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Emission Summary and Dispersion Modelling Report

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

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Document History

Version	Report Date	File Name & Project Number	Reason for Update
1.0	19 Jul 2024	ESDM Woodstock WWTP v1.0 Y23.C0004.S0084.REA	Original prepared to support Renewable Energy Approval application

Ontario Ministry of the Environment, Conservation and Parks

Emission Summary and Dispersion Modelling Report Checklist

Company Name

The County of Oxford

Company Address

Unit Number	Street Number	Street Name	PO Box
	21	Reeve Street	1614

City/Town	Province	Postal Code
Woodstock	Ontario	N4S 7Y3

Location of Facility

195 Admiral Street, Woodstock, Ontario

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

Company Contact

☑ By checking this each of the undersigned acknowledge that in providing their name on the applicable line below in electronic form will constitute a signature for the purposes of the *Electronic Commerce Act, 2000*, S.O. 2000, c. 17.

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

Emission Summary and Dispersion Modelling Report Checklist

	Required Information	Submitted	Explanation/Reference
	Executive Summary and Emission Summary Table		
	1.1 Overview of ESDM Report	☑ Yes	Executive Summary
	1.2 Emission Summary Table	☑ Yes	Executive Summary
1.0	**Introduction and Facility Description**		
	1.1 Purpose and Scope of ESDM Report (when report only represents a portion of facility)	☑ Yes	Sections 1.1, 1.2
	1.2 Description of Processes and NAICS code(s)	☑ Yes	Section 1.3
	1.3 Description of Products and Raw Materials	☑ Yes	Section 1.4
	1.4 Process Flow Diagram	☑ Yes	Section 1.5, Appendix A
	1.5 Operating Schedule	☑ Yes	Section 1.6
2.0	**Initial Identification of Sources and Contaminants**		
	2.1 Sources and Contaminants Identification Table	☑ Yes	Section 2.1, Table T1
3.0	**Assessment of the Significance of Contaminants and Sources**		
	3.1 Identification of Negligible Contaminants and Sources	☑ Yes	Sections 3.2, 3.3
	3.2 Rationale for Assessment	☑ Yes	Sections 3.2, 3.3
4.0	**Operating Conditions, Emission Rate Estimating and Data Quality**		
	4.1 Description of operating conditions, for each significant contaminant that results in the maximum POI concentration for that contaminant	☑ Yes	Section 4.1
	4.2 Explanation of Method used to calculate the emission rate for each contaminant	☑ Yes	Section 4.2
	4.3 Sample calculation for each method	☑ Yes	Section 4.3
	4.4 Assessment of Data Quality for each emission rate	☑ Yes	Section 4.4
5.0	**Source Summary Table and Property Plan**		
	5.1 Source Summary Table	☑ Yes	Section 5.1, Table T2
	5.2 Site Plan (scalable)	☑ Yes	Section 5.2, Figure 1
6.0	**Dispersion Modelling**		
	6.1 Dispersion Modelling Input Summary Table	☑ Yes	Section 6.1, Table T3
	6.2 Land Use Zoning Designation Plan	☑ Yes	Section 6.2, Appendix F
	6.3 Dispersion Modelling Input and Output Files	☑ Yes	Section 6.9, Appendix H
7.0	**Emission Summary Table and Conclusions**		
	7.1 Emission Summary Table	☑ Yes	Section 7.1, Table T4
	7.2 Assessment of Contaminants with no MECP POI Limits	☑ Yes	Section 7.2
	7.3 Conclusions	☑ Yes	Section 7.3
	Appendices (Provide supporting information or details such as...)		
	A: Process Flow Diagram; B: Source Specification Data	☑ Yes	
	C: Contaminants Screened Out Using Emission Thresholds D: Source Testing Report; E: Emission Rate Calculations	☑ Yes	
	F: Land Use Zoning Designation Plan; G: Tier 1 Dispersion Modelling; H: Air Modelling Input and Output Files	☑ Yes	

Executive Summary and Emission Summary Table

J.L. Richards & Associates Ltd. engaged Welburn Consulting to prepare this Emission Summary and Dispersion Modelling (ESDM) Report 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 ESDM Report was prepared in accordance with the requirements set out in the Ministry of the Environment, Conservation and Parks' (MECP) *Technical Guide to Renewable Energy Approvals,* the *Procedure for Preparing an Emission Summary and Dispersion Modelling Report, v 4.1* (Guideline A-10), the "*Air Dispersion Modelling Guideline for Ontario, V3.0*", (Guideline A-11), and the requirements set forth under Ontario Regulations (O. Reg.) 419/05 and 255/11.

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.

All existing and planned air emissions sources at the Facility are included in this ESDM Report.

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

The Facility 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 U.S. EPA's AERMOD dispersion model, v.22112, was used for the assessment. The predicted concentrations at the Point of Impingement (POI) were compared to the MECP's air concentration standards, guideline values and screening levels that are collected in the ACB List.

All assessed contaminants have predicted maximum concentrations at the POI that are less than their ACB. Of these, the contaminant with the greatest concentration relative to its ACB is NO_X, with a predicted maximum concentration that is 36% of the 24-hour standard, as assessed with Tier 1 modelling. The maximum concentration of NO_X when the emergency generators are operating is predicted with Tier 1 modelling to be 88% of the MECP 30-minute NO_X guideline for emergency generators.

One contaminant, odour, is not on the ACB List. Odour was assessed against an odour objective of 1.0 OU/m^3, following MECP guidance. The modelling predicted that odour concentrations from operations at the Facility exceed this objective at 1 odour-sensitive receptor up to 0.22% of the time, which is less than the 0.5% frequency considered acceptable in the MECP's Technical Bulletin titled "Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines for Odour Under O. Reg. 419/05" (Ontario MECP, 2016) ("Technical Bulletin").. The predicted odour exceedances are caused by existing sources. New sources at the Facility are not predicted to result in odour levels exceeding the objective of 1.0 OU/m^3.

Therefore, the Facility's operations as described in the maximum operating scenario are predicted to be in compliance with the requirements of O. Reg. 419/05. A copy of the Emission Summary Table is presented below.

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table T4: Emission Summary Table

Contaminant Name	CAS Registry Number	Total Facility Emission Rate (g/s)	Air Dispersion Model Used	Maximum POI Concentration (µg/m^3) [1]	Averaging Period (hr)	Air Contaminant Benchmark (µg/m^3) [2]	Limiting Effect	Section 19 or 20 of O. Reg. 419/05	% of ACB [3]	Source [4]	Benchmark [5]	Version Date of ACB List [6]
Nitrogen oxides	10102-44-0	1.10E+00	AERMOD (v.22112)	4.62E+01	24-hour	200	Health	s. 20	23%	Standard	B1	Apr-23
Nitrogen oxides	10102-44-0	1.10E+00	AERMOD (v.22112)	1.04E+02	1-hour	400	Health	s. 20	26%	Standard	B1	Apr-23
Nitrogen oxides	10102-44-0	1.10E+00	AERMOD (v.22112)	1.66E+03	½-hour	1,880	Health	s. 20	88%	Screening Guideline	N/A	N/A
Carbon monoxide	630-08-0	5.53E-01	AERMOD (v.22112)	7.49E+02	½-hour	6,000	Health	s. 20	12%	Standard	B1	Apr-23
Sulphur dioxide	7446-09-5	5.11E-03	AERMOD (v.22112)	2.12E+00	1-hour	100	Health & Vegetation	s. 20	2%	Standard	B1	Apr-23
Odour	N/A-1	1.11E+03	AERMOD (v.22112)	2.13E+00	10-minute	1	Odour	s. 20	Exceed	MECP Guidance	N/A	N/A
Suspended particulate matter (< 44 µm diameter)	N/A-2	7.74E-02	AERMOD (v.22112)	5.79E+01	24-hour	120	Visibility	s. 20	48%	Standard	B1	Apr-23

Notes:
[1] - "POI" is the "Point of Impingement" (i.e. the receptor point that experiences the highest concentration of the contaminant).
[2] - The Air Contaminant Benchmark is the maximum concentration accepted by the MECP. Each benchmark is reported as a "Standard", a "Guideline", a "Screening Level", a "Previously Approved" value from the current ECA, or an Assessment Value recommended by a Toxicological Assessment.
[3] - "% of ACB" is the ratio of the predicted concentration to the ACB value. For all contaminants considered in this assessment all predicted concentrations are below the respective ACB value.
[4] - "Standards" are maximum concentrations coded in Regulation 419/05. "Guidelines" are aligned with Ontario's ambient air quality criteria (AAQC). "SL-JSL" are screening level limits developed by the MECP. "SL-MD" are ministry-derived screening limits. "SL-PA" are previously acceptable screening level limits. "Screening Guideline" are ministry-recommended levels based on other guidance documents.
[5] - Benchmark is "B1" (Abatement required if exceeded) or "B2" (Additional analysis required if exceeded).
[6] - Version Date of ACB List: The ACB list is regularly updated. The most recent version of the list is April 2023.

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1 Introduction and Facility Description

1.1 Purpose and Scope of ESDM Report

J.L. Richards & Associates Ltd. engaged Welburn Consulting to prepare this Emission Summary and Dispersion Modelling (ESDM) Report 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 ESDM Report was prepared in accordance with the requirements set out in the Ministry of the Environment, Conservation and Parks' (MECP) *Technical Guide to Renewable Energy Approvals,* the *Procedure for Preparing an Emission Summary and Dispersion Modelling Report, v 4.1* (Guideline A-10), the "*Air Dispersion Modelling Guideline for Ontario, V3.0*", (Guideline A-11), and the requirements set forth under Ontario Regulations (O. Reg.) 419/05 and 255/11.

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.

All existing and planned air emissions sources at the Facility are included in this ESDM Report.

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 at the WWTP.

The Facility 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.

1.3 Description of Processes and NAICS Code(s)

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

The WWTP receives wastewater by way of three gravity sewage lines. Two of the lines feed directly into the grit tank (Source GT). A sewage pumping station located at the southern edge of the site pumps wastewater from the third line to the grit tank via a forcemain pipe. Septage and leachate are also delivered by truck and deposited directly into the grit tank (Source GT). Wastewater passes through a screening and grit removal process before flowing to the two (2) banks of rectangular primary clarifiers (Sources PC_E and PC_W). Secondary treatment occurs through a bank of four (4) adjacent rectangular aeration tanks (collectively, Source AT_N) and two (2) three-pass folded Gould secondary clarifiers (collectively, Source SC_N). 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) and two (2) secondary clarifiers (collectively, Source SC_S). Tertiary treatment occurs in the disinfection and dechlorination tanks. Treated effluent is then discharged to Thames River.

Solids are removed from the process, with the sludge being pumped from the primary clarifiers to a two-stage anaerobic digester system consisting of two primary and two secondary digesters. Secondary waste activated sludge is returned to the primary clarifiers. Digested sludge is dewatered via centrifuge in the dewatering building, which is served by two exhaust fans: Source EF_1 serving the sludge loading bay, and Source EF_2 serving the centrifuge room. Dewatered cake is hauled off-site for storage and eventual land application.

Biogas from the digesters is collected and routed to the digester gas room, where it passes through moisture and sediment removal. From there, an existing booster feeds the plant's dual-fired (biogas and natural gas) boiler (Source B_1). A second boiler (Source B_2) is natural gas fueled. Both boilers are located in the boiler building.

Biogas gas will also be routed to the CHP (Source CHP), where it will be combusted to produce electrical power and process heat. The four-stroke reciprocating engine will generate 250 kW of electrical power. The exhaust from the engine will pass through a heat exchanger to heat 11.3 m^3/h of process water by 20°C (i.e. from 70°C to 90°C).

The CHP unit will sit on a concrete pad placed in the area directly north of the existing primary digester building. 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 hydrogen sulphide (the main odorous component of biogas) prior to combustion.

A waste gas burner (Source WG_BN) is located between the primary clarifiers and the aeration tanks to burn off excess biogas that is not consumed by the CHP or Boiler 1.

A 546 kW diesel-fired emergency generator (Source GEN_1) provides backup power to the electrical substation. A 284 kW diesel-fueled emergency generator (Source GEN_2) provides backup power for the lift station.

The administration building houses a laboratory with two fume hoods for the analysis of wastewater samples. Emissions from the fume hoods are exhausted to the roof (Sources EF_3 and EF_4).

1.4 Description of Products and Raw Materials

1.4.1 Description of Products

Treated effluent is discharged to Thames River. Biosolids are shipped to be stored offsite prior to eventual land application. Electricity and process heat from the CHP will be used on site.

1.4.2 Description of Raw Materials

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.

1.5 Process Flow Diagram

A process flow diagram illustrating emission points is presented in Appendix A.

1.6 Operating Schedule

The Woodstock WWTP operates 24 hours per day, seven days per week. The Facility has a peak rated capacity of 66,000 m^3 per day.

2 Initial Identification of Sources and Contaminants

2.1 Sources and Contaminants Identification Table

The Sources and Contaminants Identification Table is presented in Table T1. Summary tables are provided in the Tables section at the end of this report.

2.2 Sources

A summary of sources included in this ESDM Report is provided in Table 2 below. Source specification data for the CHP unit and the two generators are provided in Appendix B.

Table 2: Process and Combustion Sources at Woodstock

Source ID	Process Served	Description
GT	Wastewater Receiving	Grit tank channel with plan area dimensions of 28.9m x 2.6m for a surface area of 74.8m^2
PC_E	Primary Clarifiers	East bank of three primary clarifier cells, each with dimensions of 26.2m x 5.6m. Total surface area of PC_E is 441.6m^2
PC_W		West bank of three primary clarifier cells, each with dimensions of 36.0m x 3.9m. Total surface area of PC_W is 416.3m^2
AT_N	Aeration Tanks	Bank of four aeration tanks, each with dimensions of 12.5m x 15.7m. Total surface area of AT is 2,350.6m^2
AT_S		Bank of two aeration tanks, with a combined surface area of 1,575.2m^2
SC_N	Secondary Clarifiers	Bank of two Gould-type secondary clarifiers, each with dimensions of 24.9m x 26.4m, for a total surface area of 1,317.8m^2
SC_S		Two octagonal secondary clarifiers, with a total surface area of 895.8m^2
EF_1	Dewatering	Exhaust serving sludge loading bay with a flow rate of 1,400 cfm (0.66 m^3/s)
EF_2		Exhaust serving centrifuge room with a flow rate of 2,350 cfm (1.11 m^3/s)
EF_3	Administration Building	Laboratory fume hood exhausts
EF_4		
CHP	Process Heat	Combined Heat and Power Unit, 250 kW of electrical power capacity and 263 kW of thermal recovery capacity
B_1		1,250 MBTU/hr boiler (dual-fired)
B_2		2,500 MBTU/hr boiler (natural gas fired)
WG_BN	Waste Gas Burner	Waste gas burner for processing excess digester gas (maximum of 7,540 MBTU/hr)
GEN_1	Emergency Power (electrical substation)	Sommers Diesel Backup Generator, 546 kW
GEN_2	Emergency Power (lift station)	Cummins Diesel Backup Generator, 284 kW

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2.3 Contaminants

The contaminants emitted from the Facility can be categorized as follows:

1. Contaminants from combustion operations, i.e., the emergency generators, the boilers, the waste gas burner, and the CHP; and
2. Odorous contaminants from the wastewater treatment process.

Contaminants from combustion include nitrogen oxides (NO_X), carbon monoxide (CO), particulate matter (PM), and sulphur dioxide (SO_2).

Odorous contaminants from wastewater treatment include odour, ammonia, and total reduced sulphur (TRS).

Although individual sulphur species, including H_2S, are included on the Air Contaminants Benchmark (ACB) List established by the Ministry of the Environment, Conservation and Parks (MECP), the ACB limit for TRS is less than or equal to the limit for each individual reduced sulphur species. Therefore, for the purpose of this dispersion modelling assessment, TRS is considered to represent all sulphur species, since compliance for TRS signifies compliance for the individual species.

3 Assessment of the Significance of Sources and Contaminants

3.1 Significant Sources

3.1.1 Combustion Sources

All combustion sources (CHP, GEN_1, GEN_2, B_1, B_2, and WG_BN) were considered significant sources of emissions to the atmosphere.

3.1.2 Wastewater Processing Sources

The odour survey and odour testing campaign conducted at the Facility in Fall 2023 detected odorous emissions from the grit tank, primary clarifiers, aeration tanks, and dewatering building. Therefore, all major wastewater processing sources that emit to the atmosphere were considered significant for the purpose of this dispersion modelling assessment.

3.2 Insignificant Sources

A list of examples of sources that generally emit contaminants in negligible amounts and can therefore be excluded from further assessment is provided in *Table B-3A: Specific Examples of Sources that Likely Emit Contaminants in Negligible Amounts* of Guideline A-10 (Ontario MECP, 2018).

The fume hood exhausts (EF_3 and EF_4) in the existing service building were considered insignificant. Fume hoods at the Facility are used exclusively for water quality analysis of wastewater. This kind of operation is listed in “Table B-3A: Specific Examples of Sources that Likely Emit Contaminants in Negligible Amounts” in Guideline A-10.

In addition, small maintenance and janitorial activities, including parts washing, are considered insignificant activities based on their inclusion in Table B-3A.

3.3 Insignificant Contaminants

The following categories of contaminants were determined to be insignificant:

- Contaminants other than NO_X from natural gas-fired combustion equipment;
- H_2S and select siloxanes from the CHP; and
- Contaminants screened out using an emission threshold.

The rationales for the determination of insignificance are presented in the following sections.

3.3.1 Contaminants Other than NO_X from Natural Gas-Fired Combustion Equipment

As per guidance in Section 7.1.1. of Guideline A-10, the significant contaminant for the combustion of natural gas and propane is NO_X. Other contaminants for this type of source are generally emitted in negligible amounts and are therefore considered insignificant.

3.3.2 Hydrogen Sulphide and Select Siloxanes from the CHP

In considering the contaminants expected from the operation of the CHP, the unit’s design specifications were consulted. This document is provided in Appendix B. The design specifications report the engine-specific emission factor for CO and NO_X. PM emissions are derived from the emission factor for an internal combustion engine for natural gas combustion. However, there are additional contaminants in digester gas that need to be considered. Two common contaminants present in digester gas are H_2S and siloxanes.

The CHP will be equipped with a gas treatment system, which includes a vessel containing 1,000L of activated carbon that is designed to remove siloxanes and H_2S from the biogas prior to combustion. The documented removal efficiencies of siloxanes and H_2S using activated carbon are 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. Table 3 presents the concentrations of contaminants identified in the raw biogas along with the expected concentration in the treated biogas and the Air Contaminant Benchmark (ACB) for the contaminant.

Table 3: 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)
Hydrogen sulphide (H_2S)	5.6	0.1	7
Decamethylcyclopentasiloxane (D5)	8830	177	500
Decamethyltetrasiloxane (L4)	<170	<2.2	0.5
Dodecamethylcyclohexasiloxane (D6)	300	3.9	500
Dodecamethylpentasiloxane (L5)	<170	<2.2	0.75
Hexamethylcyclotrisiloxane (D3)	<350	<7.6	120
Hexamethyldisiloxane (MM)	<170	<2.2	1,200
Octamethylcyclotetrasiloxane (D4)	1770	23	500
Octamethyltrisiloxane (MDM)	<170	<2.2	204

Applying the removal efficiency of 98.7%, the expected concentrations of these contaminants in the biogas are less than the ACB for all but one species (i.e., L4 siloxane). With the exception of L4 siloxane, the contaminants listed in Table 3 above have been considered insignificant because their concentration in the treated, pre-combustion biogas is less than their respective ACB.

3.3.3 Contaminants Screened Out Using an Emission Threshold

As per Guideline A-10, aggregate facility-wide emissions of a contaminant may be compared to a calculated site-specific emission threshold to evaluate whether the contaminant is significant. The emission threshold is calculated using a conservative dispersion factor (µg/m³ per g/s emission) and the relevant standard or guideline under O. Reg. 419/05. For chemicals without standards or guidelines under O. Reg. 419/05, the MECP de minimus point of impingement (POI) concentrations (24-hour average basis) presented on Table B-2A in Appendix B.1 of Guideline A-10 can be used (unless the chemical is listed on Table B-2B of Guideline A-10). If the aggregate facility-wide emission rate of a contaminant multiplied by the appropriate dispersion factor from Appendix B.1 of the Guideline A-10 is less than 50% of the standard or guideline under O. Reg. 419/05, or is less than the appropriate de minimus value (or converted to a 24-hour average concentration in the case of 24-hour average standard or guideline under O. Reg. 419/05), then the assessment for that contaminant is complete.

Contaminants screened out using the emission threshold are listed in Appendix C.

4 Operating Conditions, Emissions Estimating, and Data Quality

4.1 Description of Operating Conditions for Each Significant Contaminant that Result in the Maximum POI Concentration for that Contaminant

Section 10 of O. Reg. 419/05 states that, for the purposes of an ESDM report, an acceptable operating scenario to consider is one that would result in the highest concentration of each contaminant at a point of impingement (POI) for the relevant averaging period. It was determined that the maximum concentration scenario was equivalent to the maximum emission rate scenario.

For simplicity, maximum operating scenario was considered to be the operation of all combustion equipment simultaneously. It is recognized that in practice, the waste gas burner and CHP would not be operating at capacity simultaneously.

The maximum emission rate scenario occurs when the Facility is operating under the following conditions:

- The generators are individually tested once a month, at a maximum 40% load, for up to one hour;
- The dual-fired boiler (B_1) is operating at capacity with natural gas;
- The natural gas-fired Boiler (B_2) is operating at capacity;
- Waste gas burner is operating at capacity; and
- The CHP is operating at capacity.

The wastewater processing 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 4.2.1.4.

4.2 Explanation of Method Used to Calculate the Emission Rate

4.2.1 Emissions Tested Sources

The emission rates of odour, ammonia, and TRS used in this ESDM Report are based on source testing, which was conducted from 29 November to 1 December 2023. The Source Testing Report is provided in Appendix D. Detailed emission rate calculations are provided in Appendix E.

The Source Testing Report provides the calculated emission flux based on the reported concentration of contaminants, sampled at three locations to represent the aeration tanks, primary clarifiers, and dewatered sludge. The Source Testing Report also provides the concentrations of ammonia and H_2S measured by a handheld TSI Q-Trak QP monitor (“Q-Trak”) in odorous areas of the Facility.

The calculated emission fluxes for odour, TRS and ammonia at the sources that were sampled are presented in Table 4.

Table 4: Emission Fluxes of Odour, TRS, and Ammonia Calculated in Source Testing Report.

Location	Average Emission Flux		
	Odour ($OU/s/m^2$)	TRS ($g/s/m^2$)	Ammonia ($g/s/m^2$)
Primary Clarifier (PC_E)	2.73E-01	< 7.07E-09	3.41E-07
Aeration Tank (AT_N)	7.50E-02	< 7.07E-09	6.31E-07
Dewatered Sludge Bin (EF_1)	5.87E-01	< 7.07E-09	1.22E-05

4.2.1.1 Primary Clarifiers, Aeration Tanks and Sludge Loading Bay Exhaust

Emission rates for the primary clarifiers (Sources PC_E and PC_W), the aeration tanks (Sources AT_N and AT_S) and the sludge loading bay exhaust (Source EF_1) were calculated from emission fluxes determined in the Source Testing Report, as follows:

$$ER_{C_S} = FR_{C_S} \times A_S$$

Where:

ER_{C_S} = Emission rate of contaminant "C" from source "S" (g/s or OU/s)

FR_{C_S} = Emission flux of contaminant "C" from source "S" ($g/s/m^2$ $OU/s/m^2$)

A_S = Area of source "S" (m^2)

4.2.1.2 Grit Tank and Secondary Clarifiers

Emission rates from the grit tank (Source GT) and secondary clarifiers (Sources SC_N and SC_S) were determined by scaling the emission flux from the primary clarifiers according to the relative odour concentration between primary clarifiers, grit tank, and secondary clarifiers found in the literature (CH2M HILL, 2009).

Emission rates for the grit tank and secondary clarifiers were calculated as follows:

$$ER_{C_2} = \left(FR_{C_1} \times \frac{C_{2_{Lit}}}{C_{1_{Lit}}}\right) \times A_2$$

Where:

ER_{C_2} = Emission rate of the contaminant emitted from the grit tank and secondary clarifier (OU/s or g/s)

FR_{C_1} = Emission flux of the contaminant emitted from the primary clarifier ($OU/s/m^2$ or $g/s/m^2$)

$C_{2_{Lit}}$ = Concentration of odour detected at grit basin and secondary clarifier in Dublin San Ramon (11,000 OU/m^3 for grit basin; 330 OU/m^3 for secondary clarifier)

$C_{1_{Lit}}$ = Concentration of odour detected at a primary clarifier in Dublin San Ramon (2,600 OU/m^3)

A_2 = Area of grit tank (75 m^2) or secondary clarifier pond (1,318 m^2)

4.2.1.3 Centrifuge Room Exhaust

Emission rates of contaminants from the dewatering building centrifuge room exhaust (Source EF_2) were determined by first estimating the in-room concentration of contaminants in the centrifuge room and then applying that concentration to the exhaust flow rate of the fan.

For ammonia and TRS, emission rates were calculated from multiplying the volumetric flow rate and the concentration measured by Q-Trak, as follows:

$$ER_c = C_c \times \frac{MW_c}{V_{mol}} \times Q_{EF_2}$$

Where:

ER_c	= Emission Rate of contaminant at EF_2 (g/s)
C_c	= Concentration of contaminant from field measurement (ppm)
MW_c	= Molecular Weight of contaminant (34.082 g/mol for H_2S; 17 g/mol for ammonia)
V_{mol}	= Volume of one mol of air at 20°C (24.45 L/mol)
Q_{EF_2}	= Volumetric Flow Rate of centrifuge room exhaust fan (1,109 L/s)

The Q-Trak does not measure for odour directly; however, it was determined during the odour survey that odours in the dewatering building were dominated by ammonia emissions. Therefore, the in-room odour concentration in the centrifuge room was calculated by scaling the sampled odour concentration from the sludge loading bay. This concentration was scaled based on the relative Q-Trak-measured ammonia concentrations in the centrifuge room compared to the Q-Trak-measured ammonia concentrations in the sludge loading area (see Source Testing Report in Appendix D for details).

The emission rate of odour from Source EF_2 was calculated as follows:

$$ER_{Odour_{EF\_2}} = \left(\frac{ER_{Odour_{EF\_1}}}{Q_{EF\_1}} \times \frac{QTC_{NH_{3CR}}}{QTC_{NH_{3DWS}}}\right) \times Q_{EF\_2}$$

Where:

$ER_{Odour_{EF\_2}}$	= Emission rate of odour from EF_2 (OU/s or g/s)
$ER_{Odour_{EF\_1}}$	= Emission rate of odour from EF_1 (OU/s or g/s)
Q_{EF_1}	= Volumetric flow rate of EF_1 (0.66 m^3/s)
$QTC_{NH_{3DWS}}$	= Q-Trak measured ammonia concentration above dewatered sludge (ppm)
$QTC_{NH_{3CR}}$	= Q-Trak measured ammonia concentration in centrifuge room (ppm)
Q_{EF_2}	= Volumetric flow rate of EF_2 (1.1 m^3/s)

4.2.1.4 Emission Rate Correction for Ambient Temperature

To account for the influence of ambient temperature, the emission rates for all emissions tested sources were scaled for each month using a modified version of Equation 4-23 from the EPA's guide for modelling wastewater plants (U.S. EPA, 1994).

The emission rate correction factor for emissions tested sources was calculated as follows:

$$CF_{Cont_{Max}} = \frac{H_{v,c_{Max}}}{H_{v,c_{Test}}}$$

Where:

$CF_{c_{Max}}$ = Maximum correction factor for emission rates from emissions tested sources

$H_{v,c_{Max}}$ = Henry's volatility coefficient of contaminant (H_2S or ammonia) in water for the maximum monthly temperature

$H_{v,c_{Test}}$ = Henry's volatility coefficient of contaminant (H_2S or ammonia) in water for the temperature on the day of testing

The temperature-dependent Henry's volatility coefficient was calculated as follows:

$$H_{v,c_T} = \frac{1}{H_{S,c_T}} = \left[H_c^{\emptyset} \times exp\left(\frac{d \ln H_c^{\emptyset}}{d(1/T)} \times \left(\frac{1}{T} - \frac{1}{T_{ref}}\right)\right)\right]^{-1}$$

Where:

H_{S,c_T} = Henry's solubility coefficient of contaminant in water at temperature T, (Sander, 2015)

$H_c^{\emptyset}$ = Henry's law solubility coefficient at temperature $T^{\emptyset}$, in mol/[m³•Pa] (i.e., 1.0E-03 for H_2S and 5.9E-01 for ammonia)

$\frac{d \ln H_c^{\emptyset}}{d(1/T)}$ = Temperature dependence of the Henry solubility coefficient, in K (i.e., 2,100 for H_2S and 4,200 for ammonia)

T = Either the maximum monthly average temperature of the month (based on the site-specific meteorological dataset) or the average temperature of the day of the test (i.e., 29 November 2023)

T_{ref} = The reference temperature (i.e., 25°C)

A table summarizing the Henry's volatility coefficient by month and the associated emission rate correction factors is provided in Appendix E.

4.2.2 Combustion Sources

4.2.2.1 Combined Heat and Power Unit

Emission rates for the CHP were calculated as follows:

$$ER_c = EF_c \times Q$$

Where:

ER_c = Emission Rate of contaminant released from CHP (g/s)

EF_c = Emission factor for contaminant:
NO_X: 0.09 g/Nm³ of exhaust (Agenitor 406 specification sheet)
CO: 0.40 g/Nm³ of exhaust (Agenitor 406 specification sheet)
PM: 232 kg/106 scm of CH_4 (AP-42 Table 2.4-4 Draft Document, IC Engine)
Decamethyltetrasiloxane (L4): 2.2 g/106scf of digester gas (ALS analysis of Woodstock digester gas)

Q = Flow Rate:
NO_X and CO: 125.1 Nm³/h of exhaust (Agenitor 406 specification sheet)

PM: 0.021 scm/s of CH_4 (Calculated from Agenitor 406 specification sheet)
Decamethyltetrasiloxane (L4): 0.035 scm/s of digester gas (ALS analysis of Woodstock digester gas)

4.2.2.2 Waste Gas Burner

Emission rates for the waste gas burner (WG_BN) were calculated as follows:

$$ER_C = \frac{Q_{Ht}}{LHV_{CH_4}} \times EF_C$$

Where:

ER_C = Emission rate of contaminant C released from waste gas burner (g/s)

Q_{Ht} = Rated capacity of waste gas burner (7.540 MBTU/hr)

LHV_{CH_4} = Lower heating value for methane gas (964 BTU/scf)

EF_C = Emission factor for contaminant:
NO_X: 631 kg/10^6scm of CH_4 (AP-42 Table 2.4-4: Flare)
CO: 737 kg/10^6scm of CH_4 (AP-42 Table 2.4-4: Flare)
PM: 238 kg/10^6scm of CH_4 (AP-42 Table 2.4-4: Flare)
SO_2: 4.5 lb/10^6scf of CH_4 (WebFIRE for SCC 10300701: Publicly Owned Treatment Works Digester Gas-fired Boiler)

4.2.2.3 Generators

Emission rates for the generators (GEN_1 and GEN_2) were calculated as follows:

$$ER_{NO_X} = P_{Generator} \times Load_{\%} \times EF_C$$

Where:

ER_C = Emission rate of Contaminant from generator (g/s)

$P_{Generator}$ = Rated capacity of generator engine (based on nameplate capacity)

$Load_{\%}$ = Load Level (40%) – minimum load level during testing according to Canadian Standards Authority (CSA)

EF_C = Emission factor for contaminant, per Table 5 below

Table 5: Emission Factors for Generators

Contaminant	GEN_1 Emission Factor (g/kW.hr)	Source of GEN_1 Emission Factor	GEN_2 Emission Factor (g/kW.hr)	Source of GEN_2 Emission Factor
NO_X	6.4	Tier 3 Emission Standard	18.9	Ap-42 Table 3.3-1 Diesel
CO	3.5	Tier 3 Emission Standard	4.1	Ap-42 Table 3.3-1 Diesel
SO_2	7.4E-03	AP-42 with max 15 ppm sulphur Diesel	7.4E-03	AP-42 with max 15 ppm sulphur Diesel
PM	0.2	Tier 3 Emission Standard	1.3	Ap-42 Table 3.3-1 Diesel

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4.2.2.4 Boiler Fueled by Digester Gas

Emission rates for the dual-fired boiler, B_1, when running on digester gas were calculated as follows:

$$ER_C = \frac{BTU_{Rating}}{HV_{CH_4}} \times EF_C$$

Where:

ER_C	= Emission rate of contaminant C released from boilers (g/s)
BTU_{Rating}	= Rated capacity of dual-fired boiler B_1 (1,250 MBTU/hr)
HV_{CH_4}	= Heating value of methane (1,010 BTU/scf of methane; U.S. Energy Information Administration)
EF_C	= Emission factor for contaminant: NO_X: 677 kg/10^6scm of CH_4 (AP-42 Table 2.4-4: Boiler) CO: 116 kg/10^6scm of CH_4 (AP-42 Table 2.4-4: Boiler) PM: 41 kg/10^6scm of CH_4 (AP-42 Table 2.4-4: Boiler) SO_2: 4.5 lb/10^6scf of CH_4 (WebFIRE for SCC 10300701: Publicly Owned Treatment Works Digester Gas-fired Boiler)

4.2.2.5 Boilers Fueled by Natural Gas

Emission rates for the dual-fired boiler (B_1) when running on natural gas and for the natural gas-fueled boiler (B_2) were calculated as follows:

$$ER_C = \frac{BTU_{Rating}}{HV_{N.G.}} \times EF_C$$

Where:

ER_C	=	Emission rate of contaminant C released from boiler (g/s)
BTU_{Rating}	=	Rated capacity of boilers (1,250 MBTU/hr for B_1 and 2,500 MBTU/hr for B_2; based on nameplate capacity)
$HV_{N.G.}$	=	Heating value of natural gas (1,020 Btu/scf; U.S. EPA default value)
EF_C	=	Emission factor for contaminant: NO_X: 1,600 kg/10^6scm of natural gas (AP-42 Table 1.4-1) CO: 1,344 kg/10^6scm of natural gas (AP-42 Table 1.4-1) PM: 121.6 kg/10^6scm of natural gas (AP-42 Table 1.4-1)

4.3 Sample Calculation for Each Method

4.3.1 Emissions Tested Sources

4.3.1.1 Primary Clarifiers, Aeration Tanks and Sludge Loading Bay Exhaust

The following is a sample calculation for the emission rate of odour from the aeration tank north (Source AT_N):

$$ER_S = FR_S \times A_S$$

$$ER_{Odour} = 7.50\,E-02\frac{Ou}{s \cdot m^2} \times 2{,}351\,m^2$$

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$$ER_{Odour} = 1.76E + 02\ OU/s$$

4.3.1.2 Grit Tank and Secondary Clarifiers

The following is a sample calculation for the emission rate of odour from the grit tank:

$$ER_{C_2} = \left(FR_{C_1} \times \frac{C_{2_{Lit}}}{C_{1_{Lit}}}\right) \times A_2$$

$$ER_{C_{GT}} = \left(2.73E - 01\frac{OU}{s \cdot m^2} \times \frac{11{,}000\frac{OU}{m^3}}{2{,}600\frac{OU}{m^3}}\right) \times 61m^2$$

$$ER_{C_{GT}} = 70.3OU/s$$

4.3.1.3 Centrifuge Room Exhaust

The following is a sample calculation for the emission rate of TRS at the centrifuge exhaust in the (EF_2) in the dewatering building:

$$ER_c = C_c \times \frac{MW_c}{24.45} \times Q_{EF_2}$$

$$ER_{TRS} = \frac{0.002\ mol}{10^6\ mol} \times \frac{34.082\frac{g}{mol}}{\frac{24.45L}{mol}} \times \frac{1{,}109\ L}{s}$$

$$ER_{TRS} = 3.09\ E - 06\ g/s$$

The following is a sample calculation for the odour emission rate at EF_2.

$$ER_{Odour_{EF\_2}} = \left(\frac{ER_{Odour_{EF\_1}}}{Q_{EF\_1}} \times \frac{QTC_{NH_{3CR}}}{QTC_{NH_{3DWS}}}\right) \times Q_{EF\_2}$$

$$ER_{odour_2} = \frac{3.27OU/s}{0.66\ m^3/s} \times \frac{0.48\ ppm}{0.76\ ppm} \times 1.109\ m^3/s$$

$$ER_{odour_2} = 3.48\ OU/s$$

4.3.1.4 Emission Rate Correction for Ambient Temperature

The following sample calculation shows the H_2S driven emission correction factor of July (i.e., the hottest month), applied to fugitive emissions from the aeration tank north (Source AT_N):

Henry's law solubility coefficient of H_2S in water in July:

$$H_{v,H_2S_{July}} = \frac{1}{H_{S,H_sS_{July}}} = \left[H_c^{\emptyset} \times exp\left(\frac{d\ln H_c^{\emptyset}}{d(1/T)} \times \left(\frac{1}{T_{July}} - \frac{1}{T_{ref}}\right)\right)\right]^{-1}$$

$$H_{v,H_2S_{July}} = \frac{1}{H_{S,H_sS_{July}}} = \left[1.0E - 03 \times exp\left(2100 \times \left(\frac{1}{294.7} - \frac{1}{276.15}\right)\right)\right]^{-1}$$

$$H_{v,H_2S_{July}} = 1.62\,E + 03\,\frac{m^3.Pa}{mol}$$

Henry's law solubility coefficient of H_2S in water on testing day (November 2023):

$$H_{v,H_2S_{Test}} = \frac{1}{H_{S,H_sS_{Test}}} = \left[H_c^{\emptyset} \times exp\left(\frac{d\ln H_c^{\emptyset}}{d(1/T)} \times \left(\frac{1}{T} - \frac{1}{T_{ref}}\right)\right)\right]^{-1}$$

$$H_{v,H_2S_{Test}} = \frac{1}{H_{S,H_sS_{Test}}} = \left[1.0E - 03 \times exp\left(2100 \times \left(\frac{1}{276.15} - \frac{1}{276.15}\right)\right)\right]^{-1}$$

$$H_{v,H_2S_{Test}} = 1.00E + 03\,\frac{m^3.Pa}{mol}$$

The maximum emission correction factor for H_2S is calculated as follows:

$$CF_{Cont_{Max}} = \frac{H_{v,H_2S_{July}}}{H_{v,H_2S_{Test}}}$$

$$CF_{Cont_{Max}} = \frac{1.62\,E + 03}{1.00E + 03}$$

$$CF_{Cont_{Max}} = 1.62$$

4.3.2 Combustion Sources

4.3.2.1 Combined Heat and Power Unit

The following sample calculation is for emissions of NO_x from the CHP unit:

$$ER_c = EF_c \times Q$$

$$ER_{NO_x} = 0.09\,\frac{g}{Nm^3} \times 1{,}157\,\frac{Nm^3}{hr} \times \frac{hr}{3{,}600s}$$

$$ER_{NO_x} = 2.89E - 02\ g/s$$

4.3.2.2 Waste Gas Burner

The following sample calculation is for emissions of NO_X from the waste gas burner (WG_BN):

$$ER_C = \frac{Q_{Ht}}{LHV_{CH_4}} \times EF_C$$

$$ER_C = \frac{7{,}540{,}000\ \mathrm{BTU/hr}}{964\ BTU/ft^3} \times \frac{m^3}{35.3\ \mathrm{ft}^3} \times \frac{hr}{3{,}600s} \times 631\,\frac{kg}{10^6 scm} \times \frac{1{,}000g}{kg}$$

$$ER_C = 3.88E - 02\ g/s$$

4.3.2.3 Generators

The following sample calculation is for emissions of NO_X from the Sommers generator (GEN_1):

$$ER_{NO_X} = P_{Generator} \times Load_{\%} \times EF_{NO_X}$$

$$ER_{NO_X} = 546\ kWm\ \times 40\%\ \times 6.4\,\frac{g}{kW \bullet hr} \times \frac{1hr}{3{,}600s}$$

$$ER_{NO_X} = 0.388\ g/s$$

4.3.2.4 Boiler Fueled by Digester Gas

The following sample calculation is for emissions of NO_X from Boiler 1 (Source B_1) operating with digester gas:

$$ER_C = \frac{BTU_{Rating}}{HV_{CH_4}} \times EF_C$$

$$ER_C = \frac{1{,}250{,}000\ BTU/hr}{1010\ BTU/scf} \times \frac{m^3}{35.3\ \text{ft}^3} \times \frac{hr}{3600s} \times \frac{677kg}{10^6 scm} \times \frac{1{,}000g}{kg}$$

$$ER_C = 6.61E - 03\ g/s$$

4.3.2.5 Boilers Fueled by Natural Gas

The following sample calculation is for emissions of NO_X from Boiler 2 (Source B_2):

$$ER_C = \frac{BTU_{Rating}}{HV_{N.G.}} \times EF_C$$

$$ER_C = \frac{2{,}500{,}000\ BTU/hr}{1{,}020\ BTU/scf} \times \frac{m^3}{35.3\ \text{ft}^3} \times \frac{hr}{3{,}600s} \times \frac{1{,}600kg}{10^6 scm} \times \frac{1{,}000g}{kg}$$

$$ER_C = 3.08E - 02g/s$$

4.4 Assessment of Data Quality for Each Emission Rate

The assessment of data quality for each emission rate is provided in the Source Summary Table, Table T2. The data quality was categorized according to guidance in Section 9.2 of Guideline A-10 to describe the level of uncertainty associated with each calculation. Data quality categories in Guideline A-10 are: "highest," "above average," "average," and "marginal." Emission estimates with a marginal data quality are expected to have increased conservatisms to limit the risk of underestimating emissions.

Many emissions estimates rely on the AP-42 emission factors, which are assigned a rating of A (Excellent) to E (Poor).

4.4.1 Emissions Tested Sources and Contaminants

Emission rates determined from source testing reports that have not been validated by the MECP are assigned a data quality of “average”, following Guideline A10.

4.4.2 Combustion Sources

4.4.2.1 Combined Heat and Power Unit

The emission factors for NO_X and CO are provided by the manufacturer. Since the data is drawn from engine-specific values provided by the manufacturer, the quality of this emission rate data is considered “above average.” The U.S. EPA’s emission factor for PM from an internal combustion engine operation on digester gas has a data quality rating of “D” (“Below average”). Therefore, the data quality for PM emission rates is “marginal”. The emission factor for decamethyltetrasiloxane (L4) is based on site-specific analysis of the digester gas. However, there is little data in the literature available regarding the fate of siloxanes following combustion in an internal combustion engine. Therefore, it is assigned a data quality of “marginal.”

4.4.2.2 Waste Gas Burner

The emissions estimates for the waste gas burner rely on the AP-42 emission factors. For NO_X, CO, and PM from the waste gas burner (U.S. EPA, 2008), the emission factors are assigned a rating of “A” (“Excellent”). The emissions estimates for the waste gas burner have therefore been assigned a data quality of “above average.”

The SO_2 emission factor from WebFIRE is assigned a rating of “U” (“Unknown”). For this assessment, the emissions estimates of sulphur dioxide from the waste gas burner have been assigned a data quality of “marginal.”

4.4.2.3 Generators

The emission factors for generators are based on emissions standards and AP-42 emission factors. The quality of this emission rate data is considered “marginal.”

4.4.2.4 Boiler Fueled by Digester Gas

The emission rate calculations for the dual fired boiler running on digester gas rely on the AP-42 emission factors (U.S. EPA, 2008). For NO_X, CO, and PM from the dual-fired boiler running on digester gas, the emission factors are assigned a rating of “D” (“below average”). The SO_2 emission factor is assigned a rating of “U” (unknown). The emissions estimates from the dual-fired boilers operating on digester gas have therefore been assigned a data quality rating of “marginal.”

4.4.2.5 Boilers Fueled by Natural Gas

The emission rate calculations for the boilers running on natural gas also rely on the AP-42 emission factors. For NO_X and CO from the boilers (U.S. EPA, 1998), the emissions estimates are assigned a rating of “B.” These emission rates have been assigned a data quality rating of “above average.” For PM, the emissions estimate is assigned a rating of “D.” This emission rate has been assigned a data quality of “marginal”.

5 Source Summary Table and Site Plan

5.1 Source Summary Table

The Source Summary Table, sorted by source, is presented in Table T2. This table provides the emission rate for each contaminant emitted from each source and includes the percentage contribution of each source to the total emissions for each contaminant.

5.2 Site Plan

A scalable site plan showing the building heights, building location and property boundary is presented in Figure F1.

5.3 Building Heights and Source Locations

A facility plan showing the building heights and the location of significant sources that are considered in the AERMOD modelling is presented in Figure F2.

6 Dispersion Modelling

6.1 Dispersion Modelling Input Summary Table

The Dispersion Modelling Input Summary Table is presented in Table T3.

6.2 Land Use Zoning Designation Plan

The Land Use Zoning Designation Plan is presented in Appendix F.

6.3 Meteorological Conditions

Site specific meteorological data was provided by the MECP. The MECP developed the dataset from five years of meteorological data (i.e., 2018 – 2022) from the London airport station.

6.4 Dispersion Model Used

The U.S. EPA's AERMOD dispersion model version 22112 was used to assess off-site impacts of the air quality contaminants. This is the version of AERMOD that is approved under O. Reg. 419/05.

For this modelling exercise, all sources that emitted contaminants in significant amounts were modelled. The modelling was conducted in a tiered approach.

In Tier 1, a conservative approach to modelling was applied by using a dispersion factor for each source, multiplying it by the emission rate of each contaminant from that source and summing the product for each contaminant. The dispersion factor was generated by modelling each source at an emission rate of 1 g/s. Any contaminant with a resulting concentration exceeding 90% of the ACB using this approach would be assessed with Tier 2 modelling. A summary of the Tier 1 modelling and the dispersion factors used are provided in Appendix G.

Tier 2 modelling consisted of assigning the maximum emission rate for the Tier 2 contaminant to the appropriate source and then modelling using a dedicated AERMOD run, including the removal of meteorological anomalies following procedures described in Section 6.5 of Guideline A-11. One contaminant, odour, was assessed with Tier 2 modelling.

In order to facilitate the frequency analysis of odour impacts, the temperature-dependent emission corrections described in Section 4.2.1.4 were applied in the dispersion model using the EMISFACT / MONTH feature of AERMOD and the average monthly temperatures drawn from the site-specific meteorological file.

6.5 Area of Modelling Coverage

The area of modelling coverage was designed to meet the requirements outlined in Section 14 of O. Reg. 419/05. A multi-tiered receptor grid was developed with reference to Section 7.2 of the Air Dispersion Modelling Guideline for Ontario, Version 3.0, February 2017 (ADMGO); therefore, interval spacing was dependent on the receptor distance from on-site sources.

A separate set of discrete sensitive receptors was used in the odour assessment and is presented in Table 6. The locations of the sensitive receptors are illustrated in Figure F3.

Table 6: Discrete Sensitive Receptors for the Assessment of Odorous Compounds

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

6.6 Stack Height for Certain New Sources of Contaminant

All stack heights are less than the maximum allowable stack height obtained using the stack height formula defined under Section 15 of O. Reg. 419/05. The stack height of the CHP exhaust (Source CHP) is 10m above grade and 7.2m above the CHP roof. However, the CHP stack is located 5.7m horizontally from the Dewatering Building, which has a roof height of 7.7m. This horizontal distance is within the U.S. EPA's Good Engineering Practice (GEP) zone of the Dewatering Building. Therefore, building downwash effects have been considered in the dispersion modelling by using the U.S.EPA's Building Profile Input Program (BPIP) associated with the AERMOD model.

6.7 Terrain Data

Terrain information for the area surrounding the Facility was obtained from the Canadian Digital Elevation Model (CDEM) data in GeoTIFF format. The terrain files have been converted from digital elevation model data (DEM data) from files developed as part of the Water Resources Information Project: Provincial Watershed Project, made available to the MECP through the Provincial Geomatics Service Centre. These data were run through the AERMAP terrain pre-processor to estimate base elevations for receptors and to help the model account for changes in elevation of the surrounding terrain.

6.8 Averaging Periods Used

The 1-hour, 24-hour and annual averaging periods were used to compare predicted concentrations to the Schedule 3 standards and other POI Guidelines listed in the MECP's Air Contaminants Benchmarks (ACB) List, dated April 2023.

The 1-hour, 24-hour and annual averaging periods were obtained directly from the AERMOD model. Contaminants with a 10-minute averaging period ACB (e.g., odour) were assessed following the methods prescribed in the MECP's Technical Bulletin titled "Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines for Odour Under O. Reg. 419/05" (Ontario MECP, 2016) ("Technical Bulletin").

6.9 Dispersion Modelling Input and Output Files

Electronic copies of the AERMOD input and output files are provided in Appendix H.

7 Emission Summary Table and Conclusions

7.1 Emission Summary Table

The Emission Summary Table is presented in Table T4. This table summarizes the predicted maximum concentration for 5 significant contaminants and compares these concentrations to each contaminant's ACB or applicable guideline value.

In addition, the Emission Summary Table includes the predicted maximum concentration of NO_X from the emergency generators and compares this concentration to the MECP guideline for NO_X emissions from emergency generators.

7.2 Assessment of Contaminants Not Included on the ACB List (i.e., Odour)

Odour was assessed following the MECP's Technical Bulletin. Odour is assessed against the MECP objective of 1.0 Odour Unit (OU) per m^3. 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.

7.2.1 Odour Impacts at Sensitive Receptors

The maximum odour concentration at each sensitive receptor after the removal of meteorological anomalies is presented in Table 7.

Table 7: Maximum Predicted Odour Impact at Each Sensitive Receptor

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/m^3. The maximum predicted odour concentration at SR1 is 2.1 OU/m^3.

7.2.2 Source Groups Contributing to Odour

Table 8 lists the odour sources at the Facility and indicates their respective predicted maximum individual odour impact at sensitive receptors.

Table 8: 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_N	North Aeration Tanks	0.51	SR6
AT_S	South Aeration Tanks	0.45	SR1
SC_N	North Secondary Clarifiers	0.13	SR1
SC_S	South Secondary Clarifiers	0.11	SR1
EF_1	Sludge Loading Bay Exhaust	0.025	SR5
EF_2	Centrifuge Room Exhaust	0.017	SR5

As shown in Table 8 above, the most significant contributors to predicted odour levels at sensitive receptors are the primary clarifiers.

7.2.3 Frequency Assessment

Following the guidance in the Technical Bulletin, the predicted frequency of concentrations greater than 1.0 OU/m^3 was assessed for the receptor most impacted by odour from the Facility. Section 8 of the Technical Bulletin indicates that a frequency of exceedance of less than or equal to 0.5% is considered acceptable.

The predicted frequency of concentrations greater than 1.0 OU/m^3 at the most impacted receptor, i.e. SR1, is 0.22% of the modelled 5-year period. A histogram indicating the frequency of occurrence at this receptor is provided in Figure 1 below.

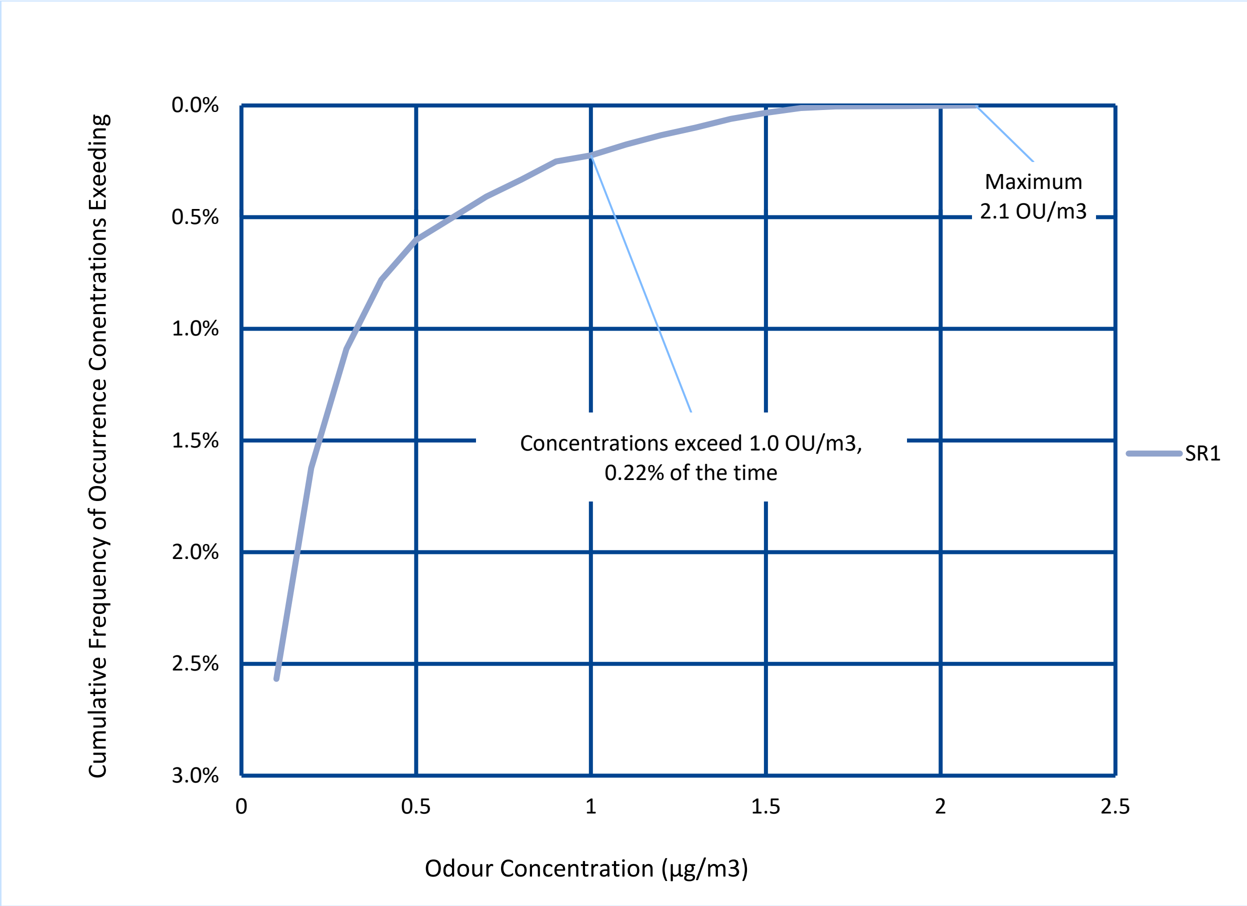

Figure 1: Frequency of Occurrence of Odour Concentrations >0.1 OU/m³ at Receptor SR1

7.2.4 Facility's Odour Minimization Efforts and Odour Complaint History

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.

7.2.5 Overall Assessment of Odour Impacts

This ESDM demonstrates that the planned new source at the Facility, the CHP, is not predicted to contribute to odour concentrations at sensitive receptors.

Modelling results showed that some existing sources are predicted to infrequently cause odour levels that exceed the odour objective. The modelled frequency of exceedance is 0.22%. In considering the odour results for existing sources, the draft document "Methodology for Completing an Odour Assessment for Odour Mixtures" (Ontario MECP, 2021) ("draft Methodology") was consulted. Section 8.1 of the draft Methodology notes that there may be instances where an existing facility has been operating long-term with minimal or no complaints, yet the odour assessment for the existing operations results in a predicted odour value greater than 1.0 OU/m³ at a sensitive receptor. Possible reasons suggested in the draft Methodology include low number or density of receptors, affected receptors occupied sporadically, location in an odour-tolerant environment (e.g., farmland), and low frequency of exceedances.

While other factors are not ruled out, the dominant factor for the Woodstock WWTP is considered the low frequency of exceedances, as this is demonstrated in Section 7.2.3 to be consistent with the Facility's odour emissions profile.

A secondary factor may be that the affected sensitive receptor, being an elementary school, is not occupied continuously. This reduces the frequency of detection of odour events at the receptor.

7.3 Conclusion

An air quality dispersion modelling assessment was performed for the Woodstock WWTP located at 195 Admiral Street, Woodstock, Ontario and owned and operated by the County of Oxford (the County). The ESDM Report was prepared for the purposes of assessing compliance with the requirements of O. Reg. 419/05 and O. Reg. 359/09 and to support a REA application for the Facility.

The U.S. EPA's AERMOD dispersion model, v.22112, was used for the assessment. The predicted concentrations at the Point of Impingement (POI) were compared to the MECP's air concentration standards, guideline values and screening levels that are collected in the ACB List.

All assessed contaminants have predicted maximum concentrations at the POI that are less than their ACB. Of these, the contaminant with the greatest concentration relative to its ACB is NO_X, with a predicted maximum concentration that is 36% of the 24-hour standard, as assessed with Tier 1 modelling. The maximum concentration of NO_X when the emergency generators are operating is predicted with Tier 1 modelling to be 88% of the MECP 30-minute NO_X guideline for emergency generators.

One contaminant, odour, is not on the ACB List. Odour was assessed against an odour objective of 1.0 OU/m^3, following MECP guidance. The modelling predicted that odour concentrations from operations at the Facility exceed this objective at 1 odour-sensitive receptor up to 0.22% of the time, which is less than the 0.5% frequency considered acceptable in the MECP's Technical Bulletin. The predicted odour exceedances are caused by existing sources. New sources at the Facility are not predicted to result in odour levels exceeding the objective of 1.0 OU/m^3.

Therefore, the Facility's operations as described in the maximum operating scenario are predicted to be in compliance with the requirements of O. Reg. 419/05.

8 Bibliography

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9 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.

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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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TABLES

Client: **J.L. Richards & Associates Ltd.**
Project: **Woodstock WWTP REA Application**
Address: **195 Admiral St., Woodstock, Ontario**

Table T1: Sources and Contaminants Identification Table

Source ID	Source Description or Title	General Location	Expected Contaminants	Significant (Yes or No?)
GEN_1	Sommers Generator	Electrical Substation	Combustion	Yes
GEN_2	Cummins Generator	East of Lift Station	Combustion	Yes
WG_BN	Waste Gas Burner	South of Aeration Tanks	Combustion	Yes
B_1	Boiler 1 (dual-fired)	Sludge Building	Combustion	Yes
B_2	Boiler 2 (natural gas fired)	Sludge Building	Combustion	Yes
CHP	Combined Heat and Power Unit	West of Screening Area	Combustion	Yes
EF_1	Dewatered Sludge Loading Bay Exhaust	East Roof of Dewatering Building	Odours	Yes
EF_2	Centrifuge Room Ventilation Exhaust	West Roof of Dewatering Building	Odours	Yes
AT_N	Aeration Tanks North	East of Blower Building	Odours	Yes
AT_S	Aeration Tanks South	South of Blower Building	Odours	Yes
GT	Grit Tank	South of PC_E	Odours	Yes
PC_E	Primary Clarifier East	North of Control Building	Odours	Yes
PC_W	Primary Clarifier West	North of Control Building	Odours	Yes
SC_N	Secondary Clarifiers North	West of Blower Building	Odours	Yes
SC_S	Secondary Clarifiers South	South of Blower Building	Odours	Yes
EF_3	Fume Hood Exhaust 1	Service Building	Laboratory fumes	No
EF_4	Fume Hood Exhaust 2	Service Building	Laboratory fumes	No

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Table T2: Source Summary Table - Sorted by Source

Point Source Data									Contaminant Data		Emission Data					
Source ID	Source Description	Stack Volumetric Flow Rate (Am3/s)	Stack Gas Exit Temperature (°C)	Stack Inner Diameter (m)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	X (m)	Y (m)	CAS #	Contaminant	Averaging Period (hr)	Air Contaminant Benchmark (µg/m3) [2]	Maximum Emission Rate (g/s)	Emission Rate Estimating Technique [1]	Emissions Data Quality [2]	% Contribution [3]
GEN_1	Sommers Generator	1.68	436.0	0.2	3.6	0.2	518609.5	4775885.8	10102-44-0	Nitrogen oxides	24-hour	200	1.62E-02	EF	Marginal	2%
									10102-44-0	Nitrogen oxides	1-hour	400	3.88E-01	EF	Marginal	35%
									630-08-0	Carbon monoxide	½-hour	6,000	2.12E-01	EF	Marginal	38%
									7446-09-5	Sulphur dioxide	1-hour	100	4.48E-04	EF	Marginal	9%
									7446-09-5	Sulphur dioxide	Annual	10	4.48E-04	EF	Marginal	9%
									N/A-2	Suspended particulate matter (< 44 µm diameter)	24-hour	120	1.21E-02	EF	Marginal	16%
GEN_2	Cummins Generator	0.78	510.0	0.2	3.6	0.1	518542.6	4775878.7	10102-44-0	Nitrogen oxides	24-hour	200	5.94E-01	EF	Marginal	82%
									10102-44-0	Nitrogen oxides	1-hour	400	5.94E-01	EF	Marginal	54%
									630-08-0	Carbon monoxide	½-hour	6,000	1.28E-01	EF	Marginal	23%
									7446-09-5	Sulphur dioxide	1-hour	100	2.32E-04	EF	Marginal	5%
									7446-09-5	Sulphur dioxide	Annual	10	2.32E-04	EF	Marginal	5%
									N/A-2	Suspended particulate matter (< 44 µm diameter)	24-hour	120	4.21E-02	EF	Marginal	54%
WG_BN	Waste Gas Burner	2.83	1,000.0	1.6	6.0	n/a	518568.3	4775997.8	10102-44-0	Nitrogen oxides	24-hour	200	3.88E-02	EF	Above Average	5%
									10102-44-0	Nitrogen oxides	1-hour	400	3.88E-02	EF	Above Average	4%
									630-08-0	Carbon monoxide	½-hour	6,000	4.53E-02	EF	Above Average	8%
									N/A-2	Suspended particulate matter (< 44 µm diameter)	24-hour	120	1.46E-02	EF	Above Average	19%
									7446-09-5	Sulphur dioxide	1-hour	100	4.43E-03	EF	Marginal	87%
									7446-09-5	Sulphur dioxide	Annual	10	4.43E-03	EF	Marginal	87%
B_1	Boiler 1 (dual-fired)	0.15	120.0	0.2	4.2	1.7	518601.7	4775945.8	10102-44-0	Nitrogen oxides	24-hour	200	1.55E-02	EF	Above Average	2%
									10102-44-0	Nitrogen oxides	1-hour	400	1.55E-02	EF	Above Average	1%
									630-08-0	Carbon monoxide	½-hour	6,000	1.30E-02	EF	Above Average	2%
									N/A-2	Suspended particulate matter (< 44 µm diameter)	24-hour	120	1.18E-03	EF	Marginal	2%
B_2	Boiler 2 (natural gas fired)	0.29	120.0	0.3	6.1	3.6	518603.8	4775949.1	10102-44-0	Nitrogen oxides	24-hour	200	3.08E-02	EF	Above Average	4%
									10102-44-0	Nitrogen oxides	1-hour	400	3.08E-02	EF	Above Average	3%
									630-08-0	Carbon monoxide	½-hour	6,000	2.59E-02	EF	Above Average	5%
									N/A-2	Suspended particulate matter (< 44 µm diameter)	24-hour	120	2.34E-03	EF	Marginal	3%
CHP	Combined Heat and Power Unit	0.3	180	0.66	10	7.2	518625.28	4776068.01	10102-44-0	Nitrogen oxides	24-hour	200	2.89E-02	EF	Above Average	4%
									10102-44-0	Nitrogen oxides	1-hour	400	2.89E-02	EF	Above Average	3%
									630-08-0	Carbon monoxide	½-hour	6,000	1.29E-01	EF	Above Average	23%
									N/A-2	Suspended particulate matter (< 44 µm diameter)	24-hour	120	4.97E-03	EF	Marginal	6%
									141-62-8	Decamethyltetrasiloxane	24-hour	0.5	7.65E-08	EF	Marginal	100%
EF_1	Dewatered Sludge Loading Bay Exhaust	0.66	20.0	0.5	5.9	0.5	518641.8	4776075.9	N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	24-hour	7	6.37E-08	ST	Average	1%
									N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	10-minute	13	6.37E-08	ST	Average	1%
									7664-41-7	Ammonia	24-hour	100	1.77E-04	ST	Average	15%
									N/A-1	Odour	10-minute	1	8.54E+00	ST	Average	49%
EF_2	Centrifuge Room Ventilation Exhaust	1.11	20.0	0.6	8.6	0.9	518635.6	4776075.3	N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	24-hour	7	4.99E-06	ST	Average	99%
									N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	10-minute	13	4.99E-06	ST	Average	99%
									7664-41-7	Ammonia	24-hour	100	9.66E-04	ST	Average	85%
									N/A-1	Odour	10-minute	1	9.07E+00	ST	Average	51%

Area Source Data								Contaminant Data		Emission Data					
Source ID	Source Description	Length of the X Side (m)	Length of the Y Side (m)	Orientation Angle from North (°)	Release Height (m)	X (m)	Y (m)	CAS #	Contaminant	Averaging Period (hr)	Air Contaminant Benchmark (µg/m3) [2]	Maximum Emission Rate (g/s)	Emission Rate Estimating Technique [1]	Emissions Data Quality [2]	% Contribution [3]
AT_N	Aeration Tanks North	49.8	47.2	79.4	0.0	518522.2	4776054.8	N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	24-hour	7	2.69E-05	ST	Average	49%
								N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	10-minute	13	2.69E-05	ST	Average	49%
								7664-41-7	Ammonia	24-hour	100	3.87E-03	ST	Average	54%
								N/A-1	Odour	10-minute	1	2.85E+02	ST	Average	34%
AT_S	Aeration Tanks South	49.8	47.2	79.4	0.0	518583.7	4775997.7	N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	24-hour	7	1.80E-05	ST	Average	33%
								N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	10-minute	13	1.80E-05	ST	Average	33%
								7664-41-7	Ammonia	24-hour	100	2.59E-03	ST	Average	36%
								N/A-1	Odour	10-minute	1	1.91E+02	ST	Average	23%
GT	Grit Tank	23.6	2.6	79.6	0.0	518616.3	4775960.1	N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	24-hour	7	2.95E-06	ST	Average	5%
								N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	10-minute	13	2.95E-06	ST	Average	5%
								7664-41-7	Ammonia	24-hour	100	2.30E-04	ST	Average	3%
								N/A-1	Odour	10-minute	1	1.14E+02	ST	Average	13%
PC_E	Primary Clarifier East	26.2	16.8	79.1	0.0	518612.0	4775988.3	N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	24-hour	7	2.29E-08	ST	Average	0%
								N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	10-minute	13	2.29E-08	ST	Average	0%
								7664-41-7	Ammonia	24-hour	100	1.78E-06	ST	Average	0%
								N/A-1	Odour	10-minute	1	8.81E-01	ST	Average	0%
PC_W	Primary Clarifier West	36.0	11.6	79.8	0.0	518587.2	4775995.1	N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	24-hour	7	4.76E-06	ST	Average	9%
								N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	10-minute	13	4.76E-06	ST	Average	9%
								7664-41-7	Ammonia	24-hour	100	3.71E-04	ST	Average	5%
								N/A-1	Odour	10-minute	1	1.83E+02	ST	Average	22%
SC_N	Secondary Clarifiers North	49.9	26.4	79.4	0.0	518484.6	4776047.1	N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	24-hour	7	1.91E-06	ST	Average	4%
								N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	10-minute	13	1.91E-06	ST	Average	4%
								7664-41-7	Ammonia	24-hour	100	1.49E-04	ST	Average	2%
								N/A-1	Odour	10-minute	1	7.37E+01	ST	Average	9%
SC_S	Secondary Clarifiers South	49.9	26.4	79.4	0.0	518535.3	4775981.7	N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	24-hour	7	1.30E-06	ST	Average	2%
								N/A-3	Total Reduced Sulphur (TRS) Compounds (other facilities)	10-minute	13	1.30E-06	ST	Average	2%
								7664-41-7	Ammonia	24-hour	100	1.01E-04	ST	Average	1%
								N/A-1	Odour	10-minute	1	5.01E+01	ST	Average	6%

Note:
[1] - Emission Estimating Technique Short-Forms are "EF" (Emission Factor), "ST" (Source Testing), and "EC" (Engineering Calculation).
[2] - Data quality categories range from: "Highest"; "Above-Average"; "Average"; and "Marginal". Emission factors reported by the EPA include a data quality rating. For details and rationale see Section 4.4 of report.
[3] - "% Contribution" is the percentage that each source contributes to the site-wide emissions for that contaminant.

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Table T3: Dispersion Modelling Input Summary Table

Relevant Section of Regulation 419/05	Section Title	Description of How the Approved Dispersion Model was Used
Section 6	Approved Air Dispersion (include Model Versions)	AERMOD v. 22112
Section 8	Negligible Sources	Please refer to Section 3 of the ESDM report, "Assessment of the Significance of Contaminants and Sources" for a description of the sources that were deemed to be negligible.
Section 9	Same Structure Contamination	Same structure contamination is not applicable.
Section 10	Operating Conditions	Please refer to Section 4.1 of the ESDM report, "Description of Operating Conditions for Each Significant Contaminant".
Section 11	Source of Contaminant Emission Rates	Please refer to Section 4.2 "Explanation of Method Used to Calculate the Emission Rate for Each Contaminant" of the attached report for an explanation of the methods used to estimate contaminant emissions.
Section 12	Combined Effect of Assumptions for Operating Conditions and Emission Rates	The operating conditions and emission rates were used in an approved dispersion model. The model predicted results that were less than the applicable POI Limits. Predicted odour concentrations exceeded the MECP's odour objective of 1 OU.
Section 13	Meteorological Conditions (include AERMET version)	Pre-processed, site specific meteorological data was provided by the MECP. The MECP developed the dataset from five years of meteorological data (i.e., 2018 – 2022) from London airport station.
Section 14	Area of Modelling Coverage	A multi-tiered receptor grid was developed with reference to Section 7.2 of the Air Dispersion Modelling Guideline for Ontario, Version 3.0, February, 2017. Interval spacing was dependent on the receptor distance from on-site sources. Sensitive receptors were selected for the evaluation of odour impacts.
Section 15	Stack Height for Certain New Sources of Contaminant	All stack heights are less than the allowable stack height obtained using the stack height formula defined under Section 15 of O. Reg. 419/05. As such, building downwash effects have been considered in the dispersion modelling by using the U.S.-EPA's Building Profile Input Program (BPIP) associated with the AERMOD model.
Section 16	Terrain Data	Terrain information for the area surrounding the Facility was obtained from the Canadian Digital Elevation Model (CDEM) data in GeoTIFF format. The terrain files have been converted from digital elevation model data (DEM data) from files developed as part of the Water Resources Information Project: Provincial Watershed Project, made available to the MECP through the Provincial Geomatics Service Centre. These data were run through the AERMAP terrain pre-processor to estimate base elevations for receptors and to help the model account for changes in elevation of the surrounding terrain.
Section 17	Averaging Periods	The 1-hour, and 24-hour averaging periods were used to compare to Schedule 3 standards and other Ministry POI Guidelines listed in the MECP's Air Contaminants Benchmark List, dated April 2023. The 1-hour and 24-hour averaging periods were obtained directly from the AERMOD model. Contaminants with 10 minute averaging period ACB were assessed following the methods prescribed in technical bulletin titled "Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines For Odour Under O. Reg. 419/05" (September, 2016).

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Table T4: Emission Summary Table

Contaminant Name	CAS Registry Number	Total Facility Emission Rate (g/s)	Air Dispersion Model Used	Maximum POI Concentration (µg/m³) [1]	Averaging Period (hr)	Air Contaminant Benchmark (µg/m³) [2]	Limiting Effect	Section 19 or 20 of O. Reg. 419/05	% of ACB [3]	Source [4]	Benchmark [5]	Version Date of ACB List [6]
Nitrogen oxides	10102-44-0	1.10E+00	AERMOD (v.22112)	4.62E+01	24-hour	200	Health	s. 20	23%	Standard	B1	Apr-23
Nitrogen oxides	10102-44-0	1.10E+00	AERMOD (v.22112)	1.04E+02	1-hour	400	Health	s. 20	26%	Standard	B1	Apr-23
Nitrogen oxides	10102-44-0	1.10E+00	AERMOD (v.22112)	1.66E+03	½-hour	1,880	Health	s. 20	88%	Screening Guideline	N/A	N/A
Carbon monoxide	630-08-0	5.53E-01	AERMOD (v.22112)	7.49E+02	½-hour	6,000	Health	s. 20	12%	Standard	B1	Apr-23
Sulphur dioxide	7446-09-5	5.11E-03	AERMOD (v.22112)	2.12E+00	1-hour	100	Health & Vegetation	s. 20	2%	Standard	B1	Apr-23
Odour	N/A-1	1.11E+03	AERMOD (v.22112)	2.13E+00	10-minute	1	Odour	s. 20	Exceed	MECP Guidance	N/A	N/A
Suspended particulate matter (< 44 µm diameter)	N/A-2	7.74E-02	AERMOD (v.22112)	5.79E+01	24-hour	120	Visibility	s. 20	48%	Standard	B1	Apr-23

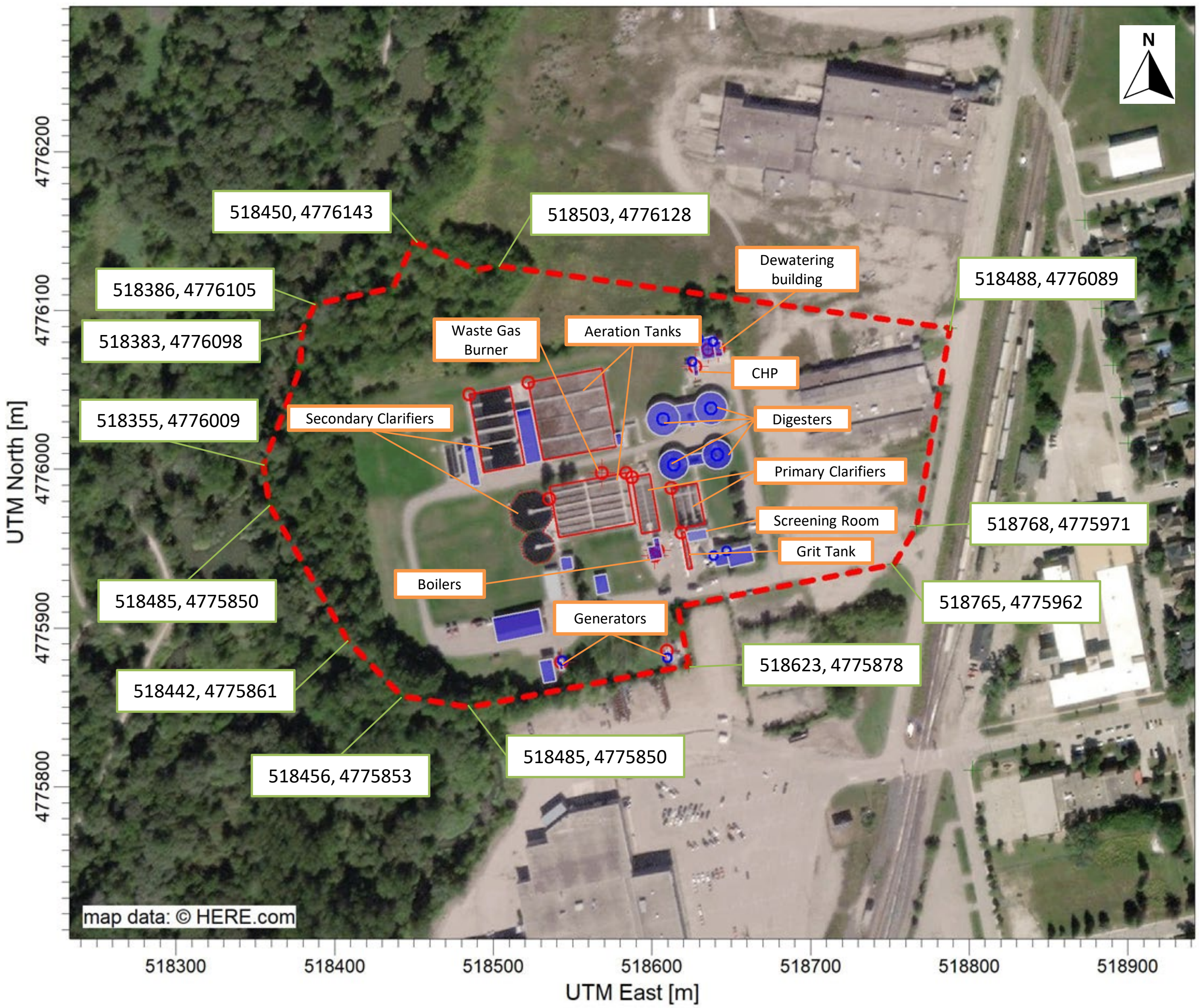
Notes:
[1] - "POI" is the "Point of Impingement" (i.e. the receptor point that experiences the highest concentration of the contaminant).
[2] - The Air Contaminant Benchmark is the maximum concentration accepted by the MECP. Each benchmark is reported as a "Standard", a "Guideline", a "Screening Level", a "Previously Approved" value from the current ECA, or an Assessment Value recommended by a Toxicological Assessment.
[3] - "% of ACB" is the ratio of the predicted concentration to the ACB value. For all contaminants considered in this assessment all predicted concentrations are below the respective ACB value.
[4] - "Standards" are maximum concentrations coded in Regulation 419/05. "Guidelines" are aligned with Ontario's ambient air quality criteria (AAQC). "SL-JSL" are screening level limits developed by the MECP. "SL-MD" are ministry-derived screening limits. "SL-PA" are previously acceptable screening level limits. "Screening Guideline" are ministry-recommended levels based on other guidance documents.
[5] - Benchmark is "B1" (Abatement required if exceeded) or "B2" (Additional analysis required if exceeded).
[6] - Version Date of ACB List: The ACB list is regularly updated. The most recent version of the list is April 2023.

FIGURES

PROJECT TITLE:

Woodstock REA ESDM, 195 Admiral St Woodstock, ON N4S 7W5

Figure F1: Site Plan



Legend

- Property Boundary
- Building
- Point Source
- Area Source

PREPARED FOR:

J.L. Richards & Associates Ltd.

MAP PROJECTION:

WGS84 UTM Zone 17T

COMPANY NAME:

Welburn Consulting

MODELER:

Colin Welburn

DATE:

18 April 2024

SCALE 1:4,000

0 0.1 km

WelburnConsulting

PROJECT NO.:

Y23.C0004.S0084.REA

PROJECT TITLE:

Woodstock REA ESDM, 195 Admiral St Woodstock, ON N4S 7W5

Figure F2: Facility Plan Showing Building Heights and Locations of Significant Sources

Legend

- Property Boundary
- Building
- Point Source
- Area Source

PREPARED FOR:

J.L. Richards & Associates Ltd.

MAP PROJECTION:

WGS84 UTM Zone 17T

COMPANY NAME:

Welburn Consulting

MODELER:

Colin Welburn

DATE:

17 April 2024

SCALE 1:1,600

0 0.04 km

WelburnConsulting

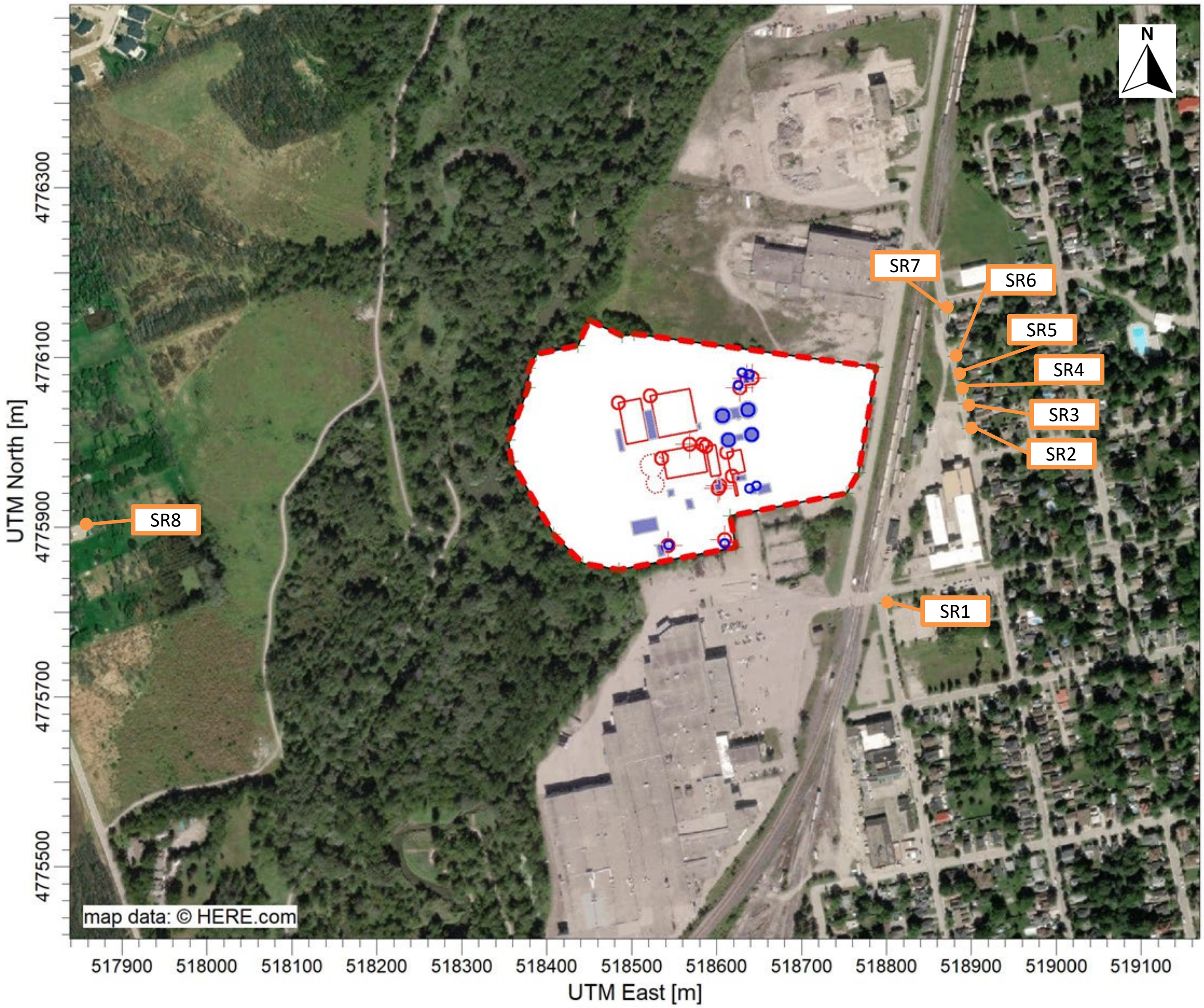
PROJECT NO.:

Y23.C0004.S0084.REA

PROJECT TITLE:

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

Figure 3: 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.

MODELER:

Colin Welburn

DATE:

17 April 2024

SCALE 1:7,500

0 0.2 km

WelburnConsulting

PROJECT NO.:

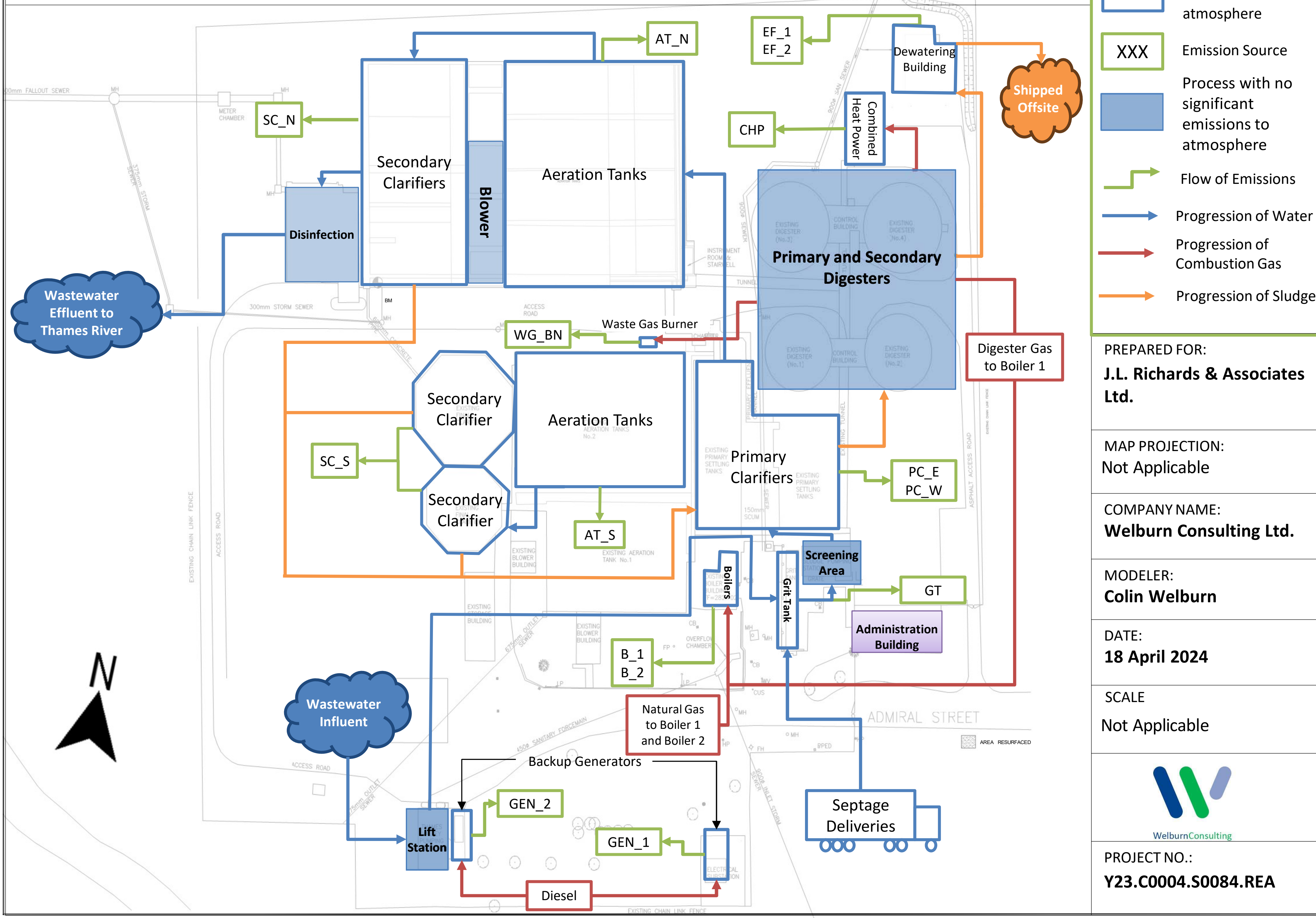
Y23.C0004.S0084.REA

APPENDIX A: PROCESS FLOW DIAGRAM

PROJECT TITLE:

Woodstock REA ESDM, 195 Admiral St Woodstock, ON N4S 7W5

ESDM Appendix A: Process Flow Diagram Showing Sources of Air Emissions



PREPARED FOR:

J.L. Richards & Associates Ltd.

MAP PROJECTION:

Not Applicable

COMPANY NAME:

Welburn Consulting Ltd.

MODELER:

Colin Welburn

DATE:

18 April 2024

SCALE

Not Applicable

WelburnConsulting

PROJECT NO.:

Y23.C0004.S0084.REA

APPENDIX B: SOURCE SPECIFICATION DATA

Technical specification

agenitor 406 BG | ct135-0

(*)

Design:

250 kW el.

60 Hz / 600 V

biogas (50% CH4, 50% CO2)

Calorific Value = 4.98 kWh/Nm³

NOx < 0.09 g/Nm³ (4),(6)

Exhaust cooling to 180 °C

Subject to technical changes!

Note: Figure on cover page may differ

1. Genset

	50 %	75 %	100 %	Load
Electrical power	125	188	250	kW (5)
Recoverable thermal output	163	216	263	kW (2)
Fuel cosumption	340	484	623	kW (1)
Efficiency Electrical	36.8	38.7	40.1	% (1)
Efficiency Thermal	47.9	44.7	42.3	% (1), (2)
Efficiency Combined (el. + th.)	84.7	83.4	82.4	% (1), (2)

	NOx	CO		
Exh. emissions without catalytic converter	< 0.09	< 0.4		g/Nm³ (4),(6)
	< 46	< 300		ppm (4),(6)
Exh. emissions with catalytic converter**	< 0.09	< 0.09		g/Nm³ (4),(6)
	< 46	< 75		ppm (4),(6)

1.1 Engine

Engine manufacturer	2G	
Engine type	agenitor 406	
Type	row	
No. of cylinders	6	
Operating method	4-stroke	
Engine displacement	11900	ccm
Bore	130	mm
Stroke	150	mm
RPM	1800	1/min
ISO standard power (mech.)	261	kW
compression ratio	14,6 : 1	
average effective pressure	14.0	bar
average piston speed	9.0	m/s
body of balance wheel	SAE 1	
Direction of rotation (based on balance wheel)	left	
tooth rim with number of teeth	167	
Engine dead weight	1250	kg
Mixture cooling to	50	°C
Engine surface noise ***	102	dB(A) (7)
Engine surface noise with sound enclosure (optional) ****	70	dB(A) (7)

*** Total sound power level at full engine load in accordance with DIN EN ISO 3746

**** Average sound pressure level under open area conditions at distance of 1 m in accordance with DIN 45635
An increased noise load must be taken into account with fresh air intake from the installation room.

1.2 Generator (utility planning data)

Manufacturer	Leroy Somer	
Type	LSA 46.3 L10/4p	
Generator type	Synchronous, directly coupled	
Voltage regualtor (AVR)	D510C	
Rated speed	1800	1/min
Frequency	60	Hz
Effective electrical power	250	kW
Apparent electrical power (cos φ 0.8)	313	kVA
Apparent electrical power (cos φ 1.0)	250	kVA
Rated generator current (cos φ 0.8)	301	A
Rated generator current (cos φ 1.0)	241	A
Rated generator voltage (± 10 %)	600	V
Subtransient reactance X"d	9.5	%
Short-circuit current Ik"3	4.0	kA
Power factor cos φ (lagging / leading)	0.8 / 0.95	
Generator circuit breaker	400	A
Efficiency (full load) at Cos φ = 1	95.90	%
Mass moment of inertia	3.91	kg · m²
Ambient air temperature	40	°C
Stator circuit	star	
Protection class	IP 23	
Generator weight	888	kg
Compensation	not available	
Engine startup	not available	

2 Mixture composition

2.1 Combustion air

Combustion air mass flow	1344	kg/h
Combustion air volume flow (25 °C, 1013 mbar)	1135	m³/h

2.2 Fuel

Fuel requirements in accordance with 'TA-004 Gas'

Reference methane number - minimum methane number	150 / 130	
Combustible mass flow	168.5	kg/h (1)
Combustible volume flow	125.1	Nm³/h (6),(1)
min. gas pressure at nom. Output *	30	mbar
Gas regulation line safety pressure	500	mbar

* At the inlet to the gas regulation line

3 Integrated heat extraction

3.1 Customer Heat Recovery Circuit

Heating water requirements in accordance with 'TA-002 Heating circuit'		
Heating water volume flow (at Δt = 20 K)	11.3	m³/h
Heating water return temperature (max)	70	°C
Heating water flow temperature (max) **	90	°C (9)
Safety valve	6.0	bar
Operating pressure (min.)	1	bar
Internal pressure loss in heating circuit (approx.) *	300.0	mbar
Pressure reserve (approx.) *	500	mbar

3.2 Engine circuit

Coolant requirements in accordance with 'TA-001 Coolant'		
Jacket Water Heat	131	kW
Engine inlet temperature (min.)	80	°C
Engine outlet temperature (max.)	88	°C
Differential inlet / outlet (max.)	6.0	K
Engine jacket water flow (min.)	21.8	m³/h
Total cooling water circulation volume	30.1	m³/h
Operating pressure (max.)	2.0	bar
Operating pressure (min.)	1	bar
Notkühlkreis Druckreserve ca. (optional) *	250	mbar
Safety valve	3.0	bar
Safety temperature limiter	110	°C
Intercooler heat high temperature circuit	25	kW
Intercooler inlet high water temperature (max.)	82	°C
Intercooler coolant flow high temperatue circuit (min.)	8.3	m³/h

3.3 Mixture cooling water circuit - low temperature (LT)

Coolant requirements in accordance with 'TA-001 Coolant'		
Intercooler heat low temperature circuit	19	kW
Intercooler inlet low water temperature (ref. / max.)	38 / 43	°C
Intercooler outlet low water temperature (ref. / max.)	41 / 46	°C
Intercooler coolant flow low temperature circuit (min.)	6.3	m³/h
Safety valve	3	bar
Min. Betriebsdruck	1	bar
Druckreserve ca.**	300	mbar

* Up to / from module interface

** depending on the design of the heating circuit pump group, information applies to design by 2G. Heating water supply temperature max., in partial load operation < 90 °C (9)

4. Exhaust system

Exhaust gas temperature after turbo charger	410	°C (3)
Exhaust temperature after exhaust heat exchanger	180	°C
Exhaust Gas Heat up to 180°C	108	kW
exhaust gas volume flow wet	1157	Nm³/h (6)
exhaust gas volume flow dry	1039	Nm³/h (6)
exhaust gas mass flow wet	1513	kg/h
exhaust gas mass flow dry	1412	kg/h
Exhaust back pressure downstream of turbine max.	60	mbar
Pressure reserve approx. (with catalytic converter) *	48	mbar
Exhaust outlet noise **	128	dB (7)

5 Ventilation

Radiation heat of engine and generator (approx.)	40	kW
Supply air volume flow min. (at Δt = 15 K)	9140	m³/h

6 Operating fluids

Lubricating oil approvals, see 'TA-003 Lubricating oil'		
Lubrication oil consumption (max.)	0.20	g/kWh
Filling capacity lubricant (max.)	40	l
Lubricating oil filling tank fill capacity (optional)	100	l
Lubricating oil volume extension tank (optional) (optional)	100	l
Füllmenge Kühlflüssigkeit Motorkreis ca. (Modul)	138	l
Füllmenge Kühlflüssigkeit Gemischkühlkreis NT ca. (Modul)	12	l
Coolant approvals, see 'TA-001 Coolant'		

7 Electronics and software

Generator Protection Relay	Bachmann GSP	
Touchscreen display	10	"
Protection class Control cabinet	Type 12	
Protection class Power switch cabinet	Type 1	
Switch cabinet environmental temperature	0 - 35	°C
Switch cabinet relative air humidity (max.)	65	%

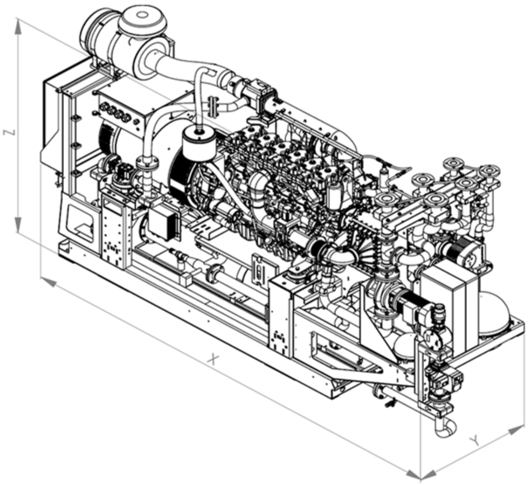
* From module interface (exhaust heat exchanger / catalytic converter in standard version and new condition)

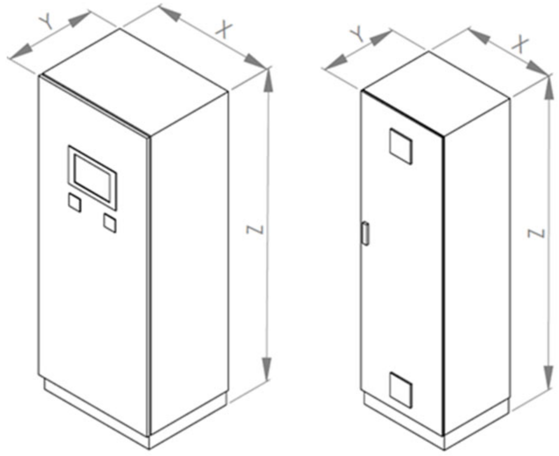
** Total sound power level at full engine load in accordance with DIN 45635-11 Annex A

8 Interfaces

8.1 Dimensions and weights

(Figures may differ)





Length Module	X	3990	mm
Width Module	Y	1110	mm
Height Module	Z	2100	mm
Weight Module (without operating fluids)		4200	kg
Weight Module with sound enclosure (optional)		5300	kg
Powder-coated CHP frame		RAL 6002	

Width Control cabinet	X	800	mm
Depth Control cabinet	Y	600	mm
Height Control cabinet	Z	2000	mm
Weight Control cabinet		200	kg
Control cabinet powder coated		RAL 7035	

Width Power switch cabinet	X	600	mm
Depth Power switch cabinet	Y	500	mm
Height Power switch cabinet	Z	2000	mm
Weight Power switch cabinet		150	kg
Power switch cabinet powder coated		RAL 7035	

8.2 Mechanical Connections

Interface Gas	65 / 10	DN / PN
Interface Exhaust	150 / 10	DN / PN
Interface Heating circuit	50 / 16	DN / PN
Interface Emergency cooling circuit	65 / 16	DN / PN

8.3 Electrical connections / utility interface

Grid connection with pre-fuse (customer-provided)	60 Hz / 600 V	
Grid system	Y	
Short-circuit proof Icc (max.)	50	kA

8.4 Data interfaces

Remote maintenance access (optional) *		DSL / UMTS (SIM)
Interfaces / Data interfaces (optional):	-	Profibus
	-	Profinet
	-	Modbus RTU
	-	Modbus TCP
	-	Ethernet IP
	-	Hardware signals
Access virtual power plant (optional)		Possible after technical clarification (bus or hardware signals)

* Access for remote maintenance must be provided by the customer

9 Technical boundary conditions

Unless otherwise specified, all data is based on full engine load with the respective indicated media temperatures and subject to technical improvements. The generator output measured at the generator terminals serves as the basis for the delivered electrical power. All power and efficiency specifications are gross specifications. The fuel gas quality must conform to the specifications of 'TA-004 Gas'. The operating fluids and plant system layout must conform to the 'Technical instructions' of 2G.

Power specifications in this document relate to standard reference conditions.

Standard reference conditions in accordance with DIN ISO 3046-1:

Air pressure	1000	mbar
Air temperature	25	°C
Relative air humidity	30	%
Methane number according to DIN EN 16726		

Power reduction

Power reduction due to installation at altitude > 300m a.s.l. and/or air suction temperature > 25°C shall be determined specifically for each project according "TI-049 Load reduction".

(1)

Performance conditions in accordance with DIN ISO 3046. Tolerance for specific fuel use amounts to + 5% of nominal performance. Efficiency specifications are based on an engine in new condition. An abatement in efficiency over the service life is reduced with observance of the maintenance requirements.
The specified efficiency is based on a heating circuit supply temperature of 90°C. The efficiency may vary for variants with higher heating circuit supply temperatures.

(2) The tolerance for usable heat output is +/- 8 % under normal load.

(3) The tolerance for the exhaust temperature is +/- 8 %.

(4) Corresponding to a residual oxygen concentration in the exhaust of 15 %.

(5) Electrical generator terminal power at cos φ = 1.0

(6) Volume specifications for normal status:

Pressure	1013	mbar
Temperature	0	°C

(7) Standard deviation of reproducibility 4 dB in accordance with DIN EN ISO 3746

(*) It is possible to retrofit the 2G plant onsite for operation with up to 100% hydrogen. Performance data and interfaces may change.

Results Summary WT2321011

Project	WOODSTOCK WWTP
Report To	Nathan Gerber, Oxford County Public Works
Date Received	12-Jul-2023 07:30
Issue Date	01-Aug-2023 09:02
Amendment	1

Client Sample ID			WWTP BIOGAS LT.OFGV130	WWTP BIOGAS RT.OFGV130	WWTP BIOGAS RT.OFGV130
Date Sampled			11-Jul-2023	11-Jul-2023	11-Jul-2023
Time Sampled			15:00	14:40	13:44
ALS Sample ID			WT2321011-001	WT2321011-002	WT2321011-003
Analyte	Lowest Detection Limit	Units	Sub-Matrix: Air	Sub-Matrix: Air	Sub-Matrix: Air
Field Tests (Matrix: Air)					
Air volume, field	0.010	L			0.060
ID, batch proof			NR	230625.115	29-May-23
ID, canister			01400-0089	01400-0120	
ID, regulator			G41	G66	
ID, tube					G0138116SVI
Pressure on receipt	0.10	Inches Hg	-4.83	-6.74	
Tube usage number					N/A
Sulfur Compounds (Matrix: Air)					
Hydrogen sulfide	4.0	ppbv		4.1	
Hydrogen sulfide	5.6	µg/m³		5.7	
Permanent Gases (Matrix: Air)					
Carbon dioxide	0.050	%	31.6		
Carbon monoxide	0.050	%	<0.050		
Methane	0.050	%	61.7		
Nitrogen	1.0	%	4.5		
Oxygen	0.10	%	0.98		
Volatile Organic Compounds (Matrix: Air)					
Decamethylcyclopentasiloxane [D5]	170	µg/m³			8830
Decamethyltetrasiloxane [L4]	170	µg/m³			<170
Dodecamethylcyclohexasiloxane [D6]	170	µg/m³			300
Dodecamethylpentasiloxane [L5]	170	µg/m³			<170
Hexamethylcyclotrisiloxane [D3]	350	µg/m³			<350
Hexamethyldisiloxane [MM]	170	µg/m³			<170
Octamethylcyclotetrasiloxane [D4]	170	µg/m³			1770
Octamethyltrisiloxane [MDM]	170	µg/m³			<170
Volatile Organic Compounds Surrogates (Matrix: Air)					
Bromofluorobenzene, 4-	0.010	%			102

SOMMERS

Generator Systems

3YR or 3000Hr Limited Parts, Travel & Labour warranty

60Hz | **VOLVO TAD 1641 GE Tier 2**

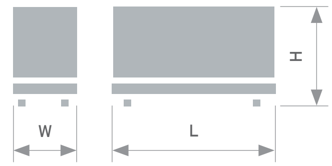
DGVSW 500 ST T2

Measures:

L: 4900 mm H: 2380 mm
W: 1716 mm

Weight (dry):

11519 lbs / 5225 kg



- 60Hz
- Diesel
- Water cooled
- Soundproofed
- 1800 RPM
- CSA Approved or Equivalent

1 Genset General Description

- Soundproof genset with automatic startup, control card allows automatic, manual or signal start-up.

General Technical Data			
Engine	VOLVO TAD 1641 GE		
Alternators	240/120V	Wdg. -	-
	208/120V	Wdg. 311	STAMFORD HCI544E
	600/347V	Wdg. 17	STAMFORD HCI544D
Performance Class	G3		
Frequency	60Hz		
Control Panel	240/120V		DSE 7320 MKII
	208/120V		DSE 7320 MKII
	600/347V		DSE 7320 MKII
Noise level (dBA@7m)	72		

Voltage (V)	PRP (KW)	ESP (KW)	PRP/ESP (A)
240/120V	-	-	-/-
208/120V	460	517	1598/1795
600/347V	460	509	556/612

PRP: Continuous power ("Prime Power") ISO 8528-1 standard.
ESP: Emergency power ("Emergency Standby Power") ISO8528-1 standard.

Sommers Motor Generator Sales Ltd.
www.sommersgen.com
1-800-690-2396

Head Office
70 Packham Ave.
Stratford, ON. N4Z 0A6

Atlantic Canada
551 Ferdinand Boulevard
Dieppe, NB E1A 7G1

2 Engine Specifications

VOLVO TAD 1641 GE Diesel engine, inline 6-cylinders, 4-stroke. Turbocharged aspiration, air intake system. Electronic regulation. Complying with Tier 2 emissions.

Engine General Data			
Manufacturer/Model	VOLVO TAD 1641 GE	Number of Cylinders	6 cylinders
R.P.M.	1800	Engine Capacity	16,1
Max. Power (kWm) (net)	546	Cooling System	Water cooled
Power PRP (Kwm) (net)	485	Regulation Type	Electronic
Fuel	Diesel	Engine Type/Injection/ Suction	Diesel /Direct/ Turbocharged

2.1 Fuel Feed System

Direct injection system, fuel filter included that prevents the passage of particles, original parts from the engine manufacturer.

50% PRP	58,9 l/h (15,6 US gals/h)
75% PRP	87,5 l/h (23,1 US gals/h)
100% PRP	118,9 l/h (31,4 US gals/h)
110% ESP	N/A l/h (N/A US gals/h)

2.2 Cooling System

Cooling by fully distributed coolant in a closed circuit driven by a pump activated by the engine. Tropicalized radiator. Original parts from the engine manufacturer.

Fan Airflow (kg/s)	Fan Power Consumption, hp (kW)	Engine + Radiator Capacity (l)	Blockheater (W/V)
6	25,5 (19)	60	4000W 240V

2.3 Lubricating System

Lubrication system is driven by the crankshaft driven pump. Filter on top with full flow cartridge inserted, front crankcase. Original parts from the engine manufacture.

Total Oil Capacity 42L

With oil pressure reading sensor

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2.4 Air Intake System

- Direct air intake system including two-stage filter. Original parts from the engine manufacturer.

Combustion Air Volume 190 l/h

2.5 Start System

- Start system by electric motor. battery (without maintenance) with disconnector and charging alternator driven by the starter motor 24V, original parts from the engine manufacturer.

Number of Batteries	2	Battery Features	8D-9	Starting Voltage	24V

2.6 Exhaust System

- Attenuation level -35dB(A). Complying Tier 2 Interim emissions.

Exhaust System	
Exhaust Gas Volume	100,6 m³/min
Exhaust Gas Temperature	436 ºC
Exhaust External Diameter	N/A" (N/Amm)
Max. Exhaust Backpressure	10kPa

3 Alternator Specifications

- Alternator STAMFORD 4-poles, brushless, alternator with class - insulation wound at 2/3 pitch and self-excited automatic voltage regulator (AVR).

Alternator General Data	240/120V	208/120V	600/347V
Brand/Model	-	STAMFORD HCI544E	STAMFORD HCI544D
Winding No.	-	311	17
Voltage Regulator AVR	-	PMG + MX341	PMG + MX341
Voltage Regulator	-	±1%	±1%
ESP Power Rating 40ºC (kW)	-	575,2	540
PRP Power Rating 40ºC (kW)	-	544,8	515,2
Number of Phases	1	3	3
Power Factor (cos φ)	1	0,8	0,8
Efficiency at 100% Load	-	94,8%	94,8%
Efficiency at 110% Load	-	94,6%	94,6%

The alternator complies with the following standards:

- Class H temperature rise 125ºC (257ºF), Standby (ESP).
- Class H temperature rise 105ºC (302ºF), Prime (PRP).
- AS 1359
- IEC 34-1
- BS EN 60034-1
- VDE 0530
- BS 5000
- CAN/CSA-C22.2-100
- NEMA MG1-32

Low wave distortion: THD (100% load) = 2%, THF < 2%, Complying with EN61000-6-3, EN61000-6-2 standards on radio interference.

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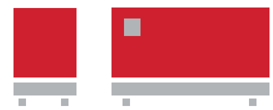
4 Bench Specifications

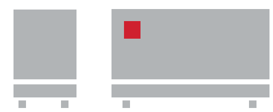
- Engine and alternator mounted on a high strength steel frame and painted with electrostatic epoxy polyester powder paint. Frame is tested in saline mist chamber to conform to ASTM B-117-09 for 500 hours. Engine and Alternator are mounted on rubber isolators to help dampen vibration while running.

5 Canopy Specifications



- Canopy made of high strength galvanized steel and is painted with electrostatic epoxy polyester paint. Canopy is lined with acoustical/fireproof rock wool. A residential exhaust muffler -35dB(A) is installed to dampen exhaust noise. All is tested in a saline mist chamber to conform with ASTM B-117-09 for 720 hour.

6 Control Panel



- The control panel protects the engine and generator and allows for manual and automatic control of the genset.

6.1 Main Line Breaker

- Main line circuit breaker: A thermo-magnetic breaker provides protection against short circuits and overloads.

240/120	-	208/120	2000 Amps, Adj.	600/347	600 Amps, Adj.

6.2 Control Panel Features

- **Emergency Stop Push Button**
- **DeepSea Battery Charger**
  Permanently connected to the battery to keep the battery fully charged. Charger is equipped with a float feature to keep battery ready in a prime starting state.
- **Panel Fusing**
  Fusing to protect the control panel wiring and accessories.

6.3 Control Card

Control card for 600/347V:
DSE 7320 MKII

Features of the DSE 7320 MKII Card:

- 132X64 pixel illuminate LCD display
- Full engine/alternator parameter and alarm read out
- 5-button menu navigation
- One touch Auto-Manual-Test and Stop buttons
- 9 factory configurable outputs
- 8 factory configurable inputs
- Programmable PLC for custom application
- Remote communication through an RS232 or RS485 connection
- Utility sensing Option

The control card complies with the following environmental tests:

- BS EN 61000-6-2 (electromagnetic compatibility)
- BS EN 61000-6-4 (electromagnetic compatibility)
- BS EN 60950 (electrical safety)
- BS EN 61000-6-2 (Temperature)
- BS EN 60068-2-6 (Vibration)
- BS EN 60068-2-30 (Humidity)
- BS EN 60068--2-27 (Shock)

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Dieppe, NB E1A 7G1

6.4 Display

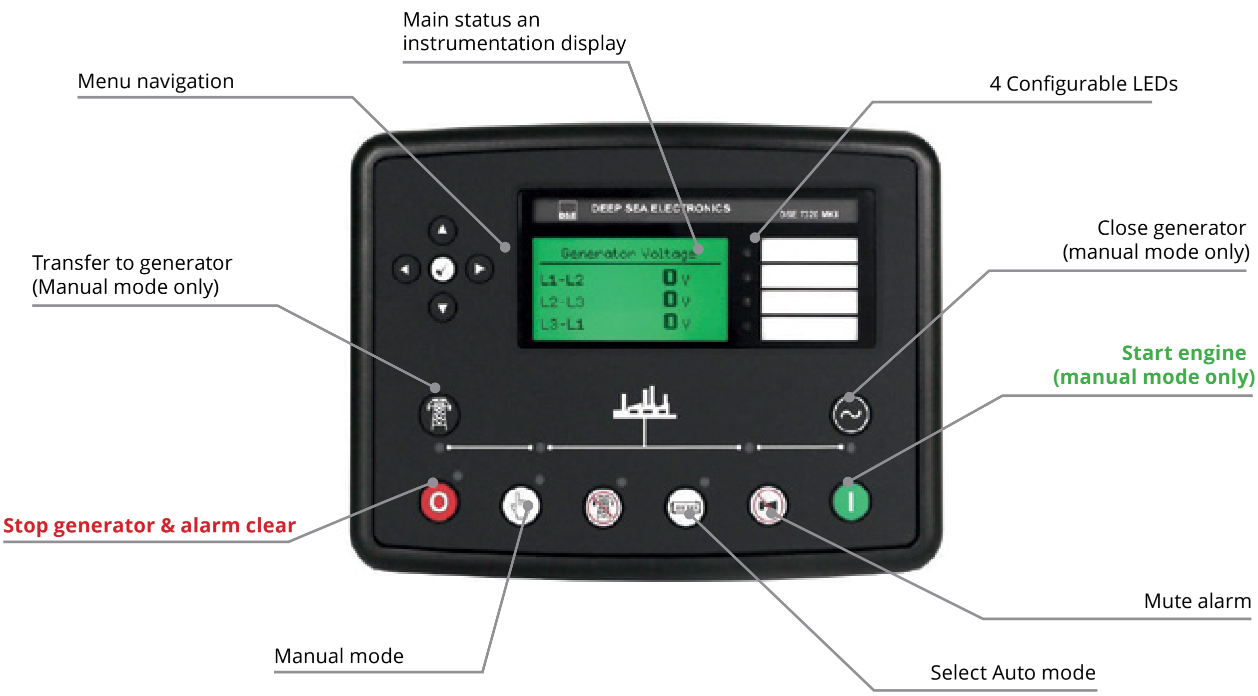
Control card for all Voltages:
DSE 7320 MKII

Engine	
Engine Speed	Engine Hours
Oil Pressure	Number Engine Starts
Battery Voltage	Fuel Consumption
Fuel level	Engine Temperature

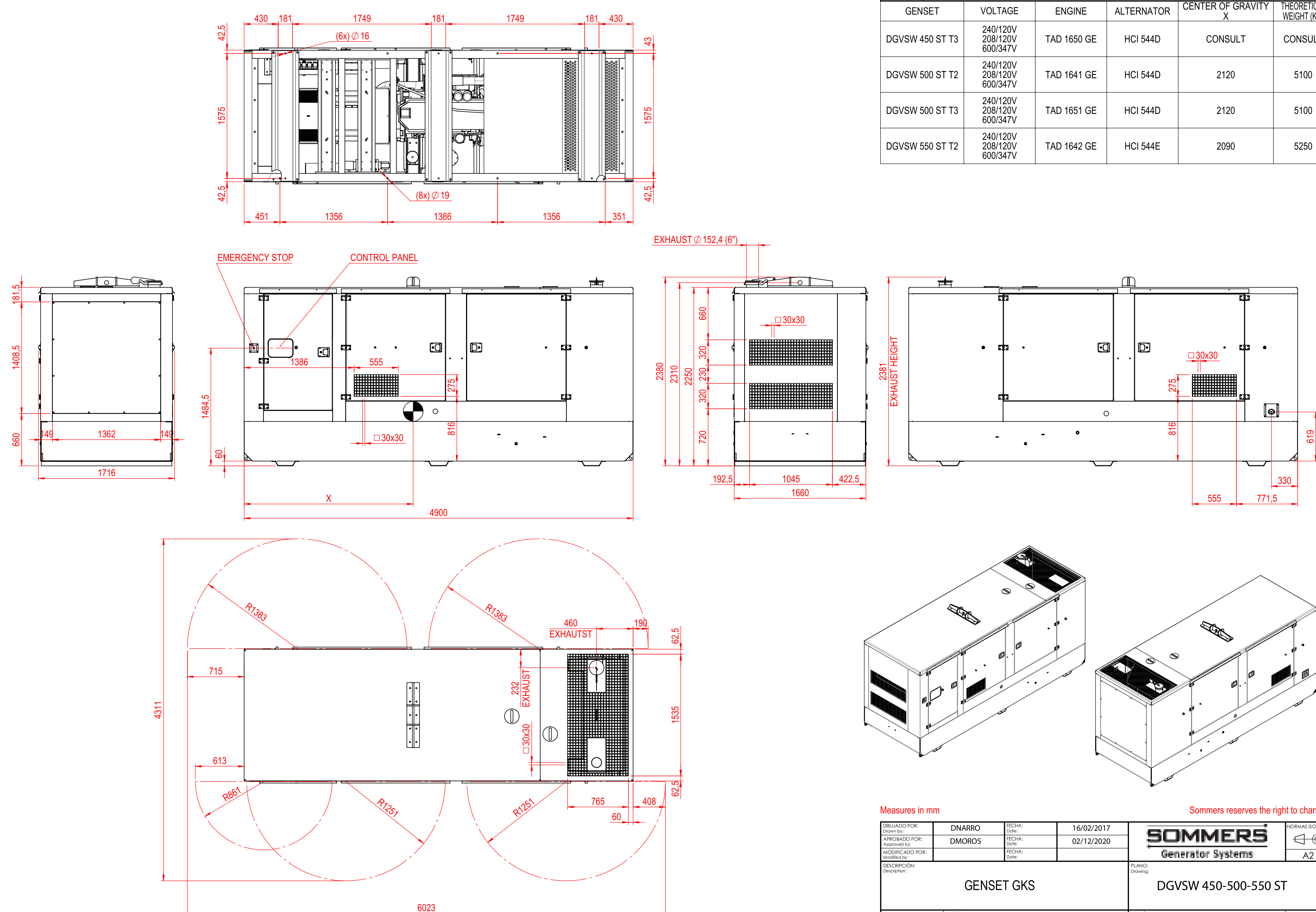
Generator	
Voltage (L-N)	Voltage (L-L)
Frequency	Amperage
Power Factor	Load (kW, kVA, kVah)

Mains
Voltage (L-N)
Voltage (L-L)
Frequency

Alarm Detected	
Overcrank	High Engine Temp.
Low Oil Pressure	Low Engine Temp.
Low Coolant Level	Low Fuel Level
Low Plant Battery Voltage	Main Line Breaker
Over Voltage	Over Frequency
Under Voltage	Over Speed
Control Not In Auto	Lamp Test Features
Radiator level sender	



Gensets rated for operational ambient temperature of 40 C, in compliance of CSA C282-15. If ambient temperature exceeds 40 C, please contact sales representative for derating information. Emergency standby power(ESP): the maximum power available for which a genset is delivering in the event of a utility power outage or under test conditions for up to 200hours per year. Prime Power(PRP): the maximum power which a genset is capable of delivering continuously for an unlimited number of hours per year.



GENSET	VOLTAGE	ENGINE	ALTERNATOR	CENTER OF GRAVITY X	THEORETICAL WEIGHT (KG)
DGVSW 450 ST T3	240/120V 208/120V 600/347V	TAD 1650 GE	HCI 544D	CONSULT	CONSULT
DGVSW 500 ST T2	240/120V 208/120V 600/347V	TAD 1641 GE	HCI 544D	2120	5100
DGVSW 500 ST T3	240/120V 208/120V 600/347V	TAD 1651 GE	HCI 544D	2120	5100
DGVSW 550 ST T2	240/120V 208/120V 600/347V	TAD 1642 GE	HCI 544E	2090	5250

Measures in mm

Sommers reserves the right to change

DIBUJADO POR: Drawn by:	DNARRO	FECHA: Date:	16/02/2017
APROBADO POR: Approved by:	DMOROS	FECHA: Date:	02/12/2020
MODIFICADO POR: Modified by:		FECHA: Date:	

SOMMERS Generator Systems

NORMAS ISO 2768-c

A2

DESCRIPCIÓN: Description: GENSET GKS

PLANO: Drawing: DGVSW 450-500-550 ST

ESPESOR: Thickness:

MATERIAL: Material:

TRATAMIENTO/COLOR: Treatment/Color:

VERSIÓN: Version: 01

PESO: Weight:

ESCALA: Scale: 1:30

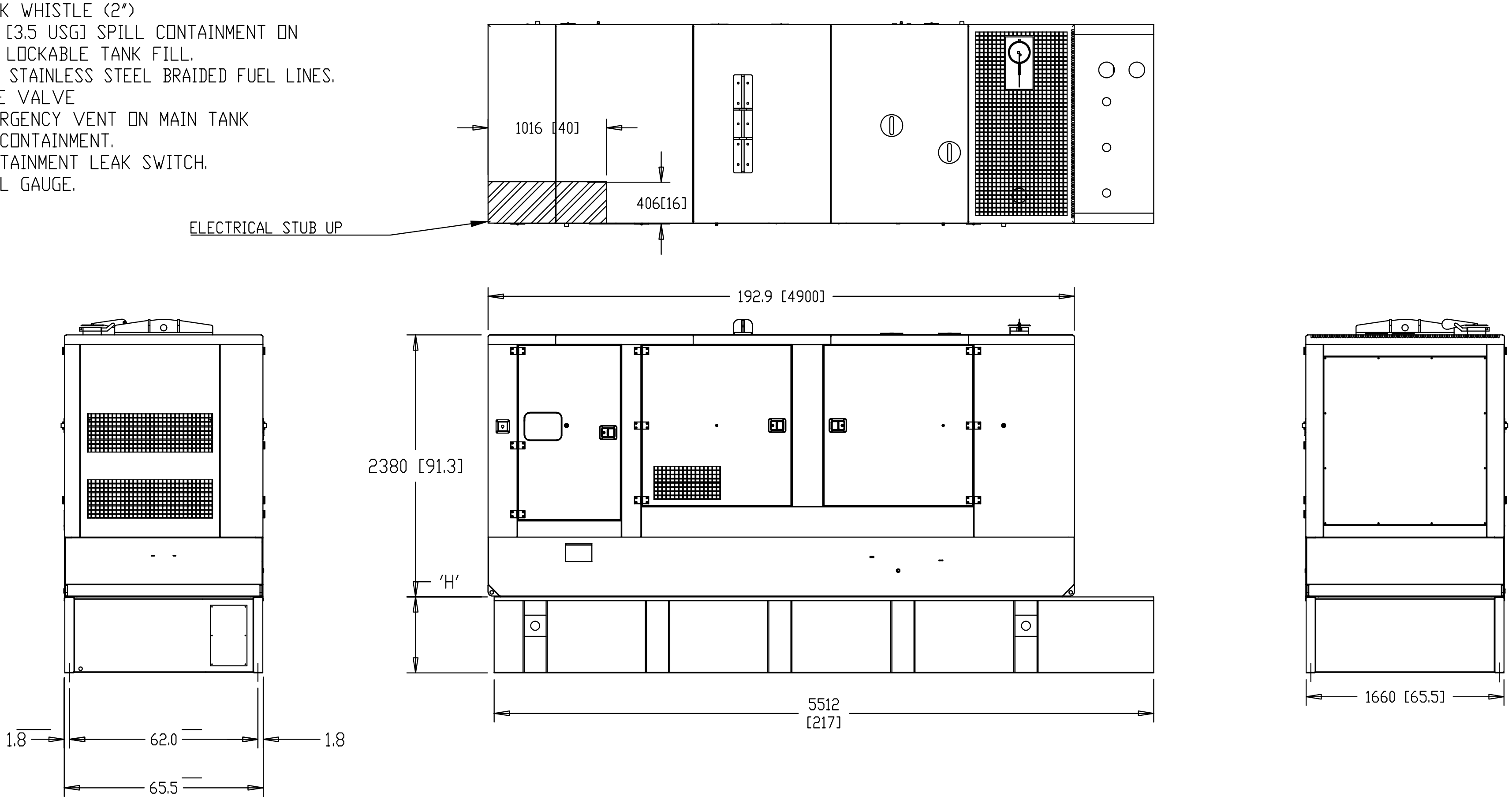
HOJA: Sheet: 1 / 2

TITLE	450-550kW VOLVO ENCLOSED GENSET

TANK	VOLUME	VALUE OF 'H'
SOGE-265	2495L(660USG)	432[17]
SOGE-266	3780L(1000USG)	635[25]

TANK ASSEMBLY
C/W

- TANK WHISTLE (2")
- 13L [3.5 USG] SPILL CONTAINMENT ON 2" LOCKABLE TANK FILL.
- 1/2" STAINLESS STEEL BRAIDED FUEL LINES.
- FIRE VALVE
- EMERGENCY VENT ON MAIN TANK & CONTAINMENT.
- CONTAINMENT LEAK SWITCH.
- FUEL GAUGE.



GENERAL NOTES:

1) DRAWING TOLERANCES: ±6mm [.25"]

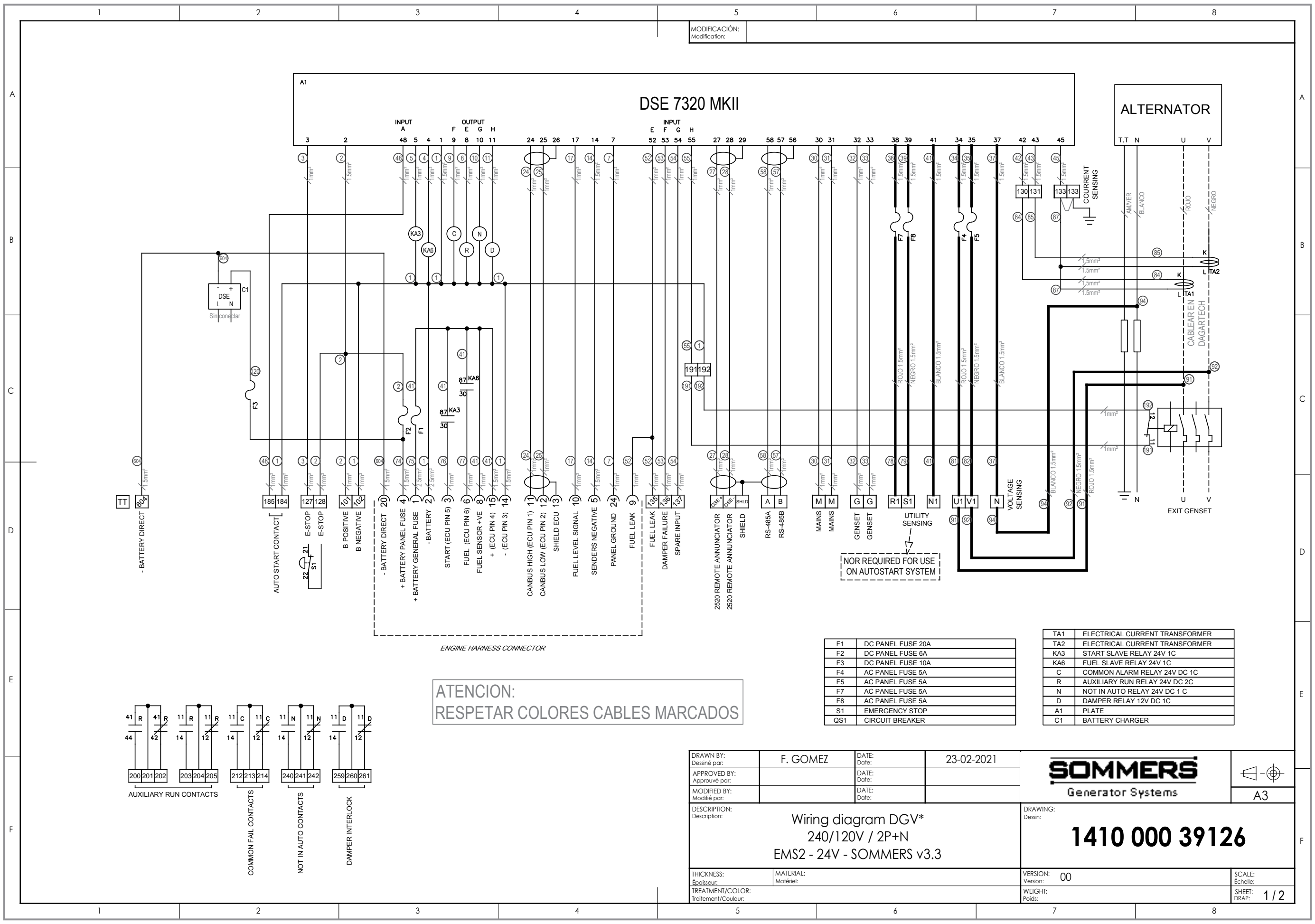
2) BASE MTG. HOLE TOLERANCES: ±3mm [.12"]

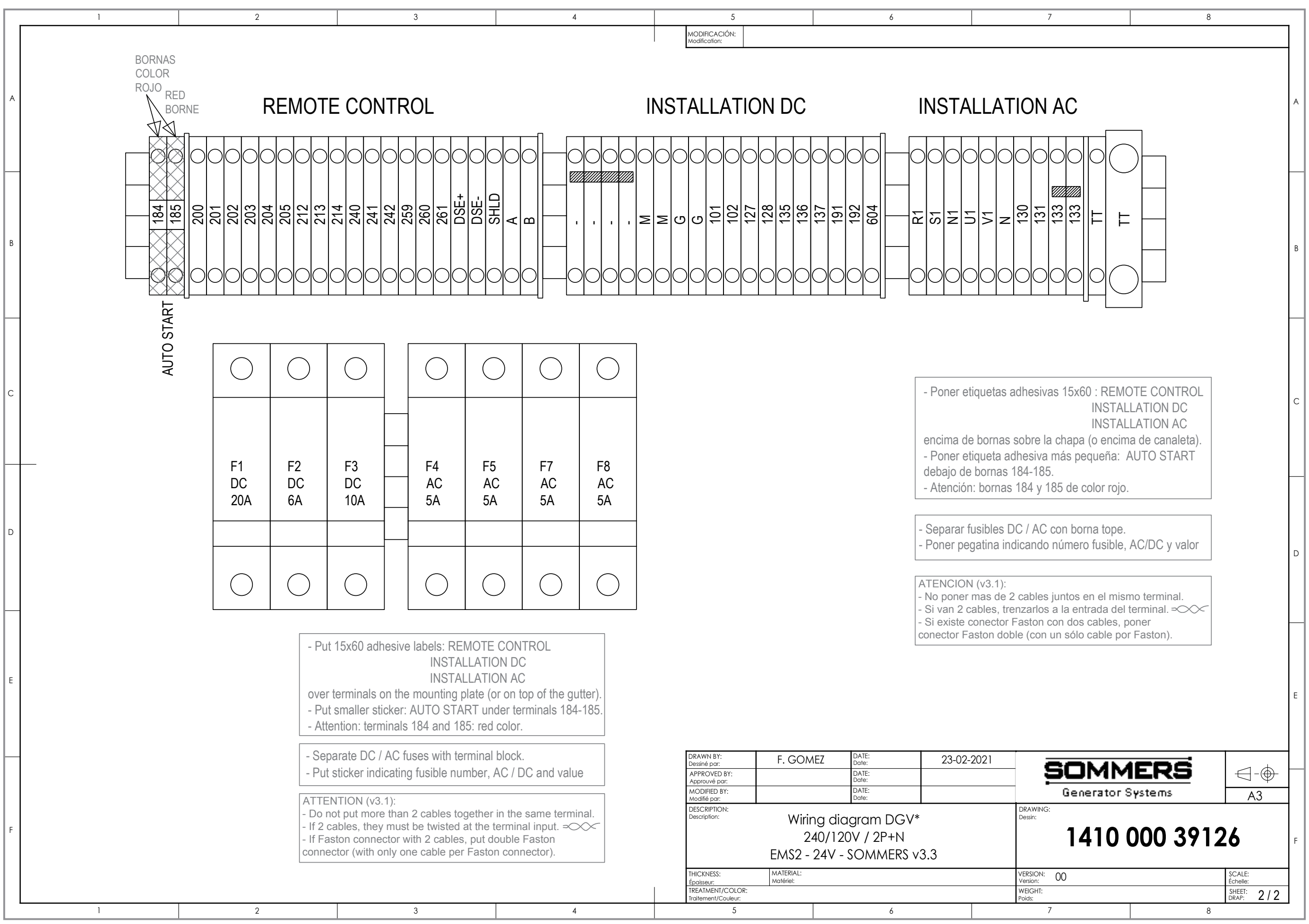
3) DIMENSIONS ARE IN: mm [INCHES].

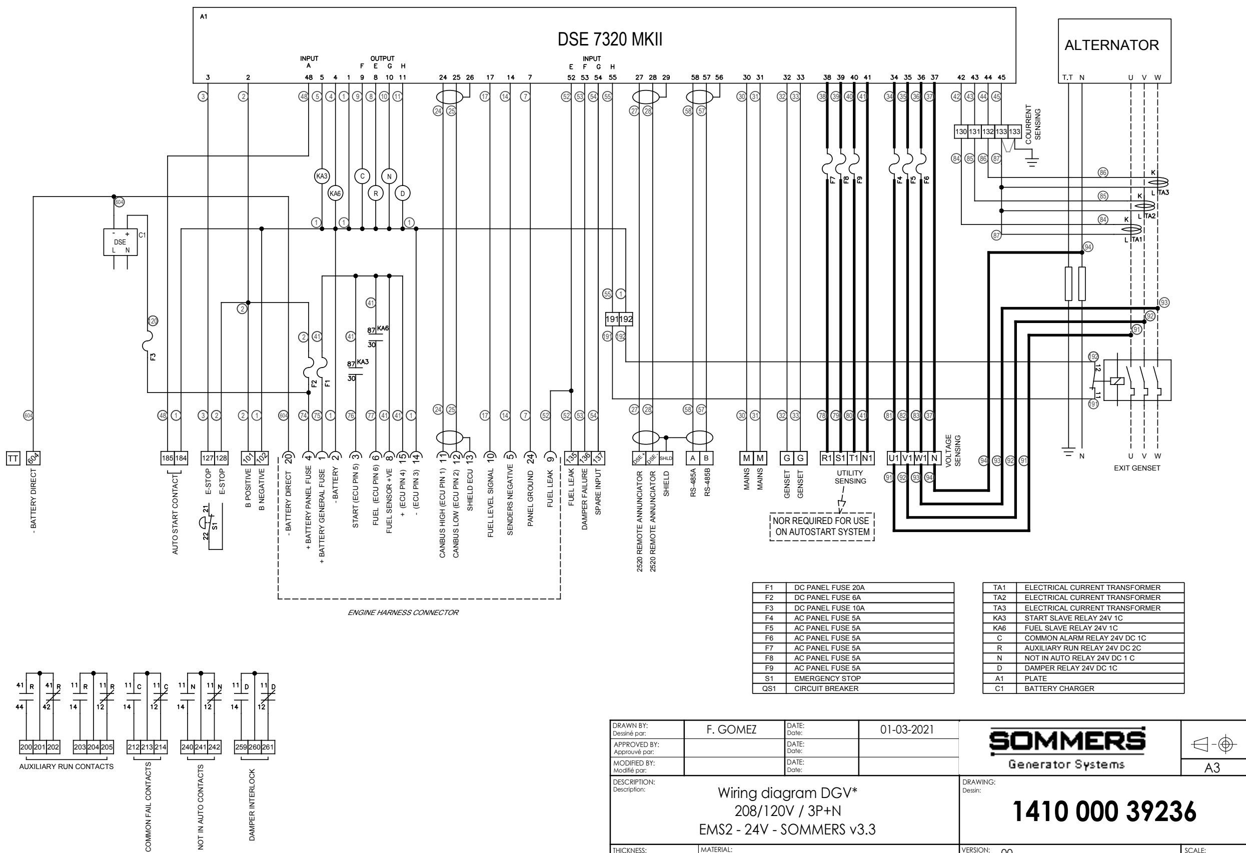
REV	DESCRIPTION	DATE	REV BY	AS BUILT
1	NEW DRAWING	1/22/18	SAK	

SOMMERS Generator Systems

CUSTOMER	SITE			GEN SET MODEL #	
QUOTE #	PO #	PO DATE	FIRST USED	ESTIMATED WEIGHT	SIZE B / DRAWING NUMBER
DRAWN BY SAK	CHK BY	TOLERANCES: SEE NOTES		SCALE NONE	FILE / SHEET 1 OF 1


DSE 7320 MKII
ALTERNATOR
ENGINE HARNESS CONNECTOR
ATENCION:
RESPETAR COLORES CABLES MARCADOS
NOR REQUIRED FOR USE ON AUTOSTART SYSTEM
AUXILIARY RUN CONTACTS
COMMON FAIL CONTACTS
NOT IN AUTO CONTACTS
DAMPER INTERLOCK
EXIT GENSET
F1 DC PANEL FUSE 20A
F2 DC PANEL FUSE 6A
F3 DC PANEL FUSE 10A
F4 AC PANEL FUSE 5A
F5 AC PANEL FUSE 5A
F7 AC PANEL FUSE 5A
F8 AC PANEL FUSE 5A
S1 EMERGENCY STOP
QS1 CIRCUIT BREAKER
TA1 ELECTRICAL CURRENT TRANSFORMER
TA2 ELECTRICAL CURRENT TRANSFORMER
KA3 START SLAVE RELAY 24V 1C
KA6 FUEL SLAVE RELAY 24V 1C
C COMMON ALARM RELAY 24V DC 1C
R AUXILIARY RUN RELAY 24V DC 2C
N NOT IN AUTO RELAY 24V DC 1 C
D DAMPER RELAY 12V DC 1C
A1 PLATE
C1 BATTERY CHARGER
DRAWN BY: F. GOMEZ DATE: 23-02-2021
SOMMERS Generator Systems
A3
Wiring diagram DGV*
240/120V / 2P+N
EMS2 - 24V - SOMMERS v3.3
DRAWING: 1410 000 39126
VERSION: 00
SHEET: 1 / 2


BORNAS COLOR ROJO
RED BORNE
REMOTE CONTROL
INSTALLATION DC
INSTALLATION AC
184 185 200 201 202 203 204 205 212 213 214 240 241 242 259 260 261 DSE+ DSE- SHLD A B
M M G G 101 102 127 128 135 137 191 192 604
R1 S1 N1 U1 V1 N 130 131 133 133 TT TT
AUTO START
F1 DC 20A
F2 DC 6A
F3 DC 10A
F4 AC 5A
F5 AC 5A
F7 AC 5A
F8 AC 5A
- Poner etiquetas adhesivas 15x60 : REMOTE CONTROL
INSTALLATION DC
INSTALLATION AC
encima de bornas sobre la chapa (o encima de canaleta).
- Poner etiqueta adhesiva más pequeña: AUTO START debajo de bornas 184-185.
- Atención: bornas 184 y 185 de color rojo.
- Separar fusibles DC / AC con borna tope.
- Poner pegatina indicando número fusible, AC/DC y valor
ATENCION (v3.1):
- No poner mas de 2 cables juntos en el mismo terminal.
- Si van 2 cables, trenzarlos a la entrada del terminal.
- Si existe conector Faston con dos cables, poner conector Faston doble (con un sólo cable por Faston).
- Put 15x60 adhesive labels: REMOTE CONTROL
INSTALLATION DC
INSTALLATION AC
over terminals on the mounting plate (or on top of the gutter).
- Put smaller sticker: AUTO START under terminals 184-185.
- Attention: terminals 184 and 185: red color.
- Separate DC / AC fuses with terminal block.
- Put sticker indicating fusible number, AC / DC and value
ATTENTION (v3.1):
- Do not put more than 2 cables together in the same terminal.
- If 2 cables, they must be twisted at the terminal input.
- If Faston connector with 2 cables, put double Faston connector (with only one cable per Faston connector).
DRAWN BY: F. GOMEZ DATE: 23-02-2021
SOMMERS Generator Systems
A3
Wiring diagram DGV*
240/120V / 2P+N
EMS2 - 24V - SOMMERS v3.3
DRAWING: 1410 000 39126
VERSION: 00
SHEET: 2 / 2



F1	DC PANEL FUSE 20A
F2	DC PANEL FUSE 6A
F3	DC PANEL FUSE 10A
F4	AC PANEL FUSE 5A
F5	AC PANEL FUSE 5A
F6	AC PANEL FUSE 5A
F7	AC PANEL FUSE 5A
F8	AC PANEL FUSE 5A
F9	AC PANEL FUSE 5A
S1	EMERGENCY STOP
QS1	CIRCUIT BREAKER

TA1	ELECTRICAL CURRENT TRANSFORMER
TA2	ELECTRICAL CURRENT TRANSFORMER
TA3	ELECTRICAL CURRENT TRANSFORMER
KA3	START SLAVE RELAY 24V 1C
KA6	FUEL SLAVE RELAY 24V 1C
C	COMMON ALARM RELAY 24V DC 1C
R	AUXILIARY RUN RELAY 24V DC 2C
N	NOT IN AUTO RELAY 24V DC 1 C
D	DAMPER RELAY 24V DC 1C
A1	PLATE
C1	BATTERY CHARGER

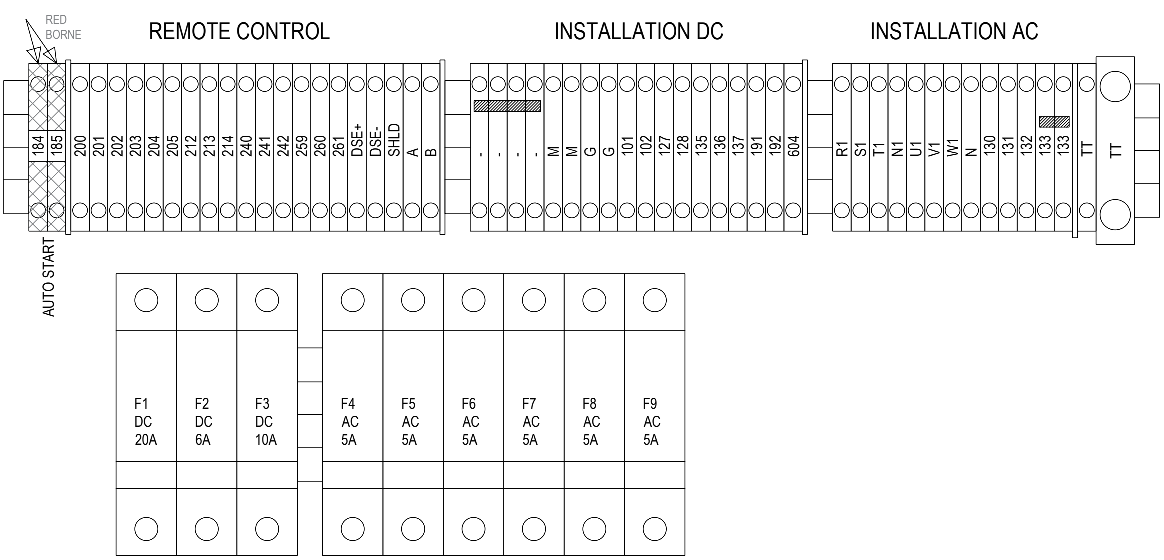
DRAWN BY: F. GOMEZ — DATE: 01-03-2021

SOMMERS Generator Systems — A3

DESCRIPTION: Wiring diagram DGV* 208/120V / 3P+N EMS2 - 24V - SOMMERS v3.3

DRAWING: 1410 000 39236

VERSION: 00 — SHEET: 1 / 2



- Put 15x60 adhesive labels: REMOTE CONTROL
INSTALLATION DC
INSTALLATION AC
over terminals on the mounting plate (or on top of the gutter).
- Put smaller sticker: AUTO START under terminals 184-185.
- Attention: terminals 184 and 185: red color.

- Separate DC / AC fuses with terminal block.
- Put sticker indicating fusible number, AC / DC and value

ATTENTION (v3.1):
- Do not put more than 2 cables together in the same terminal.
- If 2 cables, they must be twisted at the terminal input.
- If Faston connector with 2 cables, put double Faston connector (with only one cable per Faston connector).

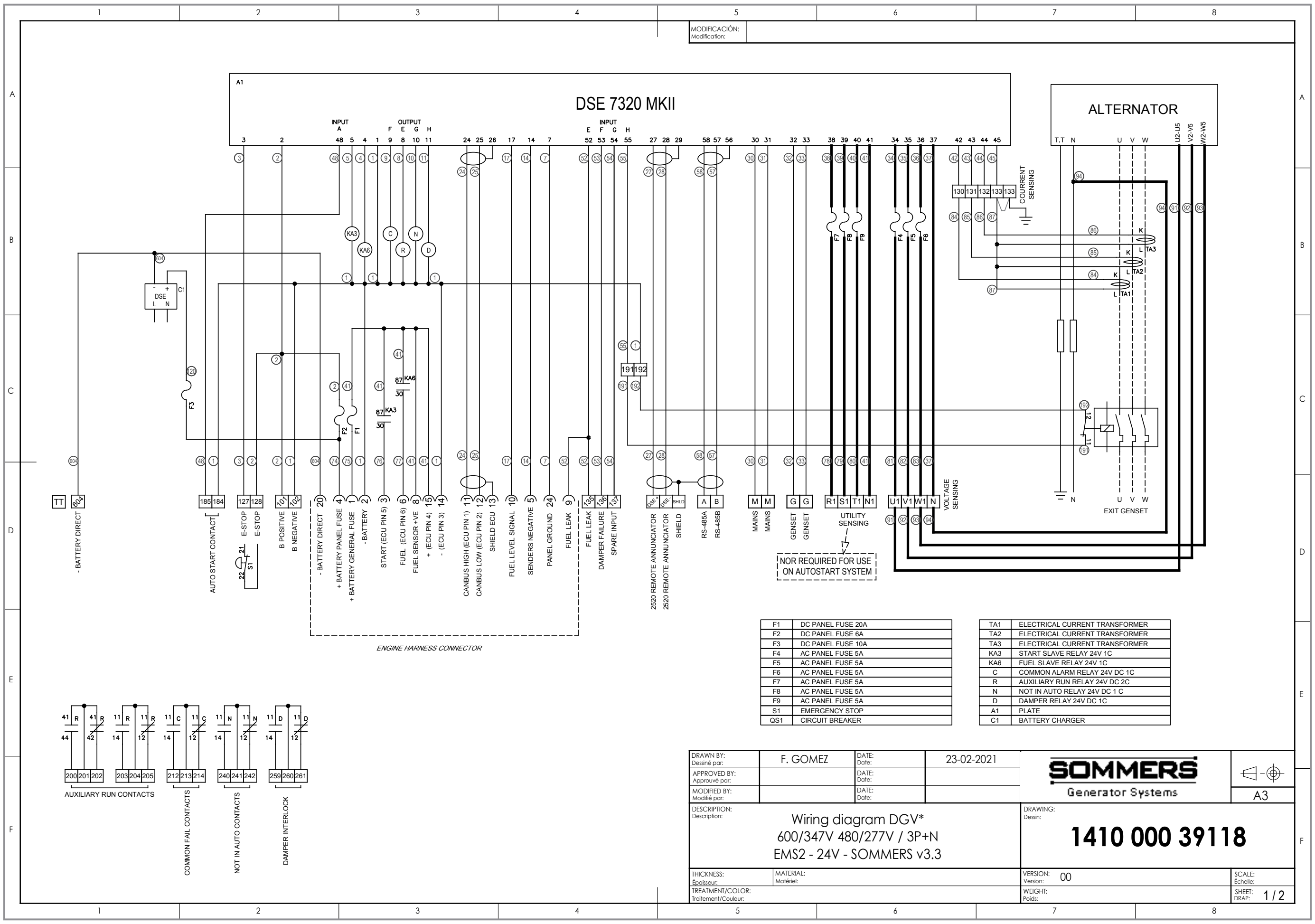
DRAWN BY: F. GOMEZ — DATE: 01-03-2021

SOMMERS Generator Systems — A3

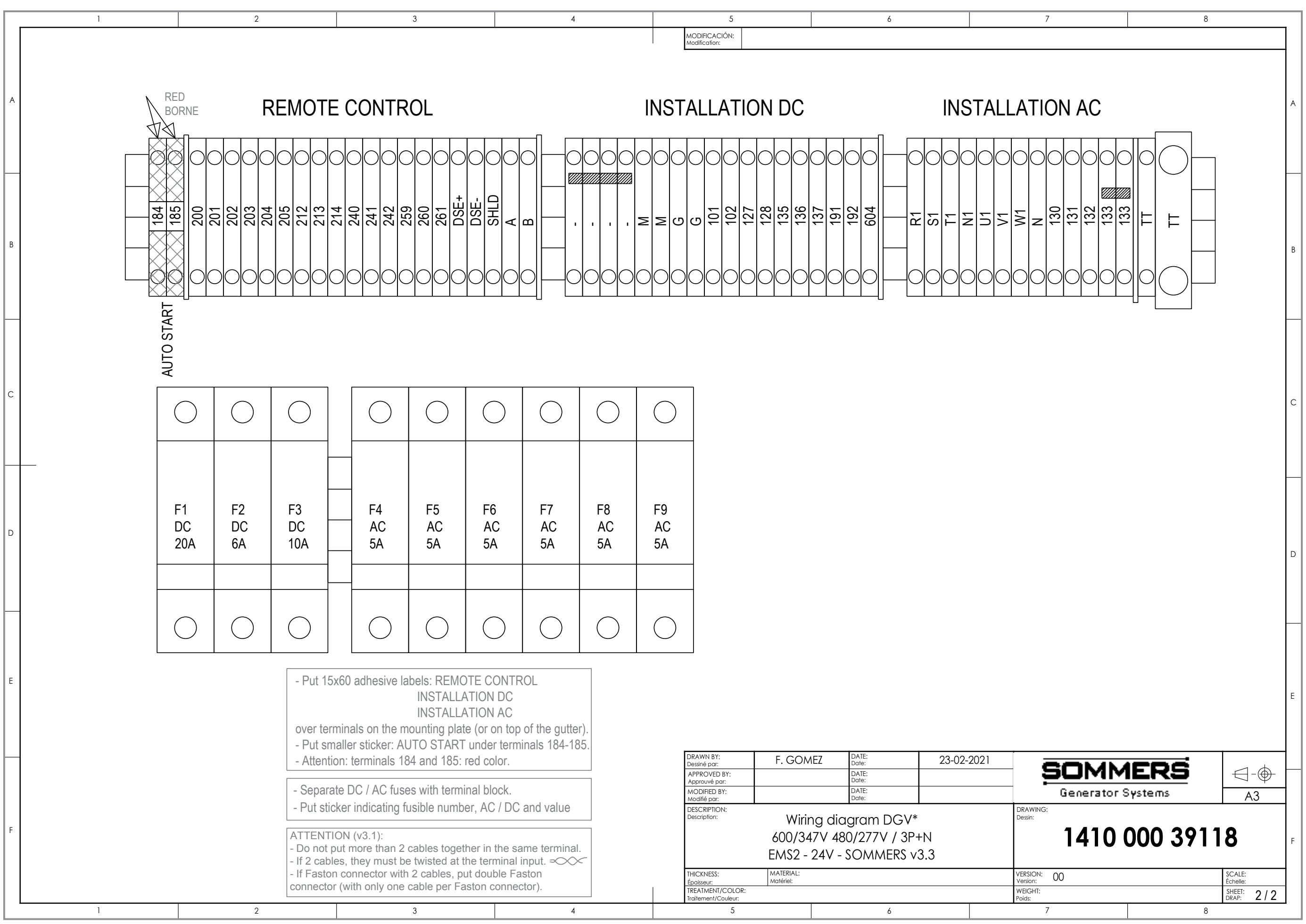
DESCRIPTION: Wiring diagram DGV* 208/120V / 3P+N EMS2 - 24V - SOMMERS v3.3

DRAWING: 1410 000 39236

VERSION: 00 — SHEET: 2 / 2



DSE 7320 MKII
ALTERNATOR
ENGINE HARNESS CONNECTOR
NOR REQUIRED FOR USE ON AUTOSTART SYSTEM
UTILITY SENSING
VOLTAGE SENSING
EXIT GENSET
AUXILIARY RUN CONTACTS
COMMON FAIL CONTACTS
NOT IN AUTO CONTACTS
DAMPER INTERLOCK
F1 DC PANEL FUSE 20A
F2 DC PANEL FUSE 6A
F3 DC PANEL FUSE 10A
F4 AC PANEL FUSE 5A
F5 AC PANEL FUSE 5A
F6 AC PANEL FUSE 5A
F7 AC PANEL FUSE 5A
F8 AC PANEL FUSE 5A
F9 AC PANEL FUSE 5A
S1 EMERGENCY STOP
QS1 CIRCUIT BREAKER
TA1 ELECTRICAL CURRENT TRANSFORMER
TA2 ELECTRICAL CURRENT TRANSFORMER
TA3 ELECTRICAL CURRENT TRANSFORMER
KA3 START SLAVE RELAY 24V 1C
KA6 FUEL SLAVE RELAY 24V 1C
C COMMON ALARM RELAY 24V DC 1C
R AUXILIARY RUN RELAY 24V DC 2C
N NOT IN AUTO RELAY 24V DC 1 C
D DAMPER RELAY 24V DC 1C
A1 PLATE
C1 BATTERY CHARGER
DRAWN BY: F. GOMEZ
DATE: 23-02-2021
SOMMERS Generator Systems
A3
Wiring diagram DGV*
600/347V 480/277V / 3P+N
EMS2 - 24V - SOMMERS v3.3
DRAWING: 1410 000 39118
VERSION: 00
SHEET: 1 / 2



RED BORNE
REMOTE CONTROL
INSTALLATION DC
INSTALLATION AC
AUTO START
F1 DC 20A
F2 DC 6A
F3 DC 10A
F4 AC 5A
F5 AC 5A
F6 AC 5A
F7 AC 5A
F8 AC 5A
F9 AC 5A
- Put 15x60 adhesive labels: REMOTE CONTROL
INSTALLATION DC
INSTALLATION AC
over terminals on the mounting plate (or on top of the gutter).
- Put smaller sticker: AUTO START under terminals 184-185.
- Attention: terminals 184 and 185: red color.
- Separate DC / AC fuses with terminal block.
- Put sticker indicating fusible number, AC / DC and value
ATTENTION (v3.1):
- Do not put more than 2 cables together in the same terminal.
- If 2 cables, they must be twisted at the terminal input.
- If Faston connector with 2 cables, put double Faston connector (with only one cable per Faston connector).
DRAWN BY: F. GOMEZ
DATE: 23-02-2021
SOMMERS Generator Systems
A3
Wiring diagram DGV*
600/347V 480/277V / 3P+N
EMS2 - 24V - SOMMERS v3.3
DRAWING: 1410 000 39118
VERSION: 00
SHEET: 2 / 2

Diesel Generator Set
Model DFAB 60 Hz

230 kW, 288 kVA Standby
210 kW, 263 kVA Prime

Description

The Cummins Power Generation DF-series commercial generator set is a fully integrated power generation system providing optimum performance, reliability, and versatility for stationary standby or prime power applications.

A primary feature of the DF GenSet is strong motor-starting capability and fast recovery from transient load changes. The torque-matched system includes a heavy-duty Cummins 4-cycle diesel engine, an AC alternator with high motor-starting kVA capacity, and an electronic voltage regulator with three-phase sensing for precise regulation under steady-state or transient loads. The DF GenSet accepts 100% of the nameplate standby rating in one step, in compliance with NFPA 110 requirements.

The standard PowerCommand® digital electronic control is an integrated system that combines engine and alternator controls for high reliability and optimum GenSet performance.

Optional weather-protective enclosures and coolant heaters shield the generator set from extreme operating conditions. Environmental concerns are addressed by low exhaust emission engines, sound-attenuated enclosures, exhaust silencers, and dual-wall fuel tanks. A wide range of options, accessories, and services are available, allowing configuration to your specific power generation needs.

Every production unit is factory tested at rated load and power factor. This testing includes demonstration of rated power and single-step rated load pickup. Cummins Power Generation manufacturing facilities are registered to ISO9001 quality standards, emphasizing our commitment to high quality in the design, manufacture, and support of our products. The generator set is CSA certified and is available as UL2200 Listed. The PowerCommand control is UL508 Listed.

All Cummins Power Generation systems are backed by a comprehensive warranty program and supported by a worldwide network of 170 distributors and service branches to assist with warranty, service, parts, and planned maintenance support.

Features

UL Listed Generator Set - The complete generator set assembly is available Listed to UL2200.

Cummins Heavy-Duty Engine - Rugged 4-cycle industrial diesel engine delivers reliable power, low emissions, and fast response to load changes.

Alternator - Several alternator sizes offer selectable motor-starting capability with low reactance 2/3 pitch windings, low waveform distortion with non-linear loads, fault-clearing short-circuit capability, and class H insulation. The alternator electrical insulation system is UL1446 Recognized.

Permanent Magnet Generator (PMG) - Offers enhanced motor starting and fault-clearing short circuit capability.

Control System - The PowerCommand electronic control is standard equipment and provides total genset system integration, including automatic remote starting/stopping, precise frequency and voltage regulation, alarm and status message display, AmpSentry™ protection, output metering, auto-shutdown at fault detection, and NFPA 110 compliance. PowerCommand control is Listed to UL508.

Cooling System - Provides reliable running at the rated power level, at up to 50°C ambient temperature.

Structural Steel Skid Base - Robust skid base supports the engine, alternator, and radiator.

E-Coat Finish - Dual electro-deposition paint system provides high resistance to scratching, corrosion, and fading.

Enclosures - Optional weather-protective and sound-attenuated enclosures are available.

Fuel Tanks - Dual wall sub-base fuel tanks are also offered.

Certifications - Generator sets are designed, manufactured, tested, and certified to relevant UL, NFPA, ISO, IEC, and CSA standards.

Warranty and Service - Backed by a comprehensive warranty and worldwide distributor network.

Generator Set

The general specifications provide representative configuration details. Consult the outline drawing for installation design.

Specifications – General

See outline drawing 500-3012 for installation design specifications.

Unit Width, in (mm)	50.0 (1270)
Unit Height, in (mm)	63.7 (1617)
Unit Length, in (mm)	134.0 (3404)
Unit Dry Weight, lb (kg)	5900 (2676)
Unit Wet Weight, lb (kg)	6090 (2762)
Rated Speed, rpm	1800
Voltage Regulation, No Load to Full Load	±0.5%
Random Voltage Variation	±0.5%
Frequency Regulation	Isochronous
Random Frequency Variation	±0.25%
Radio Frequency Interference	IEC 801.2, Level 4 Electrostatic Discharge IEC 801.3, Level 3 Radiated Susceptibility IEC 801.4, Level 4 Electrical Fast Transients IEC 801.5, Level 5 Voltage Surge Immunity MIL STD 461C, Part 9 Radiated Emissions (EMI)

Cooling	Standby	Prime
Fan Load, HP (kW)	11.4 (8.5)	11.4 (8.5)
Coolant Capacity with radiator, US Gal (L)	13.0 (49.2)	13.0 (49.2)
Coolant Flow Rate, Gal/min (L/min)	97.0 (367.1)	97.0 (367.1)
Heat Rejection To Coolant, Btu/min (MJ/min)	7600.0 (8.1)	6900.0 (7.3)
Heat Radiated To Room, Btu/min (MJ/min)	2950.0 (3.1)	2720.0 (2.9)
Maximum Coolant Friction Head, psi (kPa)	7.0 (48.3)	7.0 (48.3)
Maximum Coolant Static Head, ft (m)	60.0 (18.3)	60.0 (18.3)

Air		
Combustion Air, scfm (m^3/min)	610.0 (17.3)	560.0 (15.8)
Alternator Cooling Air, scfm (m^3/min)	1240.0 (35.1)	1240.0 (35.1)
Radiator Cooling Air, scfm (m^3/min)	13320.0 (377.0)	13320.0 (377.0)
Max. Static Restriction, in H_2O (Pa)	0.5 (124.5)	0.5 (124.5)

Rating Definitions

Standby Rating based on: Applicable for supplying emergency power for the duration of normal power interruption. No sustained overload capability is available for this rating. (Equivalent to Fuel Stop Power in accordance with ISO3046, AS2789, DIN6271 and BS5514). Nominally rated.
Prime (Unlimited Running Time) Rating based on: Applicable for supplying power in lieu of commercially purchased power. Prime power is the maximum power available at a variable load for an unlimited number of hours. A 10% overload capability is available for limited time. (Equivalent to Prime Power in accordance with ISO8528 and Overload Power in accordance with ISO3046, AS2789, DIN6271, and BS5514). This rating is not applicable to all generator set models.
Base Load (Continuous) Rating based on: Applicable for supplying power continuously to a constant load up to the full output rating for unlimited hours. No sustained overload capability is available for this rating. Consult authorized distributor for rating. (Equivalent to Continuous Power in accordance with ISO8528, ISO3046, AS2789, DIN6271, and BS5514). This rating is not applicable to all generator set models.

Site Derating Factors

Rated power available up to 7300 ft (2227 m) at ambient temperatures up to 104°F (40°C). Above 7300 ft (2227 m), derate at 4% per 1000 ft (305 m) and 1% per 10°F (2% per 11°C) above 104°F (40°C).

Engine

Cummins heavy duty diesel engines use advanced combustion technology for reliable and stable power, low emissions, and fast response to sudden load changes.

Electronic governing provides precise speed regulation, especially useful for applications requiring constant (isochronous) frequency regulation such as Uninterruptible Power Supply (UPS) systems, non-linear loads, or sensitive electronic loads. Optional coolant heaters are recommended for all emergency standby installations or for any application requiring fast load acceptance after start-up.

Specifications – Engine

Base Engine	Cummins Model LTA10-G1, Turbocharged and Aftercooled, diesel-fueled
Displacement in^3 (L)	610.0 (10.0)
Overspeed Limit, rpm	2100 ±50
Regenerative Power, kW	26.00
Cylinder Block Configuration	Cast iron with replaceable wet cylinder liners, In-line 6 cylinder
Battery Capacity	550 amps minimum at ambient temperature of 32°F (0°C)
Battery Charging Alternator	55-amps
Starting Voltage	24-volt, negative ground
Lube Oil Filter Types	Single spin-on, full flow/bypass
Standard Cooling System	122°F (50°C) ambient radiator

Power Output	**Standby**	**Prime**
Gross Engine Power Output, bhp (kWm)	380.0 (283.5)	345.0 (257.4)
BMEP at Rated Load, psi (kPa)	247.0 (1703.0)	226.0 (1558.2)
Bore, in. (mm)	4.92 (125.0)	4.92 (125.0)
Stroke, in. (mm)	5.35 (135.9)	5.35 (135.9)
Piston Speed, ft/min (m/s)	1605.0 (8.2)	1605.0 (8.2)
Compression Ratio	16.0:1	16.0:1
Lube Oil Capacity, qt. (L)	38.0 (36.0)	38.0 (36.0)
Fuel Flow		
Fuel Flow at Rated Load, US Gal/hr (L/hr)	64.0 (242.2)	64.0 (242.2)
Maximum Inlet Restriction, in. Hg (mm Hg)	4.0 (101.6)	4.0 (101.6)
Maximum Return Restriction, in. Hg (mm Hg)	6.5 (165.1)	6.5 (165.1)
Air Cleaner		
Maximum Air Cleaner Restriction, in. H_2O (kPa)	25.0 (6.2)	25.0 (6.2)
Exhaust		
Exhaust Flow at Rated Load, cfm (m^3/min)	1660.0 (47.0)	1500.0 (42.4)
Exhaust Temperature, °F (°C)	950.0 (510.0)	920.0 (493.3)
Max Back Pressure, in. H_2O (kPa)	41.0 (10.2)	41.0 (10.2)

Fuel System	Direct injection, number 2 diesel fuel; fuel filter; automatic electric fuel shutoff.

Fuel Consumption		**Standby**				**Prime**			
60 Hz Ratings, kW (kVA)		**230 (288)**				**210 (263)**			
	Load	1/4	1/2	3/4	Full	1/4	1/2	3/4	Full
	US Gal/hr	5.2	8.7	12.1	15.6	4.9	8.0	11.2	14.3
	L/hr	20	33	46	59	19	30	42	54

Alternator

Several alternators are available for application flexibility based on the required motor-starting kVA and other requirements. Larger alternator sizes have lower temperature rise for longer life of the alternator insulation system. In addition, larger alternator sizes can provide a cost-effective use of engine power in across-the-line motor-starting applications and can be used to minimize voltage waveform distortion caused by non-linear loads.

Single-bearing alternators couple directly to the engine flywheel with flexible discs for drivetrain reliability and durability. No gear reducers or speed changers are used. Two-thirds pitch windings eliminate third-order harmonic content of the AC voltage waveform and provide the standardization desired for paralleling of generator sets. The standard excitation system is a PMG excited system.

Alternator Application Notes

Separately Excited Permanent Magnet Generator (PMG) System - This standard system uses an integral PMG to supply power to the voltage regulator. A PMG system generally has better motor-starting performance, lower voltage dip upon load application, and better immunity from problems with harmonics in the main alternator output induced by non-linear loads. This system provides improved performance over self-excited regulators in applications that have large transient loads, sensitive electronic loads (especially UPS applications), harmonic content, or that require sustained short-circuit current (sustained 3-phase short circuit current at approximately 3 times rated for 10 seconds).

Alternator Sizes - On any given model, various alternator sizes are available to meet individual application needs. Alternator sizes are differentiated by maximum winding temperature rise, at the generator set standby or prime rating, when operated in a 40°C ambient environment. Available temperature rises range from 80°C to 150°C. Not all temperature rise selections are available on all models. Lower temperature rise is accomplished using larger alternators at lower current density. Lower temperature rise alternators have higher motor-starting kVA, lower voltage dip upon load application, and they are generally recommended to limit voltage distortion and heating due to harmonics induced by non-linear loads.

Alternator Space Heater - is recommended to inhibit condensation.

Available Output Voltages

Three Phase Reconnectable

[ ] 110/190

[ ] 115/200

[ ] 120/208

[ ] 127/220

[ ] 139/240

[ ] 120/240

[ ] 220/380

[ ] 240/416

[ ] 254/440

[ ] 277/480

Three Phase Non-Reconnectable

[ ] 277/480

[ ] 347/600

Specifications – Alternator

Design	Brushless, 4-pole, drip-proof revolving field
Stator	2/3 pitch
Rotor	Direct-coupled by flexible disc
Insulation System	Class H per NEMA MG1-1.65 and BS2757
Standard Temperature Rise	125°C standby
Exciter Type	Permanent Magnet Generator (PMG)
Phase Rotation	A (U), B (V), C (W)
Alternator Cooling	Direct-drive centrifugal blower
AC Waveform Total Harmonic Distortion	<5% total no load to full linear load <3% for any single harmonic
Telephone Influence Factor (TIF)	<50 per NEMA MG1-22.43.
Telephone Harmonic Factor (THF)	<3

Three Phase Table[1]		**80° C**	**80° C**	**105° C**	**105° C**	**125° C**	**125° C**	**125° C**					
Feature Code		B260	B302	B259	B301	B258	B246	B300					
Alternator Data Sheet Number		303	303	303	302	302	301	301					
Voltage Ranges		110/190 Thru 139/240 220/380 Thru 277/480	347/600	110/190 Thru 139/240 220/380 Thru 277/480	347/600	110/190 Thru 139/240 220/380 Thru 277/480	277/480	347/600					
Surge kW		256	259	256	258	254	256	256					
Motor Starting kVA (at 90% sustained voltage)	PMG	1210	1210	1210	1028	1028	904	904					

Full Load Current - Amps at Standby Rating	120/208	127/220	139/240	220/380	240/416	254/440	277/480	347/600
	798	754	691	437	399	377	346	277

Notes:
1. Single Phase Capability: Single phase power can be taken from a three phase generator set at up to 40% of the generator set nameplate kW rating at unity power factor.

Control System

PowerCommand Control with AmpSentry™ Protection

- The PowerCommand Control is an integrated generator set control system providing governing, voltage regulation, engine protection, and operator interface functions.
- PowerCommand Controls include integral AmpSentry protection. AmpSentry provides a full range of alternator protection functions that are matched to the alternator provided.
- Controls provided include Battery monitoring and testing features, and Smart-Starting control system.
- InPower PC-based service tool available for detailed diagnostics.
- Available with Echelon LonWorks™ network interface.
- NEMA 3R enclosure.
- Suitable for operation in ambient temperatures from -40C to +70C, and altitudes to 13,000 feet (5000 meters).
- Prototype tested; UL, CSA, and CE compliant.

AmpSentry AC Protection

- Overcurrent and short circuit shutdown
- Overcurrent warning
- Single & 3-phase fault regulation
- Over and under voltage shutdown
- Over and under frequency shutdown
- Overload warning with alarm contact
- Reverse power and reverse Var shutdown
- Excitation fault

Engine Protection

- Overspeed shutdown
- Low oil pressure warning and shutdown
- High coolant temperature warning and shutdown
- High oil temperature warning (optional)
- Low coolant level warning or shutdown
- Low coolant temperature warning
- High and low battery voltage warning
- Weak battery warning
- Dead battery shutdown
- Fail to start (overcrank) shutdown
- Fail to crank shutdown
- Redundant start disconnect
- Cranking lockout
- Sensor failure indication

Operator Interface

- OFF/MANUAL/AUTO mode switch
- MANUAL RUN/STOP switch
- Panel lamp test switch
- Emergency Stop switch
- Alpha-numeric display with pushbutton access, for viewing engine and alternator data and providing setup, controls, and adjustments
- LED lamps indicating genset running, not in auto, common warning, common shutdown
- (5) configurable LED lamps
- LED Bargraph AC data display (optional)

Alternator Data

- Line-to-line and line-to-neutral AC volts
- 3-phase AC current
- Frequency
- Total and individual phase kW and kVA

Engine Data

- DC voltage
- Lube oil pressure
- Coolant temperature
- Lube oil temperature (optional)

Other Data

- Genset model data
- Start attempts, starts, running hours
- KW hours (total and since reset)
- Fault history
- Load profile (hours less than 30% and hours more than 90% load)
- System data display (optional with network and other PowerCommand gensets or transfer switches

Governing

- Integrated digital electronic isochronous governor
- Temperature dynamic governing
- Smart idle speed mode
- Glow plug control (some models)

Voltage Regulation

- Integrated digital electronic voltage regulator
- 3-phase line to neutral sensing
- PMG (Optional)
- Single and three phase fault regulation
- Configurable torque matching

Control Functions

- Data logging on faults
- Fault simulation (requires InPower)
- Time delay start and cooldown
- Cycle cranking
- (4) Configurable customer inputs
- (4) Configurable customer outputs
- (8) Configurable network inputs and (16) outputs (with optional network)

Options

[ ] Power Transfer Control
[ ] Analog AC Meter Display
[ ] Thermostatically Controlled Space Heater
[ ] Key-type mode switch
[ ] Ground fault module
[ ] Engine oil temperature
[ ] Auxiliary Relays (3)
[ ] Echelon LonWorks interface
[ ] Digital input and output module(s) (loose)
[ ] Remote annunciator (loose)

Generator Set Options

Engine

- [ ] 208/240/480 V thermostatically controlled coolant heater for ambient above 40°F (4.5°C)
- [ ] 208/240/480 V thermostatically controlled coolant heater for ambient below 40°F (4.5°C)
- [ ] 120 V, 300 W lube oil heater
- [ ] 208/240 V, 300 W lube oil heater
- [ ] 480 V, 300 W lube oil heater
- [ ] Fuel/water separator
- [ ] Heavy duty air cleaner with safety element

Cooling System

- [ ] Heat exchanger cooling
- [ ] Remote radiator cooling

Fuel System

- [ ] 300 Gal (1136 L) Sub-base tank
- [ ] 400 Gal (1514 L) Sub-base tank
- [ ] 500 Gal (1893 L) Sub-base tank
- [ ] 600 Gal (2271 L) Sub-base tank
- [ ] 660 Gal (2498 L) Sub-base tank
- [ ] 720 Gal (2725 L) Sub-base tank
- [ ] 1470 Gal (5565 L) Sub-base tank

Alternator

- [ ] 80°C rise alternator
- [ ] 105°C rise alternator
- [ ] 120/240 V, 300 W anti-condensation heater

Exhaust System

- [ ] Critical grade exhaust silencer
- [ ] Industrial grade exhaust silencer
- [ ] Residential grade exhaust silencer

Generator Set

- [ ] AC entrance box
- [ ] Batteries
- [ ] Battery charger, equalizer, float type
- [ ] Export box packaging
- [ ] Ground fault alarm
- [ ] UL2200 Listed
- [ ] Main line circuit breaker
- [ ] Narrow profile skid base
- [ ] PowerCommand (3100) Digital Parallel Control
- [ ] Remote annunciator panel
- [ ] Sound-attenuated enclosure (2 levels) with internal silencers
- [ ] Spring isolators
- [ ] Weather-protective enclosure with internal silencer
- [ ] 2 year prime power warranty
- [ ] 2 year standby warranty
- [ ] 5 year basic power warranty
- [ ] 5 year comprehensive power warranty
- [ ] 10 year major components warranty

Available Products and Services

A wide range of products and services is available to match your power generation system requirements. Cummins Power Generation products and services include:

Diesel and Spark-Ignited Generator Sets

Transfer Switches

Bypass Switches

Parallel Load Transfer Equipment

Digital Paralleling Switchgear

PowerCommand Network and Software

Distributor Application Support

Planned Maintenance Agreements

Warranty

All components and subsystems are covered by an express limited one-year warranty. Other optional and extended factory warranties and local distributor maintenance agreements are available. Contact your distributor/dealer for more information.

Certifications

ISO9001 - This generator set was designed and manufactured in facilities certified to ISO9001.

CSA - This generator set is CSA certified to product class 4215-01.

PTS - The Prototype Test Support (PTS) program verifies the performance integrity of the generator set design. Products bearing the PTS symbol have been subjected to demanding tests in accordance to NFPA 110 to verify the design integrity and performance under both normal and abnormal operating conditions including short circuit, endurance, temperature rise, torsional vibration, and transient response, including full load pickup.

UL - The generator set is available Listed to UL2200, Stationary Engine Generator Assemblies. The PowerCommand control is Listed to UL508 - Category NITW7 for U.S. and Canadian usage.

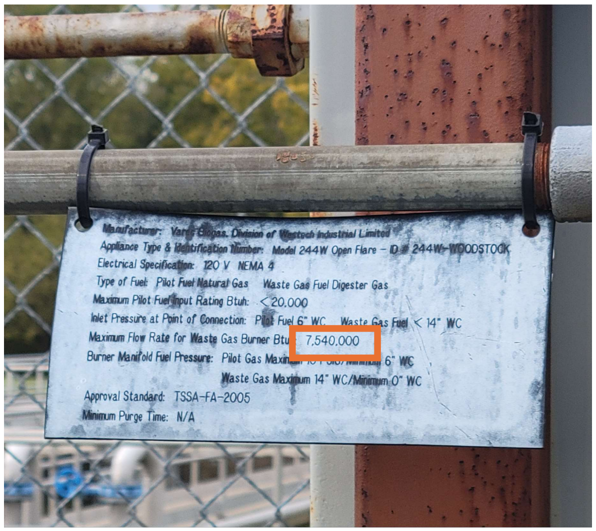
See your distributor for more information

Cummins Power Generation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
763.574.5000
Fax: 763.574.5298
www.cumminspower.com

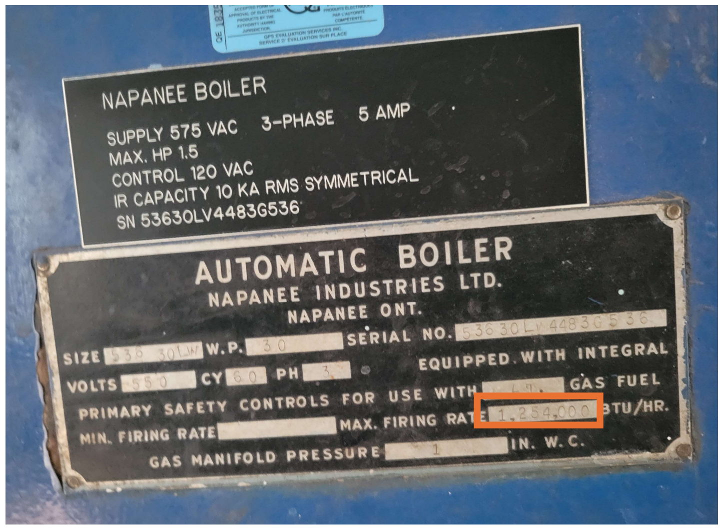
Important: Backfeed to a utility system can cause electrocution and/or property damage. Do not connect generator sets to any building electrical system except through an approved device or after building main switch is open.

Woodstock WWTP

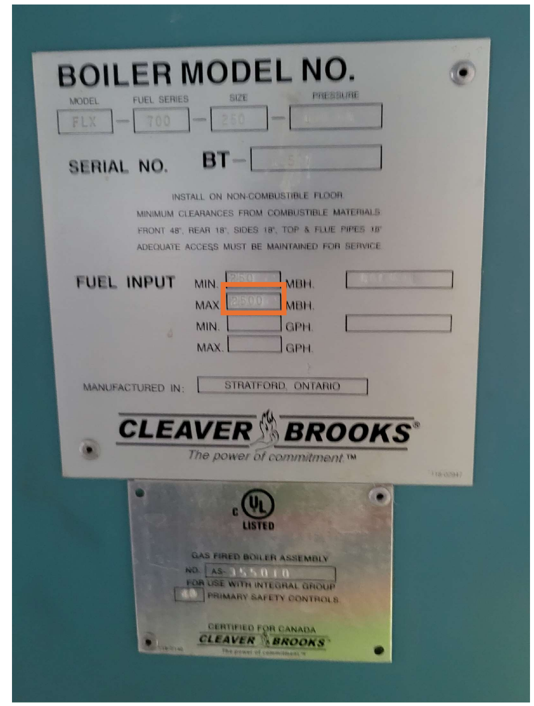
Waste Gas Burner (WG_BN)

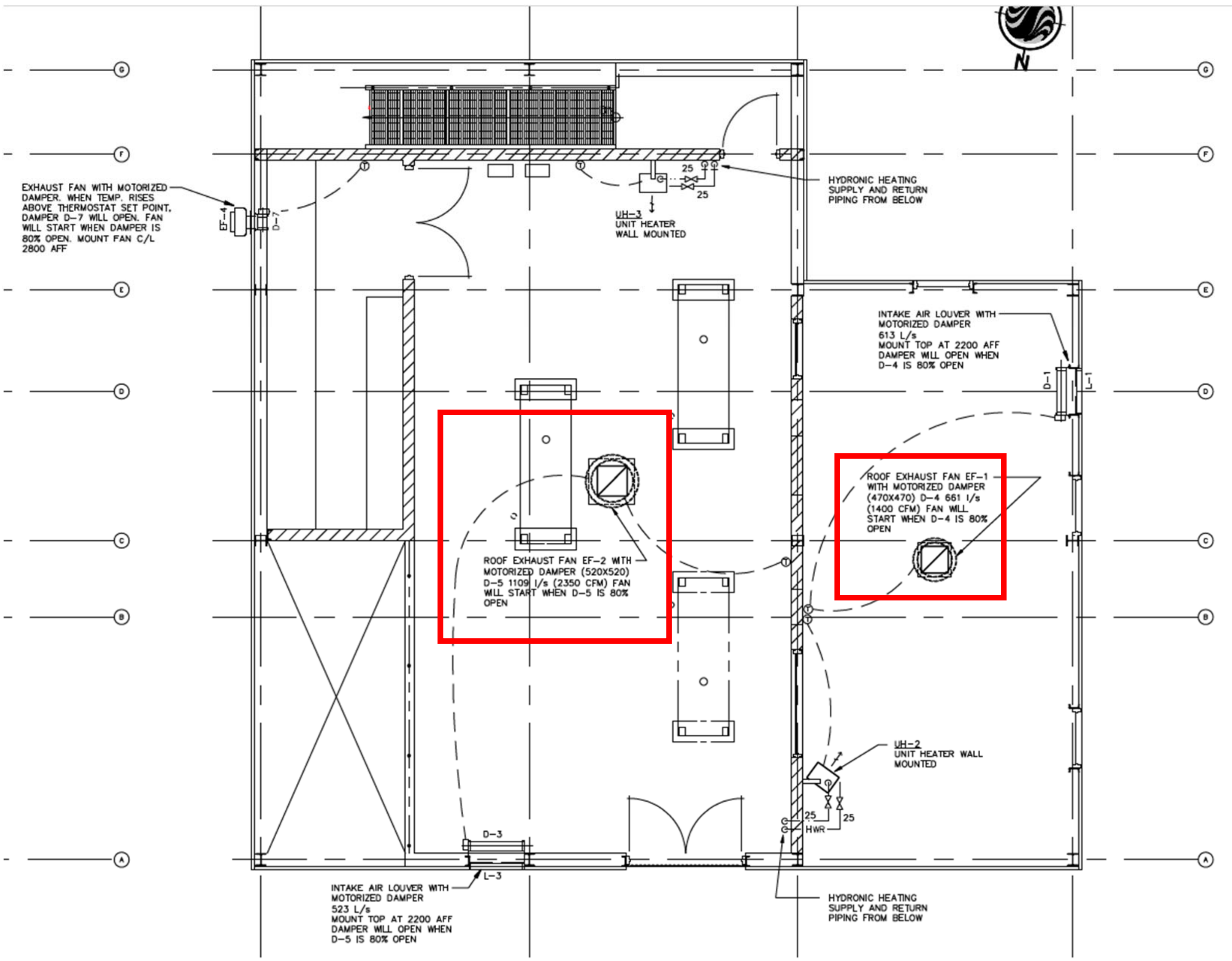


Boiler (B_1)



Boiler (B_2)





EXHAUST FAN SCHEDULE

MARK	DESCRIPTION	MANUFACTURER	MODEL No	L/s (CFM)	S.P. Pa (In. H²O)	FRPM	MOTOR kW (HP)	ELECTRICAL V/PH/HZ	FLA (AMPS)	REMARK
EF-1	ROOF EXHAUST FAN	GREENHECK	GB-161-4	660 (1400)	62 (.25)	663	.186 (¼)	115/1/60	5.8	
EF-2	ROOF EXHAUST FAN	GREENHECK	GB-200-4	1109 (2350)	62 (.25)	561	.186 (¼)	115/1/60	5.8	
EF-3	SIDEWALL EXHAUST FAN	GREENHECK	CWB-161-3	1109 (2350)	62 (.25)	926	.248 (⅓)	115/1/60	7.2	
EF-4	SIDEWALL EXHAUST FAN	GREENHECK	CW-060-D	75 (158)	37 (.15)	1550	.0124(1/60)	115/1/60		

APPENDIX C: CONTAMINANTS SCREENED OUT USING EMISSION THRESHOLDS

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Appendix C: Contaminants Screened Out Using Emission Thresholds

Contaminant Name	CAS Registry Number	Averaging Period (hours)	Total Facility Emission Rate (g/s)	Distance to Property Line (m)	ACB	Criterion (50% of ACB or de minimus) (μg/m^3)	Limiting Effect	1-hr Dispersion factor for shortest distance to property line (μg/m^3 per g/s)	Dispersion factor for averaging time (μg/m^3 per g/s)	Predicted Concentration (μg/m^3)	Ratio of C/Criterion	Contaminant Negligible?
Nitrogen oxides	10102-44-0	24-hour	1.10E+00	>20	200	100	Health	10,000	4.11E+03	4,502	45.0	No
Nitrogen oxides	10102-44-0	1-hour	1.10E+00	>20	400	200	Health	10,000	1.00E+04	10,960	54.8	No
Nitrogen oxides	10102-44-0	½-hour	1.10E+00	>20	1,880	940	Health	10,000	1.21E+04	13,308	14.2	No
Carbon monoxide	630-08-0	½-hour	5.53E-01	>20	6,000	3,000	Health	10,000	1.21E+04	6,715	2.2	No
Sulphur dioxide	7446-09-5	1-hour	5.11E-03	>20	100	50	Health & Vegetation	10,000	1.00E+04	51	1.0	No
Sulphur dioxide	7446-09-5	Annual	5.11E-03	>20	10	5	Health & Vegetation	10,000	7.87E+02	4	0.8	Yes
Ammonia	7664-41-7	24-hour	8.85E-03	>20	100	50	Health	10,000	4.11E+03	36	0.7	Yes
Odour	N/A-1	10-minute	1.11E+03 OU/s	>20	1 OU/m3	0.5 OU/m3	Odour	10,000	1.65E+04	18 OU/m3	36.6	No
Suspended particulate matter (< 44 μm diameter)	N/A-2	24-hour	7.74E-02	>20	120	60	Visibility	10,000	4.11E+03	318	5.3	No
Total reduced sulphur	N/A-3	24-hour	6.59E-05	>20	7	3.5	Health & Odour	10,000	4.11E+03	0.27	0.077	Yes
Total reduced sulphur	N/A-3	10-minute	6.59E-05	>20	13	6.5	Health & Odour	10,000	1.65E+04	1.09	0.2	Yes
Decamethyltetrasiloxane	141-62-8	24-hour	7.65E-08	>20	1	0.3	Health	10,000	4.11E+03	3.14E-04	0.0	Yes

APPENDIX D: SOURCE TESTING REPORT

Source Testing Report

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

Submitted to: J.L. Richards & Associates Ltd.
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Prepared by: Welburn Consulting Ltd.
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Email: colin@welburnconsulting.ca
Telephone: 613-852-6003

Date: 19 July 2024

Welburn Project: Y23.C0004.S0084.REA

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1 Introduction

1.1 Summary of Test Program

The Woodstock Wastewater Treatment Plant (WWTP, or the Facility) is located at 195 Admiral Street, Woodstock, Ontario and is owned and operated by the County of Oxford (the County). The Facility currently operates under an ECA (Sewage) (Reference Number 5950-7XQKXS) issued on 18 December 2009. The NAICS code for the Facility is 221320 – sewage treatment facilities.

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 Renewable Energy Approval (REA). J.L. Richards & Associates Ltd. engaged Welburn Consulting Ltd. (Welburn) to prepare an Emission Summary and Dispersion Modelling (ESDM) Report in support of the REA Application.

To determine emission rates of key odorous contaminants, Welburn, in partnership with Envirosolve, conducted source testing of key sources. The target contaminants were odour, total reduced sulphur (TRS) and ammonia. The source testing was conducted from 29 November to 01 December 2023.

This report presents the methodology and raw results of the source testing program and the calculated emission flux for each sampled source. The emission rate calculations and dispersion modelling are presented in the Facility's ESDM Report.

1.2 Description of Facility and Processes

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 will use biogas generated by the Facility's anaerobic digesters.

The Facility operates 24 hours per day, 7 days per week. It is located in an industrial and commercial 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 single family dwellings located on Oxford Street, approximately 200m from the Facility.

The WWTP receives raw wastewater with the influent capacities summarized in Table 1Table 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.

The WWTP receives wastewater by way of three gravity sewage lines. Two of the lines feed directly into the grit tank (Source GT). A sewage pumping station located at the southern edge of the site pumps wastewater from the third line to the grit tank via a forcemain pipe. Septage and leachate are also delivered by truck and deposited directly into the grit tank (Source GT). Wastewater passes through a screening and grit removal process before flowing to the two (2) banks of rectangular primary clarifiers

(Sources PC_E and PC_W). Secondary treatment occurs through a bank of four (4) adjacent rectangular aeration tanks (collectively, Source AT_N) and two (2) three-pass folded Gould secondary clarifiers (collectively, Source SC_N). 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) and two (2) secondary clarifiers (collectively, Source SC_S). Tertiary treatment occurs in the disinfection and dechlorination tanks. Treated effluent is then discharged to Thames River. Solids are removed from the process, with the sludge being pumped from the primary and secondary clarifiers to a two-stage anaerobic digester system consisting of two primary and two secondary digesters. Secondary waste activated sludge is returned to the primary clarifiers. Digested sludge is dewatered via centrifuge in the dewatering building, which is served by two exhaust fans: Source EF_1 serving the sludge loading bay, and Source EF_2 serving the centrifuge room. Dewatered cake is hauled off-site for land application.

Biogas from the digesters will be routed to the CHP as a source of 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 m^3/h of process water by 20°C (i.e. from 70°C to 90°C).

The Facility is heated by two hot water boilers located in the boiler building. Boiler 1 (B_1) is a dual-fired boiler capable of running on digester gas and natural gas. Boiler 2 (Source B_2) is natural gas fueled. A waste gas burner (Source WG_BN) is located between the primary clarifiers and the aeration tanks to burn off excess biogas that is not consumed by the CHP or Boiler 1.

A 546 kW diesel-fired emergency generator (Source GEN_1) provides backup power to the electrical substation. A second 284 kW diesel-fueled emergency generator (Source GEN_2) provides backup power for the lift station.

The control building houses a laboratory with two fume hoods for the analysis of wastewater samples. Emissions from the fume hoods are exhausted to the roof (Sources EF_3 and EF_4).

1.3 Objectives and Test Matrix

The objective of the source testing program was to determine the emission rates of odour, TRS and ammonia from key sources of odour at the Facility.

The sampling and laboratory analysis methods followed methods prescribed in the Ontario Source Testing Code (OSTC) and are presented in Table 2.

Table 2: Sampling and Analysis Methods

Contaminant / Parameter	Sampling Method	Sampling Media	Analysis Method	Laboratory
Air Flow, Moisture & Temperature	N/A – Flux Chamber	N/A	N/A	N/A
Odour	OSTC method 6	Tedlar Bag	OSTC Odour Panel	St. Croix Sensory, Inc.
TRS	EPA TO-15	Evacuated Canister	EPA TO-15 (Gas Chromatography)	ALS Canada Ltd.
Ammonia	Modified EPA CTM-027	Wet Impinger	EPA CTM-027 (Ion Chromatography)	ALS Canada Ltd.

2 Sources and Sampling Locations

2.1 Odour Survey and Identification of Target Processes

A summary of processes at the Facility, along with the associated plant and emissions sources, is provided in Table 3.

Table 3: Source Summary

Process	Equipment / Emissions Source	Source ID
Wastewater Receiving	Grit Tank	GT
Primary Clarifiers	Primary Clarifier - East	PC_E
	Primary Clarifier - West	PC_W
Aeration Tanks	Aeration Tanks	AT
Secondary Clarifiers	Secondary Clarifier Tanks	SC
Dewatering	Sludge Loading Bay Exhaust	EF_1
	Centrifuge Room Exhaust	EF_2
Laboratory	Fume Hood Exhausts	EF_3
		EF_4
Process Heat	Combined Heat and Power Unit	CHP
	Boiler 1 (dual-fired)	B_1
	Boiler 2 (natural gas fired)	B_2
Waste Gas Burner	Waste Gas Burner	WG_BN
Emergency Power (electrical substation)	Generator 1 (Sommers)	GEN_1
Emergency Power (lift station)	Generator 2 (Cummins)	GEN_2

Of the processes listed in Table 3 above, the odorous processes are wastewater receiving, aeration, clarifiers, and dewatering operations.

The selection of target sources and sampling locations was based on a site odour survey completed on October 19, 2023. During the odour survey, a TSI Q-Trak XP handheld monitor was used to measure instantaneous in-space concentrations of hydrogen sulphide (H_2S) and ammonia near odorous sources. The results of the Q-Trak measurements from the odour survey are presented in Table 4. The calibration record for the Q-Trak is provided in Appendix A.

Table 4: Q-Trak Measurement Results from Odour Survey

Process	Measurement Location	Ammonia Concentration (ppm)	H_2S Concentration (ppm)
Wastewater Receiving	Grit tank exit channel	0.19	0.25
Primary Clarifiers	Primary clarifier east inlet channel	0.02	0.05
Aeration Tanks	Aeration tank inlet channel	0.025	0.05
Secondary Clarifiers	Not detected on Q-Trak during visit	N/A	N/A
Dewatering Building	Sludge collection skip in loading bay	0.76	0.032
	Centrifuge room	0.48	0.002

The primary clarifiers, aeration tank and dewatering building were identified as target processes. Although higher concentrations of ammonia and H_2S were measured at the grit tank exit channel, it was determined that measurements at the inlet to the primary clarifiers would be more representative of overall odour emissions at the site, owing to the larger area of the primary clarifiers.

The emissions from the grit tank exit channel and the secondary clarifiers will be estimated in the ESDM Report using relative emission rate relationships determined from the literature.

2.2 Sampling Locations and Approach

For each of the target processes, it was determined most practicable to sample via flux chamber on the surface. This approach allows the determination of the emission rate by surface area, e.g. in g/s per m^2 (i.e., emission flux). For the primary clarifiers and aeration tanks, emission fluxes were directly input into the AERMOD dispersion file inputs.

The emission flux determined for the dewatered sludge was used to calculate the emissions emanating from the sludge skip, which was then used to calculate the emissions exhausted through the loading bay vent (Source EF_1). Emissions for the exhaust (Source EF_2) serving the adjacent centrifuge room were determined based on a combination of the dewatered sludge sampling results and concentrations measured with the Q-Trak during the odour survey.

Details on the sampling locations and sampling characteristics are presented in Table 5.

Table 5: Sampling Locations and Sampling Characteristics

Source ID	Source Surface Area (m^2)	Sampling Location	Sample IDs	Surface Characteristics	Number of Samples per Source	Equilibration Time (min)	Nitrogen Injection Rate (L/min)	Flux Chamber Area (m^2)
PC_E	442	SW corner of PC_E	PC1, PC2	Quiescent water	2	10	5.0	0.13
AT	2,351	SW corner of aeration tank bay	AT1, AT2	Aerated water	2			
EF_1	5.6	Skip containing dewatered sludge	DWS1, DWS2	Warm dewatered sludge	2			

3 Sampling and Analytical Procedures

3.1 Floating Flux Chamber Sampling

A schematic representing the flux chamber sampling method is presented in Figure 1.

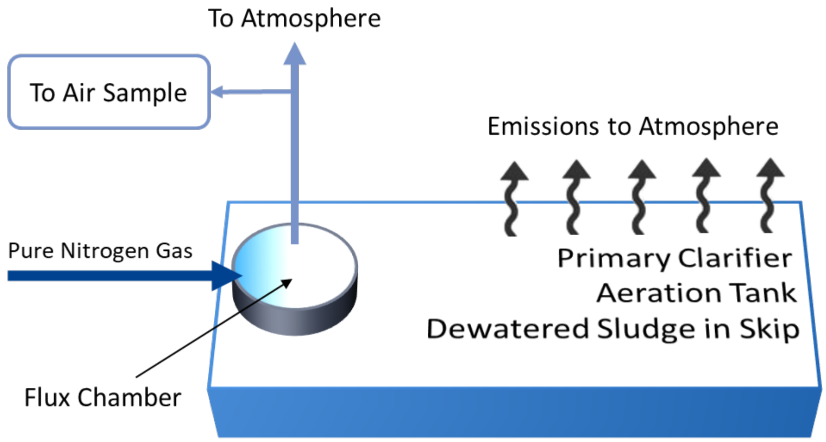

Figure 1: Schematic of Dynamic Flux Chamber Sampling

A dome-shaped flux chamber, with a foam tube attached to provide buoyancy, is used when taking samples of contaminants from area sources such as the aeration tank and primary clarifiers. The flux chamber is placed on the soil surface or on top of the water surface, covering the area of interest. The flux chamber is configured to operate as a “dynamic flux chamber”. In a dynamic flux chamber, the headspace of the flux chamber is continuously fed fresh nitrogen at a metered rate. Contaminants that are emitted from the surface into the headspace mix with the fresh nitrogen, reaching a steady state concentration. The chamber is equipped with outlet ports through which air samples can be collected. The emission of contaminants in the headspace air are then calculated from a mass balance of gas entering the headspace and gas exiting the headspace, as follows:.

$$Q_{N_2}X_{cont_{in}} + ER_{cont_{FC}} = Q_{N_2}X_{cont_{out}}$$

$$ER_{cont_{FC}} = Q_{N_2}(X_{cont_{out}} - X_{cont_{in}})$$

Where:

Q_{N_2}	= Injection rate of nitrogen (5 L/min or 8.33E-05 m^3/s). It is assumed that the flow rate of air out of the flux chamber is equal to the nitrogen injection rate.
$X_{cont_{in}}$	= Concentration of contaminant in injection gas (assumed to be 0 OU/m^3 or 0 µg/m^3)
$ER_{cont_{FC}}$	= Emission rate of contaminant from flux chamber, in g/s or OU/s
$X_{cont_{out}}$	= Concentration of contaminant in air leaving flux chamber, in OU/m^3 or µg/m^3
$ER_{cont_{FC}}$	= Emission rate of contaminant from flux chamber, in g/s or OU/s

3.2 Odour

Sampling and analysis for odour followed the methods outlined in Method ON-6, as part of the Ontario Source Testing Code (OSTC - June 2010). Prior to sampling for odour, the optimum pre-dilution ratio was calculated based on methods outlined in Method ON-6 of the OSTC using the measured moisture content of the exhaust air. It was determined that all samples could be collected neat (i.e. no pre-dilution required).

Collected odour samples were shipped overnight to St. Croix Sensory Inc. for odour panel analysis the next day. St. Croix Sensory Inc. completed the analysis of the odour sample bags within 24 hours of sample collection.

All odour bag samples were evaluated in accordance with the OSTC using an AC'SCENT International triangular forced-choice, ascending concentration, dynamic dilution Olfactometer. A panel of eight (8) trained assessors was employed in the evaluation of the odour samples. Each panel is screened for accuracy and repeatability following the procedures outlined in British Standard, BS EN 13725:2003, "Air quality – Determination of odour concentration by dynamic olfactometry," utilizing 50 ppm n-butanol calibration gas prior to sample evaluation. The samples were analysed for detection and recognition.

3.3 Total Reduced Sulphur (TRS)

Sampling and analysis procedures for TRS followed the methods outlined in EPA TO-15. Grab samples of air from the flux chamber air were collected via evacuated cannisters. Air is drawn into the evacuated cannister through a critical flow orifice, which limits the flow rate of air. The critical flow orifices used for this project were set to collect air for a period of approximately 14 minutes.

The canisters used to collect reduced sulphur samples were analyzed by ALS Canada Ltd. (ALS) in its Kitchener, Ontario laboratory, following ASTM D5504. The air from the canisters was collected into cleaned evacuated silica-coated canisters. By means of a loop system, a volume of air was transferred from the canister and cryofocused before determining the sulphur compounds by gas chromatography with a sulphur chemiluminescence detector (GC-SCD).

This method analyses for four reduced sulphur species: dimethyl disulfide, dimethyl sulfide, H_2S, and methyl mercaptan, as well as TRS. The method detection limit for TRS is 11 µg/m³, although method detection limits for individual sulphur species are lower. While the four individual species are included on the Air Contaminants Benchmark (ACB) List established by the Ministry of the Environment, Conservation and Parks (MECP), the ACB limit for TRS is less than or equal to the limit for each individual reduced sulphur species. Therefore, for the purpose of dispersion modelling assessments, TRS is considered to represent all sulphur species, since compliance for TRS signifies compliance for the individual species.

3.4 Ammonia

Sampling and analysis procedures for ammonia followed the methods outlined in EPA CTM-027. Following this method, the ammonia exhaust samples were drawn through four chilled aqueous impingers, each containing 100 mL of 0.1N sulphuric acid solution. The ammonia was converted to ammonium ion in the impinger solution. The samples were recovered on-site by rinsing the impingers with deionized water. The recovered samples were sent to ALS' Burlington, Ontario laboratory. Aliquots of the recovered samples were analyzed in the laboratory using ion chromatography with a conductivity detector.

4 Results

4.1 Conditions During Testing

The Facility was operating normally throughout the sampling campaign. Table 6 indicated the dates, times, and ambient conditions during the sampling campaign.

Table 6: Dates, Times, and Ambient Conditions during Sampling

Date	Time of Sampling	Ambient Temperatures (°C)	Atmospheric Pressure (kPa)
29 Nov. 2023	10:30 to 17:20	-6.8 to -1	98.48 to 97.69
30 Nov. 2023	11:00 to 13:10	-2.9 to 8.6	97.98 to 97.59
1 Dec. 2023	08:00 to 13:10	1.4 to 7.6	98.26 to 97.90

4.2 Laboratory Analysis Results

Tabulated raw data of ammonia, odour, and TRS from the laboratory reports are presented in Table 7. Raw field data and calibration records are presented in Appendix A. Detailed laboratory results including chain of custody records are presented in Appendix B.

Table 7. Raw Data from Laboratory Analysis Reports

Sample ID	Odour Concentration (OU/m³)	TRS Concentration (µg/m³)	Ammonia Mass (mg)
PC1	390	<11*	0.054
PC2	461	<11*	0.074
AT1	127	<11*	0.190
AT2	107	<11*	0.046
DWS1	838	<11*	2.740
DWS2	996	<11*	1.880

* The detection limit for TRS is 11 µg/m³.

As indicated in the certificate of analysis, concentrations of hydrogen sulphide (H_2S) were above the detection limit for Sample AT2, and dimethyl disulfide (DMDS) was detected in both PC1 and PC2. However, TRS concentrations were below the detection limit for all samples. To be conservative, concentrations reported as below detection limits were considered to be equal to the detection limit value.

5 Emission Flux Calculations

For each target contaminant, two samples were collected at each location. For each location, the contaminant concentration was averaged to facilitate the calculation of emission flux.

To determine the emission rate out of the flux chamber for each contaminant at each sample location, the average concentration in the flux chamber was multiplied by the nitrogen injection flow rate.

Subsequently, the emission flux was calculated by dividing the sampled emission rate by the area of surface covered by the flux chamber.

The concentration of TRS and odour in the samples are reported directly from the laboratory. For ammonia, the laboratory analysis reports mass of ammonia collected, rather than the sample concentration. To determine the concentration of ammonia in the sample, the mass of ammonia collected is divided by the volume of air drawn through the impingers, which is measured with a dry gas meter.

5.1 Odour

For each sampling location, the average concentration of odour, in Odour Units (OU), was calculated from the two odour concentrations reported by St. Croix Sensory. The average odour concentration was calculated using the geometric mean formula, as follows:

$$C_{avg} = (C_{x1} \times C_{x2})^{\frac{1}{2}}$$

Where:

C_{avg} = Geometric Mean Concentration of Odour (OU/m^3)

C_{x1} = Concentration of First Odour Sample reported at location *x* (OU/m^3)

C_{x2} = Concentration of Second Odour Sample reported at location *x* (OU/m^3)

The emission flux of odour is then calculated as follows:

$$FR_{odour} = C_{avg} \times Q_{N_2} \div A_{chamber}$$

Where:

FR_{odour} = Emission flux of odour ($OU/s/m^2$) from the surface

C_{avg} = Geometric Mean Concentration of Contaminant (OU/m^3)

Q_{N_2} = Nitrogen Injection Flow Rate (m^3/s)

$A_{chamber}$ = Flux Chamber Area (m^2)

The following is a sample calculation of the emission flux of odour at the aeration tanks:

$$C_{avg} = (127\ OU/m^3\ \times 107\ OU/m^3)^{\frac{1}{2}}$$

$$C_{avg} = 116.6\ OU/m^3$$

$$FR_{odour} = 116.6 \frac{OU}{m^3} \times 8.33\ E - 5 \frac{m^3}{s} \div 0.13 m^2$$

$$FR_{odour} = 7.50E - 2\ g/s/m^2$$

The calculated emission fluxes for odour are presented in Table 8Table 8.

Table 8. Emission Flux of Odour

Sampling Location	Average Concentration (OU/m³)	Nitrogen Injection Flow Rate (m³/s)	Flux Chamber Area (m²)	Emission Flux (OU/s/m²)
Primary Clarifier	424.0	8.33E-05	0.13	2.73E-01
Aeration Tank	116.6	8.33E-05	0.13	7.50E-02
Dewatered Sludge	913.6	8.33E-05	0.13	5.87E-01

5.2 Total Reduced Sulphur (TRS)

For each sampling location, the TRS concentrations reported by ALS were averaged using an arithmetic mean formula, as follows:

$$C_{avg} = \frac{C_{x1} + C_{x2}}{2}$$

Where:

C_{avg} = Arithmetic Mean Concentration of TRS (µg/m³)

C_{x1} = Concentration of First TRS Sample Measured at location *x* (µg/m³)

C_{x2} = Concentration of Second TRS Sample Measured at location *x* (µg/m³)

The emission flux of TRS was then calculated as follows:

$$FR_{TRS} = C_{Avg} \times Q_{N_2} \div A_{chamber}$$

Where:

FR_{TRS} = Emission Flux of TRS (µg/s/m²) from the surface

C_{avg} = Arithmetic Mean Concentration of TRS (µg/m³)

Q_{N_2} = Nitrogen Injection Flow Rate (m³/s)

$A_{chamber}$ = Flux Chamber Area (m²)

The following is a sample calculation of the emission flux of TRS at the aeration tanks:

$$C_{Avg} = \frac{< 11 + < 11}{2}$$

$$C_{Avg} = < 11\ \mu g/m^3$$

$$FR_{TRS} = < 11 \frac{\mu g}{m^3} \times 8.33\ E - 5\ \frac{m^3}{s} \div 0.13 m^2 \times \frac{g}{10^6 \mu g}$$

$$FR_{TRS} = < 7.07E - 9\ g/s/m^2$$

The calculated emission fluxes for TRS are presented in Table 9.

Table 9. Emission Flux of TRS Compounds

Location	Average Concentration (µg/m³)	Nitrogen Injection Flow Rate (m³/s)	Flux Chamber Area (m²)	Emission Flux (g/s/m²)
Primary Clarifier	<11	8.33E-05	0.13	<7.07E-09
Aeration Tank	<11	8.33E-05	0.13	<7.07E-09
Dewatered Sludge	<11	8.33E-05	0.13	<7.07E-09

5.3 Ammonia

For each ammonia sample, the concentration was calculated by dividing ammonia mass reported by ALS by the sampled volume, as follows:

$$C_{x1} = m_{x1} \div V_{x1}$$

Where:

C_{x1} = Concentration of First Ammonia Sample at location *x* (µg/m³)

m_{x1} = Measured Weight of First Ammonia Sample at location *x* (mg)

V_{x1} = Volume of First Ammonia Sample at location *x* (m³)

At each sampling location, the ammonia concentrations were then averaged using an arithmetic mean formula, as follows:

$$C_{avg} = \frac{C_{x1} + C_{x2}}{2}$$

Where:

C_{avg} = Arithmetic Mean Concentration of Ammonia (µg/m³)

C_{x1} = Concentration of First Ammonia Sample Measured at location *x* (µg/m³)

C_{x2} = Concentration of Second Ammonia Sample Measured at location *x* (µg/m³)

The emission flux of ammonia was then calculated as follows:

$$FR_{Ammonia} = C_{Avg} \times Q_{N_2} \div A_{chamber}$$

Where:

$FR_{Ammonia}$ = Emission Flux of Ammonia (µg/s/m²) from the surface

C_{avg} = Arithmetic Mean Concentration of Ammonia (µg/m³)

Q_{N_2} = Nitrogen Injection Flow Rate (m³/s)

$A_{chamber}$ = Flux Chamber Area (m²)

The following is a sample calculation of the ammonia concentrations for both samples collected at the aeration tanks:

$$C_{AT1} = 0.190\,mg \div 120.19m^3 \times \frac{1000\mu g}{mg}$$

$$C_{AT1} = 1.58E + 03\frac{\mu g}{m^3}$$

$$C_{AT2} = 0.046\,mg \div 121.23m^3 \times \frac{1000\mu g}{mg}$$

$$C_{AT2} = 3.82E + 02\frac{\mu g}{m^3}$$

The average concentration of ammonia at Aeration Tank is calculated as follows:

$$C_{Avg} = \frac{1.58E + 03 + 3.82E + 02}{2}$$

$$C_{Avg} = 9.81E + 02\,\mu g/m^3$$

The calculated average concentration for ammonia at each sampling location is presented in Table 10.

Table 10. Average Concentration of Ammonia at Each Sampling Location

Sample ID	Mass of Sample (mg)	Volume Sampled (L)	Concentration in Flux Chamber (µg/m³)	Average Concentration in Flux Chamber (µg/m³)
PC1	0.054	120.92	4.49E+02	5.31E+02
PC2	0.074	121.19	6.13E+02	
AT1	0.190	120.19	1.58E+03	9.81E+02
AT2	0.046	121.23	3.82E+02	
DWS1	2.740	122.78	2.23E+04	1.89E+04
DWS2	1.880	121.45	1.55E+04	

The emission flux of ammonia at the Aeration Tank is then calculated as follows:

$$FR_{Ammonia} = 9.81E + 02\,\frac{\mu g}{m^3} \times 8.33\,E - 05\,\frac{m^3}{s} \div 0.13m^2 \times \frac{g}{10^6\mu g}$$

$$FR_{Ammonia} = 6.31\,E - 07\,g/s/m^2$$

The calculated emission fluxes for ammonia are presented in Table 11.

Table 11. Emission Fluxes of Ammonia

Location	Average Concentration (µg/m³)	Nitrogen Injection Flow Rate (m³/s)	Flux Chamber Area (m²)	Emission Flux (g/s/m²)
Primary Clarifier	5.31E+02	8.33E-05	0.13	3.41E-07
Aeration Tank	9.81E+02	8.33E-05	0.13	6.31E-07
Dewatered Sludge	1.89E+04	8.33E-05	0.13	1.22E-05

6 Quality Assurance / Quality Control Activities

The Quality Assurance / Quality Control (QA/QC) program for this source testing program included:

- Sampling equipment calibration, where applicable;
- Sample collection and analysis procedures;
- Field activity documentation; and
- Data validation and reporting.

The following procedures were followed in the performance of this source testing program.

6.1 Pre-Test Activities

Prior to sampling, standard operating procedures and equipment checklists were created with reference to the testing campaign objectives and the Facility's health and safety protocols.

Sampling was scheduled in coordination with Facility staff to ensure that operations were running normally during the sampling period. Regular communications were maintained with staff to confirm that the facility was operating normally over the course of the test.

6.2 Sample Collection, Handling, and Custody

Odour testing was scheduled to ensure samples could be shipped in time to arrive at the laboratory the following morning. St. Croix Sensory Inc. completed the analysis of the sample bags within 24 hours of the sampling.

Chain of custody forms were completed, double-checked, and photographed on site prior to shipment with the samples.

6.3 Data Validation and Reporting

The accurate transfer of raw data, and the accuracy of calculations performed based on collected data have been validated by the following methods:

- Data values were compared for accuracy between raw field data sheets and electronic spreadsheets.
- Field data and test results were compared with anticipated temperatures, velocities, moisture contents, gas compositions, volumetric flow rates, contaminant concentrations and mass emission rates. Raw field data sheets are presented in Appendix A.

7 Conclusions

To determine emission rates of odorous contaminants, Welburn, in partnership with Envirosolve, conducted source testing of key sources at the Woodstock WWTP. The sources tested were the aeration tanks, primary clarifiers, and dewatered sludge stored in the bin located in the sludge loading area.

The target contaminants were odour, TRS and ammonia. The source testing was conducted from 29 November to 01 December 2023.

This report presented the methodology and raw results of the source testing program including the calculated emission fluxes for the target sources. Emission fluxes for each parameter were calculated based on the laboratory analysis results and sampling parameters recorded during the sampling campaign.

The emission rate calculations and dispersion modelling are presented in the Facility’s Emission Summary and Dispersion Modelling Report.

8 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.

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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.

Colin Welburn, M.Eng., P.Eng.
President
Welburn Consulting Ltd.
(613) 852-6003

APPENDIX A: CALIBRATION RECORDS AND FIELD DATA

CERTIFICATE OF CALIBRATION

The Instrument listed below has been inspected and calibrated following the Manufacturer's specifications and methods.

Instrument Model: **TSI Q-Trak XP** *Serial Number:* **75802230017/14302230007** *Calibration Date:* **October 18, 2023**

SENSOR	CALIBRATION GAS STANDARD	CALIBRATION GAS CONCENTRATION	READING PRIOR TO ADJUSTMENT	INSTRUMENT SPAN SETTINGS	Data Logging
	Zero Air Standard Lot# 23-9928				Not Specified
H2S	Hydrogen Sulfide Lot# 23-9790	25 PPM	24.65 PPM	25 PPM	
NH3	Ammonia Lot# 23-9774-100NH3	100 PPM	76 PPM	100 PPM	

The calibration gas standard used is considered to be a certified standard and is traceable to the National Institute of Standards and Technology (NIST). Certificate of Analysis is available upon request.

The instrument indicated above is now certified to be operating within the Manufacturer's specifications. This does not eliminate the requirement for regular maintenance and pre-use sensor response checks in order to ensure continued complete and accurate operating condition.

Certified By: Jeff Loney

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Welburn Consulting

Silica Coated Passivated Canisters Field Data Page

Date:	Nov 29 2024
Client:	WWWTP
Project No.:	E23025
Plant:	195 Admiral St.
Plant Location:	Woodstock ON

Test Method:	TO
Test No.:	1-2 TRS
Test Location:	Aeration Tanks / Primary / Dewater
Test Condition:	Normal

☒ *Teflon Probe* ☐ *SS Probe*
☐ *Glass Probe*

Volumetric Flow Rate Determination For Test Train: From Other Test Train NA
☐ *From Pre-Lim Data*
☐ *Engineering Calc's*

Test I.D.: 1 (AER-1) Aeration Tanks

Canister SN:	00946-0363	Test Start Time:	10:32	Initial Canister Pressure:	29"
Canister I.D.:	orifice 6149	Test Finish Time:	10:56	Final Canister Pressure:	8"

Test I.D.: 2 (AER-2) Aerations Tanks

Canister SN:	00946-0173	Test Start Time:	11:00	Initial Canister Pressure:	29"
Canister I.D.:	orifice 6113	Test Finish Time:	11:24	Final Canister Pressure:	7"

Test I.D.: 1 (PRI-1) Primary Clarifier

Canister SN:	00946-0089	Test Start Time:	13:06	Initial Canister Pressure:	30"
Canister I.D.:	orifice 6363	Test Finish Time:	13:30	Final Canister Pressure:	7"

Test I.D.: 2 (PRI-2) Primary Clarifier

Canister SN:	00946-0068	Test Start Time:	13:33	Initial Canister Pressure:	28"
Canister I.D.:	orifice 6329	Test Finish Time:	14:00	Final Canister Pressure:	7"

Test I.D.: 1 (DWS-1) Dewatering Sludge

Canister SN:	00946-0242	Test Start Time:	15:33	Initial Canister Pressure:	28"
Canister I.D.:	orifice 6256	Test Finish Time:	15:59	Final Canister Pressure:	8"

Test I.D.: 2 (DWS-2) Dewatering Sludge

Canister SN:	00946-0368	Test Start Time:	15:54	Initial Canister Pressure:	29"
Canister I.D.:	orifice 6312	Test Finish Time:	16:20	Final Canister Pressure:	8"

DWS spare (T3 DWS-3) 16:22 - 16:56 30"
canister 00946-0223 615 8"

Welburn Consulting
Odour Sampling Data

Date: November 29 2024	Plant: 195 Admiral St	Test No.: 1-2 Odours
Client: WWWTP	Plant Location: Woodstock, ON	Test Location: Aeration Tanks/Primary/Dewater
Project No.: E23025	Test Method: OSTC Method ON-6	Test Condition: Normal

Odour Diluter I.D.:	NA
Eductor Temperature:	

Atmospheric Temperature:	
Source Dew Point Temperature:	NA

Time	N2 Pressure	Sample Pressure	Dilution Ratio	Sample I.D.	Comments
11:~~30~~-11:40	—	—	—	AER-1	purge 11:25-11:30 Neat Sample
11:45-11:55	—	—	—	AER-2	purge 11:40-11:45 Neat Sample

Date: November 29 2024	Plant: 195 Admiral St	Test No.: 1-2 Odours
Client: WWWTP	Plant Location: Woodstock ON	Test Location: Primary Clarifier
Project No.:	Test Method: OSTC Method ON-6	Test Condition: Normal

Odour Diluter I.D.:	NA
Eductor Temperature:	

Atmospheric Temperature:	
Source Dew Point Temperature:	NA

Time	N2 Pressure	Sample Pressure	Dilution Ratio	Sample I.D.	Comments
14:05-14:15	—	—	—	PRI-1	purge 14:02-14:05 Neat Sample
14:20-14:20	—	—	—	PRI-2	purge 14:15-14:20 Neat Sample

Date: November 29 2024	Plant: 195 Admiral St	Test No.: 1-2 Odours
Client: WWWTP	Plant Location: Woodstock ON	Test Location: Dewatered Sludge
Project No.:	Test Method: OSTC Method ON-6	Test Condition: Normal

Odour Diluter I.D.:	NA
Eductor Temperature:	

Atmospheric Temperature:	
Source Dew Point Temperature:	NA

Time	N2 Pressure	Sample Pressure	Dilution Ratio	Sample I.D.	Comments
16:55-17:05	—	—	—	DWS-1	purge 16:50-16:55 Neat Sample
17:10-17:20	—	—	—	DWS-2	purge 17:05-17:10 Neat Sample

[signature]

Operator Signature

Welburn Consulting
Midget Impinger Field Data Sheet

Date: November 30 2023	Plant: 195 Admiral St.	Test No.: 1 Ammonia
Client: WWWTP	Plant Location: Woodstock, ON	Test Location: Dewatered Sludge
Project No.: E23025	Test Method: EPA Modified 26	Test Condition: Normal

Initial Leak Check: <0.02 LPM @ 5 in. Hg *leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower*

Test Start Time: 11:00

Sampling Time (min.)	Dry Gas Meter Volume (L)	Probe Temp. (°C)	Stack Temp. (°C)	Oven Temp. (°C)	Impinger Outlet Temp. (°C)	DGM Inlet Temp. (°C)	DGM Outlet Temp. (°C)	Meter Pressure ΔH (in. H_2O)	Pump Gauge Vacuum (in. Hg)	Actual Flow Rate (LPM)
0	0.00	NA	NA	NA	15	18	18	2.4	Ø	~2
20	40.63	↓	↓	↓	12	19	19	2.4	Ø	
40	81.13				11	21	19	2.4	Ø	
60	122.78				11	22	20	2.4	Ø	

Test Finish Time: 12:00

Final Leak Check: <0.02 LPM @ 5 in. Hg *leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower*

Comments:

M Price
Operator Signature

Welburn Consulting
Midget Impinger Field Data Sheet

Date: November 30 2023	Plant: 195 Admiral St.	Test No.: 2 Ammonia
Client: WWWTP	Plant Location: Woodstock ON	Test Location: Dewatered Sludge
Project No.: E23025	Test Method: EPA Modified 26	Test Condition: Normal

Initial Leak Check: <0.02 LPM @ 5 in. Hg *leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower

Test Start Time: 12:10

Sampling Time (min.)	Dry Gas Meter Volume (L)	Probe Temp. (°C)	Stack Temp. (°C)	Oven Temp. (°C)	Impinger Outlet Temp. (°C)	DGM Inlet Temp. (°C)	DGM Outlet Temp. (°C)	Meter Pressure ΔH (in. H_2O)	Pump Gauge Vacuum (in. Hg)	Actual Flow Rate (LPM)
0	0.00	NA	NA	NA		22	20	2.4	0	~2
20	40.25	↓	↓	↓		22	21	2.4	0	
40	80.36					23	22	2.4	0	
60	121.45					23	22	2.4	0	

Test Finish Time: 13:10

Final Leak Check: <0.02 LPM @ 5 in. Hg *leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower

Comments:

[signature]
Operator Signature

Welburn Consulting
Midget Impinger Field Data Sheet

Date: December 1 2023	Plant: 195 Admiral St	Test No.: 1 Ammonia
Client: WWWTP	Plant Location: Woodstock ON	Test Location: Aeration
Project No.: E23025	Test Method: EPA Modified 26	Test Condition: Normal

Initial Leak Check: <0.02 **LPM @** 5 **in. Hg** **leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower*

Test Start Time: 08:00

Sampling Time (min.)	Dry Gas Meter Volume (L)	Probe Temp. (°C)	Stack Temp. (°C)	Oven Temp. (°C)	Impinger Outlet Temp. (°C)	DGM Inlet Temp. (°C)	DGM Outlet Temp. (°C)	Meter Pressure ΔH (in. H_2O)	Pump Gauge Vacuum (in. Hg)	Actual Flow Rate (LPM)
0	0.00	NA	NA	NA	6	5	5	2.5	Ø	~2
20	39.67	↓	↓	↓	5	6	6	2.5	Ø	
40	79.77	↓	↓	↓	5	8	7	2.5	Ø	
60	120.19	↓	↓	↓	5	9	8	2.5	Ø	

Test Finish Time: 09:00

Final Leak Check: <0.02 **LPM @** 7 **in. Hg** **leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower*

Comments:

[signature]
Operator Signature

Welburn Consulting
Midget Impinger Field Data Sheet

Date: December 1 2023	Plant: 145 Admiral St	Test No.: 2 Ammonia
Client: WWWTP	Plant Location: Woodstock ON	Test Location: Aeration
Project No.: E23025	Test Method: EPA Modified 26	Test Condition: Normal

Initial Leak Check: <0.02 LPM @ 5 in. Hg *leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower*

Test Start Time: 09:10

Sampling Time (min.)	Dry Gas Meter Volume (L)	Probe Temp. (°C)	Stack Temp. (°C)	Oven Temp. (°C)	Impinger Outlet Temp. (°C)	DGM Inlet Temp. (°C)	DGM Outlet Temp. (°C)	Meter Pressure ΔH (in. H_2O)	Pump Gauge Vacuum (in. Hg)	Actual Flow Rate (LPM)
0	0.00	NA	NA	NA	7	9	8	2.5	0	<2
20	40.13	↓	↓	↓	6	9	9	2.5	0	
40	80.28				5	9	9	2.5	0	
60	121.23				5	9	9	2.5	0	

Test Finish Time: 10:10

Final Leak Check: <0.02 LPM @ 6 in. Hg *leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower*

Comments:

[signature]

Operator Signature

Welburn Consulting
Midget Impinger Field Data Sheet

Date: December 1 2023	Plant: 195 Admiral St	Test No.: 1 Ammonia
Client: WWWTP	Plant Location: Woodstock ON	Test Location: Primary
Project No.: E 73025	Test Method: EPA Modified 26	Test Condition: Normal

Initial Leak Check: <0.02 **LPM @** 5 **in. Hg** **leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower*

Test Start Time: 11:00

Sampling Time (min.)	Dry Gas Meter Volume (L)	Probe Temp. (°C)	Stack Temp. (°C)	Oven Temp. (°C)	Impinger Outlet Temp. (°C)	DGM Inlet Temp. (°C)	DGM Outlet Temp. (°C)	Meter Pressure ΔH (in. H_2O)	Pump Gauge Vacuum (in. Hg)	Actual Flow Rate (LPM)
0	0.00	NA	NA	NA	5	6	6	2.5	0	~2
20	40.03	↓	↓	↓	5	7	7	2.5	0	
40	79.67	↓	↓	↓	6	8	7	2.5	0	
60	120.92	↓	↓	↓	6	9	8	2.5	0	

Test Finish Time: 12:00

Final Leak Check: <0.02 **LPM @** 5 **in. Hg** **leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower*

Comments:

M Pearce
Operator Signature

Welburn Consulting
Midget Impinger Field Data Sheet

Date: December 1 2023	Plant: 195 Admiral St	Test No.: 2 Ammonia
Client: WWWTP	Plant Location: Woodstock ON	Test Location: Primary
Project No.: E23025	Test Method: EPA Modified 26	Test Condition: Normal

Initial Leak Check: <0.02 LPM @ 6 in. Hg *leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower

Test Start Time: 12:10

Sampling Time (min.)	Dry Gas Meter Volume (L)	Probe Temp. (°C)	Stack Temp. (°C)	Oven Temp. (°C)	Impinger Outlet Temp. (°C)	DGM Inlet Temp. (°C)	DGM Outlet Temp. (°C)	Meter Pressure ΔH (in. H_2O)	Pump Gauge Vacuum (in. Hg)	Actual Flow Rate (LPM)
0	0.00	NA	NA	NA	4	9	8	2.5	0	~2
20	40.69	↓	↓	↓	4	9	9	2.5	0	
40	80.92	↓	↓	↓	5	10	9	2.5	0	
60	121.19	↓	↓	↓	5	10	9	2.5	0	

Test Finish Time: 13:10

Final Leak Check: <0.02 LPM @ 5 in. Hg *leak check should be < 0.04 LPM or 2% of sampling rate, which ever is lower

Comments:

M Price
Operator Signature

Woodstock Waste Water Treatment Plant
Ammonia
Reference Volumes Sampled

Test ID	DGMCF	Barometric Pressure (in. Hg)	Initial DGM Vol (L)	Final DGM Vol (L)	Actual Sample Volume (L)	Ave. DH (in. H_2O)	Ave. DGM Temp (°C)	Dry Ref Vol (L)	Dry Ref Vol (Rm^3)
DWS Test 1	0.993	29.65	0.00	122.78	122.78	2.4	20	123.82	0.124
DWS Test 2	0.993	29.58	0.00	121.45	121.45	2.4	22	121.21	0.121
AER Test 1	0.993	29.87	0.00	120.19	120.19	2.5	7	127.70	0.128
AER Test 2	0.993	29.79	0.00	121.23	121.23	2.5	9	127.49	0.127
Pri Test 1	0.993	29.69	0.00	120.92	120.92	2.5	7	127.48	0.127
Pri Test 2	0.993	29.64	0.00	121.19	121.19	2.5	9	126.70	0.127

Reference Conditions: 77°F, 29.92 in. Hg - 25°C, 101.3 kPa

APPENDIX B: LABORATORY ANALYSIS RESULTS

St. Croix Sensory, Inc.

Odour Evaluation Report

Report Number: C2333401

Project Name: Woodstock WWTP

Samples Collected: 11/29/23

Samples Received: 11/30/23

Samples Evaluated: 11/30/23

Report Prepared For: **Welburn Consulting**
143 Sunnyside Avenue
Ottawa, ON K1S 0R2
Canada

Report Prepared By: **St. Croix Sensory Canada, Inc.**
1005 Skyview Drive, Suite 175
Burlington, ON L7P 5B1 Canada
905-580-3330
tvallarino@fivesenses.com

Data Release Authorization:

Thomas Vallarino, A.Sc.T.
Laboratory Director

Reviewed and Approved:

Michael A. McGinley, P.E.
President

Odour Evaluation Report

St. Croix Sensory, Inc.

Client: **Welburn Consulting**
Project Name: **Woodstock WWTP**
Report Number: **C2333401**
Samples Evaluated: **11/30/23**

#	Field No.	Sample Description	DT	RT	I	HT	DR	Comments
1	Blank	Blank	32	19	---	---	---	
2	AER 1	Aeration Tank	127	75	---	---	---	
3	AER 2	Aeratio Tank	107	64	---	---	---	
4	PRIM-1	Primary Clarifier	390	278	---	---	---	
5	PRIM-2	Primary Clarifier	461	301	---	---	---	
6	Sludge 1	Sludge 1	838	647	---	---	---	
7	Sludge 2	Sludge 2	996	649	---	---	---	
	Comment:	Field Pre-Dilutions Not Available.						

Odour Detection Threshold Testing (Evaluations) conducted in compliance with and under all conditions specified or required by ASTM E679 and EN13725 unless noted in report "Comments" column. The Client Chain of Custody (COC) attached to the Odour Evaluation Report provides information that may include sampling location(s), methods, and/or environmental conditions during sampling. Client, designated agents, and/or reviewers provide interpretation of results based on sampling conditions.

DT - Detection Threshold as determined by ASTM E679 and EN13725. The Practical Detection Limit (PDL) of DT is 12, based on the nominal lowest dilution presentation ratio of 8. Result is dimensionless dilution ratio at which half the assessors detect the diluted air as different from the blank air. Odour Units (OU) or Odour Units per cubic meters (OU/m3) are commonly used as pseudo-units.

RT - Recognition Threshold as determined by ASTM E679 and EN13725. Result is dimensionless dilution ratio at which half the assessors recognize a character in the diluted odourous air. Odour Units (OU) or Odour Units per cubic meter (OU/m3) are commonly used pseudo-units.

I - Perceived odour intensity as determined by ASTM E544. Intensity is expressed as average reported scale value on 10pt n-butanol in water static scale.

HT – Hedonic Tone value. Average rating of assessors' opinion of odour pleasantness on scale of -10 (most unpleasant) to +10 (most pleasant).

DR – the slope of the dose-response relationship of odour intensity with dilution (persistency of odour).

Attachments

St. Croix Sensory — Chain of Custody - Canada

St. Croix Sensory • 1005 Skyview Drive, Suite 175, Burlington, ON L7P 5B1 • Tel: +1 905-580-3330 • Email: tvallarino@fivesenses.com

Client:	Welburn Consulting Ltd.	Contact Name:	Colin Welburn
Project/Site Name:	Woodstock WWTP	Cell Number:	613-852-6003
Collected By:	Colin Welburn	Email:	colin@welburnconsulting.ca
Sample Date:	2023-11-29	Project PO:	PO-0001
Comments:			

Page 1 of ____

Scan for Odour Sampling Resources

Odour Evaluation Requests
(please check all that apply for each sample)

Lab Use Only

Evaluation Report No. C2333401

Line No.	Field No.	Sample Description	Sample Time	Field H_2S (ppm)	Thresholds (Detection & Recognition ASTM E679 & EN13725)	Intensity (ASTM E544)	Characterization (Hedonic Tone & Descriptors)	Persistency (Dose Response)	Predilution (10:1 (If DT>60,000))	LAB	CODE
1	AER 1	AERATION TANK	1130 - 1140	0.05ppm							
2	AER 2	AERATION TANK	1145 - 1155	0.05ppm							
3	PRIM-1	PRIMARY CLARIFIER	1405 - 1415	0.25 ppm							
4	PRIM-2	PRIMARY CLARIFIER	1420 - 1430	0.25 ppm							
5	SLUDGE1	SLUDGE-1	1655 1705	0.03 ppm H_2S 0.76 ppm NH_3							
6	SLUDGE.2	SLUDGE-2	1710 1720	0.03 ppm H_2S 0.76 ppm NH_3							
7											
8											
9											
10											
11											
12											

Number of Boxes Shipped: ________

Carrier (check): Purolator ___ | FedEx ___ | UPS ___

DHL ___ | Other: Drop off to St. Croix

Relinquished by	Date	Time

Received at Lab by	Date	Time	Comments & Exceptions Noted
T. Vallarino	Nov30	8:00 AM	Just Thresholds as per email & phone conversation

Prior to shipping, email a photo of this document to tvallarino@fivesenses.com

LAB COPIES WHITE & YELLOW **CLIENT COPY PINK**

GD6001C - 23272v2.0

St. Croix Sensory, Inc.

Supplemental QA/QC Laboratory Report

Report Number: **C2333401**

Project Name: **Woodstock WWTP**

Report Prepared For: **Welburn Consulting Ltd.**
143 Sunnyside Avenue
Ottawa, Ontario
K1S 0R2

Report Prepared By: **St. Croix Sensory Canada, Inc.**
1005 Skyview Drive, Suite 175
Burlington, Ontario
L7P 5B1
Tel: 905-580-3330
tvallarino@fivesenses.com

Data Release Authorization:	Reviewed and Approved:
Thomas Vallarino A.Sc.T.	Michael A. McGinley, P.E.
Laboratory Director	Laboratory Director

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1. Sample Reception Summary

St. Croix Sensory Canada Inc. was retained to evaluate odour from air samples collected as part of a project for Welburn Consulting Ltd. In total, seven (7) gas samples bags were received at the laboratory for evaluation of odour. An odour panel was scheduled for the evaluation of the samples on November 30, 2023, and details of the panel are as follows:

Date Samples Received:	November 30, 2023
Number of Samples:	Seven (7)
Condition of Sample Bags:	No leaks or visible condensation
Additional Comments:	None.
Session 1	November 30, 2023, 9:00 AM
Number of Panelists:	Eight (8)
Number of Samples Analyzed:	Four (4) + n-butanol
Measurement Parameters:	Detection & Recognition Threshold (EN13725), One Round

2. Methodology

The samples were evaluated by an odour panel within 24 hours of sample collection to determine the detection threshold (odour concentration) of each sample following the principles described in the European Standard EN13725:2003, *Determination of odour concentration by dynamic olfactometry*, and methods described by ASTM E679-19, "*Standard Practice for Determination of Odor and Taste Thresholds by Forced-Choice Ascending Concentrations Series Method of Limits".* The odour evaluation process involved obtaining the responses of pre-screened, independent panelists to the sample presented to them at various dilutions.

Olfactometry Lab – The evaluations all took place in St. Croix Sensory's odour laboratory facility in Burlington, Ontario, which includes a panelist staging room and specialized room designed to provide an odour-free environment for the odour assessment panelists to facilitate accurate and reliable measurements.

Olfactometer – An olfactometer is a device or system for presenting accurate dilutions of a sample to a panel of people, incorporating a means to record the responses of these "assessors" or "panelists". The olfactometer used in this odour sample evaluation was the commercial AC'SCENT® International triangular forced-choice, ascending concentration, dynamic dilution olfactometer. The olfactometer flow system is constructed of Teflon® tubing with Teflon® fittings, and the "sniff port" (olfactometer/nose interface) have been custom designed and manufactured to provide a uniform face velocity and allow the panelist to easily sniff from the port without the sample being diluted by ambient air.

A custom DataSense software program controls most aspects of the operation of the olfactometer. The olfactometer operator monitors the responses of the panelists, and controls the pace of the evaluation session, to ensure that panelists remain focused and do not become desensitized, and to monitor potential problems such as contamination of the olfactometer by high strength odour samples.

The air supply for the olfactometer is provided by a built-in compressor system and is filtered through stages of high capacity activated carbon filtration. At the beginning of the day, the panel operator checks the odour from this system to ensure that it is odourless.

Panelists (Odour Assessors) – Panelists are the "sensors" in an olfactometry system. The maintenance of a pool of screened, trained, and motivated panelists is essential to obtaining reliable odour threshold data. The panelists employed by St. Croix Sensory Canada Inc., have been drawn from the community near the laboratory, and have been selected based on a demonstration of a "normal" sense of smell, as shown by their responses to test odorants, in particular n-butanol, the reference odorant in the European Standard. St. Croix maintains a pool of screened trained panelists.

The panelists are required to adhere to the following code of behaviours:

- Each panelist must carry out his/her job conscientiously;

- Panelists must not cause interference with their own perception of that or others in the odour laboratory by lack of personal hygiene, or the use of perfumes, after-shaves, lotions or any other cosmetics;
- Panelists must not eat, chew gum, or drink (other than water) within 30 minutes of the start of an evaluation session, and;
- The panelist must not communicate with one another in the odour laboratory about their responses to odour presentations.

The panelist, when participating in odour evaluation sessions, must also follow certain other specific guidelines related to the actual test procedure.

Olfactometry Protocol – The AC'SCENT® olfactometer operates as a triangular "forced choice" mode, with an ascending presentation sequence (low concentration to high concentration). "Forced choice" means that the panelists are required to identify and choose which triangular setting contains the odour even if they cannot detect a difference between the triangular set points. The panelists then indicate whether their choice was a "guess", "detect", or "recognize". An ascending presentation sequence, i.e. from the most dilute (weakest) presentation to progressively stronger presentations, minimizes the possibility for "adaptation" or "olfactometry fatigue", by which exposure to odours causes a reduction in sensitivity.

Sessions were limited to 2 hours in length to ensure panelists remain alert and motivated, with consecutive session using the same panelists limited to only three (3) per day in order to ensure attentiveness.

At each presentation on the olfactometer the panelists were given 3 seconds to evaluate the air from the triangular setting and make their responses. The odorant concentration was increased by a factor of 2 or less at each presentation step.

Odour calculations were generally based on determination of individual threshold estimate for each panelist based on their "detection" responses in accordance with the guidance in EN 17325:2003. Using this approach, all panelists must detect the odour at or above 8X dilution (olfactometer minimum dilution limit) in order to calculate an individual odour threshold value, and then a value for the group. All responses, as the standard allows, were retrospectively screened and panelists whose individual threshold value differed by greater or lower than ± 5.0 ΔZ were eliminated from test results. The purpose of the retrospectively screening was to allow for exclusion of panelists that showed responses different from the group due to health factors, anosmia to the odour the sample analyzed, or general olfactometry fatigue.

3. Results

Table 1 shown below is a list of the panelists who participated in the odour panels for this sample report. Table 2 lists the sample evaluation time for each odour sample presented on the olfactometer, and Appendix - A provides the raw odour panel responses from each odour sample evaluated. Retrospective screening was not required to be completed for any odour samples in this odour panel.

Table 1 – List of Panelists Participating in Odour Panel(s)

Session 1		
Panelist Code		
14853-1931		
3009		
14853-719		
3006		
14853-3001		
14853-1231		
14853-1927		
14853-1928		

Table 2 – Sample Evaluation Times

Session 1	Time
Lab Calibration	9:00
BLANK	9:18
AER1	9:33
AER2	9:53
PRIM-1	10:11
PRIM-2	10:28
Sludge 1	10:47
Sludge 2	11:03

4. Quality Assurance and Control

To ensure quality odour measurements, St. Croix Sensory routinely performs laboratory calibration quality checks on the olfactometer system, including volumetric flow rate calibration checks of the mass flow controllers, screening of panelists with reference materials, as well as other routine maintenance of components in the laboratory. Specific quality assurance and control activities undertaken at the laboratory are described in the following headings below:

- The AC'SCENT® olfactometer was calibrated according to the manufacturer's guidelines.
- The Teflon® tubing through which the odorous sample is presented to the panelists was replaced prior to the odour evaluation session, and all sample delivery lines were purged continuously with odour free air between sample presentations.

4.1 Reference Material Testing

Primary grade standards of n-butanol (currently a concentration of 40.0 ppm, cylinder number: EA0018597 from Linde and historical concentration of 50.0 ppm, cylinder number: CC351818 from Praxair) have been used as reference materials to perform regular screening of panelists for their individual detection thresholds for n-butanol, and for assessing the response of the complete analysis system. Table 3 shows the most recent reference material screening results for the panelists used in this odour assessment. As stated in the European Standard EN13725:2003, each panelists' standard deviation value (calculated from the log values of the series of individual detection thresholds) must be equal to or less than 0.36 (antilog value of 2.3), and the panelists' individual threshold estimate value for the reference material must be between 20 and 80 parts per billion over the average values obtained.

In addition to the historical n-butanol data on individual panelists St. Croix Sensory uses a standard of n-butanol for every scheduled odour panel day, so that the response of the complete olfactometry system (hardware, software and panelists) is verified on the day of analysis. A calibration sample was a Tedlar bag filled with the 40.0 ppm n-butanol primary standard gas mixture. Evaluation of this sample, and calculation in the same way as other samples on November 30, 2023, resulted in a value of 706 OU/m^3, which calculates to a group threshold level of 57 ppb for n-butanol.

4.2 Olfactometer Instrumentation Flow Measurement

All components of the olfactometer flow delivery are checked for accuracy and precision on a recurring schedule. In Table 4, shown below, are the most recent flow measurements of the olfactometer on November 20, 2023. The volumetric flow of both the sample delivery and total flow of the olfactometer was measured using a BIOS Defenders 510 DryCal instruments, which are frictionless piston technology true primary flow air calibrators, designed for industrial hygiene and scientific purposes. Measurements from the volumetric flow check determined all flow delivery equipment of the olfactometer was met the 13725:2003 criteria.

5. References

CEN – Committee for European Normalization (2003) *Air Quality – Determination of odour concentration by dynamic olfactometry*; EN13725:2003; Brussels, Belgium.

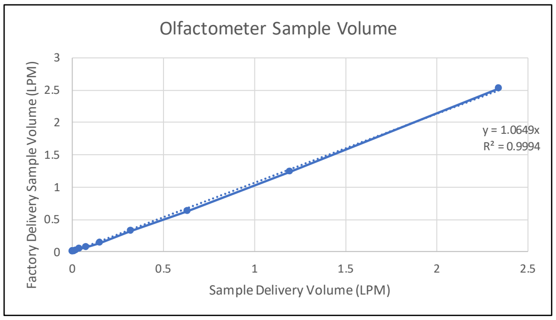
Table 3 – Panelist Screening Results

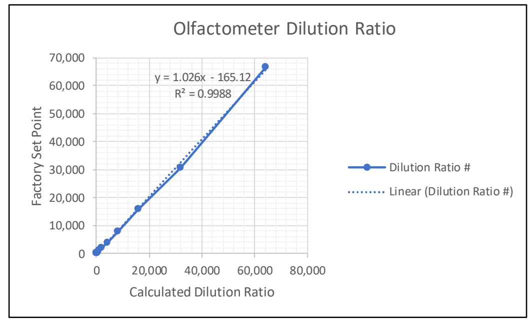
Panelist ID	*Reference Material: n-butanol*													
14853-1931	15-Sep-23	15-Sep-23	21-Sep-23	28-Sep-23	4-Oct-23	5-Oct-23	27-Oct-23	23-Nov-23	23-Nov-23	30-Nov-23			Actual	Actual
	y_{28}	y_{29}	y_{30}	y_{31}	y_{32}	y_{33}	y_{34}	y_{35}	y_{36}	y_{37}	Avg log_{10}	Std Dev	$10^{(Avg. ITE)}$	$10^{(Std Dev)}$
	708	708	708	708	708	708	708	708	708	182				
	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	219.8				
	1.7521	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**2.3421**	**1.8111**	**0.1866**	**64.7**	**1.5**
3009	12-Oct-23	12-Oct-23	20-Oct-23	20-Oct-23	25-Oct-23	27-Oct-23	22-Nov-23	23-Nov-23	23-Nov-23	30-Nov-23			Actual	Actual
	y_{14}	y_{15}	y_{16}	y_{17}	y_{18}	y_{19}	y_{20}	y_{21}	y_{22}	y_{23}	Avg log_{10}	Std Dev	$10^{(Avg. ITE)}$	$10^{(Std Dev)}$
	708	708	708	1413	708	708	708	708	708	708				
	56.5	56.5	56.5	28.3	56.5	56.5	56.5	56.5	56.5	56.5				
	1.7521	**1.7521**	**1.7521**	**1.4521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7221**	**0.0949**	**52.7**	**1.2**
14853-719	28-Sep-23	29-Sep-23	2-Oct-23	3-Oct-23	4-Oct-23	20-Oct-23	25-Oct-23	23-Nov-23	23-Nov-23	30-Nov-23			Actual	Actual
	y_{43}	y_{44}	y_{45}	y_{46}	y_{47}	y_{48}	y_{49}	y_{50}	y_{51}	y_{52}	Avg log_{10}	Std Dev	$10^{(Avg. ITE)}$	$10^{(Std Dev)}$
	1413	708	708	708	1413	708	708	708	355	708				
	35.4	70.6	70.6	70.6	28.3	70.6	70.6	70.6	112.7	56.5				
	1.5490	**1.8490**	**1.8490**	**1.8490**	**1.4521**	**1.8490**	**1.8490**	**1.8490**	**2.0521**	**1.7521**	**1.7899**	**0.1710**	**61.6**	**1.5**
3006	12-Oct-23	12-Oct-23	20-Oct-23	20-Oct-23	25-Oct-23	27-Oct-23	22-Nov-23	23-Nov-23	23-Nov-23	30-Nov-23			Actual	Actual
	y_{20}	y_{21}	y_{22}	y_{23}	y_{24}	y_{25}	y_{26}	y_{27}	y_{28}	y_{29}	Avg log_{10}	Std Dev	$10^{(Avg. ITE)}$	$10^{(Std Dev)}$
	708	1413	708	355	708	708	708	708	708	708				
	56.5	28.3	56.5	112.7	56.5	56.5	56.5	56.5	56.5	56.5				
	1.7521	**1.4521**	**1.7521**	**2.0521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**0.1414**	**56.5**	**1.4**
14853-3001	28-Sep-23	29-Sep-23	2-Oct-23	4-Oct-23	5-Oct-23	27-Oct-23	22-Nov-23	23-Nov-23	23-Nov-23	30-Nov-23			Actual	Actual
	y_{19}	y_{20}	y_{21}	y_{22}	y_{23}	y_{24}	y_{25}	y_{26}	y_{27}	y_{28}	Avg log_{10}	Std Dev	$10^{(Avg. ITE)}$	$10^{(Std Dev)}$
	191	708	708	708	1413	708	1413	1413	2818	708				
	209.9	56.5	56.5	56.5	28.3	56.5	28.3	28.3	14.2	56.5				
	2.3221	**1.7521**	**1.7521**	**1.7521**	**1.4521**	**1.7521**	**1.4521**	**1.4521**	**1.1521**	**1.7521**	**1.6591**	**0.3106**	**46.5**	**2.0**
14853-1231	30-Aug-23	13-Sep-23	3-Oct-23	12-Oct-23	12-Oct-23	25-Oct-23	22-Nov-23	23-Nov-23	23-Nov-23	30-Nov-23			Actual	Actual
	y_{38}	y_{39}	y_{40}	y_{41}	y_{42}	y_{43}	y_{44}	y_{45}	y_{46}	y_{47}	Avg log_{10}	Std Dev	$10^{(Avg. ITE)}$	$10^{(Std Dev)}$
	1413	2818	1413	708	1413	1413	1413	1413	1413	1413				
	35.4	14.2	28.3	56.5	28.3	28.3	28.3	28.3	28.3	28.3				
	1.5490	**1.1521**	**1.4521**	**1.7521**	**1.4521**	**1.4521**	**1.4521**	**1.4521**	**1.4521**	**1.4521**	**1.4618**	**0.1515**	**29.0**	**1.4**
14853-1927	31-Aug-23	13-Sep-23	19-Sep-23	20-Sep-23	26-Sep-23	4-Oct-23	5-Oct-23	12-Oct-23	12-Oct-23	30-Nov-23			Actual	Actual
	y_{36}	y_{37}	y_{38}	y_{39}	y_{40}	y_{41}	y_{42}	y_{43}	y_{44}	y_{45}	Avg log_{10}	Std Dev	$10^{(Avg. ITE)}$	$10^{(Std Dev)}$
	708	708	708	708	1413	708	708	708	708	708				
	70.6	56.5	56.5	56.5	35.4	56.5	56.5	56.5	56.5	56.5				
	1.8490	**1.7521**	**1.7521**	**1.7521**	**1.5490**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7521**	**1.7414**	**0.0742**	**55.1**	**1.2**

	13-Sep-23	19-Sep-23	20-Sep-23	26-Sep-23	27-Sep-23	4-Oct-23	5-Oct-23	12-Oct-23	12-Oct-23	30-Nov-23			Actual	Actual
14853-1928	y_{32}	y_{33}	y_{34}	y_{35}	y_{36}	y_{37}	y_{38}	y_{39}	y_{40}	y_{41}	Avg log_{10}	Std Dev	$10^{(Avg. ITE)}$	$10^{(Std Dev)}$
	708	708	708	2818	708	1413	708	1413	1413	1413				
	56.5	56.5	56.5	14.2	56.5	28.3	56.5	28.3	28.3	28.3				
	1.7521	**1.7521**	**1.7521**	**1.1521**	**1.7521**	**1.4521**	**1.7521**	**1.4521**	**1.4521**	**1.4521**	**1.5721**	**0.2098**	**37.3**	**1.6**

Table 4 – Olfactometer Flow Calibration

Dilution Level	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sample Volume Factory Setting	(LPM)	0.0003	0.00061	0.00123	0.00252	0.00506	0.01007	0.02007	0.04018	0.07773	0.1545	0.323	0.635	1.195	2.34
Dilution Ratio Factory Setting	#	64,000	32,000	16,000	8,000	4,000	2,000	1,000	500	250	125	63	32	16	8
Sample Delivery Volume	(LPM)	0.0003	0.00065	0.00126	0.00251	0.00508	0.01012	0.02019	0.04021	0.0781	0.1431	0.326	0.634	1.238	2.525
Dilution Ratio	#	66,573	30,726	15,851	7,957	3,931	1,974	989	497	256	140	61	32	16	8
Total Volume	(LPM)	19.972	19.972	19.972	19.972	19.972	19.972	19.972	19.972	19.972	19.972	19.972	19.972	19.972	19.972





Appendix – A: Raw Olfactometry Responses

Olfactometer Evaluation Results
AC'SCENT International Olfactometer

Test Name : Woodstock **Test No. :** C2333401 **Test Date :** 11/30/2023

Test Administrator : Tom Vallarino **Test Method :** Triangular Forced Choice

Flow Rate (lpm) : 20 **Sniff Time (sec) :** 3

Sample Information

Lab No. : C2333401 **Field No. :** AER1

Description : Aeration Tank

Sampling Date : 11/29/2023

Sampling Time : 11:30

Sample Collector :

Sample Source :

Dilution Level	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Sample Volume	0.30	0.61	1.27	2.52	5.06	10.1	20.1	40.2	77.73	154.5	323	635	1195	2340
Total Volume	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972
Dilution Ratio	66,573	32,741	15,726	7,925	3,947	1,983	995	497	257	129	61.8	31.5	16.7	8.5
Geometric Mean	94,149	46,687	22,691	11,164	5,593	2,798	1,405	703	357	182	89	44.1	22.9	11.9
Log (Geo. Mean)	4.97	4.67	4.36	4.05	3.75	3.45	3.15	2.85	2.55	2.26	1.95	1.64	1.36	1.08

Calibration Date : 11/20/2023

THRESHOLDS
G = Guess
D = Detection
R = Recognition

Assessor/Round																**Log G**	**Log D**	**Log R**
14853-1931	1								1	2	2	6	8	8		2.55	1.95	1.64
3009	1								2	1	8	8				2.26	2.26	2.26
14853-719	1								1	2	1	6	8	8		1.95	1.95	1.64
3006	1								2	1	1	1	8	8		1.64	1.64	1.64
14853-3001	1								1	1	1	6	6	8	8	1.95	1.95	1.36
14853-1231	1								2	8	8					2.85	2.55	2.55
14853-1927	1								1	1	2	8	8			2.26	1.95	1.95
14853-1928	1								1	6	6	8	8			2.55	2.55	1.95

NOTE : This Report represents data which includes any Retrospective Screening of data.

Sample Comments :

Specific Chemical Concentration Data

Chemical :

Concentration (ppm) :

Response Key:
1 = Incorrect Guess
2 = Correct Guess
5 = Incorrect Detection
6 = Correct Detection
7 = Incorrect Recognition
8 = Correct Recognition

Final Results

	G	**D**	**R**
Avg. Log Value	2.25	2.10	1.88
Std. Dev.	0.39	0.32	0.39
Threshold	179	127	75

Olfactometer Evaluation Results
AC'SCENT International Olfactometer

Test Name : Woodstock **Test No. :** C2333401 **Test Date :** 11/30/2023

Test Administrator : Tom Vallarino **Test Method :** Triangular Forced Choice

Flow Rate (lpm) : 20 **Sniff Time (sec) :** 3

Sample Information

Lab No. : C2333401 **Field No. :** AER2

Description : Aeration Tank

Sampling Date : 11/29/2023

Sampling Time : 11:45

Sample Collector :

Sample Source :

Dilution Level	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sample Volume	0.30	0.61	1.27	2.52	5.06	10.1	20.1	40.2	77.73	154.5	323	635	1195	2340
Total Volume	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972
Dilution Ratio	66,573	32,741	15,726	7,925	3,947	1,983	995	497	257	129	61.8	31.5	16.7	8.5
Geometric Mean	94,149	46,687	22,691	11,164	5,593	2,798	1,405	703	357	182	89	44.1	22.9	11.9
Log (Geo. Mean)	4.97	4.67	4.36	4.05	3.75	3.45	3.15	2.85	2.55	2.26	1.95	1.64	1.36	1.08

Calibration Date : 11/20/2023

THRESHOLDS
G = Guess
D = Detection
R = Recognition

Assessor/Round		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Log G	Log D	Log R
14853-1931	1								1	2	1	6	6	8	8	1.95	1.95	1.36
3009	1								1	1	8	8				2.26	2.26	2.26
14853-719	1								1	1	1	2	6	8	8	1.95	1.64	1.36
3006	1								1	2	2	1	6	8	8	1.64	1.64	1.36
14853-3001	1								1	1	6	6	8	8		2.26	2.26	1.64
14853-1231	1								2	8	8					2.85	2.55	2.55
14853-1927	1								1	1	2	2	8	8		2.26	1.64	1.64
14853-1928	1								2	5	8	8				2.26	2.26	2.26

NOTE : This Report represents data which includes any Retrospective Screening of data.

Sample Comments :

Specific Chemical Concentration Data

Chemical :

Concentration (ppm) :

Response Key:

1 = Incorrect Guess
2 = Correct Guess
5 = Incorrect Detection
6 = Correct Detection
7 = Incorrect Recognition
8 = Correct Recognition

Final Results

	G	D	R
Avg. Log Value	2.18	2.03	1.81
Std. Dev.	0.35	0.36	0.48
Threshold	151	107	64

Olfactometer Evaluation Results
AC'SCENT International Olfactometer

Test Name : Woodstock **Test No. :** C2333401 **Test Date :** 11/30/2023

Test Administrator : Tom Vallarino **Test Method :** Triangular Forced Choice

Flow Rate (lpm) : 20 **Sniff Time (sec) :** 3

Sample Information

Lab No. : C2333401 **Field No. :** Blank

Description : Blank

Sampling Date : 11/29/2023

Sampling Time : 9:00

Sample Collector :

Sample Source :

Dilution Level	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sample Volume	0.30	0.61	1.27	2.52	5.06	10.1	20.1	40.2	77.73	154.5	323	635	1195	2340
Total Volume	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972
Dilution Ratio	66,573	32,741	15,726	7,925	3,947	1,983	995	497	257	129	61.8	31.5	16.7	8.5
Geometric Mean	94,149	46,687	22,691	11,164	5,593	2,798	1,405	703	357	182	89	44.1	22.9	11.9
Log (Geo. Mean)	4.97	4.67	4.36	4.05	3.75	3.45	3.15	2.85	2.55	2.26	1.95	1.64	1.36	1.08

Calibration Date : 11/20/2023

THRESHOLDS
G = Guess
D = Detection
R = Recognition

Assessor/Round		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Log G	Log D	Log R
14853-1931	1											1	2	6	6	1.64	1.36	0.78
3009	1											1	8	8		1.64	1.64	1.64
14853-719	1											2	1	6	8	1.36	1.36	1.08
3006	1											1	1	6	8	1.36	1.36	1.08
14853-3001	1											2	6	6	8	1.95	1.64	1.08
14853-1231	1											2	8	8		1.95	1.64	1.64
14853-1927	1											2	8	8		1.95	1.64	1.64
14853-1928	1											1	5	8	8	1.36	1.36	1.36

NOTE : This Report represents data which includes any Retrospective Screening of data.

Sample Comments :

Specific Chemical Concentration Data

Chemical :

Concentration (ppm) :

Response Key:
1 = Incorrect Guess
2 = Correct Guess
5 = Incorrect Detection
6 = Correct Detection
7 = Incorrect Recognition
8 = Correct Recognition

Final Results

	G	D	R
Avg. Log Value	1.65	1.50	1.29
Std. Dev.	0.27	0.15	0.33
Threshold	45	32	19

Olfactometer Evaluation Results
AC'SCENT International Olfactometer

Test Name : Woodstock **Test No. :** C2333401 **Test Date :** 11/30/2023

Test Administrator : Tom Vallarino **Test Method :** Triangular Forced Choice

Flow Rate (lpm) : 20 **Sniff Time (sec) :** 3

Sample Information

Lab No. : C2333401 **Field No. :** LAB

Description : QC n-butanol

Sampling Date : 11/29/2023

Sampling Time : 8:00

Sample Collector : SCS

Sample Source : cylinder

Dilution Level	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sample Volume	0.30	0.61	1.27	2.52	5.06	10.1	20.1	40.2	77.73	154.5	323	635	1195	2340
Total Volume	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972
Dilution Ratio	66,573	32,741	15,726	7,925	3,947	1,983	995	497	257	129	61.8	31.5	16.7	8.5
Geometric Mean	94,149	46,687	22,691	11,164	5,593	2,798	1,405	703	357	182	89	44.1	22.9	11.9
Log (Geo. Mean)	4.97	4.67	4.36	4.05	3.75	3.45	3.15	2.85	2.55	2.26	1.95	1.64	1.36	1.08

Calibration Date : 11/20/2023

THRESHOLDS
G = Guess
D = Detection
R = Recognition

Assessor/Round		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Log G	Log D	Log R
14853-1931	1					1	2	1	6	5	8	8				2.26	2.26	2.26
3009	1					1	2	1	6	6	8	8				2.85	2.85	2.26
14853-719	1					1	1	1	6	6	8	8				2.85	2.85	2.26
3006	1					1	1	1	6	6	8	8				2.85	2.85	2.26
14853-3001	1					1	1	1	6	6	8	8				2.85	2.85	2.26
14853-1231	1					1	2	8	8							3.45	3.15	3.15
14853-1927	1					1	1	2	6	6	8	8				3.15	2.85	2.26
14853-1928	1					1	5	8	8							3.15	3.15	3.15

NOTE : This Report represents data which includes any Retrospective Screening of data.

Sample Comments :

Specific Chemical Concentration Data

Chemical : n-butanol

Concentration (ppm) : 40

Response Key:
1 = Incorrect Guess
2 = Correct Guess
5 = Incorrect Detection
6 = Correct Detection
7 = Incorrect Recognition
8 = Correct Recognition

Final Results

	G	D	R
Avg. Log Value	2.92	2.85	2.48
Std. Dev.	0.35	0.27	0.41
Threshold	839	706	304

Olfactometer Evaluation Results
AC'SCENT International Olfactometer

Test Name : Woodstock **Test No. :** C2333401 **Test Date :** 11/30/2023

Test Administrator : Tom Vallarino **Test Method :** Triangular Forced Choice

Flow Rate (lpm) : 20 **Sniff Time (sec) :** 3

Sample Information

Lab No. : C2333401 **Field No. :** PRIM-1

Description : Primary Clarifier

Sampling Date : 11/29/2023

Sampling Time : 14:05

Sample Collector :

Sample Source :

Dilution Level	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sample Volume	0.30	0.61	1.27	2.52	5.06	10.1	20.1	40.2	77.73	154.5	323	635	1195	2340
Total Volume	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972
Dilution Ratio	66,573	32,741	15,726	7,925	3,947	1,983	995	497	257	129	61.8	31.5	16.7	8.5
Geometric Mean	94,149	46,687	22,691	11,164	5,593	2,798	1,405	703	357	182	89	44.1	22.9	11.9
Log (Geo. Mean)	4.97	4.67	4.36	4.05	3.75	3.45	3.15	2.85	2.55	2.26	1.95	1.64	1.36	1.08

Calibration Date : 11/20/2023

THRESHOLDS
G = Guess
D = Detection
R = Recognition

Assessor/Round		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Log G	Log D	Log R
14853-1931	1						1	1	6	8	8					2.85	2.85	2.55
3009	1						2	2	1	8	8					2.55	2.55	2.55
14853-719	1						2	2	2	6	8	8				3.45	2.55	2.26
3006	1						1	1	1	1	8	8				2.26	2.26	2.26
14853-3001	1						2	2	5	8	8					2.55	2.55	2.55
14853-1231	1						1	5	5	8	8					2.55	2.55	2.55
14853-1927	1						2	1	2	2	8	8				2.85	2.26	2.26
14853-1928	1						1	6	6	8	8					3.15	3.15	2.55

NOTE : This Report represents data which includes any Retrospective Screening of data.

Sample Comments :

Specific Chemical Concentration Data

Chemical :

Concentration (ppm) :

Response Key:
1 = Incorrect Guess
2 = Correct Guess
5 = Incorrect Detection
6 = Correct Detection
7 = Incorrect Recognition
8 = Correct Recognition

Final Results

	G	D	R
Avg. Log Value	2.78	2.59	2.44
Std. Dev.	0.38	0.29	0.15
Threshold	597	390	278

Olfactometer Evaluation Results
AC'SCENT International Olfactometer

Test Name : Woodstock **Test No. :** C2333401 **Test Date :** 11/30/2023

Test Administrator : Tom Vallarino **Test Method :** Triangular Forced Choice

Flow Rate (lpm) : 20 **Sniff Time (sec) :** 3

Sample Information

Lab No. : C2333401 **Field No. :** PRIM-2

Description : Primary Clarifier

Sampling Date : 11/29/2023

Sampling Time : 14:20

Sample Collector :

Sample Source :

Dilution Level	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sample Volume	0.30	0.61	1.27	2.52	5.06	10.1	20.1	40.2	77.73	154.5	323	635	1195	2340
Total Volume	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972
Dilution Ratio	66,573	32,741	15,726	7,925	3,947	1,983	995	497	257	129	61.8	31.5	16.7	8.5
Geometric Mean	94,149	46,687	22,691	11,164	5,593	2,798	1,405	703	357	182	89	44.1	22.9	11.9
Log (Geo. Mean)	4.97	4.67	4.36	4.05	3.75	3.45	3.15	2.85	2.55	2.26	1.95	1.64	1.36	1.08

Calibration Date : 11/20/2023

THRESHOLDS
G = Guess
D = Detection
R = Recognition

Assessor/Round		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Log G	Log D	Log R
14853-1931	1						1	2	2	6	8	8				3.15	2.55	2.26
3009	1						2	2	6	8	8					3.45	2.85	2.55
14853-719	1						1	1	6	8	8					2.85	2.85	2.55
3006	1						1	1	5	6	6	8	8			2.55	2.55	1.95
14853-3001	1						1	1	2	8	8					2.85	2.55	2.55
14853-1231	1						1	5	8	8						2.85	2.85	2.85
14853-1927	1						1	1	6	5	8	8				2.26	2.26	2.26
14853-1928	1						2	5	8	8						2.85	2.85	2.85

NOTE : This Report represents data which includes any Retrospective Screening of data.

Sample Comments :

Specific Chemical Concentration Data

Chemical :

Concentration (ppm) :

Response Key:
1 = Incorrect Guess
2 = Correct Guess
5 = Incorrect Detection
6 = Correct Detection
7 = Incorrect Recognition
8 = Correct Recognition

Final Results

	G	D	R
Avg. Log Value	2.85	2.66	2.48
Std. Dev.	0.35	0.22	0.31
Threshold	707	461	301

Olfactometer Evaluation Results
AC'SCENT International Olfactometer

Test Name : Woodstock **Test No. :** C2333401 **Test Date :** 11/30/2023

Test Administrator : Tom Vallarino **Test Method :** Triangular Forced Choice

Flow Rate (lpm) : 20 **Sniff Time (sec) :** 3

Sample Information

Lab No. : C2333401 **Field No. :** Sludge1

Description : Sludge1

Sampling Date : 11/29/2023

Sampling Time : 16:55

Sample Collector :

Sample Source :

Dilution Level	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sample Volume	0.30	0.61	1.27	2.52	5.06	10.1	20.1	40.2	77.73	154.5	323	635	1195	2340
Total Volume	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972
Dilution Ratio	66,573	32,741	15,726	7,925	3,947	1,983	995	497	257	129	61.8	31.5	16.7	8.5
Geometric Mean	94,149	46,687	22,691	11,164	5,593	2,798	1,405	703	357	182	89	44.1	22.9	11.9
Log (Geo. Mean)	4.97	4.67	4.36	4.05	3.75	3.45	3.15	2.85	2.55	2.26	1.95	1.64	1.36	1.08

Calibration Date : 11/20/2023

THRESHOLDS
G = Guess
D = Detection
R = Recognition

Assessor/Round		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Log G	Log D	Log R
14853-1931	1						1	1	8	8						2.85	2.85	2.85
3009	1						1	8	8							3.15	3.15	3.15
14853-719	1						2	6	6	8	8					3.45	3.15	2.55
3006	1						1	1	2	8	8					2.85	2.55	2.55
14853-3001	1						1	1	8	8						2.85	2.85	2.85
14853-1231	1						1	5	8	8						2.85	2.85	2.85
14853-1927	1						1	1	8	8						2.85	2.85	2.85
14853-1928	1						1	6	8	8						3.15	3.15	2.85

NOTE : This Report represents data which includes any Retrospective Screening of data.

Sample Comments :

Specific Chemical Concentration Data

Chemical :

Concentration (ppm) :

Response Key:
1 = Incorrect Guess
2 = Correct Guess
5 = Incorrect Detection
6 = Correct Detection
7 = Incorrect Recognition
8 = Correct Recognition

Final Results

	G	D	R
Avg. Log Value	3.00	2.92	2.81
Std. Dev.	0.23	0.21	0.19
Threshold	994	838	647

Olfactometer Evaluation Results
AC'SCENT International Olfactometer

Test Name : Woodstock **Test No. :** C2333401 **Test Date :** 11/30/2023

Test Administrator : Tom Vallarino **Test Method :** Triangular Forced Choice

Flow Rate (lpm) : 20 **Sniff Time (sec) :** 3

Sample Information

Lab No. : C2333401 **Field No. :** Sludge2

Description : Sludge2

Sampling Date : 11/29/2023

Sampling Time : 17:10

Sample Collector :

Sample Source :

Dilution Level	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Sample Volume	0.30	0.61	1.27	2.52	5.06	10.1	20.1	40.2	77.73	154.5	323	635	1195	2340
Total Volume	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972	19,972
Dilution Ratio	66,573	32,741	15,726	7,925	3,947	1,983	995	497	257	129	61.8	31.5	16.7	8.5
Geometric Mean	94,149	46,687	22,691	11,164	5,593	2,798	1,405	703	357	182	89	44.1	22.9	11.9
Log (Geo. Mean)	4.97	4.67	4.36	4.05	3.75	3.45	3.15	2.85	2.55	2.26	1.95	1.64	1.36	1.08

Calibration Date : 11/20/2023

THRESHOLDS
G = Guess
D = Detection
R = Recognition

Assessor/Round		1	2	3	4	5	6	7	8	9	10	11	12	13	14	**Log G**	**Log D**	**Log R**
14853-1931	1						1	1	6	8	8					2.85	2.85	2.55
3009	1						2	8	8							3.45	3.15	3.15
14853-719	1						2	6	8	8						3.45	3.15	2.85
3006	1						1	1	2	8	8					2.85	2.55	2.55
14853-3001	1						1	6	6	8	8					3.15	3.15	2.55
14853-1231	1						1	8	8							3.15	3.15	3.15
14853-1927	1						2	1	8	8						2.85	2.85	2.85
14853-1928	1						1	6	8	8						3.15	3.15	2.85

NOTE : This Report represents data which includes any Retrospective Screening of data.

Sample Comments :

Specific Chemical Concentration Data

Chemical :

Concentration (ppm) :

Response Key:
1 = Incorrect Guess
2 = Correct Guess
5 = Incorrect Detection
6 = Correct Detection
7 = Incorrect Recognition
8 = Correct Recognition

Final Results

	G	**D**	**R**
Avg. Log Value	3.11	3.00	2.81
Std. Dev.	0.25	0.23	0.25
Threshold	1,288	996	649

ALS Canada Ltd.

right solutions. right partner.

CERTIFICATE OF ANALYSIS

Work Order	: **WT2339226**	Page	: 1 of 4
Client	: **Welburn Consulting Ltd.**	Laboratory	: ALS Environmental - Waterloo
Contact	: Colin Welburn	Account Manager	: Costas Farassoglou
Address	: 143 Sunnyside Avenue Ottawa ON Canada K1S 0R2	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: 613 852 6003	Telephone	: 613 225 8279
Project	: Y23.C0004.50084.REA	Date Samples Received	: 30-Nov-2023 09:00
PO	: ----	Date Analysis Commenced	: 01-Dec-2023
C-O-C number	: ----	Issue Date	: 03-Jan-2024 13:54
Sampler	: CLIENT		
Site	: ----		
Quote number	: SOA 2024		
No. of samples received	: 7		
No. of samples analysed	: 7		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Simon Campsall	Analyst	Air Quality, Waterloo, Ontario

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
µg/m³	micrograms per cubic metre
Inches Hg	inches of mercury
ppbv	parts per billion (volume/volume)

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: **Air**

(Matrix: **Air**)

Analyte	CAS Number	Method/Lab	LOR	Unit	AERATION #1	AERATION #2	PRIMARY #1	PRIMARY #2	DWS #1
				Client sampling date / time	29-Nov-2023 10:32	29-Nov-2023 11:00	29-Nov-2023 13:00	29-Nov-2023 13:33	29-Nov-2023 15:38
					WT2339226-001	WT2339226-002	WT2339226-003	WT2339226-004	WT2339226-005
					Result	Result	Result	Result	Result
Field Tests									
ID, batch proof	----	EF001/WT	-	-	231011.131	230930.229	230930.222	231018.121	231011.119
ID, canister	----	EF001/WT	-	-	00946-0343	00946-0173	00946-0089	00946-0068	00946-0242
ID, regulator	----	EF001/WT	-	-	G143	G113	G363	G329	G256
Pressure on receipt	----	EF001/WT	0.10	Inches Hg	-5.32	-5.52	-2.46	-5.11	-3.28
Sulfur Compounds									
Dimethyl disulfide	624-92-0	EC630/WT	7.7	µg/m³	<7.7	<7.7	9.2	8.1	<7.7
Dimethyl disulfide	624-92-0	E630/WT	2.0	ppbv	<2.0	<2.0	2.4	2.1	<2.0
Dimethyl sulfide	75-18-3	EC630/WT	10	µg/m³	<10	<10	<10	<10	<10
Dimethyl sulfide	75-18-3	E630/WT	4.0	ppbv	<4.0	<4.0	<4.0	<4.0	<4.0
Hydrogen sulfide	7783-06-4	EC630/WT	5.6	µg/m³	<5.6	10.3	<5.6	<5.6	<5.6
Hydrogen sulfide	7783-06-4	E630/WT	4.0	ppbv	<4.0	7.4	<4.0	<4.0	<4.0
Methyl mercaptan	74-93-1	EC630/WT	7.9	µg/m³	<7.9	<7.9	<7.9	<7.9	<7.9
Methyl mercaptan	74-93-1	E630/WT	4.0	ppbv	<4.0	<4.0	<4.0	<4.0	<4.0
Sulfur, total reduced (as H2S), Ontario 4	----	EC630/WT	11	µg/m³	<11	<11	<11	<11	<11

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Analytical Results

Sub-Matrix: **Air**

(Matrix: **Air**)

Analyte	CAS Number	Method/Lab	LOR	Unit	DWS #2	DWS SPARE	----	----	----
				Client sampling date / time	29-Nov-2023 15:59	29-Nov-2023 00:00	----	----	----
					WT2339226-006	WT2339226-007	--------	--------	--------
					Result	Result	----	----	----
Field Tests									
ID, batch proof	----	EF001/WT	-	-	230930.211	230930.217	----	----	----
ID, canister	----	EF001/WT	-	-	00946-0368	00946-0223	----	----	----
ID, regulator	----	EF001/WT	-	-	G312	G15	----	----	----
Pressure on receipt	----	EF001/WT	0.10	Inches Hg	-7.36	-4.91	----	----	----
Sulfur Compounds									
Dimethyl disulfide	624-92-0	EC630/WT	7.7	µg/m³	<7.7	<7.7	----	----	----
Dimethyl disulfide	624-92-0	E630/WT	2.0	ppbv	<2.0	<2.0	----	----	----
Dimethyl sulfide	75-18-3	EC630/WT	10	µg/m³	<10	<10	----	----	----
Dimethyl sulfide	75-18-3	E630/WT	4.0	ppbv	<4.0	<4.0	----	----	----
Hydrogen sulfide	7783-06-4	EC630/WT	5.6	µg/m³	<5.6	<5.6	----	----	----
Hydrogen sulfide	7783-06-4	E630/WT	4.0	ppbv	<4.0	<4.0	----	----	----
Methyl mercaptan	74-93-1	EC630/WT	7.9	µg/m³	<7.9	<7.9	----	----	----
Methyl mercaptan	74-93-1	E630/WT	4.0	ppbv	<4.0	<4.0	----	----	----
Sulfur, total reduced (as H2S), Ontario 4	----	EC630/WT	11	µg/m³	<11	<11	----	----	----

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

ALS Canada Ltd.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2339226**	Page	: 1 of 6
Client	: **Welburn Consulting Ltd.**	Laboratory	: ALS Environmental - Waterloo
Contact	: Colin Welburn	Account Manager	: Costas Farassoglou
Address	: 143 Sunnyside Avenue Ottawa ON Canada K1S 0R2	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 613 852 6003	Telephone	: 613 225 8279
Project	: Y23.C0004.50084.REA	Date Samples Received	: 30-Nov-2023 09:00
PO	: ----	Issue Date	: 03-Jan-2024 13:54
C-O-C number	: ----		
Sampler	: CLIENT		
Site	: ----		
Quote number	: SOA 2024		
No. of samples received	: 7		
No. of samples analysed	: 7		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Air**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method	*Method*	*Sampling Date*	*Extraction / Preparation*				*Analysis*			
Container / Client Sample ID(s)			*Preparation Date*	*Holding Times Rec*	*Holding Times Actual*	*Eval*	*Analysis Date*	*Holding Times Rec*	*Holding Times Actual*	*Eval*
Field Tests : Air Canister Information										
Canister AERATION #1	EF001	29-Nov-2023	----	----	----		01-Dec-2023	----	2 days	
Field Tests : Air Canister Information										
Canister AERATION #2	EF001	29-Nov-2023	----	----	----		01-Dec-2023	----	2 days	
Field Tests : Air Canister Information										
Canister DWS #1	EF001	29-Nov-2023	----	----	----		01-Dec-2023	----	2 days	
Field Tests : Air Canister Information										
Canister DWS #2	EF001	29-Nov-2023	----	----	----		01-Dec-2023	----	2 days	
Field Tests : Air Canister Information										
Canister DWS SPARE	EF001	29-Nov-2023	----	----	----		01-Dec-2023	----	2 days	
Field Tests : Air Canister Information										
Canister PRIMARY #1	EF001	29-Nov-2023	----	----	----		01-Dec-2023	----	2 days	
Field Tests : Air Canister Information										
Canister PRIMARY #2	EF001	29-Nov-2023	----	----	----		01-Dec-2023	----	2 days	

Matrix: **Air**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation: Preparation Date	Extraction / Preparation: Holding Times Rec	Extraction / Preparation: Holding Times Actual	Extraction / Preparation: Eval	Analysis: Analysis Date	Analysis: Holding Times Rec	Analysis: Holding Times Actual	Analysis: Eval
Sulfur Compounds : Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)										
Canister AERATION #1	E630	29-Nov-2023	----	----	----		01-Dec-2023	7 days	2 days	✓
Sulfur Compounds : Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)										
Canister AERATION #2	E630	29-Nov-2023	----	----	----		01-Dec-2023	7 days	2 days	✓
Sulfur Compounds : Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)										
Canister DWS #1	E630	29-Nov-2023	----	----	----		01-Dec-2023	7 days	2 days	✓
Sulfur Compounds : Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)										
Canister DWS #2	E630	29-Nov-2023	----	----	----		01-Dec-2023	7 days	2 days	✓
Sulfur Compounds : Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)										
Canister PRIMARY #1	E630	29-Nov-2023	----	----	----		01-Dec-2023	7 days	2 days	✓
Sulfur Compounds : Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)										
Canister PRIMARY #2	E630	29-Nov-2023	----	----	----		01-Dec-2023	7 days	2 days	✓
Sulfur Compounds : Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)										
Canister DWS SPARE	E630	29-Nov-2023	----	----	----		01-Dec-2023	7 days	3 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Air**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)	E630	1260762	1	7	14.2	5.0	✓
Laboratory Control Samples (LCS)							
Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)	E630	1260762	1	7	14.2	5.0	✓
Method Blanks (MB)							
Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)	E630	1260762	1	7	14.2	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ppbV)	E630 ALS Environmental - Waterloo	Air	ASTM D5504	This analysis is performed using procedures adapted from ASTM D5504. Air samples are collected into cleaned evacuated silica-coated canisters. By means of a loop system, a volume of air is transferred from the canister and cryofocused before determining the sulfur compounds by GC-SCD. Silica coated passivated canisters may allow for reliable sample analysis after 24 hours. In such cases, analysis is recommended within 7 days of collection. Canister samples will be retained for 7 calendar days after final report. If you require a longer canister storage time, please contact your Project Manager.
Reduced Sulfur Compounds in Passivated Canisters by GC-SCD (All List) (ug/m3)	EC630 ALS Environmental - Waterloo	Air	ASTM D5504	convert ppbv to ug/m3
Air Canister Information	EF001 ALS Environmental - Waterloo	Air	In-house	Air canister information provided by client and recorded on ALS report may affect the validity of results.

ALS Canada Ltd.

right solutions.
right partner.

QUALITY CONTROL REPORT

Work Order	: **WT2339226**	Page	: 1 of 3
Client	: Welburn Consulting Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Colin Welburn	Account Manager	: Costas Farassoglou
Address	: 143 Sunnyside Avenue Ottawa ON Canada K1S 0R2	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: 613 225 8279
Project	: Y23.C0004.50084.REA	Date Samples Received	: 30-Nov-2023 09:00
PO	: ----	Date Analysis Commenced	: 01-Dec-2023
C-O-C number	: ----	Issue Date	: 03-Jan-2024 13:54
Sampler	: CLIENT 613 852 6003		
Site	: ----		
Quote number	: SOA 2024		
No. of samples received	: 7		
No. of samples analysed	: 7		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Simon Campsall	Analyst	Waterloo Air Quality, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Air**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	**Client sample ID**	**Analyte**	**CAS Number**	**Method**	**LOR**	**Unit**	**Original Result**	**Duplicate Result**	**RPD(%) or Difference**	**Duplicate Limits**	**Qualifier**
Sulfur Compounds (QC Lot: 1260762)											
WT2339226-001	AERATION #1	Dimethyl disulfide	624-92-0	E630	2.0	ppbv	<2.0	<2.0	0	Diff <2x LOR	----
		Dimethyl sulfide	75-18-3	E630	4.0	ppbv	<4.0	<4.0	0	Diff <2x LOR	----
		Hydrogen sulfide	7783-06-4	E630	4.0	ppbv	<4.0	<4.0	0	Diff <2x LOR	----
		Methyl mercaptan	74-93-1	E630	4.0	ppbv	<4.0	<4.0	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Air**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Sulfur Compounds (QCLot: 1260762)						
Dimethyl disulfide	624-92-0	E630	2	ppbv	<2.0	----
Dimethyl sulfide	75-18-3	E630	4	ppbv	<4.0	----
Hydrogen sulfide	7783-06-4	E630	4	ppbv	<4.0	----
Methyl mercaptan	74-93-1	E630	4	ppbv	<4.0	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Air**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Sulfur Compounds (QCLot: 1260762)									
Hydrogen sulfide	7783-06-4	E630	4	ppbv	120 ppbv	99.7	60.0	140	----
Methyl mercaptan	74-93-1	E630	4	ppbv	88.8 ppbv	98.2	60.0	140	----

60 NORTHLAND ROAD, UNIT 1
WATERLOO, ON N2V 2B8
Phone: (519) 886-6910
Fax: (519) 886-9047
Toll Free: 1-800-668-9878

ALS Environmental

AIR QUALITY CHAIN OF CUSTODY FORM - Canister/Tube/Gas Bag

Note: All TAT Quoted is in business days which exclude statutory holidays and weekends. TAT of samples received past 3:00 pm or Saturday / Sunday begin the next day.

DATE REQUIRED	SERVICE REQUESTED			
			Rush 3 day (100%)	☐
	10 day (regular)	☐	Rush 2 day (200%)	☐
	Rush 5 day (50%)	☐	Rush 1 day (300%) - Enquire	☐

COMPANY NAME	Welburn Consulting, Ltd.
OFFICE	
PROJECT MANAGER	COLIN WELBURN
PROJECT #	Y23 • C0009.S0084.RGA
PHONE	613 852 6003
FAX	
ACCOUNT #	
QUOTATION #	
PO #	

REGULATION	
CRITERIA	
OTHER INFORMATION	

REPORT FORMAT/DISTRIBUTION

EMAIL ✓ FAX_____ BOTH _______
SELECT: PDF____ DIGITAL____ BOTH ✓
EMAIL 1 colin@welburnconsulting.ca
EMAIL 2

ANALYSIS REQUEST

All rush work requires lab approval before sample submission

SUBMISSION #: WT2339226
ENTERED BY:
DATE/TIME ENTERED:
BIN #:

SAMPLING INFORMATION

Date (dd-mmm-yy)	Time (24hr) (hh:mm)	Canister or Tube ID# (e.g. 060000-XXXX or G0XXXXXXSVI)	Regulator Serial # CS1200-XXXX or GXX	Matrix Type	SAMPLE DESCRIPTION TO APPEAR ON REPORT	TUBE AIR VOLUME - L ☐ or m³ ☐	TRS						STARTING PRESSURE - Pre-Sampling ("Hg)	ENDING PRESSURE - Post Sampling ("Hg)	COLLECTION TIME (HRS)	Field Conditions (Rain/Wind/Dust/Odour) Field PID Reading	LAB ID
29 Nov 23	1032	00946-0343	G149	SG+	AERATION # 1								29	8	0.4		
29 NOV 23	1100	00946-0173	G113	SG+	AERATION # 2								29	7	0.4		
29 NOV 23	1300	00946-089	G 363	SGx	PRIMARY # 1								30	7	0.5		
29 Nov 23	1333	00946-0068	G 329	SGx	PRIMARY #2								28	7	0.5		
29 NOV 23	15:38	00946-0242	G256 *	|	DWS # 1												
29 NOV 23	15:59	00946-0369	G 312	V	DWS # 2												
29 Nov 23		00946-0223	G15		*DWS Spare												

SPECIAL INSTRUCTIONS/COMMENTS

*G256 went to 6" in 10 min used PG47 to confirm it read 10", sampled a bit more to get

This Chain of Custody Form is only to be used for Air Quality Samples

Matrix Type
Soil Gas Vapour = SG — SG+ AERATION TANK AIR
Indoor Air = IA
Ambient Air = AA — SGx = PRIMARY CLARIFIER
Industrial Hygiene = IH

SAMPLED BY:	DATE & TIME	RECEIVED BY: Aaron Britton	DATE & TIME 30 Nov 2023 9:00	
RELINQUISHED BY:	DATE & TIME	RECEIVED AT LAB BY: FH	DATE & TIME 2023-11-30 @18:30	

Environmental Division
Waterloo
Work Order Reference
WT2339226

Telephone: +1 519 886 6910

Notes
1. Quote number must be provided to ensure proper pricing
2. TAT may vary dependent on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs.
3. Any known or suspected hazard chain of custody in comments sect

1435 Norjohn Court, Unit 1, Burlington ON, L7L 0E6
Phone: 905-331-3111, FAX: 905-331-4567

Certificate of Analysis

ALS Project Contact:	Lynne Wrona	**Client Name:**	Welburn Consulting
ALS Project ID:	25742	**Client Address:**	143 Sunnyside Avenue
ALS WO#:	L2753856		Ottawa, ON K1S 0R2
Date of Report	12-Dec-23		Canada
Date of Sample Receipt	6-Dec-23	**Client Contact:**	Colin Welburn
		Client Project ID:	

COMMENTS:

Ammonia, Total (as NH_3) via Ion Chromatography USEPA Method CTM-027 (GN 8,11-Dec-23)

LOR = Limit of Reporting
MB = Laboratory Control Blank (limits: <LOR)
LCS = Laboratory Control Sample (limits: 90-110%)
MS = Matrix Spike Sample (limits: 90-110%, NH_3: 85-115%)
RPD = Relative Percent Difference (limits: <20% for sample duplicate, <10% for duplicate injection)

Certified by: L. Wrona

Lynne Wrona
Project Manager

ALS Environmental

Sample Analysis Summary Report

Sample Name	**DWS-1**	**DWS-2**	**AER-1**	**AER-2**	**PRI-1**
ALS Sample ID	L2753856-1	L2753856-2	L2753856-3	L2753856-4	L2753856-5
Matrix	Stack	Stack	Stack	Stack	Stack
Analysis type	Sample	Sample	Sample	Sample	Sample
Sampling Date/Time	28-Nov-23	28-Nov-23	29-Nov-23	29-Nov-23	29-Nov-23
Date of Receipt	6-Dec-23	6-Dec-23	6-Dec-23	6-Dec-23	6-Dec-23
Ion Chromatography Analysis USEPA Method CTM-027 Ammonia	**mg**	**mg**	**mg**	**mg**	**mg**
Total Ammonia as NH_3	2.74	1.88	0.190	<0.0463	0.0543

ALS Environmental

Sample Analysis Summary Report

Sample Name	**PRI-2**	**BLANK**
ALS Sample ID	L2753856-6	L2753856-7
Matrix	Stack	Stack
Analysis type	Sample	Sample
Sampling Date/Time	29-Nov-23	29-Nov-23
Date of Receipt	6-Dec-23	6-Dec-23
Ion Chromatography Analysis USEPA Method CTM-027 Ammonia	**mg**	**mg**
Total Ammonia as NH_3	0.0743	<0.0444

ALS Environmental

Sample QC Summary Report

Sample Name	**MB**	**LCS**	**LCS**
ALS Sample ID	MB	LCS	LCS
Matrix	Stack	Stack	Stack
Analysis type	Method Blank	Blank Spike	Blank Spike
Sampling Date/Time	n/a	n/a	n/a
Date of Receipt	n/a	n/a	n/a
Ion Chromatography Analysis USEPA Method CTM-027 Ammonia	**mg**	**mg**	**% Rec**
Ammonia, Total (as NH_3)	<0.00472	0.0485	103%

ALS Environmental

Sample QC Summary Report

Sample Name	**DWS-1**	**DWS-1**	**DWS-1**	**DWS-1**
ALS Sample ID	L2753856-1	L2753856-1DUP	L2753856-1MS	L2753856-1MS
Matrix	Stack	Stack	Stack	Stack
Analysis type	Sample	Duplicate	Matrix Spike	Matrix Spike
Sampling Date/Time	28-Nov-23	28-Nov-23	28-Nov-23	28-Nov-23
Date of Receipt	6-Dec-23	6-Dec-23	6-Dec-23	6-Dec-23
Ion Chromatography Analysis USEPA Method CTM-027 Ammonia	**mg**	**mg**	**mg**	**% Rec**
Ammonia, Total (as NH_3)	2.74	2.62	4.93	97%

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2753856-COFC

COC Number: 17 - 793123

Page of

Report To	Contact and company name below will appear on the final report
Company:	Welburn Consulting
Contact:	Colin Welburn
Phone:	613 852-6003
Company address below will appear on the final report	
Street:	143 Sunnyside Ave
City/Province:	Ottawa
Postal Code:	K1S 0R2
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☐ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax
Email 2

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information	Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	AFE/Cost Center:	PO#
Job #:	Major/Minor Code:	Routing Code:
PO / AFE:	Requisitioner:	
LSD:	Location:	
ALS Lab Work Order # (lab use only):	ALS Contact:	Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	DWS-1	Nov 28					
	DWS-2	Nov 28					
	Aer-1	Nov 29					
	Aer-2	Nov 29					
	Pri-1	Nov 29					
	Pri-2	Nov 29					
	Blank	Nov 29					
	Impinger charge 15ml/15ml 0.1N H2SO4						
	H2O Rinse rinse						

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C: 5.7°C
FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Mike Prince	Date: Dec 6	Time: 1042	Received by: Aaron Buttar	Date: 6-Dec-2023	Time: 10:45	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — JUNE 2018 FRONT

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

APPENDIX E: EMISSION RATE CALCULATIONS

WelburnConsulting

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table E1: Average Calculated Fluxes from Source Testing Report

Location	Average Emission Flux of Each Contaminant		
	Odour	Total Reduced Sulphur (TRS) Compounds (other facilities)	Ammonia
Aeration Tanks North (AT_N)	7.50E-02	7.07E-09	6.31E-07
Primary Clarifier (PC_E)	2.73E-01	7.07E-09	3.41E-07
Dewatered Sludge (EF_1)	5.87E-01	7.07E-09	1.22E-05

Table E2: Scaled Fluxes for Secondary Clarifier and Grit Tank

Location	Flux Chamber Concentration at Representative Facility [1]	Flux Scaling Factor for Sources Not Sampled	Average Emission Flux of Each Contaminant		
			Odour	Total Reduced Sulphur (TRS) Compounds (other facilities)	Ammonia
Primary clarifier (PC_E)	2.60E+03	1.00	2.73E-01	7.07E-09	3.41E-07
Secondary Clarifiers North (SC_N)	3.30E+02	0.13	3.46E-02	8.98E-10	4.33E-08
Grit tank (GT)	1.10E+04	4.23	1.15E+00	2.99E-08	1.44E-06

Notes:
[1] Odour Dilution to Threshold Value Reported in Dublin San Ramon Services District (CH2M HILL, 2009)

Table E3: Summary of Emission Rates Calculated from Emission Flux

Location	Source Area (m^2) [1]	Emission Rate of Each Contaminant		
		Odour	Total Reduced Sulphur (TRS) Compounds (other facilities)	Ammonia
Primary Clarifier East (PC_E)	2	5.45E-01	1.41E-08	6.83E-07
Primary Clarifier West (PC_W)	416	1.14E+02	2.94E-06	1.42E-04
Aeration Tanks North (AT_N)	2351	1.76E+02	1.66E-05	1.48E-03
Aeration Tanks South (AT_S)	1575	1.18E+02	1.11E-05	9.94E-04
Dewatered Sludge (EF_1)	5.57	3.27E+00	3.94E-08	6.77E-05
Grit Tank (GT)	61	7.03E+01	1.82E-06	8.81E-05
Secondary Clarifier North (SC_N)	1318	4.56E+01	1.18E-06	5.71E-05
Secondary Clarifier South (SC_S)	896	3.10E+01	8.04E-07	3.88E-05

Notes:
[1] All Source Areas were estimated via Google Earth except EF_1. Area of EF_1 is represented by the area of the bin (3.7m x 1.5m).

Table E4: Summary of Emission Rates for EF_2

Parameter	Units	Value	Source of Information
Q-Trak Measured Concentrations			
H_2S from Centrifuge Room	ppm	0.002	Source Testing Report
Ammonia from Centrifuge Room	ppm	0.48	Source Testing Report
Ammonia from Sludge Loading Area	ppm	0.76	Source Testing Report
Parameters used to Calculate Odour Emission Rate from EF_2			
EF_1 Odour Emission Rate	OU/s	3.27E+00	Table E3
Sludge Loading Area Exhaust (EF_1) Flow Rate	m^3/s	0.66	Stantec FSW
Centrifuge Room Exhaust (EF_2) flow rate	m^3/s	1.11	Stantec FSW
Emission Rates of Contaminants from EF_2			
Odour	OU/s	3.48E+00	Calculated
TRS	g/s	3.09E-06	Calculated
Ammonia	g/s	3.70E-04	Calculated

Table E5: Summary of Temperature-Corrected Emission Rates for Emission Tested Sources

Location	Maximum Temperature Correction Ratio			Temperature-Corrected Emission Rate of Each Contaminant		
	Odour[1]	Total Reduced Sulphur (TRS) Compounds (other facilities)	Ammonia	Odour	Total Reduced Sulphur (TRS) Compounds (other facilities)	Ammonia
Primary Clarifier East (PC_E)	1.62	1.62	2.61	8.81E-01	2.29E-08	1.78E-06
Primary Clarifier West (PC_W)	1.62	1.62	2.61	1.83E+02	4.76E-06	3.71E-04
Aeration Tank North (AT_N)	1.62	1.62	2.61	2.85E+02	2.69E-05	3.87E-03
Aeration Tank South (AT_S)	1.62	1.62	2.61	1.91E+02	1.80E-05	2.59E-03
Sludge Holding Area (EF_1)	2.61	1.62	2.61	8.54E+00	6.37E-08	1.77E-04
Centrifuge Room (EF_2)	2.61	1.62	2.61	9.07E+00	4.99E-06	9.66E-04
Grit Tank (GT)	1.62	1.62	2.61	1.14E+02	2.95E-06	2.30E-04
Secondary Clarifier North (SC_N)	1.62	1.62	2.61	7.37E+01	1.91E-06	1.49E-04
Secondary Clarifier South (SC_S)	1.62	1.62	2.61	5.01E+01	1.30E-06	1.01E-04

Notes:

Table E6: H_2S-Driven Odour Emission Refinement

Value	Temperature	Henry's Solubility Coefficient ($mol/m^3.Pa$)	Temperature Dependence of Hs (K)
H_2S Conditions at Reference Temperature	293.15 K	1.00E-03	2100
Date/Month	**Average Temperature (K)**	**Henry's Volatility Coefficient ($m^3.Pa/mol$)**	**Emission Rate Correction Factor $H_{V,H2S\_mo}/H_{V,H2S\_test}$**
29-Nov-23	276.15	1.00E+03	1
Jan	268.0	7.93E+02	0.79
Feb	268.9	8.14E+02	0.81
Mar	273.9	9.40E+02	0.94
Apr	278.6	1.07E+03	1.07
May	287.0	1.33E+03	1.33
Jun	292.3	1.52E+03	1.52
Jul	294.7	1.62E+03	1.62
Aug	293.9	1.58E+03	1.58
Sep	289.9	1.43E+03	1.43
Oct	283.2	1.21E+03	1.21
Nov	276.1	9.99E+02	1.00
Dec	272.7	9.09E+02	0.91

Table E7: Ammonia-Driven Odour Emission Refinement

Value	Temperature	Henry's Solubility Coefficient ($mol/m^3.Pa$)	Temperature Dependence of Hs (K)
NH_3 Conditions at Reference Temperature	293.15 K	5.90E-01	4200
Date/Month	**Average Temperature (K)**	**Henry's Volatility Coefficient ($m^3.Pa/mol$)**	**Emission Rate Correction Factor $H_{V,H2S\_mo}/H_{V,H2S\_test}$**
29-Nov-23	276.15	1.67E-05	1
Jan	268.0	1.05E-05	0.63
Feb	268.9	1.11E-05	0.66
Mar	273.9	1.48E-05	0.88
Apr	278.6	1.91E-05	1.14
May	287.0	2.98E-05	1.78
Jun	292.3	3.88E-05	2.32
Jul	294.7	4.36E-05	2.61
Aug	293.9	4.20E-05	2.51
Sep	289.9	3.44E-05	2.05
Oct	283.2	2.45E-05	1.46
Nov	276.1	1.67E-05	1.00
Dec	272.7	1.38E-05	0.83

Table E8: Molecular Weight of Digester Gas

Component	Component Percentage (%)	Source of Information	Molecular Weight (g/mol)	Weighted molar mass (g/mol)
Carbon Dioxide (CO2)	3.16E+01	Certificate of Analysis	44	1.39E+03
Carbon Monoxide (CO)	0.05		28	1.40E+00
Methane (CH4)	61.7		16	9.87E+02
Nitrogen (N2)	4.5		28	1.26E+02
Oxygen (O2)	0.98		32	3.14E+01
Sum	**9.88E+01**			**2.54E+03**
Molecular Weight of Digested gas (g/mol)			2.57E+01	

Table E9: Emissions and Flow Rate for WG_BN

Parameter	Units	Value	Source of Information	
Volumetric Flow Rate				
Firing Rate	BTU/hr	7.54E+06	Nameplate taken during site visits	
Methane Volume Flow	cfm at STP	1.30E+02	Firing Rate / LHV of Methane x Unit Converstion	
Methane Volume Flow	m^3/s at STP	6.15E-02	Unit conversion	
Methane Flow	g/s	2.20E+01	Volume Flow / Molar Volume x Methane MW	
Gas Composition				
Methane Content	%	62%	Certificate of Analysis	
Gas Characteristics				
Digester Gas Molecular Weight	g/mol	2.57E+01	Assume balance of gas is CO2	
Molar Volume	m^3/mol at STP	2.24E-02	Ideal Gas Law, V/n = RT/P	
Lower Heating Value of Methane	MJ/kg	5.00E+01	Engineering Tool Box	
Lower Heating Value of Methane	BTU/ft^3 at STP	9.64E+02	Engineering Tool Box	
Component Flow Rate				
Digester Gas Flow	m^3/s	9.97E-02	Methane Volume Flow / Methane Content	
Digester Gas Flow	g/s	7.04E+01	Methan Volume Flow / Molar Volume x Digester Gas MW	
Digester Gas Flow	mol/s	2.74E+00	Correction for MW	
Flare Characteristics				
Number of Nozzles	Unit	1	Client data	
Qt	MJ/s	1.10E+00	Methane Flow x Heating Value	
Stack Height (m)	m	4.5	From google earth	
Density of flared gas	kg/m^3	1.07	Unit Conversion of MW	
Destruction Efficiency	%	97.7	AP-42 2.4-3	
Qn	J/s	7.69E+05	Eqn 1 of Technical Bulletin	
Heff (m)	m	6.0	Eqn 1 of Technical Bulletin	
Diameter	m	0.10	Assumed	
Vnozzle	m/s	8.41E+00	Conversion of molar flow	
Fm	m^4/s^2	1.59E-01	Eqn 2 of Technical Bulletin	
Fb	m^4/s^2	6.8	Eqn 4 of Technical Bulletin	
Veff	m/s	1.5000	Eqn 3 of Technical Bulletin, minimum 1.5m/s	
Deff	m	1.5507	Eqn 6 of Technical Bulletin	
Exhaust Volume Rate eff	m^3/s	2.83E+00	Effective exhaust released into atmosphere	
Exhaust Volume Rate fm Stoichiometry	m^3/s	3.33E+00	Exhaust released in the stack	
Emission Factors				**Data Quality**
NO_X	$kg/10^6$dscm CH4	631	AP-42 Table 2.4-4 Flare	A
CO	$kg/10^6$dscm CH4	737	AP-42 Table 2.4-4 Flare	A
PM	$kg/10^6$dscm CH4	238	AP-42 Table 2.4-4 Flare	A
SO_2	$kg/10^6$dscm CH4	72.1	Webfire SCC 10300701	U
Emission Rate				
NO_X Emission Rate	g/s	3.88E-02	Methane Flow x Emission Factor	
CO Emission Rate	g/s	4.53E-02	Methane Flow x Emission Factor	
PM Emission Rate	g/s	1.46E-02	Methane Flow x Emission Factor	
SO_2 Emission Rate	g/s	4.43E-03	Methane Flow x Emission Factor	

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table E10: Emissions and Flow Rate for B_1 on Digester Gas

Parameter	Units	Value	Source of Information	
Volumetric Flow Rate				
Firing Rate	BTU/hr	1.25E+06	Nameplate from site visit	
Methane Volume Flow	scfm methane at STP	2.07E+01	Heating capacity / Methane Heating Value	
Methane Volume Flow	sm^3/s at STP	9.76E-03	Unit conversion	
Methane Flow	g/s	6.98E+00	Methane Flow / Molar Volume * Methane MW	
Gas Composition				
Methane Content	%	62%	Certificate of Analysis	
Gas Characteristics				
Molar Volume	m^3/mol at STP	2.24E-02	Ideal Gas Law, V/n = RT/P	
Methane Heating Value	BTU/scf at STP	1.01E+03	AP-42 default value	
Digester Gas Heating Value	BTU/scf at STP	6.24E+02	Methane Heating Value * Methane Content	
Component Flow Rate				
Digester Gas Flow	scfm	3.35E+01	Methane Flow / Methane Content	
Digester Gas Flow	sm^3/s	1.58E-02	Unit conversion	
Digester Gas Flow	g/s	1.81E+01	Digester Gas Flow / Molar Volume x Digester Gas MW	
Digester Gas Flow	mol/s	7.05E-01	Correction for MW	
Exhaust Characteristics				
Destruction Efficiency	%	100.0	Assumed	
Exhaust Generation Rate	mol/mol CH4	11.6	Stoichiometry assuming 5% excess air	
Exhaust Temperature	°C	100.0	Assumed	
Exhaust Volume Flow fm Stoichiometry	Am^3/s	0.155	Stoichiometry assuming 5% excess air	
Diameter	m	0.203	1977 Drawings	
Exit Velocity	m/s	4.776	Calculated	
Emission Factors				**Data Quality**
NO_X	$kg/10^6 dscm\ CH_4$	677	AP-42 Table 2.4-4 Boiler/Steam Turbine	D
CO	$kg/10^6 dscm\ CH_4$	116	AP-42 Table 2.4-4 Boiler/Steam Turbine	D
PM	$kg/10^6 dscm\ CH_4$	41	AP-42 Table 2.4-4 Boiler/Steam Turbine	D
SO_2	$kg/10^6 dscm\ CH_4$	72.1	Webfire SCC 10300701	U
Emission Rate				
NO_X Emission Rate	g/s	6.61E-03	Methane Flow x Emission Factor	
CO Emission Rate	g/s	1.13E-03	Methane Flow x Emission Factor	
PM Emisson Rate	g/s	4.00E-04	Methane Flow x Emission Factor	
SO_2 Emisson Rate	g/s	7.03E-04	Methane Flow x Emission Factor	

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table E11: Emissions and Flow Rate for B_1 on Natural Gas

Parameter	Units	Value	Source of Information	
Volumetric Flow Rate				
Firing Rate	BTU/hr	1.25E+06	Design Spec	
Methane Volume Flow	scfm methane	2.07E+01	Heating capacity / Methane Heating Value	
Methane Volume Flow	sm^3/s	9.76E-03	Unit conversion (from Methane Volume Flow)	
Methane Flow	g/s	6.98E+00	Methane Volume Flow / Molar Volume x Methane MW	
Gas Composition				
Methane Content	%	100%	Assumed	
Gas Characteristics				
Molar Volume	m^3/mol at STP	2.24E-02	Ideal Gas Law, V/n = RT/P	
Natural Gas Molecular Weight	g/mol	1.60E+01	Assume balance of gas is CO2	
Methane Heating Value	BTU/scf	1.01E+03	AP-42 default value	
Natural Gas Heating Value	BTU/scf	1.02E+03	Methane Heating Value x Methane Content	
Component Flow Rate				
Natural Gas Flow	scfm	2.07E+01	Methane Volume Flow / Methane Content	
Natural Gas Flow	sm^3/s	9.76E-03	Unit conversion	
Natural Gas Flow	g/s	6.98E+00	Natural Gas Flow / Molar Volume x Natural Gas MW	
Natural Gas Flow	mol/s	4.35E-01	Correction for MW	
Exhaust Characteristics				
Destruction Efficiency	%	100.0	Assumed	
Exhaust Generation Rate	mol/mol CH_4	11.0	Stoichiometry assuming 5% excess air	
Exhaust Temperature	°C	100.0	Assumed	
Exhaust Flow Rate	Am^3/s	0.147	Stoichiometry assuming 5% excess air	
Diameter	m	0.203	Estimated from photos	
Exit Velocity	m/s	4.521	Calculated	
Emission Factors				**Data Quality**
NO_X	kg/10^6dscm CH_4	1,600	AP-42 Table: 1.4-1 Emission Factors for Natural Gas combustion, small boilers uncontrolled	B
CO	kg/10^6dscm CH_4	1,344	AP-42 Table: 1.4-1 Emission Factors for Natural Gas combustion, small boilers uncontrolled	B
PM	kg/10^6dscm CH_4	121.6	AP-42 Table: 1.4-2 Emission Factors for Natural Gas combustion	D
Emission Rate				
NO_X Emission Rate	g/s	1.55E-02	Methane Flow x Emission Factor	
CO Emission Rate	g/s	1.30E-02	Methane Flow x Emission Factor	
PM Emisson Rate	g/s	1.18E-03	Methane Flow x Emission Factor	

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table E12: Emissions and Flow Rate for B_2 on Natural Gas

Parameter	Units	Value	Source of Information	
Volumetric Flow Rate				
Firing Rate	BTU/hr	2.50E+06	Design Spec	
Methane Volume Flow	cfm methane	4.12E+01	Firing Rate / Methane Heating Value	
Methane Volume Flow	m^3/s	1.95E-02	Methane Flow x Unit conversion	
Methane Flow	g/s	1.39E+01	Methane Flow / Molar Volume x Methane MW	
Gas Composition				
Methane Content	%	100%	Assumed	
Gas Characteristics				
Molar Volume	m^3/mol at STP	2.24E-02	Ideal Gas Law, V/n = RT/P	
Natural Gas Molar Mass	g/mol	1.60E+01	Assume balance of gas is CO2	
Methane Heating Value	BTU/scf	1.01E+03	AP-42 default value	
Natural Gas Heating Value	BTU/scf	1.02E+03	Methane Heating Value x Methane Content	
Component Flow Rate				
Natural Gas Flow	m^3/s	1.95E-02	Methane Volume Flow / Methane Content	
Natural Gas Flow	sm^3/s	9.18E-06	Unit conversion	
Natural Gas Flow	g/s	6.57E-03	Natural Gas Flow / Molar Volume x Natural Gas MW	
Natural Gas Flow	mol/s	4.10E-04	Correction for MW	
Exhaust Characteristics				
Destruction Efficiency	%	100.0	Assumed	
Exhaust Generation Rate	mol/mol CH_4	11.0	Stoichiometry assuming 5% excess air	
Exhaust Temperature	°C	120.0	Assumed	
Exhaust Flow Rate	m^3/s	0.31	Stoichiometry assuming 5% excess air	
Emission Factors				**Data Quality**
NO_X	kg/10^6dscm CH_4	1600	AP-42 Table: 1.4-1 Emission Factors for Natural Gas combustion, small boilers uncontrolled	B
CO	kg/10^6dscm CH_4	1344	AP-42 Table: 1.4-1 Emission Factors for Natural Gas combustion, small boilers uncontrolled	B
PM	kg/10^6dscm CH_4	121.6	AP-42 Table: 1.4-2 Emission Factors for Natural Gas combustion	D
Emission Rate				
NO_X Emission Rate	g/s	3.08E-02	Methane Flow x Emission Factor	
CO Emission Rate	g/s	2.59E-02	Methane Flow x Emission Factor	
PM Emisison Rate	g/s	2.34E-03	Methane Flow x Emission Factor	

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table E13: Emissions and Flow Rate for CHP on Digester Gas

Parameter	Units	Value	Source of Information	
CHP Operating Parameters				
Fuel Consumption	kW	623	Agenitor 406 Technical Specification, page 3	
Electrical Power	kW	250	Agenitor 406 Technical Specification, page 3	
Recoverable Thermal Output	kW	263	Agenitor 406 Technical Specification, page 3	
Gas Composition				
Methane Content	%	62%	Certificate of Analysis	
Combustible Mass Flow	kg/h	168.5	Agenitor 406 Technical Specification, page 4	
Combustible Volume Flow	Nm^3/h	125.1	Agenitor 406 Technical Specification, page 4	
Methane Flow	dscm/s	0.021	Calculated (Methane Content x Combustible volume flow)	
Exhaust Characteristics				
Exhaust Temperature	°C	180	Agenitor 406 Technical Specification, page 6	
Normal Exhaust Flow Rate Wet	Nm^3/h	1,157	Agenitor 406 Technical Specification, page 6	
Actual Exhaust Flow Rate	m^3/s	0.53	Flow rate corrected for exhaust temperature	
Stack Diameter	m	0.66	Agenitor 2G Standard Basic Container Execution Plan	
Emission Factors				**Data Quality**
NO_X	g/Nm^3 exhaust	0.09	Agenitor 406 Technical Specification, page 3	A
CO	g/Nm^3 exhaust	0.40	Agenitor 406 Technical Specification, page 3	A
PM	$kg/10^6 dscm\ CH_4$	232	AP-42 Table: 2.4-4 Draft Document, IC Engine	D
Decamethyltetrasiloxane (L4)	$g/10^6$ dscm gas	2.2	Digester gas analysis	A
Emission Rate				
NO_X Emission Rate	g/s	2.89E-02	Exhaust flow x Emission factor	
CO Emission Rate	g/s	1.29E-01	Exhaust flow x Emission factor	
PM Emisison Rate	g/s	4.79E-03	Methane flow x Emission factor	
Decamethyltetrasiloxane (L4)	g/s	7.65E-08	Digester gas flow x Emission factor	

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table E14: Exhaust Flow Calculation - Digester Gas

Parameter	Units	Value	Source of Information
Basis			
Volume of Fuel	mole	1.00E+00	Design Basis
Combustion Assumptions			
Methane Content	%	62%	Manufacturer Estimate
Proportion of Combustion Air	%	105%	Standard combustion practice

Molecules In	Moles of Molecule	Elemental Analysis			
		C	H	O	N
CH_4	1.0	1	4		
CO_2	0.6	0.620745543		1.24	
O_2	2.1			4.20	
N_2	7.9				15.8
H_2O	0.0		0	0.00	
Total	**11.6**	**1.620745543**	**4**	**5.44**	**15.8**

Molecules Out	Moles of Molecule	Elemental Analysis			
		C	H	O	N
CH_4	0.0				
CO_2	1.6	1.620745543		3.241491086	
O_2	0.1			0.20	
N_2	7.9				15.8
H_2O	2.0		4	2	
Total	**11.6**	**1.620745543**	**4**	**5.441491086**	**15.8**

Table E15: Exhaust Flow Calculation - Natural Gas

Parameter	Units	Value	Source of Information
Basis			
Volume of Fuel	mole	1.00E+00	Design Basis
Combustion Assumptions			
Methane Content	%	100%	Standard combustion practice
Proportion of Combustion Air	%	105%	Standard combustion practice

Molecules In	Moles of Molecule	Elemental Analysis			
		C	H	O	N
CH_4	1.0	1	4		
CO_2	0.0	0		0	
O_2	2.1			4.2	
N_2	7.9				15.8
H_2O	0.0		0	0	
Total	**11.0**	**1**	**4**	**4.20**	**15.8**

Molecules Out	Moles of Molecule	Elemental Analysis			
		C	H	O	N
CH_4	0.0				
CO_2	1.0	1		2	
O_2	0.1			0.21	
N_2	7.9				15.8
H_2O	2.0		4	2	
Total	**11.0**	**1**	**4**	**4.21**	**15.8**

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table E16: Emissions and Flow Rates for GEN_1

Parameter	Units	Value	Source of Information	
General Information				
Manufacturer	Sommers		Gen 1 Sommers DGVSW Spec Sheet, page 1	
Model	DGVSW		Gen 1 Sommers DGVSW Spec Sheet, page 1	
Fuel Type	Diesel		Gen 1 Sommers DGVSW Spec Sheet, page 1	
Load Level	%	40%	Design 40% load for testing according to the CSA	
Max. Power	kWm	546	Gen 1 Sommers DGVSW Spec Sheet, page 2	
Engine Capacity	Bhp	732	Conversion	
Effective Engine Capacity	Bhp	293	Engine Capacity x Load Level	
Exhaust Gas Volume	m3/min	100.6	Gen 1 Sommers DGVSW Spec Sheet, page 3	
Exhaust Flow	m3/s	1.68	Conversion	
Exhaust Gas Temp	°C	436	Gen 1 Sommers DGVSW Spec Sheet, page 3	
Exhaust Diameter	m	0.20	Estimated for typical generator exhaust velocity	
Exhaust Velocity	m/s	52	Calculated from flow and diameter	
Emission Factors				**Data Quality**
NO_X	g/kW.hr	6.40E+00	Diesel Emission Standards	D
NO_X	g/hp-s	1.33E-03	Conversion	D
CO	g/kW.hr	3.50E+00	Diesel Emission Standards	D
CO	g/hp-s	7.25E-04	Conversion	D
SO_2	lb/hp-hr	1.21E-05	AP-42 Table: 3.4-1 Large Stationary Diesel	D
SO_2	g/hp-s	1.53E-06	Conversion	D
PM	g/kW.hr	2.00E-01	Diesel Emission Standards	D
PM	g/hp-s	4.14E-05	Conversion	D
Emission Rates				
NO_X Emissions	g/s	3.88E-01	Engine Capacity x NO_X(g/Hp-s)	
CO Emissions	g/s	2.12E-01	Engine Capacity x CO (g/Hp-s)	
SO_2 Emissions	g/s	4.48E-04	Engine Capacity x SO_2 (g/Hp-s)	
PM Emissions	g/s	1.21E-02	Engine Capacity x PM (g/Hp-s)	

Table E17: Emissions and Flow Rates for GEN_2

Parameter	Units	Value	Source of Information	
General Information				
Manufacturer	Cummins		Gen 2 Cummins 230DFAB spec-sheet, page 1	
Model	DFAB		Gen 2 Cummins 230DFAB spec-sheet, page 1	
Fuel Type	Diesel		Gen 2 Cummins 230DFAB spec-sheet, page 1	
Load Level	%	40%	Design 40% load for testing according to the CSA	
Gross Engine Power Output	kWm	283.5	Gen 2 Cummins 230DFAB spec-sheet, page 3	
Gross Engine Power Output	Bhp	380	Gen 2 Cummins 230DFAB spec-sheet, page 3	
Effective Engine Capacity	Bhp	152	Engine Capacity x Load Level	
Load restriction	%	75	Cummins Generator Load Test	
Operating Engine load	hp	285	Gross Engine Power Output x Load Restriction	
Exhaust Flow at Rated Load	m^3/min	47	Gen 2 Cummins 230DFAB spec-sheet, page 3	
Exhaust Flow	m^3/s	0.78	Conversion	
Exhaust Temp	°C	510	Gen 2 Cummins 230DFAB spec-sheet, page 3	
Exhaust Diameter	m	0.15	Estimated for typical generator exhaust velocity	
Exhaust Velocity	m/s	43	Calculated from flow and diameter	
Emission Factors				**Data Quality**
NO_X	lb/hp-hr	3.10E-02	AP-42 Table: 3.3-1 Diesel Fuel	D
NO_X	g/hp-s	3.91E-03	Conversion	D
CO	lb/hp-hr	6.68E-03	AP-42 Table: 3.3-1 Diesel Fuel	D
CO	g/hp-s	8.42E-04	Conversion	D
SO_2	lb/hp-hr	1.21E-05	AP-42 Table: 3.4-1 Large Stationary Diesel, EF x SOx content in fuel	D
SO_2	g/hp-s	1.53E-06	Conversion	D
PM	lb/hp-hr	2.20E-03	AP-42 Table: 3.3-1 Diesel Fuel	D
PM	g/hp-s	2.77E-04	Conversion	D
Emission Rates				
NO_X Emissions	g/s	5.94E-01	Engine Capacity x NO_X(g/Hp-s)	
CO Emissions	g/s	1.28E-01	Engine Capacity x CO (g/Hp-s)	
SO_2 Emissions	g/s	2.32E-04	Engine Capacity x SO_2 (g/Hp-s)	
PM Emissions	g/s	4.21E-02	Engine Capacity x PM (g/Hp-s)	

APPENDIX F: LAND USE ZONING DESIGNATION PLAN

Oxford County
Growing stronger together

Legend

Land Use Zoning (Displays 1:16000 to 1:500)

Notes

0 406 813 Meters

NAD_1983_UTM_Zone_17N

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. This is not a plan of survey

November 7, 2023

SECTION 4.0 ZONES

4.1 CLASSIFICATION

4.1.1 The provisions of this By-law shall apply to all lands within the limits of the Corporation of the City of Woodstock. For the purposes of this By-law, said lands are divided into the following zones:

SYMBOL	ZONE
Residential Zones	
R1	Residential Type 1 Zone
R2	Residential Type 2 Zone
R3	Residential Type 3 Zone
R4	Residential Type 4 Zone
HD	Historical District Residential Zone
Commercial Zones	
C1	Local Commercial Zone
C2	Shopping Centre Commercial Zone
C3	Entrepreneurial District Zone
C4	Highway Commercial Zone
C5	Central Commercial Zone
C6	Regional Commercial Zone
Industrial Zones	
M1	Prestige Industrial Zone
M2	Restricted Industrial Zone
M3	General Industrial Zone
M4	Transitional Industrial Zone
Institutional Zones	
NI	Neighbourhood Institutional Zone
CF	Community Facility Zone
Open Space Zones	
OS1	Passive Use Open Space Zone
OS2	Active Use Open Space Zone
Environmental Protection Zones	
EP1	Environmental Protection Zone 1
EP2	Environmental Protection Zone 2

ZONES

Development Zones

FD	Future Development Zone
PUD	Planned Unit Development Zone

Agricultural Zones

AG	Agricultural Zone

4.1.2 The *permitted uses*, minimum size and dimensions of *lots*, minimum size of *yards*, maximum *lot coverage*, *gross floor area*, minimum *setback*, minimum *landscaped open space*, maximum *height* of *buildings* and all other zone provisions are set out herein for the respective zones.

4.1.3 The extent of boundaries of all zones are shown on Schedule "A", which forms part of this By-law and is attached hereto.

4.1.4 The symbols listed in subsection 4.1.1 may be used to refer to *buildings* and *structures*, the *uses* of *lots*, *buildings* and *structures permitted* by this By-law within the said zones. Where, in this By-law, the word 'Zone' is used, preceded by any of the said symbols, such zones shall mean any area within the *Corporation* within the scope of this By-law, delineated on Schedule "A" and designated thereon by the said symbol.

4.1.5 Where the zone symbol on lands shown on Schedule "A" is followed by a dash and a number (i.e. R1-1), special provisions apply to such lands and said special provisions will be contained in that section of the By-law having reference to the specific zone.

4.2 HOLDING "H" ZONES

4.2.1 Where a zone symbol listed in subsection 4.1.1 is used in conjunction with the holding symbol "H", as illustrated on the zone maps, no *buildings* or *structures* shall be *erected* or *altered*, save and except *existing buildings* and *structures* and *accessory buildings* and *structures permitted* in the said zone and in accordance with the standards of the said zone until the "H" symbol is removed in accordance with the requirements of the Planning Act.

4.2.1.1 HOLDING ZONE PROVISIONS

i) Any interim *uses* and requirements for the lifting of the "H" symbol shall be described within the specific zone categories to which they apply.

4.3 TEMPORARY ZONES AND TEMPORARY USE BY-LAWS

Temporary zones or by-laws typically allow a *use* that would not be *permitted* otherwise on the applicable lands for a temporary period of time. Temporary zones and/or by-laws are identified on Schedule "F" of this By-law.

APPENDIX G: TIER 1 DISPERSION MODELLING

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table G1: Dispersion Factors for Tier 1 Modelling

Source	Tier 1 Dispersion Factor (µg/m^3 per g/s)				
	10-min	30-min	1-hr	24-hr	Annual
GEN_1	1,532.42	1,126.63	928	383	23
GEN_2	3,510.01	2,580.56	2,125	1,189	61
WG_BN	451.91	332.24	274	114	7
B_1	4,053.31	2,980.00	2,454	1,184	168
B_2	2,094.26	1,539.70	1,268	496	70
CHP	912.30	670.72	552	282	36
EF_1	12,991.37	9,551.27	7,866	1,669	220
EF_2	11,258.23	8,277.06	6,817	1,311	138
AT_N	22,513,787.46	16,552,157.52	13,632,208	2,288,712	152,772
AT_S	18,804,273.03	13,824,919.05	11,386,079	2,236,894	180,557
GT	4,883,628.86	3,590,448.49	2,957,061	507,696	35,558
PC_E	12,315,214.56	9,054,157.22	7,456,923	1,163,718	77,896
PC_W	10,816,586.50	7,952,364.47	6,549,496	1,013,397	62,991

Client: J.L. Richards & Associates Ltd.
Project: Woodstock WWTP REA Application
Address: 195 Admiral St., Woodstock, Ontario

Table G2: Tier 1 Dispersion Modelling - Significant Contaminants with 10-minute Averaging Time ACBs

Contaminant Name	CAS Registry Number	Total Facility Emission Rate (OU/s)	Tier 1 Level Concentration (OU/m^3)	Tier 2 Level Concentration (OU/m^3)	MECP Guideline (OU/m^3)	Limiting Effect	Compliance Ratio
Odour	N/A-1	1.11E+03	1.60E+01	2.13E+00	1	Odour	213%

Table G3: Tier 1 Dispersion Modelling - Significant Contaminants with ½-hour Averaging Time ACBs

Contaminant Name	CAS Registry Number	Total Facility Emission Rate (g/s)	Tier 1 Level Concentration ($\mu g/m^3$)	Tier 2 Level Concentration ($\mu g/m^3$)	Air Contaminant Benchmark ($\mu g/m^3$)	Limiting Effect	Compliance Ratio
Nitrogen oxides	10102-44-0	1.10E+00	1.66E+03	N/A	1880	Health	88%
Carbon monoxide	630-08-0	5.53E-01	7.49E+02	N/A	6000	Health	12%

Table G4: Tier 1 Dispersion Modelling - Significant Contaminants with 1-hour Averaging Time ACBs

Contaminant Name	CAS Registry Number	Total Facility Emission Rate (g/s)	Tier 1 Level Concentration ($\mu g/m^3$)	Tier 2 Level Concentration ($\mu g/m^3$)	Air Contaminant Benchmark ($\mu g/m^3$)	Limiting Effect	Compliance Ratio
Nitrogen oxides	10102-44-0	1.10E+00	1.04E+02	N/A	400	Health	26%
Sulphur dioxide	7446-09-5	5.11E-03	2.12E+00	N/A	100	Health & Vegetation	2%

Table G5: Tier 1 Dispersion Modelling - Significant Contaminants with 24-hour Averaging Time ACBs

Contaminant Name	CAS Registry Number	Total Facility Emission Rate (g/s) or (g/s/m2)	Tier 1 Level Concentration ($\mu g/m^3$)	Tier 2 Level Concentration ($\mu g/m^3$)	Air Contaminant Benchmark ($\mu g/m^3$)	Limiting Effect	Compliance Ratio
Nitrogen oxides	10102-44-0	1.10E+00	4.62E+01	N/A	200	Health	23%
Suspended particulate matter (< 44 µm diameter)	N/A-2	7.74E-02	5.79E+01	N/A	120	Visibility	48%

Table G6: Tier 1 Dispersion Modelling - Significant Contaminants with Annual Averaging Time ACBs

Contaminant Name	CAS Registry Number	Total Facility Emission Rate (g/s)	Tier 1 Level Concentration ($\mu g/m^3$)	Tier 2 Level Concentration ($\mu g/m^3$)	Air Contaminant Benchmark ($\mu g/m^3$)	Limiting Effect	Compliance Ratio
Sulphur dioxide	7446-09-5	5.11E-03	3.15E-02	N/A	100	Health & Vegetation	0.03%

APPENDIX H: AIR MODELLING INPUT AND OUTPUT FILES

Appendix H is provided in a separate digital file.