



WelburnConsulting

Odour Study Report

Prepared for: Renewable Energy Approval Application
Facility: Woodstock Wastewater Treatment Plant
195 Admiral Street, Woodstock, Ontario

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1 Introduction and Facility Description

1.1 Purpose and Scope of Odour Study Report

J.L. Richards & Associates Ltd. engaged Welburn Consulting to prepare this Odour Study Report (OSR) in support of a Renewable Energy Approval (REA) application for the Woodstock Wastewater Treatment Plant (WWTP, or the Facility) located at 195 Admiral Street, Woodstock, Ontario and owned and operated by the County of Oxford (the County).

This OSR was prepared in accordance with the requirements set out in Chapter 9, Section 10 of the *Technical Guide to Renewable Energy Approvals* published by the Ministry of the Environment, Conservation and Parks (MECP).

The Facility currently operates under an ECA (Sewage) (MECP reference number 5950-7XQKXS) issued on 18 December 2009.

A biogas-fueled combined heat and power (CHP) system is to be installed at the Facility. Under Ontario Regulation (O. Reg.) 359/09, the Facility falls under the definition of a Class 3 anaerobic digestion facility, and therefore will require a REA.

1.2 Facility Description

The Woodstock WWTP is a conventional activated sludge treatment plant with process stages including primary clarifiers, aeration tanks and secondary clarifiers, phosphorus removal, and disinfection and dechlorination. Solids are directed to digesters and dewatering. The proposed CHP unit will use biogas generated by the digesters.

The NAICS code for the Facility is 221320 – sewage treatment facilities.

The Facility operates 24 hours per day, 7 days per week. It is located in an industrial zoned area with a steel manufacturing plant located to the south of the WWTP. The area west of the Facility is zoned Open Space, with Residential zoning to the east. The nearest odour-sensitive receptors are an elementary school and single-family dwellings located on Oxford Street, approximately 100m from the Facility property line.

The UTM coordinates for the site centroid of the Facility are:

- Zone: 17T
- Easting: 518,554m
- Northing: 4,776,002m

2 Description of Potential Odour Sources

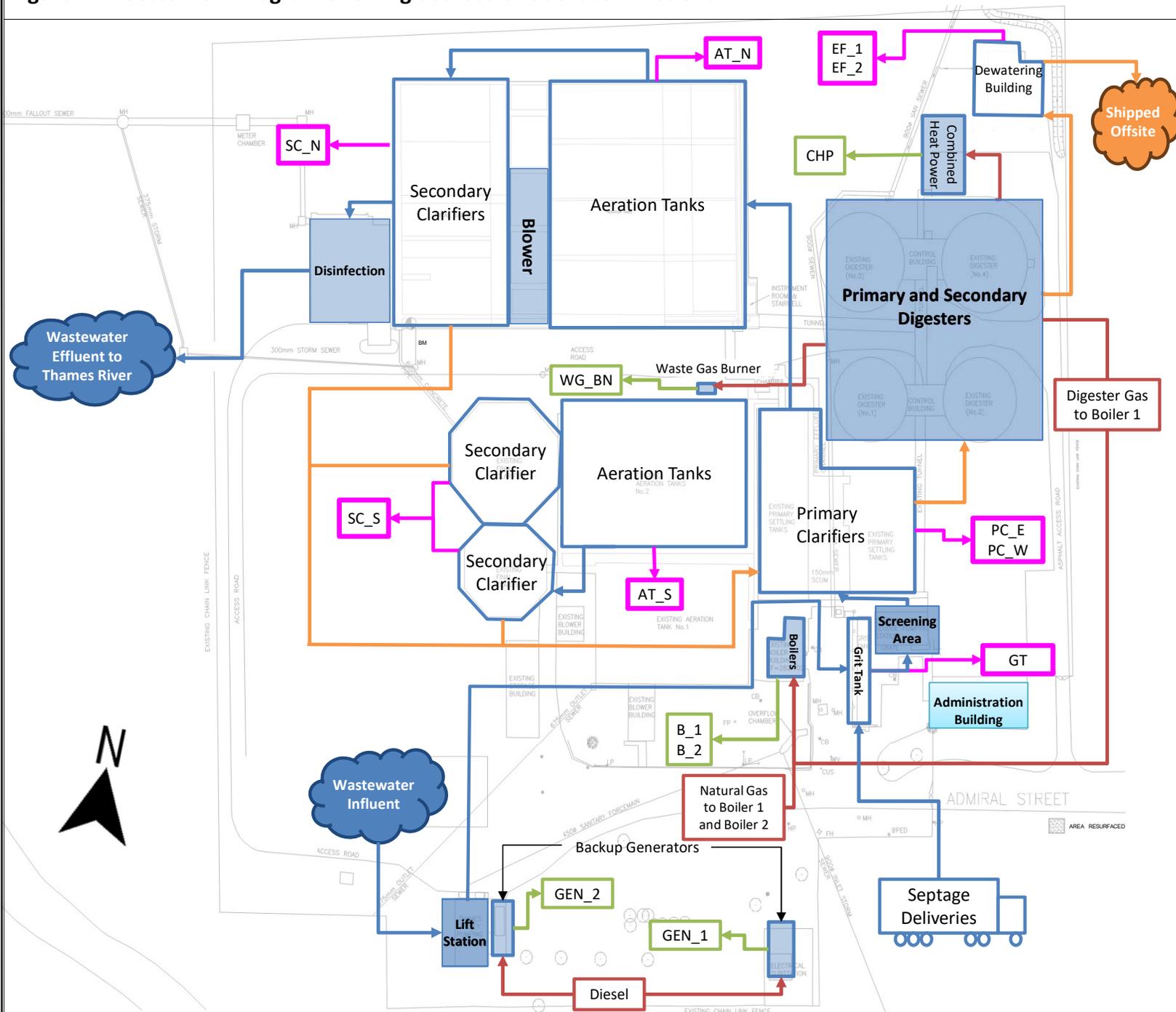
Potential odour sources at the Facility include point and fugitive sources from the wastewater treatment process. A process flow diagram illustrating odour emission points is presented as Figure 1.

Odour from wastewater treatment is the result of emissions of ammonia and of total reduced sulphur (TRS) compounds, the most significant being hydrogen sulphide (H₂S). TRS has a distinctive rotten-egg odor. Ammonia has an odour similar to urine or sweat. The relative contribution of TRS and ammonia to odour typically varies between the different operations at the WWTP.

PROJECT TITLE:

Woodstock REA Application, Odour Study Report, 195 Admiral St Woodstock, ON N4S 7W5

Figure 1: Process Flow Diagram Showing Sources of Odorous Emissions



Legend

- XXX Process with odorous emissions
- XXX Process with no odorous emissions
- XXX Odorous emission source
- Flow of odorous emissions
- XXX Combustion emission source
- Flow of combustion emissions
- Progression of Water
- Progression of Combustion Fuel
- Progression of Sludge

PREPARED FOR:
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MAP PROJECTION:
Not Applicable

COMPANY NAME:
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MODELER:
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DATE:
18 April 2024

SCALE
Not Applicable



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As a preliminary screening exercise to determine the relative odour risk, intensity, and character from each process, an odour survey was conducted at the Woodstock WWTP on 19 October 2023. This involved taking readings from a handheld TSI Q-Trak QP monitor (“Q-Trak”) in odorous areas of the Facility. The Q-Trak detected H₂S (accuracy of ± 0.5 ppm and resolution of 0.01 ppm) and ammonia (accuracy of ± 1 ppm and resolution of 0.1 ppm).

Operations at the Facility are continuous. Emissions from the open clarifiers and tanks experience minimal variability from operating parameters such as wastewater flows because these sources have a fixed surface area. However, fugitive odour emissions from some open-air sources, particularly the clarifiers and aeration tanks, increase with rising ambient temperature; therefore, slightly higher odour levels may be expected in the summer.

2.1 Odour Sources

2.1.1 Significant Sources

Significant sources of odour at the Facility are the sources associated with wastewater receiving and treatment, which are described below.

2.1.1.1 Wastewater Receiving

The Woodstock WWTP is a conventional activated sludge plant rated for an Annual Average Daily Influent Flow (AADF) of 33 million litres per day (MLD). The WWTP receives raw wastewater with the influent capacities summarized in Table 1.

Table 1: Raw Wastewater Flows

Parameter	Rated (Design Capacity) (m ³ /day) ¹
Average daily flow	33,000
Maximum daily flow	66,000

1. Flows reported here are as presented in the *2021 Annual Wastewater Treatment System Summary Report Woodstock Wastewater Treatment Plant* prepared by Oxford County, dated 31 December 2021.

Wastewater is received to an open grit tank by way of the sewage pumping station and gravity trunks. Septage and leachate are delivered by truck and deposited directly into the grit tank channel (Source GT), which is open to the atmosphere and has plan area dimensions of 28.9m x 2.6m, for a surface area of 74.8m². Fugitive odour emissions can be expected from the grit tank as the wastewater passes through the screens.

The screening room adjacent to the grit tank is enclosed. Dry screenings are stored in bins for disposal. Grit is removed monthly by clam bucket into a rolling bin. There is a potential for fugitive odour release when the screening room is opened to allow removal of stored solid waste. Fugitive releases from this source are negligible, as the room is opened only for brief periods.

2.1.1.2 Primary Clarifiers, Aeration Tanks, and Secondary Clarifiers

Screened waste is directed towards the two (2) banks of rectangular primary clarifiers (Sources PC_E and PC_W). The East bank has three primary clarifier cells, each with dimensions of 26.2m x 5.6m. The total surface area of PC_E is 442m². The West bank also has three primary clarifier cells, each with dimensions of 36.0m x 3.9m. The total surface area of PC_W is 416m².

Secondary treatment occurs through a bank of four (4) adjacent rectangular aeration tanks (collectively, Source AT_N), each with dimensions of 12.5m x 15.7m. The total surface area of AT_N is 2,351m². From there, wastewater is directed to two (2) three-pass folded Gould secondary clarifiers (collectively, Source SC_N), each with dimensions of 24.9m x 26.4m. The total surface area of SC_N is 1,318m². An

additional activated sludge plant (Plant #2) will return to service in 2025. Plant #2 consists of two (2) aeration tanks (collectively, Source AT_S) with a combined surface area of 1,575.2m², and two (2) octagonal secondary clarifiers (collectively, Source SC_S) with a combined surface area of 895.8m².

Fugitive odour emissions can be expected from the clarifiers and aeration tanks, all of which are open to the atmosphere. Fugitive odour is typically slightly greater during summer, due to the influence of ambient temperature on off-gassing.

2.1.1.3 Dewatering and Waste Output

Digested sludge is dewatered via centrifuge in the dewatering building, which exhausts to the atmosphere via two rooftop exhaust fans: Source EF_1 serving the sludge loading bay, and Source EF_2 serving the centrifuge room. Odour is expected from the two exhaust stacks. The dewatering building is opened as needed to allow trucks to enter to load and haul away the dewatered cake on covered skips for land application. Since the loads are covered, minimal odour is expected from dewatered cake haulage. Because the exhaust fan runs continuously, there is limited buildup of odour in the room. Therefore, fugitive odour emissions from the loading bay when the roller door is opened are considered negligible.

2.1.2 Insignificant Sources

Insignificant sources at the Facility are enclosed biogas generation and capture, combustion equipment, and supporting activities. These are described below.

2.1.2.1 Anaerobic Digestion, Biogas Capture, and Combustion

Solids are stabilized in two mesophilic anaerobic digesters with a total volume of approximately 2,506m³ before being transferred to two secondary anaerobic digesters with a total volume of approximately 1,739m³ for storage and equalization. Gas is collected on the roof and routed to the Digester Gas Room where it passes through moisture and sediment removal. From there, an existing booster feeds the plant's hydronic dual-fired heating boiler and two compressors pressurize the gas used to mix Digesters 3 and 4. The digester system generates approximately 56,000 m³/month of biogas. In 2022, the biogas boilers generated the equivalent of 66,000 kWh of energy.

Due to the contained nature of the anaerobic digestion and biogas capture process, the odour risk from these processes is low. The odour survey conducted on 19 October 2023 did not detect H₂S or ammonia in the atmosphere in this area of the Facility.

The existing gas network is also equipped with an enclosed waste gas burner, designed to process any biogas not consumed in the boilers.

2.1.2.2 Combined Heat and Power System

The proposed combined heat and power system will be connected to the existing biogas collection system. Biogas from the digesters will be routed to the CHP to be combusted to produce electrical power and process heat. The four-stroke reciprocating engine (Source CHP) will generate 250 kW of electrical power. The exhaust from the engine will pass through a heat exchanger to heat 11.3 m³/h of process water by 20°C (i.e. from 70°C to 90°C).

Since H₂S in the biogas will be removed via activated carbon adsorption prior to combustion, odour from the CHP exhaust is considered insignificant.

2.1.2.3 Other Insignificant Sources of Odour

In general, activities and processes at the Facility that support the wastewater treatment process are considered insignificant sources of odour. These include combustion of natural gas in the boilers (Sources B_1 and B_2), combustion of diesel in the emergency diesel generators (Sources GEN_1 and

GEN_2), water sample analysis in the laboratory fume hoods (Sources EF_3 and EF_4), janitorial cleaning, and general office ventilation.

2.2 Quantification of Odour Magnitude

The magnitude of the odours from each source on the Facility were quantified by determining the odour emission rate from each source, following the procedures described in the Ontario Source Testing Code.

To evaluate odour impacts from the Facility, the “worst-case odour scenario” was analyzed. The worst-case odour scenario refers to the combination of operating conditions and ambient conditions that would result in the highest emission rates of odour and odorous contaminants (i.e., TRS and ammonia).

The worst-case emission rates of odour, ammonia, and total reduced sulphur (TRS) were determined based on an odour survey conducted on 19 October followed by source testing conducted from 29 November to 01 December 2023. The Source Testing Report is provided as Appendix D to the Facility’s ESDM Report.

The significant sources of odorous emissions at the Facility are all components of the wastewater treatment process. These sources are either area sources or, in the case of EF_1 and EF_2, point sources with emission rates derived from emission fluxes. In general, emissions from these sources experience minimal variability from operating parameters such as wastewater flows, because the emission rates depend on the surface area, which is constant. However, off-gassing rates are influenced by ambient temperature. Therefore, the maximum emissions scenario for these sources occurs when ambient temperatures are highest. Because the source testing was conducted during cold ambient temperatures, the emission rates were scaled to account for summer temperatures, as described in Section 4.1.2.4 of the Facility’s ESDM Report.

The worst-case emission rates for each process source are presented in Table 2. Odour emission rates are provided in Odour Units (OU) per second, whereas emission rates of TRS and ammonia are provided in grams per second.

Table 2: Maximum Emission Rates of Odour, TRS and Ammonia, by Source

Source ID	Source Description	Emission Rate of Odour (OU/s)	Emission Rate of TRS (g/s)	Emission Rate of Ammonia (g/s)
GT	Grit tank (waste receiving)	1.14E+02	2.95E-06	2.30E-04
PC_E	East primary clarifier	1.94E+02	5.05E-06	3.93E-04
PC_W	West primary clarifier	1.83E+02	4.76E-06	3.71E-04
AT_N	Aeration tanks north	2.85E+02	2.69E-05	3.87E-03
AT_S	Aeration tanks south	1.91E+02	1.80E-05	2.59E-03
SC_N	Secondary clarifiers north	7.37E+01	1.91E-06	1.49E-04
SC_S	Secondary clarifiers south	5.01E+01	1.30E-06	1.01E-04
EF_1	Sludge loading bay in dewatering building	8.54E+00	6.37E-08	1.77E-04
EF_2	Centrifuge room in dewatering building	9.07E+00	4.99E-06	9.66E-04

3 Evaluation of Negative Environmental Effects

3.1 Odour Receptors

An area plan showing the location of the Facility and of the sensitive receptors for odour is provided in Figure 2.

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Woodstock REA Application, Odour Study Report, 195 Admiral St Woodstock, ON N4S 7W5

Figure 2: Area Plan Showing Locations of Odour-Sensitive Receptors



Legend

-  Property Boundary
-  Building
-  Point Source
-  Area Source
-  Sensitive Receptor

PREPARED FOR:

J.L. Richards & Associates Ltd.

MAP PROJECTION:

WGS84 UTM Zone 17T

COMPANY NAME:

Welburn Consulting Ltd.

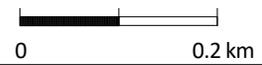
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DATE:

28 March 2024

SCALE 1:7,500



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A list of sensitive receptors and their distance from the Facility is presented in Table 3.

Table 3: Discrete Sensitive Receptors

Receptor ID	Description	Distance to Facility Property Line (m)
SR1	Holy Family French Immersion Catholic Elementary School, 177 Oxford St.	139
SR2	Residence (East) - 279 Admiral St	123
SR3	Residence (East) - 194 Oxford St	113
SR4	Residence (East) - 198 Oxford St	106
SR5	Residence (East) - 212 Oxford St	101
SR6	Residence (East) - 216 Oxford St	97
SR7	Residence (East) - 230 Oxford St	109
SR8	Residence (West) - 515112 County Rd 30	504

3.2 Magnitude of Potential Odour at Receptors

To determine odour impacts at sensitive receptors, the U.S. EPA's AERMOD dispersion model version 22112 was used. Detailed emission rate calculations and a description of the dispersion modelling methodology are presented in the Facility's ESDM Report.

The dispersion modelling analysis screened out emissions of TRS and ammonia as insignificant. Odour emissions were found to be significant.

Odour was assessed following the MECP's Technical Bulletin. Odour concentrations are assessed against the MECP objective of 1.0 OU per m³. Odour impacts were determined for 10-minute averaging times by setting the CONCUNIT flag in AERMOD to 1.65 and running AERMOD for the entire receptor grid. Concentrations associated with the 8 anomalous hours of each year when modelling the full receptor grid were removed.

The maximum predicted concentrations of odour at sensitive receptors are presented in Table 4.

Table 4: Maximum Predicted Concentrations of Odour at Sensitive Receptors

Receptor ID	Description	Maximum Predicted Odour Concentration (OU/m ³)
SR1	Holy Family French Immersion Catholic Elementary School, 177 Oxford St.	2.1
SR2	Residence (East) - 279 Admiral St	1.4
SR3	Residence (East) - 194 Oxford St	1.4
SR4	Residence (East) - 198 Oxford St	1.4
SR5	Residence (East) - 212 Oxford St	1.5
SR6	Residence (East) - 216 Oxford St	1.3
SR7	Residence (East) - 230 Oxford St	1.2
SR8	Residence (West) - 515112 County Rd 30	0.3

Among the 8 receptors identified in this assessment, 7 receptors are predicted to experience concentrations that exceed the MECP odour objective of 1.0 OU/m³. The maximum predicted concentration at SR1 is 2.1 OU/m³.

3.3 Discussion of Uncertainty

It is noted that the ESDM assessed the worst-case scenario. In general, actual odour impacts are expected to be less than the modelled impacts.

At the sensitive receptor that is predicted to the greatest odour concentration, the frequency of exposure will be extremely low. This is due to the following factors:

1. Due to the separation distance between the Facility and the sensitive receptor (i.e. 139m), only 11% of wind directions have the potential to transport odour from the Facility to the sensitive receptor.
2. The Facility's odour emissions are fugitive sources that emit odour due to evaporation. As such, the emission rates will be affected by changes in ambient temperatures (e.g. lower emissions occur with colder temperatures).
3. While an odour exceedance may occur at any hour, the affected sensitive receptor is not occupied continuously. This reduces the likelihood of individual exposure to an odour exceedance.

The expected frequency of odour concentrations greater than 1.0 OU/m³ at SR1 has been assessed following the guidance in the Technical Bulletin. The frequency assessment was based on five years of meteorological data (2018-2022) from the London Airport. Additional details on this frequency assessment are presented in the ESDM.

The predicted frequency of concentrations greater than 1.0 OU/m³ at the most impacted receptor, i.e. SR1, is 0.22% of the modelled 5-year period. According to Section 8 of the Technical Bulletin, a frequency of exceedance of less than 0.5% is considered acceptable.

Additional analysis on the hours and months associated with concentrations greater than 1.0 OU/m³ showed that 10 out of 67 (i.e. 15%) odorous events occurred between 7:00 AM and 7:00 PM.

A histogram indicating the frequency of occurrence of odour exceedances at SR1 is provided in Figure 3 below.

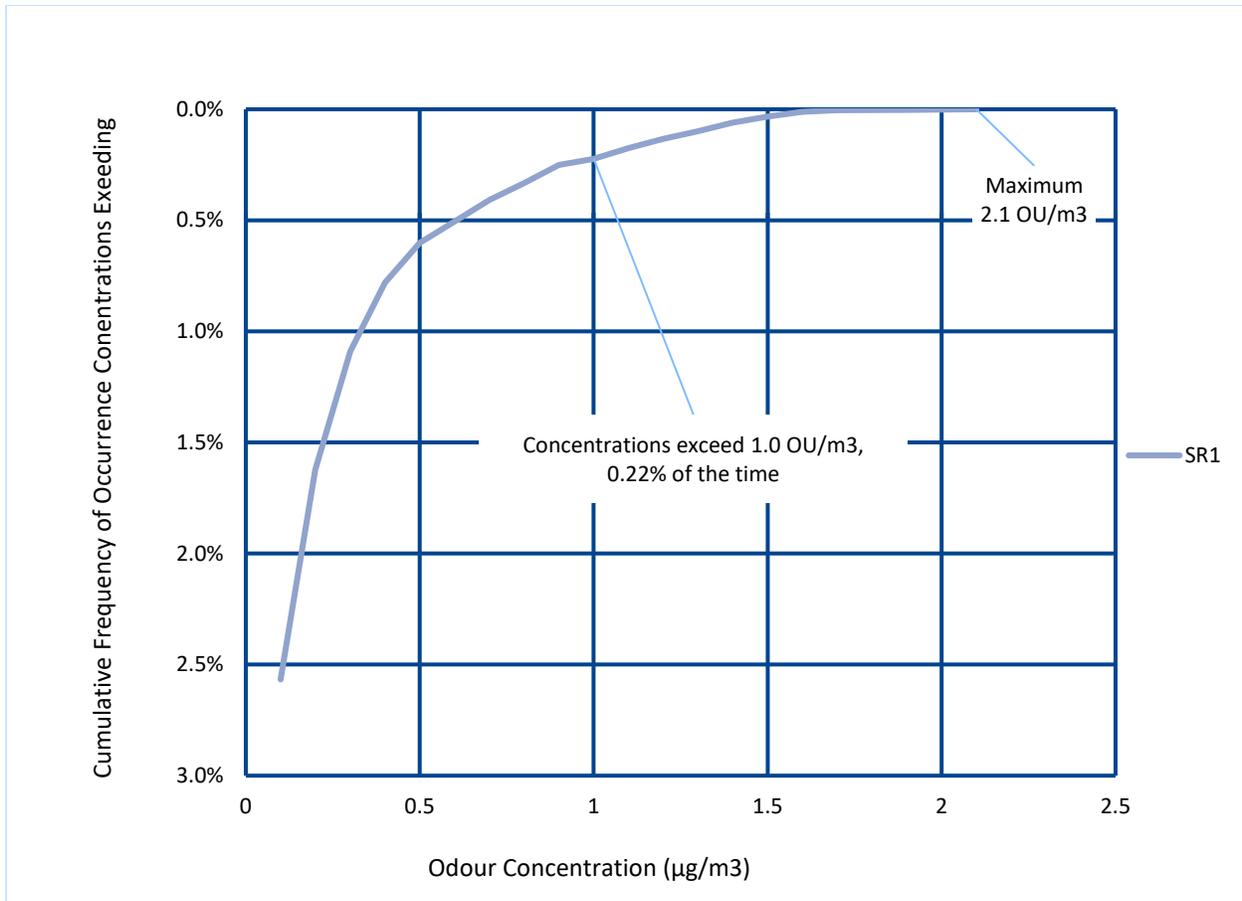


Figure 3: Frequency of Occurrence of Odour Concentrations >0.1 OU/m³ at Receptor SR1

3.4 Summary of Effects

The installation of the proposed CHP is not expected to contribute to odorous emissions from the Facility.

Emissions source testing, emissions calculations, and dispersion modelling completed for the Facility’s ESDM show that existing operations at the Facility are modelled to cause odour impacts that are below the MECP’s objective of 1.0 OU/m³ at all receptors 99.78% of the time.

4 Description of Mitigation Measures

4.1 Odour Mitigation – Existing Sources

Odour from the Facility is minimized by following the operational protocols described in the MECP’s “Odour Control and Design of Sewer” document (Ontario MECP, 2019). A review of the Facility’s odour complaint history indicates that the Facility has no record of odour complaints.

Additional odour mitigation is not required for the Facility’s existing sources at this time. As demonstrated in the Facility’s ESDM Report, modelled odour impacts from the Facility, including the CHP, are within the MECP’s odour objective.

Table 5 lists the odour sources at the Facility and indicates their respective predicted maximum individual odour impact at sensitive receptors.

Table 5: Maximum Individual Odour Impact of Each Source

Source ID	Source Description	Maximum Predicted Odour Concentration from Source (OU/m ³)	Sensitive Receptor Where the Maximum Concentration Occurs
GT	Grit Tanks	0.39	SR1
PC_W	West Primary Clarifier	0.51	SR1
PC_E	East Primary Clarifier	0.57	SR1
AT	Aeration Tanks	0.51	SR6
SC	Secondary Clarifiers	0.13	SR1
EF_1	Sludge Loading Bay Exhaust	0.025	SR5
EF_2	Centrifuge Room Exhaust	0.018	SR5

As shown in Table 5 above, the most significant contributors to predicted odour levels at sensitive receptors are the primary clarifiers.

Should measures be required in the future to reduce odour impacts, covering the primary clarifiers, either with a building or low cover, may be a candidate for further study. Air in the headspace would be treated by an odour control unit prior to being exhausted to the atmosphere.

A second option may be to enclose the waste receiving process (i.e., the grit tank and screening room) and install a ventilation system with an odour control unit.

4.2 Odour Mitigation – CHP

The CHP will be equipped with a gas treatment system, which consists of a vessel containing 1,000L of activated carbon that is designed to remove more than 98% of H₂S (the main odorous component of biogas) prior to combustion. The documented removal efficiency of H₂S from biogas using activated carbon is greater than 98.7% (Selenius, et al., 2023).

To inform the design of the gas treatment system, the Facility commissioned an analysis of the biogas composition from the anaerobic digester system. The laboratory analysis report is provided in Appendix B of the ESDM Report. Table 6 presents the concentration of H₂S identified in the raw biogas along with the expected concentration in the treated biogas and compares these values to the Air Contaminant Benchmark (ACB) and odour detection threshold for the contaminant.

Table 6: Results of Laboratory Analysis of Woodstock WWTP Biogas

Contaminant	Raw Biogas concentration (µg/m ³)	Treated Biogas Concentration (µg/m ³)	ACB (µg/m ³)	Odour Detection Threshold
Hydrogen sulphide	5.6 (4.1 ppbv)	0.1 (0.053 ppbv)	7 (5 ppbv)	10 ppbv

Applying the removal efficiency of 98.7%, the expected concentration of H₂S in the treated, pre-combustion biogas is less than the odour detection threshold and the ACB for H₂S.

Some variation may occur in the H₂S concentration in the raw biogas. As well, the removal efficiency of the activated carbon declines over time. Therefore, it will be important to monitor the quality of the biogas regularly.

4.3 Odour Impacts and Negative Environmental Effects after Implementation of Mitigation

As removing H₂S from the biogas is necessary to avoid corrosion to components of the CHP, the odour mitigation described in Section 4.2 above is integral to the functioning of the unit. Therefore, the gas treatment system was included in the odour impact assessment provided in Section 3 above.

4.4 Maintenance and Monitoring

The quality of the biogas will be monitored according to the frequency recommended by the CHP manufacturer to ensure the efficacy of the biogas treatment system. The media will be replaced according to recommendations from the manufacturer.

4.5 Odour Complaint Response Plan

The Woodstock WWTP maintains a procedure to be followed should the Facility receive a complaint from a stakeholder such as a resident, business, or regulatory authority. Complaint procedures cover situations such as odour events and spills such as a pumping station overflow. Public calls and complaints are first received by Oxford County's customer service during operating hours of 8:30 AM to 4:30 PM. After hours emergency calls are made to 519-537-7961 and Public Work's staff is contacted according to the protocol contained in the County's document "After-hours and Emergency Calls Protocol for Public Works".

After hours reports including the nature of the complaint and who responded are recorded by BearCom Alarm Monitoring and circulated to Oxford County management staff the following day. In addition, staff responding to the complaint provide the information to the Wastewater Foreperson in charge of the assigned plant who also documents the event and investigation and keeps any records on Oxford County's network drive and communicates these events to the Wastewater Supervisor and Manager Water and Wastewater Services.

These records are also used in the preparation of the annual reports.

The information recorded includes:

- Name and contact details of the complainant (if provided);
- Date and time of receipt of the odour complaint;
- Method of complaint receipt;
- Name of the person receiving the complaint;
- Date and time of odour occurrence; and
- Nature of the odour complaint, including duration, intermittency, intensity, and characterization.

An odour complaint investigation will record the weather conditions during occurrence, including temperature, wind speed, and wind direction. As well, operational conditions during the occurrence will be investigated and recorded. If the cause of the odour occurrence can be identified, it will be noted on the complaint response form along with the corrective action identified and implemented, if any.

Should multiple complaints be received, they will be analyzed for patterns that may indicate an ongoing or recurring issue, and a root cause investigation will be conducted.

5 Conclusion

This Odour Study Report was prepared in accordance with the requirements set out in Chapter 9, Section 10 of the *Technical Guide to Renewable Energy Approvals* published by the MECP.

This report identifies sources of odour and assesses their potential to cause negative effects at odour-sensitive receptors near the Woodstock Wastewater Treatment Plant. Dispersion modelling completed in support of the Facility's ESDM Report demonstrates that one receptor, SR1, is predicted to experience concentrations that exceed the MECP odour objective of 1.0 OU/m³. However, the predicted frequency of concentrations greater than 1.0 OU/m³ at this receptor is 0.16% of the modelled 5-year period. According to MECP guidance, a frequency of exceedance of less than 0.5% is considered acceptable. Maximum odour concentrations at all other receptors were predicted to be less than 1.0 OU/m³.

This report also outlines the procedures and equipment that have been implemented and are available to control, mitigate, and monitor impacts from all potential odour sources associated with the Facility's operations. No additional control measures are considered to be required.

6 Closure

This report has been prepared for the sole benefit of J.L. Richards & Associates Ltd. and its Client, the County of Oxford. This report may not be relied upon by any other person or entity without the express written consent of Welburn Consulting Ltd., J.L. Richards & Associates Ltd. and the County of Oxford. Any use of this report by a third party, or any reliance on decisions made based upon this report, are the responsibility of the third party. Welburn Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Welburn Consulting Ltd. makes no representation or warranty with respect to this report, other than the work was undertaken by trained professional and technical staff in accordance with applicable regulations, codes, and guidelines as well as generally accepted engineering and scientific practices current at the time the work was performed. Any information or facts provided by others and referred to or utilized in the preparation of this report were assumed by Welburn Consulting Ltd. to be accurate.

This study was undertaken exclusively for the purpose outlined herein and was limited to those contaminants and sources specifically referenced in this report. This report cannot be used or applied under any circumstances to another location or situation or for any other purpose without further evaluation of the data and related limitations.

If this report is sealed, the seal applies solely to the body of the report, to the tables and figures, and to those appendices prepared by Welburn Consulting Ltd. and does not apply to material such as safety data sheets, equipment specifications, reports, and other supporting documentation prepared by other qualified professionals.

This report was developed by Colin Welburn, M.Eng., P.Eng. If you have any questions regarding the contents of this report, or require any additional information, please contact the undersigned.



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