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CITY OF VANCOUVER

ADMINISTRATIVE REPORT

Report Date:	November 9, 2009
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RTS No.:	07467
VanRIMS No.:	08-2000-20
Meeting Date:	November 17, 2009

TO: Vancouver City Council

FROM: General Manager of Engineering Services

SUBJECT: Landfill Gas Emissions Related Studies at the Vancouver Landfill

RECOMMENDATION

A. THAT Council approve grants to the following institutions for completion of the following projects at the Vancouver Landfill ("Landfill") with funding from the 2009 through 2011 annual Landfill Gas Operating Budgets with costs allocated to the users of the Landfill:

   i. Landfill Gas Generation and Emissions Study in cooperation with the University of British Columbia at an annual cost of $25,000 for two years (2009-2010); and

   ii. Landfill Temperatures and Surface Emissions Monitoring Study in cooperation with California Polytechnic State University at an annual cost of $25,000 for three years (2009-2011).

B. THAT the Director of Legal Services be authorized to prepare, execute and deliver on behalf of the City the grant agreements for the studies and projects, and all other legal documents required to implement Recommendation A.

C. THAT all such legal documents be on terms and conditions satisfactory to the General Manager of Engineering Services and the Director of Legal Services.

D. THAT no legal rights or obligations will be created by Council's adoption of Recommendations A to C above unless and until such legal documents are executed and delivered by the Director of Legal Services.

GENERAL MANAGER'S COMMENTS

The General Manager of Engineering Services RECOMMENDS A to D.

COUNCIL POLICY

Consulting Agreement
Consulting services contracts exceeding $30,000 require Council contract award approval and execution by the Director of Legal Services.

Grant Funding
Approval by Council of money grants requires eight affirmative votes.

Reduction of Greenhouse Gas Emissions
On December 2, 2003 Council adopted the Corporate Climate Change Action Plan as recommended by the Cool Vancouver Task Force, which aims to reduce the City's corporate greenhouse gas ("GHG") emissions to 20% below 1990 levels by 2010.

In March 2005, Council approved the Community Climate Change Action Plan to reduce GHG emissions in the community to 6% below 1990 levels by 2012.

In March 2007, Council passed a motion directing staff to begin planning for significant, long-range GHG reductions with the eventual goal of becoming a carbon-neutral city.

In July 2007, Council adopted targets to reduce Community GHG emissions to 33% below current levels by 2020 and 80% below current levels by 2050.

In September 2007, Council received the 2007 Climate Protection Progress Report that stated, 'the success to date in reducing corporate GHG emissions to 5% below 1990 levels can be largely attributed to comprehensive energy retrofits of existing facilities and the implementation of the Landfill Gas Recovery System.' And, in order to meet the 2012 community emissions target, 'the City must proceed with the planned, multi-phase expansion of the Landfill Gas Recovery System.'

In February 2009, Mayor Gregor Robertson launched the Greenest City initiative, with a goal to map out how to earn the greenest city title by 2020. A Greenest City Quick Start report was published in the spring, and on October 20th, the Mayor introduced the Action Plan entitled 'Vancouver 2020: A Bright Green Future'. The Action Plan sets out ten targets for 2020, the second of which is to show climate leadership by reducing GHG emissions 33 percent from 2007 levels.

SUMMARY

The Landfill has been operating a landfill gas ("LFG") collection and flaring system since 1991. LFG is currently collected from a network of 208 vertical wells and 14 horizontal wells and sent for beneficial use in offsite engines to create heat and electricity. Accurately estimating GHG emissions from landfills is becoming increasingly important based on corporate emissions reductions targets, new provincial reporting requirements, and the recent regional focus on emissions from solid waste management facilities.

Currently, fugitive GHG emissions from landfills are estimated using industry specific models and actual LFG capture. Field measurements may also be undertaken to estimate methane emissions from a landfill surface; however, the methodologies available are considered to be quite new and under debate in the scientific community.

In 2009, the City was approached separately by the University of British Columbia ("UBC") and California Polytechnic State University ("Cal Poly") to pursue studies on LFG modelling and emissions, and temperature and surface emissions monitoring, respectively. The proposal by UBC is for $25,000 per year for two years, and by Cal Poly is for $25,000 per year for three years, for a total funding commitment of $125,000 over 2009-2011 inclusive. This work will assist in identifying an economical and effective method to obtain field measurements at the Landfill in order to confirm industry models and determine the true efficiency of the LFG collection system, and point to possible operational changes to reduce GHG emissions.

PURPOSE

The purpose of this report is to recommend the implementation of two projects relating to measurement of LFG emissions at the Landfill with the objective of reducing GHG emissions.

BACKGROUND

Landfill Operations and LFG Collection

The City of Vancouver owns and operates the Landfill located in Delta at 5400 72nd Street. The Landfill operates in accordance with Operational Certificate MR-01611 issued by the Ministry of Environment ("MOE") and under the provisions of the Regional Solid Waste Management Plan. As part of Vancouver's solid waste management system, the Landfill is authorized to dispose of a maximum of 750,000 tonnes of municipal solid waste (MSW) each year.

MSW is received at the Landfill and compacted in layers to form a five-metre lift which is then covered by soil. Waste placement for the next 40 years is guided by the 2000 City of Vancouver Design & Operations Plan and is designed to be completed in nine distinct phases. Phase 1 was filled to capacity in 2008 and is currently undergoing closure with completion scheduled for June 2010. Phase 2 was completed in August 2009 and closure is planned to start in the next two to three years. Current filling is occurring in Phase 3.

The Landfill's LFG collection and flaring system was initially installed in 1991 to control odours and has since been expanded on several occasions to extend coverage over recently filled areas of the Landfill. In 2003, this system was modified to beneficially utilize the LFG in off-site engines to create electricity for approximately 7,000 households and heat for local greenhouses. The current system actively collects LFG from 208 vertical and 14 horizontal wells. Filling in Phase 3 began this fall and new horizontal gas collection wells are planned for installation every second lift to maximize LFG collection.

Regulatory Requirements for LFG Collection

The Landfill's Operational Certificate requires the City to collect and combust (burn) the LFG to reduce odours and the GHG emissions.

On January 1, 2009, the MOE enacted the *Landfill Gas Management Regulation* ("Regulation"), which contains reporting requirements for BC landfills. The Regulation provides authority to the Regional Manager to require additional works based on the estimated gas collection efficiency submitted under the Regulation. The deadline for reporting is January 1, 2011 although early reporting is encouraged.

Beginning in January 2008, Metro Vancouver proposed amendments to the Greater Vancouver Regional Solid Waste Management Plan relating to the Landfill. In their draft plan, Metro Vancouver has identified Waste-to-Energy ("WTE") facilities as their preferred means of MSW

disposal rather than landfilling. As a result, Metro Vancouver and other groups, including the City, have published reports on GHG emissions from landfills. Current wording in the draft plan requires the Landfill to meet a minimum LFG collection efficiency of 75%.

Challenges Associated with Measuring GHG Emissions from Landfills
Currently, GHG emissions from landfills are estimated using modelled LFG production less LFG collected. Modelling depends strongly on input variables as well as site specific conditions and results can vary widely. Overestimations in modeled generation can easily lead to overestimations in landfill emissions.

Field measurements can be used to measure GHG emissions from the Landfill's surface. However, the methodologies available for taking field measurements are considered to be quite new and under debate in the scientific community, as noted in the March 26, 2009, Administrative Report titled *Results of the Vancouver Landfill Financial Evaluation and Estimation of Greenhouse Gas Emissions Consulting Studies* (RTS No 07468). Initial drafts of the MOE's Regulation and Metro Vancouver's draft Solid Waste Management Plan released in 2008 referred to a minimum collection efficiency requirement which prompted City staff to pursue the measurement of surface concentrations and surface emissions (flux):

- **Surface Concentration Measurement** - Hiring of a contractor to measure surface concentrations of methane using two different methodologies, flame ionization detection ("FID") and laser. FID is specified by California legislation as the most reliable method, typically conducted on foot over a predetermined grid on the Landfill surface. Laser technology is new and currently used in Alberta to detect natural gas pipeline leaks using an all terrain vehicle, obviously more efficient for traveling over 28 linear km. The total cost for both surveys in 2008 was approximately $20,000.
- **Methane Flux Measurement Proposal** - Retaining of a consulting firm to provide a statistically supportable monitoring proposal to quantify the flux of methane from the Landfill surface (quantity per unit of surface area) at an estimated cost of $180,000 per quarter. This equates to $720,000 annually which is cost-prohibitive and as a result, flux measurement was not pursued.

Surface concentrations indicate areas of localized emissions but do not differentiate whether the emissions are significant, e.g. a plume, or very small, e.g. a pinhole. Additionally, there is currently no way of correlating surface concentrations with flux to determine surface emissions. Because of the challenges with existing methodologies, additional work is needed that is specific to the Landfill. By identifying areas of significant localized emissions, Landfill staff can take steps to reduce GHG emissions through the assessment and improvement of cover material thickness and integrity in these areas; the assessment of the value of installing biocover to oxidize fugitive emissions; or the implementation of other measures.

DISCUSSION

The Landfill's LFG collection efficiency in 2008 was estimated at 62% by the City's consultant. Once Phase 1 closure is completed, the Landfill's LFG Collection efficiency will range from 73 to 90% over the remaining life of the Landfill. However, average LFG collection efficiencies upwards of 80% or more are possible according to industry publications. With the City's focus on minimizing GHG emissions through the GCAT initiative and other corporate targets coupled with the current draft SWMP requirement, it is time for the Landfill to demonstrate industry leadership and minimize GHG emissions as much as possible.

The following projects have been identified to measure GHG emissions at the Landfill and are described below:

- Landfill Gas Generation & Emissions Study (University of British Columbia)
- Landfill Temperatures and Surface Emissions Monitoring Study (California Polytechnic State University)

Landfill Gas Generation & Emissions Study (University of British Columbia)

In spring 2009, Professor Jim Atwater of the University of British Columbia ("UBC") proposed a study at the Landfill to accurately estimate LFG production and capture efficiency. Professor Atwater is an Associate Professor in the Department of Civil Engineering at UBC and has been involved in research in the area of solid waste management for over 25 years. He is currently a member of the reference panel tasked with reviewing Metro Vancouver's draft SWMP, and was retained by the MOE to review their new Regulation.

The UBC study will involve the following three components:

1. Characterizing the composition of the region's municipal solid waste;
2. Estimating the LFG generation potential by creating a site-specific model for the Landfill; and
3. Estimating emissions from the Landfill's surface using instrumentation and software.

The first component of the study, the waste characterization task, will be used to better estimate the LFG emissions specifically from the Landfill based on the composition of the waste disposed over the past twenty years. Flow rates and composition data recorded from the Landfill's LFG collection and flaring system will be combined with site measurements to quantify emissions from the Landfill's surface, validate the site-specific model created, and better estimate the Landfill's system collection efficiency. The surface measurements will be conducted using remote sensing technologies to compare with the industry-accepted flux box methodology and validate the site specific model.

Landfill Temperatures and Surface Emissions Monitoring Study (California Polytechnic State University)

In 2003, the City began a study with Dr. Jim Hanson of the California Polytechnic State University ("Cal Poly") to investigate the impact of climate on refuse degradation. Dr. Hanson is an Associate Professor in the Department of Civil and Environmental Engineering and has been involved in research related to thermal analysis of landfills for almost 10 years. This project involved installing instrumentation in gas wells at four landfills in different climatic regions of North America, which the intention of monitoring temperatures and gas concentrations over the long term (up to 20 years). Initial results show that degradation begins quickly after the waste is covered at the Landfill due to its moisture content. These results support the need to install horizontal gas wells as filling proceeds.

In fall 2009, Dr. Hanson submitted a proposal to the City to expand the existing temperature monitoring study at the Landfill and pursue related work on surface emissions monitoring. Expansion of the current temperature monitoring study will involve the installation of additional temperature sensors in newly placed waste areas to build on temperature data

collected since 2003. The surface emissions monitoring work will assess the ability of different types of cover soils (some using biosolids) to oxidize methane emissions, reducing surface GHG emissions.

In addition, Cal Poly will investigate multispectral imaging techniques for surface concentration and or flux measurement. The techniques proposed are attractive because of their ability to capture a snapshot of a large area quickly, thus minimizing temporal variability. The Landfill site is flown annually to assess volume remaining, so an imaging survey could easily be included at an incremental cost. Also, a fully-developed imaging system could possibly be more reliable than the FID/laser/flux box methods.

FINANCIAL IMPLICATIONS

The City's contribution to the LFG generation and emissions study with UBC and the Landfill temperatures and surface emissions monitoring study with Cal Poly would be in the form of a grant as set out in the following table:

Study	Funding by Year			Study Total
	2009	2010	2011	
Landfill Gas Generation & Emissions Study (UBC)	$25,000	$25,000	$0	$50,000
Landfill Temperatures and Surface Emissions Monitoring Study (Cal Poly)	$25,000	$25,000	$25,000	$75,000
Annual Totals	$50,000	$50,000	$25,000	**$125,000**

Funding of $50,000 for LFG related studies was approved in the 2009 operating budget process and is contained in the 2009, 2010 and 2011 Landfill Gas Operating Budgets. The costs will be shared by users of the Landfill for a total of $125,000 over three years as shown above.

ENVIRONMENAL IMPLICATIONS

These studies will focus on finding effective and economical technologies for estimating surface emissions specific to the Landfill. The emissions monitoring results will be used to identify operational work that can be implemented to reduce GHG emissions from the site in keeping with corporate objectives.

CONCLUSION

The General Manager of Engineering Services recommends that Council approve the following projects at the Landfill:

- A two-year LFG generation and emissions study with the University of British Columbia at an annual cost of $25,000, for a total contribution of $50,000; and
- A three-year Landfill temperature and surface emissions study with California Polytechnic State University at an annual cost of $25,000, for a total contribution of $75,000.

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