



DRAFT MEMORANDUM

To: Will Moore (Township of Chatsworth) REF. NO.: 11102058
FROM: Mike Muffels/mg/1 DATE: June 15, 2015
CC: Mohammad Islam (CRA)
RE: **Preliminary Results
Engineering and Operation Review
Georgian Bluffs and Chatsworth BioDigester (BIOGRID)
Township of Chatsworth**

Conestoga-Rovers & Associates (CRA) is pleased to provide the following draft preliminary results of the engineering and operation review of the BIOGRID plant located at 062111 Sideroad 3 (Lot 4, Concession 6) in the former township of Derby at the Georgian Bluffs sewage lagoon site. The Township of Georgian Bluffs and the Township of Chatsworth operate the BIOGRID plant together. A full report will be issued following review, discussion and acceptance of the preliminary findings by the Township of Chatsworth.

Technical Evaluation

As part of the technical evaluation, CRA reviewed available operational data and engineer reports for the BIOGRID plant, including:

- Operational data excel files (Daily Operation sheet, Food Received, Gas monitor Daily, Gas quality, Generator data, Maintenance record, Sample results, Tank volumes) received from Mr. Troy Unruh via email during the week of June 8, 2015
- Anaerobic Treatment of Septage/Biosolids to Produce Biogas, Electrical Power and Treated Biosolids (June 15, 2006) prepared by Henderson Paddon & Associates Ltd. (now WSP)
- Design Brief – Anaerobic Treatment of Septage/Corn Stover/Biosolids to Produce Biogas, Electrical Power and Treated Biosolids (February 2010) prepared by GENIVAR Consultants LP (now WSP)

In addition, Mr. Mike Muffels, P.Eng., Mr. Ron Cherkewski, P.Eng., Ms. Dana-Jill Stroeder, P.Eng. and Mr. Mohammad Islam, P.Eng. visited the BIOGRID plant and interviewed the BIOGRID plant operator, Mr. Troy Unruh, on June 5, 2015.

Table 1 summarizes the current operational mass balance against the WSP biogas plant design, CH Four Biogas design and CRA's recommendations. It was noted that the septage inlet flow meter to the drum-screen, the only flow meter at the BIOGRID plant, was not operating reliably due to the interference of air accumulation at the flow meter. The current operational mass balance was estimated based on the

estimates of quantities of incoming materials (i.e. number of barrels or number of trucks or tonnages) and flow meter readings for septage. The mass balance is closed off comparing the metered kilowatt hours (kWh) of electrical output. This is the best available mass balance information for the BIOGRID plant.

Table 1
BIOGRID Mass Balance

Parameter	Units ¹	Current Operation	WSP Design	CH Four Maximum	Recommended by CRA
Average Digester Feed	m ³ /d	16 - 18	40-45	60-70	≤60
Organic Loading Rate	kg VS/m ³ /d	1.1	2.4	4	3 - 3.5
Average Biogas Generation	m ³ /d	550	1,200	2,000	1,500
Electricity Generation	kW/h	52	100	184	135
Digester Hydraulic Retention Time (HRT)	d	50-55	25	14	17
Digester Feed Total Solids (TS)	percent	5-7	5-12	10	8-9

Notes:

Units: m³ is cubic meters, d is day, kg is kilogram, VS is volatile solids, kW/h is kilowatt per hour

Results:

- Both the current digester feed rate and the organic loading rate are significantly below design or recommended values. As a result, there is both significant hydraulic and organic loading capacity available in the digester to optimize the revenues generated by the BIOGRID plant (i.e. balance tip fees based on feedstock volumes vs. electricity revenue based on high energy feedstock). Additional feedstock is required to make the BIOGRID plant viable. See the Financial Evaluation section below for further discussion.
- The BIOGRID plant does not have the capacity to generate enough biogas to produce 340 kW of electricity per hour, as has been previously proposed (GENIVAR, February 2012). The GENIVAR proposal did not consider HRT or maximum organic loading rate in the digester recommended by CH Four (Letter dated February 1, 2010 from CH Four to Mr. Eric Slaa, Maple Reinders Construction Ltd). It primarily appeared to be concerned with digestate storage capacity. The maximum electricity generation rate remains the CH Four Biogas rating of approximately 184 kW per hour based on 100 percent utilization (no downtime) of the existing 100 kW engine. CRA recommends establishing the business case moving forward on 100 kW or 135 kW per hour as a conservative estimate.
- The Baycor drum-screen is not performing. It is rated for 68 cubic metres per hour (m³/h) (300 gallons per minute [gpm]) and normally CRA would recommend operating it at roughly half of its rated capacity for this type of material. It is currently operated at approximately 114-136 m³/h (500-600 gpm); more than four times the recommended rate. The high flow rate coupled with a

plugged screen (as observed on the day of the site visit) results in an estimated 95 percent of the septage flowing through the drum-screen to the Hydrolyzer. In essence, the septage is effectively by-passing the drum-screen. Given the low volumes of feedstock materials this is actually preferred as this maximizes the organic loading rate to the digesters from the available feedstock. CRA recommends that all septage received at the BIOGRID plant bypass the drum-screen and be fed directly to the Hydrolyzer. This will result in temporary operations and maintenance cost savings related to the operation of the drum screen and the discontinuation of polymer, and also maximize the biogas generation rate. This is a temporary measure until sufficient feedstocks are procured to warrant re-starting the drum-screen. At such time as feedstock volumes reach design levels, trucks will either need to empty slower at approximately 150 m³/h or a buffer storage tank will be required to equalize flows to the drum-screen.

4. Since there is no septage flow from screen to the lagoon, an alternative approach to feed the lagoon would be to transfer digestate supernatant from the digestate storage to the lagoon. This would partially reduce volume of digestate haulage and land application. CRA recommends evaluation of the lagoon capacity in terms of both organic loading and hydraulic capacity for digestate treatment. The Township should discuss this approach with MOECC for this treatment concept.
5. Currently the Hydrolyzer tank is operating at 30°C which is not ideal for hydrolysis. It is reported in the literature that sludge should be hydrolyzed over 150°C for reduction of complex substrate for feeding the digester.
6. The BIOGRID plant was equipped with a pasteurizer for treating fat, oil and grease (FOG) before feeding the digester. We note that pasteurizer is required for on-farm digesters permitted under the Nutrient Management Regulation (O. Reg. 267/03 under the Nutrient Management Act, 2002). We recommend reviewing the design criteria again to assess the need of this unit in terms of accepting restaurant waste or grease trap waste.

Financial Evaluation

CRA reviewed the financial statements from 2011 to 2014 for the BIOGRID plant. A summary of the financial review is presented in Table 2. Included in Table 2 is the 2009 design budget prepared by GENIVAR (now WSP) and breakeven scenarios in the last three columns for a private third-party operator under three different septage tip fee rates, namely \$0/m³, \$15/m³ and \$25/m³.

Results:

1. Current operating costs are close to \$600,000 per year. CRA conservatively estimates that operating costs for the existing facility can be reduced by at least 25 percent to approximately \$450,000 annually, including a reserve for future capital (or pay down of existing capital). Partnering with a private operator can potentially help to realize these cost savings, particularly under a revenue sharing model that encourages the operator to continually optimize operations and reduce operating costs.
2. While there is potential to produce significantly more biogas, it will be difficult to realize revenues from any biogas over and above what is required to operate the 100 kW genset. FIT 4.0 opens and closes in July 2015, which is a short turn around and Georgian Bluffs have already indicated that they may not have the resources to complete the application. Also, the previous attempt under FIT

3.0 was unsuccessful so there is no guarantee that another FIT contract can be acquired. Cleaning the gas and selling it to the natural gas grid is still a challenge and while possible will likely take considerable time to implement. Other options include compressing the biogas for Renewable Natural Gas (RNG) to be used as vehicle fuel or to be transported to fuel another under-utilized genset elsewhere in the province. The economics of these options will depend on the amount of additional biogas generated. In the short term, and possibly the long-term, the BIOGRID plant will need to rely on electricity sales under the existing power purchase agreement (100kW, \$0.16/kWh) and tip fees. Assuming operating costs can be reduced; Table 2 summarizes breakeven scenarios for three different septage tip fees, namely \$0, \$15 and \$25 per m³ and determines the required tip fees for additional organic feedstock to for the facility to breakeven. The results are summarized below:

<i>Septage Tip Fee</i>	<i>Additional Organics Tip Fee</i>
\$0	\$41-68
\$15	\$28-47
\$25	\$20-32

A \$0 septage tip fee will require feedstocks that can fetch a higher tip fee such as Source Separated Organics (SSO) (i.e. green bin waste). However, SSO will require significant investment in receiving and pre-processing facilities to manage odours and to ensure that contaminants and grit are removed from the material prior to be introduced into the Hydrolyzer tank. Grit is a specific concern with SSO as it will accumulate in the Hydrolyzer and/or digester reducing effective treatment volumes and requiring the digester to shut down for an extended period for clean out. Grit in the concrete topped Hydrolyzer will be particularly problematic to remove.

The above analysis does not include profit. Additional feedstock, higher tip fees or additional revenue sources will be required to make the facility attractive for a private operator.

TABLE 2

FINANCIAL REVIEW SUMMARY
TOWNSHIP OF CHATSWORTH
CHATSWORTH, ONTARIO

	Design Budget 2009	2011	2012	Actual Expenditures		Total	Average	Operating Budget 2015	Third-Party Operator \$0 Septage Tip Fee	Third-Party Operator \$15 Septage Tip Fee	Third-Party Operator \$25 Septage Tip Fee	
				2013	2014							
Operational Costs												
Amortization (\$2,113,300, 3%, 20 years)	\$ 142,047											
Taxes		\$ 983	\$ 5,807	\$ 8,027	\$ 10,071	\$ 24,888	\$ 7,968	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	
Insurance		\$ 6,924	\$ 15,511	\$ 15,956	\$ 19,229	\$ 57,620	\$ 16,899	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	
Engine Maintenance	\$ 15,800							\$ 20,000	\$ 27,500	\$ 27,500	\$ 27,500	
Other operational costs	\$ 31,025	\$ 23,669	\$ 47,096	\$ 42,256	\$ 43,283	\$ 156,304	\$ 44,212	\$ 121,400	\$ 100,000	\$ 100,000	\$ 100,000	
Cost of sewage haulage cost from Sunset strip	\$ 51,000			\$ 45,486	\$ 48,961	\$ 94,447	\$ 47,223	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000	
General maintenance cost	\$ 18,000	\$ 12,191	\$ 12,387	\$ 60,495	\$ 14,200	\$ 99,274	\$ 29,028	\$ 20,000	\$ 30,000	\$ 30,000	\$ 30,000	
Fuel and maintenance 60HP tractor	\$ 7,000					\$ -						
Utilities	\$ 9,636	\$ 12,987	\$ 29,170	\$ 27,866	\$ 31,240	\$ 101,264	\$ 29,426	\$ 30,500	\$ 30,000	\$ 30,000	\$ 30,000	
Corn stalks	\$ 10,500											
Land application of biosolids/digestate	\$ 12,770	\$ 6,335	\$ 95,803	\$ 32,805	\$ 49,938	\$ 184,882	\$ 59,515	\$ 42,000	\$ 15,000	\$ 15,000	\$ 15,000	
Annual professional service cost	\$ 6,500		\$ 44,018	\$ 39,153	\$ 6,151	\$ 89,323	\$ 29,774	\$ 30,000				
Other services		\$ 36,814	\$ 47,467	\$ 11,236	\$ 3,388	\$ 98,905	\$ 20,697	\$ 3,000				
Service contracts		\$ 72,616	\$ 205,688	\$ 142,693	\$ 133,824	\$ 554,821	\$ 160,735	\$ 84,600	\$ 20,000	\$ 20,000	\$ 20,000	
Future Capital Reserve / Amortization	\$ 50,000	\$ 156,655	\$ 142,108	\$ 142,317	\$ 142,606	\$ 583,686	\$ 142,344	\$ 170,000	\$ 143,000	\$ 143,000	\$ 143,000	
Total Annual Costs	\$ 354,278	\$ 329,176	\$ 645,055	\$ 568,291	\$ 502,891	\$ 2,045,413	\$ 587,820	\$ 601,500	\$ 445,500	\$ 445,500	\$ 445,500	
<i>Township Annual Costs (Taxes+Sewage Haulage from Sunset Strip+Future Capital Reserve)</i>									\$ 203,000	\$ 203,000	\$ 203,000	
<i>Operator Annual Costs</i>									\$ 242,500	\$ 242,500	\$ 242,500	
Revenue												
Electricity Revenues (\$0.16/kWh, 8000 kWh/yr)	\$ 128,000	\$ 29,779	\$ 81,785	\$ 68,987	\$ 62,639	\$ 243,190	\$ 71,137	\$ 90,000	\$ 126,000	\$ 126,000	\$ 126,000	
Tip Fees												
From Sunset Strip (25 m ³ /d)	\$ 73,456	\$ 36,721	\$ 60,988	\$ 66,030	\$ 63,557	\$ 227,295	\$ 63,525	\$ 60,000	\$ 64,000	\$ 64,000	\$ 64,000	
Septage (32.5 m ³ /d)	\$ 296,575	\$ 1,643	\$ 9,469	\$ 11,269	\$ 31,260	\$ 53,641	\$ 17,333	\$ 30,000	\$ -	\$ 81,000	\$ 135,000	
Additional Organic Waste	\$ 36,500	\$ 17,407	\$ 59,810	\$ 34,422	\$ 49,465	\$ 161,104	\$ 47,899	\$ 60,000	\$ 255,500	\$ 174,500	\$ 120,500	
Other		\$ 630	\$ 933	\$ 429	\$ 1,992							
Total Annual Revenue	\$ 534,531	\$ 85,562	\$ 212,703	\$ 181,664	\$ 207,374	\$ 687,303	\$ 199,896	\$ 240,000	\$ 445,500	\$ 445,500	\$ 445,500	
Net Annual Revenue	\$ 180,253	\$ (243,614)	\$ (432,352)	\$ (386,627)	\$ (295,517)	\$ (1,358,110)	\$ (387,925)	\$ (361,500)	\$ -	\$ -	\$ -	
<i>Township Annual Revenue (Assumed Electricity Revenue, Sunset Strip Tip Fee, Septage Tip Fee)</i>									\$ 190,000	\$ 271,000	\$ 325,000	
<i>Operator Annual Revenue (Assumed Tip Fee from Additional Organics Tip Fee for Break Even Scenario)</i>									\$ 255,500	\$ 174,500	\$ 120,500	
<i>Township Net Revenue</i>									\$ (13,000)	\$ 68,000	\$ 122,000	
<i>Contractor Net Revenue</i>									\$ 13,000	\$ (68,000)	\$ (122,000)	
<i>Organic Waste Tip Fee (per tonne or m³ received)</i>									15 m ³ /d	\$ 68.13	\$ 46.53	\$ 32.13
									20 m ³ /d	\$ 51.10	\$ 34.90	\$ 24.10
									25 m ³ /d	\$ 40.88	\$ 27.92	\$ 19.28