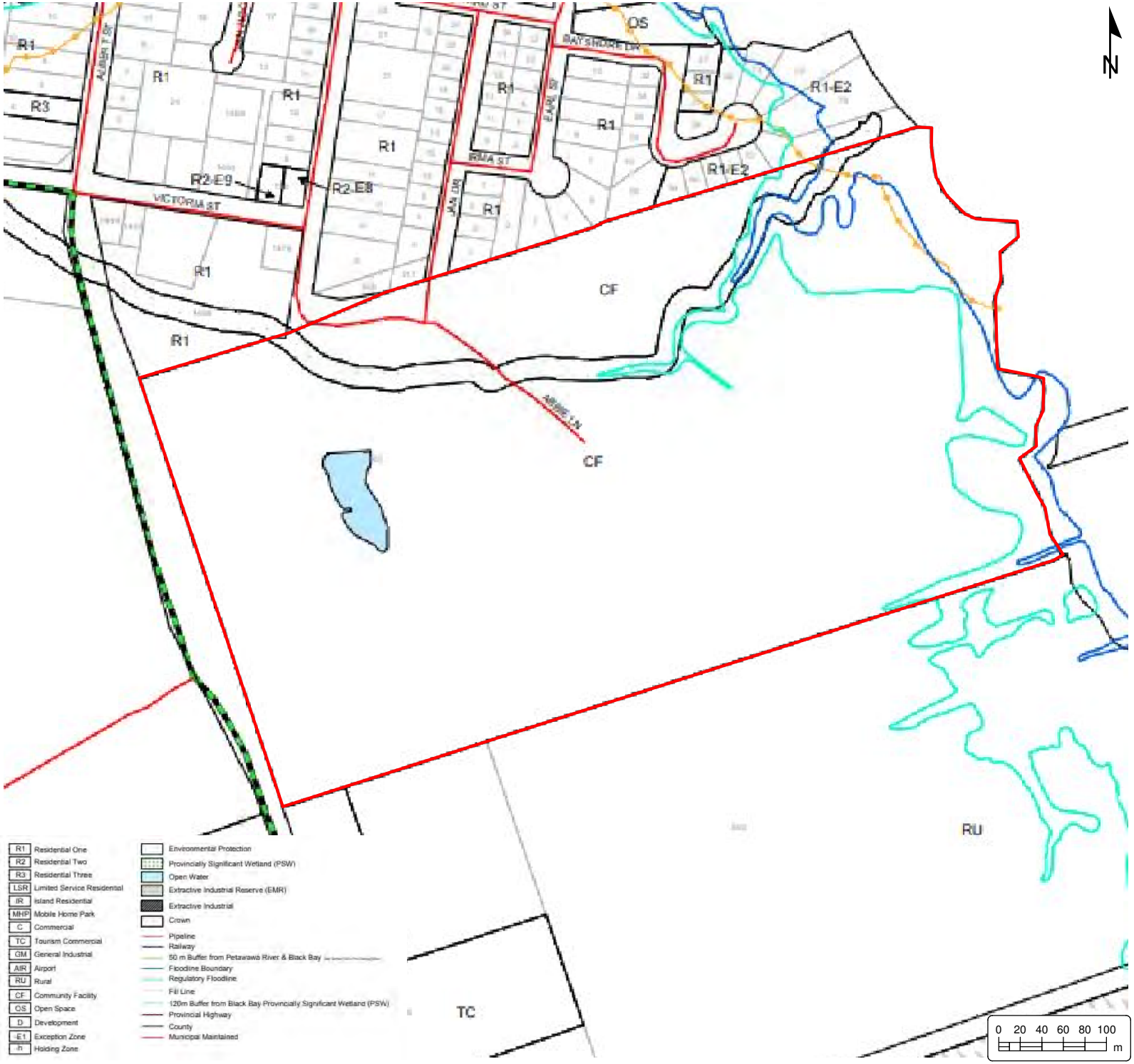
Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

CAMBIUM
P.O. Box 325, 52 Hunter Street East
Peterborough, Ontario, K9H 1G5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

SITE LOCATION PLAN

Project No.: 11757-003		Date: September 2021 Rev.:	
Scale: 1:5,000		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: SLB	Figure:	1

O:\GIS\MXDs\11700-11799\11757-003 JDM Designworks - Air & Noise - Petawawa STP\2021-09-27 ESDM - FIG 1 - Site Location Plan.mxd



EMISSION SUMMARY AND DISPERSION MODELLING REPORT

TOWN OF PETAWAWA
560 Abbie Lane
Petawawa, Ontario

LEGEND

Site (approximate)

Notes:
- Zoning was obtained from Map 1 of Schedule "A" to By-law No. 456/07 passed the 15th day of October, 2007.
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

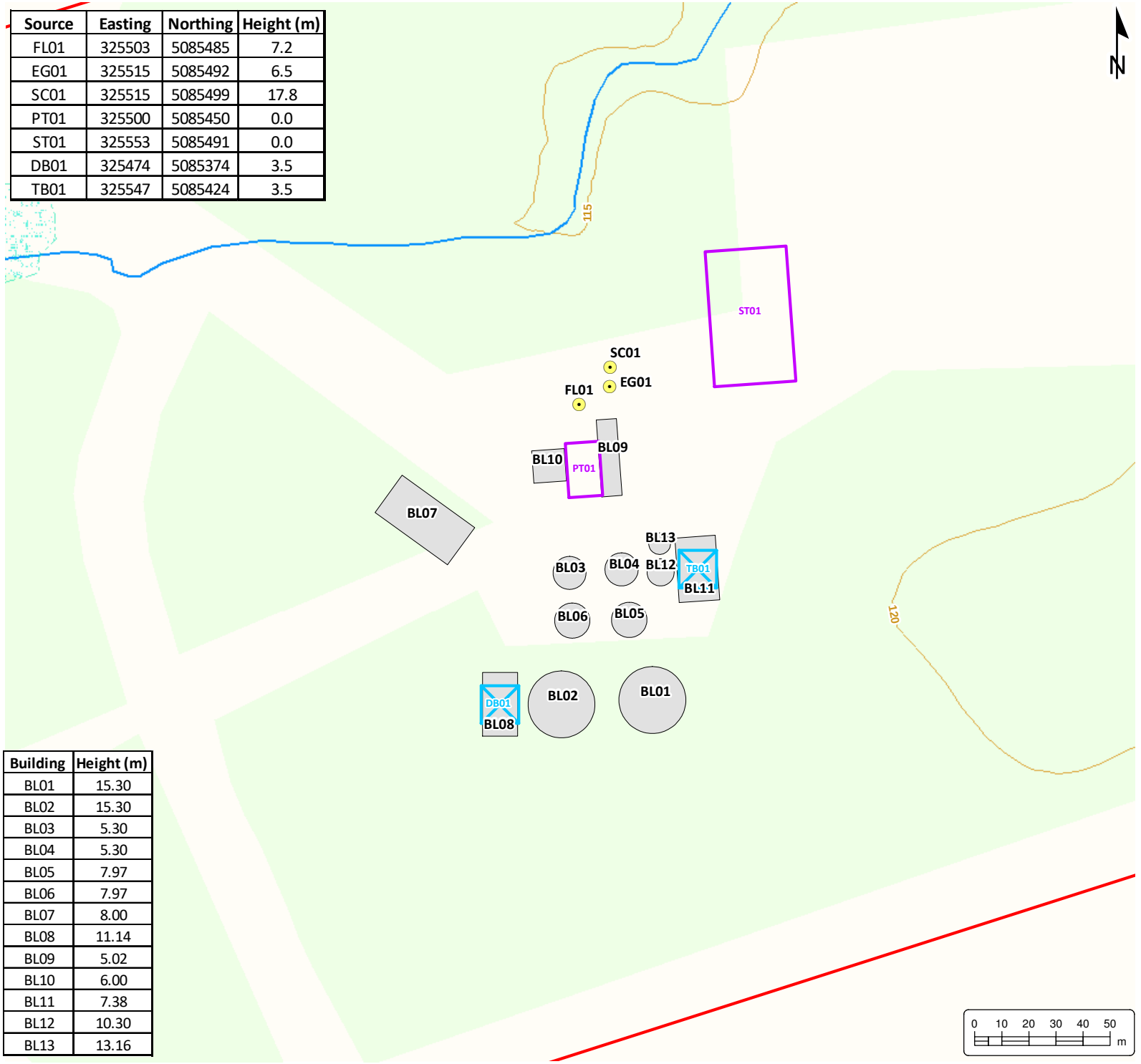
CAMBIUM
P.O. Box 325, 52 Hunter Street East
Peterborough, Ontario, K9H 1G5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

LAND USE ZONING DESIGNATION PLAN

Project No.: 11757-003		Date: September 2021	Rev.:
Scale: 1:5,000		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: SLB	Figure: 2	

O:\GIS\MXDs\11700-11799\11757-003.JDM Designworks - Air & Noise - Petawawa STP\2021-09-27 ESDM - FIG 2 - Land Use Zoning.mxd

Source	Easting	Northing	Height (m)
FL01	325503	5085485	7.2
EG01	325515	5085492	6.5
SC01	325515	5085499	17.8
PT01	325500	5085450	0.0
ST01	325553	5085491	0.0
DB01	325474	5085374	3.5
TB01	325547	5085424	3.5



Building	Height (m)
BL01	15.30
BL02	15.30
BL03	5.30
BL04	5.30
BL05	7.97
BL06	7.97
BL07	8.00
BL08	11.14
BL09	5.02
BL10	6.00
BL11	7.38
BL12	10.30
BL13	13.16

EMISSION SUMMARY AND DISPERSION MODELLING REPORT

TOWN OF PETAWAWA
560 Abbie Lane
Petawawa, Ontario

LEGEND

- Point Source
- Area Source
- Volume Source
- Watercourse, Permanent
- Contour 5m Interval (Minor)
- Unevaluated Wetlands
- Wooded Area
- Building
- Site (approximate)

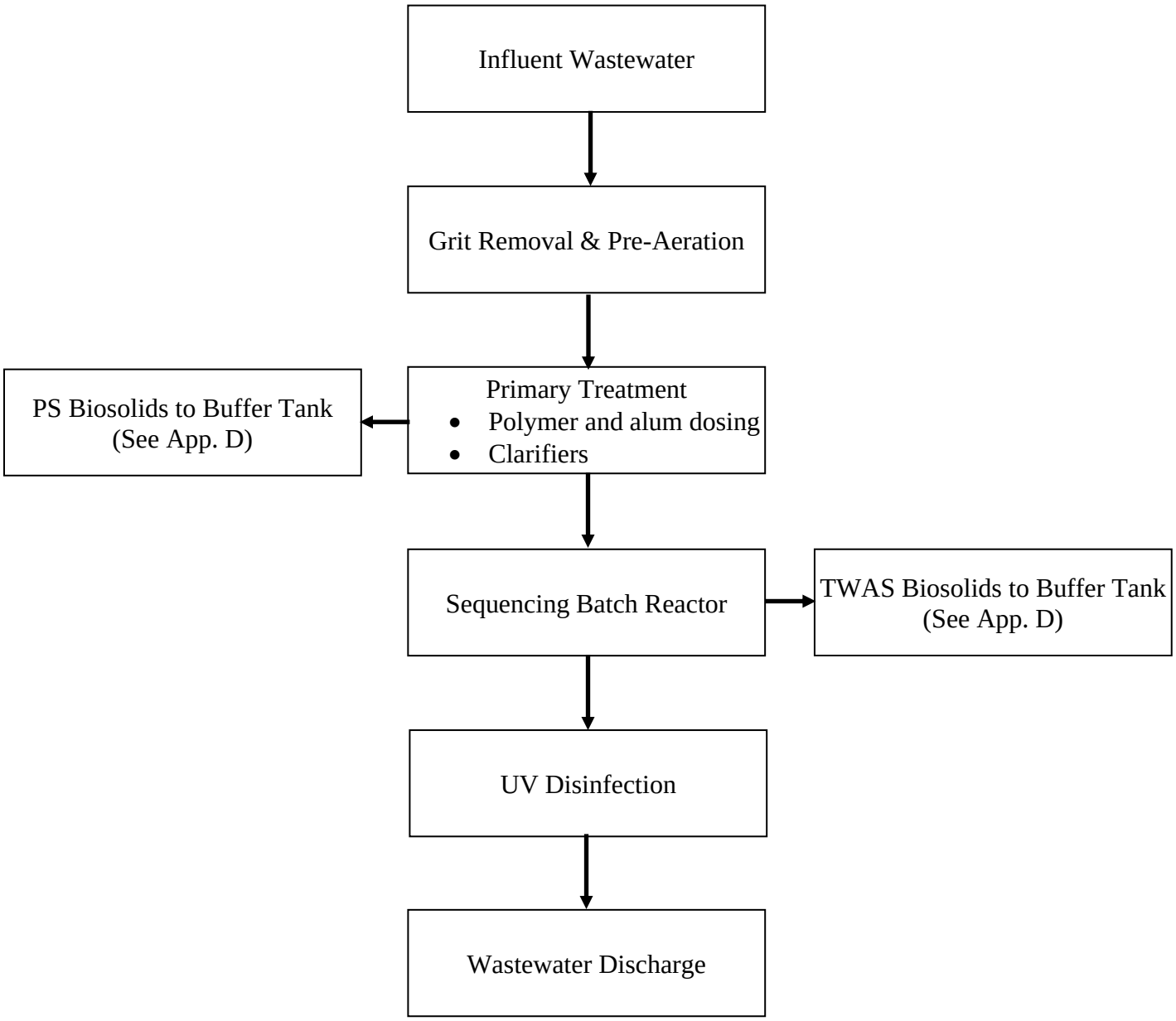
Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

P.O. Box 325, 52 Hunter Street East
Peterborough, Ontario, K9H 1G5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

SITE PLAN AND ROOF LAYOUT

Project No.: 11757-003		Date: September 2021 Rev.:	
Scale: 1:2,000		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: SLB	Figure:	3

O:\GIS\MXDs\11700-11799\11757-003.JDM Designworks - Air & Noise - Petawawa STP\2021-09-27 ESDM - FIG 3 - Site Plan and Roof Layout.mxd



CAMBIUM

P.O. Box 325,
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: (705) 742.7900
Fax: 1 (705) 742.7907
www.cambium-inc.com

Created by: C.G	Project No: 11757-003
Checked by: S.B	Scale: N/A
Date: October 2021	Figure: **4**

PROCESS FLOW DIAGRAM

EMISSION SUMMARY AND DISPERSION MODELLING REPORT

Town of Petawawa

Petawawa, Ontario

EMISSION SUMMARY AND DISPERSION MODELLING REPORT

TOWN OF PETAWAWA
560 Abbie Lane
Petawawa, Ontario

LEGEND

- 3 km Buffer
- Site (approximate)

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

CAMBIUM
P.O. Box 325, 52 Hunter Street East
Peterborough, Ontario, K9H 1G5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

THREE (3) KILOMETRE SATELLITE IMAGE

Project No.: 11757-003		Date: September 2021 Rev.:	
Scale: 1:35,000		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: SLB	Figure:	5

O:\GIS\MXDs\11700-11799\11757-003.JDM Designworks - Air & Noise - Petawawa STP\2021-09-27 ESDM - FIG 5 - 3km Satellite Image.mxd

Appended Tables

Table 1: Sources and Contaminants Identification Table

Source Information			Expected Contaminants	Included in Modelling?	
Source ID	**Source Description**	**General Location**	**Contaminant**	**Significant (Yes/No)**	**Rational**
HVAC	Emissions due to all HVAC equipment at the facility	Facility-wide	Products of NG Combustion	No	As per Table B-3 of The ESDM Procedure Document, natural gas fired boilers, water heaters, space-heaters and make-up air units when the total facility-wide heat input usage for this equipment is less than 20 million kJ/hr can be considered insignificant.
BV	General ventilation including: open spaces, washrooms, offices, etc.	Facility-wide	N/A	No	Contaminant Insignigicant (less than 5% of the total propertywide emissions) relative to total emissions as outlined in Section 7.2.2 from The ESDM Procedure Document.
Dust	Fugitive dust from roadways, traffic, and storage piles	Facility-wide	Suspended particulate matter (< 44 µm diameter)	No	The Facility is not listed in Table 7-2 or 7-3 of Section 7.4 of The ESDM Procedure Document. Additionally, the nature and quantity of dust generated from these sources were not deemed likely to pose a significant health risk if present.
FL01	Emergency flare	Centre of site	Mixed Odour	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Methane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Carbon dioxide	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Hydrogen sulphide	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Carbon monoxide	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Ammonia	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Hexamethyldisiloxane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Hexamethylcyclotrisiloxane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Octamethyltrisiloxane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Octamethylcyclotetrasiloxane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Decamethyltetrasiloxane	Yes	Not Applicable

Table 1: Sources and Contaminants Identification Table

Source Information			Expected Contaminants	Included in Modelling?	
Source ID	**Source Description**	**General Location**	**Contaminant**	**Significant (Yes/No)**	**Rational**
FL01	Emergency flare	Centre of site	Decamethylcyclopentasiloxane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Dodecamethylpentasiloxane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Propane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Propylene	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Ethane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Cyclohexane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Isooctane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Hexane, n- (n-Hexane and Hexane isomers only)	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Heptane, n-	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Butane	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Methyl ethyl ketone (2-Butanone)	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Methyl isobutyl ketone	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Benzene	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Toluene	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Ethyl benzene	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Xylenes	Yes	Not Applicable

Table 1: Sources and Contaminants Identification Table

Source Information			Expected Contaminants	Included in Modelling?	
Source ID	**Source Description**	**General Location**	**Contaminant**	**Significant (Yes/No)**	**Rational**
FL01	Emergency flare	Centre of site	Tetrahydrofuran	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Suspended particulate matter (< 44 µm diameter)	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Nitrogen oxides	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Sulphur dioxide	Yes	Not Applicable
FL01	Emergency flare	Centre of site	Silicon dioxide	Yes	Not Applicable
EG01	Combined heat and power system	Centre of site	N/A	No	Worst-case scenario modelled as all process gas flared, which occurs during maintenance (i.e. no gas capture).
SC01	Biogas upgrade system	Centre of site	N/A	No	Worst-case scenario modelled as all process gas flared, which occurs during maintenance (i.e. no gas capture).
PT01	Clarifiers	North-east of site	Mixed Odour	Yes	Not Applicable
ST01	Sequence Batch Reactors	North of site	Mixed Odour	Yes	Not Applicable
DB01	Dewatering Building	West of site	Mixed Odour	Yes	Not Applicable
TB01	Thickening Building	East of site	Mixed Odour	Yes	Not Applicable

Table 2a: Source Summary Table Sorted by Contaminant

Source Data											Emissions Data					
Contaminant	**CAS Number**	**Source ID**	**Type of Source**	**Source Description**	**Volumetric Flow Rate (m3/s)**	**Temperature (°C)**	**Inside Diameter (m)**	**Release Point Above Grade (m)**	**Release Point Above Structure (m)**	**Source Coordinates (x,y) (m)**	**Emission Rate (g/s)**	**Averaging Period**	**Emission Estimating Technique**	**Sample Calculation ID**	**Data Quality**	**Amount of Overall Emissions (%)**
Mixed Odour	NA (odour)	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	2.58E+03	10 minute	EC	2	Above-Average	98.28%
Methane	74-82-8	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	9.56E-01	24 hour	EF & MB	1	Above-Average	100.00%
Carbon dioxide	124-38-9	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	2.09E+02	24 hour	EF & MB	1	Above-Average	100.00%
Hydrogen sulphide	7783-06-4	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.09E-02	24 hour	EF & MB	1	Above-Average	100.00%
Hydrogen sulphide	7783-06-4	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.09E-02	10 minute	EF & MB	1	Above-Average	100.00%
Carbon monoxide	630-08-0	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.68E+00	30 minute	EF & MB	1	Above-Average	100.00%
Ammonia	7664-41-7	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	6.76E-03	24 hour	EF & MB	1	Above-Average	100.00%
Hexamethyldisiloxane	107-46-0	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.93E-07	24 hour	EF & MB	1	Above-Average	100.00%
Hexamethylcyclotrisiloxane	541-05-9	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	6.09E-06	24 hour	EF & MB	1	Above-Average	100.00%
Octamethyltrisiloxane	107-51-7	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	2.80E-07	24 hour	EF & MB	1	Above-Average	100.00%
Octamethylcyclotetrasiloxane	556-67-2	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	6.76E-06	24 hour	EF & MB	1	Above-Average	100.00%
Decamethyltetrasiloxane	141-62-8	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	3.68E-07	24 hour	EF & MB	1	Above-Average	100.00%
Decamethylcyclopentasiloxane	541-02-6	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	3.92E-05	24 hour	EF & MB	1	Above-Average	100.00%
Dodecamethylpentasiloxane	141-63-9	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	4.56E-07	24 hour	EF & MB	1	Above-Average	100.00%

Table 2a: Source Summary Table Sorted by Contaminant

Source Data											Emissions Data					
Contaminant	**CAS Number**	**Source ID**	**Type of Source**	**Source Description**	**Volumetric Flow Rate (m3/s)**	**Temperature (°C)**	**Inside Diameter (m)**	**Release Point Above Grade (m)**	**Release Point Above Structure (m)**	**Source Coordinates (x,y) (m)**	**Emission Rate (g/s)**	**Averaging Period**	**Emission Estimating Technique**	**Sample Calculation ID**	**Data Quality**	**Amount of Overall Emissions (%)**
Propane	74-98-6	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	3.10E-05	24 hour	EF & MB	1	Above-Average	100.00%
Propylene	115-07-1	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	6.64E-06	24 hour	EF & MB	1	Above-Average	100.00%
Ethane	74-84-0	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	4.43E-04	24 hour	EF & MB	1	Above-Average	100.00%
Cyclohexane	110-82-7	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	4.99E-08	24 hour	EF & MB	1	Above-Average	100.00%
Isooctane	540-84-1	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	6.77E-08	24 hour	EF & MB	1	Above-Average	100.00%
Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	2.36E-07	24 hour	EF & MB	1	Above-Average	100.00%
Heptane, n-	142-82-5	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.37E-06	24 hour	EF & MB	1	Above-Average	100.00%
Butane	106-97-8	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	8.16E-06	24 hour	EF & MB	1	Above-Average	100.00%
Methyl ethyl ketone (2-Butanone)	78-93-3	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	2.30E-07	24 hour	EF & MB	1	Above-Average	100.00%
Methyl isobutyl ketone	108-10-1	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	5.94E-08	24 hour	EF & MB	1	Above-Average	100.00%
Benzene	71-43-2	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.43E-07	annual	EF & MB	1	Above-Average	100.00%
Toluene	108-88-3	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.26E-05	24 hour	EF & MB	1	Above-Average	100.00%
Ethyl benzene	100-41-4	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.94E-07	10 minute	EF & MB	1	Above-Average	100.00%

Table 2a: Source Summary Table Sorted by Contaminant

Source Data											Emissions Data					
Contaminant	**CAS Number**	**Source ID**	**Type of Source**	**Source Description**	**Volumetric Flow Rate (m3/s)**	**Temperature (°C)**	**Inside Diameter (m)**	**Release Point Above Grade (m)**	**Release Point Above Structure (m)**	**Source Coordinates (x,y) (m)**	**Emission Rate (g/s)**	**Averaging Period**	**Emission Estimating Technique**	**Sample Calculation ID**	**Data Quality**	**Amount of Overall Emissions (%)**
Ethyl benzene	100-41-4	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.94E-07	24 hour	EF & MB	1	Above-Average	100.00%
Xylenes	1330-20-7	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	2.57E-07	10 minute	EF & MB	1	Above-Average	100.00%
Xylenes	1330-20-7	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	2.57E-07	24 hour	EF & MB	1	Above-Average	100.00%
Tetrahydrofuran	109-99-9	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	6.58E-07	24 hour	EF & MB	1	Above-Average	100.00%
Suspended particulate matter (< 44 µm diameter)	NA (tsp)	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	2.10E+00	24 hour	EF & MB	1	Above-Average	100.00%
Nitrogen oxides	10102-44-0	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	8.95E-01	24 hour	EF & MB	1	Above-Average	100.00%
Nitrogen oxides	10102-44-0	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	8.95E-01	1 hour	EF & MB	1	Above-Average	100.00%
Sulphur dioxide	7446-09-5	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.00E+00	1 hour	EF & MB	1	Above-Average	100.00%
Sulphur dioxide	7446-09-5	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	1.00E+00	annual	EF & MB	1	Above-Average	100.00%
Silicon dioxide	7631-86-9	FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	2.12E-03	24 hour	EF & MB	1	Above-Average	100.00%

Table 2a: Source Summary Table Sorted by Contaminant

Source Data											Emissions Data					
Contaminant	**CAS Number**	**Source ID**	**Type of Source**	**Source Description**	**Initial Vertical Dimention (m)**	**Initial Horizontal Dimention (m)**	**Temperature (°C)**	**Release Point Above Grade (m)**	**Release Point Above Structure (m)**	**Source Coordinates (x,y) (m)**	**Emission Rate (g/s)**	**Averaging Period**	**Emission Estimating Technique**	**Sample Calculation ID**	**Data Quality**	**Amount of Overall Emissions (%)**
Mixed Odour	NA (odour)	PT01	Area Source	Clarifiers	20.00	12.50	N/A	0.00	N/A	325499.80, 5085450.45	5.13E+00	10 minute	EF	2	Marginal	0.19%
Mixed Odour	NA (odour)	ST01	Area Source	Sequence Batch Reactors	50.00	30.00	N/A	0.00	N/A	325553.47, 5085491.43	5.13E+00	10 minute	EF	2	Marginal	0.19%
Mixed Odour	NA (odour)	DB01	Volume Source	Dewatering Building	5.18	3.23	N/A	5.57	N/A	325474.29, 5085373.94	1.12E+01	10 minute	EF	2	Marginal	0.43%
Mixed Odour	NA (odour)	TB01	Volume Source	Thickening Building	3.43	3.23	N/A	3.69	N/A	325547.32, 5085423.95	2.38E+01	10 minute	EF	2	Marginal	0.91%

Table 2b: Source Summary Table Sorted by Source

Source Data									Emissions Data							
Source ID	**Type of Source**	**Source Description**	**Volumetric Flow Rate (m3/s)**	**Temperature (°C)**	**Inside Diameter (m)**	**Release Point Above Grade (m)**	**Release Point Above Structure (m)**	**Source Coordinates (x,y) (m)**	**Contaminant**	**CAS Number**	**Emission Rate (g/s)**	**Averaging Period**	**Emission Estimating Technique**	**Sample Calculation ID**	**Data Quality**	**Amount of Overall Emissions (%)**
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Mixed Odour	NA (odour)	2.58E+03	10 minute	EC	2	Above-Average	98.28%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Methane	74-82-8	9.56E-01	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Carbon dioxide	124-38-9	2.09E+02	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Hydrogen sulphide	7783-06-4	1.09E-02	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Hydrogen sulphide	7783-06-4	1.09E-02	10 minute	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Carbon monoxide	630-08-0	1.68E+00	30 minute	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Ammonia	7664-41-7	6.76E-03	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Hexamethyldisiloxane	107-46-0	1.93E-07	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Hexamethylcyclotrisiloxane	541-05-9	6.09E-06	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Octamethyltrisiloxane	107-51-7	2.80E-07	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Octamethylcyclotetrasiloxane	556-67-2	6.76E-06	24 hour	EF & MB	1	Above-Average	100.00%

Table 2b: Source Summary Table Sorted by Source

Source Data									Emissions Data							
Source ID	**Type of Source**	**Source Description**	**Volumetric Flow Rate (m3/s)**	**Temperature (°C)**	**Inside Diameter (m)**	**Release Point Above Grade (m)**	**Release Point Above Structure (m)**	**Source Coordinates (x,y) (m)**	**Contaminant**	**CAS Number**	**Emission Rate (g/s)**	**Averaging Period**	**Emission Estimating Technique**	**Sample Calculation ID**	**Data Quality**	**Amount of Overall Emissions (%)**
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Decamethyltetrasiloxane	141-62-8	3.68E-07	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Decamethylcyclopentasiloxane	541-02-6	3.92E-05	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Dodecamethylpentasiloxane	141-63-9	4.56E-07	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Propane	74-98-6	3.10E-05	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Propylene	115-07-1	6.64E-06	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Ethane	74-84-0	4.43E-04	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Cyclohexane	110-82-7	4.99E-08	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Isooctane	540-84-1	6.77E-08	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	2.36E-07	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Heptane, n-	142-82-5	1.37E-06	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Butane	106-97-8	8.16E-06	24 hour	EF & MB	1	Above-Average	100.00%

Table 2b: Source Summary Table Sorted by Source

Source Data									Emissions Data							
Source ID	**Type of Source**	**Source Description**	**Volumetric Flow Rate (m3/s)**	**Temperature (°C)**	**Inside Diameter (m)**	**Release Point Above Grade (m)**	**Release Point Above Structure (m)**	**Source Coordinates (x,y) (m)**	**Contaminant**	**CAS Number**	**Emission Rate (g/s)**	**Averaging Period**	**Emission Estimating Technique**	**Sample Calculation ID**	**Data Quality**	**Amount of Overall Emissions (%)**
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Methyl ethyl ketone (2-Butanone)	78-93-3	2.30E-07	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Methyl isobutyl ketone	108-10-1	5.94E-08	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Benzene	71-43-2	1.43E-07	annual	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Toluene	108-88-3	1.26E-05	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Ethyl benzene	100-41-4	1.94E-07	10 minute	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Ethyl benzene	100-41-4	1.94E-07	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Xylenes	1330-20-7	2.57E-07	10 minute	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Xylenes	1330-20-7	2.57E-07	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Tetrahydrofuran	109-99-9	6.58E-07	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Suspended particulate matter (< 44 µm diameter)	NA (tsp)	2.10E+00	24 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Nitrogen oxides	10102-44-0	8.95E-01	24 hour	EF & MB	1	Above-Average	100.00%

Table 2b: Source Summary Table Sorted by Source

Source Data									Emissions Data							
Source ID	Type of Source	Source Description	Volumetric Flow Rate (m3/s)	Temperature (°C)	Inside Diameter (m)	Release Point Above Grade (m)	Release Point Above Structure (m)	Source Coordinates (x,y) (m)	Contaminant	CAS Number	Emission Rate (g/s)	Averaging Period	Emission Estimating Technique	Sample Calculation ID	Data Quality	Amount of Overall Emissions (%)
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Nitrogen oxides	10102-44-0	8.95E-01	1 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Sulphur dioxide	7446-09-5	1.00E+00	1 hour	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Sulphur dioxide	7446-09-5	1.00E+00	annual	EF & MB	1	Above-Average	100.00%
FL01	Point Source - Vertical Stack (uncapped)	Emergency flare	0.112	<1000	2.29	7.66	N/A	325503.47, 5085484.81	Silicon dioxide	7631-86-9	2.12E-03	24 hour	EF & MB	1	Above-Average	100.00%

Table 2b: Source Summary Table Sorted by Source

Source Data									Emissions Data							
Source ID	Type of Source	Source Description	Initial Vertical Dimention (m)	Initial Horizontal Dimention (m)	Temperature (°C)	Release Point Above Grade (m)	Release Point Above Structure (m)	Source Coordinates (x,y) (m)	Contaminant	CAS Number	Emission Rate (g/s)	Averaging Period	Emission Estimating Technique	Sample Calculation ID	Data Quality	Amount of Overall Emissions (%)
PT01	Area Source	Clarifiers	20.00	12.50	N/A	0.00	N/A	325499.80, 5085450.45	Mixed Odour	NA (odour)	5.13E+00	10 minute	EF	2	Marginal	0.19%
ST01	Area Source	Sequence Batch Reactors	50.00	30.00	N/A	0.00	N/A	325553.47, 5085491.43	Mixed Odour	NA (odour)	5.13E+00	10 minute	EF	2	Marginal	0.19%
DB01	Volume Source	Dewatering Building	5.18	3.23	N/A	5.57	N/A	325474.29, 5085373.94	Mixed Odour	NA (odour)	1.12E+01	10 minute	EF	2	Marginal	0.43%
TB01	Volume Source	Thickening Building	3.43	3.23	N/A	3.69	N/A	325547.32, 5085423.95	Mixed Odour	NA (odour)	2.38E+01	10 minute	EF	2	Marginal	0.91%

Table 3: Dispersion Modelling Input Summary Table

Relevant Section of the Regulation	Section Title	Description of How the Approved Dispersion Model was Used
Section 6	Approved Air Dispersion (include Model Versions)	Site Specific meteorological data by MECP v19191 AERMET v19191 (incl. in Met Data) BPIP v04274 AERMAP v18081 AERMOD v19191
Section 8	Negligible Sources	If any sources are deemed negligible they are discussed in Section 3 and Appendix B of the ESDM Report. Any negligible sources identified using the guidance provided in section 7 of The ESDM Procedure Document were not included in modelling as per section 8 of O. Reg. 419/05
Section 9	Same Structure Contamination	Same Structure Contamination has not been assessed as the Facility is not in a multi-tenant building.
Section 10	Operating Conditions	All equipment was assumed to be operating at the maximum production rates at the same time during their applicable hours of operation. See section 4.1 and Appendix A of the ESDM report.
Section 11	Source of Contaminant Emission Rates	See section 4.2 and Appendix A of the ESDM Report for more information.
Section 12	Combined Effect of Assumptions for Operating Conditions and Emission Rates	See section 4.1 and Appendix A of the ESDM Report for more information.
Section 13	Meteorological Conditions (include AERMET Version)	The preprocessed meteorological data (AERMET v19191) provided by the MECP for the Site following a s.13 request was used. The site specific meteorological data set consists of five years (2016-2020) of hourly readings for surface and upper air conditions for use in the AERMOD model. The height of the Petawawa surface station above sea level of 130 m was used.
Section 14	Area of Modelling Coverage	The area of modelling coverage was designed to meet the requirements outlined in O. Reg. 419/05, s. 14. A multi-tiered receptor grid was developed with reference to section 7.2 of the ADMGO, therefore interval spacing was dependent on the receptor distance from on-site sources.
Section 15	Stack Height for Certain New Sources of Contaminant	See Table 2 - Source Summary Table; no stack heights in this model (actual or modelled) exceed the restriction in section 15 of O. Reg. 419/05.

Table 3: Dispersion Modelling Input Summary Table

Relevant Section of the Regulation	Section Title	Description of How the Approved Dispersion Model was Used
Section 16	Terrain Data	See Section 6.4 of the ESDM report. Terrain information for the area surrounding the facility was obtained from the MECP Ontario Digital Elevation Model Data web site. The terrain data is based on the North American Datum 1983 (NAD83) horizontal reference datum. This data was run through the AERMAP terrain pre-processor to estimate base elevations for receptors and to help the model account for changes in elevation of the surrounding terrain.
Section 17	Averaging Periods	The appropriate averaging periods (as defined by the regulatory limits outlined in Schedule 3, and the listing of the MECP Guidelines) were modelled for each contaminant. Emission rates were calculated based on averaging periods that matched the averaging period of the respective criterion. See section 6.7 of O. Reg. 419/05.

Table 4: Emissions Summary Table

Contaminant	CAS Number	Total Facility Emission Rate (g/s)	Standard	Averaging Period	Limiting Effect	Schedule	Max POI Concentration (µg/m³)	Percentage of Ministry POI Limit (%)	Air Dispersion Model Used
Ammonia	7664-41-7	6.76E-03	1000	24 hour	URT	URT	1.97E-01	0.02%	AERMOD 19191
Ammonia	7664-41-7	6.76E-03	100	24 hour	Health	Standard	1.97E-01	0.20%	AERMOD 19191
Benzene	71-43-2	1.43E-07	4.5	annual	Health	AAV	2.33E-07	0.00%	AERMOD 19191
Benzene	71-43-2	1.43E-07	0.45	annual	Health	Standard	2.33E-07	0.00%	AERMOD 19191
Butane	106-97-8	8.16E-06	3600	24 hour	Health	SL-JSL	2.38E-04	0.00%	AERMOD 19191
Carbon dioxide	124-38-9	2.09E+02	255800	24 hour	Health	SL-PA	6.11E+03	2.39%	AERMOD 19191
Carbon monoxide	630-08-0	1.68E+00	6000	30 minute	Health	Standard	1.46E+02	2.43%	AERMOD 19191
Cyclohexane	110-82-7	4.99E-08	6100	24 hour	Health	Standard	1.46E-06	0.00%	AERMOD 19191
Cyclohexane	110-82-7	4.99E-08	61000	24 hour	URT	URT	1.46E-06	0.00%	AERMOD 19191
Decamethylcyclopentasiloxane	541-02-6	3.92E-05	500	24 hour	Health	SL-JSL	1.15E-03	0.00%	AERMOD 19191
Decamethyltetrasiloxane	141-62-8	3.68E-07	0.5	24 hour	Health	SL-JSL	1.08E-05	0.00%	AERMOD 19191
Dodecamethylpentasiloxane	141-63-9	4.56E-07	0.75	24 hour	Health	SL-PA	1.33E-05	0.00%	AERMOD 19191
Ethane	74-84-0	4.43E-04	14500	24 hour	Health	SL-JSL	1.30E-02	0.00%	AERMOD 19191
Ethyl benzene	100-41-4	1.94E-07	1000	24 hour	Health	Standard	5.66E-06	0.00%	AERMOD 19191
Ethyl benzene	100-41-4	1.94E-07	10000	24 hour	URT	URT	5.66E-06	0.00%	AERMOD 19191
Ethyl benzene	100-41-4	1.94E-07	1900	10 minute	Odour	Guideline	2.29E-05	0.00%	AERMOD 19191
Heptane, n-	142-82-5	1.37E-06	11000	24 hour	Health	Standard	4.01E-05	0.00%	AERMOD 19191
Hexamethylcyclotrisiloxane	541-05-9	6.09E-06	25	24 hour	Health	SL-JSL	1.78E-04	0.00%	AERMOD 19191
Hexamethyldisiloxane	107-46-0	1.93E-07	1200	24 hour	Health	SL-JSL	5.63E-06	0.00%	AERMOD 19191
Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	2.36E-07	25000	24 hour	URT	URT	6.89E-06	0.00%	AERMOD 19191
Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	2.36E-07	7500	24 hour	Health	Standard	6.89E-06	0.00%	AERMOD 19191
Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	2.36E-07	25000	24 hour	URT	URT	6.89E-06	0.00%	AERMOD 19191

Table 4: Emissions Summary Table

Contaminant	CAS Number	Total Facility Emission Rate (g/s)	Standard	Averaging Period	Limiting Effect	Schedule	Max POI Concentration (µg/m³)	Percentage of Ministry POI Limit (%)	Air Dispersion Model Used
Hexane, n- (n-Hexane and Hexane isomers only)	110-54-3	2.36E-07	2500	24 hour	Health	Standard	6.89E-06	0.00%	AERMOD 19191
Hydrogen sulphide	7783-06-4	1.09E-02	13	10 minute	Odour	Standard	1.29E+00	9.91%	AERMOD 19191
Hydrogen sulphide	7783-06-4	1.09E-02	7	24 hour	Health	Standard	3.18E-01	4.54%	AERMOD 19191
Hydrogen sulphide	7783-06-4	1.09E-02	70	24 hour	URT	URT	3.18E-01	0.45%	AERMOD 19191
Isooctane	540-84-1	6.77E-08	1750	24 hour	Health	SL-JSL	1.98E-06	0.00%	AERMOD 19191
Methane	74-82-8	9.56E-01	37330	24 hour	Health	SL-PA	2.79E+01	0.07%	AERMOD 19191
Methyl ethyl ketone (2-Butanone)	78-93-3	2.30E-07	10000	24 hour	URT	URT	6.73E-06	0.00%	AERMOD 19191
Methyl ethyl ketone (2-Butanone)	78-93-3	2.30E-07	1000	24 hour	Health	Standard	6.73E-06	0.00%	AERMOD 19191
Methyl isobutyl ketone	108-10-1	5.94E-08	1200	24 hour	Odour	Guideline	1.74E-06	0.00%	AERMOD 19191
Mixed Odour	NA (odour)	2.63E+03	1	10 minute	Odour	N/A	0.467 @ 140 m setback	46.65% @ 140 m setback	AERMOD 19191
Nitrogen oxides	10102-44-0	8.95E-01	200	24 hour	Health	Standard	2.61E+01	13.07%	AERMOD 19191
Nitrogen oxides	10102-44-0	8.95E-01	400	1 hour	Health	Standard	6.41E+01	16.03%	AERMOD 19191
Octamethylcyclotetrasiloxane	556-67-2	6.76E-06	500	24 hour	Health	SL-JSL	1.98E-04	0.00%	AERMOD 19191
Octamethyltrisiloxane	107-51-7	2.80E-07	204	24 hour	Health	SL-PA	8.19E-06	0.00%	AERMOD 19191
Propane	74-98-6	3.10E-05	215000	24 hour	Health	SL-JSL	9.04E-04	0.00%	AERMOD 19191
Propylene	115-07-1	6.64E-06	4000	24 hour	Health	Standard	1.94E-04	0.00%	AERMOD 19191
Propylene	115-07-1	6.64E-06	40000	24 hour	URT	URT	1.94E-04	0.00%	AERMOD 19191
Silicon dioxide	7631-86-9	2.12E-03	5	24 hour	Health	SL-MD	6.18E-02	1.24%	AERMOD 19191
Sulphur dioxide	7446-09-5	1.00E+00	100	1 hour	Health & Vegetation	Standard	7.18E+01	71.83%	AERMOD 19191
Sulphur dioxide	7446-09-5	1.00E+00	10	annual	Health & Vegetation	Standard	1.64E+00	16.38%	AERMOD 19191

Table 4: Emissions Summary Table

Contaminant	CAS Number	Total Facility Emission Rate (g/s)	Standard	Averaging Period	Limiting Effect	Schedule	Max POI Concentration (µg/m³)	Percentage of Ministry POI Limit (%)	Air Dispersion Model Used
Suspended particulate matter (< 44 µm diameter)	NA (tsp)	2.10E+00	120	24 hour	Visibility	Standard	6.14E+01	51.18%	AERMOD 19191
Tetrahydrofuran	109-99-9	6.58E-07	93000	24 hour	Odour	Guideline	1.92E-05	0.00%	AERMOD 19191
Toluene	108-88-3	1.26E-05	2000	24 hour	Odour	Guideline	3.68E-04	0.00%	AERMOD 19191
Xylenes	1330-20-7	2.57E-07	730	24 hour	Health	Standard	7.50E-06	0.00%	AERMOD 19191
Xylenes	1330-20-7	2.57E-07	3000	10 minute	Odour	Guideline	3.04E-05	0.00%	AERMOD 19191
Xylenes	1330-20-7	2.57E-07	7300	24 hour	URT	URT	7.50E-06	0.00%	AERMOD 19191

Appendix A – Supporting Calculations

Calculation 1 - Gas Emissions

Gas flow properties

Gas Type	Flow Rate[1] (Nm^3/h)	Flow Rate[1] (m^3/h)	Temperature[1] (K)	Pressure[1] (kPa)	Flow Rate[2] (mol-gas/hr)	Carbon Content[3] (mol-C/mol-gas)	Silica Content[4] (mol-Si/mol-gas)
Natural Gas	1.42	2.25	298.15	69.6	6.32E+01	1.039	0.0
Biogas - Phase 1 Total	113	13,132	313.15	1.00	5.04E+03	0.651	7.88E-06
Biogas - Phase 1 CHP	113	13,132			5.04E+03		
Biogas - Phase 2 CHP	112	13,011			5.00E+03		
Biogas - Phase 2 Total	368	42,751			1.64E+04		
Biogas - Phase 2 Gas Upgrade	256	23.54	298.15	1,203	1.14E+04		
Biogas - Phase 2 Gas Venting	88	8.06			3.91E+03		

Methane Removal Efficency of Upgrade System: 95.0%

Gas composition data[1]

Substance Name	CAS	Molecular Weight (g/mol)	Carbon Content (mol-C/mol-substance)	Silica Content (mol-Si/mol-substance)	Max Natural Gas Concentration (v-substance/v-gas)	Max Biogas Concentration (v-substance/v-gas)	Max Upgraded Concentration[5] (v-substance/v-gas)
Methane	74-82-8	16.04	1.00	0.00	9.47E-01	6.50E-01	7.36E-02
Carbon dioxide	124-38-9	44.01	1.00	0.00	3.00E-03	4.00E-01	9.06E-01
Hydrogen sulfide	7783-06-4	34.1	0.00	0.00	4.30E-06	3.50E-03	7.93E-03
Carbon monoxide	630-08-0	28.01	1.00	0.00	0.00	1.00E-03	2.27E-03
Ammonia	7664-41-7	17.03	0.00	0.00	0.00	4.35E-03	9.86E-03
Hexamethyldisiloxane	107-46-0	162.38	6.00	2.00	0.00	1.30E-08	2.95E-08
Hexamethylcyclotrisiloxane	541-05-9	222.46	6.00	3.00	0.00	3.00E-07	6.80E-07
Octamethyltrisiloxane	107-51-7	236.53	8.00	3.00	0.00	1.30E-08	2.95E-08
Octamethylcyclotetrasiloxane	556-67-2	296.62	8.00	4.00	0.00	2.50E-07	5.66E-07
Decamethyltetrasiloxane	141-62-8	310.69	10.00	4.00	0.00	1.30E-08	2.95E-08
Decamethylcyclopentasiloxane	541-02-6	370.77	10.00	5.00	0.00	1.16E-06	2.63E-06
Dodecamethylpentasiloxane	141-63-9	384.84	12.00	5.00	0.00	1.30E-08	2.95E-08
Propane	74-98-6	44.1	3.00	0.00	2.00E-03	0.00	0.00E+00
Propene	115-07-1	42.08	3.00	0.00	0.00	1.73E-06	3.92E-06
Ethane	74-84-0	30.07	2.00	0.00	4.20E-02	0.00	0.00E+00
Cyclohexane	110-82-7	84.16	6.00	0.00	0.00	6.50E-09	1.47E-08
2,2,4-Trimethylpentane	540-84-1	114.23	8.00	0.00	0.00	6.50E-09	1.47E-08
Hexane	110-54-3	86.18	6.00	0.00	0.00	3.00E-08	6.80E-08
Heptane	142-82-5	100.21	4.00	0.00	0.00	1.50E-07	3.40E-07
Butane	106-97-8	58.12	4.00	0.00	4.00E-04	0.00	0.00E+00
2-Butanone	78-93-3	72.11	4.00	0.00	0.00	3.50E-08	7.93E-08
4-Methyl-2-pentanone	108-10-1	100.16	6.00	0.00	0.00	6.50E-09	1.47E-08
Benzene	71-43-2	78.11	6.00	0.00	0.00	2.00E-08	4.53E-08
Toluene	108-88-3	92.14	7.00	0.00	0.00	1.50E-06	3.40E-06
Ethylbenzene	100-41-4	106.17	8.00	0.00	0.00	2.00E-08	4.53E-08
Xylenes	1330-20-7	106.16	8.00	0.00	0.00	2.65E-08	6.00E-08
Tetrahydrofuran	109-99-9	72.11	4.00	0.00	0.00	1.00E-07	2.27E-07
				Molecular Weight (g/mol):	16.70	28.25	41.57

Notes:

1 *Target gas properties and composition prior to combustion as provided by client*

2 *Calculated as per the ideal gas law. The vented gas molar flow rate was calculated as the total upgrade gas less 95% of the methane content. This assumption results in the greatest emission of other biogas contaminants as the upgrade system can achive up to 99.5% removal.*

3 *Stiochemtric conversion per gas composition less carbon contained in carbon dioxide, which was assumed to not undergo chemical transfermation.*

4 *Stiochemtric conversion per gas composition*

5 *Calculated from the biogas concentration less 95% molar weight of methane. The selectivity of the upgrade system will vary by contaminant, however it was assumed all other substances remained in the vented gas as a worst-case.*

Calculation 1 - Gas Emissions

Phase 1 - Scenario 1: Regular operations approximately 95% of year.

Substance Name	CAS	Flare		CHP	
		Pre-Flare Rate[1] (g/s)	Emission Rate[2] (g/s)	Pre-CHP Rate[1] (g/s)	Emission Rate[2] (g/s)
Methane	74-82-8	2.67E-01	5.33E-03	1.46E+01	2.92E-01
Carbon dioxide[2]	124-38-9	2.32E-03	2.32E-03	2.47E+01	2.47E+01
Hydrogen sulfide[3]	7783-06-4	2.57E-06	5.15E-08	1.67E-01	3.34E-03
Carbon monoxide	630-08-0	0.00E+00	0.00E+00	3.92E-02	7.85E-04
Ammonia	7664-41-7	0.00E+00	0.00E+00	1.04E-01	2.08E-03
Hexamethyldisiloxane	107-46-0	0.00E+00	0.00E+00	2.96E-06	5.91E-08
Hexamethylcyclotrisiloxane	541-05-9	0.00E+00	0.00E+00	9.35E-05	1.87E-06
Octamethyltrisiloxane	107-51-7	0.00E+00	0.00E+00	4.31E-06	8.62E-08
Octamethylcyclotetrasiloxane	556-67-2	0.00E+00	0.00E+00	1.04E-04	2.08E-06
Decamethyltetrasiloxane	141-62-8	0.00E+00	0.00E+00	5.66E-06	1.13E-07
Decamethylcyclopentasiloxane	541-02-6	0.00E+00	0.00E+00	6.03E-04	1.21E-05
Dodecamethylpentasiloxane	141-63-9	0.00E+00	0.00E+00	7.01E-06	1.40E-07
Propane	74-98-6	1.55E-03	3.10E-05	0.00E+00	0.00E+00
Propene	115-07-1	0.00E+00	0.00E+00	1.02E-04	2.04E-06
Ethane	74-84-0	2.22E-02	4.43E-04	0.00E+00	0.00E+00
Cyclohexane	110-82-7	0.00E+00	0.00E+00	7.66E-07	1.53E-08
2,2,4-Trimethylpentane	540-84-1	0.00E+00	0.00E+00	1.04E-06	2.08E-08
Hexane	110-54-3	0.00E+00	0.00E+00	3.62E-06	7.24E-08
Heptane	142-82-5	0.00E+00	0.00E+00	2.11E-05	4.21E-07
Butane	106-97-8	4.08E-04	8.16E-06	0.00E+00	0.00E+00
2-Butanone	78-93-3	0.00E+00	0.00E+00	3.54E-06	7.07E-08
4-Methyl-2-pentanone	108-10-1	0.00E+00	0.00E+00	9.12E-07	1.82E-08
Benzene	71-43-2	0.00E+00	0.00E+00	2.19E-06	4.38E-08
Toluene	108-88-3	0.00E+00	0.00E+00	1.94E-04	3.87E-06
Ethylbenzene	100-41-4	0.00E+00	0.00E+00	2.97E-06	5.95E-08
Xylenes	1330-20-7	0.00E+00	0.00E+00	3.94E-06	7.88E-08
Tetrahydrofuran	109-99-9	0.00E+00	0.00E+00	1.01E-05	2.02E-07

Conversion products

Substance Name	CAS	Flare			CHP		
		Emission Factor Units	Emission Factor	Emission Rate[4] (g/s)	Emission Factor Units	Emission Factor	Emission Rate[4] (g/s)
Total particulate matter[5]	N/A (tsp)	g/m^3	1.77E-01	6.96E-05	lb/MMBtu	6.60E-03	3.4E-03
Nitrogen oxides[6]	10102-44-0	$g\text{-}NO_2/mol\text{-}NH_3$	45.09	0.00E+00	lb/MMBtu	3.20E-01	1.6E-01
Sulphur dioxide[3,7]	7446-09-05	$g\text{-}SO_2/mol\text{-}H_2S$	62.79	2.71E-08	$g\text{-}SO_2/mol\text{-}H_2S$	62.79	1.8E-03
Carbon dioxide[7]	124-38-9	$g\text{-}CO_2/mol\text{-}C$	43.13	7.861E-01	$g\text{-}CO_2/mol\text{-}C$	43.13	3.9E+01
Carbon monoxide[8]	630-08-0	g-CO/mol-C	0.56	1.021E-02	g-CO/mol-C	0.56	5.1E-01
Silica dioxide[7]	7631-86-9	$g\text{-}SiO_2/mol\text{-}Si$	58.88	0.00E+00	$g\text{-}SiO_2/mol\text{-}Si$	58.88	6.5E-04

Notes:

1 *Calculated as the gas molar flowrate multiplied by the concentration of the substance and the corresponding molecular weight (conversion of 3600 s/hr applied).*

2 *Assumed removal efficiency of 98% for both the flare and CHP. Existing carbon dioxide in the gas was assumed to exit unconverted.*

3 *Assumed removal efficiency of 99.4% for biogas H2S removal system.*

4 *Conversion of 3600 s/hr applied.*

5 *Average flare soot concentration obtained from AP-42 CH 13.5 (conversion of 1000* µg·m³/g·L applied). Total particulate matter emission factor for stationary gas turbines from AP-42 CH 3.1 (Conversion of 453.59 g/lb and 35.31 scf/m³ applied. Assumed average heating value of 1020 btu/scf).

6 *Flare temperature assumed low such that oxidation of nitrogen gas is insignificant. Therefore, nitrogen oxides from oxidation of fuel gas was the only emission calculated from the flare. 98% of ammonia was assumed to be converted into nitrogen dioxide while flaring. Nitrogen oxide emission factor for stationary gas turbines from AP-42 CH 3.1 (Conversion of 453.59 g/lb and 35.31 scf/m³ applied. Assumed average heating value of 1020 btu/scf).*

7 *Assumed oxidation conversion of 98% of applicable substances in fuel gas.*

8 *As a worst-case 2% of carbon in the fuel gas was assumed to remain as carbon monoxide. Note, carbon dioxide calculation assumes all carbon converted to carbon dioxide as desired.*

Calculation 1 - Gas Emissions

Phase 1 - Scenario 2: Maintainence requiring all gas to be flared approximately 5% of year.

Substance Name	CAS	Flare	
		Pre-Flare Rate[1] (g/s)	Emission Rate[2] (g/s)
Methane	74-82-8	1.49E+01	2.97E-01
Carbon dioxide[2]	124-38-9	2.47E+01	2.47E+01
Hydrogen sulfide	7783-06-4	1.67E-01	3.34E-03
Carbon monoxide	630-08-0	3.92E-02	7.85E-04
Ammonia	7664-41-7	1.04E-01	2.08E-03
Hexamethyldisiloxane	107-46-0	2.96E-06	5.91E-08
Hexamethylcyclotrisiloxane	541-05-9	9.35E-05	1.87E-06
Octamethyltrisiloxane	107-51-7	4.31E-06	8.62E-08
Octamethylcyclotetrasiloxane	556-67-2	1.04E-04	2.08E-06
Decamethyltetrasiloxane	141-62-8	5.66E-06	1.13E-07
Decamethylcyclopentasiloxane	541-02-6	6.03E-04	1.21E-05
Dodecamethylpentasiloxane	141-63-9	7.01E-06	1.40E-07
Propane	74-98-6	1.55E-03	3.10E-05
Propene	115-07-1	1.02E-04	2.04E-06
Ethane	74-84-0	2.22E-02	4.43E-04
Cyclohexane	110-82-7	7.66E-07	1.53E-08
2,2,4-Trimethylpentane	540-84-1	1.04E-06	2.08E-08
Hexane	110-54-3	3.62E-06	7.24E-08
Heptane	142-82-5	2.11E-05	4.21E-07
Butane	106-97-8	4.08E-04	8.16E-06
2-Butanone	78-93-3	3.54E-06	7.07E-08
4-Methyl-2-pentanone	108-10-1	9.12E-07	1.82E-08
Benzene	71-43-2	2.19E-06	4.38E-08
Toluene	108-88-3	1.94E-04	3.87E-06
Ethylbenzene	100-41-4	2.97E-06	5.95E-08
Xylenes	1330-20-7	3.94E-06	7.88E-08
Tetrahydrofuran	109-99-9	1.01E-05	2.02E-07

Conversion products

Substance Name	CAS	Flare		
		Emission Factor Units	Emission Factor	Emission Rate[3] (g/s)
Total particulate matter[4]	N/A (tsp)	g/m^3	0.177	5.63E-03
Nitrogen oxides[5]	10102-44-0	$g\text{-}NO_2/mol\text{-}NH_3$	45.09	2.75E-01
Sulphur dioxide[6]	7446-09-5	$g\text{-}SO_2/mol\text{-}H_2S$	62.79	3.08E-01
Carbon dioxide[6]	124-38-9	$g\text{-}CO_2/mol\text{-}C$	43.13	4.012E+01
Carbon monoxide[7]	630-08-0	g-CO/mol-C	0.56	5.212E-01
Silica dioxide[6]	7631-86-9	$g\text{-}SiO_2/mol\text{-}Si$	58.88	6.50E-04

Notes:

1 *Calculated as the gas molar flowrate multiplied by the concentration of the substance and the corresponding molecular weight (conversion of 3600 s/hr applied). The flared gas includes natural gas plus all biogas.*

2 *Assumed flare removal efficiency of 98%. Existing carbon dioxide in the gas was assumed to exit unconverted.*

3 *Conversion of 3600 s/hr applied. The flared gas includes natural gas plus all biogas*

4 *Average flare soot concentration obtained from AP-42 CH 13.5 (conversion of 1000* $\mu g \cdot m^3/g \cdot L$ applied).

5 *Flare temperature assumed low such that oxidation of nitrogen gas is insignificant. Therefore, nitrogen oxides from oxidation of fuel gas was the only emission calculated from the flare. 98% of ammonia was assumed to be converted into nitrogen dioxide while flaring.*

6 *Assumed oxidation conversion of 98% of applicable substances in fuel gas.*

7 *As a worst-case 2% of carbon in the fuel gas was assumed to remain as carbon monoxide. Note, carbon dioxide calculation assumes all carbon converted to carbon dioxide as desired.*

Calculation 1 - Gas Emissions

Phase 2 - Scenario 1: Regular operations approximately 95% of year.

Substance Name	CAS	Flare		CHP		Biogas Upgrade	
		Pre-Flare Rate[1] (g/s)	Emission Rate[2] (g/s)	Pre-CHP Rate[1] (g/s)	Emission Rate[2] (g/s)	Pre-Flare Rate[1] (g/s)	Emission Rate[2] (g/s)
Methane	74-82-8	2.67E-01	5.33E-03	1.45E+01	2.89E-01	1.28E+00	2.57E-02
Carbon dioxide[2]	124-38-9	2.32E-03	2.32E-03	2.44E+01	2.44E+01	4.33E+01	4.33E+01
Hydrogen sulfide[3]	7783-06-4	2.57E-06	5.15E-08	9.47E-04	1.89E-05	1.68E-03	3.36E-05
Carbon monoxide	630-08-0	0.00E+00	0.00E+00	3.89E-02	7.78E-04	6.89E-02	1.38E-03
Ammonia	7664-41-7	0.00E+00	0.00E+00	1.03E-01	2.06E-03	1.82E-01	3.65E-03
Hexamethyldisiloxane	107-46-0	0.00E+00	0.00E+00	2.93E-06	5.86E-08	5.19E-06	1.04E-07
Hexamethylcyclotrisiloxane	541-05-9	0.00E+00	0.00E+00	9.26E-05	1.85E-06	1.64E-04	3.28E-06
Octamethyltrisiloxane	107-51-7	0.00E+00	0.00E+00	4.27E-06	8.54E-08	7.57E-06	1.51E-07
Octamethylcyclotetrasiloxane	556-67-2	0.00E+00	0.00E+00	1.03E-04	2.06E-06	1.82E-04	3.65E-06
Decamethyltetrasiloxane	141-62-8	0.00E+00	0.00E+00	5.61E-06	1.12E-07	9.94E-06	1.99E-07
Decamethylcyclopentasiloxane	541-02-6	0.00E+00	0.00E+00	5.97E-04	1.19E-05	1.06E-03	2.12E-05
Dodecamethylpentasiloxane	141-63-9	0.00E+00	0.00E+00	6.94E-06	1.39E-07	1.23E-05	2.46E-07
Propane	74-98-6	1.55E-03	3.10E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Propene	115-07-1	0.00E+00	0.00E+00	1.01E-04	2.02E-06	1.79E-04	3.58E-06
Ethane	74-84-0	2.22E-02	4.43E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cyclohexane	110-82-7	0.00E+00	0.00E+00	7.59E-07	1.52E-08	1.35E-06	2.69E-08
2,2,4-Trimethylpentane	540-84-1	0.00E+00	0.00E+00	1.03E-06	2.06E-08	1.83E-06	3.65E-08
Hexane	110-54-3	0.00E+00	0.00E+00	3.59E-06	7.18E-08	6.36E-06	1.27E-07
Heptane	142-82-5	0.00E+00	0.00E+00	2.09E-05	4.17E-07	3.70E-05	7.40E-07
Butane	106-97-8	4.08E-04	8.16E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2-Butanone	78-93-3	0.00E+00	0.00E+00	3.50E-06	7.01E-08	6.21E-06	1.24E-07
4-Methyl-2-pentanone	108-10-1	0.00E+00	0.00E+00	9.04E-07	1.81E-08	1.60E-06	3.20E-08
Benzene	71-43-2	0.00E+00	0.00E+00	2.17E-06	4.34E-08	3.84E-06	7.69E-08
Toluene	108-88-3	0.00E+00	0.00E+00	1.92E-04	3.84E-06	3.40E-04	6.80E-06
Ethylbenzene	100-41-4	0.00E+00	0.00E+00	2.95E-06	5.89E-08	5.23E-06	1.05E-07
Xylenes	1330-20-7	0.00E+00	0.00E+00	3.91E-06	7.81E-08	6.92E-06	1.38E-07
Tetrahydrofuran	109-99-9	0.00E+00	0.00E+00	1.00E-05	2.00E-07	1.77E-05	3.55E-07

Conversion products

Substance Name	CAS	Biogas Upgrade			Flare	CHP		
		Emission Factor Units	Emission Factor	Emission Rate[4] (g/s)	Emission Rate[3] (g/s)	Emission Factor Units	Emission Factor	Emission Rate[4] (g/s)
Total particulate matter[5]	N/A (tsp)	g/m^3	0.177	4.31E-03	6.96E-05	lb/MMBtu	6.60E-03	3.35E-03
Nitrogen oxides[6]	10102-44-0	g-NO_2/mol-NH_3	45.09	4.83E-01	0.00E+00	lb/MMBtu	3.20E-01	1.63E-01
Sulphur dioxide[3,7]	7446-09-5	g-SO_2/mol-H_2S	62.79	3.09E-03	4.74E-06	g-SO_2/mol-H_2S	62.79	1.74E-03
Carbon dioxide[7]	124-38-9	g-CO_2/mol-C	43.13	3.05E+01	7.861E-01	g-CO_2/mol-C	43.13	3.898E+01
Carbon monoxide[8]	630-08-0	g-CO/mol-C	0.56	3.96E-01	1.021E-02	g-CO/mol-C	0.56	5.063E-01
Silica dioxide[7]	7631-86-9	g-SiO_2/mol-Si	58.88	5.04E-04	0.00E+00	g-SiO_2/mol-Si	58.88	6.44E-04

Notes:

1 *Calculated as the gas molar flowrate multiplied by the concentration of the substance and the corresponding molecular weight (conversion of 3600 s/hr applied).*

2 *Assumed removal efficiency of 98% for both the flare and CHP. Existing carbon dioxide in the gas was assumed to exit unconverted.*

3 *Assumed removal efficiency of 99.4% for biogas H2S removal system.*

4 *Conversion of 3600 s/hr applied.*

5 *Average flare soot concentration obtained from AP-42 CH 13.5 (conversion of 1000* µg·m³/g·L applied). Total particulate matter emission factor for stationary gas turbines from AP-42 CH 3.1 (Conversion of 453.59 g/lb and 35.31 scf/m³ applied. Assumed average heating value of 1020 btu/scf).

6 *Flare temperature assumed low such that oxidation of nitrogen gas is insignificant. Therefore, nitrogen oxides from oxidation of fuel gas was the only emission calculated from the flare. 98% of ammonia was assumed to be converted into nitrogen dioxide while flaring. Nitrogen oxide emission factor for stationary gas turbines from AP-42 CH 3.1 (Conversion of 453.59 g/lb and 35.31 scf/m³ applied. Assumed average heating value of 1020 btu/scf).*

7 *Assumed oxidation conversion of 98% of applicable substances in fuel gas.*

8 *As a worst-case 2% of carbon in the fuel gas was assumed to remain as carbon monoxide. Note, carbon dioxide calculation assumes all carbon converted to carbon dioxide as desired.*

Calculation 1 - Gas Emissions

Phase 2 - Scenario 2: Maintainence requiring all gas to be flared approximately 5% of year.

Substance Name	CAS	Flare	
		Pre-Flare Rate[1] (g/s)	Emission Rate[2] (g/s)
Methane	74-82-8	4.78E+01	9.56E-01
Carbon dioxide[2]	124-38-9	8.03E+01	8.03E+01
Hydrogen sulfide	7783-06-4	5.44E-01	1.09E-02
Carbon monoxide	630-08-0	1.28E-01	2.56E-03
Ammonia	7664-41-7	3.38E-01	6.76E-03
Hexamethyldisiloxane	107-46-0	9.63E-06	1.93E-07
Hexamethylcyclotrisiloxane	541-05-9	3.04E-04	6.09E-06
Octamethyltrisiloxane	107-51-7	1.40E-05	2.80E-07
Octamethylcyclotetrasiloxane	556-67-2	3.38E-04	6.76E-06
Decamethyltetrasiloxane	141-62-8	1.84E-05	3.68E-07
Decamethylcyclopentasiloxane	541-02-6	1.96E-03	3.92E-05
Dodecamethylpentasiloxane	141-63-9	2.28E-05	4.56E-07
Propane	74-98-6	1.55E-03	3.10E-05
Propene	115-07-1	3.32E-04	6.64E-06
Ethane	74-84-0	2.22E-02	4.43E-04
Cyclohexane	110-82-7	2.49E-06	4.99E-08
2,2,4-Trimethylpentane	540-84-1	3.39E-06	6.77E-08
Hexane	110-54-3	1.18E-05	2.36E-07
Heptane	142-82-5	6.86E-05	1.37E-06
Butane	106-97-8	4.08E-04	8.16E-06
2-Butanone	78-93-3	1.15E-05	2.30E-07
4-Methyl-2-pentanone	108-10-1	2.97E-06	5.94E-08
Benzene	71-43-2	7.13E-06	1.43E-07
Toluene	108-88-3	6.30E-04	1.26E-05
Ethylbenzene	100-41-4	9.68E-06	1.94E-07
Xylenes	1330-20-7	1.28E-05	2.57E-07
Tetrahydrofuran	109-99-9	3.29E-05	6.58E-07

Conversion products

Substance Name	CAS	Flare		
		Emission Factor Units	Emission Factor	Emission Rate[3] (g/s)
Total particulate matter[4]	N/A (tsp)	g/m^3	0.177	2.10E+00
Nitrogen oxides[5]	10102-44-0	$g\text{-}NO_2/mol\text{-}NH_3$	45.09	8.95E-01
Sulphur dioxide[6]	7446-09-5	$g\text{-}SO_2/mol\text{-}H_2S$	62.79	1.00E+00
Carbon dioxide[6]	124-38-9	$g\text{-}CO_2/mol\text{-}C$	43.13	1.29E+02
Carbon monoxide[7]	630-08-0	g-CO/mol-C	0.56	1.67E+00
Silica dioxide[6]	6.76E-03	$g\text{-}SiO_2/mol\text{-}Si$	58.88	2.12E-03

Notes:

1 *Calculated as the gas molar flowrate multiplied by the concentration of the substance and the corresponding molecular weight (conversion of 3600 s/hr applied). The flared gas includes natural gas plus all biogas.*

2 *Assumed flare removal efficiency of 98%. Existing carbon dioxide in the gas was assumed to exit unconverted.*

3 *Conversion of 3600 s/hr applied. The flared gas includes natural gas plus all biogas*

4 *Average flare soot concentration obtained from AP-42 CH 13.5 (conversion of 1000* $\mu g \cdot m^3/g \cdot L$ applied).

5 *Flare temperature assumed low such that oxidation of nitrogen gas is insignificant. Therefore, nitrogen oxides from oxidation of fuel gas was the only emission calculated from the flare. 98% of ammonia was assumed to be converted into nitrogen dioxide while flaring.*

6 *Assumed oxidation conversion of 98% of applicable substances in fuel gas.*

7 *As a worst-case 2% of carbon in the fuel gas was assumed to remain as carbon monoxide. Note, carbon dioxide calculation assumes all carbon converted to carbon dioxide as desired.*

Calculation 2 - Odour Emissions

Phase 2 - Scenario 2: Maintenance requiring all gas to be flared approximately 5% of year.

Source	Source ID	Material	Quantity (tonnes/day)	Emission Factor[1] (OU/tonne)	Emission Rate (OU/s)
Flare	FL01	Hydrogen sulfide	9.41E-04	1.00E+11	2.58E+03
		Sulfur dioxide	8.66E-02	1.49E+09	
Clarifiers	PT01	Primary sludge	4.34E+01	1.02E+04	5.13E+00
Sequence Batch Reactors	ST01	Primary sludge	4.34E+01	1.02E+04	5.13E+00
Dewatering Building	DB01	Primary sludge	9.52E+01	1.02E+04	1.12E+01
Thickening Building	TB01	Thickened waste activated sludge	1.20E+02	1.02E+04	2.38E+01
		Septage	7.67E+01	1.09E+04	

Notes:

1 *Flare odour emissions were assumed to be dominated by hydrogen sulfide and sulfur dioxide. The odour emission factor for hydrogen sulfide and sulfur dioxide was developed assuming an odour threshold concentration of 0.01 and 0.67 ppm respectively. Emission factors for sludge and septage taken from Odour emission factors: Fundamental tools for air quality management (2014) assuming a material density of 1.0 g/mL.*

Flare pseudo parameters

Parameter	Description	Value	Units
Stack properties			
H_s	Stack height above ground	5.5	m
D_{noz}	Flare nozzel diameter	0.11	m
n	Flare molar flow rate	1.65E+04	mol/hr
T_{gas1}	Flare gas temperature prior to combustion	298.2	K
T_{gas2}	Flare gas temperature after combustion (as per MECP assumption)	1273	K
P_{gas1}	Flare gas presure prior to combustion	101.325	kPa
T_{air}	Ambient air temperature	298.2	K
ρ_{air}	Density of air at ambient temperature and pressure	1.183	kg/m^3
cp_{air}	specific heat of dry air constant at T_{air}	1004	J/kg·K
Calculated properties			
Q	Flare volumetric flow rate	1.12E-01	m^3/s
V_{noz}	Flare actual gas exit velocity (including lift gas) at flare nozzle before combustion	11.79	m/s
Q_t	Heat available from combustion. Sensible and radiative heat available estimated based on the properties of the flared gas stream including the pilot fuel and combustible lift gas	2.40E+06	J/s
f	height loss from radiation	30.0%	%
Q_n	Net heat released	1.68E+06	J/s
ρ_{gas}	Flare gas density prior to combustion	1.149	kg/m^3
Fm	momentum flux	0.408	m^4/s^2
Fb	buoyancy flux	14.816	m^4/s^3
Effective stack properties			
H_{eff}	Effective stack height including flame height	7.66	m
V_{eff}	Effective stack velocity (at flame tip). Assumed 1.5 m/s minimum	1.50	m/s
D_{eff}	Effective stack diameter (at flame tip)	2.29	m

Substance	Molecular Weight (g/mol)	Max Concentration (v-substance/v-gas)	Lower Heating Value (J/g-mol)
Methane	16.04	65.4%	8.02E+05
Non-combustables	50.89	34.6%	0.00E+00
Total	28.11	100.0%	5.24E+05

Molecular Weight (g/mol)	Radiative heat loss values (f)
≤ 20	25%
21 - 35	30%
36 - 50	35%
51 - 65	40%
66 - 80	45%
81 - 95	50%
>95	55%

Notes:

Calculated as per guidance in Flare Modelling Technical Bulletin (MOECC, 2020).

Flare properties for Phase 2 - Scenerio 2 (all gas to be flared).

Appendix B – Assessment for Negligibility

Supporting Information for Assessment of Negligibility

Sources were screened for negligibility using the following screening protocols listed in The ESDM Procedure Document:

- Fugitive dust from on-site roadways (Section 7.4)
- Combustion of natural gas and propane (Section 7.1.1)
- Sources listed on Table B-3 (Section 7.2.1)
- Sources that are insignificant relative to total emissions (Section 7.2.2.)

The results of the screening are discussed in greater detail below.

Fugitive Dust:

The Facility is not listed in Table 7-2 or 7-3 of Section 7.4 of The ESDM Procedure Document and accordingly dust emissions from on-site roadways, storage piles, and on-site traffic were considered as insignificant. Additionally, the nature and quantity of dust generated from these sources was not deemed likely to pose a significant health risk if present.

Combustion of Natural Gas and Propane:

Natural gas comfort heating equipment was screened and found to be insignificant according to Appendix B, Table B-3 of The ESDM Procedure Document. No units existed or were modified prior to 1989 and the total Facility-wide heat input usage is less than 20 million kilojoules/hr. The equipment includes small HVAC units, water heaters, etc.

Sources Listed on Table B-3

Table B-3 of The ESDM Procedure Document lists sources that can be considered to be insignificant; the following sources at the Facility are listed on Table B-3:

- Sewage treatment sources that are Exempt from Obtaining an ECA based on Ontario Regulation 524/98, *Environmental Compliance Approvals – Exemptions from Section 9 of the Act* were assumed to only have significant odour emissions.

- Maintenance welding stations.
- Chemical storage room ventilation.
- Standby power generators firing liquid or gaseous fuels that are used for standby power only with periodic testing as per the Regulation.
- Fume hoods for laboratories that are used for quality control and quality assurance purposes at industrial facilities.
- Parts washers for maintenance shops.
- On-site storage tanks and facilities that are used for fueling on-site vehicles.
- Natural gas fired boilers, water heaters, space-heaters and make-up air units when the total facility-wide input usage for this equipment is less than 20 million kilojoules per hour.
- Low temperature handling of compounds with a vapour pressure less than 1 kiloPascal.
- Battery chargers.
- Storage and emission of nitrogen and oxygen.
- Small maintenance and janitorial activities.
- Exhaust of inert gases.

Sources that are Insignificant Relative to Total Emissions:

It is understood that a source may be considered negligible if:

- The emission from one source of contaminants are similar (same contaminants and same relative proportions of contaminants) to another source of contaminants AND;
- One of the sources would have much higher emissions rates than the other AND;
- The nature of their emission is similar (resultant dispersion impact from either source are the same) then the smaller source can be classified as insignificant provided the resultant POI impact of all the contaminants does not result in non-compliance OR;

- That the margin of compliance is so slight that if the smaller source or sources were included the aggregate POI impacts of all the contaminants would result in non-compliance.

Therefore, sources of contaminants are determined to be negligible by comparing the difference in usage rates between sources at a Facility. If the usage rate of materials in the process are much less than the usage rates in other significant sources at the same facility than the lesser source may be considered negligible.

Building ventilation not directly involved with process emissions (i.e. office spaces, washrooms, etc.) were deemed to be negligible because of the low expected quantity and risk associated with their contaminant emissions relative to the site-wide releases.

Appendix C – Equipment Specifications

Basic Technical Data

Nominal electrical output	191	kW
Maximum heat output [1)]	891,000	BTU/h

1) maximum heat output is a sum of heat outputs of secondary and aftercooler circuit at their full utilization

Load	50	75	100	%
Heat output	538,000	713,000	891,000	BTU/h
Fuel input	990,000	1,378,000	1,766,000	BTU/h
Heat rate	10,361	9,618	9,247	BTU/kW$_e$
Electrical efficiency	32.9	35.4	36.8	%
Heat efficiency	54.4	51.8	50.4	%
Total efficiency (fuel utilization)	87.3	87.2	87.2	%
Gas consumption	1,575	2,194	2,815	CFH

The Basic Technical Data are applicable for the standard conditions pursuant to the "Technical Instructions" document.
The minimum permanent electrical power must not drop below 50 % of the nominal power.
Gas consumption is mentioned for biogas with methane content 65%, at normal conditions (32°F, 14.648 psi, Low Heat Value 628 BTU/CF)

Emissions

Emissions in exhaust gases	NO_x	CO	
Standard	1,5	1,9	g/bhp-h

Generator

Type	LSA 46.3 M7	
Producer	LEROY SOMER	
Cos φ	1,0	
Efficiency in the working point	95,2	%
Voltage	480 (600)	V
Frequency	60	Hz

Basic Technical Data

Nominal electrical output	191	kW
Maximum heat output [1)]	261	kW

1) maximum heat output is a sum of heat outputs of secondary and aftercooler circuit at their full utilization

Load	50	75	100	%
Heat output	157	209	261	kW
Fuel input	290	404	518	kW
Electrical efficiency	32,9	35,4	36,8	%
Heat efficiency	54,4	51,8	50,4	%
Total efficiency (fuel utilization)	87,3	87,2	87,2	%
Gas consumption	44,6	62,1	79,7	Nm^3/h

The Basic Technical Data are applicable for the standard conditions pursuant to the "Technical Instructions" document.
The minimum permanent electrical power must not drop below 50 % of the nominal power.
Gas consumption is mentioned for biogas with methane content 65%, at normal conditions (0°C, 101,325 kPa, Low Heat Value 23,4 MJ/Nm^3)

Emissions

Emissions with 5% of O_2 in exhaust gases	NO_x	CO	
Standard	500 244	650 520	mg/Nm^3 ppm

Engine

Type	TB 200 G8V TW 86	
Producer	TEDOM	
Number of cylinders	6	
Arrangement of cylinders	in series	
Bore × stroke	130/150	mm
Displacement	729	cui
Compression ratio	12 : 1	
Speed	1800	rpm
Oil consumption, normal / max.	0.3 / 0.5	g/kWh
Max. Engine power	200.7	kW

TB 200 G8V TW 86_850: 14.03.2013

Thermal System

Secondary circuit

Heat carrier	water	
Total system heat recovery	846,000	BTU/h
Nominal water temperature, input / output	158/194	°F
Return water temperature, min / max	104/158	°F
Nominal flow rate	46.8	GPM
Max. working pressure	87	psi
Water volume in CHP unit circuit	7.9	gal
Pressure loss at the nominal flow rate	4.4	psi
Nominal temperature drop	36	°F

Primary circuit [1)]

Total system heat recovery	846,000	BTU/h
Max. working pressure	36.3	psi
Water volume in CHP unit circuit	61.6	gal

1) parameters are valid if the dry cooler (optional) is part of delivery

Aftercooler circuit [1)]

Heat carrier	water + ethylene glycol	
Ethylene glycol's concentration	35	%
Total system heat recovery	45,000	BTU/h
Max coolant temperature at the input	95	°F
Nominal flow rate	23	GPM
Max. working pressure	43.5	psi
Water volume in CHP unit circuit	13.2	gal

1) parameters are valid if the dry cooler (optional) is part of delivery

Fuel, Gas Inlet

Methane content	65	%
Heat value	628	BTU/CF
Gas pressure	0.7 – 1.4	psi
Max. pressure change under varying consumption	10	%
Max. gas temperature	95	°F

Thermal System

Secondary circuit

Heat carrier	water	
Total system heat recovery	247	kW
Nominal water temperature, input / output	70/90	°C
Return water temperature, min / max	40/70	°C
Nominal flow rate	3,0	kg/s
Max. working pressure	600	kPa
Water volume in CHP unit circuit	30	dm^3
Pressure loss at the nominal flow rate	30	kPa
Nominal temperature drop	20	°C

Primary circuit [1)]

Total system heat recovery	247	kW
Max. working pressure	250	kPa
Water volume in CHP unit circuit	280	dm^3

1) parameters are valid if the dry cooler (optional) is part of delivery

Aftercooler circuit [1)]

Heat carrier	water + ethylene glycol	
Ethylene glycol's concentration	35	%
Total system heat recovery	13	kW
Max coolant temperature at the input	35	°C
Nominal flow rate	1,5	kg/s
Max. working pressure	300	kPa
Water volume in CHP unit circuit	50	dm^3

1) parameters are valid if the dry cooler (optional) is part of delivery

Fuel, Gas Inlet

Methane content	65	%
Heat value	23,4	MJ/Nm^3
Gas pressure	5 ÷ 10	kPa
Max. pressure change under varying consumption	10	%
Max. gas temperature	35	°C

Combustion and Ventilation Air

Unused heat removed by the ventilation air	92,000	BTU/h
Amount of combustion air	446	CFM
outdoor air temperature, min / max	-20/35	°C

Exhaust Gas and Condensate Outlet

Amount of exhaust gases	438.2	CFM
Exhaust gas temperature, nominal / max	302/356	°F
Max. back-pressure of exhaust gases downstream the CHP unit flange	0.14	psi
Speed of exhaust gases at the outlet (DN 150)	20.0	m/s

Oil

Amount of lubrication oil in the engine	14.8	gal
Replenishment oil tank volume	33.1	gal

Unit Dimensions and Weights*

Length total / transport	218.5/196.9	in
Width total / transport	118.1/98.4	in
Height total / transport	255.9/104.7	in
Service weight of the entire CHP unit	20.030	lb

** approximate values*

Combustion and Ventilation Air

Unused heat removed by the ventilation air	27	kW
Amount of combustion air	758	Nm^3/h
outdoor air temperature, min / max	-20/35	°C

Exhaust Gas and Condensate Outlet

Amount of exhaust gases	821	Nm^3/h
Exhaust gas temperature, nominal / max	150/180	°C
Max. back-pressure of exhaust gases downstream the CHP unit flange	10	mbar
Speed of exhaust gases at the outlet (DN 150)	20,0	m/s

Oil

Amount of lubrication oil in the engine	56	dm^3
Replenishment oil tank volume	125	dm^3

Unit Dimensions and Weights*

Length total / transport	5550/5000	mm
Width total / transport	3000/2500	mm
Height total / transport	6500/2660	mm
Service weight of the entire CHP unit	9085	kg

** approximate values*

Noise Parameters

CHP unit in 10 m from container	63	dB(A)

Electrical Parameters

Nominal voltage	480	V
Nominal frequency	60	Hz
Power factor	0,8C	
Nominal current at cos φ=0.8	287	A
Protection of switchboard's power part closed/open	IP 31/00	
Protection of switchboard's control part closed/open	IP 31/00	

Color Version

Engine, generator and internal parts of unit	RAL 5015 (blue)
Container	RAL 5013 (blue)

Caution

Manufacturer reserves the right to alter this document and the linked source materials.

Appendix D – Dispersion Modelling Data and Electronic Files (on CD)

Appendix E – Proposed Process Flow Diagrams

CONFIDENTIAL

Anaergia

Petawawa Food Waste Co-digestion BFD: Summary

February 4th, 2021

NOT FOR CONSTRUCTION

Phase		Stream				
		PS Feed	WAS Feed	Food reception	Digestate out of AD	Total Biogas (Nm3/d)
1A	Operation (days/wk)	7	7	5	7	7
	Flow (MT/day)	29.75	49.00	28.20	33.60	2713
	TS	3%	2%	15%	5.0%	NA
1B	Operation (days/wk)	7	7	5	7	7
	Flow (MT/day)	43.44	71.54	16.29	33.60	2111
	TS	3%	2%	15%	5.5%	NA
2A	Operation (days/wk)	7	7	5	7	7
	Flow (MT/day)	43.44	71.54	76.91	71.30	6582
	TS	3%	2%	15%	4.7%	NA
2B	Operation (days/wk)	7	7	5	7	7
	Flow (MT/day)	43.44	71.54	107.40	90.32	8831
	TS	3%	2%	15%	4.6%	NA

Rev.	Date	Edit.	Check.	Appr.	Drawing No.:
03					
02					
01	2020.09.14	IK	AK		
00	2020.09.09	IK	AK		

Drawing Name: Block Flow Diagram Future Optimized

Project: Petawawa 30% Design Basis

Project-No:

Street: 560 Abbie Lane

City: Petawawa, ON

Country: Canada

Customer: Petawawa

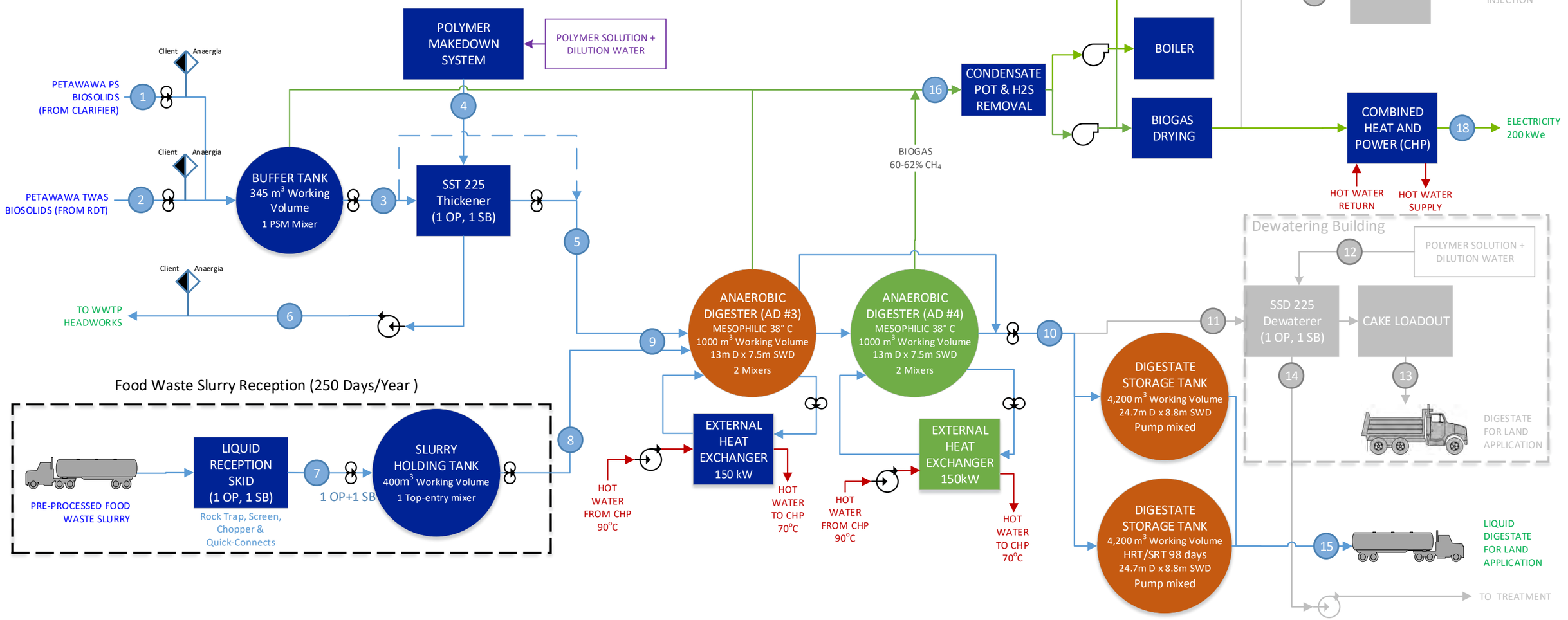
Anaergia

CONFIDENTIAL

NOT FOR CONSTRUCTION

Petawawa Food Waste Co-digestion BFD: Phase 1A

February 4th, 2021



Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Stream	PS Feed	WAS Feed	SST Feed	SST dil polymer	AD Sludge Feed	SST Filt to Headworks	Food reception	Food to AD	Sludge and Food to AD	Digestate out of AD	Digestate to SSD	SSD dilute polymer	Cake solids	SSD Filtrate	Liquid dig to land	Total Biogas (Nm3/d)	Biogas to BUG (Nm3/d)	Power (kWe)
Operation (days/wk)	7	7	7	7	7	7	5	7	7	7	NA	NA	NA	NA	5	7	NA	7
Flow (MT/day)	29.75	49.00	78.75	3.28	16.85	61.90	28.20	20.14	37.00	33.60	NA	NA	NA	NA	47.04	2713	NA	200
TS	3%	2%	2.4%	0.20%	10%	0.30%	15%	15%	13%	5.0%	NA	NA	NA	NA	5.0%			

Comments:

1. Operation is on a 365 days/year, 7 days/week, and 24 hours per day basis unless otherwise specified.
2. Flows are expressed in metric tonnes.
3. External feedstock reception is expected to operate 250 days/year, 5 days/week.

Preliminary Design – For Approval, not for construction

LEGEND

SST 225
Hydraulic Capacity: 35m3/h
Solids Loading Capacity: 700 kg/h

NEW BY ANAERGIA

EXISTING MODIFIED BY ANAERGIA

AVAILABLE – ON STANDBY

NOT APPLICABLE

Rev.	Date	Edit.	Check.	Appr.	Drawing No.:
03					
02					
01	2020.09.14	IK	AK		
00	2020.09.09	IK	AK		

Drawing Name: Block Flow Diagram Future Optimized

Project: Petawawa 30% Design Basis

Project-No:

Street: 560 Abbie Lane

City: Petawawa, ON

Country: Canada

Customer: Petawawa