

SCHEDULE E

Completion Report:
Regional Municipality of Durham Anaerobic Digestion Feasibility Study

GMF Number	#15161
Lead Applicant	Regional Municipality of Durham
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1. Introduction

The Regional Council approved consultant study was completed by technical consultant GHD Limited, who sub-contracted consultants Ernst and Young (financial) and 2cg Inc. (organics policy and markets).

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2. The Feasibility Study

- a) The Region's process from concept to final feasibility study included several investigations and interim reports to Regional Council.

In 2009, Regional Council approved a Works Committee Report (2009-WR-5) titled "Moving Towards a 70% Diversion Target for Municipal Solid Waste." Having achieved the Region's previous 50 per cent diversion target, largely through implementation of the curbside Green Bin organics collection and

processing programs, the 2009 report outlined recommendations to increase the Region's solid waste diversion rate to the new 70 per cent target. Options identified in the study included expansion of diversion programs in both the single family and multi-residential sector, and greater extraction of divertible materials, including organics, which remained within the garbage disposal stream, despite successful Blue Box and Green Bin programs.

Since 2009, several diversion initiatives investigated and/or implemented resulted in or had potential to result in only small incremental increases to the Region's diversion rate (e.g. clear bags, bag limits, by-law enforcement, additional education and promotion, user fees and re-use pilots). Greater diversion potential was anticipated with the expansion of organics diversion, however factors related to technology, scale of implementation and cost were also deemed more significant and requiring additional due diligence.

In 2012, Regional Council directed staff to complete a preliminary investigation of anaerobic digestion (AD). Kelleher Environmental Inc. was retained to complete the technical review and analysis of AD technologies. The resulting Kelleher Report confirmed that AD technology could provide a solution to expand the Region's organics program to include more problematic materials and introduce source separated organics collection to the Region's multi-residential sector.

In 2013, a comprehensive waste composition analysis of multi-residential households in Durham Region determined that the multi-residential waste stream is comprised of up to 50 per cent organic materials, which could potentially be diverted.

In 2016, staff built on the findings of the Kelleher Report, retaining HDR Corporation to conduct technical feasibility and due diligence analysis of available technologies that could potentially deliver more comprehensive organics processing. HDR's assessment concluded:

- Mixed waste processing or pre-sorting offers the best solution for capturing and diverting organics from the multi-residential sector and has the highest potential to significantly increase organics recovery from the single-family sector.
- Technology options for both sorting of mixed waste to separate organics from the waste stream and AD processing of organics have reached a maturity level in the industry that would provide the Region with reliable options for the potential development of such a processing system.
- There is a range of AD processing technologies which could be adopted for the Region's organic waste stream.
- The Region generates sufficient organic waste to support a mixed waste pre-sorting and AD facility.

The Region's 2016 Solid Waste Management Servicing and Financing Study identified other major drivers of the feasibility study, including: organic processing capacity limits which were constraining opportunities for diversion program expansions; and, existing organics processing contracts that were nearing the end of their contract terms. Regional Council approved the recommendations of this Study (Regional Report #2016-J-7) to issue a Request for Proposal (RFP) to obtain financial and technical advisors with adequate knowledge of anaerobic digestion technology, business case analysis, risk and service delivery analysis and conduct the feasibility study.

Based on Regional Council direction of February 17, 2016 Regional staff retained (through RFP #602-2016) the consultant GHD Limited to complete a three part study of long-term organics management options including anaerobic digestion.

- b) The objectives of the feasibility study were to explore suitable AD technologies and associated regulatory, market and other requirements, as well as conduct a preliminary business case and service delivery analysis as part of the broader exploration of viable long-term organics management options to determine if AD is the best long-term organics waste management option for the Region. Parts 1 and 2 included background research and technical analysis, options analysis, business case and service delivery analysis. Part 3 of the RFP included site evaluation, legislative review, project implementation schedule and assistance with procurement documentation and processes, and was made subject to additional Regional Council approvals based on completion of Parts 1 and 2 work.
- c) The feasibility study approach or methodology was defined through the RFP process as follows:

Part 1 Study:

- i. Collect background information and define the Region's status quo integrated waste management system, including organics management, including review of existing AD, waste transfer, and related studies already completed by the Region;
- ii. Based upon i, as well as industry best practice, consultant expertise and experience in the field of municipal solid waste pre-sorting/pre-treatment and AD technologies/facilities, identify and compare available waste pre-sorting/pre-treatment AD technical options and determine the most appropriate options potentially available to Durham Region to manage single family and multi-family organics and residential wastes, based on assessments of required feedstock, capital, regulatory end-market and other requirements.

Part 2 Study:

- iii. The consultant developed a set of alternative organics waste management options for the Region, including status quo management processes, the preferred technology(ies) identified through Part 1 work, and other viable organic management options (e.g. in-vessel composting and merchant capacity).
 - iv. Evaluation criteria were utilized to analyze and compare the identified waste management options on a consistent basis using qualitative and quantitative information and considering: environmental implications, diversion potential; implications for control and/or flexibility afforded the Region; components of risk and financial implications.
 - v. Business case analysis of options identified were compared to status quo, considering Regional costs and benefits over a 20-year horizon, including sensitivity analysis of key variables and a summary of assumptions, data and sources.
 - vi. Potential service delivery models for new infrastructure were assessed, including municipal ownership and operation and various public private partnership models (e.g. design build operate, design build operate finance and transfer as well as private ownership models etc.). The consultant explored the technical and financial implications of the service delivery models identified.
- d) The feasibility study was both directed and reported through Regional Council in public sessions, including a staff report, distribution of the GHD consultant report, staff and consultant presentations and also included receipt of Regional Council feedback through delegations from private citizens and other organizations which were heard and considered by Regional Council.

3. Feasibility Study Findings and Recommendations

a) Environmental Findings

There are significant changes occurring around regulations that govern and impact municipal waste management in Ontario. Two new pieces of provincial environmental legislation were considered in our evaluation of organics management options, including AD, including the:

- *Climate Change and Low-Carbon Economy Act, 2016; and the,*
- *Waste Free Ontario Act, 2016.*

The implications of each of these regulations on the Region and its organics management approach were evaluated by the consultant as summarized in the table below.

Processing Options Evaluation – Compatibility with Legislation

Evaluation Indicator	Evaluation Question	Pre-Sort with In-Vessel System	Pre-Sort with CSTR System	Pre-Sort with Plug Flow Reactor System	Pre-Sort with Percolate Bunker System
Climate Change and Low-Carbon Economy Act	Does the option have the potential to generate GHG emission reductions?	Unfavourable	Favourable	Favourable	Favourable
	Does the option have the potential to generate GHG off-set credits under the Climate Change and Low-Carbon Economy Act?	Unfavourable	Favourable	Favourable	Favourable
	Overall Evaluation	Unfavourable	Favourable	Favourable	Favourable
Waste Free Ontario Act	Does the option have the potential to enhance recovery of recyclables?	Favourable	Favourable	Favourable	Favourable
	Does the option position the Region as a leader in organics management with respect to the Strategy for a Waste Free Ontario: Building the Circular Economy Strategy?	Favourable	Favourable	Favourable	Favourable
	Overall Evaluation	Favourable	Favourable	Favourable	Favourable

Source: GHD: Background Research, Technical and Options Analysis Report (page 44-45)

Environmental performance refers to operations that do not produce an adverse impact on neighbors, the public or the environment. This is especially important for the Region, as an urbanized growth area. The summary table below presents the consultant evaluation of options with regards to Environmental Performance.

Evaluation Indicator	Evaluation Question	Pre-Sort with In-Vessel System	Pre-Sort with CSTR System	Pre-Sort with Plug Flow Reactor System	Pre-Sort with Percolate Bunker System
Environmental Performance	Does the system have a proven environmental track record?	Favourable	Favourable	Favourable	Favourable

Source: GHD: Background Research, Technical and Options Analysis Report (page 52)

b) Financial Findings

The Consultants (GHD, Preliminary Business Case Financial Analysis, page 3) developed a robust cash-flow financial model (the “**Model**”) to conduct a financial analysis of the Project. This involved establishing a period by period cash-flow profile for each option on a “like for like” basis (i.e. assuming consistent timelines, specifications, performance standards etc.). The Model included the analysis of the following options:

- ▶ Status quo;
- ▶ Pre-sort/merchant capacity;
- ▶ Pre-sort/in-vessel composting; and
- ▶ Pre-sort/anaerobic digestion.

Status Quo Option

The forecasted net operating cash flow for the status quo option was estimated by the consultant at -\$279 million on a NPV basis as shown in the table below:

Optio	Category	NPV
Status quo option	Revenues	\$8,080,013.80
	Operating costs	-\$287,448,516.83
	Net operating cash flows	-\$279,368,503.03

Source: GHD, Preliminary Business Case Financial Analysis, page 4

Pre-sort/Merchant Capacity Option

The consultant's estimated forecast net operating cash flows for the pre-sort/merchant capacity option ranged between -\$496 million and -\$634 million as shown in the breakdown in the table below.

Option	Category	Low (NPV)	High (NPV)
	Revenues	\$30,807,731.94	\$30,807,731.94
	Construction costs	-\$32,202,674.66	-\$37,444,970.54
Pre-sort/merchant capacity option	Operating costs	-\$493,311,839.60	-\$625,478,339.52
	Ancillary costs	-\$1,646,282.14	-\$1,646,282.14
	Net operating cash flows	-\$496,353,064.46	-\$633,761,860.26

Source: GHD, Preliminary Business Case Financial Analysis, page 4

Pre-sort/In-Vessel Composting Option

The consultant's forecast net operating cash flows for the pre-sort/in-vessel composting option ranged between -\$445 million and -\$548 million as shown in the breakdown in the table below.

Option	Category	Low (NPV)	High (NPV)
	Revenues	\$81,950,216.27	\$90,975,360.56
	Construction costs	-\$100,071,683.76	-\$173,182,988.73
Pre-sort/in-vessel composting option	Operating costs	-\$423,877,333.43	-\$463,154,277.00
	Ancillary costs	-\$2,548,800.11	-\$2,548,800.11
	Net operating cash flows	-\$444,547,601.02	-\$547,910,705.27

Source: GHD, Preliminary Business Case Financial Analysis, page 5

Pre-Sort/Anaerobic Digestion Option

The consultant's forecast net operating cash flows for the pre-sort/anaerobic digestion option ranged between -\$446 million and -\$555 million as shown in the breakdown in the table below.

Option	Category	Low (NPV)	High (NPV)
	Revenues	\$93,356,979.19	\$102,382,123.49
	Construction costs	-\$96,561,217.77	-\$140,418,639.51
Pre-sort/anaerobic digestion option	Operating costs	-\$440,099,278.87	-\$513,830,043.29
	Ancillary costs	-\$2,774,429.60	-\$2,774,429.60
	Net operating cash flows	-\$446,077,947.05	-\$554,640,988.91

Source: GHD, Preliminary Business Case Financial Analysis, page 5

c) The consultant recommendations and conclusions were as follows:

“Given the drivers identified, the Status Quo organics management approach is not viable for the Region. The various drivers, including increasing diversion, expiry of existing service contracts, limitations at the DYEC, and implementation of new legislation support the Region adding another component to complete its integrated waste management system that can further be enhanced by revenues related to GHG emission reductions, GHG funding, and revenues from sale of biogas-related products. Given the relative advantages of anaerobic digestion, it is expected that this technology will prevail in an open procurement over in-vessel aerobic composting technologies. The specific recommendations are:

- That the Region prioritize the implementation of a mixed waste pre-sort and organics processing system to address the important drivers identified by proceeding to next stage of this study that includes site selection permitting and procurement.
- That the procurement be open to either a design-build-operate or merchant capacity option in order to drive value for the Region.
- That the procurement be open to either in-vessel aerobic composting or anaerobic digestion systems.”

Source: GHD Background Research, Technical and Options Analysis Report: AD Study (Final), Executive Summary, page 11

4. Lead Applicant's Next Steps

On June 14, 2017, Regional Council received the results of the Part 1 and Part 2 consultant work completed by GHD and directed that the Region issue a Request for Information (RFI) process. It is hoped that this process will provide benefits by confirming or identifying additional viable organics management options that may be available and will allow the Region to confirm and/or update the business case for presentation to Regional Council.

5. Lessons Learned

- a) Municipalities considering a similar feasibility study are recommended to reach out to the many other Ontario municipalities currently exploring, implementing or continuing operations or services related to their long-term organics management goals. While each municipality is unique, up-front communication with other municipalities who have already investigated options, technologies and even made investments in enhanced organics management processes, can assist in reducing uncertainties and streamlining processes.

- b) The largest challenges throughout the study related to the presence of uncertainties related to a changing regulatory framework, existing market uncertainties and cost.

The GHD study concluded that all viable options investigated would represent a significant increase in overall costs (capital and operating) compared to status quo. However, status quo was not deemed to represent a viable option going forward as it did not address the main drivers of the study.

The significant system changes and costs for a long-term organics management solution meeting the Region's objectives led to the determination by both Regional staff and Regional Council that additional due diligence would be required to proceed with the levels of investment deemed required for a major additional shift in organics management and diversion. Furthermore, it was determined that additional processing treatments or technologies, changes to regulation or potential partnerships may be required to meet the end-market specifications for compost or energy by-products that could offset significant operating costs. It is hoped that, through the Region's approved Request for Information process over 2017/18, confirmations and additional information on markets, regulatory implications, costs and technological information will result in a clearer path and reduced uncertainty for implementation of a long-term organics management plan for the Region of Durham.

6. Knowledge Sharing

- a) The Regional staff report to Committee of the Whole and Regional Council summarizing technical and financial findings based on the consultant study and recommending next steps was approved by Regional Council on June 14, 2017 and is available by opening the following link and going to page 3 of the June 7, 2017 Addendum section 8.2 F), 2017-COW-180:

<http://www.durham.ca/apps/clerks/masearch/Search.aspx>

- b) The feasibility study has resulted in the development of a Request for Information document which GHD continues to assist the Region with, and is anticipated to be released in late 2017 and close in the spring of 2018. It is hoped that this procurement instrument can assist the Region and GHD in confirming or improving the preliminary business case conducted as well as confirming the appropriate path forward to advance the Region's long-term organics management plan.

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