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ORTECH
a Kontrol Energy Company

Report:

Lakeview Village
Air Quality Assessment - GE Booth Wastewater Treatment Plant (WWTP) Incinerator Air Emissions

Date: December 21, 2020



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Air Quality Assessment - GE Booth Wastewater Treatment Plant (WWTP) Incinerator Air Emissions

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EXECUTIVE SUMMARY

The Municipal Infrastructure Group Ltd. (TMIG) retained ORTECH Consulting Inc. (ORTECH) on behalf of Lakeview Community Partners Ltd. (LPCL) to assess the impact of air emissions from the G.E. Booth Wastewater Treatment Plant (WWTP) Incinerator Stack (WWTP Stack), on the proposed Lakeview Village Development in Mississauga, Ontario. The WWTP is owned and operated by the Region of Peel (or the Region). AERMOD (version 19191) was used in this air quality assessment to examine the potential impact of air emissions from the WWTP Stack. AERMOD is a regulatory dispersion model approved by the Ministry of the Environment, Conservation and Parks (MECP).

For the purpose of this assessment ORTECH utilized WWTP Stack source testing reports, the Region of Peel's 2019 Emission Summary and Dispersion Modelling (ESDM) report for the WWTP, G. E. Booth WWTP 2019 annual report and MECP's Air Dispersion Modelling Guidelines of Ontario (ADMGO) for finalizing the model input parameters. The Region of Peel's 2019 ESDM report for the WWTP utilizes MECP generic regional (Toronto) meteorological data. Due to proximity of the WWTP Stack to Lake Ontario, site-specific meteorological data was used by ORTECH for AERMOD modelling, as recommended in the ADMGO. Site-specific meteorological data was developed by Lakes Environmental (Lakes) and further refined by ORTECH to account for land use characteristics within the modelling domain. Elevated receptors were setup along the height of high-rise buildings representative of open space living areas (balcony areas). In addition to the recommended modelling approach explained in Section 2.8 of this report, various alternative modelling approaches were considered with the most technically valid modelling approach adopted for this assessment.

A total of six contaminants were modelled for this assessment (see Table 3). Modelling results were compared with MECP's 2018 Air Contaminant Benchmark List (ACB List, 2018), which contains air quality standards for each contaminant addressed in this report (Note: 2018 ACB List is the latest version of this list provided by the MECP). Based on 2019 operating conditions of the WWTP Stack, no contaminant was predicted to exceed the air quality criteria at the proposed building locations.

In addition to the current WWTP (2019) operating scenario, an additional future operating scenario was modelled. Modelling the impact of WWTP Stack emissions due to projected sludge volume increases at the G. E. Booth WWTP operations, suggests Nitrogen Oxides (NO_X) emissions are predicted to impact the upper floors of three (3) proposed Lakeview Village buildings (Table A.2).

It is proposed to implement measures, to address NOx exceedances at these locations through the following mitigation strategies, or combinations, which are briefly discussed in further sections of this report:

a) restrictions on open windows/balconies on impacted floors of buildings where impacts are predicted;
b) equipping air intakes servicing these areas with NO_X reduction technologies such as activated carbon filters which can be installed as part of the HVAC system;
c) mitigation at source through improved operational controls, such as excess air requirements and combustion temperatures, to minimize NO_X generation, and/or
d) mitigation at source through add-on control technologies.

1. INTRODUCTION

1.1 Purpose and Scope of this Report

The purpose of this report is to assess the potential impact of air emissions from the G.E. Booth Wastewater Treatment Plant (WWTP) Incinerator Stack (WWTP Stack), on the proposed Lakeview Village Development in Mississauga, Ontario, using MECP approved regulatory air dispersion model AERMOD (version 19191).

A refined modelling approach was undertaken for this assessment due to uniqueness of the site, as explained further in this report. Further, the outcome of this report can be used to identify the need for additional emission control strategies to mitigate the impact of air emissions from the WWTP Stack on the proposed development in the future. This report identifies that under certain meteorological conditions, elevated emission sources at the WWTP Facility could have a greater potential for impacts on elevated receptor locations at the proposed development, than predicted by the Region of Peel's 2019 ESDM report. Relevant elevated sources at the WWTP include one incinerator stack, 53.4 meters tall, with two flues. Remaining emission sources, as identified by Region of Peel's 2019 ESDM report, at the WWTP Facility are significantly shorter, ranging from 3 meters to 30 meters in height. The scope of this report focuses on the potential air quality impacts associated with the incinerator stack at future elevated receptors associated with the proposed development.

For this purpose, ORTECH has utilized the following documents and electronic files:

- AutoCAD file for Site/Buildings Layout;
- 2015, 2016, 2017, 2018 and 2019 WWTP Stack source testing reports by Wood Environment & Infrastructure Solutions (formerly, Amec Foster Wheeler Environment & Infrastructure);
- Region of Peel's 2019 ESDM report of G.E. Booth WWTP by Wood Environment & Infrastructure Solutions;
- 2019 G. E. Booth WWTP Annual Report, published by Region of Peel;
- Site-specific meteorological data developed by Lakes Environmental Consultants Inc. (Lakes);
- MECP approved generic regional (Toronto) meteorological data;
- MECP's Air Dispersion Modelling Guidelines of Ontario (ADMGO) version 3.0;
- MECP's Air Contaminant Benchmark List (ACB List, 2018);
- 2019 US EPA AERMOD Implementation Guide (the Implementation Guide); and
- 2017 Appendix W to US EPA Guideline on Air Quality Models (Appendix W).

1.2 Description of Site and WWTP Stack

The Lakeview Village is proposed to be developed adjacent to the G.E. Booth WWTP. The WWTP is located east of the proposed site with Lakeshore Road to the north. This site is proposed to be a mixed-use development, which will include mid-rise to high-rise residential buildings, townhouses, institutional and commercial facilities. The tallest building will be a 40-storey residential building, located approximately 850 meters southwest of the WWTP Stack. The single floor height of each type of building is different, as shown below. The layout of the proposed site is provided in Appendix C.

- Residential Buildings – 3 meters
- Office/Institutional/Hotel/Civic/School – 4 meters
- Retail – 6 meters

G.E. Booth WWTP is located approximately 500 meters from the shoreline of Lake Ontario. The WWTP Stack has four incinerator units (TOX 1 to TOX 4), which discharge through two separate flues of one common Stack (referred to as the WWTP Stack), as shown below.

- Flue 1 discharges emissions from TOX 1 & TOX 2
- Flue 2 discharges emissions from TOX 3 & TOX 4

2. DISPERSION MODELLING METHODOLOGY

This section describes the methodology of selection of model inputs and its rationale, identification of significant contaminants from the WWTP Stack and model setup.

2.1 Proximity to Lake Ontario

As per ADMGO, *Shoreline fumigation is a phenomenon that may occur along the shore of an ocean or a large lake. When the land is warmer than the water, a breeze forms as the warmer, lighter inland air rises. As the stable, cooler air from over the water moves inland, it is heated from below, resulting in a turbulent boundary layer of air that rises with downwind distance from the shoreline. The plume from a tall stack source located near the shoreline may intersect this turbulent layer and be rapidly mixed to the ground, a process called "fumigation," resulting in high ground level concentrations. Generally, facilities located within approximately 1 km of the shoreline of a larger lake or water body, that emit contaminants from taller stack sources greater than 50 metres in height, need assessment for the potential for shoreline fumigation to occur using the SCREEN3 model.*

The WWTP Stack is 53.4 m tall and it is located about 500 meters from the shoreline. ORTECH performed a SCREEN3 analysis which predicted that no shoreline fumigation was occurring downwind of the WWTP Stack. Hence, as per ADMGO, use of the AERMOD dispersion model is considered appropriate. This conclusion was verified in the Region of Peel's 2019 ESDM report for the WWTP, which used the AERMOD model for the dispersion modelling assessment.

AERMOD has capacity to model two types of surfaces – Rural and Urban, based on surface geophysical conditions and population density of the area. As per MECP guidelines, the surface characteristics within a three kilometer radius around the WWTP Stack is representative of rural surface conditions, predominantly due to coverage of approximately 42% of the area with water (Figure B.1). However, the Urban heat island effect due to population density around the WWTP is to be accounted for. The Urban dispersion option is also recommended in US EPA's 2019 AERMOD Implementation Guide (see below), for sources located in urban areas, in close proximity to water bodies.

"For most applications the Land Use Procedure described in Section 7.2.3(c) is sufficient for determining the urban/rural status. However, there may be sources located within an urban area, but located close enough to a body of water or to other non-urban land use categories to result in a predominately rural land use classification within 3 kilometers of the source following that procedure. Users are therefore cautioned against applying the Land Use Procedure on a source-by-source basis, but should also consider the potential for urban heat island influences across the full modeling domain. Furthermore, Section 7.2.3(f) of Appendix W recommends modeling all sources within an urban complex using the urban option even if some sources may be defined as rural based on the procedures outlined in Section 7.2.3. Such an approach is consistent with the fact that the urban heat island is not a localized effect, but is more regional in character".

Section 7.2.1.e of 2017 Appendix W Final Rule (US EPA) comments on the use of urban/rural dispersion options in AERMOD. As per this section, tall stacks near rural or small urban areas should be modelled with the rural dispersion option. ORTECH is of the opinion that the proposed development site may not be classified as a small urban area or rural area. Rather, based on population information (available on Statistics Canada), the current average population density of Mississauga is 2467 persons/sq. km. Appendix W (US EPA) suggests, if the population density is more than 750 persons/sq.km, the site can be classified as urban. Further, the section 7.2.1e does not clarify its applicability to tall stacks near large water bodies. Instead, section 7.2.1.e suggests consultation with regulatory authorities and reference to the AERMOD Implementation Guide. Section 5.1 of the AERMOD Implementation Guide suggests the use of the urban dispersion option for modelling of sources near a water body.

It should be noted that the Region of Peel's 2019 ESDM report of G. E. Booth WWTP does not mention the type of meteorological data (Crops/Suburban/Urban) but mentions that the Urban dispersion option was used for modelling.

2.2 Physical Characterization of WWTP Stack

Table 1 shows the physical WWTP Stack parameters presented in the Region of Peel's ESDM report. It is noted that except for the exhaust temperature and exhaust velocity of the flue gases, all other parameters of these flues are virtually the same in the various source testing reports available to ORTECH at the time of this report.

Table 1: Physical Stack Parameters – Region of Peel's 2019 ESDM Report

Source ID	TOX 1 & 2	TOX 3 & 4
X Coordinate (m)	617426	617426
X Coordinate (m)	4825943	4825943
Base Elevation (m)	74	74
Release Height above Grade (m)	53.4	53.4
Temperature (K)	326	329
Velocity (m/s)	26.5	28.3
Stack Diameter (m)	0.91	0.91

As per ADMGO, *"When the plumes from multiple closely-spaced stacks or flues merge, the plume rise can be enhanced. Briggs et.al. has proposed equations to account for this. The reader is referred to that document for further details. Most models do not explicitly account for enhanced plume rise from this cause, and most regulatory agencies do not permit it to be considered in regulatory applications of modelling, with one exception. That exception is the case of a single stack with multiple flues, or multiple stacks located very close together (less than approximately one stack diameter apart). In these cases, the multiple plumes may be treated as a single plume. To do this, a pseudo stack diameter is used in the calculations, such that the total volume flow rate of the stack gases is correctly represented"*.

Conservatively, ORTECH replaced the two independent flues with one merged stack (referred to as the WWTP Stack). The merged stack parameters were calculated in accordance with US EPA' document "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources Revised", 1992. Selected pages from this document, explaining the methodology to calculate the merged stack parameters are attached in Appendix E. Table 2 shows the estimated merged stack parameters as per the US EPA method.

Table 2: Estimated Merged Stack Parameters as per US EPA Method (1992)

Merged Stack Parameters	Values
UTM Coordinates	617427.64, 4825946.41
Release height (m)	53.4
Temperature (K)	326
Exhaust diameter (m)	0.91
Exhaust velocity (m/s)	26.5

2.3 Significant Contaminants from WWTP Stack

ORTECH referred to the Region of Peel's 2019 ESDM report and found out that there are 18 contaminants discharged by the WWTP Stack, which are considered to be significant (see Appendix D). It is noted that the Region of Peel's 2019 WWTP ESDM report accounts for other sources of emissions, aside from the WWTP Stack and reports ground level concentrations of contaminants emitted from the whole WWTP Facility. As per the Region of Peel's ESDM report, all the contaminant concentrations were found to be below MECP criteria.

Source testing reports for the WWTP Stack provide the emission rates (reported as grams/second, i.e. the amount of each contaminant emitted per unit time), based on site specific source testing conducted at the WWTP Stack. In these reports, the modelled ground level concentration of contaminants emitted exclusively by the incinerators via the WWTP Stack was reported. Upon observation, ORTECH selected "Significant" contaminants from a 2019 source testing report, for which the ground level concentration of more than 1% of MECP criteria was reported. These six (6) contaminants and corresponding MECP standards are shown below in Table 3.

Table 3: List of Significant Contaminants from WWTP Stack and Corresponding MECP Criteria

Name of Contaminant	MECP Air Standard (Micrograms/cubic meter)	Averaging Period
Nitrogen Oxides (NO_X)	400	1-hour
	200	24-hour
Particulate Matter or Total Suspended Particulates (TSP)	120	24-hour
Hydrogen Fluoride (HF)	0.86	24-hour
	0.34	30-day
Sulphur Dioxide (SO_2)	690	1-hour
	275	24-hour
Phosphorus	0.5	24-hour
Benzo (a) Pyrene or BaP	0.00001	Annual

2.4 Contaminant Emission Rates

The Region of Peel's 2019 ESDM report for the G. E. Booth WWTP provides the emission rates of significant contaminants emitted from the WWTP Stack, which were adopted from a 2016 source testing report. The latest source testing reports (2017, 2018 and 2019) for the WWTP Stack were provided by TMIG. For this study, emission rates reported in the Region of Peel's ESDM report and statistically calculated emission rates (see Appendix F), based on the latest source testing reports (2015 to 2019) were compared. Conservatively, the highest emission rate for each contaminant was selected. It is to be noted that, in 2015 to 2017 source testing reports, the emission rates of contaminants from the incinerator unit TOX-3 was not reported. To simplify this assessment, it was assumed that the emissions from the three operating incinerator units are equal and the combined emissions from the merged stack are equal to the sum of emissions from Flue 1 and Flue 2. The Region of Peel's 2019 ESDM report of the WWTP follows a similar approach.

2.4.1 Contaminant Emission Rates Based on 2019 WWTP Operations

G. E. Booth WWTP Annual Report 2019 provides the monthly quantities of sludge cake incinerated in G. E. Booth WWTP's incinerators (Appendix F). Conservatively, for the purpose of this report, the highest monthly incinerated quantity of sludge cake, for the month of June was selected. In June 2019, 4,662 dry Tons (dT) of combined sludge cake from G. E. Booth WWTP and Clarkson WWTP was incinerated. Hence, average daily amount of sludge cake incinerated at WWTP was approximately 4,662 dT/30 days = 155.4 dT/day.

As per the Region of Peel's Virtual Public Information Event No. 1, dated October 14, 2020 (Figure 1), existing sludge production to incinerators are as follows:

- G. E. Booth WWTP – 110 dT/day
- Clarkson WWTP – 25 dT/day

The sum total of existing sludge production from G. E. Booth WWTP and Clarkson WWTP, to the incinerators is 135 dT/day. This existing value is less than the maximum daily average of 155.4 dT/day, as calculated above. Hence, for conservatism, 155.4 dT/day was assumed to be current maximum production rate of WWTP incinerators.

Also, from 2019 source testing report, it was observed that the test results were reported based on average sludge flow of 55 dT/day to each incinerator (approximately). Hence, to address a daily maximum sludge flow of 155.4 dT/day, the number of incinerators required to operate per day would be:

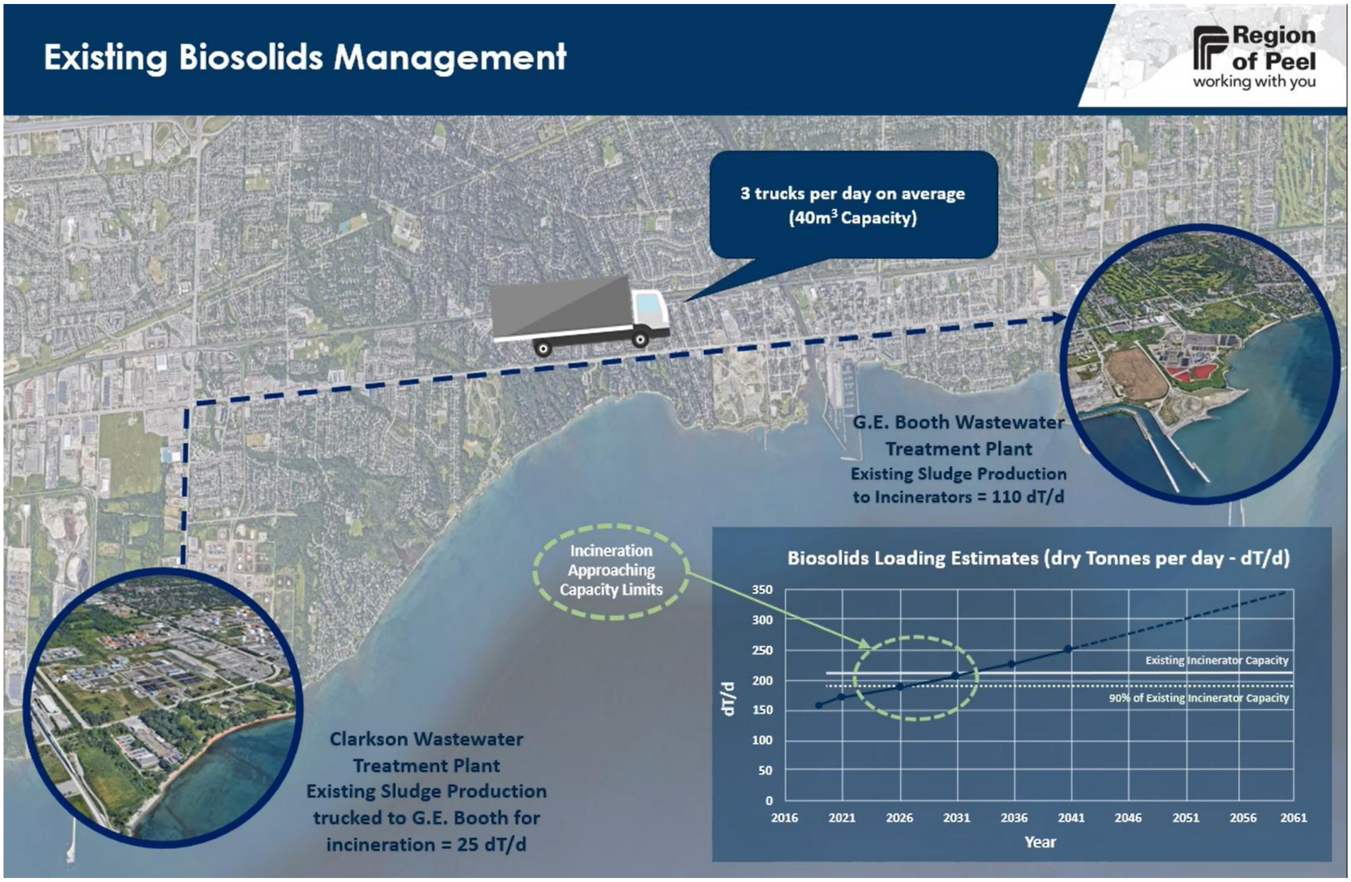
= 155.4 dT/day ÷ 55 dT/day per incinerator = 3 incinerators (approximately)

Table 4 shows the statistically calculated maximum emission rate of each Significant contaminant emitted by the WWTP Stack based on 2019 WWTP operations at a maximum sludge flow production rate of 155.4 dT/day.

Table 4: Estimated Emission Rates of Each Significant Contaminant from WWTP Stack – 2019 WWTP Operations

Significant Contaminant	Emission Rate (g/s)
NO_X	7.2
TSP	0.7
SO_2	8.8
HF	0.016
Phosphorus	0.0033
BaP	0.000003

Figure 1: G. E. Booth WWTP Incineration Rate Trend



Source: Region of Peel's Virtual Public Information Event No. 1, dated October 14, 2020

2.4.2 Contaminant Emission Rates Based on Projected WWTP Operations

As per the Region of Peel's Virtual Public Information Event No. 1, dated October 14, 2020, G. E. Booth WWTP's existing incinerator capacity is approximately 220 dT/day (see Figure 1). Based on trend analysis in Figure 1, the incinerators will operate at full existing capacity of 220 dT/day by 2031. This value corresponds to a rate of 73 dT/day per incinerator which is greater than the 70 dT/day as stated in the WWTP's current (2019) ESDM report. Based on this projected sludge incineration rate of 220 dT/day, the prorated emission rates of significant contaminants were calculated (Appendix F), which are shown in Table 5.

Table 5: Estimated Emission Rates (Prorated) of Each Significant Contaminant from WWTP Stack – Projected 220 dT/day Dry Sludge Incineration

Significant Contaminant	Emission Rate (g/s)
NO_X	10.2
TSP	1.0
SO_2	12.4
HF	0.023
Phosphorus	0.0047
BaP	0.000004

2.5 Meteorological Data

Selection of appropriate meteorological data for dispersion modelling plays a pivotal role in representative air impact assessments. Further, if the emission source is a tall stack (more than 50 meters high) which is located close to a large water body (within 1 km), then it is recommended to use site-specific meteorological data. This site-specific meteorological data is usually adopted from an on-site meteorological station, if available. Otherwise, this site-specific meteorological data is developed by MECP, according to geophysical conditions of the site. It was communicated to TMIG that MECP declined the request to provide site-specific meteorological data for this assessment. MECP provides the site-specific meteorological data only in case of regulatory applications.

The Region of Peel's 2019 ESDM report of G.E. Booth WWTP used MECP's generic Toronto regional meteorological data for dispersion modelling. Due to unavailability of MECP's site specific meteorological data for the site, ORTECH purchased AERMET 19191 processed site-specific meteorological data from Lakes Environmental (Lakes), in AERMOD-ready format. Upon receipt of purchased data, ORTECH evaluated the representativeness of the data to G.E. Booth WWTP location. The site-specific meteorological data developed by Lakes uses a prognostic weather model. Hence, the data provided by Lakes is an approximate estimation based on global weather observations.

The WWTP Stack is located on the land, very close to a large water body. Upon analysis of the Lakes data, ORTECH determined that the data was developed by treating the entire surface around the WWTP (360°) as water and actual land use characteristics were not considered. Upon inquiry, Lakes clarified that it is the technical limitation of the prognostic model that it can account for only one uniform surface condition around the site. To address this issue, ORTECH modified the Lakes data to account for suburban characteristics of terrain around the WWTP.

It should be noted that the AERMOD input meteorological data consists of hourly values of meteorological parameters, including but not limited to wind speed, wind direction, precipitation, etc. MECP's generic regional meteorological data was downloaded directly from MECP's website. This data corresponds to a time period of 5 years (1996 to 2000). Lakes' site-specific data was also processed for a time period of 5 years but considered the most recent period of 2015 to 2019. Appendix B shows the wind rose diagram (Figure B.2) of MECP's regional meteorological data for Central Region and also shows the wind rose diagram (Figure B.3) of site specific conditions using the Lakes-ORTECH meteorological data. It is noted from the wind rose diagrams that, in general, the majority of wind throughout the year blows away from the proposed development, as shown by wind flow vectors. However, comparison of the two wind rose diagrams, Figure B.2 and Figure B.3, it was observed that the specific meteorological conditions suggest a higher percentage of wind is expected to blow towards the proposed development when compared to MECP's generic meteorological data.

2.6 Buildings

The building layout for the proposed development and corresponding building IDs are provided in Appendix C.

2.7 Receptors

ORTECH used the following approach to setup elevated receptors points, consistent for each building identified in Appendix C.

- Receptors at Ground Level (GL)
- Receptors at Breathing Level (BL), 1.5 m above GL
- Receptors at each Floor Level (FL)

2.8 Modelling Approaches

The location of the WWTP Stack close to a large water body and on the edge of an urban center presents unique challenges from an air dispersion modelling perspective. Additional technical guidance in the 2019 US EPA's AERMOD Implementation Guide and 2017 Appendix W to US EPA Guideline on Air Quality Models was considered for this modelling assessment.

ORTECH's Recommended Modelling Approach for the Site:

- AERMOD 19191 with Urban dispersion option and ORTECH modified Lakes meteorological data

The modelling approach presented in Region's 2019 ESDM report for G. E. Booth WWTP includes AERMOD (19191) modelling with Urban dispersion option and MECP's regional meteorological data. ORTECH agrees that utilizing Urban dispersion option for the WWTP site is in accordance with US EPA guidance. However, considering the proximity of WWTP to shoreline, use of site-specific meteorological data is appropriate, as per MECP guidelines. Hence, ORTECH recommends modelling of Stack emissions with AERMOD 19191 using Urban dispersion option and site-specific meteorological data representative of site conditions.

2.9 Post-Processing of Modelling Results

As per ADMGO, *in modelling applications using regional or local meteorological data sets, certain extreme, rare and transient metrological conditions may be present in the data sets that may be considered outliers. As such, for assessments of 24-hour average concentrations, the highest 24-hour average predicted concentration in each single meteorological year may be discarded, and the ministry will consider for compliance assessment the highest concentration after elimination of these five 24-hour average concentrations over the 5-year period from the modelling results. In assessments of annual concentrations, the highest annual concentration in the 5-year period will be considered, without removal of any meteorological anomalies. For shorter averaging periods, such as 1-hour concentrations, the eight hours with the highest 1-hour average predicted concentrations in each single meteorological year may be discarded. The ministry will consider for compliance assessment the highest concentration after elimination of these forty hours over the five-year period from the modelling results*.

This methodology of eliminating meteorological anomalies is directly applicable to the modelled contaminant concentrations at receptors which are on the same plane, for example, when all the receptors are on the ground level or at the same elevation above ground level. However, when the receptors are at varying elevations above ground level, additional processing of modelled concentrations is required to adequately eliminate the effect of meteorological anomalies. Detailed explanation of ORTECH's post-processing approach is presented in Appendix G.

For clarity, the results presented in Section 4 reflect the impact of the WWTP Stack emissions on the proposed buildings, after elimination of meteorological anomalies.

3. RESULTS

3.1 2019 WWTP Operations

Dispersion modelling results suggest that based on 2019 operating conditions of the WWTP incinerators (155.4 dT/day), the emission rates of significant contaminants (Table 4) are not predicted to exceed the MECP air quality criteria for any relevant averaging time period, at any receptor. Due to unavailability of MECP approved site-specific meteorological data, ORTECH is of opinion that running the AERMOD model with ORTECH modified Lakes site specific meteorological data and the Urban dispersion option generates results which are technically valid.

3.2 Projected WWTP Operations

Based on prorated emission rates of Significant contaminants shown in Table 5, corresponding to for projected future WWTP incinerator operations of 220 dT/day and ORTECH's recommended modelling approach, NO_X (1 hour averaging period) concentrations are predicted to exceed the MECP standard at the upper floors of three (3) buildings of Lakeview Village (Table A.2).

Figure A.1 provides an assessment of the most impacted receptor (Building 27, Floor 22) under varying operational rates from 155.4 dT/day up to 220 dT/day. Compliance with the air quality criteria at this receptor location will result in compliance at all other building receptor locations.

To prevent future adverse impact of NO_X emissions from WWTP Stack (based on projected WWTP operations) on Lakeview Village, effective mitigation strategies are warranted. The level of control required to meet MECP's air quality criteria at Lakeview Village buildings depends on the projected operation scenarios of WWTP, as shown below:

Projected Sludge Incineration Rate of 220 dT/day:

The maximum NO_X concentration (1 hour averaged) of 504.7 $\mu g/m^3$ (Table A.2), due to sludge incineration rate of 220 dT/day, was predicted at 22nd floor of Building 27 (see Appendix C for Building IDs), which is 126% of MECP air standard for NO_X (1 hour averaged). Hence, mitigation strategies must reduce NO_X levels by at least 26% at 22nd floor of Building 27, to ensure that none of buildings of Lakeview Village are adversely impacted by WWTP Stack NO_X emissions due to sludge incineration of 220 dT/day. In other terms, if through mitigation, the 22nd floor of Building 27 complies with the air quality criteria, all other locations will also comply.

4. CONCLUSIONS AND RECOMMENDATIONS

Dispersion modelling of Significant contaminant emissions from G. E. Booth WWTP incinerator stack (WWTP Stack) based on current operation conditions of WWTP incinerators (2019 Annual Report of G. E. Booth WWTP), ORTECH's recommended modelling approach and elimination of meteorological anomalies from modelled results suggest that none of the proposed buildings are expected to be impacted by WWTP Stack emissions, when predicted concentrations are compared to MECP's current air quality criteria (ACB List, 2018). Based on projected operating conditions of G. E. Booth WWTP, NO_X (1 hour averaged)) emissions from WWTP Stack are predicted to result in concentrations that exceed the MECP standard at three (3) of the proposed buildings on the upper floors of Lakeview Village.

It is proposed to implement measures, to address NO_X exceedances at these locations through the following mitigation strategies, or combinations, which are briefly discussed in further sections of this report:

a) restrictions on open windows/balconies on impacted floors of buildings where impacts are predicted;
b) equipping air intakes servicing these areas with NO_X reduction technologies such as activated carbon filters which can be installed as part of the HVAC system;
c) mitigation at source through improved operational controls, such as excess air requirements and combustion temperatures, to minimize NO_X generation, and/or
d) mitigation at source through add-on control technologies.

Given that suitable options exist to minimize the exceedances of NO_X levels at buildings identified in Table A.2, through either at-receiver or at-source mitigation options, we suggest that such requirements be identified in a Condition of Draft Plan Approval and that these requirements be addressed at the Subdivision/Site Plan detailed design stage.

4.1 Mitigation Strategies

As noted above, mitigations strategies will be required to ensure the MECP's 1 hour NO_X POI limit of 400 $\mu g/m^3$ are not exceeded as buildings within Lakeview Village build-out. The timeline for this will depend on both the sludge incineration rate for GE Booth as well as the Lakeview development schedule. The need for mitigation will be triggered, upon occupancy of any of the three buildings noted, and when the NO_X emission rate for the GE Booth plant reaches 8.08 g/s. As depicted in Figure A.1 (Appendix A), based on GE Booth's anticipated production rates, this could be as soon as the year 2023, since a sludge incineration rate of 175 dT/day results in a NO_X emission rate of 8.08 g/s. The actual trigger for mitigation, however, is anticipated to be later since the first of these three buildings is currently not anticipated to be occupied until 2029. Any change to the building construction phasing schedule would accelerate/decelerate the timing of mitigation.

4.1.1 At-receiver Mitigation Strategies

A mitigation strategy of restricting open balconies and operable windows on specific buildings, if implemented, would in effect exclude those locations from consideration as receptor locations. In the event HVAC systems are installed on the upper floors of impacted building and draws air from the outdoors, the HVAC equipment would also need to incorporate emission control technology as part of the design, to address the building's indoor air quality. Several commercial products are currently available in the form of NO_X filters which generally consist of activated carbon filters having the ability to control up to 90% of NO_X emissions.

4.1.2 At-source Mitigation Strategies

Mitigation strategies also exist to control emissions at the source. The generation of NO_X emissions within municipal sludge incinerators has been correlated to several operational parameters including the quantity of excess air provided, operational temperature of the fluidized bed and the consistency of sludge feed rates[1]. Further investigation into this area may identify low-cost opportunities to sufficiently mitigate NO_X emissions.

Additional at-source mitigation strategies frequently employed for NO_X reduction include Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR). Both techniques involve the injection of ammonia or urea as a reactant to convert NO_X into diatomic nitrogen or N_2 within the flue gas stream and differ in the presence of a catalytic bed to aid in the reduction process. NO_X reductions between 30 – 90%[1] are commonly provided for this application. Both SCR and SNCR technologies can provide the required level of emission reduction to meet the MECP air quality standard at the Lakeview Village in the future as predicted by AERMOD modelling of projected NO_X emission scenarios.

Several case studies regarding emission control technologies for NO_X from municipal sludge incinerators can be found on the internet including the presentation "Stack Emission Test Results From Existing and New High Temperature Fluid Bed Municipal Sludge Incinerators Operating in US and Ontario" (May 18th, 2018, SUEZ) which can be found using the following link: http://njejif.org/images/NJWEA_2018_Takmaz.pdf.

At a high level the estimated cost of SNCR mitigation for NO_X is in the neighborhood of $2 million per incinerator based upon preliminary information within the US EPA's Air Pollution Control Cost Estimation Spreadsheet. This $2 million per incinerator "ball park" cost has also been verified through discussions with potential suppliers and it is expected that the mitigation implementation from incinerator to incinerator could be phased as sludge production warrants. The cost of this mitigation would be DC eligible and if front ended by the Developer, would be DC creditable.

[1] Dangtran, Ky and Holst, Troy (2001), Minimization of Major Air Pollutants From Sewage Sludge Fluid Incinerators; Proceedings of the Water Environment Federation.

4.1.3 Monitoring

Regardless of whether at-source mitigation, at-receiver mitigation, or a combination of both approaches are employed, some form of continuous emission monitoring system (CEMS) for NO_X should be considered to validate that emissions, either controlled or uncontrolled, remain below target levels. An alternate approach to monitoring would be to install monitoring equipment on Building 27 at roof level, or other suitable elevated location, to validate the accuracy of the modelled predictions.

5. LIMITATIONS

The assessment, conclusion and recommendations in this report are based on the information provided by LPCL and their representatives; documented technical guidance from regulatory bodies such as MECP and US EPA and ORTECH's profession opinion. This report is prepared for exclusive use of LPCL, their representatives and stakeholders of Lakeview Village development project plan (Appendix C). The assessment presented in this report is not applicable to other sites. Any changes to the WWTP Facility and the Lakeview Village development site plan may require revision of this assessment.

Any unique analytical methods presented in this report such as elimination of meteorological anomalies for elevated receptor grid, etc., are devised by ORTECH, exclusively for this assessment only. ORTECH does not claim that such analytical methods are recommended in regulatory guidance documents. Further, these analytical methods are not to be used by any other party without prior approval of ORTECH.

The dispersion model version, input data and technical guidance used for this assessment is current to best of ORTECH's knowledge, at the time of preparation of this report. However, these tools and guidance are dynamic in nature and are updated by relevant authorities in light of latest scientific research. ORTECH does not accept any responsibility for future changes in dispersion model versions, input data requirements and technical guidance. The conclusions presented in this assessment are based, in part, upon computer modelling predictions and actual measured impacts at receptor locations may differ from these predicted values.

Commencing July 1, 2023, a new Sulphur Dioxide (SO_2) air quality standard will come into effect. Under the scope of this assessment ORTECH has excluded an assessment of impacts associated with the future SO_2 standard pending further information from WWTP in this regards.

APPENDIX A

Results of ORTECH's Recommended Approach
AERMOD 19191 with Urban Dispersion Option
and ORTECH Modified LAKES Meteorological Data (Lakes-ORTECH Data)
(3 pages)

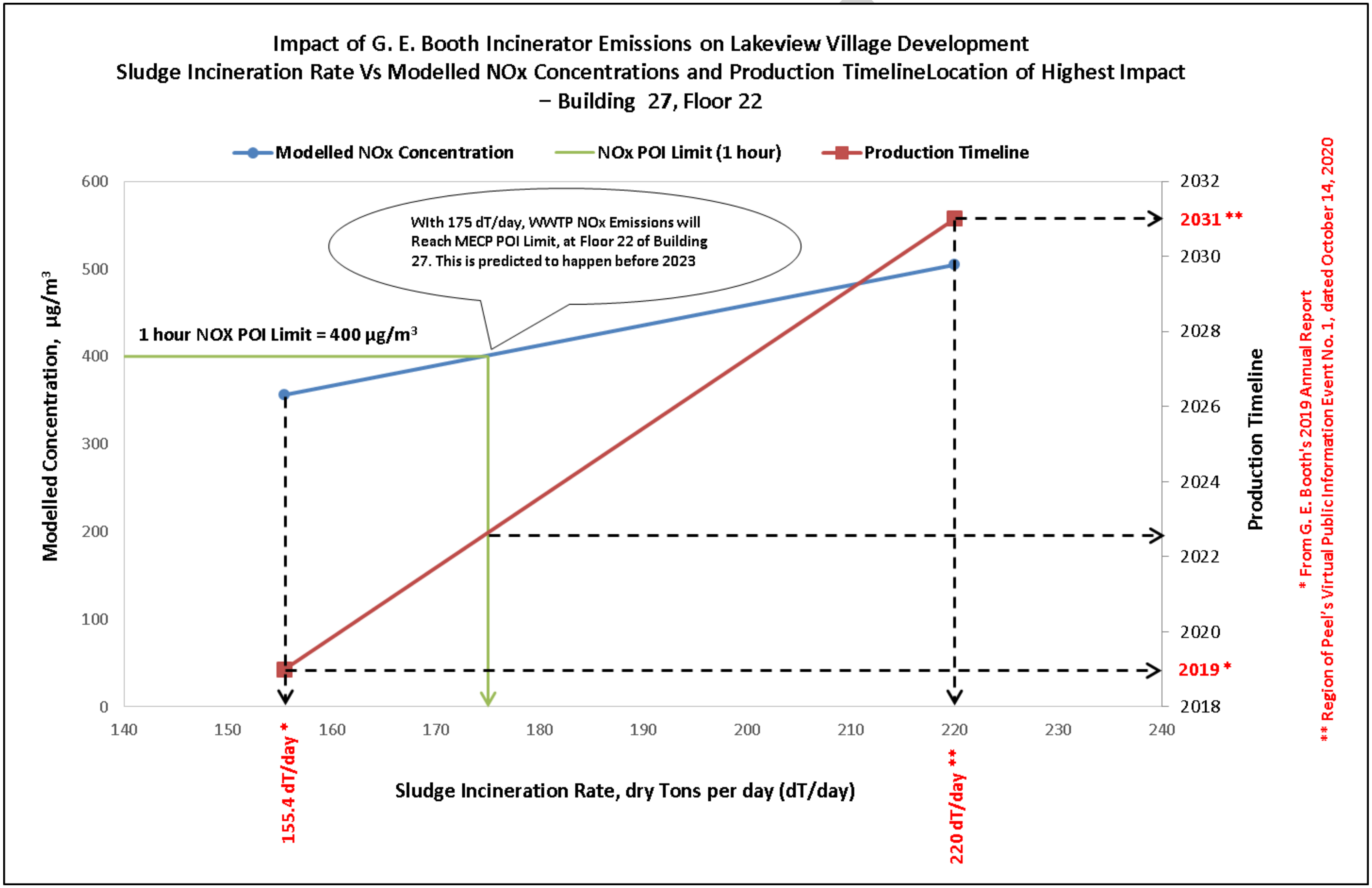
Table A.1: 1-Hour Averaged Modelling Results of NO_X – ORTECH's Recommended Approach and WWTP's 2019 Operating Conditions

2019 G. E. Booth WWTP Operations (155.4 MT/day) - 7.2 g/s NO_X (Emission Outliers and Meteorological Anomalies Excluded)							
AERMOD 19191, Urban Dispersion Option, Lakes-ORTECH Meteorological Data and MECP's 2018 Air Standard 400 µg/m³ (1-hour Average)							
Building ID	Proposed Maximum Height of the Building (meters)	Proposed Number of Floors	Impacted Floors	Highest Modelled Concentration (µg/m³)	% MECP Criteria	Floor Level Impacted by Highest Modelled Concentration	Corresponding Floor Height above GL (meters)
No Impacts were predicted on any of the proposed buildings after removal of emission outliers from model input and meteorological anomalies from the modelled results							

Table A.2: 1-Hour Averaged Modelling Results of NO_X – ORTECH's Recommended Approach and WWTP's Projected Operating Conditions (Sludge Incineration Rate 220 dT/day)

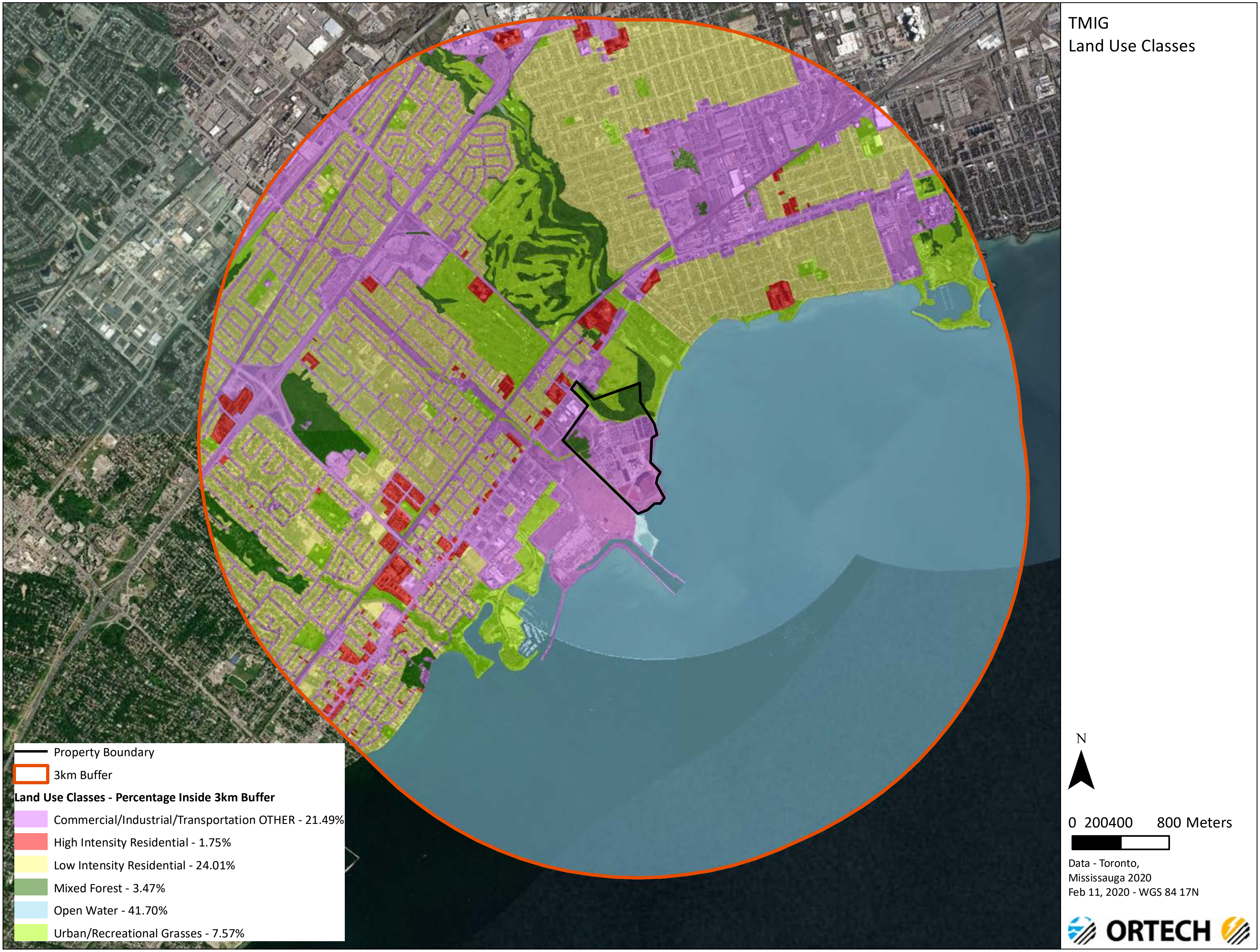
Projected G. E. Booth WWTP Operations (220 MT/day) - 10.2 g/s NO_X (Emission Outliers and Meteorological Anomalies Excluded)							
AERMOD 19191, Urban Dispersion Option, Lakes-ORTECH Meteorological Data and MECP's 2018 Air Standard 400 µg/m^3 (1-hour Average)							
Building ID	Proposed Maximum Height of the Building (meters)	Proposed Number of Floors	Impacted Floors	Highest Modelled Concentration (µg/m^3)	% MECP Criteria	Floor Level Impacted by Highest Modelled Concentration	Corresponding Floor Height above GL (meters)
B1	45	15	No Floors Impacted	-	-	-	-
B2	36	12	No Floors Impacted	-	-	-	-
B3	30	10	No Floors Impacted	-	-	-	-
B4	54	18	No Floors Impacted	-	-	-	-
B5	45	15	No Floors Impacted	-	-	-	-
B6	36	12	No Floors Impacted	-	-	-	-
B7	75	25	No Floors Impacted	-	-	-	-
B8	30	10	No Floors Impacted	-	-	-	-
B9	36	12	No Floors Impacted	-	-	-	-
B10	63	21	No Floors Impacted	-	-	-	-
B11	75	25	No Floors Impacted	-	-	-	-
B12	51	17	No Floors Impacted	-	-	-	-
B13	69	23	Floors 21 to 23	431.82	108%	23	69
B14	84	28	Floors 22 to 28	472.78	118%	27	81
B15	36	12	No Floors Impacted	-	-	-	-
B16	87	29	No Floors Impacted	-	-	-	-
B17	72	24	No Floors Impacted	-	-	-	-
B18	120	40	No Floors Impacted	-	-	-	-
B19	45	15	No Floors Impacted	-	-	-	-
B20	36	12	No Floors Impacted	-	-	-	-
B21	27	9	No Floors Impacted	-	-	-	-
B22	30	10	No Floors Impacted	-	-	-	-
B23	51	17	No Floors Impacted	-	-	-	-
B24	36	12	No Floors Impacted	-	-	-	-
B25	33	11	No Floors Impacted	-	-	-	-
B26	36	12	No Floors Impacted	-	-	-	-
B27	66	22	Floors 21 to 22	504.69	126%	22	66
B28	36	12	No Floors Impacted	-	-	-	-
B29	50	12	No Floors Impacted	-	-	-	-
School	12	3	No Floors Impacted	-	-	-	-

Figure A.1: Sludge Incineration Rate Vs Modelled NO_X Concentrations and Production Timeline (Location of Highest Impact – Building 27, Floor 22)



APPENDIX B

Land Use Map and Wind Rose Diagrams
(3 pages)

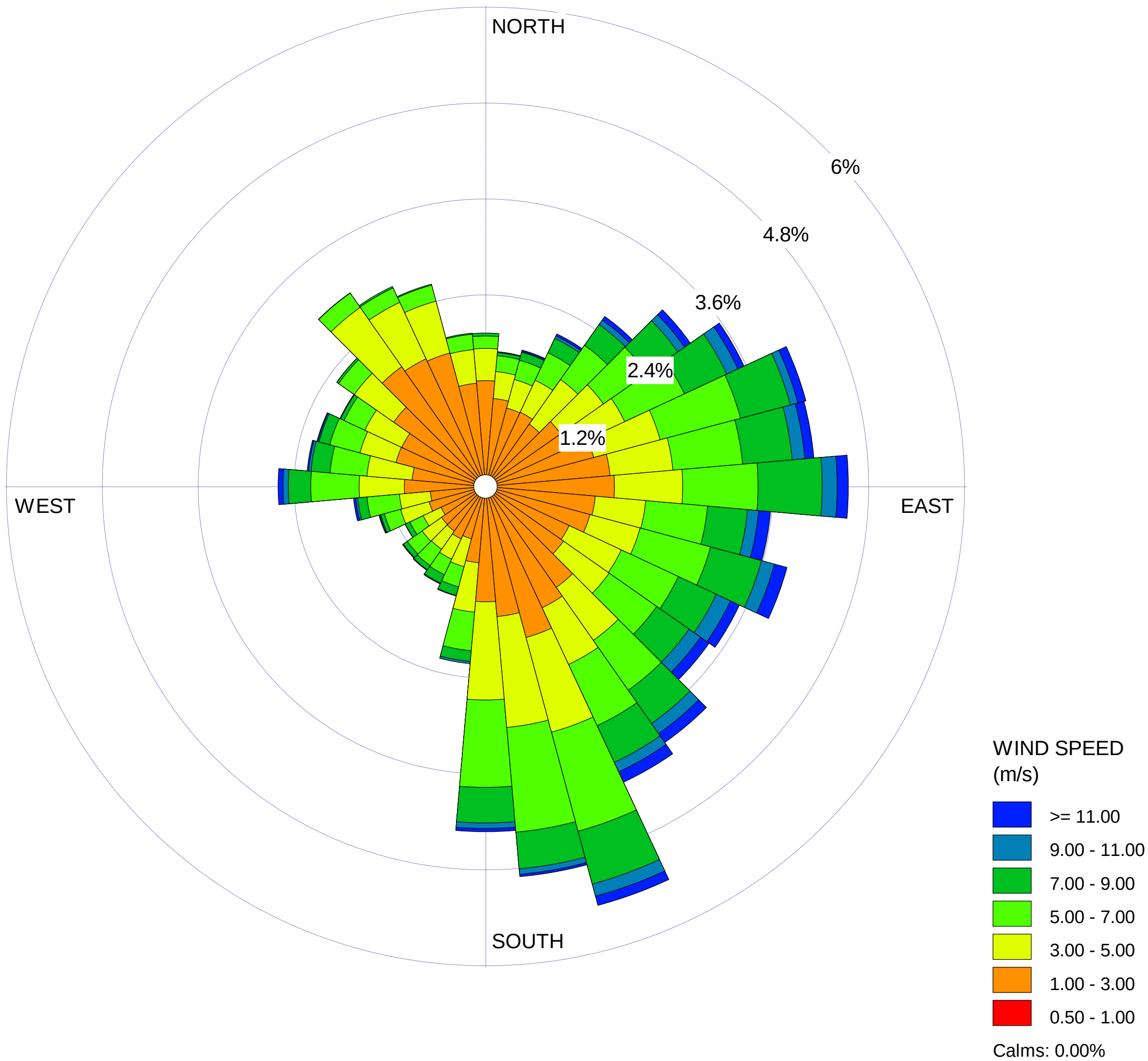

TMIG
Land Use Classes
Property Boundary
3km Buffer
Land Use Classes - Percentage Inside 3km Buffer
Commercial/Industrial/Transportation OTHER - 21.49%
High Intensity Residential - 1.75%
Low Intensity Residential - 24.01%
Mixed Forest - 3.47%
Open Water - 41.70%
Urban/Recreational Grasses - 7.57%
N
0 200400 800 Meters
Data - Toronto,
Mississauga 2020
Feb 11, 2020 - WGS 84 17N
ORTECH

WIND ROSE PLOT:

MECP Regional Meteorological Data 1996 - 2000
Central Region

DISPLAY:

Wind Speed
Flow Vector (blowing to)



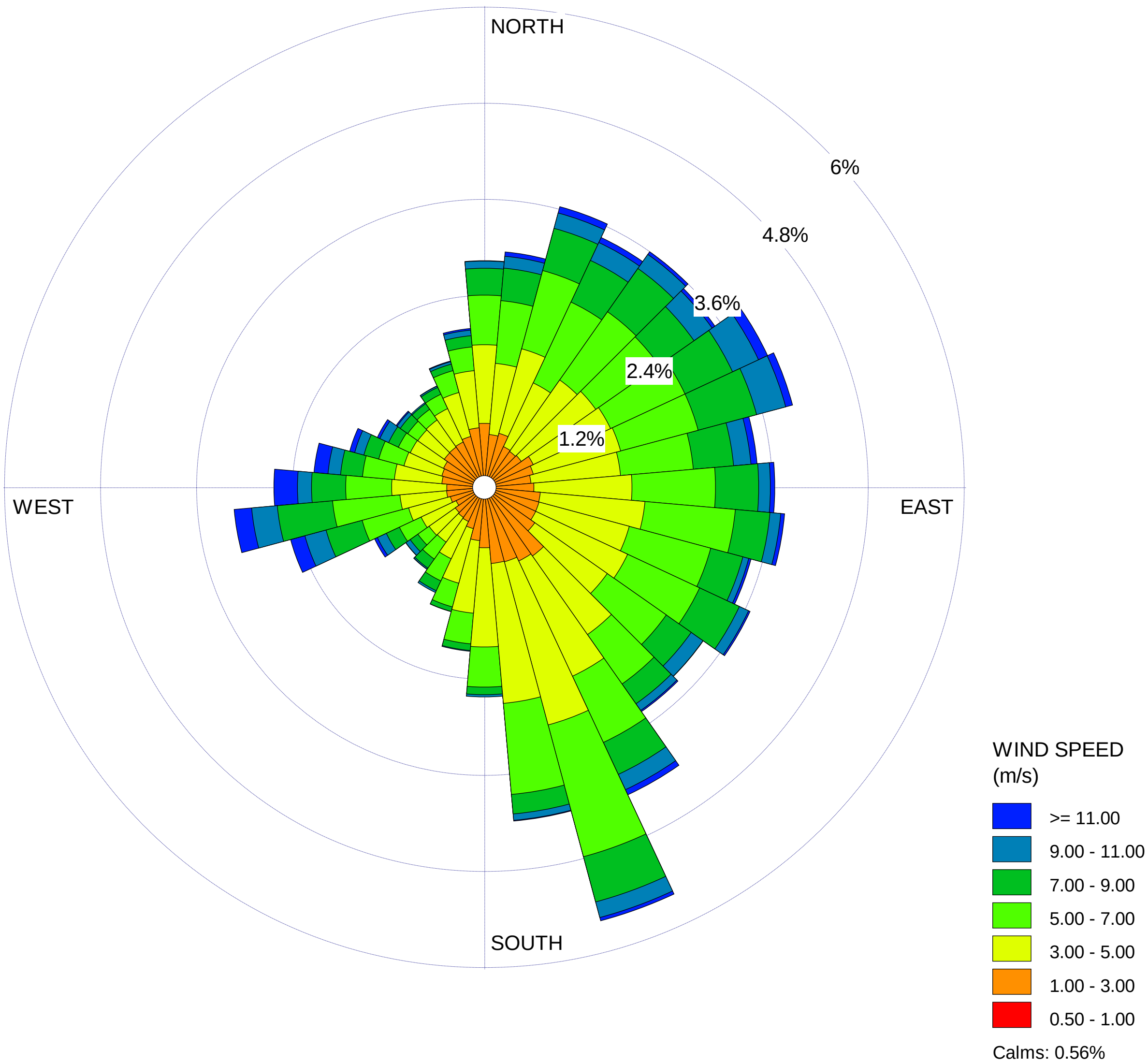
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 01/01/1996 - 00:00 **End Date: 31/12/2000 - 23:59**	**ORTECH Consulting Inc.**	
		MODELER: **Ibrahim Syed**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **43758 hrs.**	
	AVG. WIND SPEED: **3.97 m/s**	DATE: **15/12/2020**	PROJECT NO.: **92261**

WIND ROSE PLOT:

Lakes - ORTECH Meteorological Data 2015 - 2019

DISPLAY:

Wind Speed
Flow Vector (blowing to)



COMMENTS:	DATA PERIOD: **Start Date: 01/01/2015 - 00:00** **End Date: 31/12/2019 - 23:59**	COMPANY NAME: **ORTECH Consulting Inc.**	
		MODELER: **Ibrahim Syed**	
	CALM WINDS: **0.56%**	TOTAL COUNT: **43824 hrs.**	
	AVG. WIND SPEED: **4.92 m/s**	DATE: **15/12/2020**	PROJECT NO.: **92261**

WRPLOT View - Lakes Environmental Software

APPENDIX C

Lakeview Village Proposed Buildings Layout and Building IDs
(1 page)

Lakeshore Rd.
Hydro Rd.
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APPENDIX D

Emission Data Table
from Region of Peel's 2019 ESDM Report of G. E. Booth WWTP
(1 page)

TABLE B-2: EMISSION DATA TABLE

SOURCE ID	EMISSION DATA						
	CONTAMINANTS	CAS #	EMISSION RATE (g/s)	AVERAGING PERIOD (HOURS)	ESTIMATION TECHNIQUE	DATA QUALITY	% OF OVERALL EMISSION
B-1	NOx	10102-44-0	6.18E-02	1	EF	Above-Average	0.65%
	CO	630-08-0	5.19E-02	1	EF	Above-Average	2.26%
B- 2	NOx	10102-44-0	6.18E-02	1	EF	Above-Average	0.65%
	CO	630-08-0	5.19E-02	1	EF	Above-Average	2.26%
B-3	NOx	10102-44-0	6.18E-02	1	EF	Above-Average	0.65%
	CO	630-08-0	5.19E-02	1	EF	Above-Average	2.26%
B-4	NOx	10102-44-0	6.18E-02	1	EF	Above-Average	0.65%
	CO	630-08-0	5.19E-02	1	EF	Above-Average	2.26%
B-5	NOx	10102-44-0	6.18E-02	1	EF	Above-Average	0.65%
	CO	630-08-0	5.19E-02	1	EF	Above-Average	2.26%
EGEN-1	PM	NA	1.95E-01	1	EF	Marginal	18.08%
	NOx	10102-44-0	2.75E+00	1	EF	Marginal	28.84%
	SO_2	7446-09-5	1.82E-01	1	EF	Marginal	10.94%
	CO	630-08-0	5.92E-01	1	EF	Marginal	25.77%
N19	PM	NA	2.98E-01	1	EF	Marginal	27.58%
	NOx	10102-44-0	4.19E+00	1	EF	Marginal	44.01%
	SO_2	7446-09-5	2.77E-01	1	EF	Marginal	16.69%
	CO	630-08-0	9.04E-01	1	EF	Marginal	39.32%
TOX-1 & TOX-2	PM	NA	2.93E-01	1	V-ST	Above average	27.17%
	SO_2	7446-09-5	6.01E-01	1	V-ST	Above average	36.19%
	NO_X	10102-44-0	4.61E+00	1	V-ST	Above average	48.38%
	CO	630-08-0	2.71E-01	1	V-ST	Above average	11.81%
	THC (as CH_4)	74-82-8	4.92E-02	1	V-ST	Above average	50.00%
	Naphthalene	91-20-3	6.34E-05	1	V-ST	Above average	50.00%
	Dioxins/Furans (TEQ)	NA	1.73E-10	1	V-ST	Above average	50.00%
	Mercury	7439-97-6	1.65E-03	1	EC	Average	50.00%
	Nickel	7440-02-0	7.65E-04	1	V-ST	Above average	50.00%
	Hydrogen chloride	7647-01-0	6.97E-03	1	V-ST	Above average	50.00%
	Hydrogen fluoride	7664-39-3	3.17E-03	1	V-ST	Above average	50.00%
	Benzo(a)pyrene	50-32-8	4.11E-08	1	V-ST	Above average	50.00%
	Arsenic	7440-38-2	1.98E-04	1	V-ST	Above average	50.00%
	Cadmium	7440-43-9	7.86E-06	1	V-ST	Above average	50.00%
	Calcium	1305-78-8	6.53E-03	1	V-ST	Above average	50.00%
	Iron	7439-89-6	3.52E-03	1	V-ST	Above average	50.00%
	Manganese	7439-96-5	7.70E-04	1	V-ST	Above average	50.00%
	Potassium	7440-09-7	1.70E-03	1	V-ST	Above average	50.00%
TOX-3 & TOX-4	PM	NA	2.93E-01	1	V-ST	Above average	27.17%
	SO_2	7446-09-5	6.01E-01	1	V-ST	Above average	36.19%
	NO_X	10102-44-0	4.61E+00	1	V-ST	Above average	48.38%
	CO	630-08-0	2.71E-01	1	V-ST	Above average	11.81%
	THC (as CH_4)	74-82-8	4.92E-02	1	V-ST	Above average	50.00%
	Naphthalene	91-20-3	6.34E-05	1	V-ST	Above average	50.00%
	Dioxins/Furans (TEQ)	NA	1.73E-10	1	V-ST	Above average	50.00%
	Mercury	7439-97-6	1.65E-03	1	EC	Average	50.00%
	Nickel	7440-02-0	7.65E-04	1	V-ST	Above average	50.00%
	Hydrogen chloride	7647-01-0	6.97E-03	1	V-ST	Above average	50.00%
	Hydrogen fluoride	7664-39-3	3.17E-03	1	V-ST	Above average	50.00%
	Benzo(a)pyrene	50-32-8	4.11E-08	1	V-ST	Above average	50.00%
	Arsenic	7440-38-2	1.98E-04	1	V-ST	Above average	50.00%
	Cadmium	7440-43-9	7.86E-06	1	V-ST	Above average	50.00%
	Calcium	1305-78-8	6.53E-03	1	V-ST	Above average	50.00%
	Iron	7439-89-6	3.52E-03	1	V-ST	Above average	50.00%
	Manganese	7439-96-5	7.70E-04	1	V-ST	Above average	50.00%
	Potassium	7440-09-7	1.70E-03	1	V-ST	Above average	50.00%
BIO-TF1	H_2S	7664-39-4	1.59E-03	1	EF	Average	43.17%
BIO-TF2	H_2S	7664-39-4	1.59E-03	1	EF	Average	43.17%
C1	H2S	7664-39-4	1.05E-04	1	EC	Average	2.85%
C2	H2S	7664-39-4	1.05E-04	1	EC	Average	2.85%
C3	H2S	7664-39-4	1.05E-04	1	EC	Average	2.85%
C4	H2S	7664-39-4	1.05E-04	1	EC	Average	2.85%
C5	H2S	7664-39-4	8.40E-05	1	EC	Average	2.28%

NA - Not available
TEQ – Toxicity Equivalent

APPENDIX E

Selected pages from US EPA
“Screening Procedures for Estimating the
Air Quality Impact of Stationary Sources Revised”, 1992
(4 pages)

EPA 454/R-92-019

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

~~EPA-450/R-92-019~~
October 1992

Air

Screening Procedures for Estimating the Air Quality Impact of Stationary Sources Revised

EPA 454/R-92-019
~~EPA-450/R-92-019~~

Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

October 1992

of the week, and hour of the day. In most cases, emission rates vary with the source production rate or rate of fuel consumption. For example, for a coal-fired power plant, emissions are related to the kilowatt-hours of electricity produced, which is proportional to the tonnage of coal used to produce the electricity. Fugitive emissions from an area source are likely to vary with wind speed and both atmospheric and ground moisture content. If pollutant emission data are not directly available, emissions can be estimated from fuel consumption or production rates by multiplying the rates by appropriate emission factors. Emission factors can be determined using three different methods. They are listed below in decreasing order of confidence:

1. Stack-test results or other emission measurements from an identical or similar source.
2. Material balance calculations based on engineering knowledge of the process.
3. Emission factors derived for similar sources or obtained from a compilation by the U.S. Environmental Protection Agency.[5]

In cases where emissions are reduced by control equipment, the effectiveness of the controls must be accounted for in the emissions analysis. The source operator should be able to estimate control effectiveness in reducing emissions and how this effectiveness varies with changes in plant operating conditions.

2.2 Merged Parameters for Multiple Stacks

Sources that emit the same pollutant from several stacks with similar parameters that are within about 100m of each other may be analyzed by treating all of the emissions as coming from a single representative stack. For each stack compute the parameter M:

$$M = \frac{h_s \, V \, T_s}{Q} , \tag{2.1}$$

where:

M = merged stack parameter which accounts for the relative influence of stack height, plume rise, and emission rate on concentrations

h_s = stack height (m)

V = $(\pi/4)\ d_s^2\ v_s$ = stack gas volumetric flow rate (m^3/s)

d_s = inside stack diameter (m)

v_s = stack gas exit velocity (m/s)

T_s = stack gas exit temperature (K)

Q = pollutant emission rate (g/s)

The stack that has the lowest value of M is used as a "representative" stack. Then the sum of the emissions from all stacks is assumed to be emitted from the representative stack; i.e., the equivalent source is characterized by h_{s_1}, V_1, T_{s_1} and Q, where subscript 1 indicates the representative stack and $Q = Q_1 + Q_2 + \ . \ . \ . \ + Q_n$.

The parameters from dissimilar stacks should be merged with caution. For example, if the stacks are located more than about 100m apart, or if stack heights, volumetric flow rates, or stack gas exit temperatures differ by more than about 20 percent, the resulting estimates of concentrations due to the merged stack procedure may be unacceptably high.

2.3 Topographic Considerations

It is important to study the topography in the vicinity of the source being analyzed. Topographic features, through their effects on plume behavior, will sometimes be a significant factor in determining ambient ground-level pollutant concentrations. Important features to note are the locations of large bodies of water, elevated terrain, valley configurations, and general terrain roughness in the vicinity of the source.

APPENDIX F

Elimination of Emission Outliers
(6 pages)

Elimination of Emission Outliers

ORTECH has reviewed 2015 to 2019 WWTP Stack source testing reports prepared by Wood Environment & Infrastructure Solutions (formerly, Amec Foster Wheeler Environment & Infrastructure) for the purpose of this assessment. A summary of emission rates of Significant contaminants (copied from WWTP source test reports) released by WWTP Stack is presented in the following table (Table F.1). ORTECH has also reviewed Region of Peel's 2019 ESDM report of G.E. Booth WWTP by Wood Environment & Infrastructure Solutions. It was noted that for preparation of 2019 ESDM report, the WWTP Stack contaminant emission rates were adopted from 2016 source testing report. All the source testing reports assumed that the WWTP incinerators were operating at 65% of their rated capacity. As per G. E. Booth WWTP's current air ECA # 6339-BJJRCS, four incinerators are rated for a combined maximum capacity to handle 400 dry tons of sludge per day.

It was also noted that, except for the year 2018, all other source testing reports presented testing data for only three out of four incinerators. 2019 ESDM report says following about the WWTP incinerators.

GE Booth (Lakeview) WWTP operates four fluidized bed sewage sludge incinerators (TOX-1 to TOX-4) in Mississauga, Ontario. Each unit is capable of incinerating approximately 70 dry tonnes of sludge per day at temperatures ranging from 700℃ to 900℃. <u>Only three units operate at a time under the current operating regime.</u>

Hence, for the purpose of this assessment, it was assumed that current operating conditions as G. E. Booth WWTP allow only three incinerators to operate simultaneously. As calculated in Section 2.4.1 of this report, the maximum daily sludge handling capacity of WWTP incinerators is 155.4 dT/day. Therefore, average hourly sludge handling capacity of each incinerator unit is:

= 155.4 dT/day ÷ 24 hours per day ÷ 3 incinerators
= 2.16 dT/hour per incinerator

The quantity of dry sludge which was incinerated at the time of source testing is also shown in Table F.1. ORTECH used this information to estimate the hourly sludge loading to each incinerator at the time of source testing (Table F.2) and hourly contaminant emission rates per dry tone of sludge incinerated (Table F.3). A sample calculation is shown below.

Table F.1: Summary of Emission Rates of Significant Contaminants from WWTP Stack and Daily Sludge Loading to Each Incinerator during Testing Period (Region's Source Testing Reports)

Source Testing Year	Triplicate Test ID	TOX-1							TOX-2							TOX-3							TOX-4						
		Waste Incinerated dT/day	NO_X g/s	TSP g/s	SO_2 g/s	HF g/s	Phosphorus g/s	BaP g/s	Waste Incinerated dT/day	NO_X g/s	TSP g/s	SO_2 g/s	HF g/s	Phosphorus g/s	BaP g/s	Waste Incinerated dT/day	NO_X g/s	TSP g/s	SO_2 g/s	HF g/s	Phosphorus g/s	BaP g/s	Waste Incinerated dT/day	NO_X g/s	TSP g/s	SO_2 g/s	HF g/s	Phosphorus g/s	BaP g/s
2015	1	88.1	5.57E-01	6.19E-02	3.05E+00	1.31E-03	9.11E-04	4.58E-07	82.9	2.63E-01	9.13E-02	2.07E+00	1.38E-03	8.19E-04	4.60E-07	Not Reported	Not Reported						91.7	2.88E-01	7.50E-02	1.98E+00	1.28E-03	1.47E-03	4.57E-07
	2	93.1	7.88E-01	7.80E-02	3.41E+00	1.39E-03	9.71E-04	4.63E-07	94.5	2.76E-01	8.20E-02	3.07E+00	1.42E-03	9.11E-04	4.58E-07								87.0	3.14E+00	1.13E-01	4.33E-01	1.37E-03	1.13E-03	4.64E-07
	3	87.8	1.04E+00	7.26E-02	3.84E+00	1.40E-03	9.83E-04	4.61E-07	82.7	3.41E-01	9.31E-02	2.43E+00	1.26E-03	9.12E-04	4.55E-07								98.8	5.71E-01	9.33E-02	1.85E+00	1.43E-03	1.24E-03	4.57E-07
2016	1	70.1	1.91E+00	6.20E-02	8.48E-03	1.04E-03	4.82E-04	1.33E-08	66.7	6.39E-01	2.09E-02	5.95E-02	9.77E-04	4.17E-04	1.34E-08								60.8	1.96E-01	8.45E-02	1.26E-01	9.38E-04	7.74E-04	1.33E-08
	2	77.4	1.30E+00	5.27E-02	1.75E-03	1.06E-03	4.73E-04	1.33E-08	60.4	2.28E+00	3.56E-02	5.36E-02	9.03E-04	4.32E-04	1.34E-08								65.4	2.73E+00	9.32E-02	3.29E-01	1.04E-03	5.04E-04	1.33E-08
	3	59.9	6.89E-01	5.06E-02	1.43E-02	7.18E-04	5.82E-04	1.35E-08	52.1	1.58E+00	3.16E-02	1.36E-01	8.59E-04	4.17E-04	1.32E-08								55.1	1.04E+00	1.08E-01	1.32E-01	1.12E-03	4.97E-04	1.35E-08
2017	1	67.1	3.38E+00	7.86E-02	1.68E-02	8.72E-04	7.28E-04	1.35E-08	74.0	6.03E-01	4.85E-02	3.17E-02	9.92E-04	5.33E-04	1.34E-08								72.1	6.37E-01	1.21E-01	1.03E-01	9.62E-04	8.67E-04	1.29E-08
	2	66.4	6.01E+00	9.54E-02	1.04E-02	8.93E-04	6.60E-04	5.52E-08	52.1	1.59E+00	6.22E-02	2.04E-02	9.95E-04	5.27E-04	1.34E-08								64.9	2.60E-01	9.67E-02	1.34E-01	9.45E-04	9.51E-04	1.31E-08
	3	72.8	1.85E+00	7.15E-02	3.26E-02	9.85E-04	6.63E-04	2.72E-08	76.7	2.11E+00	3.08E-02	6.00E-03	9.64E-04	4.26E-04	1.34E-08								75.0	1.62E+00	9.09E-02	7.10E-02	1.01E-03	6.78E-04	1.33E-08
2018	1	50.6	1.62E-01	1.48E-01	3.31E+00	9.98E-04	1.40E-03	1.73E-08	53.6	3.54E+00	1.01E-01	6.89E-03	1.02E-03	6.48E-04	1.35E-08	54.3	6.21E-01	1.00E-01	2.38E+00	1.07E-03	9.77E-04	1.19E-06	52.7	2.51E+00	1.16E-01	5.88E-01	8.90E-04	8.29E-04	1.30E-08
	2	53.5	2.44E-01	1.92E-01	2.30E+00	8.92E-04	1.23E-03	6.43E-08	49.9	5.78E-01	5.28E-02	1.00E-02	8.03E-04	8.40E-04	1.36E-08	55.3	4.15E-01	1.25E-01	2.69E+00	1.12E-03	1.22E-03	1.11E-07	63.3	5.47E+00	8.58E-02	3.11E-01	1.01E-03	6.73E-04	1.32E-08
	3	53.1	9.21E-01	2.06E-01	2.22E+00	1.05E-03	1.18E-03	1.65E-07	50.0	2.10E+00	8.84E-02	6.88E-03	7.86E-04	7.13E-04	1.36E-08	52.3	6.27E-01	1.80E-01	1.29E+00	9.40E-04	1.05E-03	2.88E-07	50.8	2.38E+00	6.75E-02	3.64E-01	9.07E-04	8.00E-04	1.32E-08
2019	1	56.7	2.48E-01	1.58E-02	2.57E-02	9.75E-04	4.65E-04	1.33E-08	Not Reported							ORTECH could not locate this information in source test report	1.07E+00	2.04E-01	4.90E-01	4.38E-03	9.52E-04	4.86E-08	52.6	3.31E-01	5.76E-02	1.07E-02	9.25E-04	6.09E-04	1.39E-08
	2	55.1	7.62E-01	9.67E-03	1.18E-02	9.63E-04	4.74E-04	1.35E-08									4.00E-01	1.10E-01	3.10E-01	4.23E-03	9.86E-04	5.41E-08	53.3	1.79E+00	6.89E-02	1.25E-02	9.25E-04	5.34E-04	1.35E-08
	3	54.4	3.59E-01	1.44E-02	1.51E-02	9.96E-04	4.99E-04	1.35E-08									2.00E+00	2.29E-01	3.30E-01	4.12E-03	9.70E-04	5.67E-08	59.2	1.49E-01	3.76E-02	2.93E-02	9.58E-04	5.80E-04	1.34E-08

Sample Calculation:

It is clear from Table F.1 that the contaminant emission rates vary significantly across various source testing reports and that a clear relationship between sludge loading rate and contaminant emission rate is difficult to establish. To account for this variability, ORTECH utilized statistical concepts for estimation of emission rate of each significant contaminant per dry ton of sludge loading to each incinerator unit. Assuming that the source testing data, across all source testing report, follow a normal distribution pattern. Then a 95 percentile value or "Average + 2 times Standard Deviation" will represent 95% of maximum emission rate. For example, consider sludge loading rate and corresponding NO_X emissions from TOX-1, as shown in Table F.1:

Average of all triplicate test results (2015 – 2019) for sludge loading to TOX-1 = 67.1 dT/day
Average of all triplicate test results (2015 – 2019) for NO_X emissions from TOX-1 = 1.35 g/s

Standard Deviation of all triplicate test results (2015 – 2019) for sludge loading to TOX-1 = 13.7 dT/day
Standard Deviation of all triplicate test results (2015 – 2019) for NO_X emissions from TOX-1 = 1.49 g/s

95 Percentile of sludge loading rate to TOX-1 (2015 – 2019 source tests)
= Average + 2 x Standard Deviation
= 67.1 dT/day +2 x 13.7 dT/day
= 94.5 dT/day = 94.5 dT/24 hours = 3.9 dT/hour

Similarly, 95 Percentile of NO_X emission rate from TOX-1 (2015 – 2019 source tests)
= Average + 2 x Standard Deviation
= 1.35 g/s +2 x 1.49 g/s = 4.3 g/s

1-hour averaged NO_X emission rate from TOX-1 per dry ton of hourly sludge loading rate
= 95 Percentile of NO_X emission rate from TOX-1 ÷ 95 Percentile of hourly sludge loading rate to TOX-1
= 4.3 g/s ÷ 3.9 dT/hour
= 1.099 g/s per dT of hourly sludge loading

Similarly, hourly NO_X emission rates per dry tone loading of each of the other three incinerators were calculated, as shown in Table F.2. It was calculated earlier that as per current WWTP operating conditions, a 2.16 dT/hour of sludge is handled by each of the three incinerators. From Table F.2, maximum hourly NO_X emissions per dry tone of sludge loading were emitted by TOX-4 (1.11 g/s per hourly sludge loading rate). Similarly, emission rates of each contaminant per hourly dry ton loading to each incinerator were calculated and presented in Table F.3.

Conservatively, assuming all three operating incinerators emit same amount of NO_X as TOX-4, then the combined hourly NO_X emission rate from all three incinerators is:

= Hourly Sludge Handling capacity of each incinerator x Number of Simultaneously Operating Incinerators x Maximum NO_X emission Rate per hourly dry Ton Loading of Sludge

= 2.16 dT x 3 x1.11 g/s per dT = 7.2 g/s

Projected 2031 sludge handling capacity of WWTP, as per the Figure F.1 shown below, is 220 dT/day. Assuming three incinerators operating simultaneously, project hourly sludge handling capacity would be:

= 220 dT/day ÷ 24 hours per day ÷ 3 incinerators = 3.06 dT/hour

Hence, the prorated NO_X emissions from WWTP Stack (3 incinerators) based on projected 2031 sludge handling capacity of incinerators would be:

= Hourly Sludge Handling capacity of each incinerator x Number of Simultaneously Operating Incinerators x Maximum NO_X emission Rate per hourly dry Ton Loading of Sludge

= 3.06 dT/hr x 3 x 1.11 g/s per dT/hr = 10.2 g/s

Similarly, emission rates of each significant contaminant from WWTP Stack was estimated statistically and was presented in Table 4, Table 5 and Table 6.

Table F.2: Statistical Estimation of Sludge Loading Rates

Statistics	TOX-1	TOX-2	TOX-3	TOX-4
Daily Average Sludge Loading dT/day	67.1	66.3	54.0	66.9
Standard Deviation of Daily Average Sludge Loading dT/day	13.7	14.8	1.3	14.7
95 Percentile (Average + 2 times Standard Deviation)	94.5	96.0	56.5	96.2
Hourly Average Sludge Loading dT/hour	3.9	4.0	2.4	4.0

Figure F.1: Sludge Handling Capacity of G. E. Booth WWTP (dry tons/day) – from Region of Peel's 2019 Annual Report

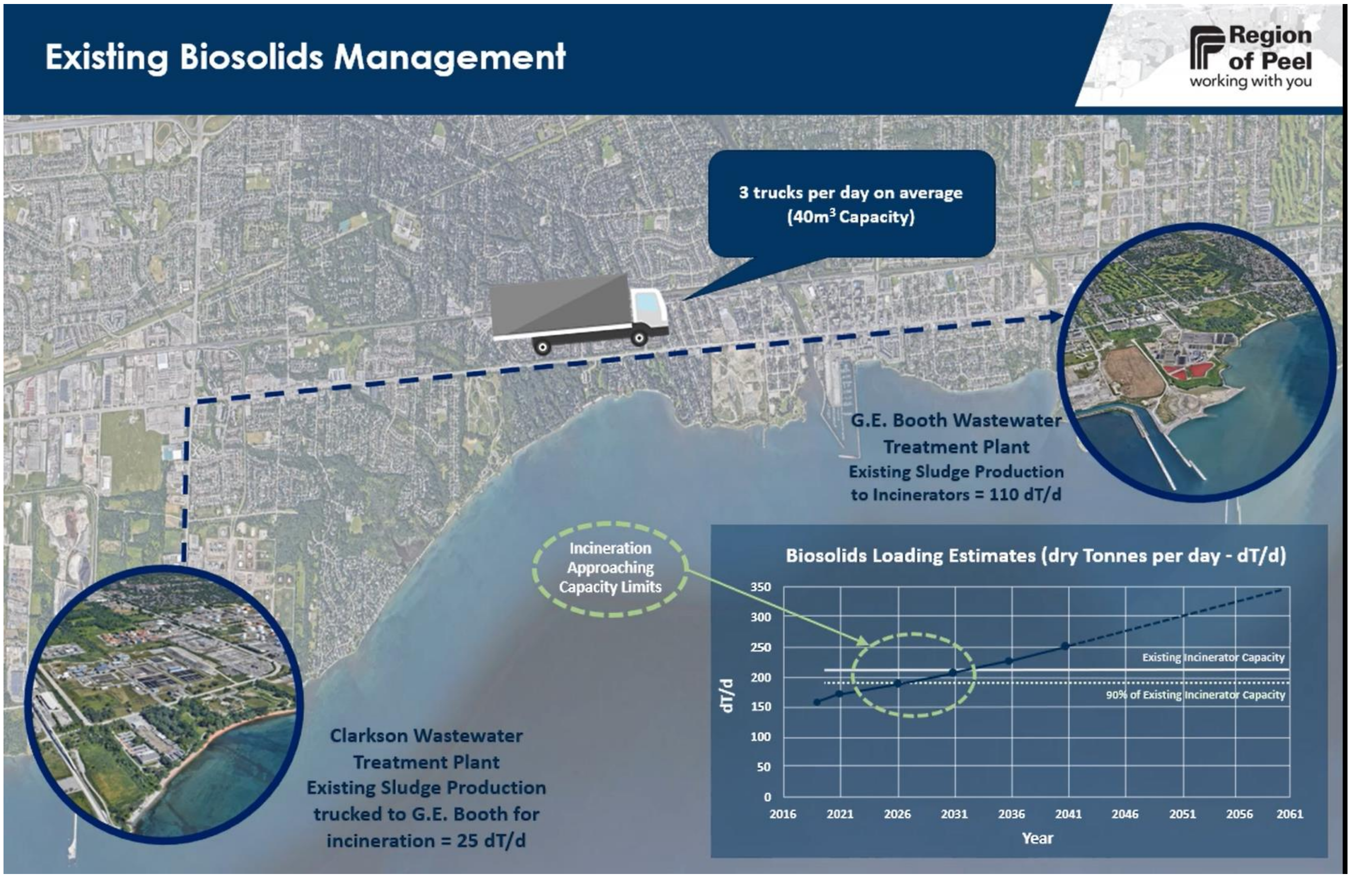

Table F.3: Statistical Estimation of Emission Rates of Significant Contaminants per Hourly Sludge Loading Rate

Statistics	TOX -1						TOX -2						TOX -3						TOX -4					
	NO_x	TSP	SO_2	HF	Phosphorus	BaP	NO_x	TSP	SO_2	HF	Phosphorus	BaP	NO_x	TSP	SO_2	HF	Phosphorus	BaP	NO_x	TSP	SO_2	HF	Phosphorus	BaP
Daily Average Emission Rate (g/s)	1.35E+00	8.06E-02	1.22E+00	1.04E-03	7.80E-04	1.20E-07	1.32E+00	6.15E-02	6.58E-01	1.03E-03	6.33E-04	1.24E-07	8.56E-01	1.58E-01	1.25E+00	2.64E-03	1.03E-03	2.91E-07	1.54E+00	8.73E-02	4.32E-01	1.05E-03	8.09E-04	1.03E-07
Standard Deviation of Average Emission Rate (g/s)	1.49E+00	5.72E-02	1.52E+00	1.86E-04	3.02E-04	1.74E-07	9.96E-01	2.74E-02	1.10E+00	2.03E-04	1.91E-04	1.92E-07	5.57E-01	4.90E-02	9.71E-01	1.60E-03	9.20E-05	4.10E-07	1.45E+00	2.23E-02	6.05E-01	1.68E-04	2.76E-04	1.78E-07
95 Percentile (Average + 2 times Standard Deviation)	4.32E+00	1.95E-01	4.26E+00	1.41E-03	1.38E-03	4.69E-07	3.32E+00	1.16E-01	2.85E+00	1.44E-03	1.01E-03	5.09E-07	1.97E+00	2.56E-01	3.19E+00	5.85E-03	1.21E-03	1.11E-06	4.44E+00	1.32E-01	1.64E+00	1.38E-03	1.36E-03	4.59E-07
Hourly Average Emission Rate (g/s) per dT of Sludge Incineration	1.10E+00	4.95E-02	1.08E+00	3.58E-04	3.52E-04	1.19E-07	8.30E-01	2.91E-02	7.13E-01	3.59E-04	2.54E-04	1.27E-07	8.37E-01	1.09E-01	1.36E+00	2.49E-03	5.14E-04	4.73E-07	1.11E+00	3.29E-02	4.09E-01	3.45E-04	3.40E-04	1.15E-07

APPENDIX G

Elimination of Meteorological Anomalies
(1 page)

As per ADMGO, *in modelling applications using regional or local meteorological data sets, certain extreme, rare and transient metrological conditions may be present in the data sets that may be considered outliers. As such, for assessments of 24-hour average concentrations, the highest 24-hour average predicted concentration in each single meteorological year may be discarded, and the ministry will consider for compliance assessment the highest concentration after elimination of these five 24-hour average concentrations over the 5-year period from the modelling results. In assessments of annual concentrations, the highest annual concentration in the 5-year period will be considered, without removal of any meteorological anomalies. For shorter averaging periods, such as 1-hour concentrations, the eight hours with the highest 1-hour average predicted concentrations in each single meteorological year may be discarded. The ministry will consider for compliance assessment the highest concentration after elimination of these forty hours over the five-year period from the modelling results*.

This methodology of eliminating meteorological anomalies is directly applicable to the modelled contaminant concentrations at receptors which are on same plane, for example, when all the receptors are on the ground level or at a same height above ground level. However, when the receptors are at varying heights above ground level, additional processing of modelled concentrations is required to eliminate the effect of meteorological anomalies. The results presented in Section 4 reflect the impact of WWTP Stack emissions on proposed buildings, after elimination of meteorological anomalies.

For elimination of meteorological anomalies from modelling output, ORTECH utilized "Threshold Violation File" option in AERMOD software. For each Significant contaminant from WWTP Stack, ORTECH calculated a threshold value, which is used to command modelling software to generate an output file of modelled concentrations, whenever the threshold value is exceeded at any receptor. For example, based on projected 2031 operations of WWTP, prorated hourly NO_X emissions expected from WWTP Stack was earlier calculated as 10.2 g/s. MECP's air quality limit for NO_X is 400 µg/m^3 (1-hour averaged).

Threshold value for prorated 1-hour NO_X emissions
= MECP's limit/prorated emission rate
= 400 µg/m^3/10.2 g/s = 39.2 µg/m^3 per g/s of NO_X emissions

This value was used to command AERMOD software to create a threshold violation file whenever the modelled concentration is exceeded at any receptor (during unit dispersion factor run). From this threshold violation file, for each meteorological year, first highest value of modelled concentration was selected. The corresponding time stamp (hour) of first highest concentration was flagged as the hour with meteorological condition that can be treated as an anomaly. All the modelled concentrations in threshold violation file corresponding to this flagged meteorological hour were discarded. Similarly, remaining seven meteorological hours were flagged and corresponding modelled concentrations were discarded. This process was repeated for all meteorological years.

Following above approach, the resulting output file with remaining modelled concentrations was treated as model output without meteorological anomalies, which are reported in this report.

APPENDIX H

AERMOD Modelling Files
(CD)