

EMISSION SUMMARY AND DISPERSION MODELLING REPORT

**WOOLWICH BIO-EN INC.
ELMIRA, ONTARIO**

FEBRUARY 2010

REF. NO. 046254 (3)

This report is printed on recycled paper.

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EXECUTIVE SUMMARY

This Emission Summary and Dispersion Modelling (ESDM) Report was prepared to support an Application for Renewable Energy Approval (REA). The ESDM Report was prepared in accordance with s.26 of O.Reg. 419/05 to support the Application for REA. In addition, guidance in the ministry publication "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009 (ESDM Procedure Document) was followed as appropriate.

Woolwich Bio-En Inc. (Bio-En) plans to construct and operate a biogas-fired power plant fuelled by biogas generated through the anaerobic digestion of various forms of biomass. The facility is to be located at 40 Martin's Lane (Plan 58R-14363, Lot 18, Part 9) in Elmira, Ontario (Facility). The Facility is located in an area zoned for industrial use. Bio-En will produce biogas from the anaerobic digestion of organic material at the Facility and will use that biogas to generate electricity.

The Facility is subject to s.19 of O.Reg. 419/05, therefore the modelled impact of contaminant emissions can be assessed as half-hour maximum point of impingement (POI) concentration. The appropriate model to assess the half-hour maximum POI impact is the model in the Appendix to Regulation 346. The Facility has made a request under O.Reg. 419/05 s.20(4) to have Schedule 3 standards apply in advance of the date specified by the regulation. This request has been made for all emissions. The appropriate model to assess the maximum POI impact for these contaminants is the United States Environmental Protection Agency (USEPA) SCREEN3 or AERMOD models.

The Facility is expected to emit volatile organic compounds (VOCs), products of combustion and odour. Some of the sources and contaminants were considered negligible in accordance with s.8 of O.Reg. 419/05.

The maximum POI concentrations were calculated based on the Operating Conditions where all significant sources are operating simultaneously at their individual maximum rates of production. The maximum emission rates for each significant contaminant emitted from the significant sources were calculated in accordance with s.11 of O.Reg. 419/05 and the data quality assessment follows the process outlined in the requirements of the ESDM Procedure Document.

A POI concentration for each significant contaminant emitted from the Facility was calculated based on the estimated emission rates and the output from the approved

dispersion model; the results are presented in the following Emission Summary Table in accordance with s.26 of O.Reg. 419/05.

The POI concentrations listed in the Emission Summary Tables were compared against criteria listed in the Ministry publication "Summary of O.Reg. 419 Standards and Guidelines to support Ontario Regulation 419: Air Pollution - Local Air Quality" and "Jurisdictional Screening Levels (JSL) List" dated February 2008.

Contaminants released by the Facility that are not found on the List of MOE POI Limits or the JSL list are considered to be Contaminants with No Ministry POI Limits. In accordance with the requirements of the ESDM Procedure Document, these contaminants are documented in the completed copy of Ministry document "Supporting Information for a Maximum Ground Level Concentration Acceptability Request Supplement for Approval, EPA S.9".

EMISSION SUMMARY TABLE
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.

Contaminant	CAS No.	Total Facility Emission Rate	Flare Conc.	Engine Conc.	Engine Conc.	Boiler Conc.	Air Dispersion Model Used	Max. Ground Level Conc.	Averaging Period	MOE POI Limit	Limiting Effect	Regulation Schedule #	Percentage of MOE POI Limit
		(g/s) or (OU/s)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	ug/m3/(OU) (2)	(hours)	(ug/m3)				
Carbon Monoxide	630-08-0	7.61	3.32E+02	3.30E+02	3.30E+02	9.71E+01	SCREEN 3	1.09E+03	0.5	6000	Health	3	18.14%
Nitrogen Oxides	10102-44-0	1.80	1.50E+01	9.16E+01	9.16E+01	1.16E+02	SCREEN3	3.14E+02	1	400	Health	3	78.42%
		1.80	6.00E+00	3.66E+01	3.66E+01	4.62E+01	SCREEN3	1.25E+02	24	200	Health	3	62.74%
NMHC	NA	0.32	NA	1.83E+01	1.83E+01	NA	SCREEN3	3.66E+01	1	NA	NA	NA	NA
									24	NA	NA	NA	NA
Particulate Matter	NA	0.24	2.49E+00	4.03E+00	4.03E+00	8.79E+00	SCREEN3	1.93E+01	24	120	Visibility	3	16.11%
Odour	NA	11111	NA	NA	NA	NA	AERMOD	0.69 See Modelling Memorandum	10 min	1 OU	Odour	G	NA
Ammonia	7664-41-7	4.84.E-02	NA	NA	NA	NA	SCREEN3	1.12E+00	24	100	Health	3	1.12%
Trimethylamine	75-50-3	2.08.E-03	NA	NA	NA	NA	SCREEN3	1.20E-01	1	0.5	Odour	3 (G)	24.07%
Triethylamine	121-44-8	1.94.E-03	NA	NA	NA	NA	SCREEN3	1.35E-01	0.5	21	NA	JSL	<1%
								4.49E-02	24	7	NA	JSL	<1%
Hydrogen Sulfide	7783-06-4	3.87.E-03	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Methyl Mercaptan	74-93-1	1.10.E-03	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Ethyl Mercaptan	75-08-1	2.56.E-03	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Dimethyl Sulphide	77-78-1	1.00.E-02	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Dimethyl disulphide	624-92-0	5.99.E-03	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Total Reduced Sulfur (4)	NA	2.35.E-02	NA	NA	NA	NA	SCREEN3	5.44E-01	24	7	Health	3	7.77%
								2.24E+00	10 min	13	Odour	3	17.26%
Butanol	71-36-3	1.67.E-02	NA	NA	NA	NA	SCREEN3	3.85E-01	24	920	Health	3	<1%
								1.59E+00	10 min	2100	Odour	G (S.20)	<1%

EMISSION SUMMARY TABLE
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.

<i>Contaminant</i>	<i>CAS No.</i>	<i>Total Facility Emission Rate (g/s) or (OU/s)</i>	<i>Flare Conc. (ug/m3)</i>	<i>Engine Conc. (ug/m3)</i>	<i>Engine Conc. (ug/m3)</i>	<i>Boiler Conc. (ug/m3)</i>	<i>Air Dispersion Model Used</i>	<i>Max. Ground Level Conc. (ug/m3 / (OU) (2)</i>	<i>Averaging Period (hours)</i>	<i>MOE POI Limit (ug/m3)</i>	<i>Limiting Effect</i>	<i>Regulation Schedule #</i>	<i>Percentage of MOE POI Limit</i>
Alpha-pinene	80-56-8	1.24.E-02	NA	NA	NA	NA	SCREEN3	8.58E-01 2.86E-01	0.5 24	810 270	NA NA	JSL JSL	<1% <1%
Limonene	5989-27-5	2.33.E-02	NA	NA	NA	NA	SCREEN3	1.62E+00 5.39E-01	0.5 24	1875 625	NA NA	JSL JSL	<1% <1%
Acetic Acid	64-19-7	8.33.E-03	NA	NA	NA	NA	SCREEN3	1.93E-01	24	2500	Odour	G (S.20)	<1%
Oleic Acid	112-80-1	9.63.E-03	NA	NA	NA	NA	SCREEN3	5.56E-01	1	5	Health	G (S.20)	11.12%
Butyric Acid	107-92-6	3.00.E-03	NA	NA	NA	NA	SCREEN3	2.08E-01 6.94E-02	0.5 24	4.32 1.44	NA NA	JSL JSL	4.82% 4.82%
Cyclopentanol	96-41-3	1.78.E-02	NA	NA	NA	NA	SCREEN3 SCREEN3	1.23E+00 4.11E-01	0.5 24	8640 2880	NA NA	JSL JSL	<1% <1%
Propyl acetate	109-60-4	1.11.E-02	NA	NA	NA	NA	SCREEN3	2.57E-01	24	6600	Health	G (S.20)	<1%
Propyl butyrat	105-66-8	1.78.E-02	NA	NA	NA	NA	SCREEN3	1.03E+00 4.11E-01	1 24	NA NA	NA NA	NA NA	NA NA
Pentanone	107-87-9	4.44.E-03	NA	NA	NA	NA	SCREEN3	3.08E-01 1.03E-01	0.5 24	6360 2120	NA NA	JSL JSL	<1% <1%
Me-isobutyl ketone	108-10-1	2.22.E-02	NA	NA	NA	NA	SCREEN3	5.13E-01	24	1200	Odour	G (S.20)	<1%
Nonanal	124-19-6	1.11.E-02	NA	NA	NA	NA	SCREEN3	7.70E-01 2.57E-01	0.5 24	180 60	NA NA	JSL JSL	<1% <1%

Notes:

1 - refers to Standards in Schedule 1 of O. Reg. 419/05

2-Screen3 model outputs 1-hour POI concentrations, the Maximum ground level concentration output by this model has been used for comparison with POI limits. The 1-hr values were converted to the appropriate averaging period using the MOE approved conversion factors as follows: to convert to 1/2 hour : multiply by 1.2, to convert to 10 minute, multiply by 1.65, to convert to 24 hr multiply by 0.4.

3- refers to Standards in Schedule 3 of O. Reg. 419/05

(G) - refers to criteria identified in the document "Summary of O. Reg. 419/05 Standards and Point of Impingement Guidelines and Ambient Air Quality Criteria (AAQCs)" date December 2005.

NA - No Available Criteria

(4) Total reduced sulfur compounds include sulphides and mercaptans and have been summed to compare against the TRS standard

1.0 INTRODUCTION AND FACILITY DESCRIPTION

This Emission Summary and Dispersion Modelling (ESDM) Report was prepared in accordance with s.26 of O. Reg. 419/05. In addition, guidance in the Ministry publication "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009 (ESDM Procedure Document) PIBS 3614e02 was followed as appropriate.

For ease of review and to promote clarity this ESDM Report is structured to correspond to each of the items listed in the ministry publication "2005 Emission Summary and Dispersion Modelling Check-List" PIBS 5357e.

The section provides a description of the facility as required by subparagraph 1 of s.26(1) of O.Reg. 419/05.

1.1 PURPOSE AND SCOPE OF ESDM REPORT

This ESDM Report was prepared to support an Application for a Renewable Energy Approval (REA) for all sources at the facility. The ESDM Report was prepared in accordance with s.26 of O.Reg. 419/05 to support the REA Application.

Woolwich Bio-En Inc. (Bio-En) plans to operate an anaerobic digestion (AD) and power generation facility to be located at 40 Martin's Lane (Plan 58R-14363, Lot 18, Part 9) in Elmira, Ontario (Facility).

The location of the Facility is presented in Figure 1 and the land use designation of the site and surrounding area is presented in Figures 2A and 2B. The location of the discharges from each of the sources is presented in Figure 3A; the location of each of the sources is specified with the source reference number.

1.2 DESCRIPTION OF PROCESSES AND NAICS CODES

An overall process schematic is included on Figure 4. The AD process to be employed at the Proposed Facility can be summarized as follows:

- Incoming renewable energy crops and other solid wastes are unloaded onto the floor in the Solids Receiving area in the Process Building.

- Liquid or slurry manure is unloaded from tankers into the first pretreatment tank or into one of the liquid storage tanks.
- Incoming dissolved air flotation solids (DAF) and fats, oils, and greases (FOG) materials are unloaded into 175 m³ storage tanks outside of the Process Building. The DAF and FOG materials are pumped to a Liquid Organics Mixing Unit in the Process Building. The incoming feedstock storage tanks are contained by a concrete barrier wall for secondary containment.
- Incoming glycerine is unloaded into a 20 m³ storage container and fed into the Liquid Organics Mixing Unit to be combined with the other feedstock materials.
- Incoming kitchen waste and food processing organic materials are processed in the Solid Organics Pre-processing and Mixing Unit and are mixed with the other organic materials and recycled process water so they can be pumped to a storage tank or pretreatment tank. Materials are pumped from the storage tank, Solid Organics Pre-processing and Mixing Unit to the Pretreatment Tanks.
- Residual material that is not suitable for AD is sorted from incoming kitchen and food processing waste and is stored in the Process Building in a dedicated area and are transported off Site when the 40 m³ bin has reached capacity.
- Surface runoff water collected in the Storm Water Management (SWM) pond or fresh municipal or off-Site water is used to supplement the recycled process water as required to balance water losses in the AD process.
- The organic materials are pumped from the Mixing Units to a Pretreatment Tank equipped with two mixers to further homogenize the materials and increase the temperature of the organics to approximately 50-60°C.
- The mixed organic materials are then pumped to one of the two other Pretreatment Tanks, equipped with only one mixer each, for a hydraulic retention time (HRT) of approximately 20 hours. The Pre-treatment Tanks are operated in batches. While the material in one of the tanks is undergoing pretreatment, the other tank is being emptied and filled with new material.
- After pretreatment, the organic material is periodically pumped to one of two Digestion Tanks to complete the AD process and generate the desired biogas. Unlike the Pre-treatment Tanks, the Digestion Tanks are operated under continuous mix and the material from the Pretreatment Tanks is intermittently dosed in to the Digestion Tanks. The digesters are insulated and heated to maintain a temperature of approximately 35-45°C and have an HRT of approximately 15 to 25 days. During the AD process, the fermenter conditions and resulting biogas is continuously monitored as part of an overall control process to optimize biogas yields and energy production.

- The methane-poor gas from the Pretreatment Tanks is injected into the Digestion Tanks through the floor to facilitate vertical mixing and maximize methane collection efficiency of the entire AD process.
- The biogas from the Main Digester Tanks and the Secondary Digester and Repository Tank is collected in biogas storage membranes and is piped to a Combined Heat and Power (CHP) cogeneration unit, or to a flare if the CHP unit is not operational and the biogas storage is full.
- Electrical and thermal energy are generated in the CHP units that are specifically designed for the combustion of biogas. Thermal energy is recovered from the CHP unit using a heat exchanger.
- The digestate is pumped from the Digestion Tanks through a solids separator to remove the solids (approximately 4 percent dry matter) for recycle water or directly to the Secondary Digester and Repository Tank to await off-Site transport and eventual land application on agricultural fields. The liquid portion of the digestate is either recirculated back to the Mixing Unit as an inoculant for the AD process or pumped to the Secondary Digester and Repository Tank. Secondary Digester and Repository Tank will have approximately 30 days storage capacity.
- The solid portion of the digestate (approximately 27 percent dry matter) is stored in a bin in the Process Building and transported off Site when the bin reaches capacity. The digestate solids are land applied as a nutrient source and soil conditioning agent (fertilizer), similar to the digestate liquids.

The North American Industry Classification System (NAICS) Codes that apply to this Facility are 221119 Other Electricity Generation and 562219 Other Nonhazardous Waste Treatment and Disposal.

1.3 DESCRIPTION OF PRODUCTS AND RAW MATERIALS

The Facility produces biogas from a variety of organic materials that may include, but are not limited to:

- Organics from food processing facilities, grocery stores, food distribution companies, and milling facilities (0 to 40,000 tonnes/year)
- Livestock manure (0 to 13,000 tonnes/year)
- Glycerol (0 to 3,000 tonnes/year)
- Kitchen waste (0 to 40,000 tonnes/year)
- Fats, oil, and grease (FOG) (0 to 20,000 tonnes/year)

- Renewable energy crops (i.e., corn silage) (0 to 12,000 tonnes/year)
- Organic solids skimmed from a dissolved air flotation (DAF) tank (0 to 20,000 tonnes/year)

Product usages and process information are provided in greater detail in Appendix A – Supporting Calculations. Refer to Table 1 - Sources and Contaminants Identification Table, which tabulates the individual sources of emissions at the Facility.

1.4 PROCESS FLOW DIAGRAM

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

1.5 OPERATING SCHEDULE

The Facility will operate 24 hours per day, 7 days a week, up to 52 weeks per year.

1.6 FACILITY PRODUCTION LIMIT

The projected production capacity of the Facility is a maximum of 2.85 MW of electricity and 3.02 MW of heat.

2.0 INITIAL IDENTIFICATION OF SOURCES AND CONTAMINANTS

This section provides an initial identification of all of the sources and contaminants emitted at the Facility, as required by subparagraphs 2 to 4 of s.26 (1) of O.Reg. 419/05.

There may be general ventilation from the Facility that only discharges uncontaminated air from the workspaces or air from the workspace that may include contaminants that come from commercial office supplies, building maintenance products or supplies and activities; these types of ventilation sources are considered to be negligible and were not identified as sources at the Facility.

It should be noted that general ventilation located in the process area that does not vent process emissions is also considered negligible.

2.1 SOURCES AND CONTAMINANTS IDENTIFICATION TABLE

Table 1 - Sources and Contaminants Identification Table tabulates all the emission sources at the Facility. Table 1 provides the information required for subparagraphs 2 to 4 of s.26 (1) of O.Reg. 419/05.

The expected contaminants emitted from each source are also identified in Table 1. Each of the identified sources has been assigned a source reference number.

The location of the discharges from each of the sources is presented in Figure 3A - Site Plan and Roof Layout; the location of each of the sources is specified with the source reference number.

3.0 ASSESSMENT OF SIGNIFICANCE OF SOURCES AND CONTAMINANTS

This section provides an explanation for each source and contaminant identified as negligible in Table 1, as requested by subparagraph 5 of s. 26(1) of O.Reg. 419/05.

In accordance with s.8 of O.Reg. 419/05 emission rate calculations and dispersion modelling does not have to be performed for emissions from negligible sources or for the emission of negligible contaminants from significant sources.

3.1 IDENTIFICATION OF NEGLIGIBLE CONTAMINANTS AND SOURCES

Of all the sources listed in Table 1, one has been identified as negligible, this being dust from onsite roads. The negligible source is identified in Table 1.

The remaining sources are significant. These sources will be included in the dispersion modelling for the site.

3.2 RATIONALE FOR ASSESSMENT

For each source in Table 1 that has been identified as being negligible there is an accompanying documented rationale. The technical information required to substantiate the argument that each of the identified sources is negligible is presented in Appendix B – Supporting Information for Assessment of Negligibility.

For each contaminant in Table 1 that has been identified as being negligible there is an accompanying rationale. The technical information required to substantiate the argument that each of the identified sources is negligible is presented in Appendix B – Supporting Information for Assessment of Negligibility.

4.0 OPERATING CONDITIONS, EMISSIONS ESTIMATING AND DATA QUALITY

This section provides a description of the operating conditions used in the calculation of the emission estimates and an assessment of the data quality of the emission estimates for each significant contaminant from the facility as required by subparagraphs 6 and 7 of s.26 (1) of O.Reg. 419/05. In accordance with s.8 of O.Reg. 419/05, emission rate calculations and dispersion modelling does not have to be performed for emissions from negligible sources.

4.1 DESCRIPTION OF OPERATING CONDITIONS

Section 10 of O.Reg. 419/05 states that an acceptable operating condition is a scenario that assumes operating conditions for the Facility that would result, for the relevant contaminant, in the highest concentration of the contaminant at a POI that the Facility is capable of. The operating condition described in this ESDM Report meets this requirement.

The averaging time for the operating condition is one hour. The operating condition used for this Facility that results in the maximum concentration at a POI is the scenario where all significant sources are operating simultaneously at their individual maximum rates of production. The individual maximum rates of production for each significant source of emissions correspond to the maximum emission rate during any hour period. The individual maximum rates of production for each significant source of emissions are explicitly described in Appendix A.

4.2 EXPLANATION OF THE METHODS USED TO CALCULATE EMISSION RATES

The maximum one hour emission rates for each significant contaminant emitted from the significant sources were calculated in accordance with requirements of the ESDM Procedure Document.

The emission rate for each significant contaminant emitted from a significant source was estimated and the methodology for the calculation is documented in Table 2.

4.3 SAMPLE CALCULATIONS

The technical rationale, including sample calculations, required to substantiate the emission rates presented in Table 2 is documented in Appendix A.

4.4 ASSESSMENT OF DATA QUALITY

This section provides an assessment of the data quality of the emission estimates for each significant contaminant from the facility.

The assessment of the data quality of the emission rate estimates for each significant contaminant emitted from the significant sources was performed in accordance with the requirements of subparagraph 7iii of s .26(1) of O.Reg. 419/05.

For each contaminant the emission rate was estimated and the data quality of the estimate is documented in Table 2. The assessment of data quality for each source is listed in Table 2 is documented in Appendix A.

All the emission rates listed in Table 2 were evaluated using the highest data quality available and correspond to the operating scenario where all significant sources are operating simultaneously at their individual maximum rates of production. Therefore, emission rate estimates listed in Table 2 are not likely to be an underestimate of the actual emission rates and use of these emission rates will result in a calculated concentration at POI greater than the actual concentrations.

5.0 SOURCE SUMMARY TABLE AND SITE PLAN

This section provides the table required by subparagraph 8 and the site plan required by subparagraph 9 of s.26(1) of O.Reg. 419/05.

5.1 SOURCE SUMMARY TABLE

For each source of significant contaminants the following parameters are referenced:

- Contaminant
- Chemical Abstract Society (CAS) reference number
- Source reference number
- Source description
- Stack parameters (flow rate, exhaust temperature, diameter, height above grade, height above roof)
- Location referenced to a Cartesian coordinates system presented in Figure 3
- Maximum emission rate
- Averaging period
- Emission estimating technique
- Estimation data quality
- Percentage of overall emission

5.2 SITE PLAN

The locations of the emission sources listed in Table 2 are presented in Figure 3A; the location of each of the sources is specified with the source reference number. The location of the property-line is indicated in Figure 3A, with the end points of each section of the property-line clearly referenced in Cartesian coordinate system. The location of each source is referenced in a UTM coordinates system under a column in Table 2.

The heights of the structures that are part of the Facility are labeled in Figure 3A.

6.0 DISPERSION MODELLING

This section provides a description of how the dispersion modelling was conducted at the Facility to calculate the maximum concentration at a POI.

The dispersion modelling was conducted in accordance with the Ministry publication "Air Dispersion Modelling Guideline for Ontario" PIBS 5165e (ADMGO).

The Site has submitted a request under s.20(4) to have schedule 3 of O.Reg. 419/05 apply for all contaminants at the Facility. Therefore, the modelled impact of contaminant emissions are assessed as 1-hour and 24-hour maximum POI concentrations. The appropriate model to assess 1-hour and 24-hour maximum POI impact is the United States Environmental Protection Agency (USEPA) SCREEN3 or AERMOD models. The USEPA SCREEN3 model was used as a screening model for all contaminants emitted from the Facility with the exception of odour. The USEPA AERMOD model was used for odour modelling for the Facility.

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

USEPA AERMOD Dispersion Modelling

Appendix C contains an Air Dispersion Modelling Memorandum outlining the procedures for the AERMOD odour modelling that was performed for the Site. This memo provides a description of how the dispersion modelling was conducted at the Facility to calculate the maximum concentration at a POI.

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

USEPA Screen3 Dispersion Modelling

The USEPA SCREEN3 model was used as a screening model for the Facility in accordance with the ADMGO. SCREEN3 uses Gaussian dispersion equations and

worst-case meteorological conditions to estimate maximum downwind concentrations due to emissions from a source.

The SCREEN3 model utilizes rectangular source areas and only one source may be modeled at a time. Since the SCREEN3 model can only model one source at a time, each source was modeled separately and the resulting ground level concentrations for each source were summed to provide an overall maximum ground level concentration of a contaminant. The exposure scenario for all sources is a one-hour average exposure. During any one-hour period, it is possible that worst-case atmospheric dispersion conditions could occur for the entire period. The SCREEN3 model was therefore used to determine the worst-case atmospheric conditions that would produce the maximum ground level concentrations. Receptor heights were set at 0 m and rural dispersion coefficients were used along with the full meteorology option.

Each source at the Facility was modelled separately using a unitized emission rate of 1 g/s. Source heights were based on the stack height of each source. Building downwash was considered using the height of the highest building tier and the minimum and maximum horizontal lengths were determined by constructing a rectangle of best fit around the building.

The results of the SCREEN3 modelling for each source is provided in Appendix D. The maximum POI concentration for each contaminant emitted from a single source was estimated by multiplying the SCREEN3 dispersion factor for the source by the emission rate of that substance. The estimated maximum POI concentrations are provided in Table 4.

6.1 DISPERSION MODELLING INPUT SUMMARY TABLE

A description of the way in which the approved dispersion model was performed is included in Table 3. This table meets both the requirements of s.26(1)11 and Sections 8-17 of O. Reg. 419/05 and follows the format provided in the ESDM Procedure Document.

6.2 LAND USE ZONING PLAN

Subparagraph 10 of s.26 (1) of O.Reg. 419/05 requires a description of the local land use conditions if meteorological data described in paragraph 2 of s.13(1) of O.Reg. 419/05 was used.

A land-use zoning plan is provided on Figures 2A and 2B. Figure 2A also illustrates the extents of the Site property boundary and provides the zoning of adjacent land uses. The Site is located in a predominantly agricultural area. Land surrounding the Site is zoned for industrial (M1) and agricultural (A) usage.

As previously noted, there are no sensitive land uses on the property, such as childcare facilities, senior citizen's residences, long-term care, or educational facilities.

6.3 DISPERSION MODELLING INPUT AND OUTPUT FILES

The information output from the SCREEN3 dispersion model is recorded in Appendix D. Appendix C also includes the input and output files from the AERMOD model in electronic form.

7.0 EMISSION SUMMARY TABLE AND CONCLUSIONS

This section provides the table required by subparagraph 14 of s.26(1) of O.Reg. 419/05 and provides an interpretation of the results as required by the ESDM Procedure Report.

7.1 EMISSION SUMMARY TABLE

A POI concentration for each significant contaminant emitted from the Facility was calculated based on the emission rates listed in Table 2 and the output from the approved dispersion model presented in Appendices C and D. The results are presented in Table 4. This Table follows the format provided in the ESDM Procedure Document. For each source of significant contaminants the following parameters are referenced:

- Contaminant name
- CAS number
- Total facility emission rate
- Approved dispersion model used
- Maximum POI concentration
- Averaging period for the dispersion modelling
- MOE POI limit
- Indication of limiting effect
- Schedule in Regulation 419/05
- The percentage of standard

The POI concentration listed in Table 4 were compared against criteria listed in the publication "Summary of Standards and Guidelines to support Ontario Regulation 419: Air Pollution - Local Air Quality" dated February 2008.

7.2 ASSESSMENT OF CONTAMINANTS WITH NO MOE POI LIMITS

Subparagraph 14 subsection viii of s.26 (1) of O.Reg. 419/05 requires an indication of the likelihood, nature and location of any adverse effect if the contaminant is not listed in any of Schedules 1, 2, and 3.

Two contaminants, Non - Methane Hydro Carbons and Propyl butyrate do not have corresponding criteria limits in the List of MOE POI Limits nor JSLs and are considered to be Contaminants with No Ministry POI Limits. In accordance with the requirements of the ESDM Procedure Document these contaminants are documented in the completed copy of MOE document "Supporting Information for a Maximum Ground Level Concentration Acceptability Request Supplement to Application for Approval, EPA S.9", which has been submitted to the Ministry in support of the ESDM. No further assessment has been completed for these contaminants.

7.3 CONCLUSIONS

This ESDM Report was prepared in accordance with s.26 of O.Reg. 419/05. In addition guidance in the ESDM Procedure Document was followed as appropriate.

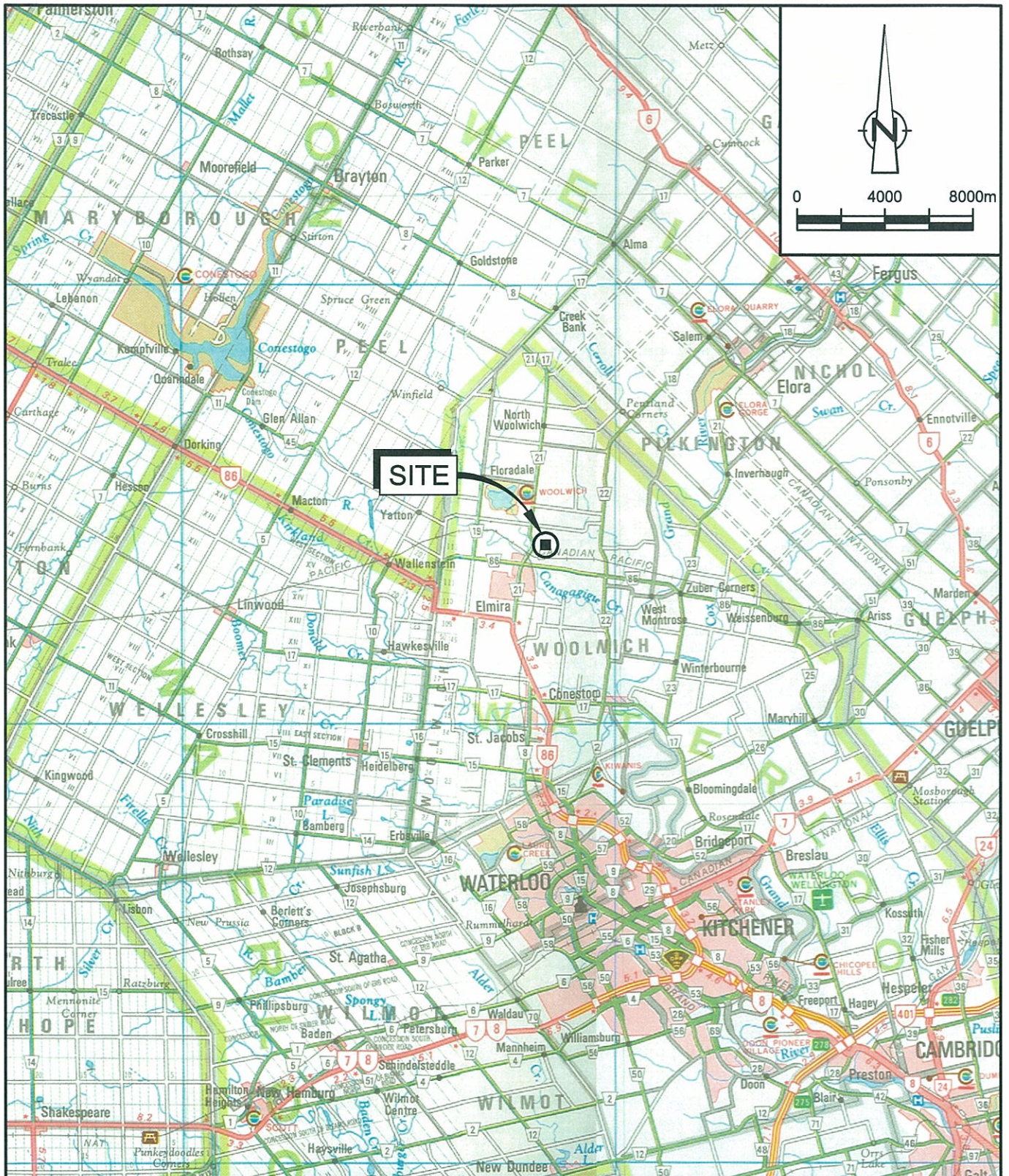
The emission rate estimates for each source of significant contaminants are documented in Table 2. All the emission rates listed in Table 2 have been estimated using the highest data quality available and correspond to the operating scenario where all significant sources are operating simultaneously at their individual maximum rates of production. Therefore these emission rate estimates listed in Table 2 are not likely to be an underestimate of the actual emission rates.

A POI concentration for each significant contaminant emitted from the Facility was calculated based on the calculated emission rates and the output from the SCREEN3 model, odour was modelled in AERMOD; the results are presented in Table 4.

The POI concentrations listed in Table 4 were compared against criteria listed in the "Summary of Standards and Guidelines to support Ontario Regulation 419: Air Pollution - Local Air Quality" and "Jurisdictional Screening Level (JSL) List" dated February 2008.

Of all the contaminants listed in Table 4 that have limits in the list of MOE POI Limits or JSLs all the predicted POI concentrations are below the corresponding limits.

This ESDM Report demonstrates that the Facility can operate in compliance with O.Reg. 419/05.



SOURCE: RAND MCNALLY ROAD ATLAS

figure 1

SITE LOCATION PLAN
EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT
WOOLWICH BIO-EN FACILITY
Elmira, Ontario



MAP SYMBOL CLASSIFICATION

- A AGRICULTURAL
- R-1 RESIDENTIAL - SETTLEMENT
- R-4 RESIDENTIAL - MIXED MEDIUM DENSITY
- R-6 RESIDENTIAL - COMMERCIAL
- C-1 CORE COMMERCIAL - URBAN
- M-1 GENERAL INDUSTRIAL - DRY
- O-1 OPEN SPACE
- P INSTITUTIONAL

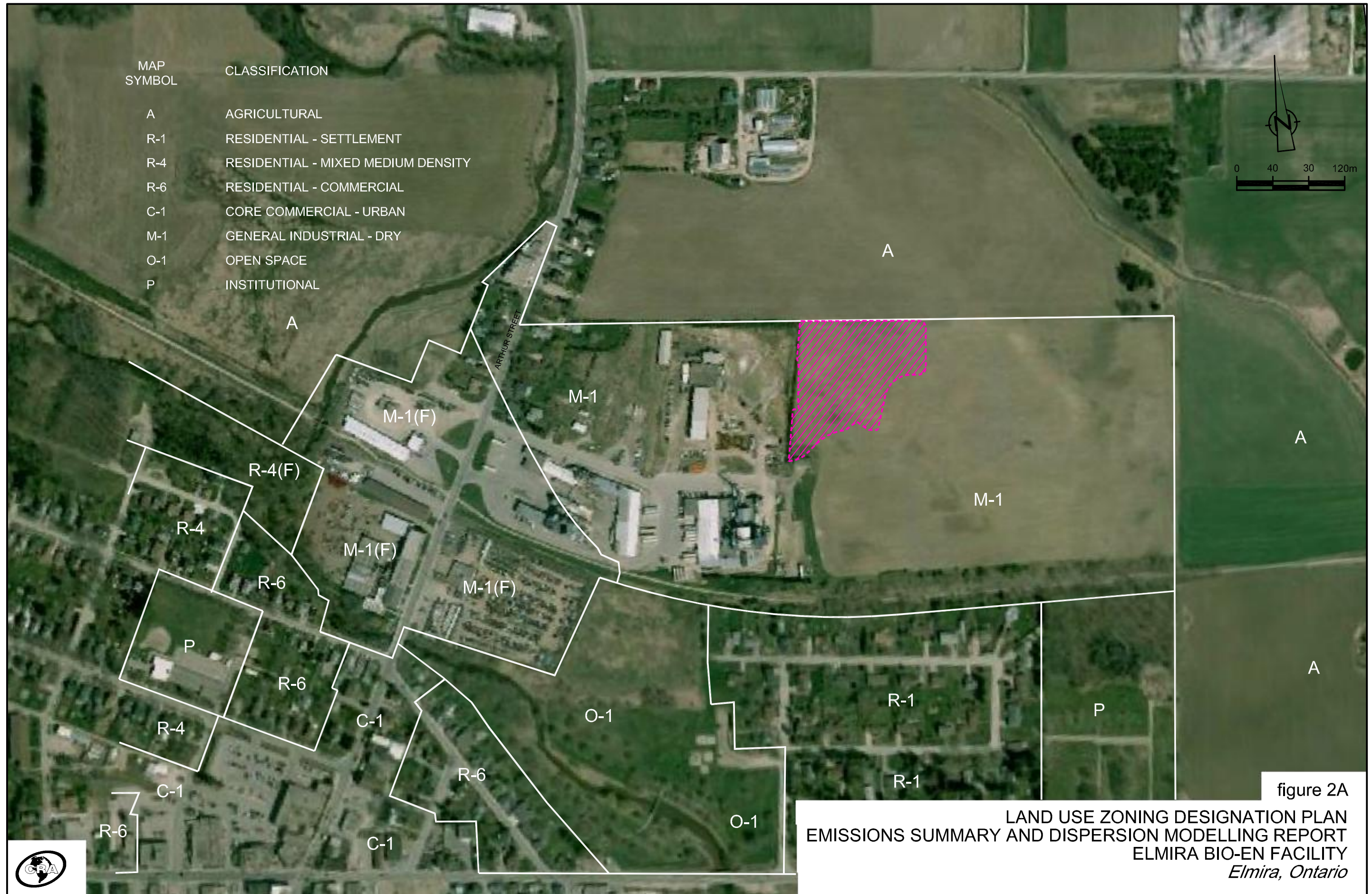
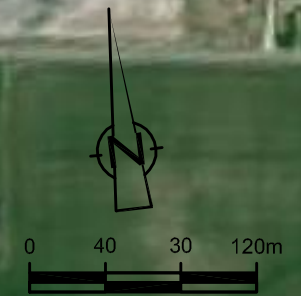


figure 2A

LAND USE ZONING DESIGNATION PLAN
 EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT
 ELMIRA BIO-EN FACILITY
 Elmira, Ontario



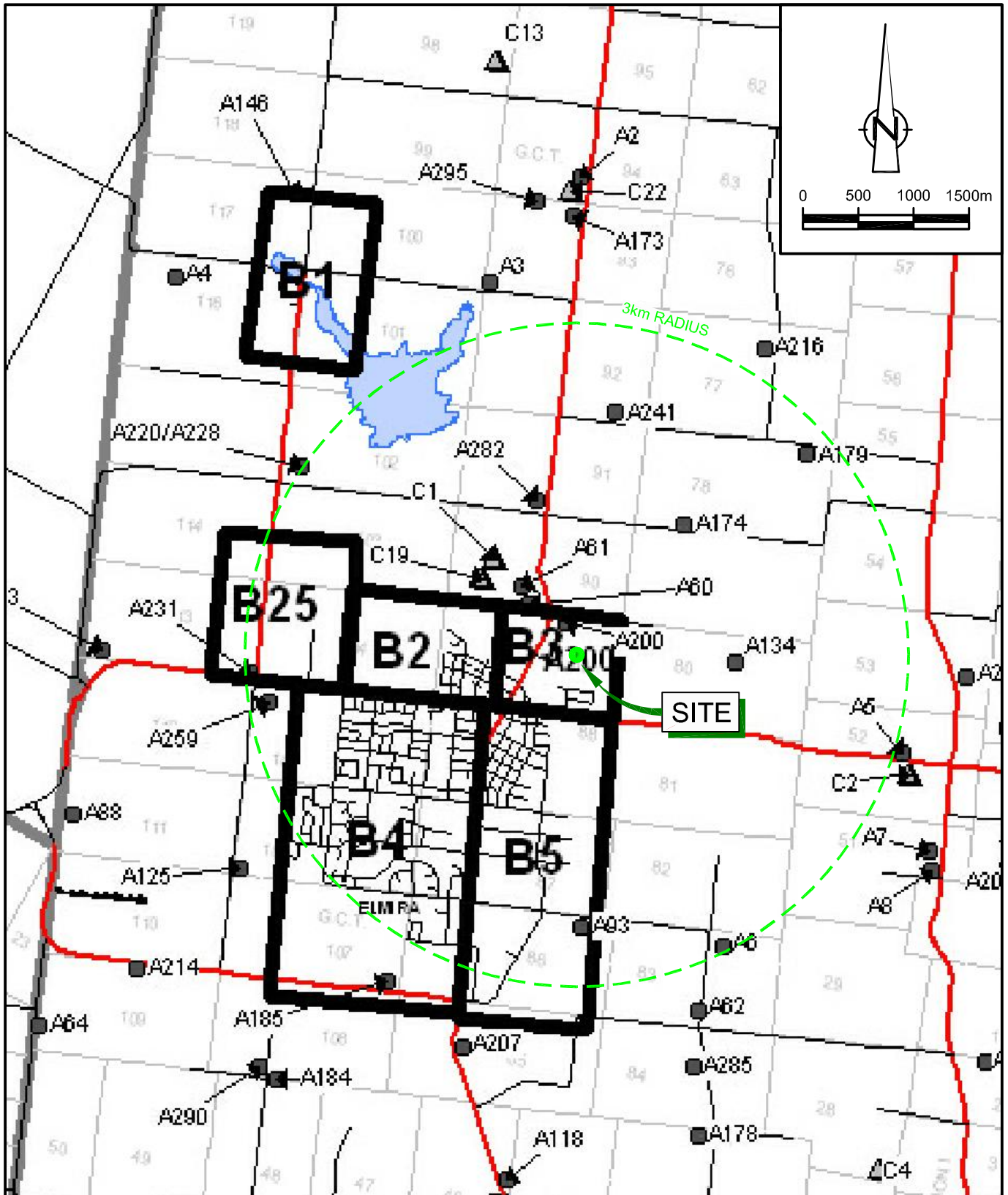
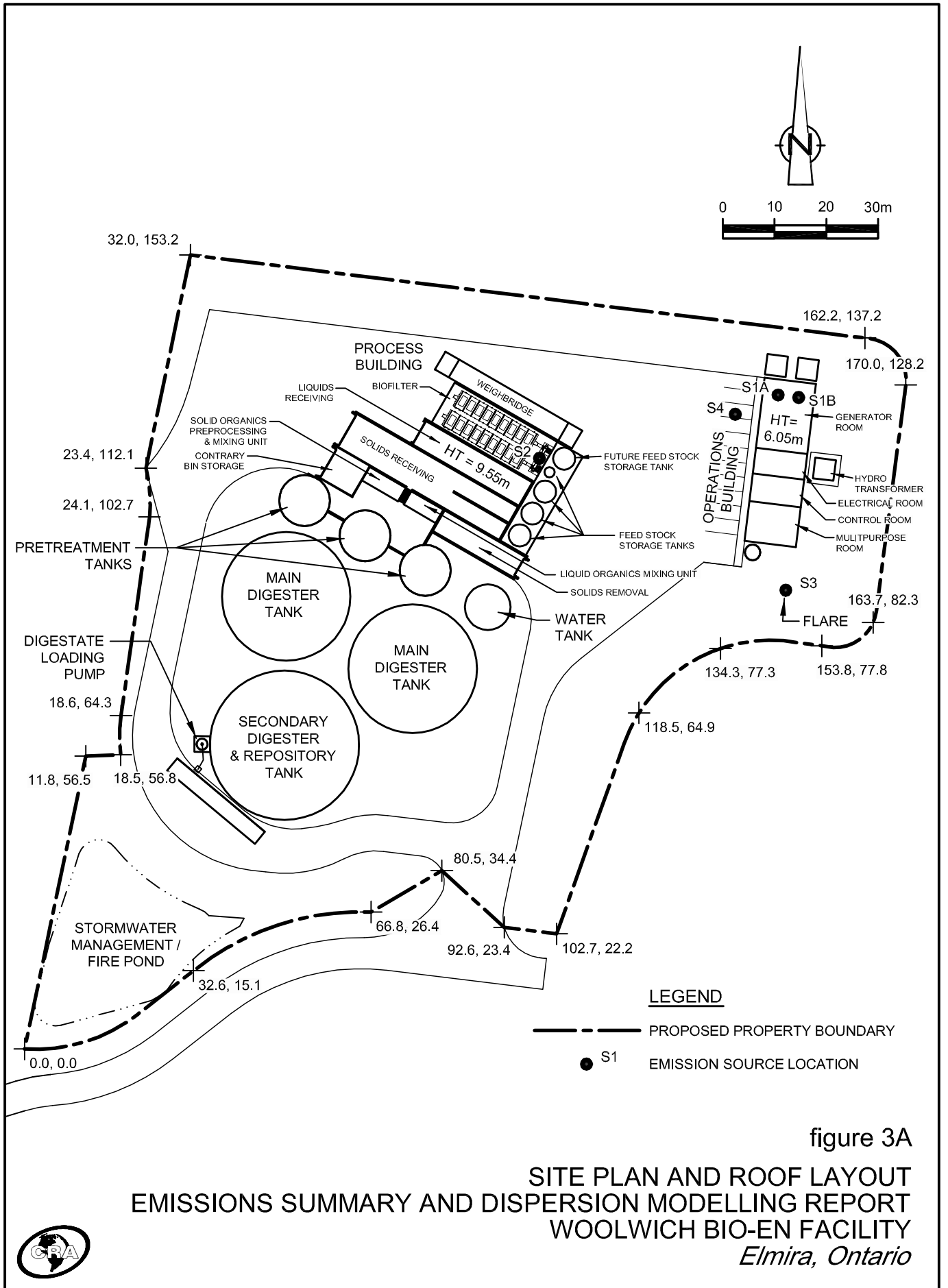
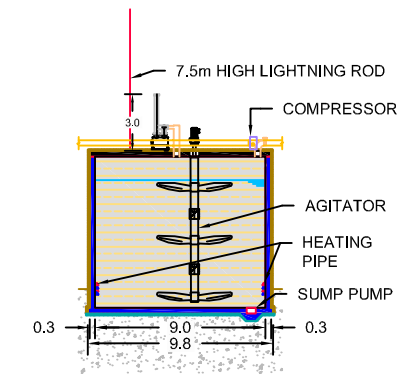
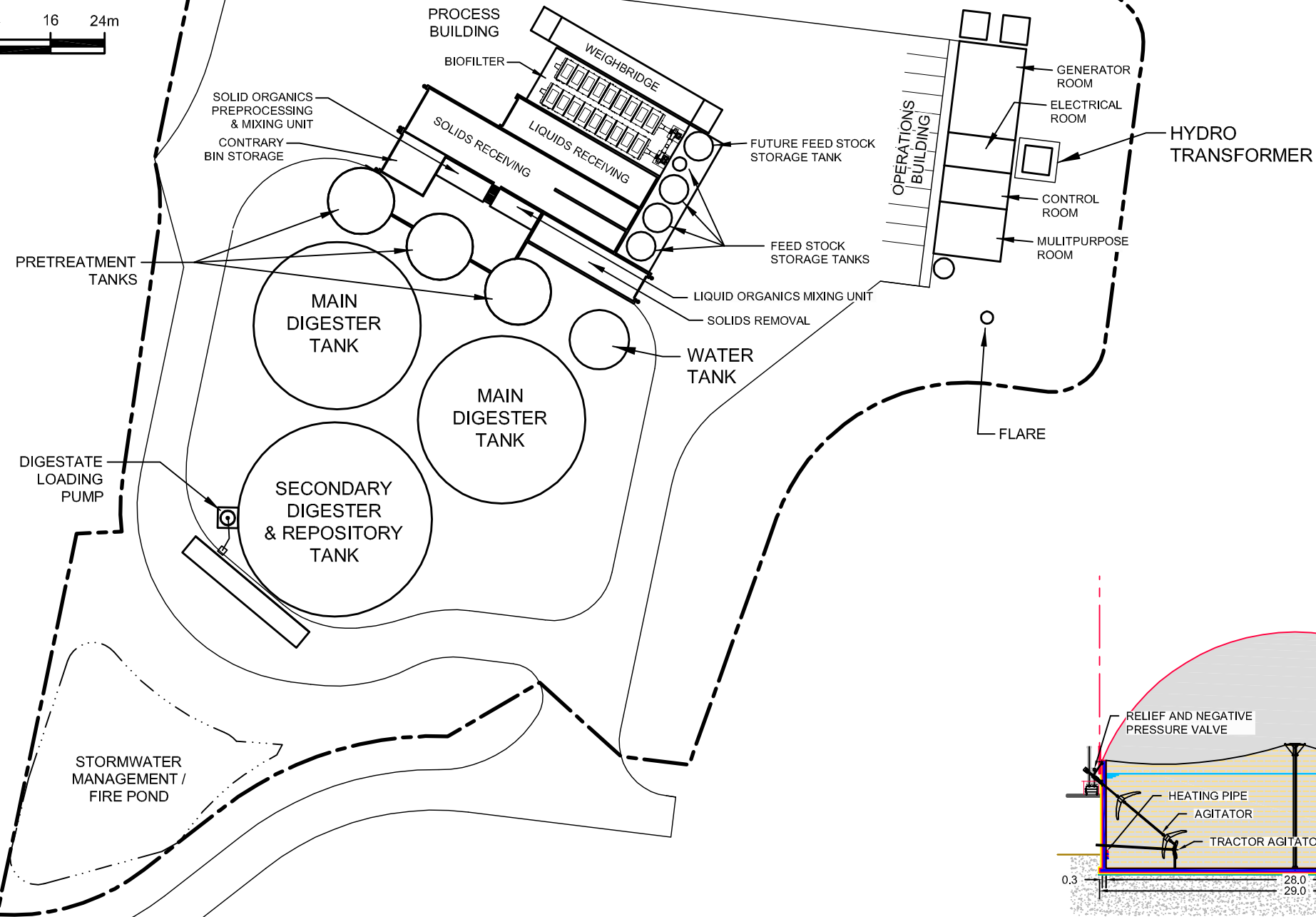
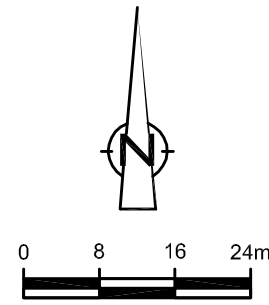


figure 2B

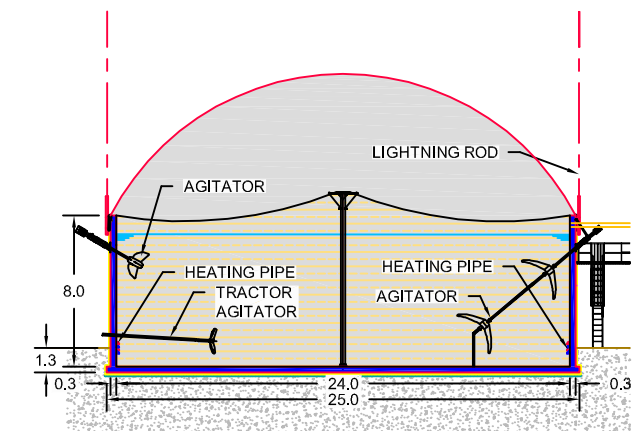
LAND USE ZONING DESIGNATION PLAN
 EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT
 WOOLWICH BIO-EN FACILITY
 Elmira, Ontario



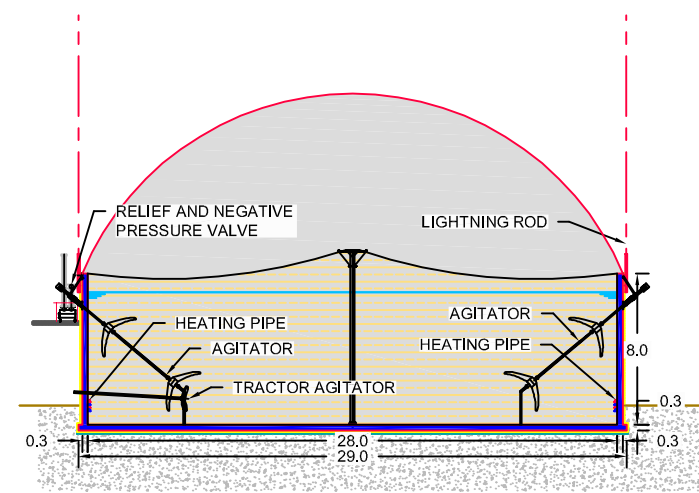




PRETREATMENT TANK (TYP)



MAIN DIGESTER TANK (TYP)

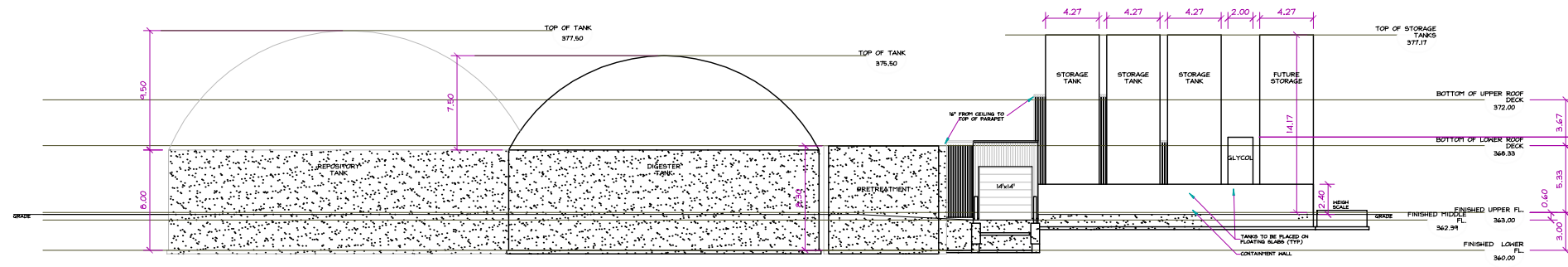


SECONDARY DIGESTER & REPOSITORY TANK (TYP)

figure 3B

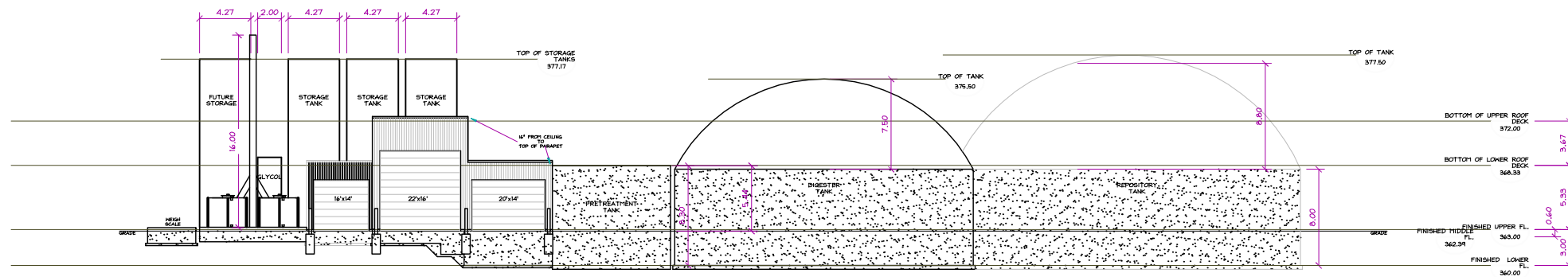
CONCEPTUAL FACILITY LAYOUT
EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT
WOOLWICH BIO-EN FACILITY
Elmira, Ontario





EAST ELEVATION

SCALE = 1:500



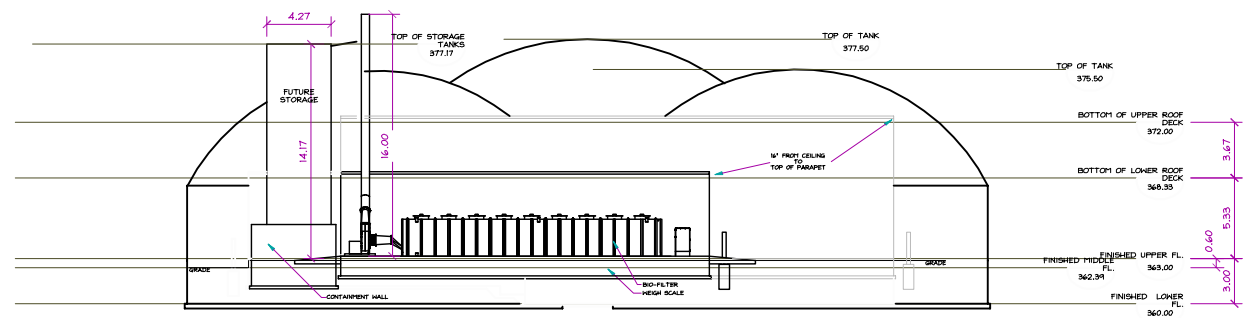
WEST ELEVATION

SCALE = 1:500

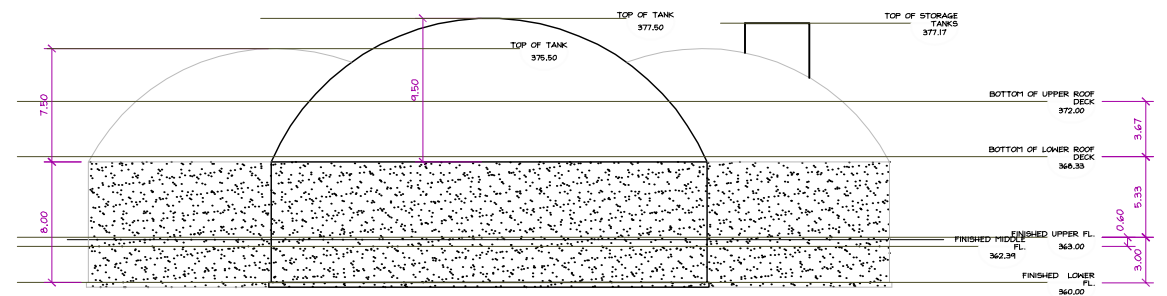
figure 3C

EAST AND WEST BUILDING ELEVATIONS
 EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT
 WOOLWICH BIO-EN FACILITY
 Elmira, Ontario





NORTH ELEVATION
SCALE = 1:500



SOUTH ELEVATION
SCALE = 1:500

figure 3D
NORTH AND SOUTH BUILDING ELEVATIONS
EMISSIONS SUMMARY AND DISPERSION MODELLING REPORT
WOOLWICH BIO-EN FACILITY
Elmira, Ontario



TABLE 1

**SOURCES AND CONTAMINANTS IDENTIFICATION TABLE
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.**

<i>Source Information</i>		<i>Location</i>	<i>Expected Contaminants</i>	<i>Significant (Y/N)</i>	<i>Rationale</i>
<i>Source ID</i>	<i>Source Description</i>				
S-1a and S-1b	Digester Gas Engines	Operations Building	Products of Combustion	Y	
S-2	Biofilter	Adjacent to Process Building	VOCs Odour Total Reduced Sulfur	Y Y Y	
S-3	Flare	Adjacent to Operations Building	Products of Combustion	Y	
S-4	Start -Up Boiler	Adjacent to Process Building	Products of Combustion	Y	
	Roads, Parking Lot		Dust	N	Not listed in Table 7-2 or 7-3 of Section 7.4 of the ESDM Procedure Document

TABLE 2
SOURCE SUMMARY TABLE
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.

Contaminant	CAS No.	Source Data								Emission Data				
		Source ID	Source Description	Stack Flow Rate (Am3/s)	Stack Exit Gas Temperature (C)	Stack Inner Diameter (m)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates (x,y) (UTM) (m)	Maximum Emission Rate (g/s) or (OU/s)	Averaging Period (hours)	Emission Estimation Technique	Emission Data Quality	% of Overall Emissions (%)
Carbon Monoxide	630-08-0	S-1a	Digester Gas Engine -1	4.36	470	0.3	9.55	3.5	536,407.76, 4,828,028.82	2.40E+00	1, 8	EC	Above Average	31%
		S-1b	Digester Gas Engine -2	4.36	470	0.3	9.55	3.5	536,412.09, 4,828,028.39	2.40E+00	1, 8	EC	Above Average	31%
		S-3	Flare	4.17	1000	0.5	4.9	NA	536,414.35, 4,828,010.76	2.80E+00	1, 8	EF	Average	37%
		S-4	Boiler	0.27	190	0.46	8	NA	536412.46, 4828037.04	3.62E-02	1,8	EF	Above Average	0.5%
Nitrogen Oxides	10102-44-0	S-1a	Digester Gas Engine -1	4.36	470	0.3	9.55	3.5	536,407.76, 4,828,028.82	8.01E-01	1, 24	EC	Above Average	45%
		S-1b	Digester Gas Engine -2	4.36	470	0.3	9.55	3.5	536,412.09, 4,828,028.39	8.01E-01	1, 24	EC	Above Average	45%
		S-3	Flare	4.17	1000	0.5	4.9	NA	536,414.35, 4,828,010.76	1.52E-01	1, 24	EF	Average	8%
		S-4	Boiler	0.27	190	0.46	8	NA	536412.46, 4828037.04	4.31E-02	1,24	EF	Above Average	2%
NMHC	NA	S-1a	Digester Gas Engine -1	4.36	470	0.3	9.55	3.5	536,407.76, 4,828,028.82	1.60E-01	24	EC	Above Average	50%
		S-1b	Digester Gas Engine -2	4.36	470	0.3	9.55	3.5	536,412.09, 4,828,028.39	1.60E-01	24	EC	Above Average	50%
Particulate	NA	S-1a	Digester Gas Engine -1	4.36	470	0.3	9.55	3.5	536,407.76, 4,828,028.82	8.81E-02	24	EC	Above Average	36%
		S-1b	Digester Gas Engine -2	4.36	470	0.3	9.55	3.5	536,412.09, 4,828,028.39	8.81E-02	24	EC	Above Average	36%
		S-3	Flare	4.17	1000	0.5	4.9	NA	536,414.35, 4,828,010.76	6.30E-02	24	EF	Uncertain	26%
		S-4	Boiler	0.27	190	0.46	8	NA	536412.46, 4828037.04	3.28E-03	24	EF	Marginal	1%
Odour	NA	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.11E+04	10 minute	EE	Average	100%
Ammonia	7664-41-7	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	4.84E-02	24	EC	Average	100%
Trimethylamine	75-50-3	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	2.08E-03	1	EC	Average	100%
Triethylamine	121-44-8	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.94E-03	0.5,24	EC	Average	100%
Hydrogen Sulfide	7783-06-4	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	3.87E-03	10 min, 24	EC	Average	100%
Methyl Mercaptan	74-93-1	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.10E-03	10 min	EC	Average	100%
Ethyl Mercaptan	75-08-1	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	2.56E-03	10 min	EC	Average	100%
Dimethyl Sulphide	77-78-1	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.00E-02	NA	EC	Average	100%
Dimethyl disulphide	624-92-0	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	5.99E-03	10 min	EC	Average	100%
Butanol	71-36-3	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.67E-02	10mine,24	EC	Average	100%

TABLE 2
SOURCE SUMMARY TABLE
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.

Contaminant	CAS No.	Source ID	Source Description	Source Data					Emission Data					
				Stack Flow Rate (Am ³ /s)	Stack Exit Gas Temperature (C)	Stack Inner Diameter (m)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates (x,y) (UTM) (m)	Maximum Emission Rate (g/s) or (OU/s)	Averaging Period (hours)	Emission Estimation Technique	Emission Data Quality	% of Overall Emissions (%)
Alpha-piene	80-56-8	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.24E-02	0.5,24	EC	Average	100%
Limonene	5989-27-5	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	2.33E-02	0.5,24	EC	Average	100%
Acetic Acid	64-19-7	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	8.33E-03	24	EC	Average	100%
Oleic Acid	112-80-1	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	9.63E-03	1	EC	Average	100%
Butyric Acid	107-92-6	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	3.00E-03	0.5,24	EC	Average	100%
Cyclopentanol	96-41-3	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.78E-02	0.5,24	EC	Average	100%
Propyl acetate	109-60-4	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.11E-02	24	EC	Average	100%
Propyl butyrat	105-66-8	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.78E-02	NA	EC	Average	100%
Pentanone	107-87-9	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	4.44E-03	0.5,24	EC	Average	100%
Me-isobutyl ketone	108-10-1	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	2.22E-02	24	EC	Average	100%
Nonanal	124-19-6	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	1.11E-02	0.5,24	EC	Average	100%
Total Reduced Sulfur	NA	S-2	Biofilter	5.56	Ambient	0.54	20	13.4	536,421.53, 4,828,041.89	2.35E-02	10min, 24	EC	Average	100%

Notes:
NMHC - Non methane hydro carbons
EC-Emission Calculation
EF-Emission Factor

TABLE 3

**DISPERSION MODELLING INPUT SUMMARY TABLE
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.**

<i>Relevant Section of the Regulation</i>	<i>Section Title</i>	<i>Description of How the Approved Dispersion Model was Used</i>
Section 8	Negligible Sources	Sources and contaminants that were considered negligible were explicitly identified, and therefore were not modelled, in accordance with s.8 of O. Reg. 419. See Table 1 - Sources and Contaminants Identification Table and Appendix B of the ESDM Report for more information
Section 9	Same Structure Contamination	Not applicable as Bio-En is the only tenant occupying the building, and does not have a child care facility, health care facility, senior's residence, long-term care facility or an educational facility located at the Facility
Section 10	Operating Conditions	All equipment was assumed to be operating at the maximum production rates at the same time. See Section 4.1 and Appendix A of the ESDM Report.
Section 11	Source of Contaminant Emission Rate	The emission rate for each significant contaminant emitted from a significant source was estimated, the methodology for the calculation is documented in Table 2 - Source Summary Table. See Section 4.1 and Section 4.2 and Appendix A of the ESDM Report for more information.
Section 12	Combined Effect of Assumptions for Operating Conditions and Emission Rates	The operating conditions were estimated in accordance with s.10(1) and 1 and S.11 (1) 1 of O. Reg. 419 and are therefore considered to result in the highest concentrations at POI that the Facility is capable of for the contaminants emitted. See Section 4.1 and Section 4.2 of the ESDM Report.
Section 13	Meteorological Conditions	MOE localized meteorological data obtained from Elora, Ontario was used for the AERMOD model. Full met data was chosen for SCREEN3
Section 14	Area of Modelling Coverage	Completed in compliance with MOE Modelling Guidance
Section 15	Stack Height	Documented in accordance with MOE Modelling Guidance
Section 16	Terrain Data	MOE available data sets were used.
Section 17	Averaging Periods	The Averaging Periods summarized in Table 2 were used.

TABLE 4

**EMISSION SUMMARY TABLE
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.**

Contaminant	CAS No.	Total Facility Emission Rate	Flare Conc.	Engine Conc.	Engine Conc.	Boiler Conc.	Air Dispersion Model Used	Max. Ground Level Conc.	Averaging Period	MOE POI Limit	Limiting Effect	Regulation Schedule #	Percentage of MOE POI Limit
		(g/s) or (OU/s)	(ug/m3)	(ug/m3)	(ug/m3)	(ug/m3)	ug/m3/(OU) (2)	(hours)	(ug/m3)				
Carbon Monoxide	630-08-0	7.61	3.32E+02	3.30E+02	3.30E+02	9.71E+01	SCREEN 3	1.09E+03	0.5	6000	Health	3	18.14%
Nitrogen Oxides	10102-44-0	1.80	1.50E+01	9.16E+01	9.16E+01	1.16E+02	SCREEN3	3.14E+02	1	400	Health	3	78.42%
		1.80	6.00E+00	3.66E+01	3.66E+01	4.62E+01	SCREEN3	1.25E+02	24	200	Health	3	62.74%
NMHC	NA	0.32	NA	1.83E+01	1.83E+01	NA	SCREEN3	3.66E+01 1.46E+01	1	NA	NA	NA	NA
									24	NA	NA	NA	NA
Particulate Matter	NA	0.24	2.49E+00	4.03E+00	4.03E+00	8.79E+00	SCREEN3	1.93E+01	24	120	Visibility	3	16.11%
Odour	NA	11111	NA	NA	NA	NA	AERMOD	0.69 See Modelling Memorandum	10 min	1 OU	Odour	G	NA
Ammonia	7664-41-7	4.84.E-02	NA	NA	NA	NA	SCREEN3	1.12E+00	24	100	Health	3	1.12%
Trimethylamine	75-50-3	2.08.E-03	NA	NA	NA	NA	SCREEN3	1.20E-01	1	0.5	Odour	3 (G)	24.07%
Triethylamine	121-44-8	1.94.E-03	NA	NA	NA	NA	SCREEN3	1.35E-01	0.5	21	NA	JSL	<1%
								4.49E-02	24	7	NA	JSL	<1%
Hydrogen Sulfide	7783-06-4	3.87.E-03	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Methyl Mercaptan	74-93-1	1.10.E-03	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Ethyl Mercaptan	75-08-1	2.56.E-03	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Dimethyl Sulphide	77-78-1	1.00.E-02	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Dimethyl disulphide	624-92-0	5.99.E-03	NA	NA	NA	NA	SCREEN3	INCLUDED IN TRS					
Total Reduced Sulfur (4)	NA	2.35.E-02	NA	NA	NA	NA	SCREEN3	5.44E-01	24	7	Health	3	7.77%
								2.24E+00	10 min	13	Odour	3	17.26%
Butanol	71-36-3	1.67.E-02	NA	NA	NA	NA	SCREEN3	3.85E-01	24	920	Health	3	<1%
								1.59E+00	10 min	2100	Odour	G (S.20)	<1%

TABLE 4

**EMISSION SUMMARY TABLE
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.**

<i>Contaminant</i>	<i>CAS No.</i>	<i>Total Facility Emission Rate (g/s) or (OU/s)</i>	<i>Flare Conc. (ug/m3)</i>	<i>Engine Conc. (ug/m3)</i>	<i>Engine Conc. (ug/m3)</i>	<i>Boiler Conc. (ug/m3)</i>	<i>Air Dispersion Model Used</i>	<i>Max. Ground Level Conc. (ug/m3 / (OU) (2)</i>	<i>Averaging Period (hours)</i>	<i>MOE POI Limit (ug/m3)</i>	<i>Limiting Effect</i>	<i>Regulation Schedule #</i>	<i>Percentage of MOE POI Limit</i>
Alpha-pinene	80-56-8	1.24.E-02	NA	NA	NA	NA	SCREEN3	8.58E-01 2.86E-01	0.5 24	810 270	NA NA	JSL JSL	<1% <1%
Limonene	5989-27-5	2.33.E-02	NA	NA	NA	NA	SCREEN3	1.62E+00 5.39E-01	0.5 24	1875 625	NA NA	JSL JSL	<1% <1%
Acetic Acid	64-19-7	8.33.E-03	NA	NA	NA	NA	SCREEN3	1.93E-01	24	2500	Odour	G (S.20)	<1%
Oleic Acid	112-80-1	9.63.E-03	NA	NA	NA	NA	SCREEN3	5.56E-01	1	5	Health	G (S.20)	11.12%
Butyric Acid	107-92-6	3.00.E-03	NA	NA	NA	NA	SCREEN3	2.08E-01 6.94E-02	0.5 24	4.32 1.44	NA NA	JSL JSL	4.82% 4.82%
Cyclopentanol	96-41-3	1.78.E-02	NA	NA	NA	NA	SCREEN3 SCREEN3	1.23E+00 4.11E-01	0.5 24	8640 2880	NA NA	JSL JSL	<1% <1%
Propyl acetate	109-60-4	1.11.E-02	NA	NA	NA	NA	SCREEN3	2.57E-01	24	6600	Health	G (S.20)	<1%
Propyl butyrate	105-66-8	1.78.E-02	NA	NA	NA	NA	SCREEN3	1.03E+00 4.11E-01	1 24	NA NA	NA NA	NA NA	NA NA
Pentanone	107-87-9	4.44.E-03	NA	NA	NA	NA	SCREEN3	3.08E-01 1.03E-01	0.5 24	6360 2120	NA NA	JSL JSL	<1% <1%
Me-isobutyl ketone	108-10-1	2.22.E-02	NA	NA	NA	NA	SCREEN3	5.13E-01	24	1200	Odour	G (S.20)	<1%
Nonanal	124-19-6	1.11.E-02	NA	NA	NA	NA	SCREEN3	7.70E-01 2.57E-01	0.5 24	180 60	NA NA	JSL JSL	<1% <1%

Notes:

1 - refers to Standards in Schedule 1 of O. Reg. 419/05

2-Screen3 model outputs 1-hour POI concentrations, the Maximum ground level concentration output by this model has been used for comparison with POI limits. The 1-hr values were converted to the appropriate averaging period using the MOE approved conversion factors as follows: to convert to 1/2 hour : multiply by 1.2, to convert to 10 minute, multiply by 1.65, to convert to 24 hr multiply by 0.4.

3- refers to Standards in Schedule 3 of O. Reg. 419/05

(G) - refers to criteria identified in the document "Summary of O. Reg. 419/05 Standards and Point of Impingement Guidelines and Ambient Air Quality Criteria (AAQCs)" date December 2005.

NA - No Available Criteria

(4) Total reduced sulfur compounds include sulphides and mercaptans and have been summed to compare against the TRS standard

APPENDIX A

SUPPORTING CALCULATIONS

APPENDIX A
SUPPORTING CALCULATIONS
WOOLWICH BIO-EN INC.

EMISSION CALCULATIONS

Source S-1a and S-1b: BioGas Combustion Sources (Cogeneration Units)

The Facility will produce heat and power using two 1426kW Jenbacher Digester Gas Engines (Combined Heat and Power (CHP) units). The biogas obtained from the digesters and stored in the gas storage membranes is utilized by the CHP units and converted to thermal and electrical energy. The electricity produced will be fed to the power grid and the thermal energy will be captured with a heat exchanger to produce usable heat. The excess gas produced will be burned through a gas flare. A portion of the sulfur is removed from the biogas prior to combustion in the engines. This will be achieved through the addition of ferric-hydroxide or other suitable chemical and air to the gas storage. The moisture content of the biogas will be reduced prior to combustion by lowering the temperature of the biogas prior to combustion. The emissions estimated from these sources are provided in Table A.2.

Methodology: Mass Balance (MB)

The emissions from the CHP units have been estimated using emissions and exhaust information provided by the engine manufacturer and are provided in Appendix E.

Sample Calculation: Nitrogen Oxides (S-1a)

$ER = \text{Contaminant Concentration} \times \text{Normalized Flowrate}$

$$\text{Normalized Flow}(V_N) = 6295 \frac{\text{Sm}^3 (298.15 \circ \text{K})}{\text{hr}} \times \frac{273.15 \circ \text{K}}{298.15 \circ \text{K}}$$

$$V_N = 5,767 \frac{\text{Nm}^3}{\text{hr}}$$

$$ER \left(\frac{\text{g}}{\text{s}} \right) = 500 \frac{\text{mg}}{\text{Nm}^3 (273.15 \circ \text{K})} \times 5,767 \frac{\text{Nm}^3}{\text{hr}} \times \frac{\text{hr}}{3600\text{s}} \times \frac{\text{g}}{1000\text{mg}}$$

$$ER \left(\frac{\text{g}}{\text{s}} \right) = 8.01 \times 10^{-1} \frac{\text{g}}{\text{s}}$$

Data Quality: Above Average

Section 8.3.2 of the ESDM Procedure Document titled "Above-Average Data Quality" Emission Estimating Techniques includes mass balance techniques that accounts for 100% of the material balance.

Operating Condition, Individual Maximum Rates of Production:

The emission rate calculations for these sources are based on the engines being fired at their full capacity. Based on information provided in the manufacturer's specification, CO emissions will be lower at startup than at full operating capacity. Based on information from the manufacturer, the NO_x levels will be maintained below the guaranteed level at full or partial load. These engines may be operated fuelled with Natural Gas during start-up of the Facility. The Engine supplier has confirmed that the emissions of this piece of equipment when operated using Natural Gas will be less than or equal to emissions generated when the equipment is operated using biogas.

Source 2: Biofilter

The biofilter is used to treat air from the process building and storage tanks that may contain potentially odourous emissions originating from organics storage or other operations in the solids and liquid organics unloading areas, processing areas and digestate loading. The air from inside the process building will be vented to the biofilter. The air is treated by a microbial inoculated mineral filter medium. The humidity of the biofilter will be regulated by a water sprinkler system. According to the biofilter manufacturer, odours are guaranteed to be reduced by 85% using this filter. The odour concentration has been estimated based on an odour inlet concentration to the biofilter of 10,000 OU and an odour removal efficiency of 80% which is conservative as the manufacturer states that a higher efficiency is guaranteed.

This odour inlet loading has been estimated based on discussions with BIOREM and CRA's experience with organic processing facilities. 10,000 OU/m³ is a reasonable worst-case inlet concentration to the biofilter from an AD facility since most AD facilities look for fresh organic waste, that has not had the opportunity to decompose to high degree. Bio-En wishes to obtain as fresh organic material as possible, as this feedstock has the greatest biogas potential. The data presented in Appendix E shows a range of odour levels at the inlet of a biofilter from a rendering and municipal source separated organics facilities. Considering the material that Bio-En will receive is fresher and is not significantly processed in the Process Building, 10,000 OU/m³ is a reasonable worst case. Additional information on the inlet odour loading of the air is provided in Appendix E.

Emissions of contaminants treated by the biofilter are based on contaminant concentrations provided by Senior BIOREM Process Engineers based on some actual sampling (ex. hydrogen sulfide), literature presented at conferences and professional estimates. To estimate conservative emissions from this source, the maximum of the concentration ranges measured has been used. Additionally, BIOREM provided destruction efficiencies for the contaminants as have been listed in Table A.3. The Total Reduced Sulfur (TRS) emissions were calculated in accordance with MOE Guidance as the aggregate emission of hydrogen sulfide, mercaptans, dimethyl sulfide and dimethyl disulfide. Equipment specifications are provided in Appendix E.

Methodology: Engineering Calculation (EC)

The estimated maximum emission rates of contaminants and odour from the biofilter were calculated based on engineering estimates.

Sample Calculation: Ammonia (g/s)

$$\text{Concentration} \left(\frac{\text{mg}}{\text{m}^3} \right) = \frac{25 \text{ ppm} \times 17.03 \frac{\text{g}}{\text{mol}}}{24.45} = 17.4 \frac{\text{mg}}{\text{m}^3}$$

$$ER \left(\frac{\text{g}}{\text{s}} \right) = 5.56 \frac{\text{m}^3}{\text{s}} \times \frac{17.4 \text{ mg}}{\text{m}^3} \times (100\% - 50\%) \times \frac{\text{g}}{1000 \text{ mg}}$$

$$ER \left(\frac{\text{g}}{\text{s}} \right) = 4.84 \times 10^{-2} \frac{\text{g}}{\text{s}}$$

Sample Calculation: Total Reduced Sulfur (g/s)

$$ER_{TRS} = ER_{H_2S} + ER_{MERCAPTANS} + ER_{DIMETHYLSULFIDE} + ER_{DIMETHYLDISULFIDE}$$

$$ER_{TRS} \left(\frac{g}{s} \right) = 3.81 \times 10^{-3} + 1.10 \times 10^{-3} + 2.56 \times 10^{-3} + 1.00 \times 10^{-2} + 5.99 \times 10^{-3}$$

$$ER_{TRS} \left(\frac{g}{s} \right) = 2.35 \times 10^{-2} \frac{g}{s}$$

Sample Calculation: Odour (OU/s)

$$ER \left(\frac{OU}{s} \right) = 5.56 \frac{m^3}{s} \times 10,000 OU \times (100\% - 80\%)$$

$$ER \left(\frac{OU}{s} \right) = 1.11 \times 10^4 \frac{OU}{s}$$

Data Quality: Average

Section 8.3.3 of the ESDM Procedure Document titled "Average Data Quality" Emission Estimating Techniques, includes engineering calculations and judgement. Emission estimates derived from fundamental scientific and engineering principles, and/or relevant empirical data can be considered to be average data quality.

Operating Condition, Individual Maximum Rates of Production:

The emission of odour and contaminants from the biofilter is based on the maximum exhaust flow rate of the biofilter and the maximum concentration provided in Appendix E for each contaminant.

Source S-3: Flare

A gas flare will be operated at the Facility to burn 100% of the generated gas if the CHP units are not operational or if the gas production exceeds the CHP capacity. This flare will operate at a temperature between 1,000 and 1,200°C with concealed combustion. The flare stack will be constructed out of stainless steel. Manufacturer's specifications are provided in Appendix E.

Methodology: Emission Factor (EF)

The composition of biogas from anaerobic digestion is similar to that of landfill gas, therefore, the USEPA AP-42 emission factors for landfill gas flares in Chapter 2.4 "Solid Waste Management" have been used to estimate the emissions from this source. The AP-42 Chapter 2.4 emission factors are expressed in the units of kilogram per million cubic meters of methane. It has been estimated that the methane content of the biogas is 60% for the purposes of these emission estimate calculations. These AP-42 emission factors have a data quality ratings of "Average" and "Uncertain". The emissions from the flare have been calculated using these emission factors and a maximum biogas flaring rate of 1,400 m³/hr as per the flare design. Emission estimates from this source are provided in Table A.4.

Sample Calculation: Nitrogen Oxides

$$ER\left(\frac{g}{s}\right) = \frac{1,400 Nm^3_{biogas}}{hr} \times \frac{6.5 \times 10^2 kg}{10^6 m^3_{methane}} \times \frac{0.6 m^3_{methane}}{m^3_{biogas}} \times \frac{1000g}{kg} \times \frac{hr}{3600s}$$

$$ER\left(\frac{g}{s}\right) = 1.52 \times 10^{-1} \frac{g}{s}$$

Calorific Value Sample Calculation for SCREEN3Modelling

$$\dot{Q} = \frac{1400 m^3_{biogas}}{hr} \times \frac{1020 BTU}{ft^3_{methane}} \times \frac{35.3 ft^3}{m^3} \times \frac{0.6 m^3_{methane}}{m^3_{biogas}} \times \frac{252 cal}{BTU} \times \frac{hr}{3600s}$$

$$\dot{Q} = 2,117,152 \frac{cal}{s}$$

Data Quality: Average and Uncertain

Section 8.3.3 of the ESDM Procedure Document titled "Average Data Quality" Emission Estimating Techniques includes emission factor calculations using USEPA emission factors with data quality ratings of "C".

Section 8.3.4 of the ESDM Procedure Document titled “Marginal” or “Uncertain Data Quality” Emission Estimating Techniques includes emission factor calculations using USEPA emission factors with data quality ratings of “D” or “E”.

Operating Condition, Individual Maximum Rates of Production:

The emission rate estimates for this source have been estimated using a biogas flow rate to the flare of 1,400 m³ per hour with a 60% methane content.

Source S-4: Start-Up Boiler

The Facility may use a Natural Gas boiler during the process start-up and commissioning phase of the project. This boiler may be used to provide heat to the pretreatment and digester tanks during start-up to achieve the process temperature conditions required to produce biogas.

Methodology: Emission Factor (EF)

USEPA AP-42 Chapter 1.4, Natural Gas Combustion, External Sources for boilers of less than 100 MMBtu/hr emission factor is 100 pounds of NO_x per million standard cubic feet of natural gas. The USEPA quotes this emission factor as having a quality rating of “B”. Emission estimates from this source are provided in Table A.5.

Sample Calculation: Nitrogen Oxides

$$ER = \frac{3,493,000 \text{ BTU}}{\text{hr}} \times \frac{100 \text{ lb}}{10^6 \text{ ft}^3} \times \frac{\text{ft}^3}{1020 \text{ BTU}} \times \frac{\text{kg}}{2.2046 \text{ lb}} \times \frac{1000 \text{ g}}{\text{kg}} \times \frac{\text{hr}}{3600 \text{ s}}$$

$$ER = 4.31 \times 10^{-2} \frac{\text{g}}{\text{s}}$$

Data Quality: Above Average and Uncertain

Section 8.3.2 of the ESDM Procedure Document titled “Above Average Data Quality ” Emission Estimating Techniques includes emission factor calculations using USEPA emission factors with data quality ratings of “B”.

Section 8.3.4 of the ESDM Procedure Document titled “Marginal” or “Uncertain Data Quality” Emission Estimating Techniques includes emission factor calculations using USEPA emission factors with data quality ratings of “D” or “E”.

Operating Condition, Individual Maximum Rates of Production:

The emission rates estimated for this piece of equipment have been estimated. It is not anticipated that this boiler will be operated concurrently with the engines, however, the emissions from this piece of equipment have been included in the overall facility emissions profile.

TABLE A.1

**LIST OF COMBUSTION EQUIPMENT
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.**

<i>Equipment Identification</i>	<i>Ratings MBTUs/hr</i>
S-1a S-1b Biogas Engines	11,468
S-4 - Start-Up Boiler	3,493
Total	14,961

TABLE A.2

**ESTIMATED MAXIMUM BIOGAS COMBUSTION EMISSIONS
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.**

Normalized Exhaust Flow Rate		5,767	Nm³/hr (1)	per engine	
<i>Compound</i>	<i>CAS No.</i>	<i>Mfr Guaranteed Emission Values (mg/Nm3) (2)</i>	<i>Estimated Maximum Emission Rate for Engine 1 (S-1a) (g/s)</i>	<i>Estimated Maximum Emission Rate for Engine 2 (S-1b) (g/s)</i>	
Carbon Monoxide	630-08-0	1500	2.40E+00	2.40E+00	
Nitrogen Oxides	10102-44-0	500	8.01E-01	8.01E-01	
NMHC	NA	100	1.60E-01	1.60E-01	
Particulate	NA	55	8.81E-02	8.81E-02	

Notes:

(1) Based on Dry Normalized Exhaust flow rate of each engine.

(2) Based on GE guaranteed emission limits.

TABLE A.3

ESTIMATED MAXIMUM EMISSIONS FROM BIOFILTER
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.

Exhaust flow rate(m ³ /s)		5.56		
<i>Contaminant</i>	<i>CAS No.</i>	<i>Concentration (mg/m³) or (OU/m³) (1)</i>	<i>Destruction Efficiency (%) (2)</i>	<i>Emission (g/s) or(OU/s)</i>
Ammonia	7664-41-7	17.4	50%	4.84E-02
Trimethylamine	75-50-3	1.5	75%	2.08E-03
Triethylamine	121-44-8	1.0	65%	1.94E-03
Hydrogen Sulfide	7783-06-4	13.9	95%	3.87E-03
Methyl Mercaptan	74-93-1	2.0	90%	1.10E-03 (3)
Ethyl Mercaptan	75-08-1	1.0	65%	2.56E-03 (3)
Dimethyl Sulphide	77-78-1	5.2	65%	1.00E-02
Dimethyl disulphide	624-92-0	3.1	65%	5.99E-03
Butanol	71-36-3	10.0	70%	1.67E-02
Alpha-pinene	80-56-8	5.6	60%	1.24E-02
Limonene	5989-27-5	10.5	60%	2.33E-02
Acetic Acid	64-19-7	5.0	70%	8.33E-03
Oleic Acid	112-80-1	5.8	70%	9.63E-03
Butyric Acid	107-92-6	1.8	70%	3.00E-03
Cyclopentanol	91-41-3	8.0	60%	1.78E-02
Propyl acetate	109-60-4	5.0	60%	1.11E-02
Propyl butyrate	105-66-8	8.0	60%	1.78E-02
Pentanone	107-87-9	2.0	60%	4.44E-03
Me-isobutyl ketone	108-10-1	10.0	60%	2.22E-02
Nonanal	124-19-6	5.0	60%	1.11E-02
Total Reduced Sulfur	NA			2.35E-02
Odour	NA	2000 (4)		1.11E+04

Notes:

- (1) Concentrations have been provide by BioRem for biofilter inlet concentrations based on data collected at organics processing and rendering facilities. To produce conservative emission estimates, the highest value in the range of concentrations, as provided in Appendix F has been used in this calculation.
- (2) Biofilter removal efficiency has been provided by BioRem for individual compounds.
- (3) Amount of Mercaptans calculated according to Note 15 on page 20 of Summary of O. Reg. 419/05 Standards and Point of Impingement Guidelines and Ambient Air Quality Criteria (AAQCs)" date December 2005.
- (4)Based on conservative odour removal efficiency of 80% provided by manufacturer. Assuming 10,000OU inlet.

TABLE A.4

**ESTIMATED MAXIMUM EMISSIONS FROM BIOGAS FLARE
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.**

Maximum Biogas Flow Rate		1,400	Nm³/hr (1)
<i>Compound</i>	<i>CAS No.</i>	<i>Emission Factor (kg/10⁶m³ methane) (2)</i>	<i>Estimated Maximum Emission Rate for Flare (S-3) (g/s) (3)</i>
Carbon Monoxide	630-08-0	1.20E+04	2.80E+00
Nitrogen Oxides	10102-44-0	6.50E+02	1.52E-01
PM	NA	2.70E+02	6.30E-02

Notes:

(1)Based on the flare capacity provided by Bio-En.

(2) Emission factors provided in Table 2.4-4 of Chapter 2.4 AP-42 using emission factors as provided for landfill gas flares as these are the factors with the highest data quality available

(3) The emission rates have been determined based on an estimated 60% methane in biogas

TABLE A.5

**ESTIMATED MAXIMUM EMISSIONS FROM BOILER
ELMIRA BIOGAS PLANT
WOOLWICH BIO-EN INC.**

<i>Compound</i>	<i>CAS No.</i>	Heat Input Rating	3.49	MMBTU/hr
		<i>Natural Gas Fuelled AP-42 Emission Factors (lb/10⁶ft³)</i>		<i>Natural Gas Fuelled Estimated Maximum Emission Rate for Boiler (S-4) (g/s)</i>
Carbon Monoxide	630-08-0		84	3.62E-02
Nitrogen Oxides	10102-44-0		100	4.31E-02
Particulate	NA		7.6	3.28E-03

Notes:

(1) Emissions estimated using emission factors provided in Table 1.4-1 of USEPA AP 42 Chapter 1.4
Natural gas combustion in boilers <100MMBTU/hr

APPENDIX B

SUPPORTING INFORMATION FOR ASSESSMENT OF NEGLIGENCE

APPENDIX B

SUPPORTING INFORMATION FOR ASSESSMENT OF NEGLIGENCE
WOOLWICH BIO-EN INC.

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

- Fugitive dust from on-site roadways (Section 7.4)

The results of the screening are discussed in greater detail in the following text.

Fugitive Road Dust:

The Facility is not listed in Table 7-2 or 7-3 of Section 7.4 of the ESDM Procedure Document and accordingly dust emissions from these sources (parking lot, paved roads) can be considered as insignificant.

APPENDIX C

AERMOD AIR DISPERSION MODELLING MEMO



MEMORANDUM - DRAFT FOR REVIEW -

TO: Sarah Tebbutt/Stacey Woodruff REF. NO.: 046254
FROM: Stephen Koo/ca/4 DATE: January 14, 2010
RE: **AERMOD Odour Modelling Assessment
Woolwich Bio-En Inc., Elmira, Ontario**

1.0 INTRODUCTION

This memorandum has been prepared to summarize the methodology and results of air dispersion modelling for determination of odour compliance of Woolwich Bio-En Inc. located at 40 Martin's Lane in Elmira, Ontario (Facility). The dispersion modelling considered all significant odour-related air emission sources that have the potential to release at the Facility. The results of the dispersion modelling will be used to evaluate the Facility's compliance with acceptable odour limits, as prescribed by the Ontario Ministry of the Environment (MOE).

Dispersion modelling for the concentration of odour was performed using the United States Environmental Protection Agency (USEPA) multi-source dispersion model AERMOD, as prescribed by Ontario Regulation 419/05 (O.Reg. 419). AERMOD is an advanced steady-state plume model that has the ability to incorporate building cavity downwash, actual source parameters, emission rates, terrain and historical meteorological information to predict ground level concentrations (GLCs) at specified locations.

Odour-based dispersion modelling was performed for both a tiered receptor grid and discrete sensitive receptors, as described by O.Reg. 419, and the MOE technical bulletin entitled, "Methodology for Modelling Assessments with 10-Minute Average Standards and Guidelines under O.Reg. 419/05" dated April 2008.

2.0 MODELLING METHODOLOGY

2.1 General Modelling Approach

As per the April 2008 technical bulletin, a series of models were performed to determine odour compliance, as described below.

- Step 1: An air dispersion model, constructed as prescribed by O.Reg. 419/05, using a tiered receptor grid, is modelled for a 1-hour averaging period at ground level. All modelled results are then converted to a 10-minute averaging period. The removal of meteorological anomalies is allowed to determine the maximum compliance odour value. After this is done, if the odour-based guideline of 1 odour unit

(OU) is not exceeded at any modelled point, no further modelling is required. If the odour-based guideline is exceeded, further modelling is required.

- Step 2: An air dispersion model, with discrete receptors located at all locations where human activities may occur, is modelled for a 1-hour averaging period at an appropriate breathing height. All modelled results are then converted to a 10-minute averaging period. The removal of meteorological anomalies, as identified previously, is allowed to determine the maximum compliance odour value. After this is done, if the odour-based guideline of 1 OU is not exceeded at any discrete receptor, no further modelling is required. If the odour-based guideline is exceeded, further modelling is required.
- Step 3: An air dispersion model, with a discrete receptor located where human activities may occur, is modelled for a 1-hour averaging period at an appropriate breathing height. All modelled results are then converted to a 10-minute averaging period. A frequency analysis by year, based on the 99.5th percentile, is then performed to determine the maximum compliance odour value. The 99.5th percentile is equivalent to removing the highest 44 modelled concentrations per year.

2.2 Model Executables

The following USEPA executables were used in the assessment:

- AERMOD meteorological pre-processor (AERMET), version 06341
- AERMOD digital terrain pre-processor (AERMAP), version 09040
- AERMIC air dispersion model (AERMOD), version 09292
- Building Profile Input Program (BPIP), version 04274

2.3 Meteorological Data

Five years of local meteorological data was obtained from the MOE for use in the assessment. This local meteorological data was used at the request of the MOE, the MOE approval of the use of the local data is provided in Attachment A. The meteorological data is from the Elora Research Climate Station, and was processed by MOE with land-use classifications for the Facility locale. The meteorology covers the dates from January 1, 2004 to December 31, 2008. The hourly data included many factors which affect the dispersion of air contaminants including wind speed, wind direction, temperature, ceiling height, and atmospheric stability.

2.4 Averaging Periods and Time-Based Concentration Conversion

Odour levels are based on 10-minute peak concentrations of 1 OU. An OU for a compound is defined as a threshold where 50 percent of the population would detect, but not identify, the odiferous compound. This definition is normally applied at sensitive receptors. Sensitive receptors may include residences, camping grounds, schools, community centres, day care centres, recreational centres and outdoor public recreational areas, or any other locations as specified by MOE.

All concentrations at the receptors were modelled for a 1-hour averaging period. As AERMOD cannot model averaging periods less than 1 hour, the 1-hour averaging period was used with the resulting predicted concentrations converted to the shorter 10-minute averaging period using the MOE conversion factor of 1.65.

2.5 Digital Elevation Model Data

Digital elevation model (DEM) data was obtained from the MOE. The DEM data was used to include the effects of terrain in the modelling. The terrain used is from the DEM dataset tile085.

DEM data was preprocessed with AERMAP for use with AERMOD.

2.6 Source Input Parameters

The one significant source of odour was modelled as point source based on its physical description. Point source parameters and locations were based on information provided by Facility personnel and site drawings. It was conservatively assumed that the source was operated, continuously, and at maximum emission rates.

Based on Facility provided information, the biofilter stack was identified as the only significant source of odour emissions at the Facility.

A summary of the AERMOD source input parameters and odour emission rates are provided in Table 1. The Facility property boundary and the locations of the modelled sources are shown on Figure 1.

2.7 Tiered Receptors and Discrete Sensitive Receptors

Two sets of receptors were used in the assessment:

- A tiered receptor grid, located at ground level, for use with the Step 1 model
- A series of discrete sensitive receptors, elevated to the breathing zone, for use with the Step 2 and Step 3 models

The tiered receptor grid was defined based on a bounding box that encapsulates all the modelled sources. The grid was then tiered starting from the edge of the bounding box with a fine resolution, and progressing to coarser resolutions at further distances. All tiered distances were defined relative to the bounding box. The receptor grid used is described as follows:

- Bounding box origin (SW corner)(X,Y): 536,372.5, 4,828,001.5 (m)
- Size (width, height): 50.4, 38.1 (m)
- 20 m spacing within 200 m of the edge of the bounding box
- 50 m spacing from 200 m to 500 m
- 100 m spacing from 500 to 1,000 m
- 200 m spacing from 1,000 to 2,000 m

A property line ground level receptor grid with 10 m spacing was used to evaluate the maximum property boundary concentration. No receptors were placed inside the Facility's property line. A total of 1,976 receptors were used in the receptor grid and along the property line.

For the discrete sensitive receptors, a series of receptors were sited at locations of human activities and elevated to 1.5 metres above grade, the approximate height of the human breathing zone. The locations for each receptor was selected based on the MOE's definition of a sensitive receptor, as follows:

"...any location where routine or normal activities occurring at reasonably expected times would experience adverse effect(s) from odour discharges from the Facility, including one or a combination of:

- (a) private residences or public facilities where people sleep...*
- (b) institutional facilities ...*
- (c) outdoor public recreational areas ...*
- (d) commercial areas where there are continuous public activities.."*

A total of three sensitive receptors were identified that may be adversely affected by odour from the Facility. All receptors were residential. The locations of these receptors are presented in Figure 2.

2.8 On-Site Building Data

All on-site Facility buildings were modelled in AERMOD to account for building cavity downwash. Cavity downwash can result in air contaminants being forced to ground level prematurely under certain meteorological conditions, which can result in higher than expected near-field odour levels.

The USEPA Building Profile Input Program (BPIP) was used to calculate downwash effects for use with the AERMOD. All modelled buildings are presented in Figure 1.

2.9 Frequency Analysis

Step 3 models were required to assess both frequency impacts and determining the compliance odour concentration at the most impacted sensitive receptors. The frequency analysis was performed using the POSTFILE output option in AERMOD to calculate the 1-hour concentrations at the sensitive receptors for each single hour across the entire five year meteorological period. The concentrations calculated were then converted to a 10-minute averaging period and aggregated for each year to determine the frequency distribution and compliance odour concentration at each receptor.

3.0 DISPERSION MODELLING RESULTS

All odour models were developed and executed following the methodology described above.

The five years of meteorological data included over 43,800 hours of data. The AERMOD model was run to calculate the maximum 1-hour ground level concentration (GLC) for odour. The meteorological conditions, which would result in the maximum odour concentrations, would typically be stable atmospheric conditions such as an inversion with low wind speed. The maximum hour out of 43,800 hours of data would not occur at each grid point simultaneously since the wind can only blow in one direction during one hour.

3.1 Step 1 Analysis

As per Step 1 of the technical bulletin, a tiered receptor grid was used to calculate the maximum 1-hour odour concentrations at each receptor location. The 1-hour concentrations were then converted to 10-minute concentrations using the MOE time-based conversion factor of 1.65. As per MOE guidelines, for each modelled year the eight meteorological 1-hour periods that resulted in the highest eight GLCs were identified and removed. This resulted in the removal of a total of 40 hours from evaluation. After the removal of meteorological anomalies, the maximum odour GLC was calculated to be 2.24 OU at the property boundary. As this GLC did not meet the 1 OU odour guideline, the Step 2 analysis was performed.

The Step 1 maximum 10-minute odour concentration isopleths are presented in Figure 3. A summary of the hours removed from the analysis is provided in Table 2.

3.2 Step 2 Analysis

As per Step 2 of the technical bulletin, elevated receptors were used to calculate the maximum 1-hour odour concentration at each sensitive receptor location. The 1-hour concentrations were then converted to 10-minute concentrations using the MOE time-based conversion factor of 1.65. As per the technical bulletin, the meteorological hours identified during Step 1 were removed from the Step 2 analysis. After the removal of meteorological anomalies, the maximum odour concentration at any sensitive receptor was calculated to be 1.86 OU. As this odour concentration did not meet the 1 OU odour guideline at all sensitive receptors, a Step 3 analysis was performed for the nearby sensitive receptors.

3.3 Step 3 Analysis

As per Step 3 of the technical bulletin, the maximum 1-hour odour concentrations for all hours in the meteorological dataset were calculated for each sensitive receptor. The 1-hour concentrations were recorded using the POSTFILE option in AERMOD. The resultant 1-hour concentrations were then converted to 10-minute concentrations using the MOE time-based conversion factor of 1.65. The 10-minute concentrations were then sorted into odour bins of 0.1 OU increments to evaluate for frequency. In addition, the compliance odour value was determined for each discrete receptor by removing the highest 44 concentrations per year (equivalent to the 99.5th percentile), as per the guidance presented in the technical bulletin.

Based on the Step 3 analysis, the compliance odour concentrations for each of the discrete receptors are as follows:

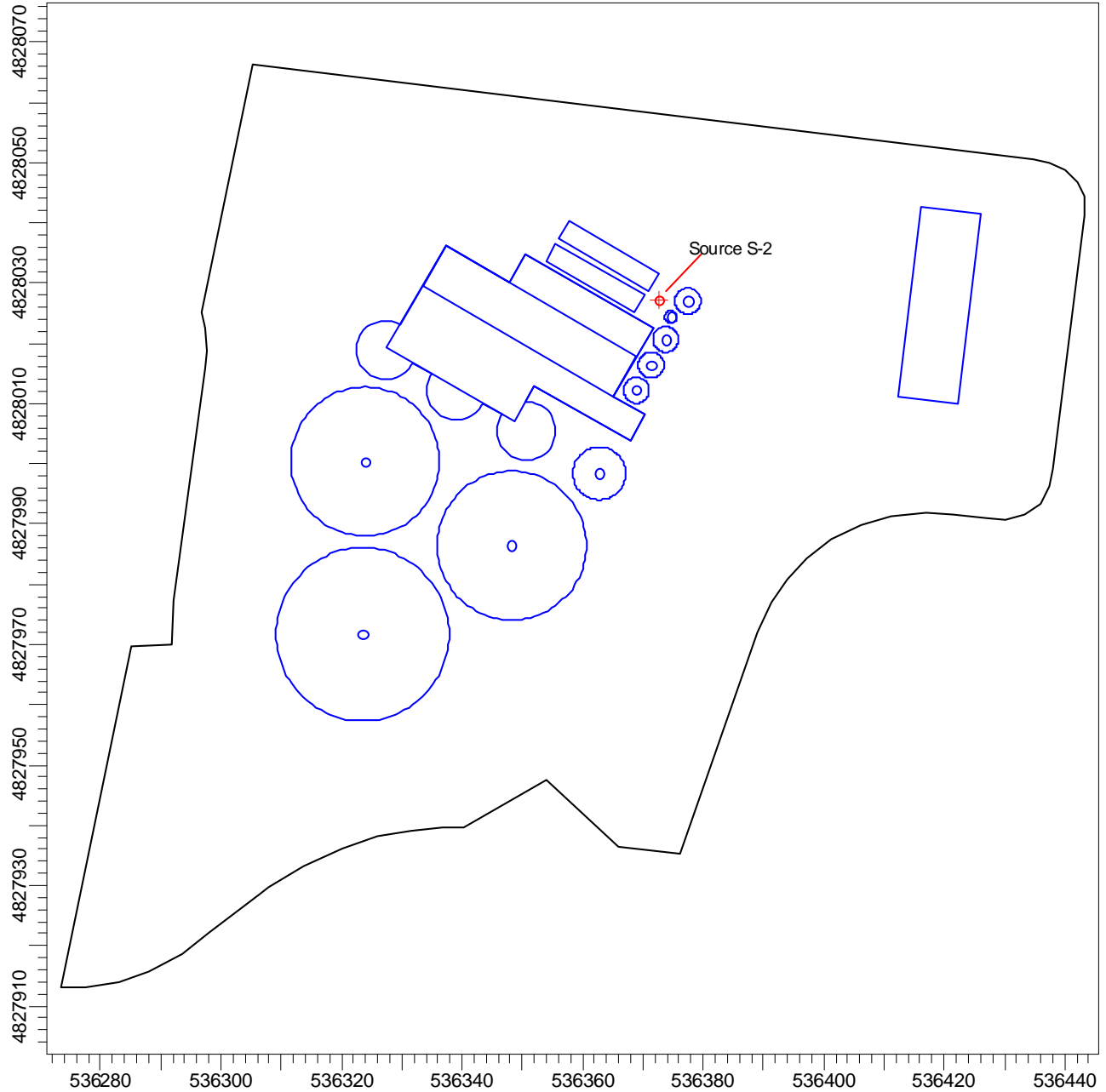
- Township Road 14 Residence, 0.85 OU
- Arthur Street N. Residence, 0.85 OU
- High Street Residence, 0.42

The compliance OU for each of the sensitive receptors is summarized in Table 3 and presented in Figure 4. The frequency distribution for each receptor is also summarized in Table 3.

Should you have any questions on the above, please do not hesitate to contact us.

PROJECT TITLE:

**FIGURE 1
FACILITY PROPERTY BOUNDARY, BUILDINGS, AND BIOSTACK (SOURCE S-2)**



COMMENTS:

SOURCES:

1

COMPANY NAME:

WOOLWICH BIO-EN INC., ELMIRA, ONTARIO

RECEPTORS:

85

MODELER:

CRA

SCALE:

1:1,065

0  0.03 km



**CONESTOGA-ROVERS
& ASSOCIATES**

DATE:

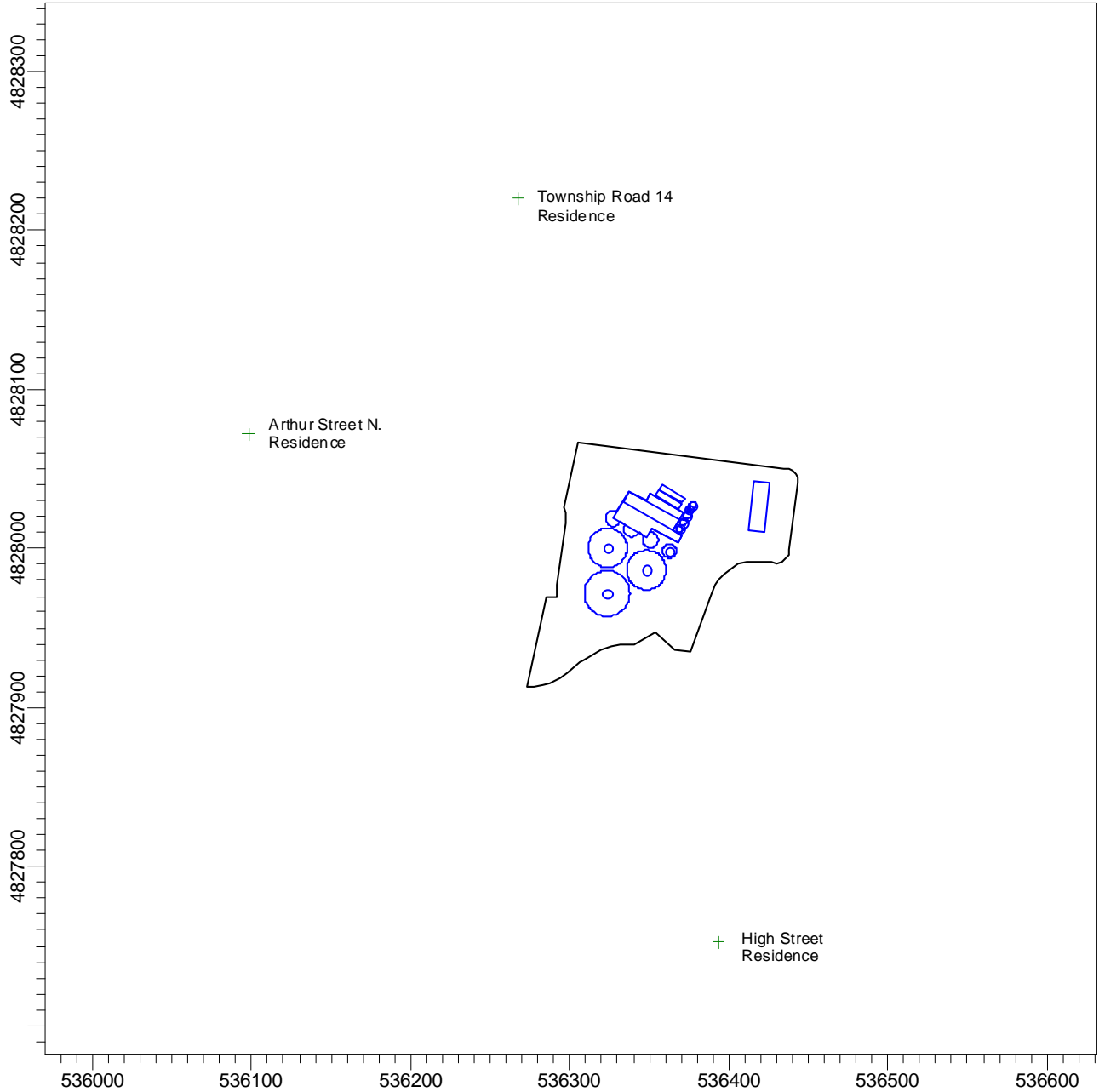
1/11/2010

PROJECT NO.:

046254

PROJECT TITLE:

FIGURE 2 DISCRETE SENSITIVE RECEPTOR LOCATIONS



COMMENTS:

SOURCES:

4

COMPANY NAME:

WOOLWICH BIO-EN INC., ELMIRA, ONTARIO

RECEPTORS:

85

MODELER:

CRA

SCALE:

1:4,034

0  0.1 km



**CONESTOGA-ROVERS
& ASSOCIATES**

DATE:

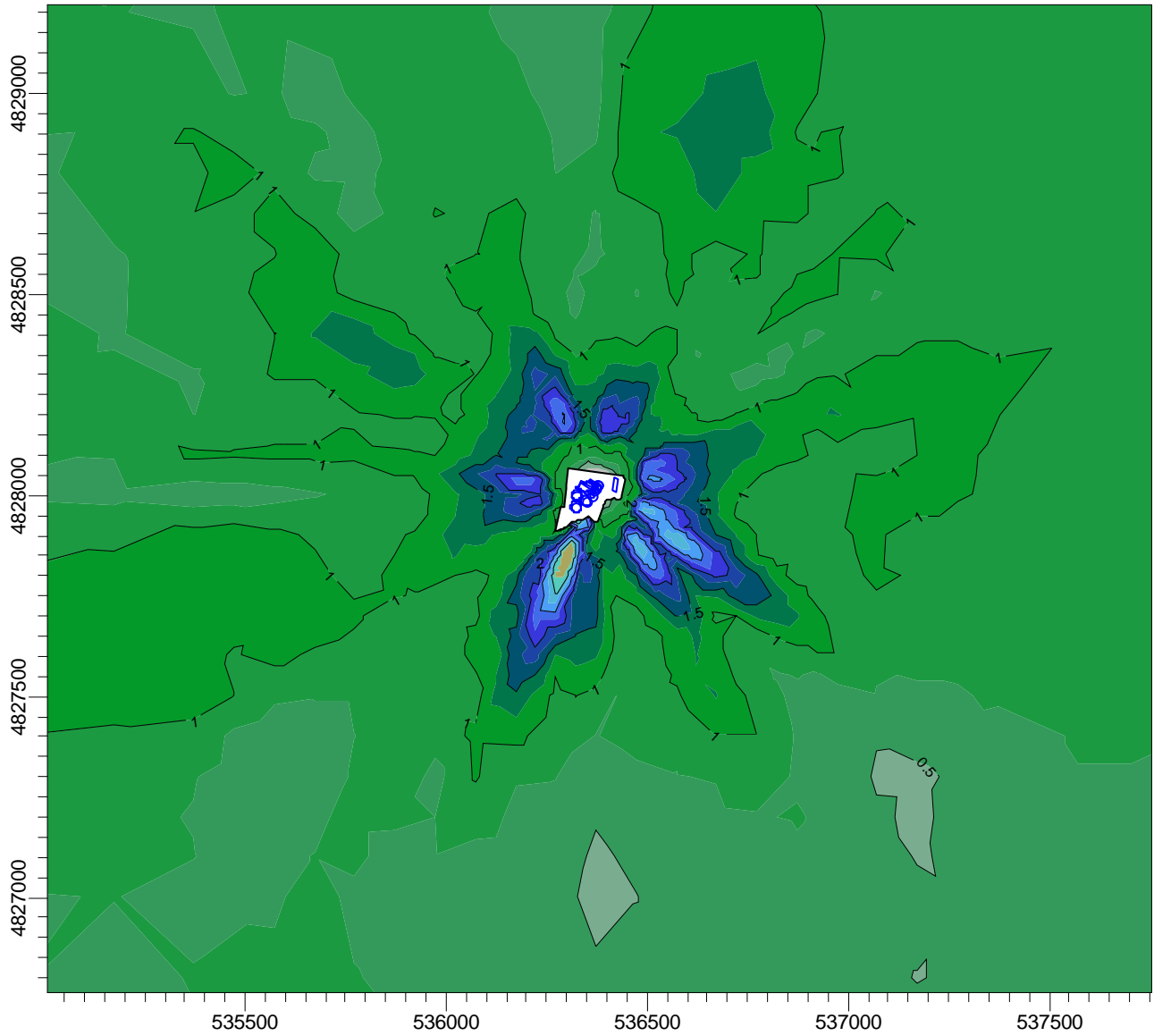
1/11/2010

PROJECT NO.:

046254

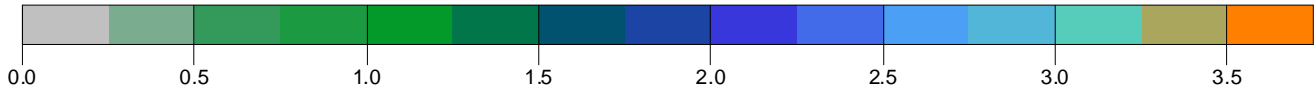
PROJECT TITLE:

**FIGURE 3
STEP 1 MAXIMUM 10-MINUTE GROUND LEVEL ODOUR CONCENTRATIONS**



PLOT FILE OF HIGH 1ST HIGH 10.0-MIN VALUES FOR SOURCE GROUP: ALL

OU



COMMENTS:

Maximum predicted odour concentration after removal of meteorological outliers is 2.24 ou.

Meteorological dataset for Elora CRS, processed for local land use by MOE Modelling Division.

SOURCES:

1

RECEPTORS:

85

Concentration

MAX:

3.52862 OU

COMPANY NAME:

WOOLWICH BIO-EN INC., ELMIRA, ONTARIO

MODELER:

CRA

SCALE: 1:16,759



DATE:

1/11/2010



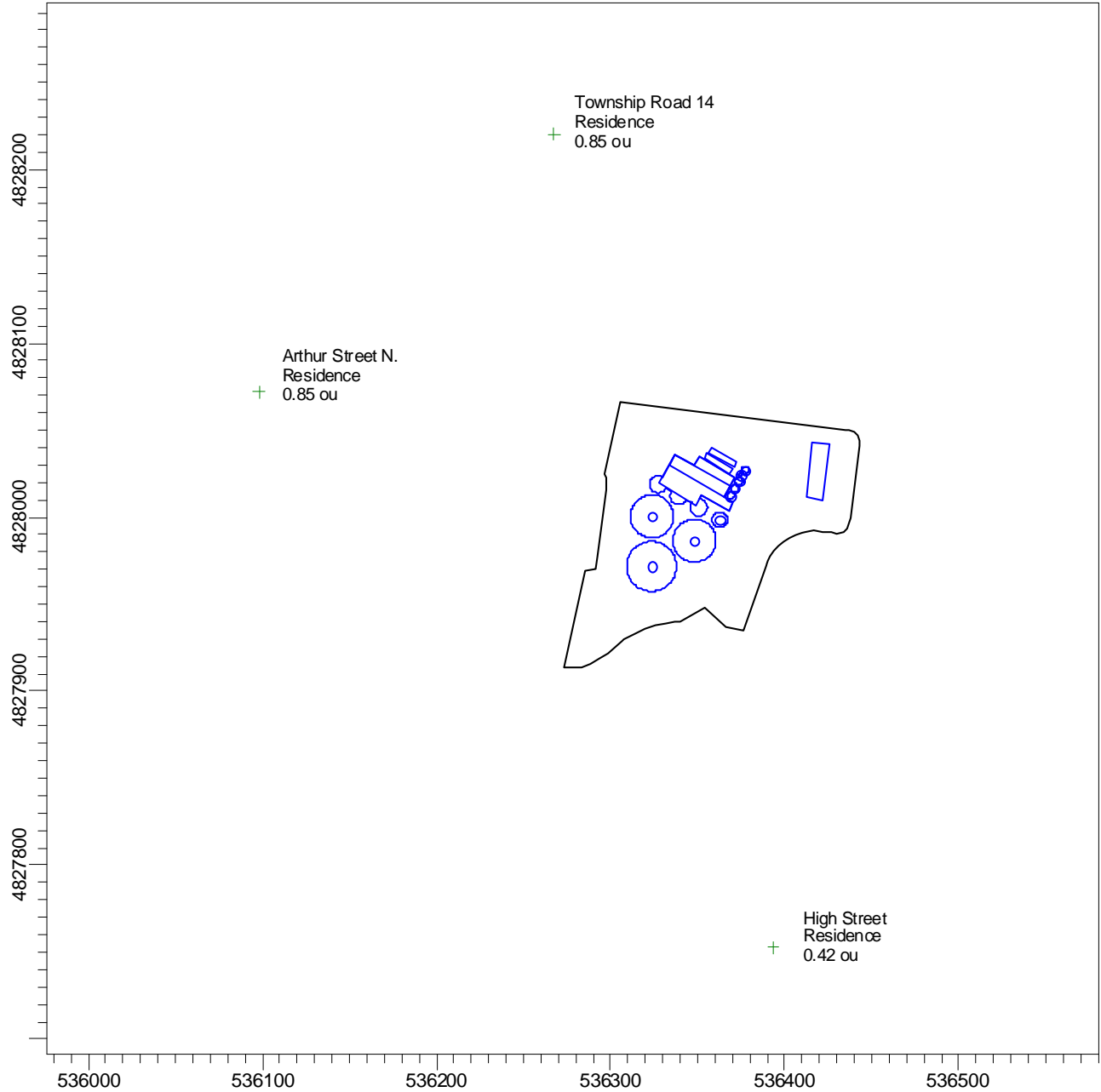
CONESTOGA-ROVERS & ASSOCIATES

PROJECT NO.:

046254

PROJECT TITLE:

FIGURE 4
STEP 3 COMPLIANCE 10-MINUTE ODOUR CONCENTRATIONS AT SENSITIVE RECEPTORS



COMMENTS:

Predicted odour concentration at sensitive receptors after removal of the highest 44 odour hours per year.

SOURCES:

4

COMPANY NAME:

WOOLWICH BIO-EN INC., ELMIRA, ONTARIO

RECEPTORS:

85

MODELER:

CRA

SCALE:

1:3,688

0 0.1 km



CONESTOGA-ROVERS & ASSOCIATES

DATE:

1/11/2010

PROJECT NO.:

046254

TABLE 1
AERMOD ODOUR DISPERSION MODELLING SOURCE PARAMETERS
WOOLWICH BIO-EN INCORPORATED
ELMIRA, ONTARIO

<i>Source Identifier</i>	<i>Description</i>	<i>Source Type</i>	<i>UTM Coordinates</i>		<i>Exit Height (m)</i>	<i>Exit Diameter (m)</i>	<i>Exit Temperature (K)</i>	<i>Exit Velocity (m/s)</i>	<i>Maximum Modelled Emission Rate (ou⁻⁶/s)</i>
			<i>X (m)</i>	<i>Y (m)</i>					
S-2	Biofilter Stack	point	536,421.5	4,828,041.9	20.00	0.54	288.15	24.02	1.11E-02

Note:
 (1) Estimated odour emission rate is 8250 ou/m³/s.

TABLE 2

**STEP 1 IDENTIFIED METEOROLOGICAL OUTLIER HOURS
WOOLWICH BIO-EN INCORPORATED
ELMIRA, ONTARIO**

<i>Summary of Hours by Model Year</i>									
<i>2004</i>		<i>2005</i>		<i>2006</i>		<i>2007</i>		<i>2008</i>	
<i>Rank</i>	<i>Date (yymmddhh)</i>	<i>Rank</i>	<i>Date (yymmddhh)</i>	<i>Rank</i>	<i>Date (yymmddhh)</i>	<i>Rank</i>	<i>Date (yymmddhh)</i>	<i>Rank</i>	<i>Date (yymmddhh)</i>
11	04071909	9	05090811	1	06081807	15	07080412	66	08092114
27	04071910	22	05081519	20	06060208	75	07081519	114	08081508
36	04072810	23	05081707	49	06080812	95	07082307	144	08090609
48	04042213	33	05050819	50	06080313	98	07082419	262	08081411
61	04083011	138	05082107	74	06041914	100	07061706	400	08081807
64	04081511	167	05061306	122	06080517	103	07072211	421	08082907
101	04072813	180	05081715	254	06081114	117	07072117	464	08092018
398	04083010	274	05102810	257	06080813	121	07060913	466	08051513

TABLE 3

**10-MINUTE COMPLIANCE ODOUR CONCENTRATION AND
FREQUENCY DISTRIBUTION AT SENSITIVE RECEPTORS
WOOLWICH BIO-EN INCORPORATED
ELMIRA, ONTARIO**

	<i>Sensitive Receptors</i>								
	<i>Township Road 14 Residence</i>			<i>Arthur Street N. Residence</i>			<i>High Street Residence</i>		
	<i>Compliance Odour Value (ou) (1)</i>	<i>Total Hours (hours)</i>	<i>Frequency (%)</i>	<i>Compliance Odour Value (ou) (1)</i>	<i>Total Hours (hours)</i>	<i>Frequency (%)</i>	<i>Compliance Odour Value (ou) (1)</i>	<i>Total Hours (hours)</i>	<i>Frequency (%)</i>
	0.85	--	--	0.85	--	--	0.42	--	--
<i>Odour Bins (ou)</i>									
less than 0.1	--	41,493	94.63%	--	39,862	90.91%	--	41,801	95.33%
0.1-0.2	--	567	1.29%	--	1104	2.52%	--	847	1.93%
0.2-0.3	--	522	1.19%	--	746	1.70%	--	674	1.54%
0.3-0.4	--	412	0.94%	--	538	1.23%	--	314	0.72%
0.4-0.5	--	218	0.50%	--	440	1.00%	--	140	0.32%
0.5-0.6	--	144	0.33%	--	378	0.86%	--	49	0.11%
0.6-0.7	--	119	0.27%	--	327	0.75%	--	10	0.02%
0.7-0.8	--	122	0.28%	--	223	0.51%	--	7	0.02%
0.8-0.9	--	103	0.23%	--	87	0.20%	--	2	0.00%
0.9-1.0	--	35	0.08%	--	49	0.11%	--	2	0.00%
1.0-1.1	--	23	0.05%	--	50	0.11%	--	1	0.00%
1.1-1.2	--	28	0.06%	--	7	0.02%	--	0	0.00%
1.2-1.3	--	16	0.04%	--	16	0.04%	--	1	0.00%
1.3-1.4	--	17	0.04%	--	13	0.03%	--	0	0.00%
1.4-1.5	--	10	0.02%	--	7	0.02%	--	0	0.00%
1.5-1.6	--	7	0.02%	--	1	0.00%	--	0	0.00%
1.6-1.7	--	4	0.01%	--	0	0.00%	--	0	0.00%
1.7-1.8	--	2	0.00%	--	0	0.00%	--	0	0.00%
1.8-1.9	--	4	0.01%	--	0	0.00%	--	0	0.00%
1.9-2.0	--	0	0.00%	--	0	0.00%	--	0	0.00%
2.0-2.1	--	0	0.00%	--	0	0.00%	--	0	0.00%
2.1-2.2	--	0	0.00%	--	0	0.00%	--	0	0.00%
2.2-2.3	--	0	0.00%	--	0	0.00%	--	0	0.00%
2.3-2.4	--	1	0.00%	--	0	0.00%	--	0	0.00%
2.4-2.5	--	1	0.00%	--	0	0.00%	--	0	0.00%
greater than 2.5	--	0	0.00%	--	0	0.00%	--	0	0.00%

Notes:

- (1) Compliance odour value is determined after removal of the highest 44 odour values per year. The maximum of the remaining 45th values for each of the five modelled meteorological years represents the compliance odour value.

APPENDIX D

SCREEN3 DISPERSION MODELLING PRINTOUTS

01/11/10
13:27:00

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

Biofilter

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.00000
STACK HEIGHT (M) = 20.0000
STK INSIDE DIAM (M) = .5400
STK EXIT VELOCITY (M/S) = 24.0200
STK GAS EXIT TEMP (K) = 288.1500
AMBIENT AIR TEMP (K) = 293.0000
RECEPTOR HEIGHT (M) = .0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 9.5500
MIN HORIZ BLDG DIM (M) = 27.2000
MAX HORIZ BLDG DIM (M) = 42.7000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

TA > TS!!! BUOY. FLUX SET = 0.0

BUOY. FLUX = .000 M**4/S**3; MOM. FLUX = 42.060 M**4/S**2.

*** FULL METEOROLOGY ***

*** SCREEN AUTOMATED DISTANCES ***

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1.	.0000	1	1.0	1.0	320.0	57.07	2.69	2.66	NO
100.	39.05	4	10.0	11.1	3200.0	23.51	8.26	11.66	HS
200.	44.22	1	1.5	1.6	480.0	44.71	50.47	30.14	NO
300.	43.69	2	1.5	1.6	480.0	44.71	52.68	30.96	NO
400.	45.00	3	2.0	2.1	640.0	38.15	44.95	26.95	NO
500.	44.48	3	1.5	1.6	480.0	44.20	55.21	33.16	NO
600.	41.75	3	1.0	1.1	320.0	56.31	65.53	39.70	NO
700.	42.03	5	1.0	1.3	10000.0	36.27	37.06	17.15	NO
800.	49.79	5	1.0	1.3	10000.0	36.27	41.81	18.85	NO
900.	54.81	5	1.0	1.3	10000.0	36.27	46.50	20.50	NO
1000.	57.57	5	1.0	1.3	10000.0	36.27	51.15	22.12	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:
1063. 57.76 5 1.0 1.3 10000.0 36.27 54.01 22.94 NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** REGULATORY (Default) ***
PERFORMING CAVITY CALCULATIONS
WITH ORIGINAL SCREEN CAVITY MODEL
(BRODE, 1988)

*** CAVITY CALCULATION - 1 ***	*** CAVITY CALCULATION - 2 ***
CONC (UG/M**3) = .0000	CONC (UG/M**3) = .0000
CRIT WS @10M (M/S) = 99.99	CRIT WS @10M (M/S) = 99.99
CRIT WS @ HS (M/S) = 99.99	CRIT WS @ HS (M/S) = 99.99
DILUTION WS (M/S) = 99.99	DILUTION WS (M/S) = 99.99
CAVITY HT (M) = 9.93	CAVITY HT (M) = 9.60
CAVITY LENGTH (M) = 35.28	CAVITY LENGTH (M) = 27.80
ALONGWIND DIM (M) = 27.20	ALONGWIND DIM (M) = 42.70

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S. CONC SET = 0.0

END OF CAVITY CALCULATIONS

*** SUMMARY OF SCREEN MODEL RESULTS ***

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
----- SIMPLE TERRAIN	----- 57.76	----- 1063.	----- 0.

** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **

01/11/10
13:11:03

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

Engine-rural

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.00000
STACK HEIGHT (M) = 9.5500
STK INSIDE DIAM (M) = .3000
STK EXIT VELOCITY (M/S) = 61.6814
STK GAS EXIT TEMP (K) = 743.1500
AMBIENT AIR TEMP (K) = 293.0000
RECEPTOR HEIGHT (M) = .0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 6.0500
MIN HORIZ BLDG DIM (M) = 10.0000
MAX HORIZ BLDG DIM (M) = 31.7500

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

STACK EXIT VELOCITY WAS CALCULATED FROM
VOLUME FLOW RATE = 4.3600000 (M**3/S)

BUOY. FLUX = 8.244 M**4/S**3; MOM. FLUX = 33.751 M**4/S**2.

*** FULL METEOROLOGY ***

*** SCREEN AUTOMATED DISTANCES ***

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1.	.0000	1	1.0	1.0	320.0	113.78	2.72	2.69	NO
100.	79.55	4	15.0	15.0	4800.0	14.19	8.31	8.83	HS
200.	44.53	4	15.0	15.0	4800.0	16.50	15.69	12.23	HS
300.	39.32	4	10.0	10.0	3200.0	19.97	22.81	15.54	HS
400.	34.53	4	8.0	8.0	2560.0	22.58	29.69	18.65	HS
500.	29.34	4	8.0	8.0	2560.0	22.58	36.34	21.52	HS
600.	25.86	4	5.0	5.0	1600.0	30.40	43.13	22.03	NO
700.	24.43	4	5.0	5.0	1600.0	30.40	49.55	24.76	NO
800.	22.68	4	4.5	4.5	1440.0	32.71	55.97	27.59	NO
900.	21.15	4	4.0	4.0	1280.0	35.61	62.33	30.39	NO
1000.	19.78	4	3.5	3.5	1120.0	39.33	68.66	33.20	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:
47. 114.3 4 15.0 15.0 4800.0 12.40 4.23 6.29 HS

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED

DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** REGULATORY (Default) ***

PERFORMING CAVITY CALCULATIONS
WITH ORIGINAL SCREEN CAVITY MODEL
(BRODE, 1988)

*** CAVITY CALCULATION - 1 ***

CONC (UG/M**3) = .0000
CRIT WS @10M (M/S) = 99.99
CRIT WS @ HS (M/S) = 99.99
DILUTION WS (M/S) = 99.99
CAVITY HT (M) = 7.18
CAVITY LENGTH (M) = 22.89
ALONGWIND DIM (M) = 10.00

*** CAVITY CALCULATION - 2 ***

CONC (UG/M**3) = .0000
CRIT WS @10M (M/S) = 99.99
CRIT WS @ HS (M/S) = 99.99
DILUTION WS (M/S) = 99.99
CAVITY HT (M) = 6.05
CAVITY LENGTH (M) = 12.38
ALONGWIND DIM (M) = 31.75

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S. CONC SET = 0.0

END OF CAVITY CALCULATIONS

*** SUMMARY OF SCREEN MODEL RESULTS ***

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
----- SIMPLE TERRAIN	----- 114.3	----- 47.	----- 0.

** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **

01/11/10
15:20:33

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

46254-flare

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = FLARE
EMISSION RATE (G/S) = 1.00000
FLARE STACK HEIGHT (M) = 4.9000
TOT HEAT RLS (CAL/S) = .211715E+07
RECEPTOR HEIGHT (M) = .0000
URBAN/RURAL OPTION = RURAL
EFF RELEASE HEIGHT (M) = 9.7159
BUILDING HEIGHT (M) = 6.0500
MIN HORIZ BLDG DIM (M) = 10.0000
MAX HORIZ BLDG DIM (M) = 31.7500

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BOUY. FLUX = 35.103 M**4/S**3; MOM. FLUX = 21.405 M**4/S**2.

*** FULL METEOROLOGY ***

*** SCREEN AUTOMATED DISTANCES ***

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1.	.0000	1	1.0	1.0	320.0	318.70	2.21	2.18	NO
100.	57.65	4	20.0	20.0	6400.0	14.39	8.36	8.88	HS
200.	29.20	4	20.0	20.0	6400.0	17.71	15.77	12.34	HS
300.	18.85	4	20.0	20.0	6400.0	20.49	22.86	15.61	HS
400.	13.47	4	20.0	20.0	6400.0	22.97	29.73	18.72	HS
500.	10.81	4	20.0	20.0	6400.0	24.20	36.41	21.65	HS
600.	9.537	4	15.0	15.0	4800.0	29.99	43.12	24.73	HS
700.	8.588	4	15.0	15.0	4800.0	29.99	49.54	27.40	HS
800.	7.689	4	10.0	10.0	3200.0	40.61	56.27	30.74	HS
900.	7.265	4	10.0	10.0	3200.0	40.61	62.51	33.27	HS
1000.	6.682	4	10.0	10.0	3200.0	40.61	68.70	34.06	HS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:
19. 98.86 4 20.0 20.0 6400.0 10.68 1.92 4.39 HS

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** REGULATORY (Default) ***
PERFORMING CAVITY CALCULATIONS
WITH ORIGINAL SCREEN CAVITY MODEL
(BRODE, 1988)

*** CAVITY CALCULATION - 1 ***

CONC (UG/M**3) = .0000
CRIT WS @10M (M/S) = 99.99
CRIT WS @ HS (M/S) = 99.99
DILUTION WS (M/S) = 99.99
CAVITY HT (M) = 7.18
CAVITY LENGTH (M) = 22.89
ALONGWIND DIM (M) = 10.00

*** CAVITY CALCULATION - 2 ***

CONC (UG/M**3) = .0000
CRIT WS @10M (M/S) = 99.99
CRIT WS @ HS (M/S) = 99.99
DILUTION WS (M/S) = 99.99
CAVITY HT (M) = 6.05
CAVITY LENGTH (M) = 12.38
ALONGWIND DIM (M) = 31.75

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S. CONC SET = 0.0

END OF CAVITY CALCULATIONS

*** SUMMARY OF SCREEN MODEL RESULTS ***

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	98.86	19.	0.

** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **

01/21/10
08:21:15

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

boiler

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.00000
STACK HEIGHT (M) = 8.0000
STK INSIDE DIAM (M) = .4572
STK EXIT VELOCITY (M/S) = 1.6393
STK GAS EXIT TEMP (K) = 463.1500
AMBIENT AIR TEMP (K) = 293.0000
RECEPTOR HEIGHT (M) = .0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 6.0500
MIN HORIZ BLDG DIM (M) = 10.0000
MAX HORIZ BLDG DIM (M) = 31.7500

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

STACK EXIT VELOCITY WAS CALCULATED FROM
VOLUME FLOW RATE = 570.25000 (ACFM)

BOUY. FLUX = .309 M**4/S**3; MOM. FLUX = .089 M**4/S**2.

*** FULL METEOROLOGY ***

*** SCREEN AUTOMATED DISTANCES ***

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1.	.0000	0	.0	.0	.0	.00	.00	.00	NA
100.	1603.	4	1.5	1.5	480.0	9.07	8.20	7.03	SS
200.	1111.	4	1.0	1.0	320.0	11.12	15.56	10.41	SS
300.	742.3	4	1.0	1.0	320.0	11.12	22.61	13.53	SS
400.	519.6	4	1.0	1.0	320.0	11.12	29.45	16.64	SS
500.	416.2	6	1.0	1.0	10000.0	17.69	17.97	10.62	SS
600.	408.9	6	1.0	1.0	10000.0	17.69	21.24	11.71	SS
700.	389.1	6	1.0	1.0	10000.0	17.69	24.46	12.73	SS
800.	365.3	6	1.0	1.0	10000.0	17.69	27.63	13.71	SS
900.	337.3	6	1.0	1.0	10000.0	17.69	30.78	14.37	SS
1000.	314.1	6	1.0	1.0	10000.0	17.69	33.88	15.22	SS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:
32. 2679. 6 2.5 2.5 10000.0 8.45 1.45 4.16 SS

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED

DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 *** REGULATORY (Default) ***
 PERFORMING CAVITY CALCULATIONS
 WITH ORIGINAL SCREEN CAVITY MODEL
 (BRODE, 1988)

*** CAVITY CALCULATION - 1 ***	*** CAVITY CALCULATION - 2 ***
CONC (UG/M**3) = 1462.	CONC (UG/M**3) = .0000
CRIT WS @10M (M/S) = 4.75	CRIT WS @10M (M/S) = 99.99
CRIT WS @ HS (M/S) = 4.75	CRIT WS @ HS (M/S) = 99.99
DILUTION WS (M/S) = 2.37	DILUTION WS (M/S) = 99.99
CAVITY HT (M) = 7.18	CAVITY HT (M) = 6.05
CAVITY LENGTH (M) = 22.89	CAVITY LENGTH (M) = 12.38
ALONGWIND DIM (M) = 10.00	ALONGWIND DIM (M) = 31.75

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S. CONC SET = 0.0

 END OF CAVITY CALCULATIONS

 *** SUMMARY OF SCREEN MODEL RESULTS ***

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
-----	-----	-----	-----
SIMPLE TERRAIN	2679.	32.	0.
BLDG. CAVITY-1	1462.	23.	-- (DIST = CAVITY LENGTH)
BLDG. CAVITY-2	.0000	12.	-- (DIST = CAVITY LENGTH)

 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **

APPENDIX E

MANUFACTURER DATA SHEETS

ENGINE MANUFACTURER DATA



Technical Description
Cogeneration Unit-Container
JMS 420 GS-B.L

Bio-En Elmira Pet Products

Electrical output	1426 kW el.
Thermal output	1510 kW

Emission values
NOx < 500 mg/Nm³ (5% O₂)



0.01 Technical Data (module)

Data at:			Full	Part Load	
			load		
Fuel gas LHV		kWh/Nm ³	6.5		
			100%	75%	50%
Energy input		kW	[2] 3,538	2,743	1,948
Gas volume		Nm ³ /h	*) 544	422	300
Mechanical output		kW	[1] 1,466	1,100	733
Electrical output		kW el.	[4] 1,426	1,068	706
Recoverable thermal output					
~ Intercooler 1st stage		kW	208	40	3
~ Lube oil		kW	165	152	114
~ Jacket water		kW	400	387	296
~ Exhaust gas cooled to 180 °C		kW	737	616	471
Total recoverable thermal output		kW	[5] 1,510	1,195	884
Total output generated		kW total	2,936	2,263	1,590
Heat to be dissipated					
~ Intercooler 2nd stage		kW	78	67	38
~ Surface heat	ca.	kW	[7] 111	106	108
~ Balance heat		kW	35	27	19
Spec. fuel consumption of engine		kWh/kWh	[2] 2.41	2.49	2.66
Lube oil consumption	ca.	kg/h	[3] 0.44	~	~
Electrical efficiency		%	40.3%	38.9%	36.2%
Thermal efficiency		%	42.6%	43.5%	45.3%
Total efficiency		%	[6] 82.9%	82.4%	81.5%
Hot water circuit:					
Forward temperature		°C	90.0	85.8	81.7
Return temperature		°C	70.0	70.0	70.0
Hot water flow rate		m ³ /h	64.9	64.9	64.9

*) approximate value for pipework dimensioning
 [] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of +/- 8% on the thermal output a further reserve of 10% is recommended for the dimensioning of the cooling requirements.



Main dimensions and weights (container)

Length	mm	~ 12,200
Width	mm	~ 3,000
Height	mm	~ 2,600
Weight empty	kg	~ 35,600
Weight filled	kg	~ 37,500

Connections

Jacket water inlet and outlet	DN/PN	100/10
Exhaust gas outlet	DN/PN	300/10
Fuel gas connection (container)	mm	150/16
Fresh oil connection	G	28x2"
Waste oil connection	G	28x2"
Cable outlet	mm	800x400
Condensate drain	mm	18

Output / fuel consumption

ISO standard fuel stop power ICFN	kW	1,466
Mean effe. press. at stand. power and nom. speed	bar	16.00
Fuel gas type		Biogas
Based on methane number	MZ d)	100
Compression ratio	Epsilon	12.50
Min./Max. fuel gas pressure at inlet to gas train	mbar	120 - 200 c)
Allowed Fluctuation of fuel gas pressure	%	± 10
Max. rate of gas pressure fluctuation	mbar/sec	10
Maximum Intercooler 2nd stage inlet water temperature	°C	55
Spec. fuel consumption of engine	kWh/kWh	2.41
Specific lube oil consumption	g/kWh	0.30
Max. Oil temperature	°C	85
Jacket-water temperature max.	°C	90
Filling capacity lube oil (refill)	lit	~ 437

c) Lower gas pressures upon inquiry

d) based on methane number calculation software AVL 3.1



0.02 Technical data of engine

Manufacturer		GE Jenbacher
Engine type		J 420 GS-A81
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		20
Bore	mm	145
Stroke	mm	185
Piston displacement	lit	61.10
Nominal speed	rpm	1,800
Mean piston speed	m/s	11.10
Length	mm	3,750
Width	mm	1,580
Height	mm	2,033
Weight dry	kg	6,600
Weight filled	kg	7,300
Moment of inertia	kgm ²	11.64
Direction of rotation (from flywheel view)		left
Flywheel connection		SAE 18"
Radio interference level to VDE 0875		N
Starter motor output	kW	9
Starter motor voltage	V	24

Thermal energy balance

Energy input	kW	3,538
Intercooler	kW	286
Lube oil	kW	165
Jacket water	kW	400
Exhaust gas total	kW	1,110
Exhaust gas cooled to 180 °C	kW	737
Exhaust gas cooled to 100 °C	kW	931
Surface heat	kW	71
Balance heat	kW	35

Exhaust gas data

Exhaust gas temperature at full load	°C [8]	470
Exhaust gas mass flow rate, wet	kg/h	8,098
Exhaust gas mass flow rate, dry	kg/h	7,526
Exhaust gas volume, wet	Nm ³ /h	6,295
Exhaust gas volume, dry	Nm ³ /h	5,609
Max. admissible exhaust back pressure after engine	mbar	60

Combustion air data

Combustion air mass flow rate	kg/h	7,466
Combustion air volume	Nm ³ /h	5,775
Max. admissible pressure drop in front of intake-air filter	mbar	10

basis for exhaust gas data: natural gas: 100% CH₄; biogas 65% CH₄, 35% CO₂



Sound pressure level

Aggregate b)		dB(A) re 20 μ Pa	97
31,5	Hz	dB	79
63	Hz	dB	87
125	Hz	dB	98
250	Hz	dB	95
500	Hz	dB	91
1000	Hz	dB	86
2000	Hz	dB	88
4000	Hz	dB	92
8000	Hz	dB	89
Exhaust gas a)		dB(A) re 20 μ Pa	115
31,5	Hz	dB	95
63	Hz	dB	117
125	Hz	dB	115
250	Hz	dB	113
500	Hz	dB	108
1000	Hz	dB	105
2000	Hz	dB	108
4000	Hz	dB	109
8000	Hz	dB	107

Sound power level

Aggregate		dB(A) re 1pW	117
Measurement surface		m ²	107
Exhaust gas		dB(A) re 1pW	123
Measurement surface		m ²	6.28

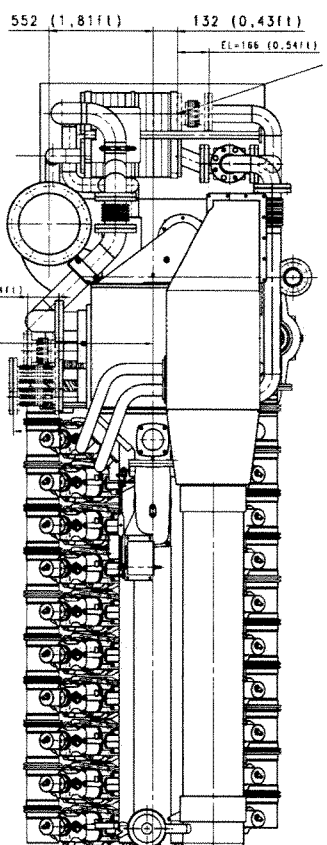
a) average sound pressure level on measurement surface in a distance of 1m according to DIN 45635, precision class 2.

b) average sound pressure level on measurement surface in a distance of 1m (converted to free field) according to DIN 45635, precision class 3.

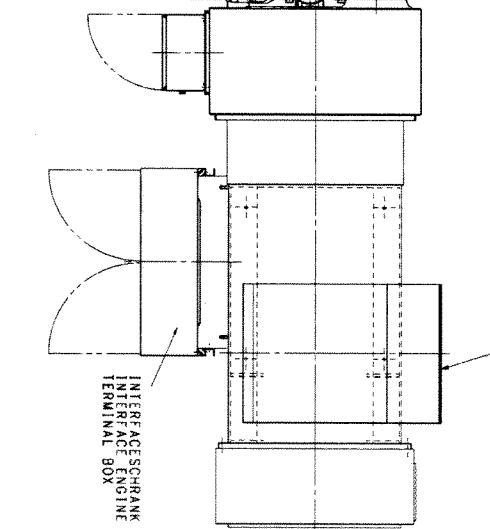
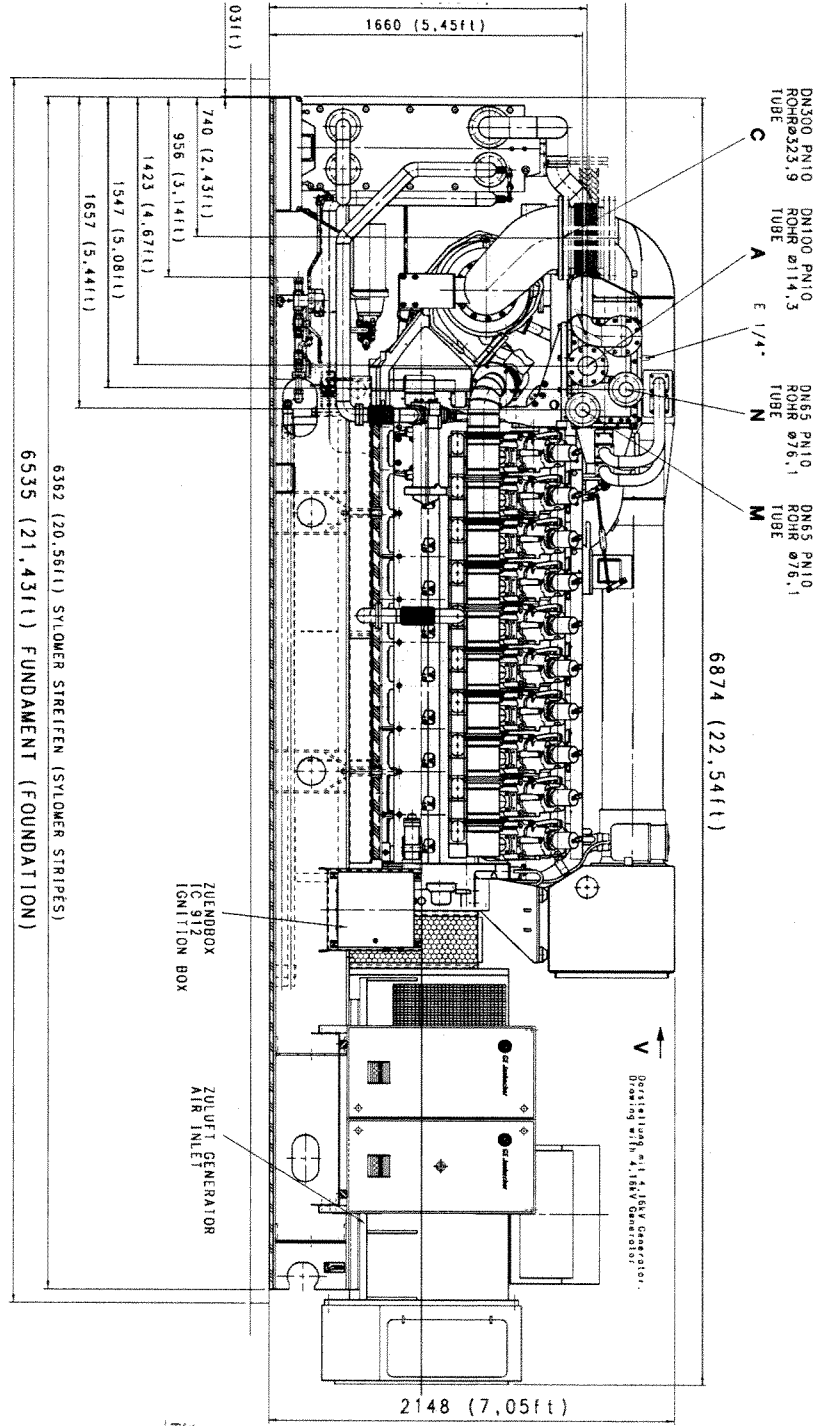
Operation with 1200 rpm see upper values, operation with 1800 rpm add 3 dB to upper values.

Engine tolerance \pm 3 dB

ZUR INFORMATION
Y FOR INFORMATION



RÜCKLAUF ≤ 74°C
RETURN TEMP. ≤ 74°C



GEWICHT/MASS:

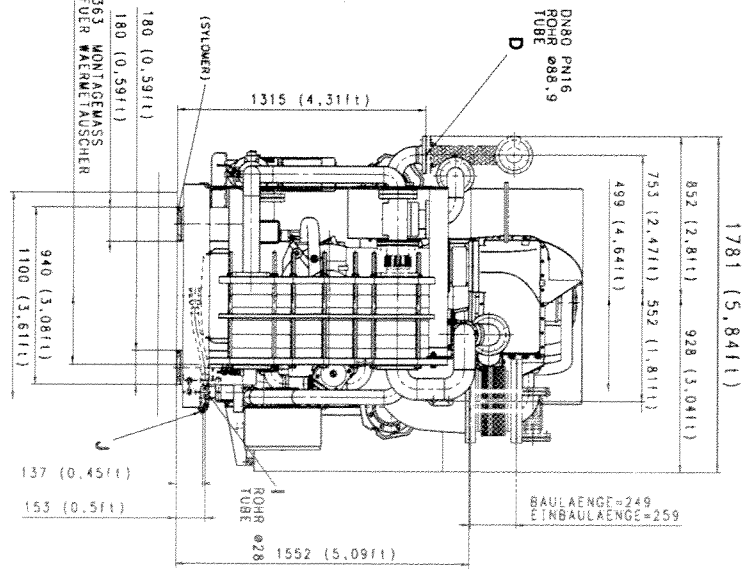
M 1530	kg
M 1820	kg

LACKIERUNG/ COAT OF LAQUER

RAL 6018	
RAL 6018	
RAL 6018	

LEGENDE STEHE
E 12344 XX
LEGEND SEE

- ANSCHLÜSSE
- A WASSEREINLEITUNG
 - B WASSERABFUHRUNG
 - C ÜBERBRÜCKUNG
 - D STÖBEREINLEITUNG
 - E STÖBEREINLEITUNG
 - F WASSERABFUHRUNG
 - G WASSERABFUHRUNG
 - H WASSERABFUHRUNG
 - I WASSERABFUHRUNG
 - J WASSERABFUHRUNG
 - K WASSERABFUHRUNG
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 - P WASSERABFUHRUNG
 - Q WASSERABFUHRUNG
 - R WASSERABFUHRUNG
 - S WASSERABFUHRUNG
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 - U WASSERABFUHRUNG
 - V WASSERABFUHRUNG
 - W WASSERABFUHRUNG
 - X WASSERABFUHRUNG
 - Y WASSERABFUHRUNG
 - Z WASSERABFUHRUNG
- CORRECTIONS
- A HEATING WATER INLET
 - B HEATING WATER OUTLET
 - C FUEL GAS INLET
 - D SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - E SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - F SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - G SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - H SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - I SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - J SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - K SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - L SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - M SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - N SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - O SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - P SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - Q SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - R SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - S SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - T SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - U SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - V SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - W SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - X SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - Y SAFETY VALVE FOR THE SAFETY WATER PRESSURE
 - Z SAFETY VALVE FOR THE SAFETY WATER PRESSURE



BAULÄNGE = 249
EINBAULÄNGE = 259

STANDARDMOT. 60Hz
RÜCKLAUFTEMP. 74°C
ANS 420 GSS-X 42000°C

ÄNDERUNGEN VORBEHALTEN
DESIGN SUBJECT TO CHANGE
TECHNISCHE DATEN STEHE TECHN. SCHEM
FOR TECHNICAL DATA SEE TECHN. DIAGR

GEWICHT/MASS:

M 1530	kg
M 1820	kg

LACKIERUNG/ COAT OF LAQUER

RAL 6018	
RAL 6018	
RAL 6018	

AGREGATZICHENUNG

AGREGATZICHENUNG	
AGREGATZICHENUNG	
AGREGATZICHENUNG	

GE 8710 00122
422003

STANDARD VALUES for exhaust gas emissions

GE Jenbacher gas engines 2007

		J420	
		C81	C82
		bio	bio
bhp		1966	1966
kWel		1426	1426
Minimum MN			
NOx			
	mg/m ³	500	250
	g/bhp.hr	1.1	0.6
	ppm (15%O ₂)	92	46
	lbs/hr	4.77	2.60
	tons/yr	20.9	11.4
CO			
	mg/m ³	1500	1500
	g/bhp.hr	3.4	3.4
	ppm (15%O ₂)	450	450
	lbs/hr	14.7	14.7
	tons/yr	64.6	64.6
NMHC			
	mg/m ³	100	100
	g/bhp.hr	0.2	0.2
	ppm (15%O ₂)	25	25
NMNEHC			
	mg/m ³	50	50
	g/bhp.hr	0.1	0.1
	ppm (15%O ₂)	10	10
PM10			
	mg/m ³	55	55
	g/bhp.hr	0.15	0.15
	lbs/hr	0.65	0.65

- Remarks:
- These are standard values. **Specific emission values may vary** with fuel gas analysis and engine adjustment.
 - CO emissions are long time values provided engine maintenance according factory schedule;CO emissions at startup are lower
 - Standard conditions 60 degF , 14.696 psia
 - tons/yr are based on 8760 hrs/ yr and 907.2 kg/ton
 - mg/m³ are at normal conditions of 0 deg C and 1.013 bar and at 5% O₂
 - Natural gas composition used: 95% Methane (CH₄), 2% Ethane (C₂H₆), 1% Propane (C₃H₈), 1% CO₂, 1% others
 - Biogas composition used: 65% Methane (CH₄), 35% CO₂
 - NMHC: Ethan density used; NMNEHC: Propane density used
 - MN means Methane Number which is 100 for Methane and 33 for Propane (MN is not the CH₄ contents!)

BIOFILTER MANUFACTURER DATA



BIOREM

BIO-EN Proposal – Two Modular Units

1.0 Product Description

The BASYS[®] modular system extracts foul air for subsequent preconditioning in the humidification stage and oxidation through the BIOSORBENS[®] media bed prior to atmospheric discharge.

Odourous compounds in the air entering the biofilter are solubilized into the moisture layer surrounding the individual media particles or are adsorbed directly to their surface. Bacteria present within this moisture film utilize the compounds as substrate. The compounds are biologically oxidized to CO₂, H₂O and inorganic salts and clean air is discharged to atmosphere. It is critical that the filter creates an optimal environment to enhance microbial development. Maintaining proper air temperature, pH, moisture and nutrient levels are essential for favorable biofilter performance and removal efficiency.

2.0 Project Details

The biofilter system shall be designed to remove odourous constituents from a process air stream under the following operating conditions:

<u>Process Parameter</u>	<u>Value</u>
Flow Rate	20,000 m ³ /hr
Inlet Air Temperature:	18 C – 40 C
Average Inlet RH:	Min 30 %
Average Inlet Particulate Conc.:	Clean Air
Type of Contaminant:	Average / Peak Concentration Levels
H ₂ S (ppm)	<10 <15
NH ₃ (ppm)	< 5 < 15
Organic Sulfides	< 2
Odour (Odour Units)	< 10,000

The biofilter system will conform to the following specified parameters:

<u>Design Parameter</u>	<u>Value</u>
Model of Modular Biofilter:	BASYS [®] 50X
Material of Construction:	FRP
Media Depth:	1.83 m
Media Volume:	94 m ³
Internal Biofilter Dimensions (L:W:H):	15.2 m : 3.4 m : 2.4 m
Footprint Dimensions (L:W):	16.7 m : 3.7 m
Water Consumption (Humidification):	3.34 m ³ /day
Water Consumption (Irrigation):	2.3 m ³ /day
Electrical (V):	575V, 120V
Empty Weight Biofilter Unit (kg):	10120 kg
Full Weight Biofilter Unit (kg):	153,735 kg



BIOREM

BIO-EN Proposal – Two Modular Units

3.0 System Performance

- A. When loaded under average and peak conditions the biofilter system shall provide at least 99 percent removal of H₂S when operated at a maximum, equal to the design air flow rate.
- B. Odour Removal Requirements: The biofilter system shall provide 85% removal for average inlet concentration levels of less than 10,000 and greater than or equal to 5000 OU. For inlet concentration levels less than 5000 OU, the outlet concentration levels shall be less than 500 D/T. (Odor D/T concentrations to be determined using ASTM-E679 with a 20 liter/minute odor panel presentation rate).
- C. The system shall be operated under positive pressure.

4.0 Warranties

- A. The Manufacturer warrants that the biofilter media will not compact, degrade or decompose for a period of 10 years from the date of Substantial Completion, provided that the system is operated in accordance with the Manufacturer's printed Operation and Maintenance Manuals.
- B. All mechanical components shall be warranted free of manufacturing defects for a period of 12 months from substantial completion.

5.0 Scope of Supply

- A. The following components are provided with each BASYS 50X unit:
 - 1. Modular biofilter tank with integral humidification and removable covers. Material of Construction to be UV and H₂S resistant FRP.
 - 2. 94 m³ of BIOSORBENS[®] biofilter media provided in bulk.
 - 3. Media surface irrigation systems. Composed of 25 mm, schedule 80 PVC pipe, with unions, tees and spray nozzles for full surface coverage of the Biofilter media bed.
 - 4. Humidification system, integral to the biofilter vessel. Complete with humidification packing and spraying system
 - 5. 25 HP Centrifugal FRP exhaust fan, TEFC, Class 1, Division 2 motor.
 - 6. Level 1 Instrumentation and controls.
 - i. NEMA 12 steel control panel (Compact Logix AB PLC with HMI) , complete with fused disconnect. Includes all system controls, pilot and alarm lights, motor starters, and (2) dry contacts for transmitting signals



BIOREM

BIO-EN Proposal – Two Modular Units

- to remote location [To be mounted inside – 1 Control Panel for Two Biofilter Units].
- ii. 25 HP VFD with dial speed control.
 - iii. Timer and normally closed solenoid valve for irrigation control
 - iv. Flow indicating totalizer to record irrigation system water usage.
 - v. Flow indicator/switch, to display humidification water flow rate and signal alarm in case of reduced water flow.
 - vi. Local pressure gauge on humidification line.
 - vii. Media temperature gauge.
 - viii. Static pressure gauges before and after system fan.
 - ix. Static pressure gauge to measure pressure drop across media bed.
 - x. 3 HP Recirculation Pump
7. Winterization system: consisting of a 95.3 KW immersion heater with integral thermostat for temperature control.
 8. 5 Submittal packages
 9. Operation and Maintenance Manuals – CD form.
 10. A 1-year BIOSERVE service support package. Includes site visit and system inspection within the first 6 months of system commissioning, media sampling and analysis, system spot performance testing.
 11. Commissions will consist of 1 trip and a maximum of 3 days for system commissioning & operator training.
- B. The following items listed are to be supplied by the Contractor and are not in the Manufacturer's Scope of Supply.
1. All equipment offloading, temporary storage and placement.
 2. Installation and assembly of all equipment and instrumentation components required for a complete system including labor, equipment and materials. Equipment installation to include biofilter vessel, fan, control panel and all associated instrumentation and components, where applicable.
 3. Installation site including site preparation and clearing of materials.
 4. Design and provide an appropriately sized reinforced concrete slab to handle full load of the biofilter vessel and fan.
 5. Supply and install all required protective coatings.



BIOREM

BIO-EN Proposal – Two Modular Units

6. Supply and install all external water piping and drain piping to and from the biofilter vessel and humidification equipment including heat tracing, insulation, piping supports, drainage traps where necessary and / or UV protective paint.
7. Supply and install air ductwork to and from the biofilter system including exhaust stack, interconnecting ducting, manual or actuated dampers, filters, insulation and piping supports.
8. Supply and install all hardware, supports, guide wires, duct gaskets, expansion joints and connectors needed for a complete and operational system.
9. Media onsite storage and installation. The OTHER party shall be required to remove biofilter cover, install and distribute media evenly across the biofilter, assemble media irrigation system and reinstall cover. Media to be shipped in bulk (end dump truck), unless otherwise requested in writing.
10. Utility requirements including main electrical service and system field wiring outside the main biofilter control panel, water supply at minimum pressure of 40psi. All electrical requirements for heat tracing and equipment not specifically provide by BIOREM[®] to be provided by others.
11. Duct balancing, and system functional, hydrostatic, vibration and performance testing to be conducted by OTHERS as specified.



Potential Contaminants in inlet ducting before biofilter from organic waste facilities

Compound	Range
Ammonia	5 - 25 ppm
Trimethylamine	0.005 – 1.5 mg/m ³
Triethylamine	0.02 – 1.0 mg/m ³
Hydrogen Sulphide	ND – 10 ppm
Methyl Mercaptan	0.05 – 1.0 ppm
Ethyl Mercaptan	0.05 - 0.4 ppm
Dimethyl Sulphide	0.05 – 1.0 ppm
Dimethyl Disulphide	0.1 – 0.8 ppm
Butanol	0.002 – 10 mg/m ³
Alpha-pinene	ND – 1ppm
Limonene	ND – 10.5 mg/m ³
Acetic Acid	0.3 – 5.0 mg/m ³
Oleic Acid	ND – 0.5 ppm
Butyric Acid	ND – 0.5 ppm

Cyclopentanol	ND – 8 mg/m ³
Propylacetate	ND – 5 mg/m ³
Propylbutyrate	ND – 8 mg/m ³
Pentanone	0.05 – 2 mg/m ³
Me-isobutylketone	0.003 – 10 mg/m ³
Nonanal	ND – 5 mg/m ³

NOTES:

- 1) This summary data is provided by Senior BIOREM Process Engineers based on some actual sampling (ex. hydrogen sulfide, TRS compounds), literature presented at conferences and professional estimates. Normally in applications where odour removal is the primary requirement very little data is collected on the individual chemicals compounds except perhaps for hydrogen sulfide or possibly some reduced sulfur compounds.
- 2) None of this data would include the impacts of manure as BIOREM has not yet installed any animal manure applications; however, BIOREM has many installations in municipal wastewater treatment plants.

Summary of Odour Levels Going into the Biofilter from Organics Management Facilities

Location / Source	Odour Levels	Comments
Rendering Plants Odours	10,200 OU/m ³ (Max.) 6,275 OU/m ³ (Avg.)	Article in Render Magazine June 2005 about Rothsay Dundas Pg 10, 11, 21. About 75% of the air volume at this facility is from plant air (tipping floor etc) and about 25% is from Process Air (cookers, dryers etc) so it probably overstates the odour levels vs an AD facility that does not include much processing or elevated temperatures.
Source Separated Organics (Region of Peel)	6,150 OU/m ³	See Paper, <i>Advanced Odour Management Program for Municipal Composting</i> . Odours are from both the tipping floor and composting tunnels so odour levels are probably higher than what an AD process would experience.
Source Separated Organics & Biosolids (Cape Breton Regional Municipality)	13, 085 OU/m ³	See Paper, <i>Advanced Odour Management Program for Municipal Composting</i> . Odours are from both the tipping floor and composting tunnels so odour levels are probably higher than what an AD process would experience.

The National Magazine of Rendering June 2005

Render

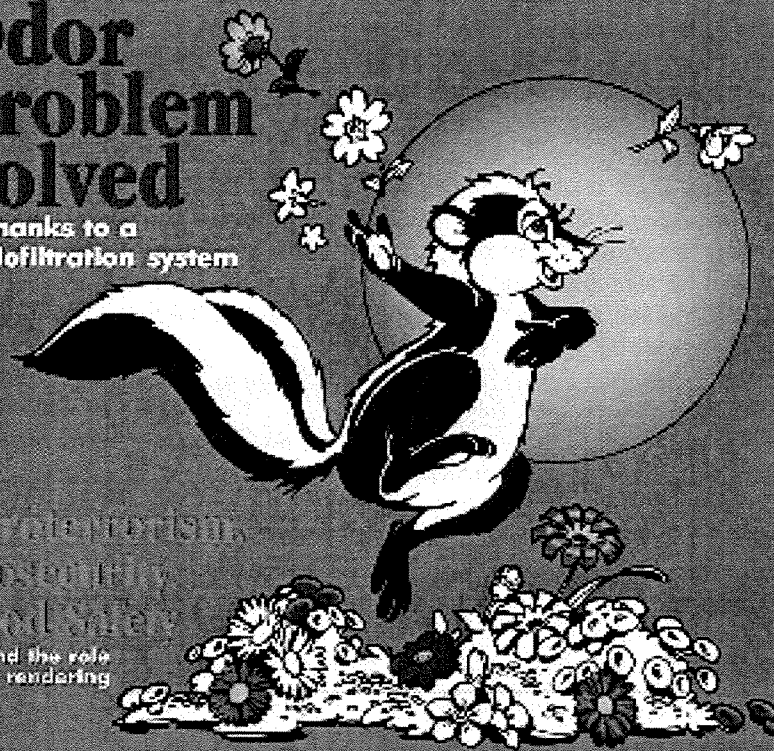
Odor Problem Solved

Thanks to a biofiltration system

Agriculture, Bioscience, Food Safety

And the role of rendering

Winds of Change in the Windy City



Odor Problem Solved

By Clifford Seth
Indumark

Engineering management at Rothsay, a rendering facility in Canada, reports it has all but eliminated odor complaints by installing a 250,000 cubic feet per minute (cfm) biofiltration system, replacing a scrubber system that could no longer provide sufficient removal efficiencies.

Tests conducted soon after startup in August 2003, with triplicate samples collected on three occasions over a two-week period, revealed an overall removal of greater than 94 percent. Preliminary results of Ontario's Ministry of the Environment (MOE) compliance testing that began in the spring of 2004 indicated average odor removal of 92 percent. Recent testing by a third-party consulting firm confirmed average removal efficiencies of 94 percent, with highs of 97 percent.

The new system was designed, manufactured, and installed by Biorem Technologies of Guelph, ON, Canada, who used their Biosorbens inorganic biofilter media. The company's technology was selected following extensive study and consideration of alternatives by Rothsay's corporate environmental engineering group and their consulting firm. The team established a 90 percent odor removal at all times as the primary design criterion.

"The scrubber system did its job for a long time, but increased residential development around the facility resulted in odor issues," recalled Amar Aulkh, Rothsay's chief engineer at their Dundas, ON, plant. "Performance testing on the scrubber system conducted in 2002 showed that odor removal efficiency was below our 90 percent target.

"We've seen a big difference since we installed the new system, with four or five tests since startup all

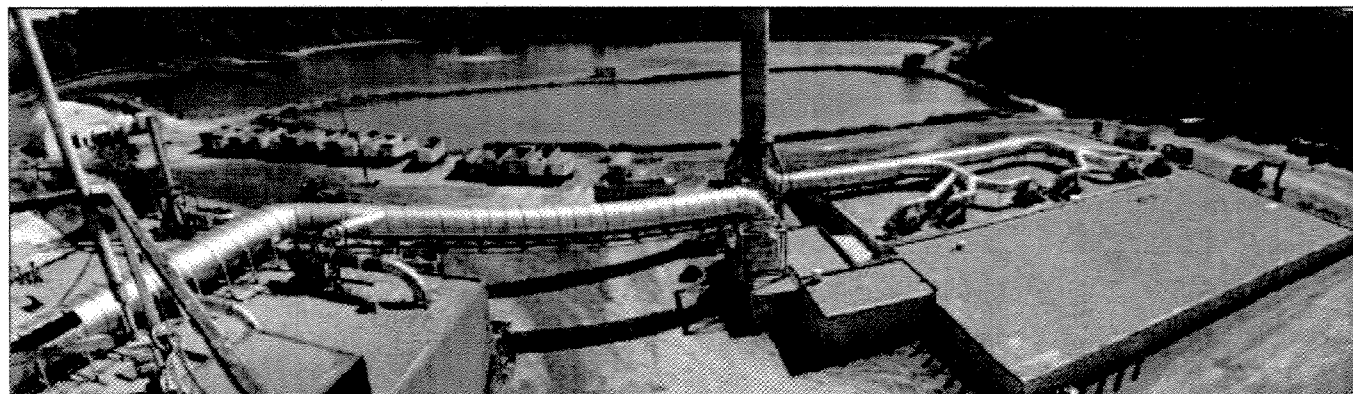
showing 90 percent removal, and community concerns have significantly decreased," Aulkh commented. "This has helped us fulfill our environmental commitment, which includes assuring sound environmental management by requiring visible technology accountability at every level."

In addition to the technology accountability requirement, Rothsay's mission statement includes setting specific environmental performance goals as part of strategic planning and designing for the future. Environmental performance of the facility has been incorporated into the operation of the plant since its startup in the mid-1950s, and continues to be an integral aspect of operations.

The plant started with one scrubber, increasing to six by 2002 as the treated odorous gas stream increased from 50,000 cfm to 250,000 cfm. Its odor control system main collection duct receives input from multiple areas in two main buildings, with input from each area ranging from 60 cfm to 10,000 cfm. The scrubbers, two including primary with venturi, one with venturi only, and the other three air-through, had utilized sodium hypochlorite at 12 percent to remove odor, and potassium hydroxide to maintain pH.

"When we tested the scrubbers' performance in 2002, we found their performance no longer met our standard," Aulkh said. "To solve the problem, we tested alternative scrubbers that utilized chlorine dioxide, ozone, chlorine dioxide and ozone simultaneously, and a neutralizer, but could not get the 90 percent removal efficiency we needed.

"At the same time," he continued, "we had learned about biofiltration and incineration as part of a broad alternative methodology search that we also conducted. We determined that incineration was a cost-prohibitive alter-



A multiple-port duct collection network from the original scrubber system was incorporated into the replacement biofiltration system. Input from ports in two main buildings ranges from 60 cfm to 10,000 cfm for each port.



Thanks to a biofiltration system



native for our operations at [one] point in time, and that this technology relies on long-term dependence on fuels.

“That moved the focus to biofiltration, and we spent a month testing odor removal efficiencies from airstreams from different areas of the plant, using media supplied by Biorem that they claimed had important differences compared to standard wood chip media,” Aulkh stated. “The other biofiltration technology providers claimed to achieve similar effectiveness with their wood chip media, but their wood chips needed replacement every two or three years, which was a big job we wanted to avoid. Biorem claimed theirs would last 10 years.

“We evaluated all of the biofiltration technology providers, and chose Biorem because they had a combination of better warranty, closer proximity to our operations, and fair pricing. They also had a willingness to help us solve the problem as quickly as possible, which was important because MOE wanted quick action on the concerns we were receiving from the local community.”

The odor control project decision was finalized in November 2002, following a one-month pilot-testing program with a proportional flow taken from each area of the plant.

“It did considerably better than the scrubbers right away, and we quickly got the removal efficiency over 90 percent,” Aulkh noted. “The pilot was important, because while we had visited four or five biofiltration installations and were impressed with the performance of all of them – you could stand on the filtration bed and not smell anything offensive – we didn’t know if they would work for our plant.”

Construction of the final system began in January 2003, with both the plant’s consulting firm and Biorem on site until completion in August. The multiple-port duct collection network from the original scrubber system was incorporated into the biofiltration system, but the main duct now leads into the Biorem system. This new system begins with its three-chamber preconditioning unit, where water from plant recycling and fresh water sources is sprayed into the gas stream at 500 gallons per minute in each chamber to achieve 98 percent relative humidity within the stream – above the 95 percent minimum Biorem recommends.

The gas stream then moves to a mist eliminator for water drop removal, followed by an inlet plenum common to the two banks of three biofiltration cells. Each of the six cells contains a five-and-a-half-foot bed of the Biosorbens media, and has a fan to draw the stream from the top of the bed and out the bottom to the outlet plenum. Individual cells can be isolated for work if needed, with the other five still in operation. As part of the contract, media

Test Day 1. Media Temp 18-20°C

	Inlet odor units/m ³	Inlet odor units/m ³	% Removal
Sample 1	2,856	364	
Sample 2	3,152	357	
Sample 3	2,664	282	
Average	2,901	328	89

Test Day 2. Media Temp 16°C

	Inlet odor units/m ³	Inlet odor units/m ³	% Removal
Sample 1	10,168	164	
Sample 2	10,212	173	
Sample 3	10,212	164	
Average	10,197	167	98

Test Day 3. Media Temp 14°C

	Inlet odor units/m ³	Inlet odor units/m ³	% Removal
Sample 1	4,218	237	
Sample 2	5,905	228	
Sample 3	7,060	182	
Average	5,728	215	95

m³- cubic meter

As shown above, the first few tests for the biofiltration system showed average odor removal greater than 94 percent, exceeding the 90 percent design criterion. Later testing by Ontario’s regulatory agency indicated average odor removal of 92 percent, and recent tests by a third-party consulting firm showed 94 percent.

samples are sent to Biorem every four months for checking on the effectiveness of the odor-removing microbes.

Each cell handles an equivalent amount of captured plant and process air, with each 150 horsepower fan working with a variable frequency drive (VFD) and controlled by a programmable logic controller (PLC). Rothsay has recently completed installation of a similar size biofiltration system at their Moorefield, ON, plant.

“The VFDs are good to have,” Aulkh noted. “With the extremes of heat and cold we have, we can vary the horsepower accordingly, knocking it down to as low as 25 percent of capacity when there is no processing going on during a winter weekend.

“It is a good, environmentally-friendly system that works,” he concluded. “There are no chemicals. It is easy

Continued on page 21

Biofilter *Continued from page 11*

to operate, all automatic, with our stationary engineers having PLC panels for routine monitoring of temperatures, pressures, and flows. There haven't been any problems with the process, we've just had to clean out the mist eliminator and the preconditioning chamber sump every couple of months."

Biorem describes its Biosorbens media as designed to handle a wide range of odor-causing compounds, and also suitable for removal of volatile organic compounds. Compound classes successfully treated include aldehydes, ketones, alcohols, volatile fatty acids, and aliphatic and aromatic hydrocarbons.

The media is said to maintain a balance between optimal growing conditions for the microbes, while offering ideal pressure drop through the media, high moisture retention, long operating life, and resistance to decomposition and compaction, while providing a surface on which the biomass film can flourish.

It is described as consisting of inert, uniformly shaped hydrophilic cores that are produced with nutrient-rich organic and inorganic adsorbents. These characteristics are said to decrease residence time, and increase serviceable life to more than 10 years. Its high surface area-to-volume ratio is said to result in requiring only one-third the space needed by organic medias.

Biorem, established in 1994, offers a comprehensive monitoring and support program for its biofilters and media. Its resources include experienced engineers, chemists, and industrial microbiologists, and state-of-the-art laboratory and research facilities. ♦

FLARE MANUFACTURER DATA

WASTE GAS BURNERS MODEL 8391B

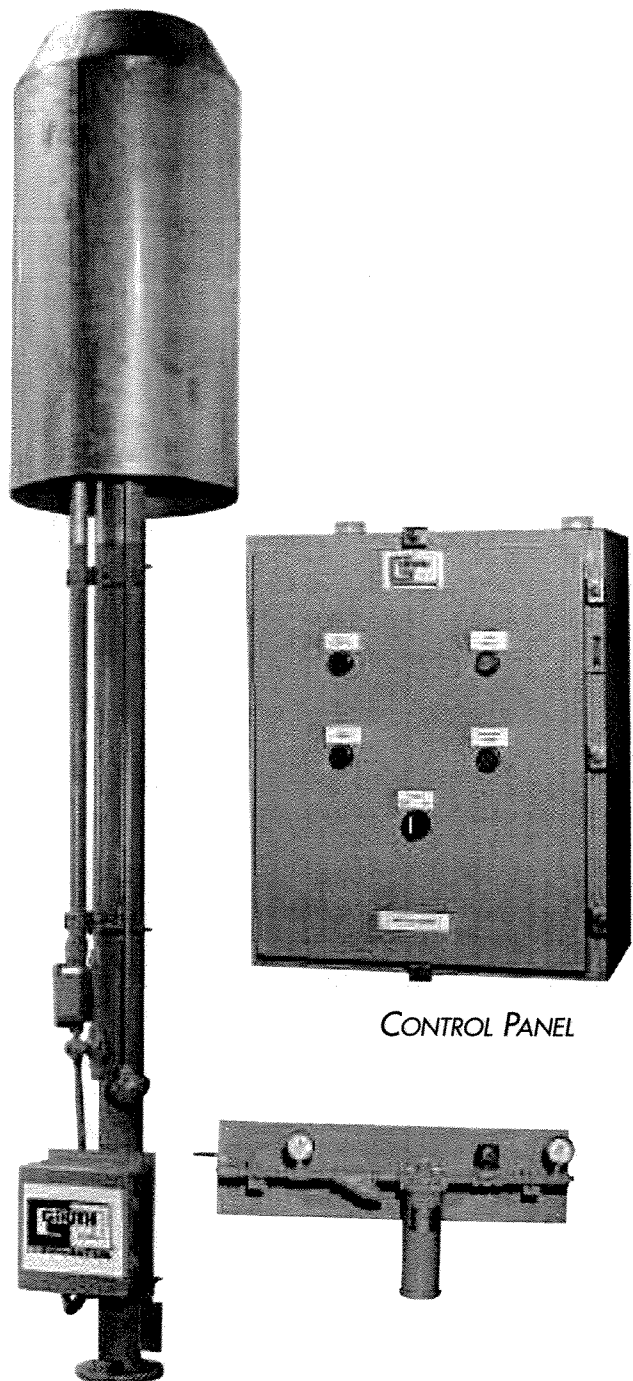
- Sizes 2" through 12"
- All stainless steel construction in flame area
- Automatic ignition and re-ignition
- Stoichiometric pilot on all burners
- Efficient combustion with biogas BTU value as low as 300/cu. ft.
- Reliable "downdraft prevention" for wind protection
- Flame retention vortex vanes vastly improve burning efficiency
- Pilot system operates as low as 4" WC
- Quick, easy maintenance
- Flame front generator (FFG) pilot ignition system available
- Fully enclosed flare (FEF) configuration available for high destruction rate efficiency

WASTE GAS IGNITION & BURNER SYSTEM

The Model 8391B includes an ignition system with all of the best features available in a waste gas burner. The burner wind shield contains the unique "downdraft prevention" with a bevel design which virtually eliminates the possibility of the flame being blown out. The design also provides the proper air/fuel mixture to ensure an efficient burn. The wind shield will control outside winds, up to 150 MPH, and operates efficiently in heavy rains. This will prevent smoke and odors from permeating the neighborhood.

FEATURES

The automatic ignition option provides extra high reliability coupled with "state-of-the-art" positive pilot ignition. When gas is to flow, a signal to the control panel causes the solenoid to open providing gas to the pilot. The ignitor then sparks until the pilot is lit. The system does not require compressed air,



CONTROL PANEL

MODEL 8391B

adjustments for various gases, or separate ignition line. You may choose to locate the control panel close to the burner or at some remote distance.

The unique burning system of the Groth gas flares contain flame retention vortex vanes in the tip of the burners and when coupled with the "downdraft prevention" in the shield, the result is an updraft and an air mixing action that will provide excellent high efficiency, smokeless and odorless burning. With the prevention of "flame licking", the requirement for a remote ignition source (flame front) and associated piping and other problems are eliminated. Trouble-free start-up is assured. All adjustments and maintenance can be performed safely at ground level. An additional benefit to the "downdraft prevention" in the main burner is the fact that winds up to 150 MPH or heavy rain will not take out the flame.

The control system provides contacts for remote indication of "Pilot flame failure" and "Pilot flame on", as well as panel lights for "Pilot flame on", "Pilot flame failure", "Thermocouple OK" and "Pilot gas on". All Groth pilot systems are provided with an inspirating venturi to insure a stoichiometric mixture of the pilot gas. A solenoid valve is included with each automatic pilot system. Fuel consumption of the pilot is only 22-150 SCFH. Normal operating pressure range of the pilot is 4" WC to 10 psig. The reduced fuel consumption at a manageable waste gas pressure means that it might be possible to utilize biogas for the operation of the pilot system. However, natural gas with a supply pressure of 5 to 10 psig (specify exact pressure when ordering) is recommended for optimum pilot operation.

The Groth Model 8391B offers several options to meet your specific requirements. For example, the burner can be provided with (1) Manual Electric Ignitor which will provide manual start-up ignition

from a remote location. A switch in a remote weatherproof enclosure will be provided to operate a sparking electrode at the pilot tip. (Flame sensing is not included in this system). (2) Automatic Electric Pilot Ignition System which provides a fully automatic start-up, flame monitoring, re-ignition and alarming system. This automatically operated system will provide auto-ignition from a contact closure (usually a pressure switch), sense pilot flame status, provide automatic re-ignition sequencing and flame failure alarm, and provide status lights on the control panel and contacts for remote monitoring. A manual mode override will be provided on the control panel. Additionally, the pilot solenoid valve is included in the fully automatic system manifold. (3) Dual Flame Sensing which provides pilot shut down while main burner flame is burning and re-ignition if main burner flame fails, conserving pilot fuel. (4) Flame front generator which meters and combines fuel gas and air creating a combustible air/gas mixture (fireball) in the ignition line. An automatic self-inspirated control system for ignition and reignition provided.

OPERATION

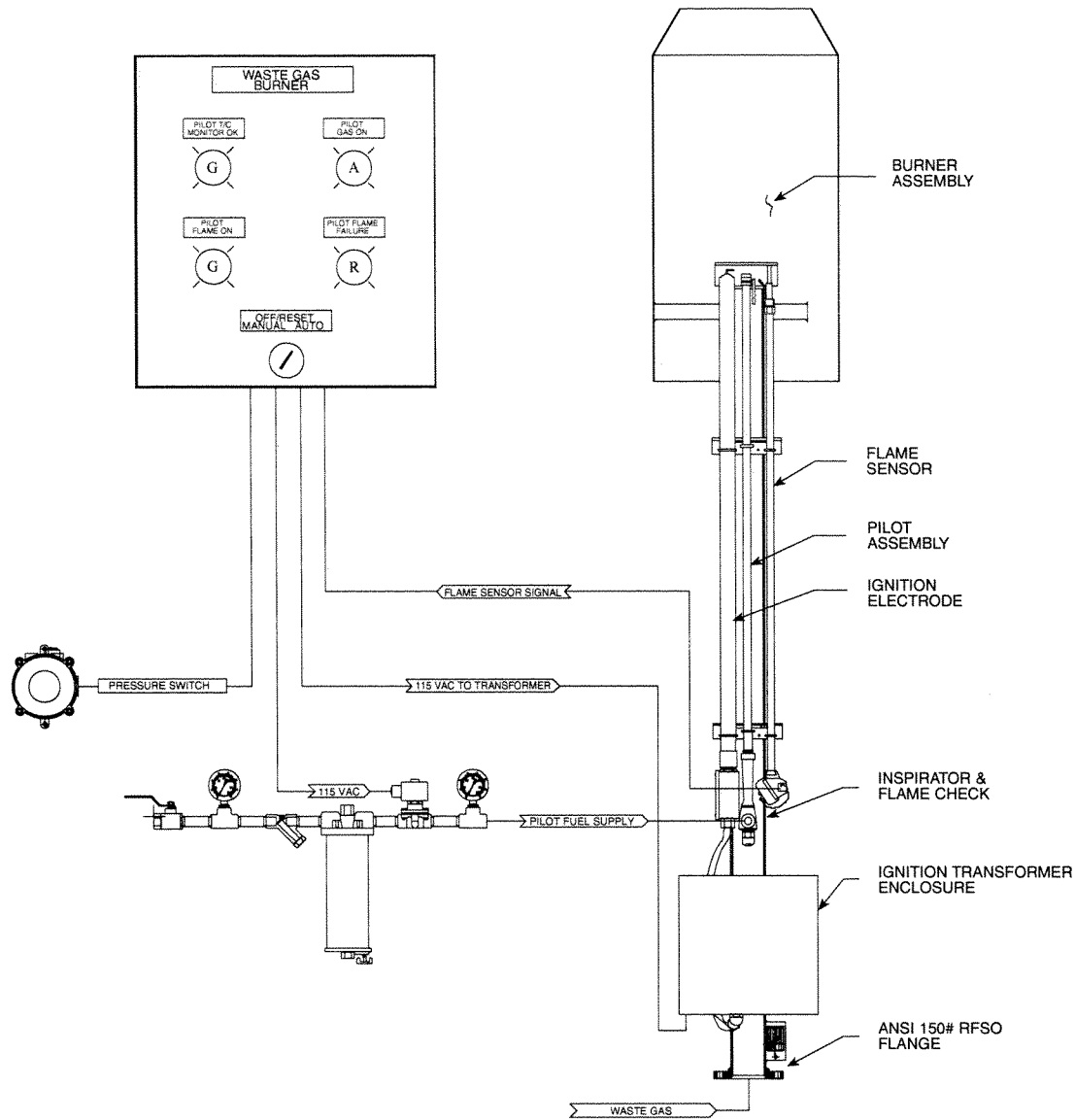
When gas is to flow to the burner, a signal to the control panel (normally, a contact closure) causes the solenoid to open, providing a stoichiometric air/fuel mixture to the pilot. The ignitor begins sparking and continues until the pilot is lit. The flame sensor will signal "flame on" and the sparking will cease.

When the biogas arrives at the burner tip, ignition immediately takes place and the burn is continuous until the gas supply is removed. The pilot will continue to be ignited until the signal is received (contact is opened). The pilot start signal may be provided by a Groth supplied pressure switch. When flaring of the gas is required again, the above sequence will be repeated.

SPECIFICATION TABLE • MODEL 8391B

Specifications subject to change without notice. Certified dimensions available upon request.

Nominal Diameter of Burner D _f (mm)	Flow Rate SCFH S _G = 0.8 ∅P = .50" WC Temp = 60°F	Minimum Recommended Overall Height Above Grade H _S (mm)	Minimum Recommended Safe Distance To Control Panel D _S (mm)	Diameter of Shield D (mm)	Burner Weight Lbs (kg)
2" (50 mm)	4,040 (114)	10' (3.0 m)	8" (203 mm)	18" (457 mm)	176 (80 kg)
3" (76 mm)	9,090 (253)	12' (3.7 m)	10' (3.0 m)	18" (457 mm)	212 (97 kg)
4" (100 mm)	16,200 (450)	12' (3.7 m)	15' (4.6 m)	24" (610 mm)	272 (124 kg)
6" (150 mm)	36,400 (1001)	12' (3.7 m)	22' (6.7 m)	24" (610 mm)	363 (165 kg)
8" (203 mm)	64,600 (1782)	16' (4.9 m)	28' (8.5 m)	30" (762 mm)	512 (233 kg)
10" (250 mm)	100,930 (2785)	20' (6.1 m)	36' (11.0 m)	36" (914 mm)	572 (260 kg)
12" (300 mm)	144,600 (3995)	25' (7.6 m)	42' (12.8 m)	36" (914 mm)	619 (280 kg)



MAINTENANCE

All components and controls for the pilot system are easily accessible at ground level. No components that would require adjustment or periodic maintenance are located in the flame area. Most maintenance checks can be made safely while the burner is in operation.

BURNER CAPACITY

Digester gas containing methane, see page 41.

BURNER CONSTRUCTION

Carbon Steel lower burner pipe with 150# flange mounting. Stainless steel upper burner pipe and windshield. Alloy pilot nozzle and cast iron venturi. Self supporting on 150# flange with 150 mph winds and zone 4 seismic coefficient. Other mounting plates optional. Control panel may be remotely installed from burner.

SPECIFICATIONS

Electrical

115V, 1PH, 60 Hz, 10 AMP, grounded neutral
 Contacts for remote monitoring — (1) NO, 3 AMP, "Flame On" — (1) NO, 3 AMP, "Flame Failure"

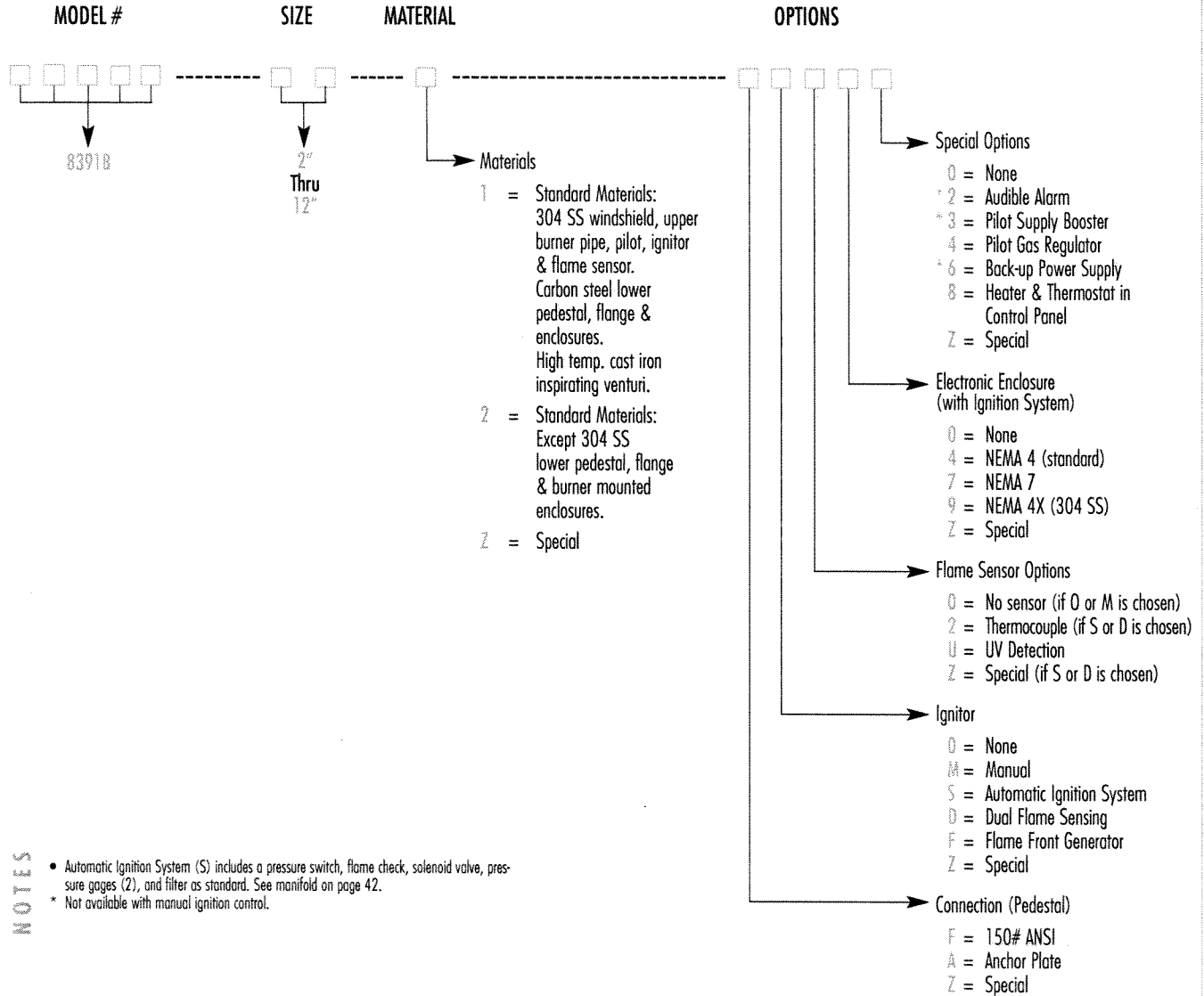
Enclosures

Standard: Nema 4, Weatherproof
 Optional: Nema 4X, Nema 7, etc.
 Pressure Switch — Explosion Proof; 4" - 20" WC
 Range; 0.4" - 0.6" WC Deadband

Pilot Fuel for stoichiometric pilot

- * Natural Gas — 4" WC to 10 psig Supply Pressure
 - * LPG — 1 psig to 10 psig Supply Pressure
 - * Digester Gas 4" WC to 10 psig Supply Pressure
- Pilot Consumption: 22-150 SCFH

**HOW TO ORDER
FOR EASY ORDERING, SELECT PROPER MODEL NUMBER**



NOTES

- Automatic Ignition System (S) includes a pressure switch, flame check, solenoid valve, pressure gages (2), and filter as standard. See manifold on page 42.
- * Not available with manual ignition control.

EXAMPLE

8 3 9 1 B — 1 0 — 2 — F S 2 4 0

Indicates a 10" Model 8391B constructed with standard materials except stainless steel lower pedestal. Options include 150# ANSI connection, automatic ignition system using a thermocouple sensor in a standard NEMA 4 electronic enclosure.

APPENDIX F

LEASE AGREEMENT

APPENDIX G

START UP AND COMMISSIONING PROTOCOL

Start up and commissioning protocol

Woolwich Bio-En

Elmira Anaerobic Digestion Facility

Elmira, ON

January 2010

1 INTRODUCTION

This start up protocol provides an overview of the start up operations of the proposed 2.85 MW biogas plant to be located in Elmira, Ontario, Canada.

The start up of the biogas plant takes place in four (4) different steps:

1. Filling the tanks
2. Heating up to process temperature
3. Constantly increasing load to full power
4. Operating plant on full power

In order to minimize the environmental impact during these stages, several measures are in place to prevent possible releases to the air, groundwater and soil.

2.0 DIGESTER SYSTEM START UP PROTOCOL

2.1 TANK FILLING STAGE

Before the digesters are filled all electrical and mechanical systems are tested for proper function and availability. All tanks including pretreatment, main digesters, the secondary digester and repository tank, storage tanks as well as piping's and heating system will be tested to ensure that they are waterproof and free of leaks.

After the waterproof test Digester 1 will be filled with manure and water to its maximum level. The manure is pumped from the truck into the tank ensuring that there are no open manure storage tanks on the site. The tanks are gas proof to inhibit odour emissions. This procedure will take about 1 week.

Impact on:	extent	Measurement in place
ground water	none	Waterproof tanks are used
soil	none	Waterproof tanks are used
air	none	no gas production at this point

2.2 TANK HEATING STAGE

The first main digester is heated up to approximately 40°C using an external heat source (portable boiler or CHP operated using Natural Gas). To protect the concrete structure the increase in temperature will be approximately 1.5°C per day. During this procedure the first biogas is formed. The productivity of the digester is very low and the biogas has low methane concentrations. The formed biogas is stored in the gas buffer and flared when full capacity of the buffer is reached. This procedure will take about two weeks.

Impact on:	extent	Measurement in place
ground water	none	Waterproof tanks are used
soil	none	Waterproof tanks are used
air	minimum	Gas proof tanks with gas buffer are used. Excess biogas is flared.

2.3 INCREASING BIOGAS PRODUCTION STAGE

During this stage of the startup procedure the first input material is processed in the plant. Liquid input material like DAF and FOG are transported to the process building and stored in the liquid input storage tanks. The transfer from truck to tank is a pipe on pipe system. From the liquid storage tank the material is pumped in the pretreatment tank and heated to approximately 50 to 60°C. This organic material stays in the pretreatment tank for at least 20hrs at that temperature to reach a sufficient sanitation effect. Discharge air from the liquid storage tanks is processed by the biofilter. Biogas formed in the pretreatment tanks is stored in the gas buffer. The main digesters are nearly constantly fed with input material from the pretreatment tanks.

Biological control of the process is maintained by periodic measurement of VOC (volatile organic compounds) and TAC (total alkalinity).

The loading rate of kg organic dry matter/ m³ digester volume is increased over a period of about 6 weeks until full capacity is reached. As the capacity of gas production reaches 25% of full capacity the first of the two CHPs (combined heat and power plant) is operated at 50%. At this point all the biogas produced is used in the CHP and not flared.

Biogas residue overflows into the secondary digester and repository tank that is a waterproof concrete tank covered with a biogas storage membrane. When the amount of biogas residue reaches 3700 m³ all this material is used to fill the second main digester to maximum level. With the second main digester in operation the gas production will be further increased until full capacity of both CHPs is reached.

Impact on:	extent	Measurement in place
ground water	none	Waterproof storage tanks are used
soil	none	Waterproof storage tanks are used, sanitation is done on the input material.
air	minimum	Gas proof tanks with gas buffer are used. Excess biogas is flared or processed in CHP. Reduced amounts of discharge air need to be treated because less ventilation of the receiving hall is required due to smaller quantities of organics being processed during start up.

2.4 FULL PLANT OPERATION STAGE

After the second main digester reaches full gas production capacity the plant is in full power operation. At this point the biofilter will be able to handle larger amounts of discharge air as the biofilter biological activity will have increased as the quantity of organics processed increases over the start up period.

Impact on:	extent	Measurement in place
ground water	none	Waterproof storage tanks are used
soil	none	Waterproof storage tanks are used, sanitation is done on the input material.
air	minimum	Gas proof tanks with biogas storage membrane are used

3.0 BIOFILTER START UP

The BIOREM BASYS modular biofilter system extracts foul air for subsequent preconditioning in the humidification stage and oxidation through the BIOSORBENS media bed prior to atmospheric discharge.

Odourous compounds in the air entering the biofilter are solubilized into the moisture layer surrounding the individual media particles or are adsorbed directly to their surface. Bacteria present within this moisture film utilize the compounds as substrate. The compounds are biologically oxidized to CO₂, H₂O and inorganic salts and clean air is discharged to atmosphere. Maintaining proper air temperature, pH, moisture and nutrient levels are essential for favorable biofilter performance and removal efficiency.

The BIOSORBENS® media has significant adsorptive capacity. BioRem believes that this media will provide at least a 70% odour removal in less than 2 weeks of installation. This removal should be obtained assuming that the biofilter media temperature is in the appropriate operating range and that the media has been properly moistened at least 2 weeks before system start up.

In order to build the microbial population as quickly as possible in the inorganic media, it is desirable to treat an odour load as soon as possible after the filter is installed and operational. This initial odour load will come from the organic materials that will be processed during the first stages of the anaerobic digestion process start up.

In order to ensure that odour levels are not excessive during the start up process, the Facility will operate the plant at reduced airflow. During start up of the process, the Facility will process less waste than during normal operation. As a result, the Facility will have less odour loading to the biofilter.

For planning purposes a 50% odour removal will be achieved in the first week of operation (assuming that the media is in the temperature range of approximately 20°C to 40°C. Operations at the Facility will preli minarily include the processing of less odourous materials while operating a minimum of 12 hours per day. The second

week of operations, the Facility will achieve a 60% odour reduction while operating a minimum of 12 hours per day. The odour removal efficiency will increase to 70% during the third week with the Facility operating a minimum of 16 hours per day. The guaranteed 80% removal efficiency will be reached by the end of the fourth week when the Facility will be operating a minimum of 20 hours per day.

All removal efficiencies and start up times are based on the time following the complete installation and commissioning with all the water and power connections made to the biofilter system.