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The Regional Municipality of Durham Report

To:	Works Committee
From:	Acting Commissioner of Works
Report:	#2023-WR-7
Date:	October 4, 2023

Subject:

Update on the Regional Landfill Mining Program Pilot

Recommendations:

That the Works Committee recommends to Regional Council that this report be received for information.

Report:

1. Purpose

1.1 The purpose of this report is to inform Regional Municipality of Durham (Region) Council of the intent to defer further consideration of the landfill mining program as a mitigative measure to reduce methane emissions from the Region's landfill sites until the conclusion of the biocover pilot that is currently underway at the Oshawa Landfill.

2. Background

2.1 The decomposition of organic material generates Landfill Gas (LFG). LFG is composed of 50 percent methane (CH_4), 50 percent carbon dioxide (CO_2) and a small amount of non-methane organic compounds (NMOCs). According to the United States Environmental Protection Agency (U.S. EPA), methane is considered a 28 to 36 times more potent greenhouse gas (GHG) than carbon dioxide over a 100-year period. This ratio measurement indicates the global

warming potential of different GHGs compared to that of carbon dioxide over a specified time frame.

2.2 LFG generated at the Region's seven landfill sites passively vents from the landfill surface to the atmosphere. There are currently no engineered controls in place to treat methane emissions. Traditional treatment can involve the extraction of LFG through a series of vertical wells or horizontal collection trenches connected to a blower/flare system where the methane component of the LFG is captured. From this point, the gas can be flared or upgraded to a renewable natural gas.

2.3 The Region undertook an LFG Production and Collection Feasibility Study at the Brock landfill site in 2009. The report from the study indicated that given the small size of the landfill and the low LFG production, operating a collection and control system for effective flaring/combustion would be difficult and operation would be intermittent. Assuming the same site constraints exist at all the Region's landfill sites due to similar or more challenging site characteristics and site histories, staff continue investigating alternative methods and technologies to mitigate LFG emissions, including monitoring evolutions in flaring technology, landfill mining and biocover applications.

3. Landfill Mining

3.1 Landfill mining involves excavating and screening waste and recyclable material from the soil contained in the landfill. For older, smaller landfill sites where waste was minimally compacted during disposal, buried waste can account for up to 40 percent to 50 percent by volume of the landfill airspace, with the remaining volume occupied by daily, interim, and final cover soils. Typically, screened waste from the landfill is placed back into the landfill and compacted to a smaller volume to reclaim disposal capacity; however, in keeping with the Region's primary objective to reduce methane emissions from its landfill sites, the waste screened from the Region's landfill mining operation in 2019 at the Blackstock Landfill site in the Township of Scugog was transported off-site to a transfer station for mixing with curbside waste prior to processing at the Durham York Energy Centre (DYEC). The non-combustible fraction of the screened landfill waste was transferred to another landfill for disposal. Removal of the screened waste eliminates the source of the methane generation from the landfill and lowers the methane emission rate.

3.2 Excavation work and waste screening were completed on January 24, 2019, at the Blackstock Landfill. Lessons learned from this project informed the preliminary investigative work and budgeting for a potential landfill mining project at other Regional landfill sites. The Scott Landfill site located in the Township of Uxbridge was identified as the next preferred site for a potential landfill mining project.

3.3 This report is a follow-up to the Works Committee's request to provide periodic updates on the assessment work being undertaken.

4. Biocover Applications

4.1 A biocover is an enhanced natural landfill cap system designed to increase the methane oxidation rate that naturally occurs in soil landfill covers. The final cover at older landfill sites typically consists of layers of soil and topsoil. A biocover consists of a layer of gravel or other inert material overlain by a mixed layer of compost and sand. The gravel layer facilitates the flow of landfill gas to the sand/compost layer, where naturally occurring bacteria in the soil/compost layer oxidize methane at a much higher rate than within a comparable soil layer. The bacteria convert methane into carbon dioxide, which has significantly less impact as a greenhouse gas. Typically, biocover systems would be placed in sections over areas of the landfill with the highest rates of methane emissions at the surface.

4.2 Biocover systems are an emerging technology within the waste management industry. As they are biologically active systems, site-specific considerations related to climate (rainfall, temperature, etc.) are essential in assessing potential effectiveness.

4.3 Environment and Climate Change Canada has been seeking input from interested parties on the development of new federal regulations under the Canadian Environmental Protection Act (CEPA) to reduce landfill methane emissions. According to Federal guidelines, biocover is identified as a methane emission control approach. However, the Region-owned closed landfill sites will not be captured under the proposed regulations.

5. Previous Reports and Decisions

5.1 The biocover pilot at the Oshawa landfill site was identified as a key initiative to reduce corporate GHG emissions in Report #2021-A-3 Section 4.1 d.

5.2 An update on the Blackstock landfill mining pilot project was received by Council on February 14, 2020 (Report #2020-INFO-9).

6. Scott Landfill Site

6.1 The Scott Landfill is located on Part Lot 24, Concession 5, near the intersection of Zephyr Road and Concession Road 6, in the Township of Uxbridge. The site was operated by the Township of Scott from about 1965 to 1973. The Region assumed operation of the site in 1974 under an Environmental Compliance Approval (ECA) Number A3900801. The site reached its maximum capacity in 1995 and was closed. The placement and grading of a final cover with topsoil and seeding was completed in 1996.

6.2 The initial ECA permitted the use and operation of a four-acre landfill site for the disposal of domestic waste and non-hazardous industrial waste from agricultural operations. The Region currently owns this section of the site. The Region obtained approval in 1985 to extend the waste footprint to the north by 2.3 acres through an amendment to the ECA. The northern section of the Landfill is privately owned.

6.3 The estimated methane emissions from the Scott Landfill site for 2021 is 1,211 tonnes (t) reported as CO_2 equivalents, with a slight decrease for each subsequent year as the waste in the landfill further degrades. The combined reported emissions for 2020 from the Region's landfill sites are 43,100t CO_2e or 25 percent of the Region's corporate total GHG emissions.

6.4 Since groundwater monitoring began at the site in 1986, selected constituent concentrations within the groundwater at the monitoring wells have fluctuated or been stable, with no apparent increasing or decreasing trends and no significant concerns noted with the overall landfill condition.

7. Preliminary Sub-surface Investigations – Scott Landfill

7.1 In December 2019 and May 2020, sub-surface investigations involving a geophysical survey, shallow test pits, and borehole drilling were conducted at the Scott Landfill site to evaluate the vertical and horizontal extent of the waste and waste composition. The study area was limited to the southern section of the Landfill owned by the Region. Access to the northern section of the Landfill was not available at the time of the study.

7.2 Based on a geophysical survey and 16 test pits, the landfill cover was observed to range in thickness from 0.3 metres (m) to 1.9 m with an average thickness of 1 m over an estimated surface area of 12,000 m^2 (2.97 acres). The thickness of the waste mound was inferred from the findings of five boreholes advanced in the study area. The thickness of the waste varied from 3.1 m to 10.3 m, with an estimated average of 5.7 m. The estimated volume of the Region-owned section of the Landfill is 68,400 m^3.

7.3 Assuming an area of 2.3 acres (9,300 m^2) based on aerial imagery and an average waste thickness of 5.7 m, consistent with the southern portion, the landfill volume of the northern section of the site would be approximately 9,964 tonnes (53,000 m^3).

7.4 The information above would correspond to a total landfill airspace volume of 121,400 m^3. Based on similar site characteristics, with 40 percent of the volume containing waste and a waste density of 0.47 tonnes per cubic metre, the total estimated amount of waste at the Scott Landfill is 22,823 tonnes. For comparison purposes, the total amount of waste mined from the Blackstock Landfill was 4,796 tonnes and required 286 trips using standard roll-off containers to transport the waste to the transfer station.

8. Cost Estimates

8.1 Based on final costing from the Blackstock Landfill mining project and estimated waste tonnages as described in Section 7, the preliminary estimated cost for landfill mining at the Scott Landfill site, including consulting fees, preliminary site work, excavation and screening, site restoration and grading, and haulage and disposal of the screened waste (overs) from the Scott Landfill site to an engineered landfill site is approximately $6.9 million. The cost estimates do not include costs associated with purchasing the northern section of the waste footprint or costs related to access rights to that property. Excavated waste from the Blackstock Landfill was sent to DYEC for processing; however, there is limited capacity at the DYEC, which will result in additional disposal costs for any future landfill mining projects.

Table 1 Estimated Costs

ITEMS	COST
General Items: Bonds, insurance, Soil Erosion Plans, Health and Safety Plans, etc.	$361,000
Site Preparation Items: Clearing, well decommissioning, relocation of services	$27,000
Earthwork Items: Excavation, screening and materials management	$2,663,000
Haulage and Disposal	$2,739,000
Site Restoration Items: Topsoil supply and application, hydroseeding, erosion controls	$360,000
Consulting: Work Plan, ECA amendment application, oversight during screening operations	$400,000
Contingency	$350,000
Total cost	**$6,900,000**

9. Biocover Systems

9.1 In conventional landfill soil covers, methane and oxygen may appear at the same depth due to the natural production of methane from the waste and diffusion of oxygen from ambient air. At this depth and under certain environmental conditions, a suitable habitat is established for methanotrophic bacteria present in the soil to oxidize methane into carbon dioxide before the gas passively vents into the atmosphere. U.S. EPA has adopted a default value of 10 percent for methane oxidation for conventional soil/clay landfill covers.

9.2 In recent years, laboratory-scale and pilot-scale studies have been conducted to assess methane oxidation rates within layers of various organic materials placed over a methane source. The studies indicate that alternative organic materials used in place of traditional clay/soil landfill covers generate significantly higher methane oxidation rates.

9.3 Construction of one ‘biofilter’ and one ‘biowindow’ at the Oshawa Landfill site was completed during Q2/Q3 2023. With a biofilter, the gravel and compost layers are placed in a rectangular open-top structure, and the gas is conveyed to the structure through piping from three gas wells. A biowindow is constructed by removing a small section of the existing landfill cover and replacing it with gravel and compost/sand layers. With a biowindow, methane is oxidized as it migrates from the waste through the biocover layers. The monitoring period for the pilot period is scheduled for 18 months. Methane measurements at various intervals will be compared to baseline methane data to assess the performance of the pilot-scale biocover. The primary objectives of this pilot are to identify the methane oxidizing material and site-specific environmental conditions that provide and sustain the highest possible oxidation rates of methane gas passively venting from the site.

9.4 Any full-scale biocover system at a Regional site would require preliminary methane monitoring, construction of multiple biofilters or biowindows, retaining a consultant for engineering, permitting, construction oversight, and ongoing monitoring. The required sizing of the systems will be assessed following the completion of the pilot to generate specific cost estimates, but initial estimates indicate increased cost effectiveness, especially at larger sites.

9.5 The application of biocover systems presents opportunities to reduce methane emissions from closed landfill sites using a naturally occurring biological process without disturbing in-place waste, using repurposed materials such as compost and implementing a viable low-cost alternative to mechanical landfill gas extraction systems that may not operate efficiently at the Region’s older closed landfill sites.

10. Next Steps

10.1 Following the conclusion of the biocover pilot monitoring period, further evaluations to assess the feasibility and effectiveness of larger scale applications will be conducted. This evaluation will assist in the determination of suitable applications to other landfill sites.

11. Relationship to Strategic Plan

11.1 This report aligns with and addresses the following strategic goals and priorities in the Durham Region Strategic Plan:

- Environmental Sustainability Goal 1.4: Demonstrating leadership in sustainability and addressing climate change.

12. Conclusion

12.1 Based on the preliminary sub-surface investigations at the Scott Landfill, the estimated amount of waste is approximately 22,800 tonnes.

12.2 The estimated total cost to complete mining is $6,900,000. This estimate assumes that all screened waste from the site would have to be hauled for disposal at an engineered landfill.

12.3 With biocover applications, the waste remains in place and is not disturbed; the reduction in methane emissions is achieved through the oxidation of methane through natural, biological processes as the landfill gas passes through the biocover systems placed on the landfill surface.

12.4 The application of biocover systems will present opportunities to reduce methane emissions without excavation and screening of the waste for disposal/processing off-site and provide a viable non-intrusive alternative to mechanical landfill gas extraction systems that may not operate efficiently at the Region’s landfill sites.

12.5 Given the ongoing emergence of new technologies and changing regulatory framework within the sector, staff will defer the implementation of further landfill mining projects until the completion of the Oshawa biocover pilot.

12.6 Staff will continue to monitor and assess other emerging approaches to LFG monitoring and control.

12.7 This report has been reviewed by the Finance Department.

12.8 For additional information, please contact Andrew Evans, Director, Waste Management Services, at 905-668-7711 extension 4102.

Respectfully submitted,

Original signed by:

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Recommended for Presentation to Committee

Original signed by:

Elaine C. Baxter-Trahair
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