Appendix C

2019 Financial Assurance

Financial Assurance Estimate

Terrapure Environmental

Stoney Creek Regional Facility
ECA No. A181008

Stoney Creek, Ontario
May 1, 2019

May 1, 2019

Mr. Lorenzo Alfano,
District Manager, Stoney Creek Regional Facility
Terrapure Environmental
65 Green Mountain Road W.
Stoney Creek, ON L8J 1X5

Re: Stoney Creek Regional Facility Financial Assurance Estimate

Dear Mr. Alfano,

HDR is pleased to submit a report providing an estimate of the financial assurance associated with the Stoney Creek Regional Facility (SCRF). Terrapure is in the process of obtaining Environmental Assessment and Environmental Compliance Approval for an expansion of the existing landfill.

The purpose of this document is to provide an estimate of the financial assurance for the Stoney Creek Regional Facility incorporating the additional landfill capacity and an extended operating life for the SCRF.

If you have any questions please do not hesitate to contact the undersigned

Sincerely,
HDR Corporation

Larry Fedec, P.Eng., MBA
Solid Waste Program Leader, Canada
Associate

Encl.

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1 Introduction

The Stoney Creek Regional Facility (SCRF) is owned by Revolution Landfill LP and is operated by Terrapure Environmental under Environmental Compliance Approval (ECA) No. A181008 issued by the Ministry of Environment, Conservation and Parks (MECP). The SCRF is located at the northwest corner of Mud Street and Upper Centennial Parkway, in the City of Hamilton, and has been operating since 1996.

The existing SCRF landfill has a total approved site capacity of 6,500,000 cubic metres (m^3) for residual material and an additional 2,000,000 m^3 for industrial fill. Terrapure has now completed an Environmental Assessment to increase the total approved landfill capacity for post-diversion solid, non-hazardous industrial residual material at the SCRF by 3,680,000 m^3. This includes converting the area for industrial fill to waste. The total capacity of the expanded landfill is 10,180,000 m^3.

The existing Site covers a total area of 75.1 hectares (ha). The current approved landfill footprint for residual material is 41.5 ha. The industrial fill material covers an area of approximately 17.6 ha, while the Site buffers and other infrastructure (e.g., stormwater management system, Site office) cover an area of approximately 16.0 ha. The proposed capacity increase of the SCRF will increase the overall size of the landfill to 59.1 ha. The overall Site area will remain unchanged. Vertical limits will extend higher increasing the peak height by approximately 2.5 m. Horizontal limits will extend further toward the north, back to original approved footprint of the SCRF. The area currently approved to accept industrial fill will be replaced with a base liner system to accept residual material.

The purpose of this document is to provide an estimate of the financial assurance for the Stoney Creek Regional Facility incorporating the additional landfill capacity and an extended operating life for the SCRF.

1.1 General Site Information

The Operating Stoney Creek Regional Facility is maintained by Terrapure Environmental following the site acquisition by Revolution Landfill LP as part of the sale of the former Industrial Division of Calgary-based Newalta Corporation in March 2015. The site is located approximately 1 kilometre (km) south of the Niagara Escarpment in the City of Hamilton bordered by First Road West to the west, Mud St. West to the south, Upper Centennial Parkway to the east and Green Mountain Road West to the north. The site is located directly east of the Closed Stoney Creek Regional Facility located at the northwest corner of Mud Street and First Road West. First Road West separates the two sites.

As of the end of 2018, a total of 12,377,649.24 tonnes of residual material have been landfilled. Based on a total capacity of 10,180,000 m^3 and a density of 1.9 tonnes/m^3, the landfill is estimated to receive approximately 19,342,000 tonnes during its operating life, The Site can receive up to 750,000 tonnes of residual material per year and has received an average of 562,000 tonnes per year over the past ten years. It is estimated that the Site will reach capacity in approximately 2032, with final closure occurring in 2033.

In the early 1960s, a quarry operation began east of First Road West within the northern portion of the area of the Operating Stoney Creek Regional Facility. The quarry located at site of the Operating Facility was developed to further the operations of an existing dolostone quarry, which began operations in the late 1940s, at the location of the closed facility. Site operations also included on-site concrete and asphalt production. The two operations continued concurrently until the mid-1980s when the original quarry on the west side of First Road West was depleted to the limits of the aggregate extraction license. Although the initial operation began in a rural environment, urbanization has continued to encroach on the area around the site, utilizing municipal piped water and sewer services.

Construction of the engineered Operating Stoney Creek Regional Facility began in 1996 with Phase 1A. The landfill base liner system has been constructed to Phase 7A, after which an ECA amendment granted a change to the site design allowing for a reduced footprint and higher elevation.

The groundwater collection system has been constructed to dewater the quarry to permit base liner construction under dry conditions. Its secondary function is to serve as a contingency leachate collection system, to collect any unexpected leakage of leachate through the liner system. The system consists of trenches excavated into the quarry floor, both around the perimeter and beneath the landfill, and backfilled with crushed stone. The portion of the trench system around the perimeter of the site contains a perforated pipe that can be accessed via cleanouts which will be extended to the surface of the final cover. The perforated pipe and cleanouts provide a level of redundancy to the groundwater collection system, and also permit monitoring of groundwater quality at the perimeter of the landfill. The groundwater flows by gravity due to the 0.5% slope in the landfill base grades towards the southeast corner of the landfill, the deepest area of the quarry. A pumping station has been constructed at the low point of the base liner system in the southeast corner of the landfill.

The hydraulic control layer (HCL) consists of a 0.5 m thick layer of 50 mm diameter crushed stone between the primary and secondary liners on the landfill base and side slopes. The HCL provides several important leachate control functions both during and after the operating period of the landfill. During the operating period, the HCL functions as a contingency collection layer for leachate that has unexpectedly migrated through the primary liner. Upon completion of landfilling, the HCL will be saturated with clean water, and the head within the HCL maintained above the leachate head within the landfill in order to provide hydraulic containment.

The leachate collection system has been constructed immediately overlying the primary liner on the landfill base and side slopes. It consists of a 0.35 m thick drainage blanket consisting of coarse crushed stone overlain by a 0.15 m thick granular filter layer. The leachate flows by gravity along the 0.5% slope of the landfill base to the low point in the southeast corner of the site. Leachate is pumped out of the landfill from this point into a forcemain, which discharges to the City of Hamilton sanitary sewer. Each section of the piping is accessible for maintenance via cleanout structures which will be extended to the surface of the final cover.

1.2 Regulatory Requirements

A Financial Assurance Re-evaluation Report is typically prepared for the Stoney Creek Regional Facility as per Condition 85.6(1) of the ECA. The current financial assurance estimate for the SCRF was prepared in May 2017.

2 Closure and Post-Closure Costs

The Stoney Creek Regional Facility accepts solid, non-hazardous waste consisting mainly of waste from the steel making industry (e.g., basic oxygen furnace oxide, slag, foundry sand) and soils from contaminated site cleanups. The Facility was approved in 1995, prior to the introduction of Regulation 232/98 – Landfilling Sites. With the expansion of the landfill the SCRF is subject to the requirements of Reg. 232/98, including financial assurance.

The financial assurance estimate presented in this report is based on estimated closure and post closure care costs for the landfill. The closure of the facility occurs when the landfill ceases to accept solid waste for disposal and is currently expected to reach capacity by the end of 2032. Post-closure care costs consist of recurring maintenance and monitoring costs.

The various post closure care costs, contaminating lifespan, inflation rate and discount rate, used in this report are described in the following sections. Cost estimates where possible have been estimated using present costs for site operations.

2.1 Closure Costs

Development of the Site to-date has involved the progressive covering and closure of completed areas of the landfill, as active landfilling areas are progressively filled to the approved final contours. While sections of existing final cover will be removed to accommodate the additional capacity, Terrapure will continue to cover and close areas of the landfill progressively during future operations.

Regulation 232/98 Section 18.(5) outlines that financial assurance for planned closure of an area requiring final cover is not required if closed within less than five years. Typically closure of a landfill area occurs within 1 – 2 years of reaching final contours. Terrapure intends to maintain this operating practice.

General costs associated with the closure of the Stoney Creek Regional Facility include an allowance for mobilization and demobilization from the Site, insurance and bonding, access road maintenance, dust control, health and safety, contractor's grade control as required, and miscellaneous contractor items. The estimated general/miscellaneous costs are $50,000 based on current costs.

2.2 Post Closure Costs

Terrapure maintains detailed records associated with ongoing annual operating and maintenance costs for the operating and closed facilities. The annual post-closure care costs for the landfill, in 2019 dollars, and any anticipated future cost reductions are outlined below. A detailed breakdown of the various post-closure costs are included in Appendix A.

2.2.1 Site Staffing

Based on the current level of effort to monitor and maintain the site Terrapure has identified the need for one half (0.5) full time equivalent employees to be assigned to the site during the post-closure care period. The staff will be responsible for maintenance activities including monitoring of control systems at the site including leachate collection system (leachate levels, leachate flow and leachate quality), hydraulic control layer (includes monitoring water levels, replacement water flows and water quality), the groundwater collection system; which includes groundwater levels, and flow determination, and surface water sampling and monitoring. The 2019 estimated cost for site staffing is $31,000.

2.2.2 Leachate Collection System

Leachate collection system related costs include operation, inspection and maintenance costs associated with the leachate collection piping and the leachate pumping station and gravity sewer. Operational costs include electricity, leachate disposal ($1.68/m^3 in 2019) and oxidant purchase. The volume of leachate to be disposed annually after closure is estimated to be 173,500 m^3. Inspection costs include periodic probe cleanouts for sediment accumulation, video inspection of pipes, inspection of pump operations, inspections of the gravity sewer, and general inspection and service of the pump/switch/alarms. Maintenance activities accounted for include sediment removal, flushing piping, pump replacement and general maintenance costs. Based on Terrapure's operational experience with the collection and pumping system from the closed site, minimal maintenance is required for the collection system compared to other landfills based on the differences in materials placed within the cells. Annual costs associated with the leachate collection system are estimated to be approximately $309,420, in 2019, and will exist for the duration of the contaminating lifespan of the landfill.

2.2.3 Hydraulic Control Layer

This estimated cost includes electricity costs, water replacement (annual flushing and leakage losses) and water disposal to sewer. Also included is the inspection of the extraction pump and associated maintenance (pump service or replacement), as required. The estimated annual costs of the hydraulic containment layer are approximately $50,900, in 2019, for the duration of the contaminating lifespan of the landfill.

2.2.4 General Site Works

Annual costs associated with general site works include the inspection of all fences, gates, signs, roads and road cleaning programs, and maintenance such as grass cutting and snow removal. General site works also includes inspection of surface water controls, the gas venting system and final cover, and allowance for maintenance for these works as needed. The estimated annual cost for general site works is $7,500, in 2019 dollars, for the duration of the contaminating lifespan of the landfill.

2.2.5 Environmental Monitoring Program

Monitoring the environment surrounding the facility, and the various control systems in place will continue post-closure. The current annual laboratory costs of the monitoring program outlined in the ECA is $86,000, and this cost is anticipated to reflect monitoring within the first five year period post closure. Beyond this five year period a reduction in monitoring requirements (number of samples and frequency) is anticipated as a result of periodic review of the monitoring requirements, these costs have currently been assumed to be incurred for the duration of the contaminating lifespan of the landfill at 50% of the present efforts.

The frequency and specifics of monitoring events are outlined in the ECA and supporting documents, but in general terms surface water is sampled monthly (when not frozen), groundwater is sampled quarterly, and combustible gases are tested (field test only) on a bi-weekly basis on average. Sampling is completed by Terrapure staff and by the consultants. Following sampling, an annual monitoring report is produced by an external consultant

2.2.6 Compliance Reporting

Current costs for annual compliance reporting related to the development of annual monitoring reports are reported to be $45,000. After the first 5 years, once the landfill cover has been established and site conditions following closure are understood, it is anticipated that the level of effort required to ensure continued compliance will be reduced to approximately $22,500 for the remaining duration of the contaminating lifespan of the landfill.

2.2.7 Summary of Annual Costs

The total estimated annual post-closure care cost for the first 5 years post-closure is $529,820, in 2019. After 5-years of post-closure, the annual costs are reduced to approximately $464,320, in 2019 dollars.

3 Contaminating Lifespan

Leachate is formed when precipitation infiltrates into waste materials and dissolves various minerals, elements, and chemical compounds out of the waste. The wastes are expected to produce leachate that will initially exceed various regulatory limits for surface water and groundwater quality and thus cannot be released to the environment without some form of treatment. The dissolution of these constituents is an ongoing process, and eventually, a sufficient amount of these constituents will be removed from the waste so that the leachate can no longer adversely impact the environment. The “contaminating lifespan” is defined as the length of time that the waste can produce leachate that is unacceptable for direct release to the environment.

The contaminating lifespan for the Stoney Creek Regional Facility has historically been estimated to be in the order of 200 - 300 years. This estimate was understood to be overly conservative and a detailed review of the contaminating lifespan calculations for the SCRF was undertaken as part of the recent Environmental Assessment. A copy of the contaminating lifespan (CLS) assessment completed is included in Appendix B.

The following provides a summary of the assessment completed and the rationale for updating the estimated CLS:

- Previous modelling assumed a much higher amount of evapotranspiration than the value determined through current HELP modelling. This higher evapotranspiration rate reduced the amount of precipitation available for infiltration (i.e. precipitation surplus). Therefore previous modelling yielded a much lower rate of infiltration through the landfill cap, resulting in a much longer contaminating lifespan due to less water being available on an annual basis to dissolve contaminants from the waste mass.
- The recommended minimum infiltration rate of 0.15 m/year as outlined in O.Reg. 232/98 (as amended) was used in the assessment. This infiltration rate is lower than the infiltration rate yielded by current HELP modelling and accordingly, this value represents a conservative estimate of leachate generation for the purposes of CLS calculations.
- The target concentrations for the contaminants of concern should be evaluated against the Ontario Drinking Water Standards (ODWS). Previous modelling used Reasonable Use Guideline concentrations as the basis for CLS calculations. Reasonable Use Guideline concentrations only apply at the Site boundary and accordingly using these concentrations for leachate within the landfill mound is overly conservative.
- The original contaminants of concern used in CLS calculations (i.e. sodium and fluoride) were assumed using leachate generated from the adjacent Closed West Landfill. Based on historical waste analyses for waste streams for the active SCRF and leachate quality for the active SCRF, it was determined that chloride and cadmium are more representative of current leachate characteristics.

Given the above, updated CLS calculations were developed for the SCRF using chloride and cadmium as contaminants of concern. CLS calculations completed identified a contaminating lifespan of 68 years. This value is conservative in comparison to O.Reg. 232, which specifically references chloride loading and requires a minimum CLS of 25 years.

4 Inflation Rate

In March 2013, the MECP prepared an Addendum to the Financial Assurance (F-15) Guideline titled “Approved Procedures for Deriving Inflation Rates, Discount Rates and O.Reg. 232/98 Contingency Costs for Landfill Financial Assurance Calculations. The amended procedure for deriving the inflation rate is summarized as follows.

1. An inflation rate to represent all of Ontario is derived by computing the most recent 10-year averages for the combined Non-Residential Building Construction Price Indices (NRBCPI) for Toronto and for Ottawa-Gatineau (Ontario Part).
2. Combine the averages for the two indices to compute the 10-year average Non-Residential Building Construction Price Index for Ontario (NRBCPIO).
3. Calculate the year to year annual % changes in the NRBCPIO.
4. Calculate the average of the year-to-year % changes over 10 years.

Using this method, the inflation rate to be applied in the financial assurance calculation would be 2.14% (see Table 4-1).

Table 4-1. Non Residential Building Construction Price Index for Toronto and Ottawa Gatineau

Year	Annual Average Non-Residential Building Construction Price Index for Ottawa - Gatineau (Ontario Part)	Percentage Change	Annual Average Non-Residential Building Construction Price Index for Toronto	Percentage Change	Annual Average Non-Residential Building Construction Price Index for Toronto and Ottawa - Gatineau (Ontario Part)	Average Percentage Change
2009	84.4	-1.63%	84.5	-4.20%	84.45	-2.93%
2010	88.4	4.74%	85.9	1.66%	87.15	3.20%
2011	93.2	5.43%	90.0	4.77%	91.6	5.11%
2012	94.5	1.39%	91.2	1.33%	92.85	1.36%
2013	94.1	-0.42%	91.3	0.11%	92.7	-0.16%
2014	95.6	1.59%	93.0	1.86%	94.3	1.73%
2015	97.1	1.57%	94.6	1.72%	95.85	1.64%
2016	98.2	1.13%	98.1	3.70%	98.15	2.40%
2017	101.1	2.95%	100.8	2.75%	100.95	2.85%
2018	107.9	6.73%	106.5	5.65%	107.2	6.19%
					Inflation Rate	**2.14%**

Note: Table is based on Addendum to the Financial Assurance (F-15) Guideline titled "Approved Procedures for Deriving Inflation Rates, Discount Rates and O.Reg. 232/98 Contingency Costs for Landfill Financial Assurance Calculations. March 2013.

Statistics Canada. Table 18-10-0135-01 (formerly CANSIM 327-0058 - Price indexes of non-residential building construction, by class of structure, annual (index, 2017=100). Replaces Table 18-10-0049-01. Accessed April 11, 2019

5 Discount Rate

The MECP's March 2013 Addendum describes the use of a discount rate based on the most recent 10 year annual average of Long Term, or 30 year, Government of Canada benchmark bond yields. This would apply for an initial 30 year period of the post-closure contaminating lifespan, starting from the year of closure. It is then suggested that a constant 3% real interest rate be added to the inflation rate for future years (5.14%). The nominal discount rate for the period from 2009 to 2018 based on the Long-Term (30 year) Bond Yield is calculated to be 2.77%.

6 Calculation of Financial Assurance

The calculation of financial assurance for the Stoney Creek Regional Facility is presented in Appendix C. The financial assurance is estimated to be $29,257,903 in 2019. This is inclusive of the MECP procedure for the calculation of contingency plan costs and closure and post-closure costs. Based on the assumption of a fill rate of 550,000 tonnes per year, the annual increase in financial assurance for the next three years (2020-2022) is approximately $1,281,300.

When the Stoney Creek Regional Facility closes at the end of 2032, the total amount of financial assurance will begin to decrease each year going forward, over the remaining years of contaminating life.

7 Summary

The total financial assurance for closure and post closure care costs associated with Terrapure's Stoney Creek Regional Facility is estimated to be $29,257,903 in 2019.

8 References

GHD

2019. Stoney Creek Regional Facility Environmental Assessment, Facility Characteristics Report", January 2019

Ministry of the Environment and Climate Change (MOECC):

2011 Guideline F-15, Financial Assurance Guideline. June 2011.

Ministry of the Environment and Climate Change (MOECC):

2013 Addendum to the Financial Assurance (F-15) Guideline titled "Approved Procedures for Deriving Inflation Rates, Discount Rates and O.Reg. 232/98 Contingency Costs for Landfill Financial Assurance Calculations. March 2013.

Appendix A

Detailed Cost Breakdown

Closure Costs Breakdown

Table 1: Closure Cost Estimate - Progressive Closure

Item	*Quantity*	*Unit*	*Unit Rate*	*Amount*	*Assumptions/Comment*
1. General/Maintenance					
Allowance for mob/demob., insurance and bonding, access road maintenance, dust control, health and safety, contractor's grade control as required, miscellaneous contractor items.	*1*	*lump sum*	*$ 50,000.00*	*$ 50,000*	
		Total Estimated Closure Cost		***$ 50,000***	

Post Closure Cost Breakdown
Operating Stoney Creek Regional Facility Financial Assurance Review - April 2019
Table 1: Review of Annual Post Closure Costs - First 5 Years following Closure

TASKS	EFFORT	COSTS				COMMENTS
	Number of events/yr	Unit Costs		TOTAL COST (by task) $/yr	TOTAL COST (summary) $/yr	
		$/event	$/year			
1. LEACHATE COLLECTION SYSTEM						
A. Leachate Collection Piping						System operates continuously in post closure
a.flush piping system		$ 21,150	$ 4,230	$ 4,230		Based on $1.88/m for 11,250 m once every 5 years.
b.allowance for maintenance as needed			$ 250	$ 250		
B. Leachate Pumping Station and Gravity Sewer						
OPERATION						
a.electricity for pumps	365	$ 4.00	$ 1,460	$ 1,460		Based on 6 hours per day pumping@4.5kW
b.leachate disposal to sewer	1	$ 291,480	$ 291,480	$ 291,480		Based on 173,500 m3/yr @$1.68/m3 for sanitary sewer disposal
c.oxidant purchase	12	$ 1,000	$ 12,000	$ 12,000		
INSPECTION						
a.check pump operation						
b.inspection pump station for sediment accumulation						
c.inspect gravity sewer for sediment accumulation						Video inspection of gravity sewer not anticipated in future based on existing experience and data collected at the site which has indicated no issues.
d.pump/switch/alarm inspeection and service						
e. Video Inspection of gravity sewer						
MAINTENANCE						
a.sediment removal						Sediment removed through flushing in conjunction with leachate piping
b.flush sewer piping						
c.allowance for maintenance as needed						
Sub-total					$ 309,420	
2. HYDRAULIC CONTROL LAYER						System operated continuously for post-closure period.
OPERATION						
a.electricity for pumps			$ 500	$ 500		
b. water replacement (annual flushing and leakage loss)			$ -	$ -		50,000 m3/yr stormwater from on-site sources
c.water disposal to sewer			$ 50,400	$ 50,400		30,000 m3/yr flushing disposal to sewer @ $1.68/m3
Sub-total					$ 50,900	

3. GENERAL SITE WORKS						
INSPECTION						General inspections carried out as part of other work at
roads and road cleaning programs, inspection of surface water controls, passive gas venting system and final cover						
b. grass cutting on exterior of perimeter berm						
c. snow removal to pumping stations			$ 7,500	$ 7,500		Contracted snow clearing
Sub-total					$ 7,500	
4. MONITORING OF CONTROL SYSTEMS (STAFF)						
Full Time Staff						
One half full time equivalent	0.5		$ 62,000	$ 31,000		
Sub-total					$ 31,000	
5. ENVIRONMENTAL MONITORING	1		$ 86,000	$ 86,000		Based on actual costs
Sub-total					$ 86,000	
6. COMPLIANCE REPORTING			$ 45,000	$ 45,000		Based on actual costs
Sub-total					$ 45,000	
TOTALS					**$ 529,820**	

Newalta Stoney Creek Landfill Finanical Assurance - April 2019

Table 2: Review of Annual Post Closure Costs - After 5 Years following Closure

TASKS	EFFORT	COSTS				COMMENTS
	Number of events/yr	Unit Costs		TOTAL COST (by task) $/yr	TOTAL COST (summary) $/yr	
		$/event	$/year			
1. LEACHATE COLLECTION SYSTEM						
A. Leachate Collection Piping						System operates continuously in post closure
a.flush piping system		$ 21,150	$ 4,230	$ 4,230		Based on $1.88/m for 11,250 m once every 5 years.
b.allowance for maintenance as needed			$ 250	$ 250		
B. Leachate Pumping Station and Gravity Sewer						
OPERATION						
a.electricity for pumps	365	$ 4.00	$ 1,460	$ 1,460		Based on 6 hours per day pumping@4.5kW
b.leachate disposal to sewer	1	$ 291,480	$ 291,480	$ 291,480		Based on 173,500 m3/yr @$1.68/m3 for sanitary sewer disposal
c.oxidant purchase	12	$ 1,000	$ 12,000	$ 12,000		
INSPECTION						
a.check pump operation						
b.inspection pump station for sediment accumulation						
c.inspect gravity sewer for sediment accumulation						
d.pump/switch/alarm inspeection and service						Video inspection of gravity sewer not anticipated in future based on existing experience and data collected at the site which has indicated no issues.
e. Video Inspection of gravity sewer						
MAINTENANCE						
a.sediment removal						Sediment removed through flushing in conjunction with leachate piping
b.flush sewer piping						
c.allowance for maintenance as needed						
Sub-total					$ 309,420	
2. HYDRAULIC CONTROL LAYER						System operated continuously for post-closure period. Assume HCL saturated prior to site closure.
OPERATION						Assume layer sturated prior to site closure
a.electricity for pumps			$ 500	$ 500		
b. water replacement (annual flushing and leakage loss)			$ -	$ -		50,000 m3/yr stormwater from on-site sources
c.water disposal to sewer			$ 50,400	$ 50,400		30,000 m3/yr flushing disposal to sewer @ $1.68/m3
Sub-total					$ 50,900	

3. GENERAL SITE WORKS						General inspections carried out as part of other work at the site
INSPECTION						
roads and road cleaning programs, inspection of surface water controls, passive gas venting system and final cover						
b. grass cutting on exterior of perimeter berm						
c. snow removal to pumping stations			$ 7,500	$ 7,500		Contracted snow clearing
Sub-total					$ 7,500	
4. MONITORING OF CONTROL SYSTEMS (STAFF)						
Full Time Staff						
One half full time equivalent	0.5		$ 62,000	$ 31,000		
Sub-total					$ 31,000	
5. ENVIRONMENTAL MONITORING	1		$ 43,000	$ 43,000		Assume 50% reduction in monitoring requirements
Sub-total					$ 43,000	
6. COMPLIANCE REPORTING			$ 22,500	$ 22,500		Assume 50% reduction in reporting requirements
Sub-total					$ 22,500	
TOTALS					**$ 464,320**	

Appendix B

Assessment of Contaminating Lifespan

Memorandum

January 2□, 201□

To:	Brian Dermody	Ref. No.:	11102□□1
From:	Neil S□anni□□□□A□S□□	Tel:	□1□-340-3□3□
Subject:	**Contaminating Life Span Evaluation** **Stoney Creek Regional Facility Landfill Expansion, Stoney Creek, Ontario**		

1. Introduction

1.1 Background

The Stoney Creek Regional Facility (SCRF), located in Stoney Creek, Ontario, is an approved waste disposal site operating under Environmental Compliance Approval (ECA) No. A1□100□□□, is currently undergoing an Environmental Assessment (EA) for landfill expansion. The purpose of this undertaking is to evaluate the contaminating life span (CLS) of the SCRF. Solid waste landfills need to be managed after closure during the CLS of the landfill. This aftercare comprises the treatment and monitoring of residual emissions as well as the maintenance and control of landfill elements. These measures can be terminated when a landfill does not pose a threat to the environment anymore. This is considered the end of the CLS of a landfill. The CLS of the Site was determined based on the data provided and models available from a literature review.

In 1□□□, Gartner Lee Limited (GLL) prepared the *Taro East Quarry Environmental Assessment, Waste and Leachate Characterization Report* (WLCR), where the life span of the contaminants from the SCRF were assessed, specifically sodium and chloride. In this report, GLL calculated the CLS based on data available from the West Quarry Landfill and projected waste streams for the East Quarry Landfill, which was not constructed at the time of the report. In 201□, the CLS for the SCRF was refined utilizing leachate quality data from the operational East Quarry Landfill. The CLS was also refined to evaluate with respect to chloride and cadmium. These parameters were selected in lieu of sodium and chloride, as GHD interpreted them to be more representative of current leachate characteristics. The evaluation of the CLS was carried out by employing a model prepared by Dr. Kerry Rowe (Rowe 1□□1; Rowe et al. 2004), used in establishing Ont Reg. 232 (MECP, 1□□□).

The Site is currently undergoing the EA process with the Ministry of the Environment, Conservation and Parks (MECP) for a proposed vertical and horizontal expansion. This memorandum will provide a discussion related to the Preferred Landfill Footprint and the anticipated CLS.

1.2 Contaminating Life Span

The CLS of a landfill may be defined as "*the period of time during which the site will produce contaminants at concentrations that could have unacceptable impact if they were to be discharged from the site*" (MECP, 1□□□). "*For landfills, planning period is equal to the operating period of the facility plus the contaminating life span of the landfill after closure.*" (MECP, 2011). As such, CLS is the period of time that

GHD
4□□ Phillip Street Waterloo Ontario N2L 3□2 Canada
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REGISTERED COMPANY FOR ISO 9001 ENGINEERING DESIGN monitoring and maintenance are required at the SCRF following closure of the landfill, representing the time period for which financial assurance (FA) is required.

The CLS of a landfill will depend on the mass of contaminant within the landfill, the infiltration rate, and the pathways for contaminant release. With all other things being equal, an increase in the mass of any given contaminant within the landfill will increase the CLS. For landfills with a leachate collection system, which removes leachate for subsequent treatment, increased infiltration (and therefore increased leachate generation) will reduce the CLS (Rowe, 2004). Although the peak concentration of a given contaminant species can be estimated through routine monitoring of leachate quality (i.e., as part of a site monitoring program), the total mass of contaminant is more difficult to estimate. Nevertheless, upper-bound estimates can be made by considering the observed variation in concentration with time at landfills where leachate concentration has been monitored, or by considering the composition of the waste (Rowe et al., 2004). Parameters used in the CLS evaluation model are detailed in Section 2.

As noted above, the CLS defines the time period where FA is required, which influences the amount of FA required per year. The minimum CLS to be considered for the determination of FA requirements is 25 years, as detailed in "*Guideline F-15: Financial Assurance Guideline*" (MECP, 2011). Previous investigations by GLL have calculated the CLS of the SCRF to range between 200 and 300 years, based on evaluation of sodium and fluoride. This memorandum will provide detail regarding the updated calculation of the CLS of the Preferred Landfill Footprint using chloride and cadmium.

[illegible] Site Design

This Section provides a brief description of the existing approved SCRF design and the Preferred Landfill Footprint design. The final cover for the approved design and Preferred Landfill Footprint will consist of 0.[illegible] m of final cover material overlain by 0.1[illegible] m of vegetated topsoil.

Existing Approved Site Design

The existing SCRF design was prepared and approved as part of the Design and Operations Report (GLL, 1[illegible]). The landfill footprint was revised in 2013 as part of the Reconfiguration Report (AECOM, 2013). The current approved design as shown in Figure [illegible]1 consists of two distinct areas: the Residual Material area comprising the majority of the landfill and the Industrial Fill area located in the northern portion.

The Residual Material area is to be constructed (i.e., landfilled) with 4 horizontal to 1 vertical (4H:1V) side slopes to an elevation of 212.0 to 213.0 metres above sea level (mASL) at the northern and eastern boundaries, further extending at a three percent slope to a peak elevation of 21[illegible] mASL. The western and southern portions of the Residual Material area form a shallower plateau, with elevations ranging from 202.[illegible] to 213.0 mASL with three percent side slopes.

The Industrial Fill area is to be filled with five percent side slopes to an elevation of 20[illegible] mASL. The southern boundary will tie in to the Residual Material area. All other sides will transition to surrounding grade at 4H:1V side slopes.

Preferred Landfill Footprint

The final contours for the [illegible] daily cover of the Preferred Landfill Footprint are presented on Figure 1[illegible]. Landfilling will conducted with maximum side slopes of 4H:1V to a crest elevation of 211.[illegible] mAMSL. The top

Peak slope is three percent with a peak elevation of 221.0 mAMSL. The elevations and slopes given are for the top of waste.

The final cover will consist of a 0.6 m thick soil cover overlain with a 0.15 m topsoil layer and a vegetative cover. The soil cover will consist of on-site material and/or imported material to provide a cover that will allow a minimum infiltration rate of 0.15 m per year in accordance with O.Reg. 232/98 for an engineered site.

2. Contaminating Lifespan Models

This Section identifies the models that have been utilized to calculate CLS for the SCRF. Input parameters have been selected based on SCRF conditions, and are detailed in this Section. The results of the CLS modeling are presented in Section 3.

2.1 Previous Modeling Related to the Contaminating Life Span for the Site

In 199[illegible], GLL prepared the WLCR wherein contaminating life span was calculated using two methods. The first method utilized a formula developed in *Contaminant Impact Assessment and the Contaminating Lifespan of Landfills - Canadian Journal of Civil Engineering* (Rowe, 1991) to evaluate CLS. The formula is as follows:

$$t = \frac{-Mln(\frac{C_t}{C_o})}{qAC_o}$$

The second method utilized a mass balance approach consisting of dividing the total mass of contaminant by its concentration in leachate to calculate the volume of water required to dissolve the mass of contaminants. This volume was then divided by the infiltration rate to calculate the time required to dissolve the contaminants.

The first method estimated CLS values ranging from 2[illegible]2 to 2[illegible]3 years. The second method estimated CLS in the range of 1[illegible]2 to 2[illegible] years. The report identified the overall predicted range in CLS to be 200 to 300 years.

2.2 Rowe (1991)/Rowe et al. (2004) Model

Rowe (1991) examined the issue of leachate strength decrease for conservative contaminant species (e.g., chloride) where the decrease in strength is essentially due to dilution (i.e., no biological breakdown or precipitation) as water infiltrated through the waste with time. Assuming that the decrease is due to dilution, the variation in concentration at any time t is given by:

$$C_{(t)} = C_o e^{-[(\frac{q_o}{H_r}+\lambda)t]}$$

Where:

$$H_r = \frac{(pm_o)}{(AC_o)} \quad \text{(Source: Rowe, 1991; Rowe et al. 2004)}$$

$$k = \frac{q_o AC_o}{pm_o} + \lambda$$

Where:

C_t = target concentration (i.e., ODWS/RUC) (g/m^3)

C_o = chloride concentration (i.e., the peak average value) (mg/L)

q_o = average rate of infiltration (m/yr)

H_r = reference height of leachate (m)

λ = first order rate constant (yr^{-1}) (assumed to be zero for chloride

t = time required (yr)

p = proportion of the total mass of waste that is contributed by chloride

m_o = total mass of waste (kg)

A = area of the landfill (m^2)

[illegible] Site Parameters

Target Contaminant Concentration

It is necessary to define "unacceptable impact" to calculate the CLS of a landfill. In the Province of Ontario, the MECP has a "Reasonable Use" Policy (MECP, 1[illegible]). The chloride concentration where the contamination from the landfill is assumed to have no unacceptable impact is either the Ontario Drinking Water Standard (ODWS) applied at point of release or the Reasonable Use Criteria (RUC - applied at Site boundary). GHD has utilized the ODWS criteria for chloride as RUC criteria is considered to be overly conservative.

Groundwater monitoring has identified chloride concentrations well in excess of the ODWS downgradient of the SCRF. As such, the ODWS of 250 mg/L has been utilized for evaluation of the CLS with respect to chloride. This allows GHD to estimate the time required until leachate passing through the base of the landfill is no longer negatively impacting the groundwater below.

During recent monitoring periods, cadmium was below the ODWS criteria in downgradient groundwater. In the absence of calculated RUC values and given that cadmium has a health-based ODWS criteria, GHD assumed a target concentration of one quarter of the ODWS representing the worst case scenario for RUC compliance at the property boundary.

Peak Average Contaminant Concentration in Leachate

Contaminant concentrations in leachate were measured via samples from the Leachate Collection System. For this evaluation, GHD utilized data from 1[illegible] to 201[illegible] to estimate the peak average concentration for each parameter. GHD estimated peak average concentrations of 2[illegible]00 mg/L for chloride and 0.003 mg/L for

Cadmium. Note that where cadmium was not detected above method detection limits, concentrations were assumed at half of the detection limit.

Source: 201□ Annual Monitoring and Operations Report, Terrapure Environmental Operating Stoney Creek Regional Facility (GHD, 201□); Terrapure Environmental Operating - Stoney Creek Regional Facility Annual Report 201□ (Hausman Geoscience Inc., 201□).

Average Rate of Infiltration

The Hydrologic Evaluation of Landfill Performance (HELP) model Version 3□0□ (Schroeder, et al., 1□□4a and 1□□4b) was utilized to calculate the average rate of infiltration through the final cover of the landfill (I_0). The HELP model requires input of climate data as well as soil and design data.

GHD input SCRF specific climate data obtained from the Environment Canada 1□□1-2010 Canadian Climate Normals & Averages data base (Environment Canada, 201□). Specifically, temperature, precipitation, relative humidity, and wind speed data were obtained from the Hamilton A station (John C. Munro Hamilton International Airport - Climate ID: □1□31□4), based on proximity to the SCRF and availability of data.

GHD specified soil and design data based on the general design of the landfill, with consideration given to the following:

- Layer types (i.e., final cover, waste, landfill base) and thicknesses were entered as identified in Section □.1.11 of the D&O.
- Specific soil types were selected for each layer based on existing conditions and typical properties of these materials for landfill design (i.e., soil classification, saturated hydraulic conductivity).
- Side slopes and slope lengths based on the design conditions.
- Modeling was based on closure conditions, assuming a good stand of grass.

The HELP Model estimated the average annual infiltration through the final cover to be 0.2□2 m/yr per unit area for each of the model runs. No appreciable difference in infiltration rate was observed for the various modeling conditions, including side slope versus landfill plateau and existing approved versus expansion design. Note that the latter was anticipated, as the final cover design is the same for the existing approved design and the Preferred Landfill Footprint.

Ontario Regulation (O.Reg.) 232/□□, as amended (O.Reg. □□□/00) specifies landfill design requirements. Section 10 (4)2 states that *The infiltration rate through the final cover of the landfilling site must be greater than or equal to 0.15 m per year.* GHD has utilized an infiltration rate of 0.1□ m per year to represent a conservative estimate of CLS relative to the infiltration rate predicted by the HELP Model.

Contaminant Percentage in Waste

The mass of contaminant can be characterized in terms of the mass of waste and proportion of that mass which is the chemical of interest. GLL (1□□□) provided bulk analytic data measuring the mass of contaminants in waste for each of the sources of waste accepted at the Closed West Quarry Landfill. GLL (1□□□) also predicted the East Quarry Landfill waste stream per source. GHD calculated the predicted percentage of each contaminant in waste using a weighted average of the bulk analytic and waste stream contributions per waste source.

□a□ed on t□i□ eval□ation□G□D e□timated t□at □□loride and □admi□m re□re□ent 0□0334 and 0□00023 □er□ent o□t□e □a□te□re□□e□tivel□□

Dr□Den□it□o□□a□te

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T□e □□rrent a□□roved □ite □a□a□it□i□ □□□00□000 m^3 and t□e □ro□o□ed e□□an□ion re□re□ent□an additional 3□□□0□000 m^3□Note t□at t□e□e vol□me□re□re□ent □a□te onl□□i□e□□no □over or liner material□□G□D m□lti□lied t□e a□□roved and □ro□o□ed total vol□me□ □□t□e a□ove den□it□to e□timate t□e total ma□□o□□a□te □or ea□□ □□enario□G□D t□en □tili□ed t□e □ontaminant □er□enta□e val□e□to e□timate t□e total ma□□o□□□loride and □admi□m□

3. Modeling Results

□□□ Model Re□□lt□

A□noted in Se□tion 2□t□e land□ill □a□modeled □or t□o de□i□n □ondition□□t□e e□i□tin□ a□□roved de□i□n and t□e Pre□erred Land□ill Foot□rint de□i□n□Ea□□ de□i□n □a□modeled □□in□t□e Ro□e Model□CLS val□e□ □or □□loride and □admi□m □a□ □al□□lated □□in□t□e Ro□e Model□are □□ □ear□and □ □ear□□re□□e□tivel□□A□t□e □al□□lated val□e □or □admi□m i□le□□t□an t□e minim□m allo□a□le□t□e CLS □or □admi□m i□e□timated to □e 2□ □ear□□

T□e re□□lt□indi□ate t□at t□e Pre□erred Land□ill Foot□rint de□i□n e□□i□it□CLS val□e□t□at are □ell □elo□ GLL□□ e□timated ran□e o□200 to 300 □ear□in 1□□□□

4. Conclusions

T□e □ontaminatin□li□e □□an o□t□e land□ill □or t□e SCRF□□a□ed on o□□erved □□loride and □admi□m □on□entration□□i□a□□ro□imated a□ □0 to □0 □ear□□rom t□e □oint o□land□ill □lo□□re □nder t□e □□enario o□t□e □ro□o□ed e□□an□ion □nder t□e □re□erred alternative to rea□□ drin□in□ □ater □□alit□o□□e□tive□□

Existing Approved Landfill Design

Chloride

	Peak Average	Units	Comments
C_t	250	mg/L	Target concentration
C_t	0.25	kg/m^3	Target concentration
q_o	0.150	m/y	Average rate of infiltration
p	0.000334	-	Proportion of total waste mass that is contaminant
A_o	591,000	m^2	Unit area[2]
$V_{landfill}$	6,500,000	m^3	Volume of landfill
V_{cover}	0	m^3	Volume of cover
V_o	6,500,000	m^3	Volume of waste
C_o	2500	mg/L	Chloride concentration (peak average)
C_o	2.5	kg/m^3	Chloride concentration (peak average)
H_w	24.00	m	Maximum waste thickness
r_d	1,900	kg/m^3	Dry density of waste
M_o	###########	kg	
H_r	2.79	m	Reference height of leachate
λ	0.000	y^{-1}	
k	0.0538	y^{-1}	
k	0.0538	y^{-1}	
t	**42.81**	**years**	
	43.00		

Notes

1. The Rowe Model, as described in the 1995 publication, utilized the total area of the landfill.
2. Rate constants were not used in the CLS calculations for chloride.

Approved Capacity	6,500,000	m^3	EA - D&O - Detailed Impact Assessment Report, Section 1.2
Expansion Capacity	3,680,000	m^3	EA - D&O - Detailed Impact Assessment Report, Section 1.2
Cover Volume	591,000	m^2	EA - D&O - Detailed Impact Assessment Report, Section 1.2
	0.75	m	EA - D&O - Detailed Impact Assessment Report, Section 6.1.10
	443,250	m^3	Note: Cover not included in air space calculation, capacity is waste only
Waste Density	1,900	kg/m^3	EA - D&O - Detailed Impact Assessment Report, Section 6.1.3
Infiltration Rate	2,920.877	$m^3/ha/y$	From HELP Model
	292.0877	mm/ha/y	From HELP Model
	0.292088	m/ha/yr	
	150	mm/ha/y	O. Reg. 232/98, as amended
	0.15	m/ha/yr	
Chloride ODWS	250	mg/L	
Chloride proportior	0.000334		Calculated from bulk analysis data provided in "Taro East Quarry Environmental Assessment, Waste and Leachate Characterization Report", Gartner Lee, January 1995

Cadmium

	Peak Average	Units	Comments
C_t	0.00125	mg/L	Target concentration
C_t	0.00000125	kg/m^3	Target concentration
q_o	0.150	m/y	Average rate of infiltration
p	0.000002	-	Proportion of total waste mass that is contaminant
A_o	591,000	m^2	Unit area[2]
$V_{landfill}$	6,500,000	m^3	Volume of landfill
V_{cover}	0	m^3	Volume of cover
V_o	6,500,000	m^3	Volume of waste
C_o	0.003	mg/L	Chloride concentration (peak average)
C_o	0.000003	kg/m^3	Chloride concentration (peak average)
H_w	24	m	Maximum waste thickness
r_d	1,900	kg/m^3	Dry density of waste
M_o	###########	kg	
H_r	16306.46	m	Reference height of leachate
λ	0.125	y^{-1}	
k	0.1250	y^{-1}	
k	0.1250	y^{-1}	
t	**7.00**	**years**	
	25.00		

Target concentrations are quarter of ODWS, to represent worst case RUC for a health based objective

ODWS	0.005	mg/L	
RUC	0.00125	mg/L	
Cadmium proportic	2.34E-06		Calculated from bulk analysis data provided in "Taro East Quarry Environmental Assessment, Waste and Leachate Characterization Report", Gartner Lee, January 1995
Cadmium rate cons	0.125	y^{-1}	Lu et al, 1981, Leachate Production and Management from Municipal Landfill: Summary and Assessment, Land Disposal: Municipal Solid Waste - Proceedings of the Seventh Annual Research Symposium, EPA

Note that the measured/calculated concentration for Scenario 3 was 0. Concentration assumed to be 0.005 (i.e., half of detection limit)

Preferred Landfill Footprint

Chloride

	Peak Average	Units	Comments
C_t	250	mg/L	Target concentration
C_t	0.25	kg/m^3	Target concentration
q_o	0.150	m/y	Average rate of infiltration
p	0.000334	-	Proportion of total waste mass that is contaminant
A_o	591,000	m^2	Unit area[2]
$V_{landfill}$	10,180,000	m^3	Volume of landfill
V_{cover}	0	m^3	Volume of cover
V_o	10,180,000	m^3	Volume of waste
C_o	2500	mg/L	Chloride concentration (peak average)
C_o	2.5	kg/m^3	Chloride concentration (peak average)
H_w	26.25	m	Maximum waste thickness
r_d	1,900	kg/m^3	Dry density of waste
M_o	############	kg	
H_r	4.37	m	Reference height of leachate
λ	0.000	y^{-1}	
k	0.0343	y^{-1}	
k	0.0343	y^{-1}	
t	**67.05**	**years**	
	68.00		

Notes
1. The Rowe Model, as described in the 1995 publication, utilized the total area of the landfill.
2. Rate constants were not used in the CLS calculations for chloride.

Approved Capacity	6,500,000	m^3	EA - D&O - Detailed Impact Assessment Report, Section 1.2
Expansion Capacity	3,680,000	m^3	EA - D&O - Detailed Impact Assessment Report, Section 1.2
Cover Volume	591,000	m^2	EA - D&O - Detailed Impact Assessment Report, Section 1.2
	0.75	m	EA - D&O - Detailed Impact Assessment Report, Section 6.1.10
	443,250	m^3	Note: Cover not included in air space calculation, capacity is waste only
Waste Density	1,900	kg/m^3	EA - D&O - Detailed Impact Assessment Report, Section 6.1.3
Infiltration Rate	2,920.877	m^3/ha/y	From HELP Model
	292.08771	mm/ha/y	From HELP Model
	0.2920877	m/ha/yr	
	150	mm/ha/y	O. Reg. 232/98, as amended
	0.15	m/ha/yr	
Chloride ODWS	250	mg/L	
Chloride proportion	0.0003337		Calculated from bulk analysis data provided in "Taro East Quarry Environmental Assessment, Waste and Leachate Characterization Report", Gartner Lee, January 1995

Cadmium

	Peak Average	Units	Comments
C_t	0.00125	mg/L	Target concentration
C_t	0.00000125	kg/m^3	Target concentration
q_o	0.150	m/y	Average rate of infiltration
p	0.000002	-	Proportion of total waste mass that is contaminant
A_o	591,000	m^2	Unit area[2]
$V_{landfill}$	10,180,000	m^3	Volume of landfill
V_{cover}	0	m^3	Volume of cover
V_o	10,180,000	m^3	Volume of waste
C_o	0.003	mg/L	Chloride concentration (peak average)
C_o	0.000003	kg/m^3	Chloride concentration (peak average)
H_w	26.25	m	Maximum waste thickness
r_d	1,900	kg/m^3	Dry density of waste
M_o	############	kg	
H_r	25538.42	m	Reference height of leachate
λ	0.125	y^{-1}	
k	0.1250	y^{-1}	
k	0.1250	y^{-1}	
t	**7.00**	**years**	
	25.00		

Target concentrations are quarter of ODWS, to represent worst case RUC for a health based objective

ODWS	0.005	mg/L	
RUC	0.00125	mg/L	
Cadmium proportio	2.341E-06		Calculated from bulk analysis data provided in "Taro East Quarry Environmental Assessment, Waste and Leachate Characterization Report", Gartner Lee, January 1995
Cadmium rate const	0.125	y^{-1}	Lu et al, 1981, Leachate Production and Management from Municipal Landfill: Summary and Assessment, Land Disposal: Municipal Solid Waste - Proceedings of the Seventh Annual Research Symposium, EPA 600/9 81, pp. 1 17, 1981.

Note that the measured/calculated concentration for Scenario 3 was 0. Concentration assumed to be 0.005 (i.e., half of detection limit)

Appendix C

Calculation of Financial Assurance Requirements

Terrapure Environmental
Calculation of Financial Assurance in respect of
Operating Stoney Creek Regional Facility
As at : December 31, 2018
In accordance with Regulation 232/98

Prepared May 2019

Contingency Plan	$	13,025,886
Closure and Post-closure Costs	$	15,809,536
Total (As of Dec 2018)	$	28,835,421
Current Year FA (2019)	$	29,257,903

Summary of Projected Annual FA Amount to Closure

Year	Waste Added (tonnes)	Waste Deposited (tonnes)	Contingency	Incremental Post Close Reduction	FA as of Dec. 31st
2018		12,377,649	$ 13,025,886	$ 15,809,536	$ 28,835,421
2019	181,351	12,559,000	$ 13,216,734	$ 16,041,169	$ 29,257,903
2020	550,000	13,109,000	$ 13,795,539	$ 16,743,665	$ 30,539,203
2021	550,000	13,659,000	$ 14,374,343	$ 17,446,160	$ 31,820,503
2022	550,000	14,209,000	$ 14,953,147	$ 18,148,656	$ 33,101,803
2023	550,000	14,759,000	$ 15,531,952	$ 18,851,152	$ 34,383,103
2024	550,000	15,309,000	$ 16,110,756	$ 19,553,647	$ 35,664,403
2025	550,000	15,859,000	$ 16,689,560	$ 20,256,143	$ 36,945,703
2026	550,000	16,409,000	$ 17,268,365	$ 20,958,639	$ 38,227,003
2027	550,000	16,959,000	$ 17,847,169	$ 21,661,134	$ 39,508,303
2028	550,000	17,509,000	$ 18,425,973	$ 22,363,630	$ 40,789,603
2029	550,000	18,059,000	$ 19,004,778	$ 23,066,126	$ 42,070,903
2030	550,000	18,609,000	$ 19,583,582	$ 23,768,621	$ 43,352,203
2031	550,000	19,159,000	$ 20,162,386	$ 24,471,117	$ 44,633,503
2032	183,000	19,342,000	$ 20,354,970	$ 24,704,856	$ 45,059,827
2033					
2034					
2035					

Terrapure Environmental
Calculation of Contingency Plan Financial Assurance in respect of
Operating Stoney Creek Regional Facility
As at : December 31, 2018
In accordance with Section 17(3) of Regulation 232/98

$F = \$0.50 \times W \times (I_2 / I_1)$

$F =$ Amount of financial assurance
$W =$ the number of tonnes of waste that have been deposited in the landfilling site at December 31, 2018
$I_1 =$ 50.6

$I_2 =$ 106.5

W		12,377,649
I_2		106.5
I_1		50.6
F =	**$**	**13,025,885.56**

Terrapure Environmental
Calculation of Financial Assurance for Closure and Post-closure Costs in respect of Operating Stoney Creek Regional Facility
As at : December 31, 2018
In accordance with Section 18(7) of Regulation 232/98

$$A = B(C \div D)$$

A = the minimum amount of financial assurance to be provided.
B = the total amount of financial assurance
C = the total amount of waste deposited at the site
D = the total amount of waste that will be deposited at the site

C		12,377,649
D		19,342,000
B	$	24,704,856
A	**$**	**15,809,536**

PLANNED CLOSURE & POST CLOSURE MAINTENANCE OF LANDFILL AFTER YEAR 2032

Max capacity	19,342,000	
Deposited to date (end 2018)	12,377,649	
Capacity remaining	6,964,351	tonnes
Current Year	2019	
Years until Post-Closure Costs	13	
1st Year of Closure	2033	
Contaminating Lifespan =	68	years
Interest Factors: Inflation =	2.14%	
Discount rate 1-30 years post closure =	2.77%	
Discount rate after 30 years =	5.14%	

$67,253	IN 2033 DOLLARS FOR PLANNED CLOSURE - CAPITAL
$24,637,603	IN 2033 DOLLARS FOR PLANNED POST CLOSURE - OPERATING
$24,704,856	***TOTAL NEEDED IN 2033 FOR PLANNED CLOSURE & POST CLOSURE***

Planned Closure Fund

Capital Works

Calendar Year	Closure Year	General/ Miscellaneous		Capital	PV(2033)
2019		**50,000**		**50,000**	
2019	0	-		-	-
2020	0	-		-	-
2021	0	-		-	-
2022	0	-		-	-
2023	0	-		-	-
2024	0	-		-	-
2025	0	-		-	-
2026	0	-		-	-
2027	0	-		-	-
2028	0	-		-	-
2029	0	-		-	-
2030	0	-		-	-
2031	0	-		-	-
2032	0	-		-	-
2033	0	67,253		67,253	67,253
2034	1	-		-	-
2035	2	-		-	-
2036	3	-		-	-
2037	4	-		-	-
2038	5	-		-	-
			Total Capital	PV(2033)	$67,253

Planned Post Closure Fund

Annual Operating Costs

Calendar Year	Operating Year	Site Staff	Leachate Collection System	Hydraulic Control Layer	General Site Works	Environmental Monitoring of Control Systems	Reporting		SUM	PV(2033)
2019	<6 years	**31,000**	**309,420**	**50,900**	**7,500**	**86,000**	**45,000**	**-**	**529,820**	**-**
2019	6-68 yrs	**31,000**	**309,420**	**50,900**	**7,500**	**43,000**	**22,500**	**-**	**464,320**	**-**
2019	0	-	-	-	-	-	-	-	-	-
2020	0	-	-	-	-	-	-	-	-	-
2021	0	-	-	-	-	-	-	-	-	-
2022	0	-	-	-	-	-	-	-	-	-
2023	0	-	-	-	-	-	-	-	-	-
2024	0	-	-	-	-	-	-	-	-	-
2025	0	-	-	-	-	-	-	-	-	-
2026	0	-	-	-	-	-	-	-	-	-
2027	0	-	-	-	-	-	-	-	-	-
2028	0	-	-	-	-	-	-	-	-	-
2029	0	-	-	-	-	-	-	-	-	-
2030	0	-	-	-	-	-	-	-	-	-
2031	0	-	-	-	-	-	-	-	-	-
2032	0	-	-	-	-	-	-	-	-	-
2033	0	41,697	425,095	69,929	10,304	118,151	61,823	-	726,998	726,998
2034	1	42,589	434,192	71,425	10,524	120,679	63,146	-	742,556	722,542
2035	2	43,501	443,484	72,954	10,750	123,262	64,497	-	758,447	718,112
2036	3	44,432	452,974	74,515	10,980	125,899	65,878	-	774,678	713,710
2037	4	45,382	462,668	76,110	11,215	128,594	67,287	-	791,256	709,335
2038	5	46,354	472,569	77,738	11,455	131,346	68,727	-	808,189	704,987
2039	6	47,346	482,682	79,402	11,700	67,078	35,099	-	723,307	613,938
2040	7	48,359	493,012	81,101	11,950	68,514	35,850	-	738,785	610,174
2041	8	49,394	503,562	82,837	12,206	69,980	36,617	-	754,595	606,434
2042	9	50,451	514,338	84,609	12,467	71,477	37,401	-	770,744	602,716
2043	10	51,530	525,345	86,420	12,734	73,007	38,201	-	787,238	599,021
2044	11	52,633	536,588	88,269	13,006	74,569	39,019	-	804,084	595,349
2045	12	53,759	548,071	90,158	13,285	76,165	39,854	-	821,292	591,700
2046	13	54,910	559,799	92,088	13,569	77,795	40,707	-	838,867	588,072
2047	14	56,085	571,779	94,058	13,859	79,460	41,578	-	856,819	584,467
2048	15	57,285	584,015	96,071	14,156	81,160	42,468	-	875,155	580,884
2049	16	58,511	596,513	98,127	14,459	82,897	43,376	-	893,884	577,323
2050	17	59,763	609,278	100,227	14,768	84,671	44,305	-	913,013	573,784
2051	18	61,042	622,317	102,372	15,084	86,483	45,253	-	932,551	570,267
2052	19	62,348	635,634	104,563	15,407	88,334	46,221	-	952,508	566,771
2053	20	63,683	649,237	106,800	15,737	90,224	47,210	-	972,891	563,297
2054	21	65,045	663,131	109,086	16,074	92,155	48,221	-	993,711	559,844
2055	22	66,437	677,322	111,420	16,418	94,127	49,253	-	1,014,977	556,412
2056	23	67,859	691,816	113,805	16,769	96,141	50,307	-	1,036,697	553,001
2057	24	69,311	706,621	116,240	17,128	98,199	51,383	-	1,058,882	549,611
2058	25	70,795	721,743	118,728	17,494	100,300	52,483	-	1,081,543	546,242
2059	26	72,310	737,188	121,268	17,869	102,447	53,606	-	1,104,688	542,893
2060	27	73,857	752,964	123,864	18,251	104,639	54,753	-	1,128,328	539,565
2061	28	75,438	769,077	126,514	18,642	106,878	55,925	-	1,152,474	536,257
2062	29	77,052	785,536	129,222	19,041	109,166	57,122	-	1,177,137	532,970
2063	30	78,701	802,346	131,987	19,448	111,502	58,344	-	1,202,328	529,703
2064	31	80,385	819,516	134,812	19,864	113,888	59,593	-	1,228,058	259,664
2065	32	82,105	837,054	137,696	20,289	116,325	60,868	-	1,254,338	252,255
2066	33	83,862	854,967	140,643	20,723	118,814	62,170	-	1,281,181	245,057
2067	34	85,657	873,263	143,653	21,167	121,357	63,501	-	1,308,598	238,065
2068	35	87,490	891,951	146,727	21,620	123,954	64,860	-	1,336,602	231,272
2069	36	89,362	911,039	149,867	22,083	126,607	66,248	-	1,365,205	224,673
2070	37	91,275	930,535	153,074	22,555	129,316	67,665	-	1,394,421	218,262
2071	38	93,228	950,449	156,350	23,038	132,084	69,113	-	1,424,261	212,035
2072	39	95,223	970,788	159,696	23,531	134,910	70,593	-	1,454,741	205,985
2073	40	97,261	991,563	163,113	24,034	137,797	72,103	-	1,485,872	200,107
2074	41	99,342	1,012,782	166,604	24,549	140,746	73,646	-	1,517,670	194,397
2075	42	101,468	1,034,456	170,169	25,074	143,758	75,222	-	1,550,148	188,851
2076	43	103,640	1,056,593	173,811	25,611	146,834	76,832	-	1,583,321	183,462
2077	44	105,857	1,079,204	177,531	26,159	149,977	78,476	-	1,617,204	178,227
2078	45	108,123	1,102,299	181,330	26,719	153,186	80,156	-	1,651,812	173,142
2079	46	110,437	1,125,889	185,210	27,290	156,464	81,871	-	1,687,161	168,201
2080	47	112,800	1,149,983	189,174	27,874	159,813	83,623	-	1,723,266	163,402
2081	48	115,214	1,174,592	193,222	28,471	163,233	85,412	-	1,760,144	158,740
2082	49	117,679	1,199,729	197,357	29,080	166,726	87,240	-	1,797,811	154,210
2083	50	120,198	1,225,403	201,580	29,702	170,294	89,107	-	1,836,284	149,810
2084	51	122,770	1,251,626	205,894	30,338	173,938	91,014	-	1,875,581	145,536

2085	52	125,397	1,278,411	210,300	30,987	177,660	92,962	-	1,915,718	141,383
2086	53	128,081	1,305,769	214,801	31,650	181,462	94,951	-	1,956,715	137,349
2087	54	130,822	1,333,713	219,398	32,328	185,346	96,983	-	1,998,588	133,430
2088	55	133,621	1,362,254	224,093	33,020	189,312	99,059	-	2,041,358	129,623
2089	56	136,481	1,391,406	228,888	33,726	193,363	101,178	-	2,085,043	125,924
2090	57	139,401	1,421,182	233,786	34,448	197,501	103,344	-	2,129,663	122,331
2091	58	142,385	1,451,596	238,789	35,185	201,728	105,555	-	2,175,238	118,840
2092	59	145,432	1,482,660	243,900	35,938	206,045	107,814	-	2,221,788	115,450
2093	60	148,544	1,514,389	249,119	36,707	210,454	110,121	-	2,269,334	112,155
2094	61	151,723	1,546,797	254,450	37,493	214,958	112,478	-	2,317,898	108,955
2095	62	154,970	1,579,898	259,895	38,295	219,558	114,885	-	2,367,501	105,846
2096	63	158,286	1,613,708	265,457	39,115	224,256	117,344	-	2,418,166	102,826
2097	64	161,673	1,648,241	271,138	39,952	229,056	119,855	-	2,469,914	99,892
2098	65	165,133	1,683,514	276,940	40,807	233,957	122,420	-	2,522,771	97,042
2099	66	168,667	1,719,541	282,867	41,680	238,964	125,039	-	2,576,758	94,273
2100	67	172,276	1,756,339	288,920	42,572	244,078	127,715	-	2,631,900	91,583
2101	68	175,963	1,793,925	295,103	43,483	249,301	130,448	-	2,688,223	88,970
2102	69	-	-	-	-	-	-	-	-	-
2103	70	-	-	-	-	-	-	-	-	-
2104	71	-	-	-	-	-	-	-	-	-
2105	72	-	-	-	-	-	-	-	-	-
2106	73	-	-	-	-	-	-	-	-	-
2107	74	-	-	-	-	-	-	-	-	-
2108	75	-	-	-	-	-	-	-	-	-
2109	76	-	-	-	-	-	-	-	-	-
2110	77	-	-	-	-	-	-	-	-	-
2111	78	-	-	-	-	-	-	-	-	-
2112	79	-	-	-	-	-	-	-	-	-
2113	80	-	-	-	-	-	-	-	-	-
2114	81	-	-	-	-	-	-	-	-	-
2115	82	-	-	-	-	-	-	-	-	-
2116	83	-	-	-	-	-	-	-	-	-
2117	84	-	-	-	-	-	-	-	-	-
2118	85	-	-	-	-	-	-	-	-	-
2119	86	-	-	-	-	-	-	-	-	-
2120	87	-	-	-	-	-	-	-	-	-
2121	88	-	-	-	-	-	-	-	-	-
2122	89	-	-	-	-	-	-	-	-	-
2123	90	-	-	-	-	-	-	-	-	-
2124	91	-	-	-	-	-	-	-	-	-
2125	92	-	-	-	-	-	-	-	-	-
2126	93	-	-	-	-	-	-	-	-	-
2127	94	-	-	-	-	-	-	-	-	-
2128	95	-	-	-	-	-	-	-	-	-
2129	96	-	-	-	-	-	-	-	-	-
2130	97	-	-	-	-	-	-	-	-	-
2131	98	-	-	-	-	-	-	-	-	-
2132	99	-	-	-	-	-	-	-	-	-
2133	100	-	-	-	-	-	-	-	-	-
					Total Annual Operating		PV(2033)			$24,637,603

100 York Boulevard
Suite 300
Richmond Hill, ON
L4B 1J8

Appendix D

2021 3R Review

2021 3R Review

3Rs Review

The Environmental Assessment Approval for the Stoney Creek Regional Facility, issued on July 16, 1996, includes conditions relating to the development and operation of the landfill. Condition 3.1 require that:

"Every five years after the site becomes operational, the proponent shall assess the waste residues received from Inter-Co and waste received from other sources to determine whether any 3R's technologies could be used economically to further divert the residues from Landfill. The proponent will present the findings of the assessment to the CLC."

This review is intended to meet the requirements of the condition. This review was completed in early 2021 under the former ownership of Terrapure Environmental. The original ownership of the Company changed from Terrapure in October of 2021 to GFL Environmental.

Contributing to a cleaner environment is what the people at Terrapure do every day for our customers, as well as in our own operations. In addition to helping customers reduce their environmental footprint, Terrapure is committed to minimizing the impact of its own operations. The company strives to be one of the most progressive in environmental stewardship through innovation and responsible management.

Terrapure is in the Sustainability Business

Terrapure Environmental is a leading Canadian provider of innovative, cost-effective environmental services and recycling solution that help address industry's most complex environmental challenges. Headquartered in Burlington, ON, Terrapure employs 1,000 people and operates an integrated network of more than 30 government-regulated facilities from coast to coast. With an unwavering focus on health and safety excellence, the company provides services that minimize waste and maximize the recovery or recycling of valuable industrial by-products through its facility network and on customer sites. This includes a used lubricating oil re-refinery in North Vancouver, BC; Canada's largest lead-acid battery recycling facility in Ville Ste-Catherine, QC; an engineered non-hazardous industrial waste landfill in Stoney Creek, ON; as well as operations that enhance the environmental sustainability of industry sectors, including automotive, chemical, and petro-chemical, manufacturing, marine, mining, municipal, pulp and paper and transportation.

Terrapure Environmental Stoney Creek Regional Facility

Terrapure provides industrial waste management, recycling, and other environmental services to Eastern Canadian markets, through an integrated network of high-quality facilities including:

- Industrial solid waste pre-treatment facilities
- Industrial waste transfer and processing facilities
- A fleet of specialized vehicles and equipment for waste transport and onsite handling

- An Emergency Response service
- Stoney Creek Regional Facility

3 Rs Assessment

Since the last 3Rs report in 2016, the landfill has handled an average of approximately 372,000 metric tonnes of waste per year.

Since the time of its original approval, the majority of the wastes received at the Terrapure Stoney Creek Regional Facility have been materials that have exhausted all recycling or recovery options and cannot otherwise be utilized. The site receives solid non-hazardous industrial waste which is low in organic content. The majority of these material are contaminated soils and steel-making wastes containing low levels of metals in a form that does not lend itself to recovery.

Most of the steel making wastes come from ArcelorMittal Dofasco (AMD) where significant effort tis expended on an ongoing basis to find ways to divert the materials from disposal. AMD reports that:

> *"Since 2004 the Company has implemented an on-site diversion system for oxide dusts, which would otherwise have been disposed of in the Stoney Creek Landfill (Terrapure SCRF), from landfill and used them in the sintering and cement manufacturing markets. Since 2001 all zinc-rich dust from AMD's Electric Arc Furnace has been recycled at a metals recovery facility. A project to recycle all remaining dusts from AMD's steelmaking operations was initiated in 2004 to redirect from landfill approximately 4,000 tonnes of dust to the Electric Arc Furnace and continues today. All slag from AMD's blast furnace and steelmaking operations have been recycled since 2004. The slag was used in the manufacture of cement, cinder blocks, road aggregate and asphalt, as well as other substitutes for natural aggregate."*

This is an indication of the efforts that large companies such as ArcelorMittal Dofasco make in diverting materials from landfill and that landfill is typically only chosen when other options are not available.

In a similar manner, in-situ stabilization techniques are being applied to various site remediate locations where Brownfield legislation issued by the Ministry of Environment, Conservation and Parks allows low levels of contaminants to remain at the site when there will be limited after use of the site, thus reducing the amount of material that needs to be disposed of in a landfill such as the Terrapure SCRF.

Other waste streams such as foundry sands are wholly recycled. As Terrapure continues to develop its businesses it will continue to explore ways to recycle materials rather than landfilling them as will the customers that the Company currently services.

Additionally, the Terrapure facilities that send materials to the Stoney Creek Regional Facility are all focused first and foremost on minimizing the amount of material ultimately requiring disposal. Examples of this are as follows:

239 Lottridge Street

At the 239 Lottridge Street location collecting and recycling paint began in the early 1990's and in 1994 were recognized by the Recycling Council of Ontario for the paint recycling program.

The paint recycling process involves reworking and repackaging distressed paint products and unused paint collected through Municipal, Hazardous & Special Waste (MHSW) collection depots and events throughout Ontario.

The facility currently produces eight colours of a recycled latex paint product as well as three colours of an alkyd product.

The Facility is a registered processor (recycler) of paint under Resource Productivity & Recovery Association (RPRA), working closely with Product Care Association (PCA) to ensure that paint collected in Ontario are handled correctly under the Ontario Regulation 449/21; Hazardous & Special Products Regulation.

In 2021 the Lottridge Street Facility recycled over 365,000 litres of latex and alkyd paint that was collected throughout Ontario".

Battery Recycling – Imperial Street

Call2Recycle collected and recycled 4.1 million kilograms of used consumer batteries, the largest volume of batteries ever diverted from landfills in a single year. Call2Recycle owes much of its success to its strong relationships with program members and collection partners, who continued collecting batteries despite store closures, staff shortages and other pandemic challenges. Together, we all share in Call2Recycle's achievement of diverting more than 26 million batteries from landfills in Canada.

Other material accepted at the SCRF comes from a variety of customers and businesses that divert at their own operations and have implemented their own diversion and recovery system. Terrapure has Standard Operating Procedures (SOP) that addresses the screening and verification of material that is received on-site to ensure the materials received on-site match the Generator's Waste Profile, and that the Generator of the material has made the determination that the material cannot reasonably be diverted or reintroduced into the circular economy from both an economical and feasible perspective. Diversion at the source of the generated residual material from generators and customers considers both the economic viability of diversion as well as ensuring that there is a viable end market for the diverted material. It is not appropriate or reasonable for Terrapure to develop a diversion plan at the site given that the volumes of material that could be potentially diverted are minimal and lack an established and financially viable end-market. Regardless, in the spirit of the province's new Waste Free Ontario Act (WFOA) that sets goals to increase diversion in Ontario, Terrapure reviews the potential for on-site diversion (viability and financial feasibility of diversion for the types of materials received at the site currently). Terrapure also works with its customers to continue to ensure diversion at the source of the generated material takes place. It should be noted that the WFOA represents a major shift in how the Province of Ontario will manage residual material and attempt to move the province to an aspirational goal of “zero waste”. Given that the WFOA is in its infancy, Terrapure will continue to monitor the introduction of Regulations that may assist in creating more financially viable diversion tools as well as the establishment of viable end-markets for the diverted material.

Irrespective of the above, Terrapure continues to explore means for diversion off-site within its own facilities as well and continue to evaluate means for recovering and diverting materials from disposal. Most recently, Terrapure has been exploring further opportunities for diversion of a steel making by-product currently being received at the SCRF for recovery of iron. Economic viability will continue to be a significant to challenge for 100 percent diversion of this waste stream.