AECOM

Appendix M

Air Quality and Odour Impact Assessment

DILLON
CONSULTING

CITY OF SAULT STE. MARIE

Solid Waste Management Landfill

Air Quality, Odour, and Greenhouse Gas Impact Assessment

February 2020 – 06-6988

Table of Contents

Figures

Tables

Appendices

Acronyms, Abbreviations, Definitions

AAQC, Ontario's Ambient Air Quality Criteria.

Act (the), refers to the Environmental Assessment Act. Also known as EAA, or the EA Act.

ADMGO, Air Dispersion Modeling Guideline for Ontario.

CAAQS, Canadian Ambient Air Quality Standards.

Discrete Receptor, a discrete receptor is a single receptor placed in a precise location of interest. Discrete receptors include a location where human activities regularly occur at a time when those activities regularly occur.

EA, Environmental Assessment, means an environmental assessment process described in Part II *of the EAA and/or report submitted pursuant to subsection 5(1) of the* EAA[1]

ECCC, Environment Canada and Climate Change.

Environment, the Environmental Assessment Act de*fi*nes environment to mean:

- Air, land or water;
- Plant and animal life, including human life;
- *The social, economic and cultural conditions that influence the life of humans or a* community;
- Any building, structure, machine or other device or thing made by humans;
- *Any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from human activities; or,*
- *Any part or combination of the foregoing and the interrelationships between any two or* more of them.

GHG, greenhouse gas.

LCS, Leachate Collection System.

LFG, refers to landfill gas.

MECP*, Ministry of the Environment, Conservation and Parks; formerly Ministry of the* Environment and Climate Change (MOECC), Ministry of the Environment (MOE), and Ministry of the Environment and Energy (MOEE).

[1] Ministry of the Environment, Conservation and Parks (1990). Environmental Assessment Act, R.S.O. 1990, c. E.18. Last Updated: July 2019.

MOVES, Motor Vehicle Emission Simulator.

NAPS, National Air Pollution Surveillance Program.

OLM*, Ozone Limiting Method*

off-site, this refers to the area that is ten (10) km outside of the Sault Ste. Marie Landfill site boundary.

on-site, this refers to the area within the Sault Ste. Marie Landfill site boundary.

PM, Particulate Matter.

POI, Points-of-Impingement.

TSP, total suspended particulate matter.

US EPA, United States Environmental Protection Agency.

The City of Sault Ste. Marie, or “the City”, is the proponent for this Undertaking.

	Units
km	kilometre
m	metre
m^3	cubic metres
g	gram
kg	kilogram
t	Metric tonne

Executive Summary

The City of Sault Ste. Marie (the City) has undertaken an Environmental Assessment (EA) pursuant to the Environmental Assessment Act (Act) to expand its Solid Waste Management Landfill (Site) in the City of Sault Ste. Marie. The EA proposes to increase the life of the facility for a 25-year planning period, from 2023 to 2048.

This assessment has been developed to address indicator air emissions (particulate [TSP, PM_{10}, $PM_{2.5}$], SO_2, CO, NOx, H_2S, acetone, acrylonitrile, vinyl chloride, chloroform, and benzene) and odour from the development of the preferred alternative expansion.

Background air quality was characterized through the use of data from the closest stations of Ontario Ministry of the Environment, Conservation and Parks (MECP), Environment Canada and Climate Change (ECCC) National Air Pollution Surveillance Program (NAPS), and ECCC reference documentation.

The greatest potential impact to the air quality for the landfill expansion will be associated with changes to on-site operations. After reviewing the cell sequencing plans for the lifecycle of the preferred alternative expansion method, eight (8) development phases were considered as part of the air quality impact assessment. In order to determine which scenario represents the worst-case operating scenario in terms of potential for air quality effects, a screening level assessment was completed. This screening assessment considered vehicle and equipment activities at the site, as well as vehicle and equipment travel distances (unpaved roads).

Emissions from Scenario 2 are expected to represent the worst-case scenario, as the travel paths associated with the active waste disposal area (working face) are the greatest, waste mining activities add to emissions from mobile and stationary combustion sources, and emission sources associated with waste mining activities are located southwest of the existing waste cells, closer to the property line and receptors. This scenario was therefore used to assess the potential air quality impacts of the proposed landfill expansion.

The worst-case year of landfill gas generation for the Site occurs the first year after closure (2049). The landfill gas generation from this year was used to determine the potential impact on local air quality from landfill gas compounds and odour emitted from the Site. Total odour emissions from the site were conservatively estimated using the worst-case potential landfill gas generation year and worst-case location of the active working face.

Emission rates were developed for the preferred alternative worst-case development scenario 2 using industry accepted methodologies.

The environmental effects assessment includes a combination of the background air quality for the region and the contribution of all activities at the landfill with the potential to cause residual effects on the atmospheric environment. In addition to the evaluation of environmental effects, a compliance assessment was performed to determine whether the site would be anticipated to operate in compliance under O. Reg. 419/05.

Atmospheric dispersion modelling was conducted using the MECP approved AERMOD version 16216r, MECP terrain data, and a site-specific MECP processed site-specific 5-year meteorological dataset.

The cumulative air quality for each indicator compound and odour was compared against the most stringent applicable air quality criteria or guideline. The predicted concentrations for all contaminants are below their respective O.Reg. 419/05 and AAQC criteria.

The predicted concentrations for all contaminants are below their respective CAAQS aspirational air quality objectives with the exception of the 1-hr NO_2 comparison to the 2025 CAAQS. The predicted cumulative levels of NO_2 for the environmental effects assessment are not considered to be significant due to the infrequency of occurrence and the CAAQS are stringent aspirational drivers for air quality management across Canada that are intended to be used as objectives and not as criteria.

A greenhouse gas (GHG) assessment was undertaken in support of the EA. This report examined the impact of the proposed landfill expansion on climate change. The results of the on-site impact assessment concluded that the current predicted emissions of GHG are negligible compared to total provincial emissions. Scaling the GHG inventory to a representative regional (service area) value based on population, indicated the landfill was not a significant contributor to Ontario's solid waste disposal GHGs when comparing existing conditions (0.70%) to future conditions (0.83%).

1.0 Introduction and Project Description

This document presents the findings of the air quality and odour impact assessment as part of the Environmental Assessment (EA) of the proposed expansion of the City of Sault Ste. Marie's landfill located on Fifth Line (the "Site").

The air quality impact assessment examines and evaluates the potential for impact to public health and safety as a result of air quality impacts from the landfill expansion. The air quality assessment also considers the potential for dust associated with the expansion which is considered as a disruption effect on local residents and businesses as part of the socio-economic assessment.

The air quality impact assessment concentrates on identifying and analyzing any effects on the environment arising from the proposed project. It also aims to identify and address key interactions between communities and the proposed project.

The odour assessment examines the potential for change in odour level as a result of the proposed expansion and discusses any need for mitigation to reduce levels. The results of the odour assessment will provide information for the socio-economic evaluation which considers potential for disruption to residents and businesses during operation of the expanded landfill.

The greenhouse gas (GHG) assessment identifies sources of emissions at the Site including: flare, landfill gas fugitives, vehicles, and on-site heavy equipment. The existing conditions and future development annual emissions are estimated to determine the project impacts on climate change in Ontario and Canada.

Following on from this introductory section, the report takes on the following format:

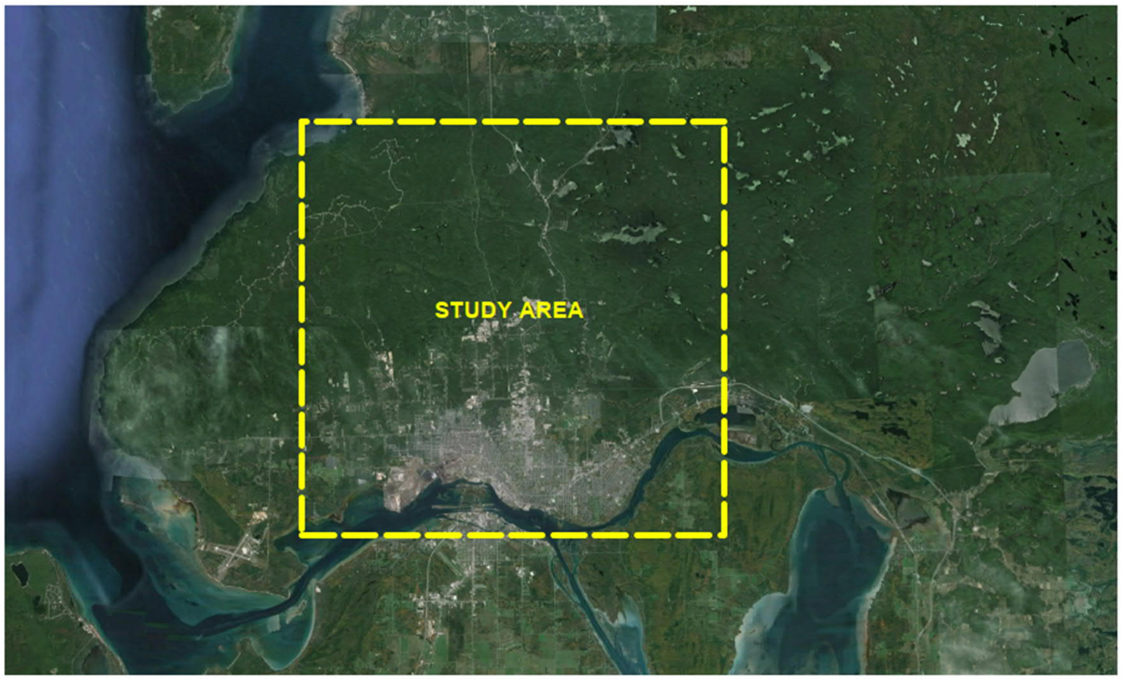
- Air Quality:
    - Description of the study area;
    - Outline of methodology and approach to air quality assessment;
    - Summary of existing air quality; and
    - Evaluation of potential air quality impacts.
- Odour:
    - Outline of methodology and approach to odour assessment;
    - Summary of existing odour conditions; and
    - Evaluation of potential odour impacts.
- Greenhouse Gas Emissions
    - Greenhouse gas emission estimates; and
    - Project impacts on climates change.

2.0 Air Quality

2.1 Study Area

The study area for the air quality assessment is shown on Figure 1. This area was selected based on defining an area around the Site that would incorporate potential impacts of the Site operations (i.e., capture maximum concentrations) and also defining a boundary that would allow for consideration of the City of Sault Ste. Marie (i.e., capture potential impacts to nearest major population centre, if applicable).

Figure 1: Study Area



AIR QUALITY, ODOUR, AND GREENHOUSE GAS IMPACT ASSESSMENT
CITY OF SAULT STE. MARIE
SOLID WASTE MANAGEMENT
SAULT STE. MARIE, ON

STUDY AREA

STUDY AREA

SCALE 1:200,000
0 1.25 2.5 5km

MAP/DRAWING INFORMATION
Aerial image from 2014 Google Earth Pro.

CREATED BY: GCC
CHECKED BY: RM
DESIGNED BY: RM

File Location:
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PROJECT: 06 6998
STATUS: DRAFT
DATE: 12/03/19

2.2 Methodology and Approach

The air quality assessment for the proposed Sault Ste. Marie Landfill Expansion was completed using the following steps:

- Definition of baseline concentrations of indicator compounds based on ambient air quality data (detailed in Section 2.4 below);
- Review of future operational scenarios (including equipment location and estimated emissions) to select a worst-case operating scenario specific to air quality (detailed in Section 2.6.1 below);
- Prediction of off-property concentrations of air quality indicator compounds (detailed in Section 2.6.4 below);
- Comparison of the predicted concentrations and baseline conditions to relevant air quality criteria (detailed in Section 2.6.4 below).

The indicator compounds selected for the air quality assessment were those of greatest significance from typical landfill operations, namely:

- Oxides of Nitrogen (NOX) and Nitrogen Dioxide (NO2)
  - Generated from combustion of fuel in mobile and stationary equipment at the landfill.
  - Air quality criteria are based on prevention of health impacts.
- Total Suspended Particulate (TSP)
  - Generated from movement of vehicles on paved roads, movement of vehicles on unpaved roads/surfaces and material handling and movement.
  - Air quality criteria are based on visibility (dust).
- Particulate Matter with aerodynamic diameter less than 10µm (PM10)
  - Generated from movement of vehicles on paved roads, movement of vehicles on unpaved roads/surfaces and material handling and movement.
  - Air quality criteria are based on prevention of health impacts.
- Particulate Matter with aerodynamic diameter less than 2.5µm (PM2.5)
  - Generated from movement of vehicles on paved roads, movement of vehicles on unpaved roads/surfaces and material handling and movement.
  - Air quality criteria are based on prevention of health impacts.
- Carbon Monoxide (CO)
  - Generated from the flare, vehicular traffic on site, and stationary combustion sources.
  - Air quality criteria are based on prevention of health impacts.
- Sulphur Dioxide (SO2)
  - Generated from fugitive landfill gas, flare, vehicular traffic on site, and stationary combustion sources.
  - Air quality criteria are based on prevention of health impacts.

- Vinyl Chloride, Chloroform, Acetone, Acrylonitrile, and Benzene
  - Generated from fugitive landfill gas and flare emissions.
  - Air quality criteria are based on prevention of health impacts.
- Hydrogen Sulphide (H2S)
  - Generated from fugitive landfill gas and flare emissions.
  - Air quality criteria are based on prevention of health impacts and odour.

2.3 Study Period

The time horizon for the air quality impact, odour, and GHG assessments include the existing conditions of the site as reflective of the most recent full calendar year (2018) and the operating life during the development of the expansion, assumed to be from 2024 to 2048 (25 years).

2.4 Existing Air Quality

In order to define existing air quality (baseline conditions), a review was performed of ambient air quality monitoring stations close to or within the Study Area. The Ministry of the Environment, Conservation and Parks (MECP) and Environment and Climate Change Canada (ECCC) National Air Pollution Surveillance (NAPS) stations were reviewed for reach indicator compound. The closest monitoring station to the study areas with a three (3) year data set was selected. A summary of the MECP and ECCC NAPS station IDs and data range available for each indicator compounds is summarized in Table 1 below.

Table 1: Indicator Compound MECP and ECCC NAPS Station ID

Indicator Compound	Station ID	Data Range
TSP	NA	NA
PM_{10}	NA	NA
$PM_{2.5}$	Sault Ste. Marie (71078)	2015-2017
Nitrogen Oxides (NO_x)	Sault Ste. Marie (71078)	2015-2017
Hydrogen Sulphide (H_2S)	NA	NA
Vinyl Chloride	NA	NA
Chloroform	NA	NA
Acetone	NA	NA
Acrylonitrile	NA	NA
Benzene	NA	NA
Carbon Monoxide (CO)	Sault Ste. Marie (71078)	2006-2008
Sulphur Dioxide (SO_2)	Sault Ste. Marie (71078)	2015-2017
Nitrogen Dioxide (NO_2)	Sault Ste. Marie (71078)	2015-2017
Odour	NA	NA

The background concentrations for the indicator compounds from the MECP and ECCC NAPS stations were estimated based on the 90th percentile of the data obtained for the monitoring stations.

Ambient monitoring data for hydrogen sulphide is not readily available for the study areas. The ECCC documents an overall average concentration, measured in urban area presumed to be away from major anthropogenic (originating from human activity) sources in Canada[2] , which was used as the background concentration for this assessment.

Ambient monitoring data for acetone and acrylonitrile are not readily available from ECCC NAPS stations. Background data is available from various ECCC NAPS stations for vinyl chloride, chloroform, and benzene, however, the background concentrations in these areas are not considered to be representative of the study area. The location of the available ECCC NAPS stations vary from the study area by:

- Industry type and prevalence;
- Differences in transportation types and volume;
- Differences in urban development; and
- Geographical variances.

It would therefore not be appropriate to use background ambient air quality data as a surrogate for data that is unavailable at the Sault Ste. Marie ECCC NAPS station. As described in Section 2.6.4.1, contributions from Site activities to the ambient air quality criteria are shown to be minimal. Therefore the Site's potential impact to cumulative air quality is expected to be minimal and the contribution to the ambient air quality is likely dominated by background concentrations.

MECP and ECCC ambient monitoring data for TSP and PM10 size fractions are not readily available for the study areas. To be consistent with using 3-years of background data where possible, the MECP station PM2.5 data was scaled to calculate TSP and PM10 background data. As PM2.5 is a size fraction subset of PM10, and PM10 is a size fraction subset of TSP, the PM10 and TSP background concentrations can be estimated based on the PM2.5 background concentration. Background concentrations of PM10 and TSP can be estimated by applying a PM2.5/PM10 ratio of 0.54 and a PM2.5/TSP ratio of 0.3 as shown below[3]:

$$PM2.5_{concentration} / 0.3 = TSP_{concentration}$$

$$PM2.5_{concentration} / 0.54 = PM10_{concentration}$$

The environment surrounding the site consists of primarily forest, aggregate operations, and light manufacturing. It is expected that the ambient odour would be characteristic of this setting. There have

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[2] ECCC. Draft Screening Assessment: Hydrogen Sulfide (H_2S), Sodium Sulfide (NA(SH)) and Sodium Sulfide (Na_2S). September 2017.

[3] Lall, R., Kendall, M., Ito, K., Thurston, G., 2004. Estimation of historical annual $PM_{2.5}$ exposures for health effects assessment. Atmospheric Environment 38(2004) 5217-5226.

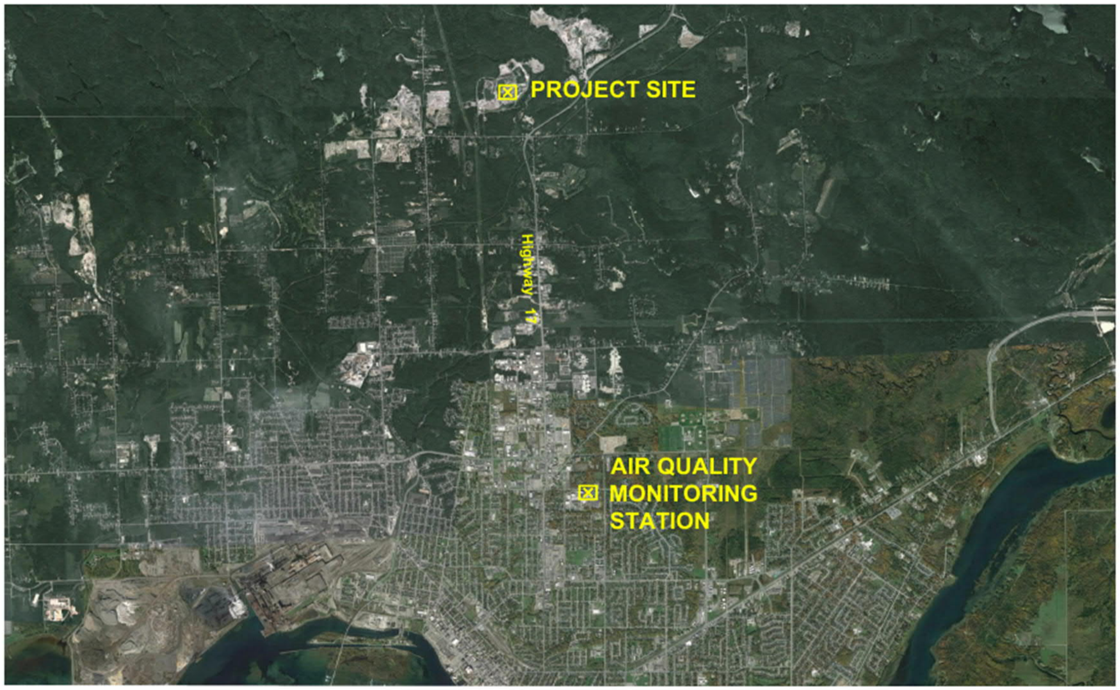
not been any odour studies performed within the study area and therefore no baseline value has been defined for odour.

The background concentrations defined for this project are shown below in the Table 2.

Table 2: Background Air Quality Concentrations of Indicator Compounds

Indicator Compound	Averaging Period	Background Concentration ($\mu g/m^3$)
TSP	24 hr.	30.6
	Annual	19.8
PM_{10}	24 hr.	17.0
$PM_{2.5}$	24 hr.	9.2
	Annual	6.0
Nitrogen Oxides	1 hr.	23.4
	24 hr.	20.0
Nitrogen Dioxide	1 hr.	18.8
	24 hr.	13.5
	Annual	9.1
Hydrogen Sulphide	10 min	1.4
	24 hr.	1.4
Carbon Monoxide	0.5 hr.	389.5
	1 hr.	389.5
	8 hr.	458.2
Sulphur Dioxide	10-min	2.6
	1 hr.	2.6
	24 hr.	5.3
	Annual	2.0

Figure 2: Air Quality Monitoring Station and Project Site



AIR QUALITY, ODOUR, AND GREENHOUSE GAS IMPACT ASSESSMENT
CITY OF SAULT STE. MARIE
SOLID WASTE MANAGEMENT
SAULT STE. MARIE, ON

AIR QUALITY MONITORING STATION AND PROJECT SITE

SCALE 1:60,000
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MAP/DRAWING INFORMATION
Aerial image from 2014 Google Earth Pro.

CREATED BY: GCC
CHECKED BY: RM
DESIGNED BY: RM

File Location:
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PROJECT: 06 6998
STATUS: DRAFT
DATE: 12/03/19

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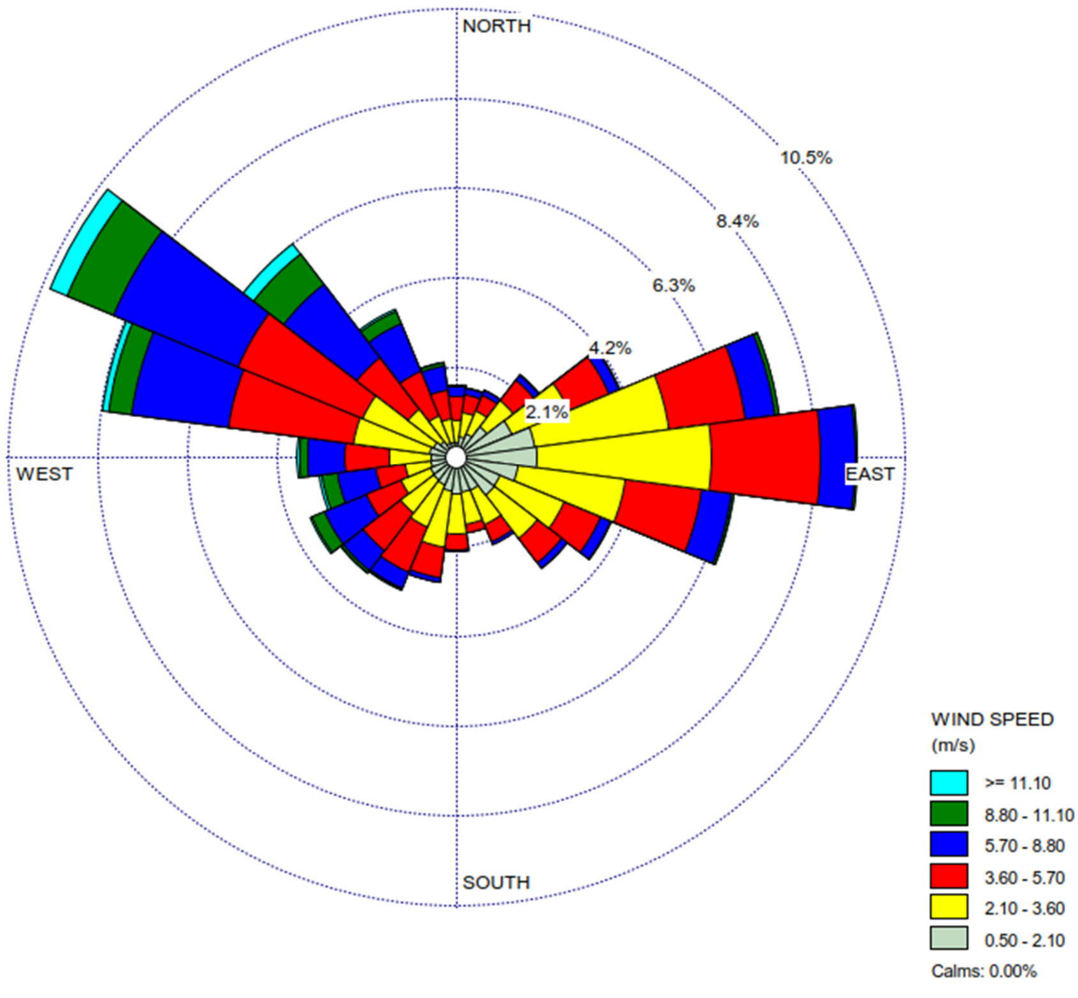
The Sault College station is located more than 6 km to the south of the project site, and more than 4 km east of the major industrial activity within the City of Sault Ste. Marie (see Figure 2). As shown in Figure 3 below, the predominant wind directions in the area of the project site are winds from the North West, East and South East. The Sault College station should therefore provide a reasonable indication of air quality in Sault Ste. Marie, without being significantly impacted by the industrial areas located in the western area of the City.

Figure 3: Wind Rose for Project Site (2014 to 2018)



2.5 Air Quality and Odour Criteria

The criteria for air quality in Ontario are established in Ontario Regulation 419/05[4] (O. Reg. 419/05) and in Ontario's Ambient Air Quality Criteria[5] (AAQC). O. Reg. 419/05 provides contaminant concentration standards and guidelines to assess impacts for permitting requirements (i.e., compliance). The AAQCs developed by the MECP are commonly used in environmental assessments, special studies using ambient air monitoring data, assessment of general air quality in a community and annual reporting on air quality across the province.

Federally, the Canadian Council of Ministers of the Environment has a set of Canadian Ambient Air Quality Standards[6] (CAAQS) that were developed to be outdoor air quality targets for air quality actions across the country.

The applicable Ontario and Canada-wide standards and criteria are provided in Table 3. The most stringent criteria, standard, or guideline for each averaging period (shown in bold in Table 3) will be used throughout the assessment.

Table 3: Ontario and Canada-Wide Standards and Criteria

Indicator Compound	Averaging Period	Criterion ($\mu g/m^3$)	Regulation/Guideline
TSP	24 hr.	120	O. Reg. 419/05, AAQC
	Annual	60	AAQC
PM_{10}	24 hr.	50	AAQC
$PM_{2.5}$	24 hr.	30	AAQC
	24 hr.	28	CAAQS
	24 hr.	27	CAAQS 2020
	annual	10	CAAQS
	annual	8.8	CAAQS 2020)
Nitrogen Oxides	1 hr.	400	O. Reg. 419/05
	24 hr.	200	O. Reg. 419/05
Nitrogen Dioxide	1 hr.	400	AAQC
	24 hr.	200	AAQC
	1 hr.	112.8	CAAQS 2020
	annual	31.96	CAAQS 2020
	1 hr.	78.96	CAAQS 2025
	annual	22.56	CAAQS 2025
Hydrogen Sulphide	24 hr.	7	O. Reg. 419/05, AAQC
	10 min	13	O. Reg. 419/05, AAQC

4 MECP. Environmental Protection Act. Ontario Regulation 419: Air Pollution – Local Air Quality. January 1, 2019.
5 MECP. Ontario's Ambient Air Quality Criteria. April 30, 2019.
6 ECCC. Canadian Ambient Air Quality Standards (CAAQS) for Fine Particulate Matter (PM2.5) and Ozone. October 2012.

Indicator Compound	Averaging Period	Criterion (µg/m³)	Regulation/Guideline
Vinyl Chloride	24 hr.	1	O. Reg. 419/05, AAQC
	annual	0.2	AAQC
Chloroform	24 hr.	1	O. Reg. 419/05, AAQC
	annual	0.2	AAQC
Acetone	24 hr.	11,800	O. Reg. 419/05, AAQC
Acrylonitrile	24 hr.	0.6	O. Reg. 419/05, AAQC
	annual	0.12	AAQC
Benzene	24 hr.	2.3	AAQC
	annual	0.45	O. Reg. 419/05, AAQC
Carbon Monoxide	0.5 hr.	6000	O. Reg. 419/05
	1 hr.	36200	AAQC
	8 hr.	15700	AAQC
Sulphur Dioxide	10 min	180	AAQC
	1 hr.	690	O. Reg. 419/05, AAQC
	1 hr.	100	O. Reg. 419/05 (Future 2023)
	24 hr.	275	O. Reg. 419/05, AAQC
	annual	10	O. Reg. 419/05 (Future 2023)
Odour	10-min	1 (OU/m³)	MECP Guideline

2.6 Air Quality and Odour Impact Assessment

The evaluation of potential effects on air quality of the project activities included the following tasks:

- Analysis of Operating Scenarios - Identification of the worst-case operating scenario for air quality;
- Emission Estimation - Estimation of emissions of indicator compounds from significant sources/activities at the landfill, including vehicles travelling into and out of the site, vehicles and equipment traveling within the site, combustion emissions from stationary and mobile equipment operating within the site, and the handling of materials within the site;
- Dispersion Modelling - Prediction of the concentrations of indicator compounds at sensitive receptors, resulting from the project emissions defined above; and
- Analysis of Potential Effects - Estimation of the cumulative concentrations of indicator compounds (based on the addition of project activities to existing conditions) and comparison of these concentrations to relevant air quality criteria.

In addition to the evaluation of environmental effects, a compliance assessment was performed to determine whether the site would be anticipated to operate in compliance under O. Reg. 419/05. Background air quality is not considered in a compliance assessment under O. Reg. 419/05.

Each of these tasks is elaborated on in the following sections.

2.6.1 Analysis of Operating Scenarios

On-site operations will vary throughout the lifecycle of the landfill. Different operational scenarios were assessed to determine the worst-case potential impact to air quality and odour for the landfill expansion.

2.6.1.1 On-Site Activity Worst-Case Operating Scenarios

Eight (8) future operational scenarios representing different stages of landfill operations were considered as part of the air quality impact assessment. These scenarios include the development of the first three (3) cells as the landfill activity will be at its highest during this time. During this development period activities such as: landfill mining, landfill base preparation (construction), and general landfill operations will occur. It is assumed that the development of cells 4-7 will have less overall vehicle activity and travel distances and were not considered to be a worst-case operations with regards to air quality impact. A brief description of the scenarios is provided in Table 4:

Table 4: SSM Landfill Operational Scenarios

Scenario Number	Anticipated Timeframe	Main Project Activities
1	2024	Cell 1 construction and existing landfill operations
2	2025 - 2026	Cell 1 operation and mining operations on Cell 1A
3	2027	Cell 1operation and Cell 1A construction
4	2027 - 2031	Cell 1A operation
5	2032	Cell 1A operation and Cell 2 construction
6	2033	Cell 2 operation and Cell 3 construction
7	2034 - 2037	Cell 3 operation
8	2038	Cell 3 operation and Cell 4 construction

For all the scenarios, normal landfill activities are expected to be in operation (i.e., disposal of waste at the active area). In general, the scenarios can be divided into three main categories:

- Cell construction with normal landfill operations (Scenarios 1, 3, 5, 6, 8);
- Waste mining (with normal landfill operations) (Scenario 2); and
- Normal landfill operations (Scenarios 4, 7).

The vehicles and equipment associated with normal landfill operations would be the same for all scenarios, however, the vehicles and equipment required for cell construction and waste mining would vary.

In order to determine which scenario represents the worst-case operating scenario in terms of potential for air quality effects, a screening level assessment was completed. This screening assessment considered vehicle and equipment activities at the site, as well as vehicle and equipment travel distances (unpaved roads). Vehicle activity on paved roads was not considered as part of the screening assessment, as it is considered to be the same for each scenario.

Based on the screening assessment, Scenarios 1 and 2 were determined to have the greatest potential to impact air quality. Scenarios 1, 3, 5, 6, and 8 all include cell construction activities, however, Scenario 1 represents the longest travel path for cell construction vehicles. Scenario 2 is the only scenario representative of waste mining. Scenarios 4 and 7 are representative of normal landfill operations.

Since the cell construction and waste mining activities would contribute to emissions in addition to those during normal landfill operations, the normal landfill operation Scenarios were not considered to be significant in terms of impacts.

Emissions from Scenario 2 are expected to represent the worst-case scenario, as the travel paths associated with the active waste disposal area (working face) are the greatest, waste mining activities add to emissions from mobile and stationary combustion sources, and emission sources associated with waste mining activities are located southwest of the existing waste cells, closer to the property line and receptors. This scenario was therefore used to assess the potential air quality impacts of the proposed landfill expansion.

A detailed calculation summary for the worst-case scenario is provided in Appendix A.

2.6.1.2 Landfill Gas and Odour Generation Worst-Case Operating Scenarios

The worst-case year of landfill gas generation for the Site occurs the first year after closure (2049). The landfill gas generation from this year was used to determine the potential impact on local air quality from landfill gas compounds and odour emitted from the Site.

Odour will be fugitively emitted across the landfill footprint, however, concentrated odour emissions have been observed at landfills from agitation at the active working face. Odour generated from the active working face has been included in this assessment at four (4) worst-case locations. The worst-case odour locations were estimated to be areas of the landfill footprint in closest proximity to discrete receptors in every direction surrounding the Site. Odour emissions from the active working face were estimated at Cell 1 (during operating Scenario 2), Cell 1A, Cell 6, and Cell 7.

Total odour emissions from the site were conservatively estimated using the worst-case potential landfill gas generation year and worst-case location of the active working face.

Landfill mining will occur during the worst-case air quality effects operating Scenario 2. Odour emissions from landfill mining cannot be quantified without site-specific measurements (which are not possible to obtain unless the activity is undertaken). Therefore, odour will be assessed from the landfill footprint and working face only. Landfill mining can be considered qualitatively as a compounding odour source which will be mitigated at the Site using techniques outlined in Section 3.0.

A detailed calculation summary for the worst-case scenario is provided in Appendix A.

2.6.2 Emission Rate Estimation

The emissions were developed for the operating Scenario 2 and worst-case landfill gas generation year using industry accepted methodologies.

2.6.2.1 Landfill Gas and flare Emission Estimates

Landfill gas emissions from the landfill footprint were estimated using the historic and projected waste receipts at the Site as provided in Appendix A, Table A.1 and the US EPA LandGEM model. The US EPA LandGEM model results are presented in Appendix A, Table A.2 for the worst-case emission year (2049) over the lifespan of the landfill.

Emissions from the landfill gas flare was estimated based on US EPA LandGEM models, flare specifications, and US EPA emission factors[7]. The emission estimates from the landfill gas flare is provided in Appendix A, Table A.3.

Combustion by-products (NOx, CO, TSP, PM10, and PM2.5) emissions were calculated in the following manner:

$$ER = EF \times LG_{Flow} \times MC$$

where:

ER = Emission Rate (g/s)

EF = Emission Factor ($kg/10^6 dscm_{CH4}$)

LG_{Flow} = Landfill Gas Flare Flow (m3/s)

MC = Methane Content (%)

Emissions of SO_2 were calculated in the following manner:

$$ER = CM_p / (\text{Flare Hours})$$

[7] US EPA. AP-42 Chapter 2.4 "Municipal Solid Waste Landfills. Draft Section. October 2008.

where:

ER = Emission Rate (g/s)

CM_p = Controlled mass emissions of pollutant (kg/year)

Flare Hours = Hours of flaring per year (hours)

$$CM_p = UM_s \times n_{col} / 100 \times 2$$

where:

CM_p = Controlled mass emissions of SO_2 (kg/yr.)

UM_s = Uncontrolled emissions of reduced sulfur compounds as sulfur (kg/yr.)

n_{col} = Efficiency of the landfill gas collection system (%)

2 = Ratio of the molecular weight of SO_2 to the molecular weight of S

Landfill gas indicator compounds (H2S, vinyl chloride, and chloroform) were calculated in the following manner:

$$ER = LFG_{gen} \times LFG_{eff} \times (1\text{-}DE) / (\text{Flare Hours})$$

where:

ER = Emission Rate (g/s)

LFG_{gen} = Landfill gas generated (kg/yr.)

LFG_{eff} = Landfill gas collection efficiency (%)

DE = Destruction Efficiency (%)

Flare Hours = Hours of flaring per year (hours)

Odour emissions from the landfill footprint were estimated using an MECP screening-level emission factor as a function of landfill gas generation[8] . Odour emissions from the working face were based on previous field testing and analytical work conducted by RWDI at several landfill sites and other facilities in Southern Ontario[9].

The emission estimates from the fugitive release of landfill gas from the landfill footprint and odour emissions from the active working face are provided in Appendix A, Table A.4.

[8] MECP. Interim Guide to Estimate and Assess Landfill Air Impacts. October 1992.

[9] Rowan, Williams, Davies and Irwin Inc. (RWDI). 1996. BFI Ridge Landfill Expansion EA, Impact Assessment, Appendix M.

2.6.2.2 Vehicle and On-Site Equipment Activity

The vehicle activity that will be operating as part of Scenario 2 is summarized in Appendix A, Table A.5. The on-site equipment activity that will be operating as part of Scenario 2 is summarized in Appendix A, Table A.6.

Emission rates associated with peak vehicles in operations will differ between 1-hr and 24-hr averaging periods. The emission rate estimates for 1-hr averaging periods use the peak number of vehicles that can be operating in any given hour during the day (worst case). The emission rate estimates for a 24-hr averaging period use the maximum number of vehicles that can operate in 24 hours.

Other considerations/estimates that were accounted for in emission calculations include:

- Composting operations are expected to occur primarily during the spring and fall months and waste mining operations primarily during the summer months, the worst-case emission scenario for the purposes of this assessment consists of the peak (i.e., period of greatest activity) composting and waste mining operations occurring at the same time as the landfill. Although each operation may occur during the same periods of the year at lower levels of activity, the peak of each operation is not expected to occur simultaneously.
- Landfill and waste mining operations will occur year-round and composting operations will not occur in winter.
- Engine sizes, empty/loaded weights and dimensions were assumed based on available information.
- Ancillary equipment (e.g., vacuum, water truck) were assumed to be insignificant contributors to the site emissions.

2.6.2.3 Road Dust Emissions

The emissions for paved and unpaved roads were estimated based on US EPA emission factors[10,11] and on-site vehicle activity along the haul route. For this assessment, vehicles traveling on paved roads included waste trucks, mining trucks, yard waste vehicles, and public vehicles.

Particulate emission rates from the re-suspension of road dust on paved roads were estimated using the following equation.

$$EF_{paved} = k \times (sL)^{0.91} \times (W)^{1.02}$$

[10] US EPA. AP-42 Chapter 13.2.1 "Paved Roads". Final Section. January 2011.

[11] US EPA. AP-42 Chapter 13.2.2 "Unpaved Roads". Final Section. November 2006.

where:

EF_{paved} = particulate emission factor (matching units of k)
k = particle size multiplier for particle size range of interest (g/VKT)
sL = road surface silt loading (g/m2)
W = average weight of the vehicles traveling the road (tons)

For the purposes of this assessment, sL was assumed to be 7.4%, representative of municipal landfills (from the AP-42 guidance document). In addition, the average weight of each vehicle type traveling on paved roads was determined based on a detailed assessment of 2013 daily weigh scale data.

Vehicles traveling on unpaved roads included waste trucks, the compactor, the bulldozer, the rock truck, etc. Particulate emission rates from the re-suspension of road dust on unpaved roads were estimated using following equation.

$$EF_{unpaved} = k \times (s/12)^a \times (W/3)^b$$

where:

$EF_{unpaved}$ = particulate emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)
k, a and b = empirical constants (unitless)

For the purposes of this assessment, s was assumed to be 6.4%, representative of municipal landfills[12]. In addition, the average weight of waste trucks traveling on unpaved roads was determined based on a detailed assessment of 2013 daily weigh scale data.

Travel distances for each vehicle were determined based on measurement of travel pathways (for vehicles that travel across the site) and/or estimated distances based on an average travel speeds and runtimes (for equipment that moves within a defined work area). The emission estimates from paved and unpaved road dust generation are provided in Appendix A, Table A.7.

2.6.2.4 Combustion Emissions – On-Road Vehicles

Onroad vehicles consist of traffic generated from waste trucks, mining trucks, yard waste vehicles, and public waste vehicles. Onroad vehicle emissions were estimated using the US EPA Motor Vehicle Emission Simulator (MOVES) model. MOVES was used to estimate an emission rate per unit distance for tailpipe emissions from the typical on-road vehicles expected at the site. A summary of the major inputs for the MOVES model is provided in Table 5 below.

[12] US EPA. AP-42 Chapter 13.2.2 "Unpaved Roads". Final Section. November 2006.

Table 5: MOVES Input Parameters

Parameter	Input
Scale/Geographic Bounds	County Domain – Chippewa County, Michigan
Meteorology	Default fuel inputs for temperature and relative humidity from Chippewa County, Michigan were used to represent Sault Ste. Marie.
Fuels	Default fuel inputs for diesel fuels from Chippewa County, Michigan were used to represent Sault Ste. Marie.
Source Use Types	Refuse truck and light passenger truck
Road Type	Rural unrestricted access
Contaminants	NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$. TSP cannot be directly modelled in MOVES. It was estimated that all tailpipe emissions were PM_{10} or less, therefore, the PM_{10} emissions were used for TSP.
Vehicle Age Distribution	Vehicle age was based on US EPA's default distribution[13].

The emission factors generated from the MOVES model are provided in Appendix A, Table A.8.

The onroad vehicle emissions are estimated for each indicator compound using the MOVES generated emission factor equation used as part of the calculation is presented below.

$$ER_{on\text{-}road} = MOVES_{EF} \times \text{Travel Distance}$$

where:

$MOVES_{EF}$ = mobile emission factor

Travel Distance = round-trip distance travelled (miles)

The estimated emission rates for onroad vehicles are provided in Appendix A, Table A.9.

2.6.2.5 Combustion Emissions – Nonroad Vehicles

Nonroad vehicle emissions were estimated using the US EPA nonroad engine emission factors[14] and the hours of operation.

The nonroad vehicles at the Landfill are expected to include: the articulating truck, dump truck, tractor, compactor, bulldozers, front end loader, excavator, trammel screeners, tub grinders, and other equipment that primarily operated on-site.

[13] US EPA. Population and Activity of On-road Vehicles in MOVES2014. Draft Report. EPA-420-D-15-001. July 2015.

[14] US EPA. "Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression-Ignition NR-009d". July 2010.

Based on the proposed timing of Scenario 2 (2025-2026), it was assumed that all non-road equipment would meet the US EPA Tier 3 emission standards (phased in 2006); therefore, Tier 3 emission factors were applied.

The equations used as part of the nonroad equipment emission factor calculations are presented below.

$$EF_{non\text{-}road\ (NOx,\ SO2,\ CO,\ CO2,)} = EF_{ss} \times TAF \times DF$$

where:

EF = final emission factor used in model, after adjustments to account for transient operation and deterioration (g/hp.hr)

EF_{ss} = zero-hour, steady-state emission factor (g/hp/hr)

TAF = transient adjustment factor (unitless)

DF = deterioration factor (unitless)

$$EF_{non\text{-}road\ (PM)\ =\ EFss\ x\ TAF\ x\ DF\ -\ SPMadj}$$

where:

S_{PMadj} = adjustment to PM emission factor to account for variations in fuel sulphur content (g/hp.hr)

A summary of the calculated nonroad emission factors are provided in Appendix A, Table A.10.
Based on the previous assessment it is estimated that nonroad mobile combustion equipment at the Landfill operate at full load for 50% of the time, and 10% load (idle) for 50% of the time. The nonroad emission estimate were calculated as follows:

$$ER_{stationary} = ESTier3 \times \text{Engine Power Rating}$$

where:

ES_{Tier3} = emission standard based on Tier 3 timing (g/kW.hr)

Engine Power Rating = power capacity of the diesel engine (kW)

A summary of the nonroad emission estimates are provided in Appendix A, Table A.11.

2.6.2.6 Material Handling Emissions

The emissions from material transfers at the working face and storage piles were estimated based on average hourly transfer rates and US EPA emission factors[15] . It is estimated that the rock truck would deliver cover soil to the working face once per hour.

The particulate emission rate associated with the dumping of cover soil was estimated using following equation.

$$EF_{soil\ cover} = \frac{k \times 0.0016 \times (U/2.2)^{1.3}}{(M/2)^{1.4}}$$

where:

$EF_{soil\ cove}r$ = particulate emission factor (kg/Mg)

K = particle size multiplier for particle size range of interest (unitless)

U = mean wind speed (m/s)

M = material moisture content (%)

The average wind speed was obtained from Sault Ste. Marie surface meteorological data processed by the MECP for the period of 2014 – 2018. The material moisture content was take to be 7.4%, representative of the sandy soil used at the landfills[16] .

A summary of the material handling emission estimates are provided in Appendix A, Table A.12.

2.6.2.7 Material Storage Emissions

Potential emissions from wind erosion of exposed surfaces at the Landfill were estimated using US EPA methodologies and emission factors[17] . It was determined that wind erosion events have the potential to occur 133 hours (0.30%) during 64 days (3.51%) over a 5-year meteorological dataset. The rare wind erosion events do not account for the mitigating effects of precipitation and snow cover.

A summary of hours with erosion potential over a 5-year meteorological dataset is provided in Appendix A, Table A.13.

A summary of the average estimated emission rate for days with erosion potential over a 5-year meteorological dataset is provided in Appendix A, Table A.14.

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[15] US EPA. AP-42 Chapter 13.2.4 "Aggregate Handling and Storage Piles". Final Section. November 2006.

[16] US EPA. AP-42 Chapter 13.2.4 "Aggregate Handling and Storage Piles". Final Section. November 2006.

[17] US EPA. AP-42 Chapter 13.2.5 "Industrial Wind Erosion". Final Section. November 2006.

The following calculations were completed for each hour of the meteorological data set:

u_{10}= u x 1.5

where:

u_{10} = fastest mile wind speed (m/s)
u = hourly wind speed data (m/s)
1.5 = conversion to fastest mile

u* = 0.053 x u10

where:

u* = friction velocity (m/s)

$P = 58 \times (u^* - ut^*)^2 / 25 \times (u^* - ut^*)$

where:

P = Erosion Potential
ut^* = threshold friction velocity of overburden (m/s)
$EF_{TSP} = k_{TSP} \times P$

where:

EF_{TSP} = Emission factor (g/m2)
k_{TSP} = particle size multiplier

2.6.2.8 Assumptions

The air quality effects assessment is based on the assumptions summarized in Table 6.

Table 6: Assumptions Used within the Air Quality Effects Assessment

Assumption	Rationale
Nonroad mobile and stationary combustion equipment will be in compliance with U.S. EPA Tier 3 emission standards.	• Based on the timeframe of operating Scenario 2 (2025 – 2026), it is expected that the majority of nonroad equipment will comply with Tier 3 emissions standards.
Nonroad equipment engines will not operate at 100% load all the time.	• It is expected that during a typical hour of operation, nonroad equipment engines will operate at 100% half the time, and a reduced load (10%) the remainder of the time.

Assumption	Rationale
Particulate emissions from the storage and handling of waste were assumed to be negligible.	• Based on the moisture content of typical waste materials (expected to be 20-25% for landfilled waste and 35-65% for mined waste), the handling of waste materials (associated with landfill operations and waste mining) are not expected to generate significant levels of particulate. It is generally accepted that materials with a moisture content of 12% or greater have a low potential for dust (particulate matter) generation.
Dust control is provided as part of the fugitive dust management plan for the site.	• A fugitive dust management plan will be in-place at the site to control dust emissions from landfill activities. It is assumed that this plan would also carry over to waste mining activities.

2.6.3 Dispersion Modelling

This section provides a description of how the dispersion modelling was conducted at the facility to calculate the maximum concentration at a point-of-impingement (POI).

The dispersion modelling was conducted in accordance with MECP Guidelines (the ADMGO)[18] . A general description of the input data used in the dispersion model is provided below and summarized in Table 7.

As the site emits odours, the modelled impact of emissions was assessed at discrete receptor locations for a 10-minute averaging period. The US EPA's AERMOD air dispersion model was used to determine POI concentrations.

The AERMOD modelling system has been identified by the MECP as one of the approved dispersion models under O.Reg. 419/05. The use of a more refined model, such as AERMOD, is necessary when assessing air quality against Schedule 3 Standards. The AERMOD modelling system is made up of the AERMOD dispersion model, the AERMET meteorological pre-processor and the AERMAP terrain pre-processor. AERMOD version 16216r was used for this application.

The emission rates used in the dispersion model meet the requirements of s.11(1)1 of O. Reg. 419/05, which requires that the emission rate used in the dispersion model is at least as high as the maximum emission rate that the source of contaminant is reasonably capable of for the relevant contaminant.

[18] MECP. Air Dispersion Modelling Guideline for Ontario (ADMGO). February 2017.

2.6.3.1 Source Parameterization

The following provides a detailed breakdown of source configurations used as inputs to the dispersion model. Fugitive sources of emissions such as: construction activities, cell excavation, active working face operations, and landfill mining were modelled as volume sources. Emissions associated with roadways, both paved and unpaved were modelled as line volume sources. Emissions associated with the landfill footprints were modelled as area sources. The landfill gas flare stack and individual stationary nonroad equipment were modelled as an individual point sources.

The sources at the landfill that fit the physical parameters associated with a well-mixed plume provided by a volume source include areas with material transfer and non-road vehicle movement. The volume source dimensions have been estimated based on satellite imagery of existing working areas and release heights of equipment operating within the volume source.

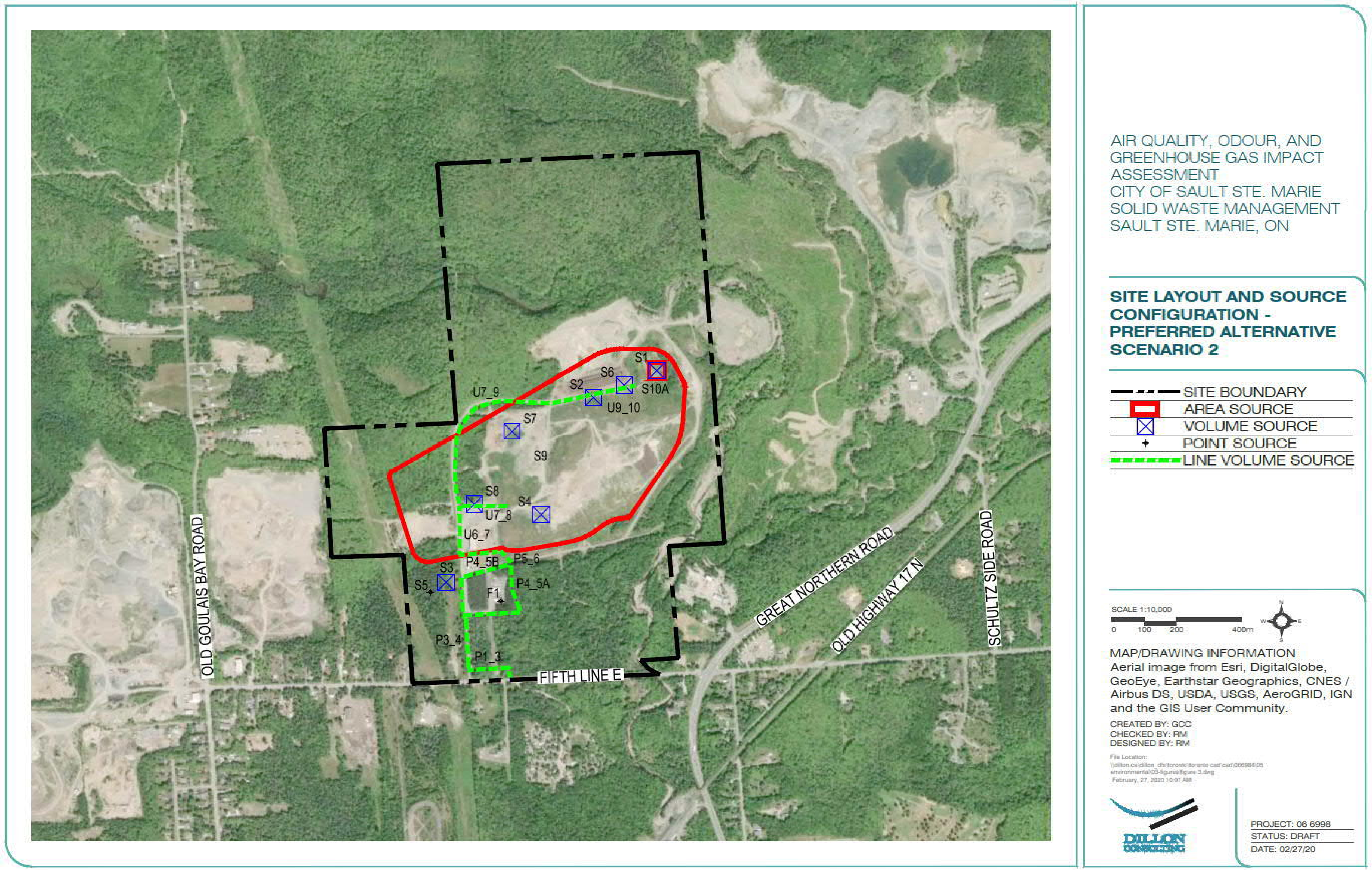
The ADMGO recommends that roadways be modelled using a line volume source which is represented by a series of separated volume sources. The MECP recognizes the limitations of this modelling approach (inability to appropriately simulate the turbulence and added dispersion that occurs in the wake of vehicular traffic) and understands the potential for the model to produce overly conservative results. The paved and unpaved roadway volume sources were defined based on the average height of a refuse truck (4.0 m) and on-site haul road width (10 m) to calculate the volume sources initial plume height and width.

Fugitive emissions from the landfill footprint and active working face are best represented by area sources which are used to model low level or ground releases from flat surfaces. The landfill footprint and the active working face were modelled as a separate area source. The release elevation of the emissions of these sources were conservatively estimated as half of the final landfill height.

The source layout and configuration for the preferred alternative scenario 2 are displayed on Figure 4. The source layout and configuration for the assessment of odour are displayed on Figure 5.

A source summary table is provided in Appendix B, Table B.1.

Figure 4: Site Layout and Source Configuration for the Preferred Alternative Scenario 2



Note: The air assessment was completed based on the landfill property boundaries prevailing at the time of the DRAFT EA submission. This assessment identified that the proposed expansion will be compliant from an air perspective. With the purchase of additional properties since the DRAFT EA submission the concentrations of contaminants at site boundaries may be reduced relative to reported values at locations where buffer lands have been enhanced.

Figure 5: Site Layout and Source Configuration for Odour Sources

Note: The air assessment was completed based on the landfill property boundaries prevailing at the time of the DRAFT EA submission. This assessment identified that the proposed expansion will be compliant from an air perspective. With the purchase of additional properties since the DRAFT EA submission the concentrations of contaminants at site boundaries may be reduced relative to reported values at locations where buffer lands have been enhanced.

2.6.3.2 Coordinate System

The coordinate system used within the modelling was the Universal Transverse Mercator (UTM) projection, as per Section 5.2.2 of the ADMGO. The Datum of the UTM projection was North American Datum of 1983 (NAD83).

2.6.3.3 Meteorology

Sub-paragraph 10 of s.26(1) of O. Reg. 419/05 requires a description of the local land use conditions if meteorological data described in paragraph 2 of s.13(1) of O. Reg. 419/05 was used. The dispersion model required a frequency assessment at discrete receptors and therefore pre-processed local meteorological data from the Sault Ste. Marie Airport monitoring station was provided by the Air Modelling and Emissions Unit of the MECP.

2.6.3.4 Terrain Data

Terrain data was incorporated into the model using MECP provided digital elevation data (MECP, 2015). The following DEM Tiles were used in the dispersion model for UTM Zone 17:

- 0215_2.DEM
- 0215_3.DEM
- 0215_4.DEM
- 0216_2.DEM
- 0216_3.DEM
- 0216_4.DEM
- 0217_2.DEM
- 0217_3.DEM
- 0217_4.DEM

2.6.3.5 Receptors

Environmental Effects Discrete Receptors

Receptors were chosen to determine the impact of environmental effects from a grid of discrete receptors identified using satellite imagery and local knowledge. The discrete receptors for the study area were residences and businesses located in the vicinity of the landfill.

Figure 6 presents the discrete receptors for the study area.

Compliance Assessment MECP Receptor Grid

Receptors were chosen based on recommendations provided in Section 7.1 of the ADMGO, which is in accordance with s.14 of O. Reg. 419/05. As the areas of highest impact from site operations are anticipated close to or at the property line, a 5 km multi-tier grid was decided to be appropriate for the modelling that was conducted. Although the off-site study area extends 10 km to the centre of the site, the results of the assessment confirmed that the highest area of impact were localized near the site, and therefore confirmed the appropriateness of a 5 km receptor grid. Specifically, a nested receptor grid, centered around the buildings at the site, were placed as follows:

a) 20 m spacing, within an area of 200 m by 200 m;
b) 50 m spacing, within an area surrounding the area described in (a) with a boundary at 500 m by 500 m outside of the boundary described in (a);
c) 100 m spacing, within an area surrounding the area described in (b) with a boundary at 1,000 m by 1,000 m outside of the boundary described in (a);
d) 200 m spacing, within an area surrounding the area described in (c) with a boundary at 2,000 m by 2,000 m outside of the boundary described in (a); and
e) 500 m spacing, within an area surrounding the area described in (d) with a boundary at 5,000 m by 5,000 m outside of the boundary described in (a).

In addition to using the nested receptor grid, receptors were also placed every 10 m along the property line.

The highest predicted impacts occur at or near the property line and therefore the 5,000 m coverage provided within the model captures the worst-case impacts.

There is no child care facility, health care facility, senior's residence, or long-term care facility located at the site. Therefore, same-structure contamination was not assessed.

Figure7 presents the MECP grid of receptors for the study area.

Figure 6: Environmental Effects Discrete Receptors

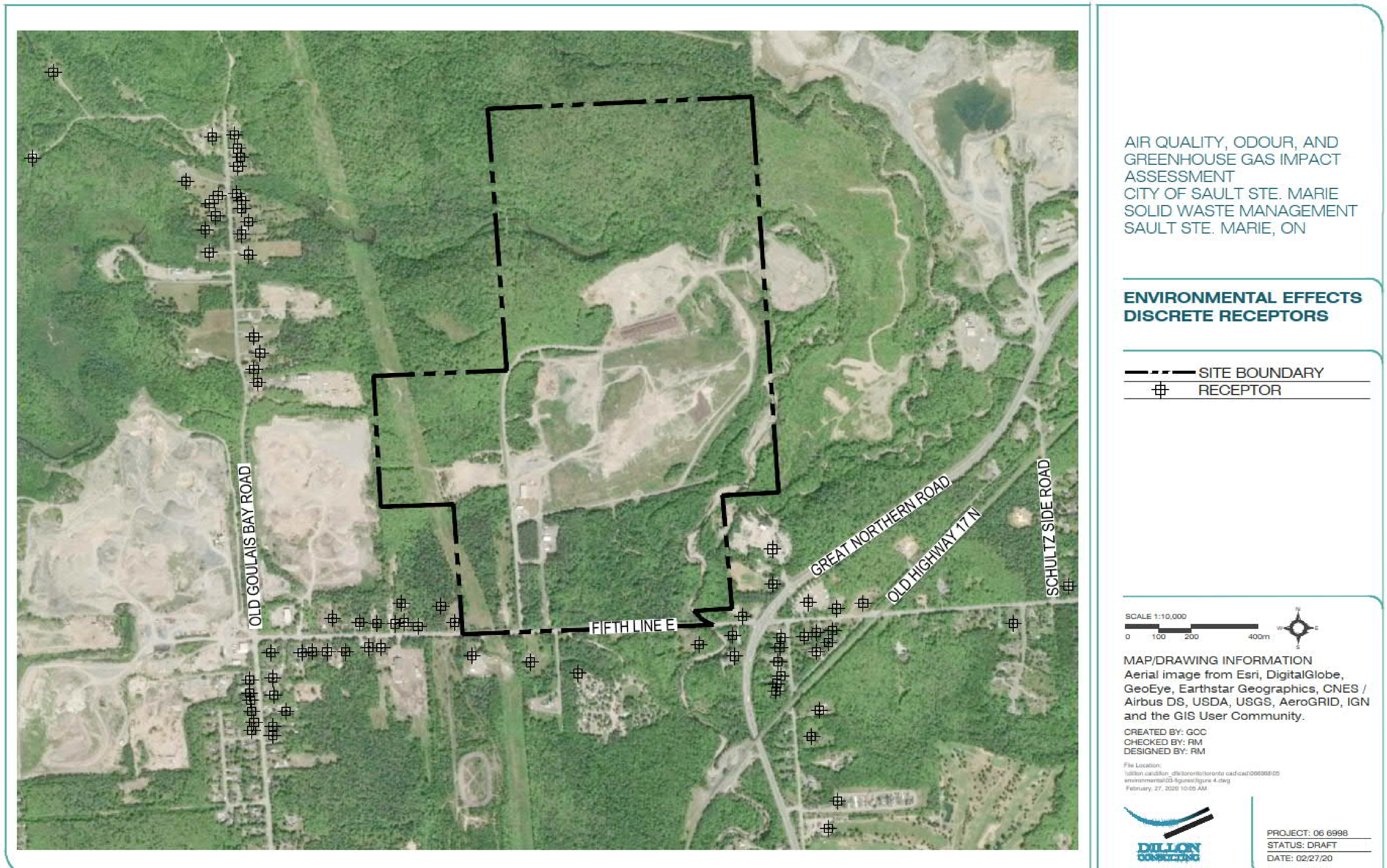
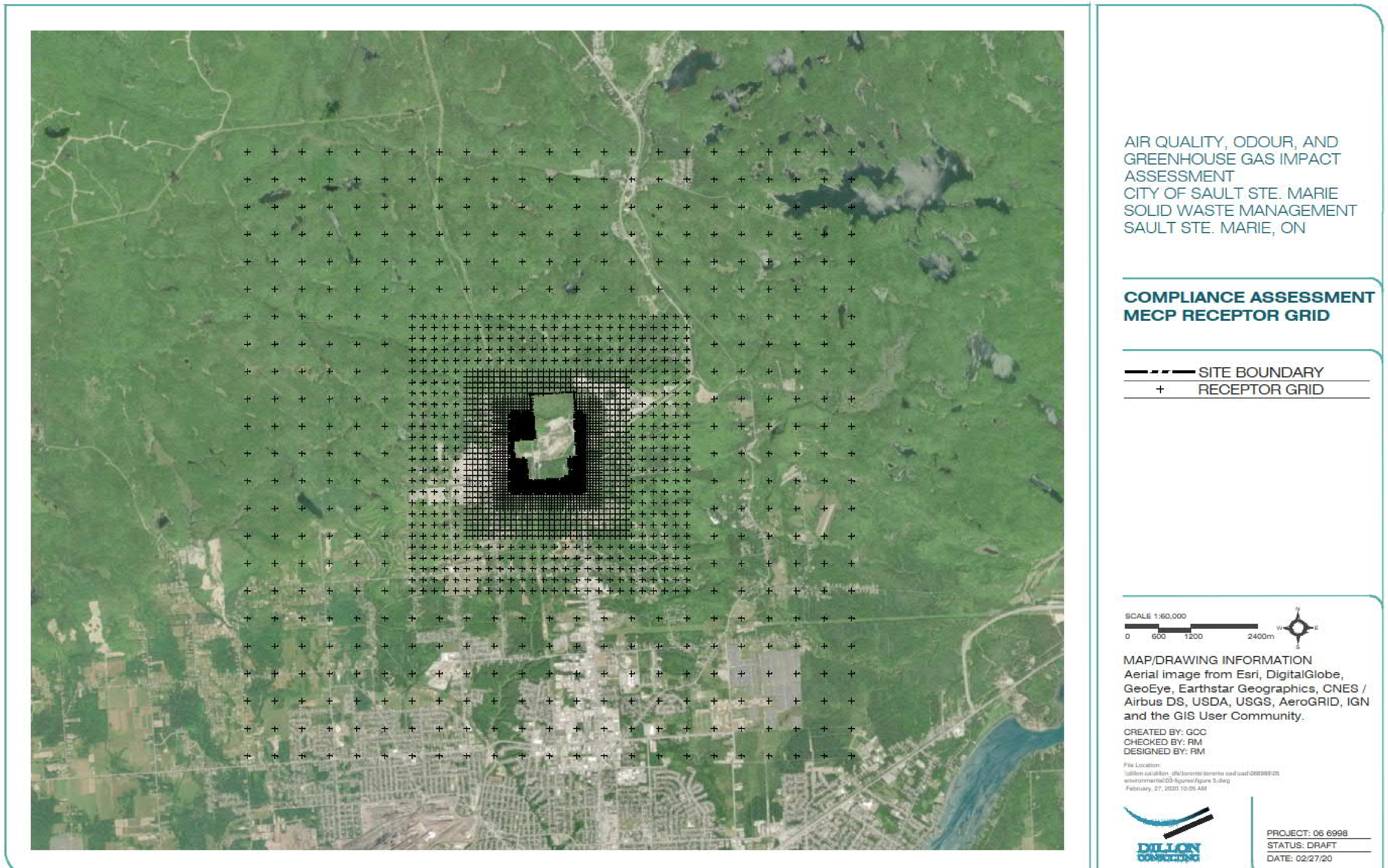


Figure 7: Compliance Assessment MECP Receptor Grid



2.6.3.6 Building Downwash

Building wake effects are calculated by AERMOD for point sources using the US EPA's Building Profile Input Program (BPIP-PRIME), another pre-processor to AERMOD. The inputs into this processor include the coordinates and heights of each tier of the buildings and point sources. The point sources modeled within the assessment are not associated with any on-site buildings/structures that could affect dispersion characteristics. Therefore building profiles generated from the BPIP pre-processor were not input to AERMOD.

2.6.3.7 Deposition

AERMOD has the algorithms to account for wet and dry depositions of substances that would reduce ground level concentrations at POI. However, the deposition algorithms were not activated for this assessment which assumes that no particulates will be removed from the plume and therefore adds to the conservatism of the assessment presented herein.

2.6.3.8 Averaging time and Conversions

The shortest time scale that AERMOD predicts is a 1-hr average value. 10-minute odour concentrations were determined by using an "x1.65" scaling factor applied to the modelled 1-hour concentrations. The x1.65 scaling factor was implemented directly within the AERMOD modelling system. The x1.65 scaling factor represents the MECP recommended conversion factors as per the MECP's ESDM procedure document[19].

2.6.3.9 NOx to NO_2 Conversion Methods

AERMOD has a three tiered approach to converting NO_X concentrations to NO_2 for use in predicting potential impact to the nitrogen dioxide ambient air criteria.

For the comparison of potential NO_2 concentrations to the AAQC, a tier 1 (full conversion) approach was taken. This approach conservatively estimates that all of the NO_X emitted from site operations are expressed as NO_2.

To appropriately compare the predicted NO_X concentrations against the aspirational CAAQS, the NO_X concentrations were converted to NO_2 using the tier 3 ozone limited method (OLM).

[19] MECP. Procedure for Preparing an Emission Summary and Dispersion Modelling Report. March 2018.

The NO_X emitted from sources at the landfill are typically 10% NO_2[20 21] and the remaining 90% is NO_X (in the form of nitric oxide [NO]) with the potential to be oxidized by ambient ozone (O_3) to the form NO_2. If the background O_3 concentration is greater than the amount of NO_X, a full conversion to NO_2 is assumed. If the NO_X concentration is greater than the background O_3, the formation of NO_2 will be limited by the background O_3 concentration.

The 1-hr NO_2 model used the most recent 3-years of available background ozone data to determine the average hourly concentrations for each hour of the day, each day of the week, and each month of the year. The annual NO_2 model used the average annual ozone concentration from the 3-years of available background ozone data.

The 1-hr NO_2 modelled results for each receptor were post processed to obtain the 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations for comparison against the 1-hr NO_2 CAAQS.

2.6.3.10 Dispersion Modelling Options and Inputs

The regulatory default options for AERMOD were used for this assessment. Selected key options used within the modelling are summarized in Table 7.

Table 7: Summary of AERMOD Options

Modelling Parameter	Description	Used in the Assessment?
DFAULT	Specifies the regulatory default options will be used	Yes
CONC	Specifies that concentration values will be calculated	Yes
NODRYDPLT	Specifies that no dry deposition will be calculated	Dry deposition was not considered.
NOWETDPLT	Specifies that no wet deposition will be calculated	Wet deposition was not considered.
FLAT	Specifies that the non-default option of assuming flat terrain will be used	No – elevated terrain used
NOSTD	Specifies that the non-default option of no-stack tip downwash will be used	No
AVERTIME	Averaging periods used	1-hour, 24-hour, and annual

[20] Esplin, Gordon. Reduction of Nonroad Diesel Emissions in the Lower Fraser Valley and the rest of BC. Genisis Engineering Inc. Pg. 11. November 2005.
[21] Dallmann TR, Demartini SJ, Kirchstetter TW, Herndon SC, Onasch TB, Wood EC, et al. 2012 On-road measurement of gas and particle phase pollutant emission factors for individual heavy-duty diesel trucks. Environmental Science and Technology. 46, 15, 8511-8518. July 2012.

Modelling Parameter	Description	Used in the Assessment?
URBANOPT	Specifies that the urban dispersion coefficients will be used	No
URBANROUGHNESS	Specifies the urban roughness (m) if URBANOPT is used	Default
FLAGPOLE	Specifies that receptor heights above local ground level are allowed on the receptors	Yes

2.6.4 Predicted Air Quality

Predicted concentrations for each indicator compound were generated based on the estimated emission rates and the modeling that was conducted.

2.6.4.1 Environmental Effects Predicted Air Quality

The predicted air quality for the worst-case operational scenario 2 and worst-case landfill gas generation year is summarized in Table 8 below. The predicted POI concentrations from the dispersion model have been added to the background concentrations to determine the cumulative air quality.

The cumulative air quality for each indicator compound was compared against the most stringent applicable air quality criteria. The predicted concentrations for all contaminants are below their respective O.Reg. 419/05 and AAQC criteria.

The predicted concentrations for all contaminants are below their respective CAAQS aspirational air quality objectives with the exception of the 1-hr NO2 comparison to the 2025 CAAQS.

The background air quality for 1-hr NO2 was estimated at 18.8 µg/m3, which is 23.8% of the 2025 CAAQS. The cumulative air quality predictions for 1-hr NO2 are higher than the 2025 CAAQS at 28 receptors as summarized in Table 9.

The predicted cumulative levels of NO2 for the environmental effects assessment are not considered to be significant due to the infrequency of occurrence. Table 10 provides a comparison of the frequency that receptors with 1-hr NO2 cumulative concentrations higher than the 2025 CAAQS. The CAAQS are stringent aspirational drivers for air quality management across Canada that are intended to be used as objectives and not as criteria.

Outlined in Table 8 below the resulting ambient air quality maximum value for each contaminate was calculated based on adding each contaminant's modelled maximum POI concentration to their respective background ambient air concentration.

As indicated in Section 2.4, representative background data was not available for select VOC species (vinyl chloride, chloroform, acetone, acrylonitrile, and benzene). However, contributions from Site activities to the ambient air quality criteria are shown to be minimal. The highest percent contribution to applicable criteria for the selected VOC species is acrylonitrile (O. Reg. 419/05, AAQC 24 hour averaging period) at 2.4% of the applicable criteria. Therefore the Site's potential impact to cumulative air quality is expected to be minimal and the contribution to the ambient air quality is likely dominated by background concentrations.

Table 8: Summary of Predicted Cumulative Air Quality

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Averaging Periods [hrs.]	Maximum POI Concentration [ug/m³][(1)]	Background Concentration [ug/m³]	Resulting Ambient Air Quality [ug/m³]	Most Stringent POI Criteria [ug/m³]	Criteria	Percent of Criteria [%]
Nitrogen oxides	10102-44-0	2.59E+00	1	177.4	23.4	200.8	400	O. Reg. 419/05	50.2%
Nitrogen oxides	10102-44-0	9.33E-01	24	11.8	20.0	31.8	200	O. Reg. 419/05	15.9%
Nitrogen dioxide	10102-44-0	2.59E+00	1	177.4[(2)]	18.8	196.2	400	AAQC	49.1%
Nitrogen dioxide	10102-44-0	2.59E+00	1	128.4[(3)]	18.8	147.2	78.96	CAAQS 2025	186.4%
Nitrogen dioxide	10102-44-0	9.33E-01	24	11.8[(2)]	13.5	25.2	200	AAQC	12.6%
Nitrogen dioxide	10102-44-0	9.33E-01	annual	1.5[(3)]	9.1	10.6	22.56	CAAQS 2025	47.2%
Sulphur dioxide	7446-09-05	3.56E-02	10 min	0.7	2.6	3.3	180	AAQC	1.8%
Sulphur dioxide	7446-09-05	3.56E-02	1	0.4	2.6	3.0	100	O. Reg. 419/05 (Future 2023)	3.0%
Sulphur dioxide	7446-09-05	3.34E-02	24	0.2	5.3	5.4	275	O. Reg. 419/05, AAQC	2.0%
Sulphur dioxide	7446-09-05	3.32E-02	annual	0.02	2.0	2.0	10	O. Reg. 419/05 (Future 2023)	20.3%
Carbon monoxide	630-08-0	1.35E+00	0.5	101.7	389.5	491.2	6,000	O. Reg. 419/05	8.2%

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Averaging Periods [hrs.]	Maximum POI Concentration [ug/m^3][(1)]	Background Concentration [ug/m^3]	Resulting Ambient Air Quality [ug/m^3]	Most Stringent POI Criteria [ug/m^3]	Criteria	Percent of Criteria [%]
Carbon monoxide	630-08-0	1.35E+00	1	84.8	389.5	474.3	36,200	AAQC	1.3%
Carbon monoxide	630-08-0	1.35E+00	8	22.4	458.2	480.6	15,700	AAQC	3.1%
TSP	N/A - TSP	7.36E-01	24	6.8	30.6	37.3	120	O. Reg. 419/05, AAQC	31.1%
TSP	N/A - TSP	7.36E-01	annual	1.0	19.8	20.8	60	AAQC	34.7%
PM10	N/A - PM10	3.21E-01	24	2.6	17.0	19.6	50	AAQC	39.1%
PM2.5	N/A - PM2.5	1.51E-01	24	1.3	9.2	10.5	27	CAAQS 2020	38.7%
PM2.5	N/A - PM2.5	1.35E-01	annual	0.2	6.0	6.1	8.8	CAAQS 2020	69.8%
Hydrogen sulphide	7783-06-04	4.45E-03	10-min	0.5	1.4	1.9	13	O. Reg. 419/05, AAQC	14.5%
Hydrogen sulphide	7783-06-04	4.45E-03	24	0.1	1.4	1.5	7	O. Reg. 419/05, AAQC	20.8%
Vinyl chloride	75-01-4	1.66E-03	24	0.020	-	0.020	1	O. Reg. 419/05, AAQC	2.0%
Vinyl chloride	75-01-4	1.66E-03	annual	0.002	-	0.002	0.2	AAQC	1.1%
Chloroform	67-66-3	1.30E-05	24	0.0002	-	0.0002	1	O. Reg. 419/05, AAQC	<1%
Chloroform	67-66-3	1.30E-05	annual	0.00002	-	0.00002	0.2	AAQC	<1%
Acetone	67-64-1	1.48E-03	24	0.017	-	0.017	11,880	O. Reg. 419/05, AAQC	<1%

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Averaging Periods [hrs.]	Maximum POI Concentration [ug/m^3][(1)]	Background Concentration [ug/m^3]	Resulting Ambient Air Quality [ug/m^3]	Most Stringent POI Criteria [ug/m^3]	Criteria	Percent of Criteria [%]
Acrylonitrile	107-13-1	1.21E-03	24	0.014	-	0.014	0.6	O. Reg. 419/05, AAQC	2.4%
Acrylonitrile	107-13-1	1.21E-03	annual	0.002	-	0.002	0.12	AAQC	1.4%
Benzene	71-43-2	3.12E-03	24	0.037	-	0.037	2.3	O. Reg. 419/05, AAQC	1.6%
Benzene	71-43-2	3.12E-03	annual	0.004	-	0.004	0.45	O. Reg. 419/05, AAQC	<1%
Odour[(5)]	N/A - Odour	3.57E+03 OU/S	10-min	0.65 OU[(4)]	-	0.65 OU	1 OU	MECP Guideline	64.6%

Table Notes:

(1) All modelled maximum POI concentrations are taken from the worst-case discrete receptor with meteorological outliers removed as per MECP guidance (ADMGO).

(2) Maximum concentration of NO2 estimated using a full conversion from NOX for comparison against the applicable AAQC.

(3) Maximum concentration of NO2 estimated using the ozone limiting method of conversion from NOX for comparison against the CAAQS 2025 aspirational air quality objective.

(4) Maximum odour concentration corresponding to 99.5% frequency occurrence at discrete receptors.

(5) Maximum odour concentration modelled with the working face located at the worst-case position in Cell 6.

Table 9: Preferred Alternative Scenario 2 NO_2 1-hr. Average Comparison to 2025 CAAQS

Receptor	Coordinate [x]	Coordinate [y]	Maximum POI Concentration [ug/m^3][(1)]	Resulting Ambient Air Quality [ug/m^3]	Percent of 2025 CAAQS [%]
1	702911.5	5163337.87	33.10	51.91	66%
2	702973.6	5163599.12	36.97	55.78	71%
3	703378.3	5163266.77	49.85	68.67	87%
4	703435.5	5163118.59	48.95	67.77	86%
5	703447.9	5163050.38	49.87	68.69	87%
6	703449.6	5163199.48	49.46	68.28	86%
7	703456.8	5163402.92	60.24	79.06	100%
8	703467.9	5163160.81	44.66	63.47	80%
9	703474.4	5163223.84	52.90	71.72	91%
10	703523.8	5163407.01	63.24	82.05	104%
11	703532	5163230.73	58.33	77.14	98%
12	703532.5	5163366.56	64.70	83.52	106%
13	703535.6	5163311.04	59.29	78.11	99%
14	703544.1	5163340.67	63.84	82.66	105%
15	703546.1	5163209.19	59.33	78.15	99%
16	703546.9	5163105.31	55.97	74.79	95%
17	703547.6	5163182.71	57.94	76.75	97%
18	703567.1	5163142.89	58.44	77.26	98%
19	703568.2	5163043.72	57.61	76.42	97%
20	703571.6	5161709.85	53.69	72.51	92%
21	703572.1	5161748.72	56.23	75.04	95%
22	703574.3	5161687.71	53.13	71.95	91%
23	703577.3	5161654.51	54.17	72.98	92%
24	703578	5161595.47	52.86	71.68	91%
25	703584.7	5161620.07	53.80	72.62	92%
26	703584.7	5162695.08	84.55	103.37	131%
27	703584.7	5162695.08	68.68	87.50	111%
28	703595.1	5162656.62	87.15	105.96	134%
29	703602.7	5162744.35	77.68	96.49	122%

Receptor	Coordinate [x]	Coordinate [y]	Maximum POI Concentration [ug/m³][(1)]	Resulting Ambient Air Quality [ug/m³]	Percent of 2025 CAAQS [%]
30	703634.1	5161833.64	61.93	80.75	102%
31	703640	5161580.22	56.66	75.48	96%
32	703640.2	5161608.57	58.03	76.85	97%
33	703641.3	5161754.92	59.86	78.67	99.6%
34	703643.5	5161704.47	60.42	79.23	100%
35	703681.2	5161655.69	62.87	81.68	103%
36	703729.5	5161833.55	70.72	89.53	113%
37	703762.6	5161834.77	72.71	91.53	116%
38	703805.9	5161834.37	79.62	98.44	125%
39	703821.9	5161938.09	84.63	103.44	131%
40	703862.3	5161834.37	88.42	107.24	136%
41	703904.8	5161924.08	96.21	115.03	146%
42	703932.8	5161849.58	98.31	117.13	148%
43	703958.9	5161922.08	108.00	126.81	160%
44	703971.3	5161847.18	103.37	122.18	155%
45	704013.3	5161920.47	118.07	136.88	173%
46	704032.6	5161982.92	128.38	147.20	186%
47	704039.4	5161926.08	123.08	141.90	180%
48	704082.2	5161913.26	116.86	135.67	172%
49	704152.7	5161974.14	120.05	138.86	176%
50	704194	5161925.28	86.56	105.38	133%
51	704245.6	5161823.61	63.64	82.45	104%
52	704423.6	5161803.65	51.60	70.42	89%
53	704568.2	5161769.84	39.34	58.15	74%
54	704936.9	5161856.85	27.24	46.06	58%
55	705039.5	5161885.7	28.78	47.60	60%
56	705045.6	5161821.89	24.22	43.03	54%
57	705070.1	5161942.63	34.73	53.55	68%
58	705159.9	5162147.4	66.88	85.70	108%
59	705162.2	5162041.19	48.37	67.18	85%
60	705170.1	5161717.05	19.38	38.19	48%

Receptor	Coordinate [x]	Coordinate [y]	Maximum POI Concentration [ug/m³][(1)]	Resulting Ambient Air Quality [ug/m³]	Percent of 2025 CAAQS [%]
61	705172.8	5161739.24	20.72	39.54	50%
62	705178.2	5161804.69	24.79	43.61	55%
63	705181.6	5161847.42	27.07	45.89	58%
64	705185.4	5161879.6	29.08	47.90	61%
65	705186.7	5161763.1	22.28	41.10	52%
66	705256.5	5161880.71	29.06	47.88	61%
67	705270	5161985.09	39.71	58.52	74%
68	705279.4	5161578.88	14.18	32.99	42%
69	705293.1	5161836.87	25.47	44.29	56%
70	705293.6	5161895.13	30.82	49.63	63%
71	705302.7	5161657.12	17.54	36.36	46%
72	705330.3	5161863.51	28.35	47.17	60%
73	705331.1	5161298.85	9.73	28.55	36%
74	705344.1	5161899.57	30.78	49.59	63%
75	705354.1	5161966.16	37.01	55.82	71%
76	705358.2	5161381.07	9.82	28.64	36%
77	705436.2	5161983.91	37.19	56.00	71%
78	705891.7	5161921.63	26.66	45.48	58%
79	706059.8	5162035.52	23.94	42.76	54%

Table Notes:

(1) Modelled concentration post processed for the maximum 3 year average of the annual 98th percentile of the NO_2 daily maximum 1-hr average concentration.

Table 10: Preferred Alternative Scenario 2 NO_2 1-hr. Average Percent Occurrences above CAAQS

Receptor	Coordinate [x]	Coordinate [y]	# of Occurrences Above 2025 CAAQS	Percent of Occurrences Above 2025 CAAQS [%]
7	703456.8	5163402.92	35	0.08%
10	703523.8	5163407.01	47	0.11%
12	703532.5	5163366.56	47	0.11%
14	703544.1	5163340.67	44	0.10%
26	703584.7	5162695.08	76	0.17%
27	703584.7	5162695.08	50	0.11%
28	703595.1	5162656.62	99	0.23%
29	703602.7	5162744.35	64	0.15%
30	703634.1	5161833.64	65	0.15%
34	703643.5	5161704.47	41	0.09%
35	703681.2	5161655.69	49	0.11%
36	703729.5	5161833.55	77	0.18%
37	703762.6	5161834.77	88	0.20%
38	703805.9	5161834.37	96	0.22%
39	703821.9	5161938.09	119	0.27%
40	703862.3	5161834.37	100	0.23%
41	703904.8	5161924.08	136	0.31%
42	703932.8	5161849.58	108	0.25%
43	703958.9	5161922.08	157	0.36%
44	703971.3	5161847.18	96	0.22%
45	704013.3	5161920.47	151	0.34%
46	704032.6	5161982.92	240	0.55%
47	704039.4	5161926.08	157	0.36%
48	704082.2	5161913.26	160	0.37%
49	704152.7	5161974.14	236	0.54%
50	704194	5161925.28	158	0.36%
51	704245.6	5161823.61	78	0.18%
58	705159.9	5162147.4	42	0.10%

2.6.4.2 Compliance Assessment Emission Summary

The predicted concentrations for each indicator compounds was assessed using the MECP receptor grid for an assessment of compliance under O.Reg. 419/05 as provided in Table 11 below.

As a conservative assessment, sources of fugitive dust, including road dust (paved and unpaved) that are not regulated by O.Reg. 419/05 have been included in the compliance assessment.
The concentrations for each indicator compound were compared against their applicable criteria. The predicted concentrations are below their respective criteria for each indicator compound. This air quality impact assessment demonstrates that the site is predicted to comply with O. Reg. 419/05 through the development of the preferred alternative.

Table 11: Compliance Assessment Emission Summary Table

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Maximum POI Concentration [ug/m^3]	Averaging Periods [hrs.]	MECP POI Limit [ug/m^3][(1)]	Percentage of MECP POI Limit [%]
Nitrogen oxides	10102-44-0	2.59E+00	327.4	1	400	81.8%
Nitrogen oxides	10102-44-0	9.33E-01	36.6	24	200	18.3%
Sulphur dioxide	7446-09-05	3.56E-02	0.7	1	100[(2)]	<1%
Sulphur dioxide	7446-09-05	3.34E-02	0.4	24	275	<1%
Sulphur dioxide	7446-09-05	3.32E-02	0.04	Annual	10[(2)]	<1%
Carbon monoxide	630-08-0	1.35E+00	199.8	0.5	6,000	3.3%
TSP	N/A - TSP	7.36E-01	54.7	24	120	45.6%
Hydrogen sulphide	7783-06-04	4.45E-03	1.0	10-min	13	7.7%
Hydrogen sulphide	7783-06-04	4.45E-03	0.2	24	7	3.5%
Vinyl chloride	75-01-4	1.66E-03	0.1	24	1	9.0%
Chloroform	67-66-3	1.30E-05	0.0007	24	1	<1%
Acetone	67-64-1	1.48E-03	0.08	24	11,880	<1%
Acrylonitrile	107-13-1	1.21E-03	0.07	24	0.6	11.0%
Benzene	71-43-2	3.12E-03	0.03	annual	0.45	6.9%
Odour[(3)]	N/A - Odour	3.57E+03 OU/S	0.65 OU	10-min	1 OU	64.6%

Table Notes:

(1) Criteria listed in the MECP Air Contaminants Benchmarks (ACB) List: Standards, Guidelines, and Screening Levels for Assessing POI Concentrations of Air Contaminants, Version 2.0, dated April 2018.

(2) MECP proposed POI Limit, effective on July 1, 2023.

(3) Maximum odour concentration corresponding to 99.5% frequency occurrence at discrete receptors.

3.0 Odour Management

In addition to the quantitative odour impact assessment, a qualitative assessment of the odour potential of operations at the Site is provided in the context of the MECP's recommended FIDOL (Frequency, Intensity, Duration, Offensiveness and Location) approach[22].

The baseline and future operations of the project were compared to determine whether significant changes in the odour profile of the site would be expected. Where significant changes may occur, an analysis has been performed on the approaches to be used at the Site to reduce the potential for odour impacts.

3.1 Existing Odour Conditions

The baseline environment at the Site is characterized by an odour profile typical of the disposal of waste in a landfill. The Site maintains relationships with neighbours and staff are trained on the management of odour from the operations.

Practices in place to manage odourous emissions from the Site are documented within the Annual Design and Operations Report for the Site. A historical summary of the actions taken by the City to better manage nuisance odours is provided below:

- In 2003 the City conducted an odour study in response to increased number of odour complaints. During the study the following activities were performed in an attempt to reduce odours from suspected sources:
  - Changes to sludge handling;
  - Purchase and deployment of odour control granules to neutralize surface emissions; and
  - Application of clay cover to an inactive but uncompleted area (due to settlement) of the landfill in the northeast corner.
- A formalized complaint recording procedure was adopted and complaints were analysed to assist in the determination of the source of odours and factors contributing to odour complaint incidents (e.g., weather).
- In 2004 an odour study was completed and it was concluded that landfill gas emissions were likely the sources of odours.
- In 2006, an odour control spray system was also installed along a portion of the south fence line. The system included four (4) spray nozzles mounted directly on the fence. The system ran 24/7 appropriately nine months of the year (i.e., April to November). This system was decommissioned in 2010 when excavation activities related to the active landfill gas collection system required the

[22] MECP. 2006. Proposed Approach for the Implementation of Odour-Based Standards and Guidelines. Position Paper. June 2006.

removal of the fence. Throughout the construction period, a portable deodorizing system was employed to mitigate off-site odours.

- In 2010, the City completed an upgrade from a passive system to an active landfill gas collection system over a portion of the Site. The system reduced the quantity of methane released to the atmosphere and also reduced the odours generated at the Site. The active landfill gas collection system has been continuously active with the exception of occasional shutdowns required for system maintenance and repairs.

- In 2013, the City initiated programs, in a proactive approach, to manage and mitigate odours associated with the transport, management and disposal of biosolids, including:
  - The use of an odour neutralizing agent, which is applied to the biosolids at the water pollution control plants prior to delivery to the landfill site. Once the biosolids are tipped at the working face, they are mixed with other wastes and cover is applied. A hand held sprayer is also used by the vehicle operators to apply the odour neutralizing agent to the empty trailers before they leave the Site;
  - Purchase of a portable odour fogging machine, which effectively distributes an odour neutralizing agent in the form of a light mist. The fogging machine typically runs from the time the first load of biosolids arrives until after the last lead has been received, tipped and covered;
  - Enhanced biosolids trailer washing to remove residual biosolids from the outside faces and wheels of the trailers; and
  - Replacement of mesh tarps with impermeable waterproof tarps on the biosolids trailers.
- In May 2015 the Notice of Completion for a Class Environmental of Assessment (EA) was published. This EA identify and assess various long term biosolids management strategies with the objective to develop a sustainable and effective approach that reduces the impact on the City's landfill, more effectively manages nuisance odours in transit and at the landfill site.

In addition to the foregoing the following are included in the operating protocols for the Site:

- Minimizing the size of the active area;
- Minimizing the storage time of waste prior to disposal within the active area;
- Appropriate management of leachate;
- Use of special practices for disposal of highly odorous waste; and
- Use of daily cover.

The City continues to be committed to a process of continual improvement in its odour management protocols. The Site's odour management program (OMP) will continue to include the on-going review of operational practices with potential for odour generation, completion of odour studies if necessary, formal response to odour complaints, and the implementation of capital improvements to reduce the potential impacts of odour.

The Site's OMP has led to proactive relations with nearby stakeholders and improved odour management from the site.

3.2 Evaluation of the Potential for Odour Impacts

The proposed project will consist of two activities that may have the potential to result in odour impacts: typical landfill operations (within new waste cells) and waste mining.

The proposed activities associated with cell construction and typical landfill operations will not significantly increase the daily waste acceptance rate of the Site. However, with the additional improvements to waste deposition (e.g. the use of fully sealed trailers to transport biosolids in conjunction with the implementation of a biosolids processing facility), the odour profile (Frequency, Intensity, Duration, Offensiveness and Location) of the Site's operations is anticipated to improve with these proposed enhancements. It is expected that the Site's existing OMP would be able to effectively manage odour impacts associated with these activities.

Waste mining is proposed for the southwestern portion of the existing disposal footprint, as part of an environmental enhancement at the landfill to further mitigate the potential for groundwater impacts associated with unlined waste cells. The evaluation of alternative methods identified a preference for an expansion that included landfill mining, concluding that the shorter term odour effects and additional effort and cost to manage them was worth the opportunity to enhance groundwater management along the western site boundary. This conclusion was based on the experience of other landfill sites in North America where odour impacts were effectively managed through the implementation of best management practices. The proposed waste mining activities are expected to occur over a period of two years, with the majority of activity occurring up to five months each year.

The mining process will involve the excavation of waste from a currently dormant area of the landfill and transfer of this waste to a lined cell. The mining process may include:

- Screening of this waste to separate large and small factions;
- Removal of recyclables or material with residual value; and,
- Transfer of screened residual waste to a lined cell.

In order to mitigate the potential for waste mining to generate odour impacts, an OMP supplement will be developed specifically for this activity to support the Site OMP. A preliminary version of the OMP supplement is included in Appendix C. The OMP will be finalized as the waste mining program is designed and developed, and will include input from the contractor/landfill mining team and effective best management practices that have been implemented at similar sites. The OMP will be shared with the MECP in preparation for the waste mining activities.

Table 12 shows the linkage between some of the key planned odour management measures associated with the proposed waste mining process and the MECP recognized FIDOL approach for assessing/managing odours.

Table 12: Summary of Odour Criteria and Proposed Management Practices

Odour Assessment Criterion	Management Practices
Frequency	• Management of operations based on meteorological conditions (e.g., shut down during calm periods or specific wind direction) • Daily inspection program used to adjust and refine mining operations • Bypass screening of waste where highly odorous material is excavated
Intensity	• Use of chemical and biological treatment to reduce significance of odour • Use of periphery odour misting system • Minimize size of active excavation • Bypass screening of waste where highly odorous material is excavated
Duration	• Cover applied to excavated area at the end of the day • Daily inspection program used to adjust and refine mining operations • Bypass screening of waste where highly odorous material is excavated
Offensiveness	• Use of chemical and biological treatment to reduce significance of odour • Use of periphery odour misting system • Minimize size of active excavation • Bypass screening of waste where highly odorous material is excavated
Location	• Management of operations based on meteorological conditions (e.g., shut down when winds blowing to nearest receptors) • Daily inspection program used to adjust and refine mining operations

In developing the waste mining program, the following will be completed:

- Draw upon the experience of other municipalities and landfill operators in setting up the waste mining process and detailed mitigation strategies;
- Complete a pilot mining program, to better characterize the type of waste, odour profile of the waste and logistical processes for screening and transfer to lined cell;
- Use findings of pilot mining program to guide the development of Standard Operating Practices (SOPs) and the OMP for full-scale waste mining;
- Engage local stakeholders to keep them abreast of the waste mining process and gather their feedback on the process;
- Train all staff on SOPs and the OMP; and
- Conduct a monitoring campaign for odours around the waste mining process.

The overall OMP for the Site will be enhanced to incorporate additional measures to mitigate potential impacts associated with the waste mining process, and will become a 'living' document, requiring review and update as Site conditions change. The City is committed to making continuous improvement to reduce the sources of odours at the Site and along travel routes, and effectively manage and mitigate source of odour that are inherent with typical landfill operations. Through the implementation of the odour management practices outlined above, and ongoing engagement with local stakeholders, it is expected that odours associated with the proposed landfill expansion can be effectively managed.

4.0 Greenhouse Gas Emissions

The impacts of the project on climate change were assessed by evaluating the potential increases in greenhouse gas (GHG) emissions resulting from the site development. The approach to assessing the impact of the project on climate change is as follows:

- Step 1: Review emission estimation methodologies for determining average annual GHG emissions;
- Step 2: Review the existing operations and determine a baseline for average annual GHG emissions;
- Step 3: Review future operations (post-closure scenario) and determine annual GHG emissions
- Step 4: Review potential increases in GHG emissions to the Project's contribution to the GHG profile of the province and region.

4.1 GHG Emission Estimation Methodologies

Estimation of GHGs, specifically; carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) from on-site activities (e.g., onsite equipment, LFG collection system, and flare) was completed using emission factors from industry accepted methodologies.

As per consultation with the MECP, the emissions from the landfill footprints were estimated using United States Environmental Protection Agency (U.S. EPA) LandGEM models for the landfill footprint and the landfill gas generation rate for the preferred alternative.

Emissions from the landfill gas flare was estimated based on U.S. EPA LandGEM models, flare specifications, and U.S. EPA emission factors[23]. The landfill gas collection system efficiency of 75% taken from US EPA AP-42 Chapter 2.4 "Municipal Solid Waste Landfills" was taken into account when quantifying emissions.

Non-road vehicle emissions were estimated using available U.S. EPA non-road engine emission factors[24] and the hours of operation.

On-road vehicle emissions were estimated using the U.S. EPA MOVES model. MOVES was used to estimate an emission rate per unit distance for tailpipe emissions from the typical on-road vehicles expected at the site.

These methodologies were followed to allow for a comparison to potential GHG emissions from the existing conditions and the preferred alternative, as well as to be inclusive of all sources of GHG emissions from the site.

4.2 Existing Site GHG Emissions

The assessment of annual GHG emissions from the existing and project condition was completed for operations during the last complete calendar year (2018). The operating conditions of the existing conditions are described briefly below:

The GHG emissions from sources on-site for the existing condition included:

- The use of one (1) landfill gas flare as part of the landfill gas collection system;
- Operations associated with vehicular traffic and material transfer at the active working face;

[23] United States Environmental Protection Agency (2008). AP-42 Chapter 2.4 Municipal Solid Waste Landfills. Draft Section. October 2008.

[24] United States Environmental Protection Agency (2010). Exhaust and Crankcase Emission Factors for Non-road Engine Modelling – Compression-Ignition NR-009d. July 2010.

- Operations occurring at storage piles;
- The use of stationary combustion equipment;
- Traffic activities along the paved and unpaved roads on-site; and
- Landfill gas that is generated and fugitively emitted.

Existing GHG emissions were estimated to be approximately 37,660 tonnes of carbon dioxide equivalent (CO_2e) per year. Table 13 below provides a breakdown of the baseline (existing conditions) GHG emissions.

A detailed calculation summary for the existing conditions is provided in Appendix D.

Table 13: Annual Average GHG Emissions – Existing Conditions (Year 2018)

Source Category	CO_2 Equivalents			Total tonnes CO_2e/year
	CO_2	CH_4	N_20	
	tonnes CO_2e/year	tonnes CO_2e/year	tonnes CO_2e/year	
Flare	11,705	5,326	-	17,031
Other[1]	924	<1	<1	924
Landfill Fugitives	1,949	17,755	-	19,704
Total	14,578	23,081	<1	37,660

Table Note:
Sources included within the "Other" source category include on-site vehicle and non-road equipment emissions.

4.3 Landfill Expansion GHG Emissions

After reviewing the cell sequencing plans for the lifecycle of the preferred landfill expansion alternative, the worst-case Scenario 2 was identified for this assessment. The assessment of annual GHG emissions from the preferred alternative was completed for the development Scenario 2 and the worst-case post closure emission scenario.

The landfill development Scenario 2 is estimated to occur between 2025 and 2026. To conservatively estimate landfill gas emissions from this scenario, the worst-case year 2026 was used. The Scenario 2 operating conditions are described briefly below:

The GHG emissions from sources on-site for the landfill development Scenario 2 included:

- The use of one (1) landfill gas flare as part of the landfill gas collection system;
- Operations associated with vehicular traffic and material transfer at the active working face;
- Operations associated with landfill mining;
- Operations occurring at storage piles;
- The use of stationary combustion equipment;
- Traffic activities along the paved and unpaved roads on-site; and
- Landfill gas that is generated and fugitively emitted.

A detailed calculation summary for the landfill development Scenario 2 are provided in Appendix E. Scenario 2 GHG emissions were estimated to be approximately 44,370 tonnes CO_2e per year. Table 14 below provides a breakdown of the landfill development Scenario 2 GHG emissions.

Table 14: Annual Average GHG Emissions – Landfill Development Scenario 2 (Year 2026)

Source Category	CO_2 Equivalents			Total tonnes CO_2e/year
	CO_2	CH_4	$N_2$0	
	tonnes CO_2e/year	tonnes CO_2e/year	tonnes CO_2e/year	
Flare	12,621	5,743	-	18,364
Other[1]	4,757	<1	<1	4,757
Landfill Fugitives	2,101	19,144	-	21,245
Total	18,410	23,081	<1	44,370

Table Note:
Sources included within the "Other" source category include on-site vehicle and non-road equipment emissions.

The worst-case GHG emissions from sources on-site during post closure were estimated during the 2049 year at the Site.

The GHG emissions from sources on-site for post closure of the landfill included:

- The use of one (1) landfill gas flare as part of the landfill gas collection system; and
- Landfill gas that is generated and fugitively emitted.

A detailed calculation summary for post closure is provided in Appendix F. Post closure GHG emissions were estimated to be approximately 44,415 tonnes CO_2e per year. Table 15 provides a breakdown of the post closure GHG emissions.

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Table 15: Annual Average GHG Emissions – Post Closure (Year 2049)

Source Category	CO_2 Equivalents			Total tonnes CO_2e/year
	CO_2 tonnes CO_2e/year	CH_4 tonnes CO_2e/year	N_2O tonnes CO_2e/year	
Flare	14,152	6,440	-	20,592
Landfill Fugitives	2,356	21,467	-	23,823
Total	16,508	27,907	<1	44,415

4.4 Project Impacts on Climate Change

The best available estimate of Ontario's reported GHG emissions is provided in the ECCC National Inventory Report (NIR). A review of the 2015-2017 GHG emission summaries from the ECCC NIR[25] show that Ontario had an average annual total GHG emission of 162 mega-tonnes (Mt) CO_2e.

The existing conditions at the Sault Ste. Marie Landfill account for an estimated 0.038 Mt CO_2e which would result in a 0.02% contribution to Ontario's total GHG emission profile.

The GHG emissions profile from the worst-case future condition (post-closure) is estimated to be 0.044 Mt CO_2e. The Sault Ste. Marie Landfill's future contribution to Ontario's total GHG emissions profile is estimated to be 0.03%.

Ontario's GHG emission data by sector is also available in the NIR. A review of the 2015-2017 GHG emission summaries from the ECCC NIR[26] show that Ontario Solid Waste Disposal facilities contributed an average annual total of 5.4 Mt of CO2e. The Sault Ste. Marie Landfill's existing condition would result in a 0.70% contribution to Ontario's Solid Waste Disposal total GHG emission profile. The Sault Ste. Marie Landfill's post-closure condition would result in a 0.83% contribution to Ontario's Solid Waste Disposal total GHG emission profile.

A region specific GHG inventory is not available, and limited methodologies exist to accurately estimate the regional baseline GHGs. One cursory approach is to scale the provincial emissions by population. For the purpose of the assessment, Sault Ste. Marie is considered to be the service area of the landfill. Scaling

[25] Environment and Climate Change Canada (2019). National Inventory Report 1990-2017: Greenhouse Gas Sources and Sinks in Canada. Part 3. 2019.

[26] Environment and Climate Change Canada (2019). National Inventory Report 1990-2017: Greenhouse Gas Sources and Sinks in Canada. Part 3. 2019.

Ontario's overall GHG emissions by the relative populations of the service area and Ontario[27] results in an approximate service area annual total GHG emission of 0.942 Mt CO2e.

The Sault Ste. Marie Landfill's existing conditions account for 4.0% of the service area GHG emission profile (<0.1% of Ontario's GHG emissions). The average GHG emissions under the future post-closure condition are expected to account for 4.7% of the service area GHG emissions profile (<0.1% of Ontario's GHG emissions).

[27] Statistics Canada, 2016 Census of Population. Ontario and Ontario [Province]. November 29, 2017.

Appendix A

Air Quality Impact Calculations

Table A.1
Historic and Projected Waste Receipts
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Landfill Info

Operating Hours
- 7:30 am to 5:00 pm
- 6 days per week

Landfill Waste Projections

Year	Landfilled Waste (tonne)	Cumulative Total (tonne)
1954	1,000	1,000
1955	1,000	2,000
1956	1,000	3,000
1957	1,000	4,000
1958	1,000	5,000
1959	1,000	6,000
1960	1,000	7,000
1961	1,000	8,000
1962	1,000	9,000
1963	1,000	10,000
1964	1,000	11,000
1965	1,000	12,000
1966	1,000	13,000
1967	1,000	14,000
1968	1,000	15,000
1969	1,000	16,000
1970	38,000	54,000
1971	38,000	92,000
1972	38,000	130,000
1973	38,000	168,000
1974	38,000	206,000
1975	38,000	244,000
1976	38,000	282,000
1977	38,000	320,000
1978	38,130	358,130
1979	38,400	396,530
1980	38,700	435,230
1981	38,900	474,130
1982	39,600	513,730
1983	40,300	554,030
1984	41,000	595,030
1985	41,700	636,730
1986	42,350	679,080

Landfill Waste Projections

Year	Landfilled Waste	Cumulative Total
	(tonne)	(tonne)
1987	60,000	739,080
1988	78,000	817,080
1989	96,289	913,369
1990	110,632	1,024,001
1991	119,123	1,143,124
1992	77,938	1,221,062
1993	74,288	1,295,350
1994	69,877	1,365,227
1995	72,185	1,437,412
1996	106,219	1,543,631
1997	81,677	1,625,308
1998	79,573	1,704,881
1999	72,940	1,777,821
2000	74,785	1,852,606
2001	74,151	1,926,757
2002	85,054	2,011,811
2003	74,152	2,085,963
2004	70,579	2,156,542
2005	64,599	2,221,141
2006	57,681	2,278,822
2007	59,972	2,338,794
2008	57,725	2,396,519
2009	59,419	2,455,938
2010	66,014	2,521,952
2011	63,010	2,584,962
2012	58,393	2,643,356
2013	56,300	2,699,655
2014	52,163	2,751,818
2015	49,085	2,800,903
2016	42,647	2,843,550
2017	39,940	2,883,490
2018	37,974	2,921,464
2019	77,672	2,999,136
2020	77,925	3,077,061
2021	78,177	3,155,238
2022	68,117	3,223,355
2023	68,354	3,291,709
2024	68,591	3,360,300
2025	68,828	3,429,128
2026	67,668	3,496,796
2027	67,000	3,563,796
2028	66,301	3,630,097

Landfill Waste Projections

Year	Landfilled Waste (tonne)	Cumulative Total (tonne)
2029	65,572	3,695,669
2030	64,812	3,760,481
2031	65,494	3,825,975
2032	66,032	3,892,007
2033	66,570	3,958,577
2034	67,108	4,025,685
2035	67,645	4,093,330
2036	68,183	4,161,513
2037	68,613	4,230,126
2038	69,046	4,299,172
2039	69,481	4,368,653
2040	69,919	4,438,572
2041	70,360	4,508,932
2042	70,804	4,579,736
2043	71,250	4,650,986
2044	71,699	4,722,685
2045	72,152	4,794,837
2046	72,607	4,867,444
2047	73,065	4,940,509
2048	73,526	5,014,035

Table A.2
LandGEM Model Results
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Maximum Emssion Scenario Year 2049 (Post Closure)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)[1]
Total landfill gas	1.29E+07	1.03E+07	3.21E+06
Methane	3.43E+06	5.15E+06	8.59E+05
Carbon dioxide	9.42E+06	5.15E+06	2.36E+06
Acetone	1.74E+02	7.21E+01	4.35E+01
Acrylonitrile - HAP/VOC	1.43E+02	6.49E+01	3.58E+01
Benzene - No or Unknown Co-disposal - HAP/VOC	6.36E+01	1.96E+01	1.59E+01
Carbon disulfide - HAP/VOC	1.89E+01	5.97E+00	4.73E+00
Carbon monoxide	1.68E+03	1.44E+03	4.20E+02
Carbonyl sulfide - HAP/VOC	1.26E+01	5.05E+00	3.15E+00
Chloroform - HAP/VOC	1.53E+00	3.09E-01	3.83E-01
Dimethyl sulfide (methyl sulfide) - VOC	2.08E+02	8.03E+01	5.19E+01
Ethyl mercaptan (ethanethiol) - VOC	6.12E+01	2.37E+01	1.53E+01
Hydrogen sulfide	5.25E+02	3.71E+02	1.31E+02
Methyl mercaptan - VOC	5.15E+01	2.57E+01	1.29E+01
Vinyl chloride - HAP/VOC	1.95E+02	7.52E+01	4.88E+01

Existing Conditions Landfill Gas Flare Flow Rate (m^3/year)[1]	Estimated Landfill Gas Collection Efficiency (%)[2]	Methane Concentration in Landfill Gas[3] (%)	Total Methane Gas Produced from LandGEM (m^3/year)	Methane Gas Flare Flow Rate (m^3/year)
7,722,461	75.0%	50%	5,148,307	3,861,230

Sulphur Compounds	Molecular Weight	Volume (m^3/year)	Concentration (ppm)	Concentration of Sulphur Compounds (ppm)
Carbonyl Sulphide	60.07	5.05E+00	4.90E-01	4.90E-01
Carbon Disulphide	76.14	5.97E+00	5.80E-01	1.16E+00
Dimethyl Sulphide	62.13	8.03E+01	7.80E+00	7.80E+00
Ethyl Mercaptan	62.13	2.37E+01	2.30E+00	2.30E+00
Hydrogen Sulphide	34.08	3.71E+02	3.60E+01	3.60E+01
Methyl Mercaptan	48.11	2.57E+01	2.50E+00	2.50E+00
	Total	5.11E+02	Total	5.03E+01

Notes:

(1) The worst-case emission inventory year (2049) of the landfill footprint was taken.
(2) Typical collection efficiency from landfill gas capture design systems from US EPA AP-42 Chapter 2.4 "Municipal Solid Waste Landfills".
(3) Landfill gas methane concentration conservatively estimated based on the default LandGEM methane content and the rated methane content in ECA (Air) No. 4306-7ZHPR3 dated April 30, 2010.

Table A.3
Estimated Landfill Gas Flare Emissions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Source	Source ID	Contaminant	CAS No.	Molecular Weight	Emission Factor ($kg/10^6 dscm_{CH4}$)[1]	Total Emission Rate (g/s)
Flare 1	F1	Nitrogen Oxides	10102-44-0	46.01	631	1.15E-01
		Sulphur Dioxide	9/5/7446	66.01	-- [2]	3.23E-02
		Carbon Monoxide	630-08-0	28.01	737	1.34E-01
		Particulate Matter	N/A - TSP	--	238	4.33E-02
		Hydrogen sulphide	6/4/7783	34.08	--[3][4]	2.87E-04
		Vinyl chloride	75-01-4	62.50	--[3][4]	1.07E-04
		Chloroform	67-66-3	119.39	--[3][4]	8.39E-07
		Acetone	67-64-1	58.08	--[3][4]	9.52E-05
		Acrylonitrile	107-13-1	53.06	--[3][4]	7.83E-05
		Benzene	71-43-2	78.11	--[3][4]	2.01E-04

(1) Emission factors obtained from US EPA AP-42 Chapter 2.4 "Municipal Solid Waste Landfills" Table 2.4-4 for a flare.
(2) Emission estimates obtained from US EPA AP-42 Chapter 2.4 "Municipal Solid Waste Landfills" equations 3, 4, 7, and 8.
(3) Emission estimates obtained from landfill gas collection efficiency, flare efficiency, and LandGEM generated emissions.
(4) Flare parameters:

Landfill Gas Flare 1 Flow[6]	0.364	m^3/s
Methane Content[6]	50	%
Destruction Efficiency[7]	97.7	%

(5) Emission estimates obtained from US EPA AP-42 Chapter 2.4 equations 4 and 6.
(6) Flow rate of landfill gas to the flare and methane content taken from ECA (Air) No. 4306-7ZHPR3 dated April 30, 2010.
(6) Landfill gas methane concentration conservatively estimated based on the default LandGEM methane content and the rated methane content in ECA (Air) No. 4306-7ZHPR3 dated April 30, 2010.

(7) Typical control efficiency for LFG NMOC and VOC for a flare taken from US EPA AP-42 Chapter "Municipal Solid Waste Landfills" Table 2.4-3.

Table A.4
Estimated Landfill Footprint Emissions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Landfill	LandGEM Contaminant	Source ID	Fugitive Emissions (kg/year)	Fugitive Emissions (m^3/hr)	Odour Concentration (OU/m^3)(1)	Contaminant	CAS No.	Total Emission Rate (OU/s or g/s)
Landfill	Total Landfill Gas	S9	--	294	10,000	Odour	N/A - Odour	8.16E+02
	Hydrogen Sulphide		131	--		Hydrogen Sulphide	7783-06-04	4.17E-03
	Vinyl Chloride		49	--		Vinyl Chloride	75-01-4	1.55E-03
	Chloroform		0.4	--		Chloroform	67-66-3	1.22E-05
	Acetone		43.5			Acetone	67-64-1	1.38E-03
	Acrylonitrile		35.8	--		Acrylonitrile	107-13-1	1.13E-03
	Benzene		92.0	--		Benzene	71-43-2	2.92E-03

Location	Source ID	Area (m^2)	Odour Flux Rate ($OU/m^2/s$)(2)	Contaminant	CAS No.	Total Emission Rate (OU/s)
Working Face	S10	2,500	1.1	Odour	N/A - Odour	2.75E+03

Notes
(1) Screening level taken from Interim Guide to Estimate and Assess Landfill Air Impacts (MECP, 1992).
(2) Odour flux rate taken from RWDI BFI Ridge Landfill Expansion EA, Impact Assessment, Appendix M. 1996.

Table A.5
Vehicle Activity
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Source	Distance Travel [m]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Passes
$P_{1\text{-}3}$	158.2	Public waste	21	188	3	1
		Yard waste	1	5	15	1
		Waste truck	6	49	18	1
$P_{2\text{-}3}$	17.6	Public waste	21	188	3	1
		Yard waste	1	5	15	1
		Waste truck	6	49	18	1
$P_{3\text{-}4}$	149.2	Public waste	21	188	3	2
		Yard waste	1	5	15	2
		Waste truck	6	49	18	2
$P_{4\text{-}5a}$	325.9	Public waste	21	188	3	1
		Yard waste	1	5	15	1
$P_{4\text{-}5b}$	250.8	Public waste	21	188	3	1
		Yard waste	1	5	15	1
		Waste truck	6	49	18	2
$P_{5\text{-}6}$	46.2	Waste truck	6	49	18	2
$U_{6\text{-}7}$	266.1	Waste truck	6	49	18	2
$U_{7\text{-}8}$	139.3	Mining truck	2	18	18	2
$U_{7\text{-}9}$	651.2	Waste truck	6	49	18	2
		Mining truck	2	18	18	2
$U_{9\text{-}10}$	153.2	Waste truck	6	49	18	2
		Mining truck	2	18	18	2
		Soil cover truck	1	9	9	2

Table A.6
Construction Equipment
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Type of Equipment	Average Operating Hours per Day	# in Operation	Weight Information (lb)	Engine Size Information	Dimensions (L x W x H)
Landfill Operations					
Sterling LT 8500 roll-off	4	1	60000 / 80000	300 hp engine (diesel)	5.3 m x 2.4 m x 2.4 m
CAT 826 Compactor	6	1	82000	341 hp engine (diesel)	7.7 m x 3.8 m x 4.0 m
CAT D-6 Bulldozer	4	1	36000	189 hp engine (diesel)	4.1 m x 2.7 m x 3.2 m
Terex TA 27 Rock Truck	4	1	49000 / 104000	365 hp engine (diesel)	9.8 m x 2.2 m x 3.6 m
Case 821 Front End Loader	5	1	31000	186 hp engine (diesel)	7.5 m x 2.7 m x 3.3 m
Trackless MT-5	5 hrs per week	1	Negligible		
Kubota 1100 RTV UTV	6 hrs per month	1	Negligible		
MadVac litter vacuum	5	1	Negligible		
Composting Operations					
Sittler compost turner	5 every 3rd day	1		Pulled by tractor	
RotoScreen Compost Screener	5	1		225 hp engine (diesel)	4.6 m x 2.6 m x 4.1 m
Odour turbine	7.5	1			
John Deere Farm Tractor 5420	5 every 3rd day	1	7000	81 hp engine (diesel)	3.8 m x 2.0 m x 2.6 m
Sterling STE flow truck/sander	5	1	60000 / 80000	300 hp engine (diesel)	5.3 m x 2.4 m x 2.4 m
Various front end loaders	5	1			
Various water trucks	5	1			
Cell Construction Operations					
CAT D-7 Bulldozer	9	1	45000	200 hp engine (diesel)	4.2 m x 2.6 m x 3.3 m
Cell Mining Operations					
McCloskey MCB 733 Trommel Screeners	9	2	-	225 hp engine (diesel)	21.1 m x 3.3 m x 4.1 m
McCloskey Stacker	9	1	-	90 hp engine (diesel)	15.2 m x 3.4 m x 3.4 m
Mobark 1100 Tub Grinder	9	1	-	600 hp engine (diesel)	17.1 m x 3.4 m x 3.9 m
CAT 345 Excavator	9	2	100000	345 hp engine (diesel)	11.9 m x 3.5 m x 7.6 m
CAT D-7 Bulldozer	9	1	45000	200 hp engine (diesel)	4.2 m x 2.6 m x 3.3 m
CAT 735 Articulating Truck	9	2	67000 / 140000	413 hp engine (diesel)	10.9 m x 3.4 m x 3.7 m

Table A.7
Estimated Fugitive Dust Emissions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Fugitive Dust From Mobile OnRoad Equipment

							TSP			PM10			PM2.5		
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	Emission Factor (lb/VMT)[1][2]	24-hr Emission Rate (g/s)[4]	TOTAL 24-hr Emission Rate (g/s)	Emission Factor (lb/VMT)[1][2]	24-hr Emission Rate (g/s)[4]	TOTAL 24-hr Emission Rate (g/s)	Emission Factor (lb/VMT)[1][2]	24-hr Emission Rate (g/s)[4]	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	188	3	1	0.106	2.1E-03	5.8E-03	0.021	4.1E-04	1.2E-03	0.005	2.5E-04	7.1E-04
	158.2	0.098	Yard waste	5	15	1	0.562	2.9E-04		0.112	5.8E-05		0.028	3.6E-05	
	158.2	0.098	Waste truck	49	18	1	0.674	3.4E-03		0.135	6.8E-04		0.033	4.2E-04	
P2-3	17.6	0.011	Public waste	188	3	1	0.106	2.3E-04	6.4E-04	0.021	4.6E-05	1.3E-04	0.005	2.8E-05	7.9E-05
	17.6	0.011	Yard waste	5	15	1	0.562	3.2E-05		0.112	6.5E-06		0.028	4.0E-06	
	17.6	0.011	Waste truck	49	18	1	0.674	3.8E-04		0.135	7.6E-05		0.033	4.7E-05	
P3-4	149.2	0.093	Public waste	188	3	2	0.106	3.9E-03	1.1E-02	0.021	7.8E-04	2.2E-03	0.005	4.8E-04	1.3E-03
	149.2	0.093	Yard waste	5	15	2	0.562	5.5E-04		0.112	1.1E-04		0.028	6.7E-05	
	149.2	0.093	Waste truck	49	18	2	0.674	6.4E-03		0.135	1.3E-03		0.033	7.9E-04	
P4-5a	325.9	0.203	Public waste	188	3	1	0.106	4.2E-03	4.8E-03	0.021	8.5E-04	9.7E-04	0.005	5.2E-04	5.9E-04
	325.9	0.203	Yard waste	5	15	1	0.562	6.0E-04		0.112	1.2E-04		0.028	7.3E-05	
P4-5b	250.8	0.156	Public waste	188	3	1	0.106	3.3E-03	1.5E-02	0.021	6.5E-04	2.9E-03	0.005	4.0E-04	1.8E-03
	250.8	0.156	Yard waste	5	15	1	0.562	4.6E-04		0.112	9.2E-05		0.028	5.6E-05	
	250.8	0.156	Waste truck	49	18	2	0.674	1.1E-02		0.135	2.2E-03		0.033	1.3E-03	
P5-6	46.2	0.029	Waste truck	49	18	2	0.674	2.0E-03	2.0E-03	0.135	4.0E-04	4.0E-04	0.033	2.4E-04	2.4E-04
U6-7	266.1	0.165	Waste truck	49	18	2	3.668	6.2E-02	6.2E-02	0.990	1.7E-02	1.7E-02	0.099	4.2E-03	4.2E-03
U7-8	139.3	0.087	Mining truck	18	18	2	3.663	1.2E-02	1.2E-02	0.989	3.2E-03	3.2E-03	0.099	8.1E-04	8.1E-04
U7-9	651.2	0.405	Waste truck	49	18	2	3.668	1.5E-01	2.1E-01	0.990	4.1E-02	5.6E-02	0.099	1.0E-02	1.4E-02
	651.2	0.405	Mining truck	18	18	2	3.663	5.6E-02		0.989	1.5E-02		0.099	3.8E-03	
U9-10	153.2	0.095	Waste truck	49	18	2	3.668	3.6E-02	3.6E-02	0.990	9.7E-03	9.7E-03	0.099	2.4E-03	2.4E-03
	153.2	0.095	Mining truck	18	18	2	3.663	1.3E-02	1.3E-02	0.989	3.6E-03	3.6E-03	0.099	8.9E-04	8.9E-04
	153.2	0.095	Soil cover truck	9	9	2	2.682	4.8E-03	4.8E-03	0.724	6.5E-03	6.5E-03	0.072	3.3E-04	3.3E-04

Fugitive Dust From Mobile Off-Road Equipment

						TSP			PM10			PM2.5		
Source	Distance Travelled per day [miles]	Equipment Type	Number of Units	Truck Weight (tons)	# of Vehicle Passes	Emission Factor (lb/VMT)[1][2]	24-hr Emission Rate (g/s)[4]	TOTAL 24-hr Emission Rate (g/s)	Emission Factor (lb/VMT)[1][2]	24-hr Emission Rate (g/s)[4]	TOTAL 24-hr Emission Rate (g/s)	Emission Factor (lb/VMT)[1][2]	24-hr Emission Rate (g/s)[4]	TOTAL 24-hr Emission Rate (g/s)
S1	2.25	CAT 826 Compactor	1	41	-	5.306	1.25E-02	2.1E-02	1.432	3.4E-03	5.7E-03	0.143	3.4E-04	5.7E-04
	2.25	CAT D-6 Bulldozer	1	18	-	3.663	8.65E-03		0.989	2.3E-03		0.099	2.3E-04	
S2	2.25	Case 821 Front End Loader	1	15.5	-	3.425	8.09E-03	8.1E-03	0.925	2.2E-03	2.2E-03	0.092	2.2E-04	2.2E-04
S3	2.25	John Deere Farm Tractor 5420	1	3.5	-	1.753	4.14E-03	4.1E-03	0.473	1.1E-03	1.1E-03	0.047	1.1E-04	1.1E-04
S4	2.25	CAT 345 Excavator	2	50	-	5.802	2.74E-02	2.7E-02	1.566	7.4E-03	7.4E-03	0.157	7.4E-04	7.4E-04
S4	2.25	CAT D-7 Bulldozer	1	22.5	-	4.050	9.57E-03	9.6E-03	1.093	2.6E-03	2.6E-03	0.109	2.6E-04	2.6E-04

(1) Emission factors obtained from US EPA AP-42 Chapter 13.2.2 "Unpaved Roads" equations (1a) and (2).
(2) Emission factor parameters:

Precipitation days (P)	176	days (at least 0.2 mm [0.01 in] of precipitation per year taken from the Environment Canada Climate Normals: Sault Ste Marie A, 1981 to 2010
Averaging period	365	days

Paved Road Segments

Inputs

k = particle size multiplier

Particle Size Multiplier			
Size Range	**g/VKT**	**g/VMT**	**lb/VMT**
$PM_{2.5}$	0.15	0.25	0.00054
PM_{10}	0.62	1.00	0.0022
PM_{30}	3.23	5.24	0.011

sl = road surface silt loading (municipal solid waste landfill - mean) = 7.4 g/m^2

Unpaved Road Segments

Inputs

Constant	**Industrial Roads (Equation 1a)**		
Particle	$PM_{2.5}$	PM_{10}	PM_{30}
k (lb/VMT)	0.15	1.5	4.9
a	0.9	0.9	0.7
b	0.45	0.45	0.45

s = surface material silt content (municipal solid waste landfill - mean) = 6.4 g/m^2

(4) Reduction has been applied to the total emission rate due to dust mitigation techniques as per the "AECOM - Sault Ste. Marie Landfill Regulatory Reporting (NPRI, O.Reg. 127/01, GHG) - 2018 Reporting Year" report dated July 2019 by Dillon Consulting. 80 %

Table A.8
MOVES Emission Factors
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Refuse - MOVES Emission Factors

Pollutant	Emission Factor (g/VMT)[1]
NOx	5.163
SO2	0.019
CO	1.420
PM	0.751
PM_{10}	0.751
$PM_{2.5}$	0.342

Note:
(1) Based on a speed of 30 km/hr.

Light Trucks - MOVES Emission Factors

Pollutant	Emission Factor (g/VMT)[1]
NOx	0.220
SO2	0.004
CO	2.561
PM	0.086
PM_{10}	0.086
$PM_{2.5}$	0.016

Note:
(1) Based on a speed of 30 km/hr.

Table A.9
OnRoad Mobile Emission Estimates
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

								TSP			PM10			PM2.5		
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	24-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)	MOVES Emission Factor (g/VMT)	24-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)	MOVES Emission Factor (g/VMT)	24-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	0.086	1.8E-05	6.1E-05	0.086	1.8E-05	6.1E-05	0.016	3.4E-06	2.3E-05
		0.098	Yard waste	1	5	15	1	0.086	4.9E-07		0.086	4.9E-07		0.016	9.1E-08	
		0.098	Waste truck	6	49	18	1	0.751	4.2E-05		0.751	4.2E-05		0.342	1.9E-05	
P2-3	17.6	0.011	Public waste	21	188	3	1	0.086	2.0E-06	6.8E-06	0.086	2.0E-06	6.8E-06	0.016	3.8E-07	2.5E-06
		0.011	Yard waste	1	5	15	1	0.086	5.4E-08		0.086	5.4E-08		0.016	1.0E-08	
		0.011	Waste truck	6	49	18	1	0.751	4.7E-06		0.751	4.7E-06		0.342	2.1E-06	
P3-4	149.2	0.093	Public waste	21	188	3	2	0.086	3.5E-05	1.1E-04	0.086	3.5E-05	1.1E-04	0.016	6.5E-06	4.3E-05
		0.093	Yard waste	1	5	15	2	0.086	9.2E-07		0.086	9.2E-07		0.016	1.7E-07	
		0.093	Waste truck	6	49	18	2	0.751	7.9E-05		0.751	7.9E-05		0.342	3.6E-05	
P4-5a	325.9	0.203	Public waste	21	188	3	1	0.086	3.8E-05	3.9E-05	0.086	3.8E-05	3.9E-05	0.016	7.1E-06	7.2E-06
		0.203	Yard waste	1	5	15	1	0.086	1.0E-06		0.086	1.0E-06		0.016	1.9E-07	
P4-5b	250.8	0.156	Public waste	21	188	3	1	0.086	2.9E-05	1.6E-04	0.086	2.9E-05	1.6E-04	0.016	5.4E-06	6.6E-05
		0.156	Yard waste	1	5	15	1	0.086	7.7E-07		0.086	7.7E-07		0.016	1.4E-07	
		0.156	Waste truck	6	49	18	2	0.751	1.3E-04		0.751	1.3E-04		0.342	6.0E-05	
P5-6	46.2	0.029	Waste truck	6	49	18	2	0.751	2.4E-05	2.4E-05	0.751	2.4E-05	2.4E-05	0.342	1.1E-05	1.1E-05
U6-7	266.1	0.165	Waste truck	6	49	18	2	0.751	1.4E-04	1.4E-04	0.751	1.4E-04	1.4E-04	0.342	6.4E-05	6.4E-05
U7-8	139.3	0.087	Mining truck	2	18	18	2	0.751	2.7E-05	2.7E-05	0.751	2.7E-05	2.7E-05	0.342	1.2E-05	1.2E-05
U7-9	651.2	0.405	Waste truck	6	49	18	2	0.751	3.4E-04	4.7E-04	0.751	3.4E-04	4.7E-04	0.342	1.6E-04	2.1E-04
		0.405	Mining truck	2	18	18	2	0.751	1.3E-04		0.751	1.3E-04		0.342	5.8E-05	
U9-10	153.2	0.095	Waste truck	6	49	18	2	0.751	8.1E-05	1.3E-04	0.751	8.1E-05	1.3E-04	0.342	3.7E-05	5.7E-05
		0.095	Mining truck	2	18	18	2	0.751	3.0E-05		0.751	3.0E-05		0.342	1.4E-05	
		0.095	Soil cover truck	1	9	9	2	0.751	1.5E-05		0.751	1.5E-05		0.342	6.8E-06	

								NOX				
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	1-hr Emission Rate (g/s)	24-hr Emission Rate (g/s)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	0.220	1.3E-04	4.7E-05	9.8E-04	3.4E-04
		0.098	Yard waste	1	5	15	1	0.220	6.0E-06	1.3E-06		
		0.098	Waste truck	6	49	18	1	5.163	8.5E-04	2.9E-04		
P2-3	17.6	0.011	Public waste	21	188	3	1	0.220	1.4E-05	5.2E-06	1.1E-04	3.7E-05
		0.011	Yard waste	1	5	15	1	0.220	6.7E-07	1.4E-07		
		0.011	Waste truck	6	49	18	1	5.163	9.4E-05	3.2E-05		
P3-4	149.2	0.093	Public waste	21	188	3	2	0.220	2.4E-04	8.9E-05	1.8E-03	6.3E-04
		0.093	Yard waste	1	5	15	2	0.220	1.1E-05	2.4E-06		
		0.093	Waste truck	6	49	18	2	5.163	1.6E-03	5.4E-04		
P4-5a	325.9	0.203	Public waste	21	188	3	1	0.220	2.6E-04	9.7E-05	2.7E-04	1.0E-04
		0.203	Yard waste	1	5	15	1	0.220	1.2E-05	2.6E-06		
P4-5b	250.8	0.156	Public waste	21	188	3	1	0.220	2.0E-04	7.5E-05	2.9E-03	9.9E-04
		0.156	Yard waste	1	5	15	1	0.220	9.5E-06	2.0E-06		
		0.156	Waste truck	6	49	18	2	5.163	2.7E-03	9.1E-04		
P5-6	46.2	0.029	Waste truck	6	49	18	2	5.163	4.9E-04	1.7E-04	4.9E-04	1.7E-04
U6-7	266.1	0.165	Waste truck	6	49	18	2	5.163	2.8E-03	9.7E-04	2.8E-03	9.7E-04
U7-8	139.3	0.087	Mining truck	2	18	18	2	5.163	5.0E-04	1.9E-04	5.0E-04	1.9E-04
U7-9	651.2	0.405	Waste truck	6	49	18	2	5.163	7.0E-03	2.4E-03	9.3E-03	3.2E-03
		0.405	Mining truck	2	18	18	2	5.163	2.3E-03	8.7E-04		
U9-10	153.2	0.095	Waste truck	6	49	18	2	5.163	1.6E-03	5.6E-04	2.5E-03	8.6E-04
		0.095	Mining truck	2	18	18	2	5.163	5.5E-04	2.0E-04		
		0.095	Soil cover truck	1	9	9	2	5.163	2.7E-04	1.0E-04		

								SO2				
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	1-hr Emission Rate (g/s)	24-hr Emission Rate (g/s)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	0.004	2.0E-06	7.6E-07	5.2E-06	1.8E-06
		0.098	Yard waste	1	5	15	1	0.004	9.7E-08	2.0E-08		
		0.098	Waste truck	6	49	18	1	0.019	3.1E-06	1.1E-06		
P2-3	17.6	0.011	Public waste	21	188	3	1	0.004	2.3E-07	8.4E-08	5.8E-07	2.0E-07
		0.011	Yard waste	1	5	15	1	0.004	1.1E-08	2.2E-09		
		0.011	Waste truck	6	49	18	1	0.019	3.5E-07	1.2E-07		
P3-4	149.2	0.093	Public waste	21	188	3	2	0.004	3.8E-06	1.4E-06	9.9E-06	3.5E-06
		0.093	Yard waste	1	5	15	2	0.004	1.8E-07	3.8E-08		
		0.093	Waste truck	6	49	18	2	0.019	5.9E-06	2.0E-06		
P4-5a	325.9	0.203	Public waste	21	188	3	1	0.004	4.2E-06	1.6E-06	4.4E-06	1.6E-06
		0.203	Yard waste	1	5	15	1	0.004	2.0E-07	4.1E-08		
P4-5b	250.8	0.156	Public waste	21	188	3	1	0.004	3.2E-06	1.2E-06	1.3E-05	4.6E-06
		0.156	Yard waste	1	5	15	1	0.004	1.5E-07	3.2E-08		
		0.156	Waste truck	6	49	18	2	0.019	9.9E-06	3.4E-06		
P5-6	46.2	0.029	Waste truck	6	49	18	2	0.019	1.8E-06	6.2E-07	1.8E-06	6.2E-07
U6-7	266.1	0.165	Waste truck	6	49	18	2	0.019	1.0E-05	3.6E-06	1.0E-05	3.6E-06
U7-8	139.3	0.087	Mining truck	2	18	18	2	0.019	1.8E-06	6.9E-07	1.8E-06	6.9E-07
U7-9	651.2	0.405	Waste truck	6	49	18	2	0.019	2.6E-05	8.7E-06	3.4E-05	1.2E-05
		0.405	Mining truck	2	18	18	2	0.019	8.6E-06	3.2E-06		
U9-10	153.2	0.095	Waste truck	6	49	18	2	0.019	6.0E-06	2.1E-06	9.1E-06	3.2E-06
		0.095	Mining truck	2	18	18	2	0.019	2.0E-06	7.6E-07		
		0.095	Soil cover truck	1	9	9	2	0.019	1.0E-06	3.8E-07		

Me

								CO				
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	1-hr Emission Rate (g/s)	24-hr Emission Rate (g/s)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	2.561	1.5E-03	5.5E-04	1.8E-03	6.4E-04
		0.098	Yard waste	1	5	15	1	2.561	7.0E-05	1.5E-05		
		0.098	Waste truck	6	49	18	1	1.420	2.3E-04	7.9E-05		
P2-3	17.6	0.011	Public waste	21	188	3	1	2.561	1.6E-04	6.1E-05	2.0E-04	7.1E-05
		0.011	Yard waste	1	5	15	1	2.561	7.8E-06	1.6E-06		
		0.011	Waste truck	6	49	18	1	1.420	2.6E-05	8.8E-06		
P3-4	149.2	0.093	Public waste	21	188	3	2	2.561	2.8E-03	1.0E-03	3.3E-03	1.2E-03
		0.093	Yard waste	1	5	15	2	2.561	1.3E-04	2.7E-05		
		0.093	Waste truck	6	49	18	2	1.420	4.4E-04	1.5E-04		
P4-5a	325.9	0.203	Public waste	21	188	3	1	2.561	3.0E-03	1.1E-03	3.2E-03	1.2E-03
		0.203	Yard waste	1	5	15	1	2.561	1.4E-04	3.0E-05		
P4-5b	250.8	0.156	Public waste	21	188	3	1	2.561	2.3E-03	8.7E-04	3.2E-03	1.1E-03
		0.156	Yard waste	1	5	15	1	2.561	1.1E-04	2.3E-05		
		0.156	Waste truck	6	49	18	2	1.420	7.4E-04	2.5E-04		
P5-6	46.2	0.029	Waste truck	6	49	18	2	1.420	1.4E-04	4.6E-05	1.4E-04	4.6E-05
U6-7	266.1	0.165	Waste truck	6	49	18	2	1.420	7.8E-04	2.7E-04	7.8E-04	2.7E-04
U7-8	139.3	0.087	Mining truck	2	18	18	2	1.420	1.4E-04	5.1E-05	1.4E-04	5.1E-05
U7-9	651.2	0.405	Waste truck	6	49	18	2	1.420	1.9E-03	6.5E-04	2.6E-03	8.9E-04
		0.405	Mining truck	2	18	18	2	1.420	6.4E-04	2.4E-04		
U9-10	153.2	0.095	Waste truck	6	49	18	2	1.420	4.5E-04	1.5E-04	6.8E-04	2.4E-04
		0.095	Mining truck	2	18	18	2	1.420	1.5E-04	5.6E-05		
		0.095	Soil cover truck	1	9	9	2	1.420	7.5E-05	2.8E-05		

Table A.10
Nonroad Equipment Combustion Emission Factors
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Based on guidance provided by USEPA AP-42 Exhaust and Crankcase Emission Factors for Non-Road Engine Modeling Compression-Ignition (2010).

Non Road Emission Factors

Zero-hour, steady-state emission factors for non-road CI Engines (US EPA, 2010, Table A4)

Engine Power (hp)	Technology Type	BSFC (lb/hp-hr)	Emission Factors (g/hp-hr)						
			HC	CO	NOx	PM	SO2	CO2	S_{PMadj}
>75 to 100	Tier 3	0.408	0.1836	2.3655	3.0	0.20	0.0038	589.8	0.096
>100 to 175	Tier 3	0.367	0.1836	0.8667	2.5	0.22	0.0034	530.5	0.086
>175 to 300	Tier 3	0.367	0.1836	0.7475	2.5	0.15	0.0034	530.5	0.086
>300 to 600	Tier 3	0.367	0.1669	0.8425	2.5	0.15	0.0034	530.5	0.086
>600 to 750	Tier 3	0.367	0.1669	1.3272	2.5	0.15	0.0034	530.5	0.086

Transient Adjustment Factors by Equipment type for nonroad CI equipment (US EPA, 2010, Table A5)

Equipment Type	Cycle	TAF Assignment	HC	CO	NOx	PM
Excavator	Excavator	Hi LF	1.05	1.53	1.04	1.47
Off-highway Tractors	Crawler	Hi LF	1.05	1.53	1.04	1.47
Rubber Tire Loader	RTLoader	HI LF	1.05	1.53	1.04	1.47
Rubber Tire Dozer	Crawler	Hi LF	1.05	1.53	1.04	1.47
Other Construction Eqmt.	Crawler	HiLF	1.05	1.53	1.04	1.47

Deterioration Factors for Nonroad Diesel Engines (US EPA, 2010, Table A6)

Pollutant	Tier 3 Relative Deterioration Factor (A) (%increate/%useful life)
CO	0.151
NOx	0.008
PM	0.473

Nonroad Equipment Emission Factors

Equipment	Equipment Type	Cycle	Power Rating (hp)	NOx Emission Factor (g/hp.hr)	PM Emission Factor (g/hp.hr)	SO2 Emission Factor (g/hp.hr)	CO2 Emission Factor (g/hp.hr)	CO Emission Factor (g/hp.hr)
Landfill Operations								
CAT 826 Compactor	Other Construction Eqmt.	Crawler	341	2.621	0.239	0.0034	530.5	1.484
CAT D-6 Bulldozer	Rubber Tire Dozer	Crawler	189	2.621	0.239	0.0034	530.5	1.316
Terex TA 27 Rock Truck	Rubber Tire Loader	RTLoader	365	2.621	0.239	0.0034	530.5	1.484
Case 821 Front End Loader	Rubber Tire Loader	RTLoader	186	2.621	0.239	0.0034	530.5	1.316
John Deere Farm Tractor 5420	Off-highway Tractors	Crawler	81	3.145	0.337	0.0038	589.8	4.166
Cell Construction Operations								
CAT D-7 Bulldozer	Rubber Tire Dozer	Crawler	200	2.621	0.239	0.0034	530.5	1.316
Cell Mining Operations								
CAT 345 Excavator	Excavator	Excavator	345	2.621	0.239	0.0034	530.5	1.484
CAT D-7 Bulldozer	Rubber Tire Dozer	Crawler	200	2.621	0.239	0.0034	530.5	1.316
CAT 735 Articulating Truck	Rubber Tire Loader	RTLoader	413	2.621	0.239	0.0034	530.5	1.484

Nonroad Equipment Steady-State Emission Factors

Equipment Type	Power Rating (hp)	NOx Emission Factor (g/hp.hr)	PM Emission Factor (g/hp.hr)	SO2 Emission Factor (g/hp.hr)	CO2 Emission Factor (g/hp.hr)	CO Emission Factor (g/hp.hr)
Landfill Operations						
RotoScreen Compost Screener	225	2.5	0.15	0.0034	530.5	0.7475
Cell Mining Operations						
McCloskey MCB 733 Trommel Screeners	225	2.5	0.15	0.0034	530.5	0.7475
McCloskey Stacker	90	3.0	0.2	0.0038	589.8	2.366
Mobark 1100 Tub Grinder	600	2.5	0.15	0.0034	530.5	0.8425

Table A.11
NonRoad Equipment Emission Estimates
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

							TSP			PM10			PM2.5		
Source ID	**Included Sources**	**Emission Type**	**Average Daily Operating Hours**	**hp**	**Number of Units**	**Emission Factor (g/hp.hr)**	1-hr Emission Rate (g/s)(1)	24-hr Emission Rate (g/s)(1)	TOTAL 24-hr Emission Rate (g/s)	1-hr Emission Rate (g/s)(1)	24-hr Emission Rate (g/s)(1)	TOTAL 24-hr Emission Rate (g/s)	1-hr Emission Rate (g/s)(1)(2)	24-hr Emission Rate (g/s)(1)(2)	TOTAL 24-hr Emission Rate (g/s)
S1	CAT 826 Compactor	Non Road Mobile Combustion	6	341	1	0.239	1.24E-02	3.11E-03	4.26E-03	1.24E-02	3.11E-03	4.26E-03	1.24E-02	3.11E-03	4.26E-03
	CAT D-6 Bulldozer	Non Road Mobile Combustion	4	189	1	0.239	6.89E-03	1.15E-03		6.89E-03	1.15E-03		6.89E-03	1.15E-03	
S2	Case 821 Front End Loader	Non Road Mobile Combustion	5	186	1	0.239	6.78E-03	1.41E-03	1.41E-03	6.78E-03	1.41E-03	1.41E-03	6.78E-03	1.41E-03	1.41E-03
S3	John Deere Farm Tractor 5420	Non Road Mobile Combustion	5	81	1	0.337	4.17E-03	8.70E-04	8.70E-04	4.17E-03	8.70E-04	8.70E-04	4.17E-03	8.70E-04	8.70E-04
S4	CAT 345 Excavator	Non Road Mobile Combustion	9	345	2	0.239	2.52E-02	9.44E-03	9.44E-03	2.52E-02	9.44E-03	9.44E-03	2.52E-02	9.44E-03	9.44E-03
S4	CAT D-7 Bulldozer	Non Road Mobile Combustion	9	200	1	0.239	7.29E-03	2.73E-03	2.73E-03	7.29E-03	2.73E-03	2.73E-03	7.29E-03	2.73E-03	2.73E-03
S5	RotoScreen Compost Screener	Stationary Combustion	5	225	1	0.150	9.38E-03	1.95E-03	1.95E-03	9.38E-03	1.95E-03	1.95E-03	9.38E-03	1.95E-03	1.95E-03
S6	Terex TA 27 Rock Truck	Non Road Mobile Combustion	4	365	1	0.239	1.33E-02	2.22E-03	2.22E-03	1.33E-02	2.22E-03	2.22E-03	1.33E-02	2.22E-03	2.22E-03
S4	McCloskey MCB 733 Trommel Screeners	Stationary Combustion	9	225	2	0.150	1.88E-02	7.03E-03	1.83E-02	1.88E-02	7.03E-03	1.83E-02	1.88E-02	7.03E-03	1.83E-02
	McCloskey Stacker	Stationary Combustion	9	90	1	0.200	5.00E-03	1.88E-03		5.00E-03	1.88E-03		5.00E-03	1.88E-03	
	Mobark 1100 Tub Grinder	Stationary Combustion	9	600	1	0.150	2.50E-02	9.38E-03		2.50E-02	9.38E-03		2.50E-02	9.38E-03	
S7	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	0.239	3.01E-02	1.13E-02	1.13E-02	3.01E-02	1.13E-02	1.13E-02	3.01E-02	1.13E-02	1.13E-02
S8	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	0.239	3.01E-02	1.13E-02	1.13E-02	3.01E-02	1.13E-02	1.13E-02	3.01E-02	1.13E-02	1.13E-02

							NOX			
Source ID	**Included Sources**	**Emission Type**	**Average Daily Operating Hours**	**hp**	**Number of Units**	**Emission Factor (g/hp.hr)**	1-hr Emission Rate (g/s)(1)	24-hr Emission Rate (g/s)(1)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
S1	CAT 826 Compactor	Non Road Mobile Combustion	6	341	1	2.621	1.37E-01	3.41E-02	2.12E-01	4.67E-02
	CAT D-6 Bulldozer	Non Road Mobile Combustion	4	189	1	2.621	7.57E-02	1.26E-02		
S2	Case 821 Front End Loader	Non Road Mobile Combustion	5	186	1	2.621	7.45E-02	1.55E-02	7.45E-02	1.55E-02
S3	John Deere Farm Tractor 5420	Non Road Mobile Combustion	5	81	1	3.145	3.89E-02	8.11E-03	3.89E-02	8.11E-03
S4	CAT 345 Excavator	Non Road Mobile Combustion	9	345	2	2.621	2.76E-01	1.04E-01	2.76E-01	1.04E-01
S4	CAT D-7 Bulldozer	Non Road Mobile Combustion	9	200	1	2.621	8.01E-02	3.00E-02	8.01E-02	3.00E-02
S5	RotoScreen Compost Screener	Stationary Combustion	5	225	1	2.500	1.56E-01	3.26E-02	1.56E-01	3.26E-02
S6	Terex TA 27 Rock Truck	Non Road Mobile Combustion	4	365	1	2.621	1.46E-01	2.44E-02	1.46E-01	2.44E-02
S4	McCloskey MCB 733 Trommel Screeners	Stationary Combustion	9	225	2	2.500	3.13E-01	1.17E-01	8.04E-01	3.02E-01
	McCloskey Stacker	Stationary Combustion	9	90	1	3.000	7.50E-02	2.81E-02		
	Mobark 1100 Tub Grinder	Stationary Combustion	9	600	1	2.500	4.17E-01	1.56E-01		
S7	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	2.621	3.31E-01	1.24E-01	3.31E-01	1.24E-01
S8	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	2.621	3.31E-01	1.24E-01	3.31E-01	1.24E-01

							SO2			
Source ID	**Included Sources**	**Emission Type**	**Average Daily Operating Hours**	**hp**	**Number of Units**	**Emission Factor (g/hp.hr)**	1-hr Emission Rate (g/s)(1)	24-hr Emission Rate (g/s)(1)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
S1	CAT 826 Compactor	Non Road Mobile Combustion	6	341	1	0.0034	1.79E-04	4.47E-05	2.78E-04	6.13E-05
	CAT D-6 Bulldozer	Non Road Mobile Combustion	4	189	1	0.0034	9.92E-05	1.65E-05		
S2	Case 821 Front End Loader	Non Road Mobile Combustion	5	186	1	0.0034	9.76E-05	2.03E-05	9.76E-05	2.03E-05
S3	John Deere Farm Tractor 5420	Non Road Mobile Combustion	5	81	1	0.0038	4.72E-05	9.84E-06	4.72E-05	9.84E-06
S4	CAT 345 Excavator	Non Road Mobile Combustion	9	345	2	0.0034	3.62E-04	1.36E-04	3.62E-04	1.36E-04
S4	CAT D-7 Bulldozer	Non Road Mobile Combustion	9	200	1	0.0034	1.05E-04	3.93E-05	1.05E-04	3.93E-05
S5	RotoScreen Compost Screener	Stationary Combustion	5	225	1	0.0034	2.15E-04	4.47E-05	2.15E-04	4.47E-05
S6	Terex TA 27 Rock Truck	Non Road Mobile Combustion	4	365	1	0.0034	1.92E-04	3.19E-05	1.92E-04	3.19E-05
S4	McCloskey MCB 733 Trommel Screeners	Stationary Combustion	9	225	2	0.0034	4.29E-04	1.61E-04	1.10E-03	4.11E-04
	McCloskey Stacker	Stationary Combustion	9	90	1	0.0038	9.55E-05	3.58E-05		
	Mobark 1100 Tub Grinder	Stationary Combustion	9	600	1	0.0034	5.72E-04	2.15E-04		
S7	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	0.0034	4.33E-04	1.63E-04	4.33E-04	1.63E-04
S8	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	0.0034	4.33E-04	1.63E-04	4.33E-04	1.63E-04

							CO			
Source ID	**Included Sources**	**Emission Type**	**Average Daily Operating Hours**	**hp**	**Number of Units**	**Emission Factor (g/hp.hr)**	1-hr Emission Rate (g/s)(1)	24-hr Emission Rate (g/s)(1)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
S1	CAT 826 Compactor	Non Road Mobile Combustion	6	341	1	1.484	7.73E-02	1.93E-02	1.15E-01	2.57E-02
	CAT D-6 Bulldozer	Non Road Mobile Combustion	4	189	1	1.316	3.80E-02	6.34E-03		
S2	Case 821 Front End Loader	Non Road Mobile Combustion	5	186	1	1.316	3.74E-02	7.79E-03	3.74E-02	7.79E-03
S3	John Deere Farm Tractor 5420	Non Road Mobile Combustion	5	81	1	4.166	5.16E-02	1.07E-02	5.16E-02	1.07E-02
S4	CAT 345 Excavator	Non Road Mobile Combustion	9	345	2	1.484	1.56E-01	5.87E-02	1.56E-01	5.87E-02
S4	CAT D-7 Bulldozer	Non Road Mobile Combustion	9	200	1	1.316	4.02E-02	1.51E-02	4.02E-02	1.51E-02
S5	RotoScreen Compost Screener	Stationary Combustion	5	225	1	0.748	4.67E-02	9.73E-03	4.67E-02	9.73E-03
S6	Terex TA 27 Rock Truck	Non Road Mobile Combustion	4	365	1	1.484	8.27E-02	1.38E-02	8.27E-02	1.38E-02
S4	McCloskey MCB 733 Trommel Screeners	Stationary Combustion	9	225	2	0.748	9.34E-02	3.50E-02	2.93E-01	1.10E-01
	McCloskey Stacker	Stationary Combustion	9	90	1	2.366	5.91E-02	2.22E-02		
	Mobark 1100 Tub Grinder	Stationary Combustion	9	600	1	0.843	1.40E-01	5.27E-02		
S7	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	1.484	1.87E-01	7.02E-02	1.87E-01	7.02E-02
S8	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	1.484	1.87E-01	7.02E-02	1.87E-01	7.02E-02

Notes:
(1) Estimated that nonroad mobile combustion equipment operates at full load for 50% of the time, and 10% load (idle) for 50% of the time.

Table A.12
Material Handling Emission Estimates
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Amount of Material Handled

Scenario	Quantity (tonnes/hr)
Soil cover	24.9

Emission Rates

Source	Scenario	PM Fraction	Emission Factor (kg/tonne)[1]	24-hr Emission Rate (g/s)[2]
S1	Soil cover	$PM_{2.5}$	2.83E-05	7.75E-05
		PM_{10}	1.87E-04	5.12E-04
		PM_{30}	3.95E-04	1.08E-03

Notes:
(1) Based on guidance provided by USEPA AP-42 Compilation of Emission Factors Chapter 13.2.4 - Aggregate Handling and Storage Piles (Nov. 2006).

k = particle size multiplier

Particle Size Multiplier		
$PM_{2.5}$	PM_{10}	PM_{30}
0.053	0.35	0.74

U = mean wind speed[3] =	3.9	m/s
M = material moisture content (sandy soil) =	7.4	%

(2) Based on site operating hours of 7:30 a.m. - 5:00 p.m.
(3) Taken from local meteorological data processed by the MECP for the period of 2014-2018.

Table A.13
Wind Erosion Emission Factors
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Anemometer Height	10	m
Threshold Friction Velocity[1]	1.02	m/s
Roughness Height[1]	0.3	cm
Conversion to fastest mile[2]	1.5	
Particle Size Multipliers[1]	1.0	k_{TSP}
	0.5	k_{PM10}
	0.075	$k_{PM2.5}$

Year	Month	Day	Hour	Wind Speed (m/s)	Fastest Mile Wind Speed (m/s)	Friction Velocity (m/s)	Erosion Potential (g/m^2)	EF_{TSP} (g/m^2)	EF_{PM10} (g/m^2)	$EF_{PM2.5}$ (g/m^2)
14	1	25	3	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	1	25	4	13.9	20.9	1.11	2.55	2.55	1.27	0.19
14	2	21	2	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	3	22	8	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	3	22	10	15.4	23.1	1.22	7.53	7.53	3.76	0.56
14	3	22	11	15.4	23.1	1.22	7.53	7.53	3.76	0.56
14	3	22	12	13.4	20.1	1.07	1.25	1.25	0.63	0.09
14	3	22	13	13.4	20.1	1.07	1.25	1.25	0.63	0.09
14	3	22	14	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	3	22	15	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	4	5	2	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	4	5	3	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	10	14	21	13.4	20.1	1.07	1.25	1.25	0.63	0.09
14	10	25	18	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	10	25	21	15.4	23.1	1.22	7.53	7.53	3.76	0.56
14	10	25	22	14.4	21.6	1.14	4.02	4.02	2.01	0.30
14	10	25	23	13.9	20.9	1.11	2.55	2.55	1.27	0.19
14	10	25	24	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	10	26	1	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	11	8	13	13.4	20.1	1.07	1.25	1.25	0.63	0.09
14	11	8	15	13.4	20.1	1.07	1.25	1.25	0.63	0.09
14	11	20	3	14.9	22.4	1.18	5.68	5.68	2.84	0.43
14	12	1	10	13.4	20.1	1.07	1.25	1.25	0.63	0.09
14	12	1	11	13.9	20.9	1.11	2.55	2.55	1.27	0.19
14	12	1	12	13.9	20.9	1.11	2.55	2.55	1.27	0.19
14	12	3	17	13.4	20.1	1.07	1.25	1.25	0.63	0.09
14	12	3	18	13.4	20.1	1.07	1.25	1.25	0.63	0.09
14	12	3	19	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	12	27	21	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	12	27	22	12.9	19.4	1.03	0.14	0.14	0.07	0.01
14	12	31	18	13.9	20.9	1.11	2.55	2.55	1.27	0.19
15	1	1	18	13.4	20.1	1.07	1.25	1.25	0.63	0.09
15	1	29	17	12.9	19.4	1.03	0.14	0.14	0.07	0.01
15	3	17	13	13.4	20.1	1.07	1.25	1.25	0.63	0.09
15	3	17	14	15.4	23.1	1.22	7.53	7.53	3.76	0.56
15	3	17	15	12.9	19.4	1.03	0.14	0.14	0.07	0.01
15	4	10	13	12.9	19.4	1.03	0.14	0.14	0.07	0.01
15	11	6	8	13.4	20.1	1.07	1.25	1.25	0.63	0.09
16	1	28	14	12.9	19.4	1.03	0.14	0.14	0.07	0.01
16	1	28	15	12.9	19.4	1.03	0.14	0.14	0.07	0.01
16	2	29	10	13.4	20.1	1.07	1.25	1.25	0.63	0.09
16	2	29	11	18	27.0	1.43	20.07	20.07	10.04	1.51
16	2	29	12	16.5	24.8	1.31	12.23	12.23	6.12	0.92
16	2	29	13	16.5	24.8	1.31	12.23	12.23	6.12	0.92
16	2	29	14	17	25.5	1.35	14.66	14.66	7.33	1.10
16	2	29	15	13.4	20.1	1.07	1.25	1.25	0.63	0.09
16	2	29	16	13.9	20.9	1.11	2.55	2.55	1.27	0.19
16	4	2	17	12.9	19.4	1.03	0.14	0.14	0.07	0.01
16	5	14	14	12.9	19.4	1.03	0.14	0.14	0.07	0.01
16	5	14	15	12.9	19.4	1.03	0.14	0.14	0.07	0.01
16	5	14	17	12.9	19.4	1.03	0.14	0.14	0.07	0.01
16	6	8	15	13.4	20.1	1.07	1.25	1.25	0.63	0.09
16	9	10	14	13.4	20.1	1.07	1.25	1.25	0.63	0.09
16	11	19	13	16.5	24.8	1.31	12.23	12.23	6.12	0.92
16	11	19	14	15.4	23.1	1.22	7.53	7.53	3.76	0.56
16	11	19	16	12.9	19.4	1.03	0.14	0.14	0.07	0.01
16	12	14	10	12.9	19.4	1.03	0.14	0.14	0.07	0.01
16	12	14	16	13.9	20.9	1.11	2.55	2.55	1.27	0.19
16	12	14	17	12.9	19.4	1.03	0.14	0.14	0.07	0.01
16	12	14	18	13.4	20.1	1.07	1.25	1.25	0.63	0.09
16	12	14	19	14.4	21.6	1.14	4.02	4.02	2.01	0.30
16	12	14	21	15.4	23.1	1.22	7.53	7.53	3.76	0.56
16	12	15	4	13.4	20.1	1.07	1.25	1.25	0.63	0.09
16	12	15	5	13.9	20.9	1.11	2.55	2.55	1.27	0.19
16	12	15	6	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	1	4	1	12.9	19.4	1.03	0.14	0.14	0.07	0.01

Year	Month	Day	Hour	Wind Speed (m/s)	Fastest Mile Wind Speed (m/s)	Friction Velocity (m/s)	Erosion Potential (g/m^2)	EF_{TSP} (g/m^2)	EF_{PM10} (g/m^2)	$EF_{PM2.5}$ (g/m^2)
17	1	4	12	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	1	4	13	14.4	21.6	1.14	4.02	4.02	2.01	0.30
17	1	4	14	14.9	22.4	1.18	5.68	5.68	2.84	0.43
17	1	7	24	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	1	10	22	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	1	10	23	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	1	10	24	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	1	11	1	16	24.0	1.27	9.98	9.98	4.99	0.75
17	1	11	2	16	24.0	1.27	9.98	9.98	4.99	0.75
17	1	11	3	14.9	22.4	1.18	5.68	5.68	2.84	0.43
17	1	13	1	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	1	26	20	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	2	5	9	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	2	8	3	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	2	12	15	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	2	12	16	13.9	20.9	1.11	2.55	2.55	1.27	0.19
17	2	12	17	13.9	20.9	1.11	2.55	2.55	1.27	0.19
17	2	12	18	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	2	12	20	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	2	25	19	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	3	7	13	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	3	7	14	14.4	21.6	1.14	4.02	4.02	2.01	0.30
17	3	7	16	14.4	21.6	1.14	4.02	4.02	2.01	0.30
17	3	9	3	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	3	10	14	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	3	10	15	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	3	10	20	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	3	21	12	14.9	22.4	1.18	5.68	5.68	2.84	0.43
17	5	6	14	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	5	7	15	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	7	6	13	13.9	20.9	1.11	2.55	2.55	1.27	0.19
17	11	3	9	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	11	9	13	16	24.0	1.27	9.98	9.98	4.99	0.75
17	11	9	15	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	11	9	16	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	11	21	12	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	11	25	14	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	11	26	18	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	11	29	3	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	12	11	24	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	12	19	16	12.9	19.4	1.03	0.14	0.14	0.07	0.01
17	12	19	20	16	24.0	1.27	9.98	9.98	4.99	0.75
17	12	19	21	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	12	19	23	13.4	20.1	1.07	1.25	1.25	0.63	0.09
17	12	19	24	14.9	22.4	1.18	5.68	5.68	2.84	0.43
17	12	20	2	14.4	21.6	1.14	4.02	4.02	2.01	0.30
17	12	25	10	12.9	19.4	1.03	0.14	0.14	0.07	0.01
18	1	11	22	12.9	19.4	1.03	0.14	0.14	0.07	0.01
18	2	1	6	13.4	20.1	1.07	1.25	1.25	0.63	0.09
18	4	4	15	13.4	20.1	1.07	1.25	1.25	0.63	0.09
18	4	6	16	13.4	20.1	1.07	1.25	1.25	0.63	0.09
18	9	21	15	13.4	20.1	1.07	1.25	1.25	0.63	0.09
18	9	21	16	14.9	22.4	1.18	5.68	5.68	2.84	0.43
18	9	21	17	17	25.5	1.35	14.66	14.66	7.33	1.10
18	9	21	18	15.4	23.1	1.22	7.53	7.53	3.76	0.56
18	10	4	3	20.1	30.2	1.60	33.82	33.82	16.91	2.54
18	10	4	4	15.4	23.1	1.22	7.53	7.53	3.76	0.56
18	10	4	5	17	25.5	1.35	14.66	14.66	7.33	1.10
18	10	4	6	16.5	24.8	1.31	12.23	12.23	6.12	0.92
18	10	4	7	12.9	19.4	1.03	0.14	0.14	0.07	0.01
18	10	4	11	13.4	20.1	1.07	1.25	1.25	0.63	0.09
18	10	15	15	13.4	20.1	1.07	1.25	1.25	0.63	0.09
18	10	17	15	13.4	20.1	1.07	1.25	1.25	0.63	0.09
18	11	16	19	13.9	20.9	1.11	2.55	2.55	1.27	0.19
18	11	21	2	14.9	22.4	1.18	5.68	5.68	2.84	0.43
18	12	17	4	14.4	21.6	1.14	4.02	4.02	2.01	0.30
18	12	17	5	14.9	22.4	1.18	5.68	5.68	2.84	0.43

Notes:

(1) Threshold friction velocity and roughness height taken for overburden material and particle size multipliers taken from US EPA AP-42 Chapter 13.2.5 " Industrial Wind Erosion". Final Section. Novemeber 2006.

(2) In Canada, the fastest mile of wind is not routinely recorded by the ECCC or MECP. Accordingly, a conversion factor of 1.5 is applied to the hourly wind speed recorded to estimate the fastest mile of wind.

Table A.14
Wind Erosion Emission Estimates
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Disturbed Area[1]	5,000	m^2
Days with Erosion Potential	64	days

			Maximum Erosion Potential per Event[2]		
			EF_{TSP}	EF_{PM10}	$EF_{PM2.5}$
Year	**Month**	**Day**	**($g/m^2/day$)**	**($g/m^2/day$)**	**($g/m^2/day$)**
14	1	25	2.55	1.27	0.19
14	2	21	0.14	0.07	0.01
14	3	22	7.53	3.76	0.56
14	4	5	0.14	0.07	0.01
14	10	14	1.25	0.63	0.09
14	10	25	7.53	3.76	0.56
14	10	26	0.14	0.07	0.01
14	11	8	1.25	0.63	0.09
14	11	20	5.68	2.84	0.43
14	12	1	2.55	1.27	0.19
14	12	3	1.25	0.63	0.09
14	12	27	0.14	0.07	0.01
14	12	31	2.55	1.27	0.19
15	1	1	1.25	0.63	0.09
15	1	29	0.14	0.07	0.01
15	3	17	7.53	3.76	0.56
15	4	10	0.14	0.07	0.01
15	1	16	1.25	0.63	0.09
16	1	28	0.14	0.07	0.01
16	2	29	20.07	10.04	1.51
16	4	2	0.14	0.07	0.01
16	5	14	0.14	0.07	0.01
16	6	8	1.25	0.63	0.09
16	9	10	1.25	0.63	0.09
16	11	19	12.23	6.12	0.92
16	12	14	7.53	3.76	0.56
16	12	15	2.55	1.27	0.19
17	1	4	5.68	2.84	0.43
17	1	7	0.14	0.07	0.01
17	1	10	0.14	0.07	0.01
17	1	11	9.98	4.99	0.75
17	1	13	1.25	0.63	0.09
17	1	26	0.14	0.07	0.01
17	2	5	0.14	0.07	0.01
17	2	8	0.14	0.07	0.01
17	2	12	2.55	1.27	0.19
17	2	25	1.25	0.63	0.09
17	3	7	4.02	2.01	0.30
17	3	9	0.14	0.07	0.01
17	3	10	1.25	0.63	0.09
17	3	21	5.68	2.84	0.43
17	5	6	0.14	0.07	0.01
17	5	7	0.14	0.07	0.01
17	7	6	2.55	1.27	0.19
17	1	19	9.98	4.99	0.75
17	11	21	0.14	0.07	0.01
17	11	25	1.25	0.63	0.09
17	11	26	0.14	0.07	0.01
17	11	29	0.14	0.07	0.01
17	12	11	1.25	0.63	0.09
17	12	19	9.98	4.99	0.75
17	12	20	4.02	2.01	0.30
17	12	25	0.14	0.07	0.01
18	1	11	0.14	0.07	0.01
18	2	1	1.25	0.63	0.09
18	4	4	1.25	0.63	0.09
18	4	6	1.25	0.63	0.09
18	9	21	14.66	7.33	1.10
18	10	4	33.82	16.91	2.54
18	10	15	1.25	0.63	0.09
18	10	17	1.25	0.63	0.09
18	11	16	2.55	1.27	0.19
18	11	21	5.68	2.84	0.43
18	12	17	5.68	2.84	0.43

Average Daily Erosion Potential:

TSP	3.4	g/m^2
PM10	1.7	g/m^2
PM2.5	0.3	g/m^2

Average Daily Emission Rates:

TSP	0.2	g/s
PM10	0.1	g/s
PM2.5	0.01	g/s

Notes:

(1) Disturbed area estimated as the working face (2,500 m^2) and storage pile (2,500 m^2)

(2) It is estimated that one (1) distrubance event can occur per day. The maximum erosion potentail per day has been selected to represent the worst-case erosion potential per disturbance event.

(3) The worst-case erosion potential emissions were averaged to represent an erosion event.

Appendix B

Source Summary Table

Table B.1
Source Summary Table
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

		Source Data							Emissions Data				
Source Identifier	Source Description	Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof	UTM Coordinate		Contaminant	CAS No.	Max Emission Rate	Averaging Period	Percent of Overall Emission
		[m³/s]	[°C]	[m]	[m]	[m]	X	Y			[g/s]	[hours]	
F1	Flare	17.86	760	2.3	8.5	-	704490	5162142	Nitrogen oxides	10102-44-0	1.15E-01	1	4.44%
									Nitrogen oxides	10102-44-0	1.15E-01	24	12.31%
									Sulphur dioxide	9/5/7446	3.23E-02	1	90.59%
									Sulphur dioxide	9/5/7446	3.23E-02	24	96.67%
									Sulphur dioxide	9/5/7446	3.23E-02	annual	97.14%
									Carbon monoxide	630-08-0	1.34E-01	0.5	9.95%
									TSP	N/A - TSP	4.33E-02	24	5.89%
									TSP	N/A - TSP	4.33E-02	annual	6.52%
									PM10	N/A - PM10	4.33E-02	24	13.50%
									PM2.5	N/A - PM2.5	4.33E-02	24	28.74%
									PM2.5	N/A - PM2.5	4.33E-02	annual	32.06%
									Hydrogen sulphide	6/4/7783	2.87E-04	24	6.45%
									Hydrogen sulphide	6/4/7783	2.87E-04	10-min	6.45%
									Vinyl chloride	75-01-4	1.07E-04	24	6.45%
									Chloroform	67-66-3	8.39E-07	24	6.45%
									Acetone	67-64-1	9.52E-05	24	6.45%
									Acrylonitrile	107-13-1	7.83E-05	24	6.45%
									Benzene	71-43-2	2.01E-04	annual	6.45%
P1_3	Paved Road	Modelled as a line volume source					various		Nitrogen oxides	10102-44-0	9.78E-04	1	0.04%
									Nitrogen oxides	10102-44-0	3.36E-04	24	0.04%
									Sulphur dioxide	9/5/7446	5.24E-06	1	0.01%
									Sulphur dioxide	9/5/7446	1.84E-06	24	0.01%
									Sulphur dioxide	9/5/7446	1.57E-06	annual	0.00%
									Carbon monoxide	630-08-0	1.77E-03	0.5	0.13%
									TSP	N/A - TSP	5.82E-03	24	0.79%
									TSP	N/A - TSP	4.98E-03	annual	0.75%
									PM10	N/A - PM10	1.21E-03	24	0.38%
									PM2.5	N/A - PM2.5	7.29E-04	24	0.48%
									PM2.5	N/A - PM2.5	6.24E-04	annual	0.46%
P2_3	Paved Road	Modelled as a volume source					704393.22	5161912.42	Nitrogen oxides	10102-44-0	1.09E-04	1	0.00%
									Nitrogen oxides	10102-44-0	3.74E-05	24	0.00%
									Sulphur dioxide	9/5/7446	5.83E-07	1	0.00%
									Sulphur dioxide	9/5/7446	2.04E-07	24	0.00%
									Sulphur dioxide	9/5/7446	1.75E-07	annual	0.00%
									Carbon monoxide	630-08-0	1.97E-04	0.5	0.01%
									TSP	N/A - TSP	6.48E-04	24	0.09%
									TSP	N/A - TSP	5.54E-04	annual	0.08%
									PM10	N/A - PM10	1.35E-04	24	0.04%
									PM2.5	N/A - PM2.5	8.12E-05	24	0.05%
									PM2.5	N/A - PM2.5	6.94E-05	annual	0.05%
P3_4	Paved Road	Modelled as a line volume source					various		Nitrogen oxides	10102-44-0	1.85E-03	1	0.07%
									Nitrogen oxides	10102-44-0	6.34E-04	24	0.07%
									Sulphur dioxide	9/5/7446	9.89E-06	1	0.03%
									Sulphur dioxide	9/5/7446	3.47E-06	24	0.01%
									Sulphur dioxide	9/5/7446	2.96E-06	annual	0.01%
									Carbon monoxide	630-08-0	3.34E-03	0.5	0.25%
									TSP	N/A - TSP	1.10E-02	24	1.49%
									TSP	N/A - TSP	9.38E-03	annual	1.41%
									PM10	N/A - PM10	2.29E-03	24	0.71%
									PM2.5	N/A - PM2.5	1.38E-03	24	0.91%
									PM2.5	N/A - PM2.5	1.18E-03	annual	0.87%
P4_5A	Paved Road	Modelled as a line volume source					various		Nitrogen oxides	10102-44-0	2.73E-04	1	0.01%
									Nitrogen oxides	10102-44-0	9.96E-05	24	0.01%
									Sulphur dioxide	9/5/7446	4.38E-06	1	0.01%
									Sulphur dioxide	9/5/7446	1.60E-06	24	0.00%
									Sulphur dioxide	9/5/7446	1.37E-06	annual	0.00%
									Carbon monoxide	630-08-0	3.17E-03	0.5	0.24%
									TSP	N/A - TSP	4.88E-03	24	0.66%
									TSP	N/A - TSP	4.18E-03	annual	0.63%
									PM10	N/A - PM10	1.01E-03	24	0.31%
									PM2.5	N/A - PM2.5	6.02E-04	24	0.40%
									PM2.5	N/A - PM2.5	5.15E-04	annual	0.38%
P4_5B	Paved Road	Modelled as a line volume source					various		Nitrogen oxides	10102-44-0	2.89E-03	1	0.11%
									Nitrogen oxides	10102-44-0	9.89E-04	24	0.11%
									Sulphur dioxide	9/5/7446	1.33E-05	1	0.04%
									Sulphur dioxide	9/5/7446	4.60E-06	24	0.01%
									Sulphur dioxide	9/5/7446	3.93E-06	annual	0.01%
									Carbon monoxide	630-08-0	3.18E-03	0.5	0.24%
									TSP	N/A - TSP	1.47E-02	24	2.00%
									TSP	N/A - TSP	1.26E-02	annual	1.89%
									PM10	N/A - PM10	3.07E-03	24	0.96%
									PM2.5	N/A - PM2.5	1.85E-03	24	1.23%
									PM2.5	N/A - PM2.5	1.58E-03	annual	1.17%
P5_6	Paved Road	Modelled as a line volume source					various		Nitrogen oxides	10102-44-0	4.94E-04	1	0.02%
									Nitrogen oxides	10102-44-0	1.68E-04	24	0.02%
									Sulphur dioxide	9/5/7446	1.82E-06	1	0.01%
									Sulphur dioxide	9/5/7446	6.20E-07	24	0.00%
									Sulphur dioxide	9/5/7446	5.30E-07	annual	0.00%
									Carbon monoxide	630-08-0	1.36E-04	0.5	0.01%
									TSP	N/A - TSP	2.01E-03	24	0.27%
									TSP	N/A - TSP	1.72E-03	annual	0.26%
									PM10	N/A - PM10	4.23E-04	24	0.13%
									PM2.5	N/A - PM2.5	2.55E-04	24	0.17%
									PM2.5	N/A - PM2.5	2.18E-04	annual	0.16%

		Source Data							Emissions Data				
Source Identifier	Source Description	Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof	UTM Coordinate		Contaminant	CAS No.	Max Emission Rate	Averaging Period	Percent of Overall Emission
		[m³/s]	[°C]	[m]	[m]	[m]	X	Y			[g/s]	[hours]	
U6_7	Unpaved Road	Modelled as a line volume source					various		Nitrogen oxides	10102-44-0	2.85E-03	1	0.11%
									Nitrogen oxides	10102-44-0	9.68E-04	24	0.10%
									Sulphur dioxide	9/5/7446	1.05E-05	1	0.03%
									Sulphur dioxide	9/5/7446	3.57E-06	24	0.01%
									Sulphur dioxide	9/5/7446	3.05E-06	annual	0.01%
									Carbon monoxide	630-08-0	7.83E-04	0.5	0.06%
									TSP	N/A - TSP	6.25E-02	24	8.50%
									TSP	N/A - TSP	5.35E-02	annual	8.05%
									PM10	N/A - PM10	1.70E-02	24	5.29%
									PM2.5	N/A - PM2.5	4.28E-03	24	2.84%
									PM2.5	N/A - PM2.5	3.65E-03	annual	2.70%
U7_8	Unpaved Road	Modelled as a line volume source					various		Nitrogen oxides	10102-44-0	4.97E-04	1	0.02%
									Nitrogen oxides	10102-44-0	1.86E-04	24	0.02%
									Sulphur dioxide	9/5/7446	1.83E-06	1	0.01%
									Sulphur dioxide	9/5/7446	6.87E-07	24	0.002%
									Sulphur dioxide	9/5/7446	5.87E-07	annual	0.002%
									Carbon monoxide	630-08-0	1.37E-04	0.5	0.01%
									TSP	N/A - TSP	1.20E-02	24	1.63%
									TSP	N/A - TSP	1.03E-02	annual	1.55%
									PM10	N/A - PM10	3.26E-03	24	1.02%
									PM2.5	N/A - PM2.5	8.21E-04	24	0.54%
									PM2.5	N/A - PM2.5	7.02E-04	annual	0.52%
U7_9	Unpaved Road	Modelled as a line volume source					various		Nitrogen oxides	10102-44-0	9.28E-03	1	0.36%
									Nitrogen oxides	10102-44-0	3.24E-03	24	0.35%
									Sulphur dioxide	9/5/7446	3.42E-05	1	0.10%
									Sulphur dioxide	9/5/7446	1.20E-05	24	0.04%
									Sulphur dioxide	9/5/7446	1.02E-05	annual	0.03%
									Carbon monoxide	630-08-0	2.55E-03	0.5	0.19%
									TSP	N/A - TSP	2.09E-01	24	28.43%
									TSP	N/A - TSP	1.79E-01	annual	26.93%
									PM10	N/A - PM10	5.68E-02	24	17.71%
									PM2.5	N/A - PM2.5	1.43E-02	24	9.49%
									PM2.5	N/A - PM2.5	1.22E-02	annual	9.05%
U9_10	Unpaved Road	Modelled as a line volume source					various		Nitrogen oxides	10102-44-0	2.46E-03	1	0.10%
									Nitrogen oxides	10102-44-0	8.65E-04	24	0.09%
									Sulphur dioxide	9/5/7446	9.06E-06	1	0.03%
									Sulphur dioxide	9/5/7446	3.19E-06	24	0.01%
									Sulphur dioxide	9/5/7446	2.73E-06	annual	0.01%
									Carbon monoxide	630-08-0	6.76E-04	0.5	0.05%
									TSP	N/A - TSP	3.61E-02	24	4.90%
									TSP	N/A - TSP	3.08E-02	annual	4.64%
									PM10	N/A - PM10	9.82E-03	24	3.06%
									PM2.5	N/A - PM2.5	2.48E-03	24	1.65%
									PM2.5	N/A - PM2.5	2.12E-03	annual	1.57%
S1	Working Face	Modelled as a volume source					704946.54	5162827.7	Nitrogen oxides	10102-44-0	2.12E-01	1	8.20%
									Nitrogen oxides	10102-44-0	4.67E-02	24	5.01%
									Sulphur dioxide	9/5/7446	2.78E-04	1	0.78%
									Sulphur dioxide	9/5/7446	6.13E-05	24	0.18%
									Sulphur dioxide	9/5/7446	5.24E-05	annual	0.16%
									Carbon monoxide	630-08-0	1.15E-01	0.5	8.55%
									TSP	N/A - TSP	1.26E-01	24	17.09%
									TSP	N/A - TSP	1.22E-01	annual	18.36%
									PM10	N/A - PM10	6.01E-02	24	18.73%
									PM2.5	N/A - PM2.5	1.23E-02	24	8.19%
									PM2.5	N/A - PM2.5	1.06E-02	annual	7.81%
S2	Stock Pile	Modelled as a volume source					704752.17	5162745.31	Nitrogen oxides	10102-44-0	7.45E-02	1	2.88%
									Nitrogen oxides	10102-44-0	1.55E-02	24	1.66%
									Sulphur dioxide	9/5/7446	9.76E-05	1	0.27%
									Sulphur dioxide	9/5/7446	2.03E-05	24	0.06%
									Sulphur dioxide	9/5/7446	1.74E-05	annual	0.05%
									Carbon monoxide	630-08-0	3.74E-02	0.5	2.78%
									TSP	N/A - TSP	1.09E-01	24	14.78%
									TSP	N/A - TSP	1.07E-01	annual	16.17%
									PM10	N/A - PM10	5.32E-02	24	16.59%
									PM2.5	N/A - PM2.5	9.07E-03	24	6.02%
									PM2.5	N/A - PM2.5	7.76E-03	annual	5.74%
S3	John Deere Farm Tractor 5420	Modelled as a volume source					704296.06	5162174.49	Nitrogen oxides	10102-44-0	3.89E-02	1	1.50%
									Nitrogen oxides	10102-44-0	8.11E-03	24	0.87%
									Sulphur dioxide	9/5/7446	4.72E-05	1	0.13%
									Sulphur dioxide	9/5/7446	9.84E-06	24	0.03%
									Sulphur dioxide	9/5/7446	8.41E-06	annual	0.03%
									Carbon monoxide	630-08-0	5.16E-02	0.5	3.82%
									TSP	N/A - TSP	5.01E-03	24	0.68%
									TSP	N/A - TSP	4.28E-03	annual	0.65%
									PM10	N/A - PM10	1.99E-03	24	0.62%
									PM2.5	N/A - PM2.5	9.81E-04	24	0.65%
									PM2.5	N/A - PM2.5	8.39E-04	annual	0.62%

Source Identifier	Source Description	Source Data							Emissions Data				
		Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof	UTM Coordinate		Contaminant	CAS No.	Max Emission Rate	Averaging Period	Percent of Overall Emission
		[m³/s]	[°C]	[m]	[m]	[m]	X	Y			[g/s]	[hours]	
S4	CAT 345 Excavator, CAT D-7 Bulldozer, & Stationary Equipment	Modelled as a volume source					704590.94	5162382.61	Nitrogen oxides	10102-44-0	1.16E+00	1	44.87%
									Nitrogen oxides	10102-44-0	4.35E-01	24	46.65%
									Sulphur dioxide	9/5/7446	1.56E-03	1	4.39%
									Sulphur dioxide	9/5/7446	5.87E-04	24	1.76%
									Sulphur dioxide	9/5/7446	5.01E-04	annual	1.51%
									Carbon monoxide	630-08-0	4.90E-01	0.5	36.33%
									TSP	N/A - TSP	6.74E-02	24	9.16%
									TSP	N/A - TSP	5.76E-02	annual	8.68%
									PM10	N/A - PM10	4.04E-02	24	12.60%
									PM2.5	N/A - PM2.5	3.14E-02	24	20.87%
									PM2.5	N/A - PM2.5	2.69E-02	annual	19.90%
S5	RotoScreen Compost Screener	0.24 (1)	50	0.1	-	1.0 (1)	704272.80	5162169.29	Nitrogen oxides	10102-44-0	1.56E-01	1	6.04%
									Nitrogen oxides	10102-44-0	3.26E-02	24	3.49%
									Sulphur dioxide	9/5/7446	2.15E-04	1	0.60%
									Sulphur dioxide	9/5/7446	4.47E-05	24	0.13%
									Sulphur dioxide	9/5/7446	3.82E-05	annual	0.12%
									Carbon monoxide	630-08-0	4.67E-02	0.5	3.47%
									TSP	N/A - TSP	1.95E-03	24	0.27%
									TSP	N/A - TSP	1.67E-03	annual	0.25%
									PM10	N/A - PM10	1.95E-03	24	0.61%
									PM2.5	N/A - PM2.5	1.95E-03	24	1.30%
									PM2.5	N/A - PM2.5	1.67E-03	annual	1.24%
S6	Rock Truck	Modelled as a volume source					704846.54	5162783.09	Nitrogen oxides	10102-44-0	1.46E-01	1	5.65%
									Nitrogen oxides	10102-44-0	2.44E-02	24	2.61%
									Sulphur dioxide	9/5/7446	1.92E-04	1	0.54%
									Sulphur dioxide	9/5/7446	3.19E-05	24	0.10%
									Sulphur dioxide	9/5/7446	2.73E-05	annual	0.08%
									Carbon monoxide	630-08-0	8.27E-02	0.5	6.14%
									TSP	N/A - TSP	2.22E-03	24	0.30%
									TSP	N/A - TSP	1.90E-03	annual	0.29%
									PM10	N/A - PM10	2.22E-03	24	0.69%
									PM2.5	N/A - PM2.5	2.22E-03	24	1.47%
									PM2.5	N/A - PM2.5	1.90E-03	annual	1.40%
S7	Articulating Truck	Modelled as a volume source					704501.03	5162640.39	Nitrogen oxides	10102-44-0	3.31E-01	1	12.79%
									Nitrogen oxides	10102-44-0	1.24E-01	24	13.29%
									Sulphur dioxide	9/5/7446	4.33E-04	1	1.22%
									Sulphur dioxide	9/5/7446	1.63E-04	24	0.49%
									Sulphur dioxide	9/5/7446	1.39E-04	annual	0.42%
									Carbon monoxide	630-08-0	1.87E-01	0.5	13.89%
									TSP	N/A - TSP	1.13E-02	24	1.53%
									TSP	N/A - TSP	9.65E-03	annual	1.45%
									PM10	N/A - PM10	1.13E-02	24	3.52%
									PM2.5	N/A - PM2.5	1.13E-02	24	7.49%
									PM2.5	N/A - PM2.5	9.65E-03	annual	7.15%
S8	Articulating Truck	Modelled as a volume source					704383.13	5162415.06	Nitrogen oxides	10102-44-0	3.31E-01	1	12.79%
									Nitrogen oxides	10102-44-0	1.24E-01	24	13.29%
									Sulphur dioxide	9/5/7446	4.33E-04	1	1.22%
									Sulphur dioxide	9/5/7446	1.63E-04	24	0.49%
									Sulphur dioxide	9/5/7446	1.39E-04	annual	0.42%
									Carbon monoxide	630-08-0	1.87E-01	0.5	13.89%
									TSP	N/A - TSP	1.13E-02	24	1.53%
									TSP	N/A - TSP	9.65E-03	annual	1.45%
									PM10	N/A - PM10	1.13E-02	24	3.52%
									PM2.5	N/A - PM2.5	1.13E-02	24	7.49%
									PM2.5	N/A - PM2.5	9.65E-03	annual	7.15%
S9	Landfill	Modelled as an area source					704817.86	5162913.44	Odour	N/A - Odour	8.16E+02 OU/s	10-min	22.89%
									Hydrogen sulphide	6/4/7783	4.17E-03	24	93.55%
									Hydrogen sulphide	6/4/7783	4.17E-03	10-min	93.55%
									Vinyl Chloride	75-01-4	1.55E-03	24	93.55%
									Chloroform	67-66-3	1.22E-05	24	93.55%
									Acetone	67-64-1	1.38E-03	24	93.55%
									Acrylonitrile	107-13-1	1.13E-03	24	93.55%
									Benzene	71-43-2	2.92E-03	annual	93.55%
S10	Landfill Working Face	Modelled as an area source					704921.37	5162802.62	Odour	N/A - Odour	2.75E+03 OU/s	10-min	77.11%

Notes:
(1) Engineering estimate.

Appendix C

Draft Odour Management Plan

1.0 INTRODUCTION

This Odour Management Plan (OMP) is part of the air quality impact and odour assessments which have been completed to support an Environmental Assessment (EA) of the proposed expansion of the City of Sault Ste. Marie's landfill, located at 402 Fifth Line East in Sault Ste. Marie, Ontario (the "Site"). The OMP focuses on the activities with the potential to cause odour impacts and the existing and proposed odour management practices to mitigate them.

1.1 PURPOSE OF THE ODOUR MANAGEMENT PLAN

The City of Sault Ste. Marie has an ongoing commitment to proper management of the landfill, in which odour management is an important part of this commitment. Proper landfill design and operating practices can reduce the potential for odour impacts.

This OMP describes mitigation measures to manage odours and reduce the potential for off-property impacts. Information on typical landfill operations and waste mining is provided as separate sections, with the following described for each:

- Operational controls, and
- Administrative controls.

The OMP is intended to be a 'living document', and will be updated as required, based on Site conditions. A waste mining pilot project will be completed prior to full-scale waste mining activities to further develop and refine the OMP based on actual Site conditions.

1.2 SITE DESCRIPTION

The Site consists of an active landfill site, covering 83.6 ha of land, west of the intersection of Fifth Line East and Highway #17, in the City of Sault Ste. Marie. The Site is surrounding by woodlots to the north, woodlots and industrial land use (quarry) to the east, woodlots and residential/agricultural/recreational land use to the south, and woodlots and residential/industrial land use (quarry) to the west. The nearest sensitive odour receptor (residential land) to the Site is located along Fifth Line East, less than 500 m from the proposed work area(s).

The proposed landfill expansion is presented to address the limited remaining landfill capacity, which has an existing estimated life of less than 10 years, based on the anticipated average disposal rate.

1.3 POTENTIAL ODOUR EMISSION SOURCES

In general, odours are a combination of many chemical compounds generated by decomposing organic wastes. The potential for odours at a landfill site is influenced by many factors, including the nature and volume of the waste, temperature, age of the waste, weather, and others.

The landfill is licensed to accept various forms of non-hazardous residential, commercial and industrial waste, including organic waste. Odours may originate from landfilling of waste, including tipping, spreading, compacting or other movement of waste, or waste mining.

The proposed waste mining process would involve the excavation of waste from a dormant area of the landfill and transfer of this waste to a lined cell. Specifically, the mining process may include:

- Screening of waste to separate large and small fractions;
- Removal of recyclables or material with residual value; and
- Transfer of screened waste to a lined cell.

2.0 TYPICAL LANDFILL OPERATIONS

This section describes existing and proposed odour management measures for typical landfill operations. Measures specific to landfill mining operations are included in a later section.

2.1 OPERATIONAL CONTROLS

This OMP builds from existing odour management practices at the landfill. In 2003, the City of Sault Ste. Marie initiated an odour management program at the Site in response to odour complaints. Since then, a number of operational changes and capital improvements have been implemented at the Site to reduce the potential for impacts from odour. These include, but are not limited to:

- Changes to sludge handling activities;
- Purchase and deployment of odour control granules to neutralize surface emissions;
- Application of clay cover to inactive but uncompleted areas of the landfill;
- Installation of passive and active flare systems to reduce the potential contribution of landfill gas to odours;
- Installation of an odour control spray system along portions of the Site perimeter and use of a portable deodorizing system during construction activities;
- Changes to biosolids management activities, including the application of an odour reduction agent at water pollution control plants prior to delivery to the Site, mixing with other wastes, and covered promptly; and
- Review and assessment of alternative approaches to waste transportation and disposal methods.

In addition to the control measures identified above, the operational measures outlined in *Table 1* have been implemented at the Site to mitigate potential odour concerns:

Table 1: Summary of Existing Operational Odour Control Measures for Typical Landfill Operations

Operational Control	Description
Keep working face areas and active area as small as reasonably possible	· This reduces the exposed waste area, thus minimizing the potential for odours · Also required the use of less daily cover

Operational Control	Description
Apply daily cover	· Applying daily cover reduces the potential for odourous gases to escape from the working face
Minimize the storage time of waste prior to disposal in the active area	· Minimizing the time between collection and deposition of waste can reduce odours, since the waste has less time to degrade
Employ special practices for the disposal of highly odourous wastes	· Highly odourous waste may require special handling · This waste receives priority for landfilling, and additional odour mitigation measures may be employed, such as spray odour suppressants · The City of Sault Ste. Marie has developed special practices for managing odours from biosolids, as described above
Manage leachate appropriately	· Ensuring leachate collection is functioning properly avoids the build-up of potentially odourous leachate · Leachate management controls have been in place since the 1990s and have been upgraded since then, including a leachate collector, purge wells, and forcemain from the landfill pump station to the sanitary sewer system · The Site's Certificate of Approval requires an annual assessment of leachate management controls, and the controls undergo continuous maintenance to ensure proper function
Consider meteorological conditions	· Considering meteorological conditions during landfill operations can mitigate odour impacts · For example, activities with high potential to generate odour are avoided where possible when winds are blowing in the direction of sensitive receptors
Continue to optimize operation of the landfill gas collection system	· The active landfill gas collection system has effectively mitigated off-site methane odours · The collection system has continuously operated since its installation in 2010, with the exception of shutdowns for maintenance or repair

Odour control measures implemented at the Site have resulted in a decline in odour-related complaints at the Site since 2010.

2.2 ADMINISTRATIVE CONTROLS

The administrative controls presented in *Table 2* have been or will be implemented at the Site to support the operational mitigation measures to control odour impacts from typical landfill operations.

Table 2: Summary of Existing and Proposed Administrative Odour Control Measures for Typical Landfill Operations

Administrative Control	Description
Complaint response procedure (existing)	· Complaints of any nature are recorded by landfill employees and resolved as soon as possible after notification · The telephone number for the landfill is made available for the public and is posted on a sign at the entrance to the Site · Complaints can also be made after-hours by phone · The complaint is documented and referred to the Landfill Manager for response · A response to the complaint is made on the same day (if practical) confirming the receipt and nature of the complaint and results of any follow-up · If the complaint cannot be resolved within a reasonable time period, the complainant is notified of what action will be taken and when it will be taken · Complaint forms are completed when a verbal complaint is received (see Appendix A) · The form is kept on file, along with copies of any correspondence or other records of discussions with the complainant · The form includes the following information: - Date and time of the day the complaint was received - Date and time the complaint incident occurred - Complainant's name, address, telephone number, and the location of the incident relative to the Site - Nature of the complaint - Receipt of complaint (by phone, or site visit, and which staff received the complaint) - Nature and result of any investigation or follow-up - Weather conditions and meteorological measurements at the time of the complaint · Odour complaints received by the landfill are documented and reported to the MOE as part of the landfill's annual performance report
Odour monitoring (existing)	· Landfill employees continuously monitor for odours throughout the day and report/document accordingly · Highly odourous wastes are flagged and identified by landfill employees for special management practices

Administrative Control	Description
Employee training (to be implemented)	· All on-site landfill employees will receive training to review the OMP and related Standard Operating Procedures (SOPs)
Routine inspections (to be implemented)	· Landfill employees will continuously monitor for odour concerns throughout the day · An Odour Inspection Form (see Appendix B) should be completed periodically · Any incident observed will be reported to the Landfill Manager as soon as possible, and documented on the Odour Inspection Form · The Landfill Manager will investigate the incident and apply corrective actions as necessary

3.0 WASTE MINING

This section describes existing and proposed odour management measures to mitigate potential odours from waste mining activities.

Waste mining has been employed at sites throughout Canada, the United States, and elsewhere. Based on a review of technical studies completed at representative sites, while odours from landfill mining are a potential concern, concerns can be mitigated through the implementation of best management practices and the development of a site-specific odour management plan.

The operational and administrative controls described below are proposed for the Site to reduce the potential for odour impacts from the waste mining process. These proposed controls will be re-assessed and revised accordingly based on the completion of a waste mining pilot project that will be completed at the Site.

3.1 OPERATIONAL CONTROLS

Proposal operational controls that will be implemented as part of the waste mining activities at the Site are summarized in *Table 3*.

Table 1: Summary of Proposed Operational Odour Control Measures for Waste Mining

Operational Control	Description
Minimize the area of active excavation	· The area of active excavation would be minimized to one day's production wherever possible, and would be covered as soon as possible with soil · This would minimize exposing freshly excavated waste to the air, which could cause significant odour emissions · All reasonable precautions would be taken to prevent the movement of adjacent material when waste is being mined

Operational Control	Description
Increase the slope of excavation	· A steeper than typical slope can mitigate odour emissions · The slopes of exposed waste would not be greater than 2H:1V (2 horizontal units per 1 unit vertical) unless a slope monitoring plan is approved by the MOE prior to commencement of mining · The waste sideslopes would be inspected before the start of each working day.
By-pass screening of waste where highly odourous waste may be excavated	· Some types or ages of waste may have higher odour generation potential than others · For example, older waste typically generates fewer odours than newer waste · Site operators should by-pass screening of waste with known high potential for odour generation
Avoid mining in areas of known or suspected to have perched leachate	· Encountering perched leachate during mining could cause odour emissions · Leachate impacted water encountered during mining would be pumped using tanker trucks or other methods and disposed of appropriately as soon as possible
Manage operations based on meteorological conditions	· As with typical landfill operations, site operators should consider meteorological conditions to mitigate potential off-property odour emissions · Examples include avoiding mining on hot days, mining during wet days wherever possible, and avoiding mining when winds are blowing strongly in the direction of residences or other sensitive odour receptors · Observations documented during similar waste mining projects completed by others indicated reduced odour generation by conducting waste mining activities during the colder months of the year
Use chemical and/or biological treatment to reduce the significance of odour	· The City has experience using odour neutralizing agents and an odour fogging machine at the landfill · The waste mining process would include the use of this existing equipment at the location of the mining where feasible, and use of additional chemical odour controls as required

3.2 ADMINISTRATIVE CONTROLS

The administrative controls presented in *Table 4* will be implemented at the Site, in addition to those for typical landfill operations, to support the operational mitigation measures to control odour impacts from waste mining.

Table 4: Summary of Proposed Administrative Odour Control Measures for Waste Mining

Administrative Control	Description
Process-specific employee training	· Landfill employees associated with the waste mining process will receive training to review the OMP, operational controls and related Standard Operating Procedures (SOPs)
Contractor selection	· A contractor for the project will be selected that demonstrates adequate experience with similar waste mining projects, and knowledge of how to effectively manage odours · The contract for the project will incorporate requirements to strictly comply with the SOPs
Monitoring program	· The contract will include a requirement for the periodic collection and analysis of air samples
Routine inspections	· Daily inspections will be completed of the active waste mining area(s) to document Site conditions, adherence to the control measures and SOPs, and potential odour impacts

Appendix D

Greenhouse Gas Calculations Existing Conditions

Table D.1
LandGEM Model Results - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Maximum Emssion Scenario Year 2018 (Existing Conditions)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)[(1)]
Total landfill gas	1.06E+07	8.52E+06	2.66E+06
Methane	2.84E+06	4.26E+06	7.10E+05
Carbon dioxide	7.79E+06	4.26E+06	1.95E+06

Existing Conditions Landfill Gas Flare Flow Rate (m^3/year)[(1)]	Estimated Landfill Gas Collection Efficiency (%)[(2)]	Methane Concentration in Landfill Gas[(3)] (%)	Total Methane Gas Produced from LandGEM (m^3/year)	Methane Gas Flare Flow Rate (m^3/year)
6,387,175	75.0%	50%	4,258,117	3,193,587

Notes:

(1) The existing conditionds of the Site are represented by the emission inventory year 2018.
(2) Typical collection efficiency from landfill gas capture design systems from US EPA AP-42 Chapter 2.4 "Municipal Solid Waste Landfills".
(3) Landfill gas methane concentration conservatively estimated based on the default LandGEM methane content and the rated methane content in ECA (Air) No. 4306-7ZHPR3 dated April 30, 2010.

Table D.2
Estimated Landfill Gas Flare Emissions - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Source	Source ID	Contaminant	CAS No.	Molecular Weight	Total Emission Rate (g/s)[(1)(2)]
Flare 1	F1	Carbon Dioxide	124-38-9	44.01	3.71E+02
		Methane[(3)]	74-82-8	16.04	6.76E+00

(1) Emission estimates obtained from US EPA AP-42 Chapter 2.4 equations 4 and 6.
(2) Emission estimates obtained from landfill gas collection efficiency, combustion efficiency, and LandGEM generated emissions.
(3) Non combusted methane emissions were taken from the LandGEM generated emissions and a combustion efficiency of 90% as per the MECP Landfill Gas Collection Form.

Table D.3
Estimated Landfill Footprint Emissions - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Landfill	LandGEM Contaminant	Source ID	Fugitive Emissions (kg/year)	Contaminant	CAS No.	Total Emission Rate (g/s)
Landfill	Carbon Dioxide	S9	1,948,619	Carbon Dioxide	124-38-9	6.18E+01
	Methane		710,199	Methane	74-82-8	2.25E+01

Notes
(1) Screening level taken from Interim Guide to Estimate and Assess Landfill Air Impacts (MECP, 1992).

Table D.4
Vehicle Activity - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Source	Distance Travel [m]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Passes
P_{1-3}	158.2	Public waste	21	188	3	1
		Yard waste	1	5	15	1
		Waste truck	6	49	18	1
P_{2-3}	17.6	Public waste	21	188	3	1
		Yard waste	1	5	15	1
		Waste truck	6	49	18	1
P_{3-4}	149.2	Public waste	21	188	3	2
		Yard waste	1	5	15	2
		Waste truck	6	49	18	2
P_{4-5a}	325.9	Public waste	21	188	3	1
		Yard waste	1	5	15	1
P_{4-5b}	250.8	Public waste	21	188	3	1
		Yard waste	1	5	15	1
		Waste truck	6	49	18	2
P_{5-6}	46.2	Waste truck	6	49	18	2
U_{6-7}	266.1	Waste truck	6	49	18	2
U_{7-9}	651.2	Waste truck	6	49	18	2
U_{9-10}	153.2	Waste truck	6	49	18	2
		Soil cover truck	1	9	9	2

Table D.5
Construction Equipment - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Type of Equipment	Average Operating Hours per Day	# in Operation	Weight Information (lb)	Engine Size Information	Total Emission Rate (g/s)[1][2]
Landfill Operations					
Sterling LT 8500 roll-off	4	1	60000 / 80000	300 hp engine (diesel)	5.3 m x 2.4 m x 2.4 m
CAT 826 Compactor	6	1	82000	341 hp engine (diesel)	7.7 m x 3.8 m x 4.0 m
CAT D-6 Bulldozer	4	1	36000	189 hp engine (diesel)	4.1 m x 2.7 m x 3.2 m
Terex TA 27 Rock Truck	4	1	49000 / 104000	365 hp engine (diesel)	9.8 m x 2.2 m x 3.6 m
Case 821 Front End Loader	5	1	31000	186 hp engine (diesel)	7.5 m x 2.7 m x 3.3 m
Trackless MT-5	5 hrs per week	1	Negligible		
Kubota 1100 RTV UTV	6 hrs per month	1	Negligible		
MadVac litter vacuum	5	1	Negligible		
Composting Operations					
Sittler compost turner	5 every 3rd day	1		Pulled by tractor	
RotoScreen Compost Screener	5	1		225 hp engine (diesel)	4.6 m x 2.6 m x 4.1 m
Odour turbine	7.5	1			
John Deere Farm Tractor 5420	5 every 3rd day	1	7000	81 hp engine (diesel)	3.8 m x 2.0 m x 2.6 m
Sterling STE flow truck/sander	5	1	60000 / 80000	300 hp engine (diesel)	5.3 m x 2.4 m x 2.4 m
Various front end loaders	5	1			
Various water trucks	5	1			
Cell Construction Operations					
CAT D-7 Bulldozer	9	1	45000	200 hp engine (diesel)	4.2 m x 2.6 m x 3.3 m

Table D.6
MOVES Emission Factors - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Refuse - MOVES Emission Factors

Pollutant	Emission Factor (g/VMT)[(1)]
Carbon dioxide	2219.409
Methane	0.031
Nitrous oxide	0.004

Note:
(1) Based on a speed of 30 km/hr.

Light Trucks - MOVES Emission Factors

Pollutant	Emission Factor (g/VMT)[(1)]
Carbon dioxide	531.722
Methane	0.003
Nitrous oxide	0.006

Note:
(1) Based on a speed of 30 km/hr.

Table D.7
OnRoad Mobile Emission Estimates - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

								CO2				
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	1-hr Emission Rate (g/s)	24-hr Emission Rate (g/s)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	531.722	3.0E-01	2.8E-01	6.8E-01	6.0E-01
		0.098	Yard waste	1	5	15	1	531.722	1.5E-02	7.6E-03		
		0.098	Waste truck	6	49	18	1	2219.409	3.6E-01	3.1E-01		
P2-3	17.6	0.011	Public waste	21	188	3	1	531.722	3.4E-02	3.2E-02	7.6E-02	6.7E-02
		0.011	Yard waste	1	5	15	1	531.722	1.6E-03	8.4E-04		
		0.011	Waste truck	6	49	18	1	2219.409	4.0E-02	3.4E-02		
P3-4	149.2	0.093	Public waste	21	188	3	2	531.722	5.8E-01	5.4E-01	1.3E+00	1.1E+00
		0.093	Yard waste	1	5	15	2	531.722	2.7E-02	1.4E-02		
		0.093	Waste truck	6	49	18	2	2219.409	6.9E-01	5.8E-01		
P4-5a	325.9	0.203	Public waste	21	188	3	1	531.722	6.3E-01	5.9E-01	6.6E-01	6.0E-01
		0.203	Yard waste	1	5	15	1	531.722	3.0E-02	1.6E-02		
P4-5b	250.8	0.156	Public waste	21	188	3	1	531.722	4.8E-01	4.5E-01	1.7E+00	1.4E+00
		0.156	Yard waste	1	5	15	1	531.722	2.3E-02	1.2E-02		
		0.156	Waste truck	6	49	18	2	2219.409	1.2E+00	9.8E-01		
P5-6	46.2	0.029	Waste truck	6	49	18	2	2219.409	2.1E-01	1.8E-01	2.1E-01	1.8E-01
U6-7	266.1	0.165	Waste truck	6	49	18	2	2219.409	1.2E+00	1.0E+00	1.2E+00	1.0E+00
U7-9	651.2	0.405	Waste truck	6	49	18	2	2219.409	3.0E+00	2.5E+00	3.0E+00	2.5E+00
U9-10	153.2	0.095	Waste truck	6	49	18	2	2219.409	7.0E-01	6.0E-01	8.2E-01	7.1E-01
		0.095	Soil cover truck	1	9	9	2	2219.409	1.2E-01	1.1E-01		

								CH4				
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	1-hr Emission Rate (g/s)	24-hr Emission Rate (g/s)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	0.003	1.7E-06	6.2E-07	6.9E-06	2.4E-06
		0.098	Yard waste	1	5	15	1	0.003	8.0E-08	1.7E-08		
		0.098	Waste truck	6	49	18	1	0.031	5.1E-06	1.7E-06		
P2-3	17.6	0.011	Public waste	21	188	3	1	0.003	1.9E-07	6.9E-08	7.7E-07	2.7E-07
		0.011	Yard waste	1	5	15	1	0.003	8.9E-09	1.8E-09		
		0.011	Waste truck	6	49	18	1	0.031	5.7E-07	1.9E-07		
P3-4	149.2	0.093	Public waste	21	188	3	2	0.003	3.2E-06	1.2E-06	1.3E-05	4.5E-06
		0.093	Yard waste	1	5	15	2	0.003	1.5E-07	3.1E-08		
		0.093	Waste truck	6	49	18	2	0.031	9.7E-06	3.3E-06		
P4-5a	325.9	0.203	Public waste	21	188	3	1	0.003	3.4E-06	1.3E-06	3.6E-06	1.3E-06
		0.203	Yard waste	1	5	15	1	0.003	1.6E-07	3.4E-08		
P4-5b	250.8	0.156	Public waste	21	188	3	1	0.003	2.7E-06	9.9E-07	1.9E-05	6.6E-06
		0.156	Yard waste	1	5	15	1	0.003	1.3E-07	2.6E-08		
		0.156	Waste truck	6	49	18	2	0.031	1.6E-05	5.5E-06		
P5-6	46.2	0.029	Waste truck	6	49	18	2	0.031	3.0E-06	1.0E-06	3.0E-06	1.0E-06
U6-7	266.1	0.165	Waste truck	6	49	18	2	0.031	1.7E-05	5.9E-06	1.7E-05	5.9E-06
U7-9	651.2	0.405	Waste truck	6	49	18	2	0.031	4.2E-05	1.4E-05	4.2E-05	1.4E-05
U9-10	153.2	0.095	Waste truck	6	49	18	2	0.031	1.0E-05	3.4E-06	1.2E-05	4.0E-06
		0.095	Soil cover truck	1	9	9	2	0.031	1.7E-06	6.2E-07		

								N2O				
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	1-hr Emission Rate (g/s)	24-hr Emission Rate (g/s)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	0.006	3.2E-06	3.0E-06	4.1E-06	3.7E-06
		0.098	Yard waste	1	5	15	1	0.006	1.5E-07	8.0E-08		
		0.098	Waste truck	6	49	18	1	0.004	6.8E-07	5.8E-07		
P2-3	17.6	0.011	Public waste	21	188	3	1	0.006	3.6E-07	3.3E-07	4.5E-07	4.1E-07
		0.011	Yard waste	1	5	15	1	0.006	1.7E-08	8.9E-09		
		0.011	Waste truck	6	49	18	1	0.004	7.5E-08	6.4E-08		
P3-4	149.2	0.093	Public waste	21	188	3	2	0.006	6.1E-06	5.7E-06	7.7E-06	6.9E-06
		0.093	Yard waste	1	5	15	2	0.006	2.9E-07	1.5E-07		
		0.093	Waste truck	6	49	18	2	0.004	1.3E-06	1.1E-06		
P4-5a	325.9	0.203	Public waste	21	188	3	1	0.006	6.7E-06	6.2E-06	7.0E-06	6.4E-06
		0.203	Yard waste	1	5	15	1	0.006	3.2E-07	1.6E-07		
P4-5b	250.8	0.156	Public waste	21	188	3	1	0.006	5.1E-06	4.8E-06	7.5E-06	6.7E-06
		0.156	Yard waste	1	5	15	1	0.006	2.4E-07	1.3E-07		
		0.156	Waste truck	6	49	18	2	0.004	2.1E-06	1.8E-06		
P5-6	46.2	0.029	Waste truck	6	49	18	2	0.004	4.0E-07	3.4E-07	4.0E-07	3.4E-07
U6-7	266.1	0.165	Waste truck	6	49	18	2	0.004	2.3E-06	1.9E-06	2.3E-06	1.9E-06
U7-9	651.2	0.405	Waste truck	6	49	18	2	0.004	5.6E-06	4.7E-06	5.6E-06	4.7E-06
U9-10	153.2	0.095	Waste truck	6	49	18	2	0.004	1.3E-06	1.1E-06	1.5E-06	1.3E-06
		0.095	Soil cover truck	1	9	9	2	0.004	2.2E-07	2.1E-07		

Table D.8
Nonroad Equipment Combustion Emission Factors - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Based on guidance provided by USEPA AP-42 Exhaust and Crankcase Emission Factors for Non-Road Engine Modeling Compression-Ignition (2010).

Non Road Emission Factors

Zero-hour, steady-state emission factors for non-road CI Engines (US EPA, 2010, Table A4)

Engine Power (hp)	Technology Type	BSFC (lb/hp-hr)	Emission Factors (g/hp-hr) CO2
>75 to 100	Tier 3	0.408	589.8
>100 to 175	Tier 3	0.367	530.5
>175 to 300	Tier 3	0.367	530.5
>300 to 600	Tier 3	0.367	530.5
>600 to 750	Tier 3	0.367	530.5

Nonroad Equipment Emission Factors

Equipment	Equipment Type	Cycle	Power Rating (hp)	CO2 Emission Factor (g/hp.hr)
Landfill Operations				
CAT 826 Compactor	Other Construction Eqmt.	Crawler	341	530.5
CAT D-6 Bulldozer	Rubber Tire Dozer	Crawler	189	530.5
Terex TA 27 Rock Truck	Rubber Tire Loader	RTLoader	365	530.5
Case 821 Front End Loader	Rubber Tire Loader	RTLoader	186	530.5
John Deere Farm Tractor 5420	Off-highway Tractors	Crawler	81	589.8
Cell Construction Operations				
CAT D-7 Bulldozer	Rubber Tire Dozer	Crawler	200	530.5

Nonroad Equipment Steady-State Emission Factors

Equipment Type	Power Rating (hp)	CO2 Emission Factor (g/hp.hr)
Landfill Operations		
RotoScreen Compost Screener	225	530.5

Table D.9
NonRoad Equipment Emission Estimates - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

							CO2			
Source ID	**Included Sources**	**Emission Type**	**Average Daily Operating Hours**	**hp**	**Number of Units**	**Emission Factor (g/hp.hr)**	1-hr Emission Rate (g/s)[1]	24-hr Emission Rate (g/s)[1]	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
S1	CAT 826 Compactor	Non Road Mobile Combustion	6	341	1	530.511	2.76E+01	6.91E+00	4.30E+01	9.46E+00
	CAT D-6 Bulldozer	Non Road Mobile Combustion	4	189	1	530.457	1.53E+01	2.55E+00		
S2	Case 821 Front End Loader	Non Road Mobile Combustion	5	186	1	530.457	1.51E+01	3.14E+00	1.51E+01	3.14E+00
S3	John Deere Farm Tractor 5420	Non Road Mobile Combustion	5	81	1	589.784	7.30E+00	1.52E+00	7.30E+00	1.52E+00
S5	RotoScreen Compost Screener	Stationary Combustion	5	225	1	530.457	3.32E+01	6.91E+00	3.32E+01	6.91E+00
S6	Terex TA 27 Rock Truck	Non Road Mobile Combustion	4	365	1	530.511	2.96E+01	4.93E+00	2.96E+01	4.93E+00

Notes:
(1) Estimated that nonroad mobile combustion equipment operates at full load for 50% of the time, and 10% load (idle) for 50% of the time.

Appendix E

Greenhouse Gas Calculations – Scenario 2

Table E.1
LandGEM Model Results - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Maximum Emssion Scenario Year 2026 (Scenario 2)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)[(1)]
Total landfill gas	1.15E+07	9.18E+06	2.87E+06
Methane	3.06E+06	4.59E+06	7.66E+05
Carbon dioxide	8.40E+06	4.59E+06	2.10E+06

Existing Conditions Landfill Gas Flare Flow Rate (m^3/year)[(1)]	Estimated Landfill Gas Collection Efficiency (%)[(2)]	Methane Concentration in Landfill Gas[(3)] (%)	Total Methane Gas Produced from LandGEM (m^3/year)	Methane Gas Flare Flow Rate (m^3/year)
6,886,848	75.0%	50%	4,591,232	3,443,424

Notes:

(1) The scenario 2 conditions of the Site are represented by the emission inventory year 2026.
(2) Typical collection efficiency from landfill gas capture design systems from US EPA AP-42 Chapter 2.4 "Municipal Solid Waste Landfills".
(3) Landfill gas methane concentration conservatively estimated based on the default LandGEM methane content and the rated methane content in ECA (Air) No. 4306-7ZHPR3 dated April 30, 2010.

Table E.2
Estimated Landfill Gas Flare Emissions - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Source	Source ID	Contaminant	CAS No.	Molecular Weight	Total Emission Rate (g/s)(1)(2)
Flare 1	F1	Carbon Dioxide	124-38-9	44.01	4.00E+02
		Methane(3)	74-82-8	16.04	7.28E+00

(1) Emission estimates obtained from US EPA AP-42 Chapter 2.4 equations 4 and 6.
(2) Emission estimates obtained from landfill gas collection efficiency, combustion efficiency, and LandGEM generated emissions.
(3) Non combusted methane emissions were taken from the LandGEM generated emissions and a combustion efficiency of 90% as per the MECP Landfill Gas Collection Form.

Table E.3
Estimated Landfill Footprint Emissions - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Landfill	LandGEM Contaminant	Source ID	Fugitive Emissions (kg/year)	Contaminant	CAS No.	Total Emission Rate (g/s)
Landfill	Carbon Dioxide	S9	2,101,061	Carbon Dioxide	124-38-9	6.66E+01
	Methane		765,758	Methane	74-82-8	2.43E+01

Notes
(1) Screening level taken from Interim Guide to Estimate and Assess Landfill Air Impacts (MECP, 1992).

Table E.4
Vehicle Activity - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Source	Distance Travel [m]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Passes
P_{1-3}	158.2	Public waste	21	188	3	1
		Yard waste	1	5	15	1
		Waste truck	6	49	18	1
P_{2-3}	17.6	Public waste	21	188	3	1
		Yard waste	1	5	15	1
		Waste truck	6	49	18	1
P_{3-4}	149.2	Public waste	21	188	3	2
		Yard waste	1	5	15	2
		Waste truck	6	49	18	2
P_{4-5a}	325.9	Public waste	21	188	3	1
		Yard waste	1	5	15	1
P_{4-5b}	250.8	Public waste	21	188	3	1
		Yard waste	1	5	15	1
		Waste truck	6	49	18	2
P_{5-6}	46.2	Waste truck	6	49	18	2
U_{6-7}	266.1	Waste truck	6	49	18	2
U_{7-8}	139.3	Mining truck	2	18	18	2
U_{7-9}	651.2	Waste truck	6	49	18	2
		Mining truck	2	18	18	2
U_{9-10}	153.2	Waste truck	6	49	18	2
		Mining truck	2	18	18	2
		Soil cover truck	1	9	9	2

Table E.5
Construction Equipment - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Type of Equipment	Average Operating Hours per Day	# in Operation	Weight Information (lb)	Engine Size Information	Total Emission Rate (g/s)[(1)(2)]
Landfill Operations					
Sterling LT 8500 roll-off	4	1	60000 / 80000	300 hp engine (diesel)	5.3 m x 2.4 m x 2.4 m
CAT 826 Compactor	6	1	82000	341 hp engine (diesel)	7.7 m x 3.8 m x 4.0 m
CAT D-6 Bulldozer	4	1	36000	189 hp engine (diesel)	4.1 m x 2.7 m x 3.2 m
Terex TA 27 Rock Truck	4	1	49000 / 104000	365 hp engine (diesel)	9.8 m x 2.2 m x 3.6 m
Case 821 Front End Loader	5	1	31000	186 hp engine (diesel)	7.5 m x 2.7 m x 3.3 m
Trackless MT-5	5 hrs per week	1	Negligible		
Kubota 1100 RTV UTV	6 hrs per month	1	Negligible		
MadVac litter vacuum	5	1	Negligible		
Composting Operations					
Sittler compost turner	5 every 3rd day	1		Pulled by tractor	
RotoScreen Compost Screener	5	1		225 hp engine (diesel)	4.6 m x 2.6 m x 4.1 m
Odour turbine	7.5	1			
John Deere Farm Tractor 5420	5 every 3rd day	1	7000	81 hp engine (diesel)	3.8 m x 2.0 m x 2.6 m
Sterling STE flow truck/sander	5	1	60000 / 80000	300 hp engine (diesel)	5.3 m x 2.4 m x 2.4 m
Various front end loaders	5	1			
Various water trucks	5	1			
Cell Construction Operations					
CAT D-7 Bulldozer	9	1	45000	200 hp engine (diesel)	4.2 m x 2.6 m x 3.3 m
Cell Mining Operations					
McCloskey MCB 733 Trommel Screeners	9	2	-	225 hp engine (diesel)	21.1 m x 3.3 m x 4.1 m
McCloskey Stacker	9	1	-	90 hp engine (diesel)	15.2 m x 3.4 m x 3.4 m
Mobark 1100 Tub Grinder	9	1	-	600 hp engine (diesel)	17.1 m x 3.4 m x 3.9 m
CAT 345 Excavator	9	2	100000	345 hp engine (diesel)	11.9 m x 3.5 m x 7.6 m
CAT D-7 Bulldozer	9	1	45000	200 hp engine (diesel)	4.2 m x 2.6 m x 3.3 m
CAT 735 Articulating Truck	9	2	67000 / 140000	413 hp engine (diesel)	10.9 m x 3.4 m x 3.7 m

Table E.6
MOVES Emission Factors - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Refuse - MOVES Emission Factors

Pollutant	Emission Factor (g/VMT)[1]
Carbon dioxide	2219.409
Methane	0.031
Nitrous oxide	0.004

Note:
(1) Based on a speed of 30 km/hr.

Light Trucks - MOVES Emission Factors

Pollutant	Emission Factor (g/VMT)[1]
Carbon dioxide	531.722
Methane	0.003
Nitrous oxide	0.006

Note:
(1) Based on a speed of 30 km/hr.

Table E.7
OnRoad Mobile Emission Estimates - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

								CO2				
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	1-hr Emission Rate (g/s)	24-hr Emission Rate (g/s)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	531.722	3.0E-01	2.8E-01	6.8E-01	6.0E-01
		0.098	Yard waste	1	5	15	1	531.722	1.5E-02	7.6E-03		
		0.098	Waste truck	6	49	18	1	2219.409	3.6E-01	3.1E-01		
P2-3	17.6	0.011	Public waste	21	188	3	1	531.722	3.4E-02	3.2E-02	7.6E-02	6.7E-02
		0.011	Yard waste	1	5	15	1	531.722	1.6E-03	8.4E-04		
		0.011	Waste truck	6	49	18	1	2219.409	4.0E-02	3.4E-02		
P3-4	149.2	0.093	Public waste	21	188	3	2	531.722	5.8E-01	5.4E-01	1.3E+00	1.1E+00
		0.093	Yard waste	1	5	15	2	531.722	2.7E-02	1.4E-02		
		0.093	Waste truck	6	49	18	2	2219.409	6.9E-01	5.8E-01		
P4-5a	325.9	0.203	Public waste	21	188	3	1	531.722	6.3E-01	5.9E-01	6.6E-01	6.0E-01
		0.203	Yard waste	1	5	15	1	531.722	3.0E-02	1.6E-02		
P4-5b	250.8	0.156	Public waste	21	188	3	1	531.722	4.8E-01	4.5E-01	1.7E+00	1.4E+00
		0.156	Yard waste	1	5	15	1	531.722	2.3E-02	1.2E-02		
		0.156	Waste truck	6	49	18	2	2219.409	1.2E+00	9.8E-01		
P5-6	46.2	0.029	Waste truck	6	49	18	2	2219.409	2.1E-01	1.8E-01	2.1E-01	1.8E-01
U6-7	266.1	0.165	Waste truck	6	49	18	2	2219.409	1.2E+00	1.0E+00	1.2E+00	1.0E+00
U7-8	139.3	0.087	Mining truck	2	18	18	2	2219.409	2.1E-01	2.0E-01	2.1E-01	2.0E-01
U7-9	651.2	0.405	Waste truck	6	49	18	2	2219.409	3.0E+00	2.5E+00	4.0E+00	3.5E+00
		0.405	Mining truck	2	18	18	2	2219.409	1.0E+00	9.4E-01		
U9-10	153.2	0.095	Waste truck	6	49	18	2	2219.409	7.0E-01	6.0E-01	1.1E+00	9.3E-01
		0.095	Mining truck	2	18	18	2	2219.409	2.3E-01	2.2E-01		
		0.095	Soil cover truck	1	9	9	2	2219.409	1.2E-01	1.1E-01		

								CH4				
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	1-hr Emission Rate (g/s)	24-hr Emission Rate (g/s)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	0.003	1.7E-06	6.2E-07	6.9E-06	2.4E-06
		0.098	Yard waste	1	5	15	1	0.003	8.0E-08	1.7E-08		
		0.098	Waste truck	6	49	18	1	0.031	5.1E-06	1.7E-06		
P2-3	17.6	0.011	Public waste	21	188	3	1	0.003	1.9E-07	6.9E-08	7.7E-07	2.7E-07
		0.011	Yard waste	1	5	15	1	0.003	8.9E-09	1.8E-09		
		0.011	Waste truck	6	49	18	1	0.031	5.7E-07	1.9E-07		
P3-4	149.2	0.093	Public waste	21	188	3	2	0.003	3.2E-06	1.2E-06	1.3E-05	4.5E-06
		0.093	Yard waste	1	5	15	2	0.003	1.5E-07	3.1E-08		
		0.093	Waste truck	6	49	18	2	0.031	9.7E-06	3.3E-06		
P4-5a	325.9	0.203	Public waste	21	188	3	1	0.003	3.4E-06	1.3E-06	3.6E-06	1.3E-06
		0.203	Yard waste	1	5	15	1	0.003	1.6E-07	3.4E-08		
P4-5b	250.8	0.156	Public waste	21	188	3	1	0.003	2.7E-06	9.9E-07	1.9E-05	6.6E-06
		0.156	Yard waste	1	5	15	1	0.003	1.3E-07	2.6E-08		
		0.156	Waste truck	6	49	18	2	0.031	1.6E-05	5.5E-06		
P5-6	46.2	0.029	Waste truck	6	49	18	2	0.031	3.0E-06	1.0E-06	3.0E-06	1.0E-06
U6-7	266.1	0.165	Waste truck	6	49	18	2	0.031	1.7E-05	5.9E-06	1.7E-05	5.9E-06
U7-8	139.3	0.087	Mining truck	2	18	18	2	0.031	3.0E-06	1.1E-06	3.0E-06	1.1E-06
U7-9	651.2	0.405	Waste truck	6	49	18	2	0.031	4.2E-05	1.4E-05	5.6E-05	2.0E-05
		0.405	Mining truck	2	18	18	2	0.031	1.4E-05	5.3E-06		
U9-10	153.2	0.095	Waste truck	6	49	18	2	0.031	1.0E-05	3.4E-06	1.5E-05	5.3E-06
		0.095	Mining truck	2	18	18	2	0.031	3.3E-06	1.2E-06		
		0.095	Soil cover truck	1	9	9	2	0.031	1.7E-06	6.2E-07		

								N2O				
Source	Distance Travel [m]	Distance Travel [miles]	Equipment Type	Vehicle Numbers (#/hour)	Vehicle Numbers Per Day	Average Truck Weight (tons)	# of Vehicle Passes	MOVES Emission Factor (g/VMT)	1-hr Emission Rate (g/s)	24-hr Emission Rate (g/s)	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
P1-3	158.2	0.098	Public waste	21	188	3	1	0.006	3.2E-06	3.0E-06	4.1E-06	3.7E-06
		0.098	Yard waste	1	5	15	1	0.006	1.5E-07	8.0E-08		
		0.098	Waste truck	6	49	18	1	0.004	6.8E-07	5.8E-07		
P2-3	17.6	0.011	Public waste	21	188	3	1	0.006	3.6E-07	3.3E-07	4.5E-07	4.1E-07
		0.011	Yard waste	1	5	15	1	0.006	1.7E-08	8.9E-09		
		0.011	Waste truck	6	49	18	1	0.004	7.5E-08	6.4E-08		
P3-4	149.2	0.093	Public waste	21	188	3	2	0.006	6.1E-06	5.7E-06	7.7E-06	6.9E-06
		0.093	Yard waste	1	5	15	2	0.006	2.9E-07	1.5E-07		
		0.093	Waste truck	6	49	18	2	0.004	1.3E-06	1.1E-06		
P4-5a	325.9	0.203	Public waste	21	188	3	1	0.006	6.7E-06	6.2E-06	7.0E-06	6.4E-06
		0.203	Yard waste	1	5	15	1	0.006	3.2E-07	1.6E-07		
P4-5b	250.8	0.156	Public waste	21	188	3	1	0.006	5.1E-06	4.8E-06	7.5E-06	6.7E-06
		0.156	Yard waste	1	5	15	1	0.006	2.4E-07	1.3E-07		
		0.156	Waste truck	6	49	18	2	0.004	2.1E-06	1.8E-06		
P5-6	46.2	0.029	Waste truck	6	49	18	2	0.004	4.0E-07	3.4E-07	4.0E-07	3.4E-07
U6-7	266.1	0.165	Waste truck	6	49	18	2	0.004	2.3E-06	1.9E-06	2.3E-06	1.9E-06
U7-8	139.3	0.087	Mining truck	2	18	18	2	0.004	4.0E-07	3.7E-07	4.0E-07	3.7E-07
U7-9	651.2	0.405	Waste truck	6	49	18	2	0.004	5.6E-06	4.7E-06	7.4E-06	6.5E-06
		0.405	Mining truck	2	18	18	2	0.004	1.9E-06	1.7E-06		
U9-10	153.2	0.095	Waste truck	6	49	18	2	0.004	1.3E-06	1.1E-06	2.0E-06	1.7E-06
		0.095	Mining truck	2	18	18	2	0.004	4.4E-07	4.1E-07		
		0.095	Soil cover truck	1	9	9	2	0.004	2.2E-07	2.1E-07		

Table E.8
Nonroad Equipment Combustion Emission Factors - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Based on guidance provided by USEPA AP-42 Exhaust and Crankcase Emission Factors for Non-Road Engine Modeling Compression-Ignition (2010).

Non Road Emission Factors

Zero-hour, steady-state emission factors for non-road CI Engines (US EPA, 2010, Table A4)

Engine Power (hp)	Technology Type	BSFC (lb/hp-hr)	Emission Factors (g/hp-hr) CO_2
>75 to 100	Tier 3	0.408	589.8
>100 to 175	Tier 3	0.367	530.5
>175 to 300	Tier 3	0.367	530.5
>300 to 600	Tier 3	0.367	530.5
>600 to 750	Tier 3	0.367	530.5

Nonroad Equipment Emission Factors

Equipment	Equipment Type	Cycle	Power Rating (hp)	CO_2 Emission Factor (g/hp.hr)
Landfill Operations				
CAT 826 Compactor	Other Construction Eqmt.	Crawler	341	530.5
CAT D-6 Bulldozer	Rubber Tire Dozer	Crawler	189	530.5
Terex TA 27 Rock Truck	Rubber Tire Loader	RTLoader	365	530.5
Case 821 Front End Loader	Rubber Tire Loader	RTLoader	186	530.5
John Deere Farm Tractor 5420	Off-highway Tractors	Crawler	81	589.8
Cell Construction Operations				
CAT D-7 Bulldozer	Rubber Tire Dozer	Crawler	200	530.5
Cell Mining Operations				
CAT 345 Excavator	Excavator	Excavator	345	530.5
CAT D-7 Bulldozer	Rubber Tire Dozer	Crawler	200	530.5
CAT 735 Articulating Truck	Rubber Tire Loader	RTLoader	413	530.5

Nonroad Equipment Steady-State Emission Factors

Equipment Type	Power Rating (hp)	CO_2 Emission Factor (g/hp.hr)
Landfill Operations		
RotoScreen Compost Screener	225	530.5
Cell Mining Operations		
McCloskey MCB 733 Trommel Screeners	225	530.5
McCloskey Stacker	90	589.8
Mobark 1100 Tub Grinder	600	530.5

Table E.9
NonRoad Equipment Emission Estimates - Existing Conditions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

							CO2			
Source ID	**Included Sources**	**Emission Type**	**Average Daily Operating Hours**	**hp**	**Number of Units**	**Emission Factor (g/hp.hr)**	1-hr Emission Rate (g/s)[(1)]	24-hr Emission Rate (g/s)[(1)]	TOTAL 1-hr Emission Rate (g/s)	TOTAL 24-hr Emission Rate (g/s)
S1	CAT 826 Compactor	Non Road Mobile Combustion	6	341	1	530.511	2.76E+01	6.91E+00	4.30E+01	9.46E+00
	CAT D-6 Bulldozer	Non Road Mobile Combustion	4	189	1	530.457	1.53E+01	2.55E+00		
S2	Case 821 Front End Loader	Non Road Mobile Combustion	5	186	1	530.457	1.51E+01	3.14E+00	1.51E+01	3.14E+00
S3	John Deere Farm Tractor 5420	Non Road Mobile Combustion	5	81	1	589.784	7.30E+00	1.52E+00	7.30E+00	1.52E+00
S4	CAT 345 Excavator	Non Road Mobile Combustion	9	345	2	530.511	5.59E+01	2.10E+01	5.59E+01	2.10E+01
S4	CAT D-7 Bulldozer	Non Road Mobile Combustion	9	200	1	530.457	1.62E+01	6.08E+00	1.62E+01	6.08E+00
S5	RotoScreen Compost Screener	Stationary Combustion	5	225	1	530.457	3.32E+01	6.91E+00	3.32E+01	6.91E+00
S6	Terex TA 27 Rock Truck	Non Road Mobile Combustion	4	365	1	530.511	2.96E+01	4.93E+00	2.96E+01	4.93E+00
S4	McCloskey MCB 733 Trommel Screeners	Stationary Combustion	9	225	2	530.457	6.63E+01	2.49E+01	1.69E+02	6.36E+01
	McCloskey Stacker	Stationary Combustion	9	90	1	589.784	1.47E+01	5.53E+00		
	Mobark 1100 Tub Grinder	Stationary Combustion	9	600	1	530.511	8.84E+01	3.32E+01		
S7	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	530.511	6.69E+01	2.51E+01	6.69E+01	2.51E+01
S8	CAT 735 Articulating Truck	Non Road Mobile Combustion	9	413	2	530.511	6.69E+01	2.51E+01	6.69E+01	2.51E+01

Notes:
(1) Estimated that nonroad mobile combustion equipment operates at full load for 50% of the time, and 10% load (idle) for 50% of the time.

Appendix F

Greenhouse Gas Calculations - Post Closure

Table F.1
LandGEM Model Results
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Maximum Emssion Scenario Year 2049 (Post Closure)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)[1]
Total landfill gas	1.29E+07	1.03E+07	3.21E+06
Methane	3.43E+06	5.15E+06	8.59E+05
Carbon dioxide	9.42E+06	5.15E+06	2.36E+06

Existing Conditions Landfill Gas Flare Flow Rate (m^3/year)[1]	Estimated Landfill Gas Collection Efficiency (%)[2]	Methane Concentration in Landfill Gas[3] (%)	Total Methane Gas Produced from LandGEM (m^3/year)	Methane Gas Flare Flow Rate (m^3/year)
7,722,461	75.0%	49%	5,148,307	3,784,006

Notes:

(1) The worst-case emission inventory year (2049) of the landfill footprint was taken.
(2) Typical collection efficiency from landfill gas capture design systems from US EPA AP-42 Chapter 2.4 "Municipal Solid Waste Landfills".

(3) Landfill gas methane concentration conservatively estimated based on the default LandGEM methane content and the rated methane content in ECA (Air) No. 4306-7ZHPR3 dated April 30, 2010.

Table F.2
Estimated Landfill Gas Flare Emissions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Source	Source ID	Contaminant	CAS No.	Molecular Weight	Total Emission Rate (g/s)(1)(2)
Flare 1	F1	Carbon Dioxide	124-38-9	44.01	4.49E+02
		Methane(3)	74-82-8	16.04	8.17E+00

(1) Emission estimates obtained from US EPA AP-42 Chapter 2.4 equations 4 and 6.
(2) Emission estimates obtained from landfill gas collection efficiency, combustion efficiency, and LandGEM generated emissions.
(3) Non combusted methane emissions were taken from the LandGEM generated emissions and a combustion efficiency of 90% as per the MECP Landfill Gas Collection Form.

Table F.3
Estimated Landfill Footprint Emissions
Sault Ste. Marie Solid Waste Management
Air Quality, Odour, and Greenhouse Gas Impact Assessment

Landfill	LandGEM Contaminant	Source ID	Fugitive Emissions (kg/year)	Contaminant	CAS No.	Total Emission Rate (g/s)
Landfill	Carbon Dioxide	S9	2,355,993	Carbon Dioxide	124-38-9	7.47E+01
	Methane		858,671	Methane	74-82-8	2.72E+01

Notes
(1) Screening level taken from Interim Guide to Estimate and Assess Landfill Air Impacts (MECP, 1992).