TORONTO

STAFF REPORT
ACTION REQUIRED

Biosolids Master Plan Update – Highland Creek Treatment Plant

Date:	April 7, 2011
To:	Public Works and Infrastructure Committee
From:	General Manager, Toronto Water
Wards:	All Wards
Reference Number:	P:\2011\Cluster B\TW\pw11006

SUMMARY

This report responds to the request made by the Public Works and Infrastructure Committee at its meeting of March 23, 2011, for more information regarding the biosolids management options for the Highland Creek Treatment Plant (HCTP). The report summarizes the findings contained in the Biosolids Master Plan (BMP) for HCTP and provides significant technical updates on the implications of proceeding with the various biosolids management options.

The report documents the implications of Council's direction to change the preferred option recommended in the Biosolids Master Plan for HCTP from Thermal Reduction (incineration) using new Fluidized Bed technology to 100% Beneficial Use of biosolids and landfill disposal as a contingency.

The updated information continues to support, if not enhance, the original findings of the Biosolids Master Plan for HCTP. It is recommended that Council approve the original preferred option of using existing Thermal Reduction (incineration) facilities and then replacing them with the first Fluidized Bed incinerator by 2015 and the second by no later than 2020. The new Fluidized Bed incineration technology will be coupled with enhanced emission scrubbing technologies to allow the City to set voluntary emissions standards that are significantly more stringent than the existing regulatory standards.

RECOMMENDATIONS

The General Manager of Toronto Water recommends that:

1. City Council approve the recommendations contained in the Biosolids Master Plan with respect to the Highland Creek Wastewater Treatment Plant, namely the On-site Thermal Reduction of biosolids by replacing existing multiple hearth incinerators with new modern Fluidized Bed incinerators with state of the art scrubbing technology. An additional incinerator is planned to provide the contingency necessary to ensure reliable biosolids management capacity.

2. Subject to the adoption of the recommendation in (1) above, authorize the General Manager of Toronto Water to re-allocate funds and make the necessary provisions in the 2011 Capital Budget to allow the completion of the first Fluidized Bed incinerator by 2015 and the second by no later than 2020.

3. Subject to adoption of recommendations in (1) and (2), authorize the General Manager of Toronto Water to include enhanced emission scrubbing technologies as part of the construction project allowing the City to set, for this facility, voluntary emissions standards that are significantly more stringent than the existing regulatory standards.

Financial Impact
There are no financial implications resulting from the adoption of this report as there is funding available in the approved Toronto Water 2011 Capital Budget and 10 year forecast.

DECISION HISTORY

At its meeting on March 8, 2005, Works Committee requested that the General Manager of Toronto Water, together with the Medical Officer of Health, undertake a peer review of the decision model and methodology used to determine the recommended management options in the Biosolids and Residuals Master Plan (BRMP).
http://www.toronto.ca/legdocs/2005/minutes/committees/wks/wks050308.pdf

At its May 26, 2005 meeting, the Works Committee approved the model to undertake the peer review proposed by staff and requested that staff develop a Terms of Reference for the hiring of a facilitator to undertake a peer review of the BRMP and that the Terms of Reference be presented to the Works Committee prior to its release. City Council subsequently endorsed this recommendation at its meeting on June 14, 15 and 16, 2005.
http://www.toronto.ca/legdocs/2005/minutes/committees/wks/wks050526.pdf

At its July 11, 2005 meeting, the Board of Health requested that this report be prepared jointly by Toronto Water and the Medical Officer of Health and that it be presented to both the Board of Health and the Works Committee for consideration.
http://www.toronto.ca/legdocs/2005/minutes/committees/hl/hl050711.pdf

At its meeting on April 25, 26 and 27, 2006, City Council amended and approved the Draft Terms of Reference for the Peer Review of the Biosolids and Residuals Master Plan Decision Making Model.
http://www.toronto.ca/legdocs/2006/agendas/council/cc060425/cofa.pdf

At its meeting on July 15, 16 and 17, 2008, City Council approved The Terms of Reference to update and finalize the Biosolids Master Plan taking into consideration the findings of the Peer Review Report.
http://www.toronto.ca/legdocs/mmis/2008/pw/reports/2008-06-27-pw17-cr.pdf

At its meeting on November 30, December 1, 2, 4 and 7, 2009, City Council approved the Biosolids Master Plan Environmental Assessment for Ashbridges Bay, Humber and North Toronto Treatment Plants and requested staff report back to Public Works and Infrastructure Committee on the feasibility of accelerating the preferred biosolids management strategy for Highland Creek Treatment Plant (HCTP). Staff were also asked to report back on the options and costs of achieving higher emissions control standards than those required by regulation.
http://www.toronto.ca/legdocs/mmis/2009/cc/decisions/2009-11-30-cc42-dd.htm

At its meeting on January 5, 2010, Public Works and Infrastructure Committee requested staff also consider and report back on the feasibility of biosolids truck haulage using a future shoreline road as well as the construction of facilities that would be required for transportation of biosolids by rail.
http://www.toronto.ca/legdocs/mmis/2010/pw/decisions/2010-01-05-pw29-dd.htm

At its meeting on May 18, 2010, Public Works and Infrastructure (PWI) Committee received a staff report titled "Biosolids Master Plan Update – Highland Creek Treatment Plant" dated March 31, 2010. PWI recommended that the report be received and that City Council approve a different preferred alternative for HCTP, namely the Beneficial Use Option and direct the appropriate staff to implement the beneficial use biosolids management strategy. The PWI Committee Decision Document can be found at:
http://www.toronto.ca/legdocs/mmis/2010/pw/decisions/2010-05-18-pw33-dd.htm

At its meeting on June 8 and 9, 2010, City Council considered the March 31, 2010 staff report as well as a supplementary report titled: "Supplementary Report: Biosolids Master Plan Update – Highland Creek Treatment Plant." Council directed staff to implement a beneficial use biosolids management strategy for this facility with landfilling as a contingency option. Council also directed a specific haul route and asked that the General Manager report back on the potential use of enclosed van dumpsters or tanker trailers.
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2010.PW33.4

At its meeting on March 23, 2011, PWI requested that staff report back on a number of issues including the feasibility of pursuing beneficial use at HCTP, impact of the Council directed haulage route, legal issues with respect to the Master Plan under the Provincial

Environmental Assessment Act, air impacts of incineration, impacts on Canada-Ontario Agreement respecting the Great Lakes, impact of the Canada-United States Great Lakes Water Quality Agreement, impacts on the Ontario Clean Water Act and source water protection plans, options with respect to van dumpsters and tanker trucks, cost comparison between land application and Fluidized Bed Technology, and Environmental impacts of land application and Fluidized Bed Technology. PWI also requested that the Medical Officer of Health report on the potential health impacts of the available biosolids management options.
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2011.PW2.9

ISSUE BACKGROUND

In the fall of 2002, the City of Toronto initiated a Biosolids and Residuals Master Plan (BRMP) that was to provide direction on the future management of biosolids and water residuals generated by the City's water and wastewater treatment plants to the year 2025. The BRMP was undertaken in accordance with the Class Environmental Assessment process as defined in the Environmental Assessment Act. A draft of the BRMP was released for 30-day public comment on September 16, 2004. The public comment period was subsequently extended indefinitely by Works Committee in October 2004 until such time as a peer review of the BRMP was completed.

(1) Peer Review and Biosolids and Residuals Master Plan
In 2005, Works Committee requested that the General Manager of Toronto Water, together with the Medical Officer of Health, undertake a peer review of the decision-making model and methodology used to assess the various biosolids management options in the BRMP.

In 2006, City staff hired an independent facilitator through a Request for Proposal (RFP) who in turn assembled a panel of qualified, independent reviewers.

By the end of 2007, the Peer Review Panel concluded that the decision-making model used in the draft BRMP was a reasonable model that is commonly used in Master Plans and Environmental Assessments. The report recommended some improvements that could be made to the decision making process in order to provide more clarity to the Master Plan.

In 2008, Council approved a Terms of Reference to update the BRMP taking into account the comments and recommendations of the Peer Review Panel. The City's consultant, AECOM, completed the work outlined in this Terms of Reference as part of the original BRMP project. The study of Water Treatment Plant residuals was dropped from the study as implementation deadlines for this component were quickly approaching and the project then became known as the Biosolids Master Plan (BMP).

(a) Participation by Toronto Public Health in the BRMP and BMP Process
Toronto Public Health (TPH) has had continuous involvement throughout the biosolids master planning process. During the preparation of the first BRMP document, TPH was

represented on the Biosolids and Residual Master Plan Advisory Committee, a stakeholder committee whose mandate was to provide input to the project team during the completion of the Master Plan. The Committee met monthly to review and provide advice to the City and consulting team.

To address concerns raised by some stakeholders upon completion of the draft BRMP, Toronto Water and TPH coordinated the peer review of the decision model and methodology used to determine the recommended biosolids management options. The recommendations of this process were implemented through the update of the BMP. Representatives of TPH were kept informed during key milestones and attended public information sessions held during the process. TPH provided comments on the document during the 30 day review period, which was taken under consideration in drafting the final BMP report.

(b) Public Consultation

Extensive public consultation was undertaken during the drafting of both the BRMP and the BMP. For both, a dedicated website was maintained and updated regularly; project newsletters were issues; and, a dedicated email address and phone line to contact the City was established. During the drafting of the BRMP, a Biosolids and Residuals Master Plan Advisory Committee was formed and met monthly with representation that included interested stakeholders and various regulatory bodies.

In addition, a total of 18 Public Information Sessions were held during the drafting of the BRMP and the BMP. These sessions were held around each of the treatment plants as well as in rural areas where Toronto biosolids were being agriculturally land applied. Sessions were advertised in local community papers, the Toronto Star, in newsletters and mail outs and on the City's website. Meeting minutes and a consolidated list of questions asked by the public at these meeting with responses by the Project Team were posted on the website and mailed to those attending the Public Information Sessions.

For the HCTP community, four sessions were held to obtain input. In addition, the Highland Creek TP Neighbourhood Liaison Committee was kept periodically informed of the progress of the BMP and its findings.

(c) Final Biosolids Master Plan Recommendations for Highland Creek

In 2009, the updated Biosolids Master Plan (BMP) was released again for a 30 day public review period of October 1 - October 30, 2009 to fulfill the requirements of Phase 1 and 2 of the Municipal Engineers Association Class Environmental Assessment Master Planning process. After the public comment period expired, the final BMP was submitted to Council for review and approval.

The final Biosolids Master Plan ("BMP") can be viewed at the following web sites:
http://www.toronto.ca/wes/techservices/involved/wws/biosolids/pdf/master_plan_report_with_app_a_vol_1_to_m.pdf
http://www.toronto.ca/wes/techservices/involved/wws/biosolids/pdf/master_plan_app_a_vol_2.pdf

http://www.toronto.ca/wes/techservices/involved/wws/biosolids/pdf/master_plan_app_a_vol_3.pdf

The preferred option recommended by the BMP for the HCTP was on-site Thermal Reduction (using Fluidized Bed technology) as it scored the highest using the methodology as developed during the public consultation process and approved during the peer review process.

In its evaluation of the alternatives, the BMP assessed eleven (11) different alternatives against environmental (40%), social (40%) and economic indices (20%) – referred to as a Triple Bottom Line Assessment. The differential weightings, as directed by the peer review, were established through input from public consultation. The objectives for each index are as follows:

- Environmental
  - Protect air quality,
  - Protect global climate,
  - Protect surface water, groundwater, land and terrestrial resources
  - Ensure reliable and sustainable end use
- Social
  - Protect public (and operations staff) health
  - Maximize quality of community life
- Economic
  - Minimize cost
  - Minimize risk of unforeseen future costs

The following potential biosolids management alternatives were assessed for the HCTP:
1. Land application of biosolids cake;
2. Thermal drying (pelletization) both on-site and off-site;
3. Alkaline stabilization both on-site and off-site;
4. Composting both on-site and off-site;
5. Upgrade current Thermal Reduction (incineration) to Fluidized Bed technology or other Thermal Reduction technologies both on-site and off-site;
6. Landfilling; and
7. Feedstream to off-site private sector industries.

In June 2010, Council did not approve the preferred option recommended by the BMP and, instead, directed staff to implement a beneficial use biosolids management strategy for HCTP using landfilling as a contingency option. Council also directed a specific haul route and asked that the General Manager report back on the potential use of enclosed van dumpsters or tanker trailers.

(2) Current Situation at Highland Creek Treatment Plant

Presently, biosolids generated at the HCTP are managed using two Multiple Hearth incinerators commissioned in 1976. Each has a reported capacity of about 35 dry tonnes per day – however the incinerators are never operated at this level due to reliability

concerns. The resulting inorganic non-hazardous ash is stored onsite in lagoons and hauled by trucks once annually over a week long period to the City's Green Lane Landfill site. Air emissions from the facility are governed by Provincial regulations discussed in detail later in this report. Annual emissions testing from the main facility stack confirms that emissions meet current regulatory requirements.

During the preparation of the BMP, the existing Highland Creek incinerators were found to be in need of urgent repair. To ensure their continued and safe operation within applicable regulatory standards staff immediately developed a major maintenance and refurbishment program of these incinerators. This work is underway and will extend the service life of the facility for a maximum of 10 years.

The major refurbishment will ensure the facility reliably meets the requirements under present regulations. It is uncertain whether the refurbished multiple hearth incinerators and the existing emissions control equipment can meet future requirements that take effect on February 1, 2020.

COMMENTS

(1) Biosolids Master Plan Preferred Option for the Highland Creek Treatment Plant
The BMP recommendation regarding HCTP is to continue the existing biosolids management strategy for the next five years, replace the aging Multiple Hearth incinerators with energy efficient Fluidized Bed incinerators and recover waste heat for in-plant process and building use. Also, air emissions control equipment is to be upgraded to new state of the art scrubbing technology that will meet requirements that take effect in 2020. Since the BMP was completed, further research has confirmed that emissions scrubbing in excess of that assumed in the BMP is possible and is therefore now also being recommended.

The reasons for the BMP recommendation and the specific benefits are as follows:

- Reliability: The "do nothing" alternative is not viable as the Multiple Hearth technology is outdated and the existing equipment at HCTP is approaching the end of its useful life. Conversion to Fluidized Bed incinerators would ensure state of the art technologies for both biosolids processing and air emission control and would provide long-term primary and contingency capacity.
- Public Acceptance: Residents in the neighbourhoods surrounding the HCTP are opposed to increased truck traffic on the residential streets used to access the treatment plant. Both beneficial use of biosolids cake and landfilling would require an average of 4 to 5 biosolids haulage trucks per day which will increase over time as the solids loading at the plant increases with population growth.
- Limited Beneficial Use Capacity: The City's current and future biosolids Beneficial Use and landfill capacity is allocated to the Ashbridges Bay Treatment Plant (ABTP). At present, 65% of ABTP biosolids are beneficially used – the balance are landfilled. Any additional beneficial use capacity that is developed over the coming years has already been committed to the ABTP through the December 2009 Council approval of the Biosolids Master Plan for that facility.

- Diversification: Diversification of the City's overall Biosolids program remains a priority. Although the City has successfully diversified the ABTP biosolids program by retaining a number of different service providers each making available differing end use and/or disposal options, continued incineration at HCTP helps maintain overall program diversification.
- Financial: The cost of implementing a long term beneficial use program for Highland Creek has been estimated but is subject to long term risks. Assumptions used in the BMP financial assessment are based on current ABTP program costs and are subject to escalation due to any number of risk factors – i.e., regulatory changes, public perception of biosolids, land availability, weather, and haulage distances. The Fluidized Bed option does not have the availability and demand risks that are associated with the Beneficial Use program.

(2) Implications of Council Decision to Implement Beneficial Use Options for HCTP

The following sections of the report address the implications of Council's decision to implement Beneficial Use options for HCTP. It provides updated information on emission calculations, future costs and environmental issues and addresses the motions from the March 23, 2011 Public Works and Infrastructure meeting.

(a) Operational Feasibility and Logistical Challenges of Pursuing Beneficial Use Program at Highland Creek

The BMP presented an analysis for beneficial use options including agricultural land application of biosolids cake, alkaline stabilization, composting and pelletization (followed by agricultural land application).

However, the BMP recognized that there is a significant shortfall of beneficial use capacity available to the City. This has been well documented over the past few years as the City has been unable to meet Council's target of 100% beneficial use of the ABTP biosolids production. Presently, all of the available biosolids beneficial use capacity is allocated to ABTP. Any additional beneficial use capacity that becomes available will, over the next number of years, be allocated to ABTP in order to further reduce reliance landfill disposal.

In 2010, approximately 65% of the 134,000 wet tonnes of biosolids produced at ABTP were beneficially used leaving approximately 47,000 wet tonnes that were landfilled. As all viable beneficial use outlets are now being utilized, further increase in beneficial use quantities is, over the foreseeable future, unlikely. The HCTP biosolids would add approximately 40,000 wet tonnes per year to the total amount currently going to landfill. The total volume destined for landfill would increase to approximately 87,250 wet tonnes, or an equivalent of more than 2,720 truck loads per year.

The City's Green Lane Landfill site currently accepts three loads per day, five days per week. Solid Waste Management Division staff has indicated that the Green Lane site can in the future accept between 4 to 6 truck loads per day, five days per week. The site is constrained by two factors. First, excessive biosolids loads can quickly overwhelm Green Lane's leachate collection and treatment system and therefore cause operational

and regulatory challenges. Second, an excessive number of biosolids loads per day greatly increases site odours thereby generating odour complaints. These limitations can be mitigated by continued use of other landfills in New York State – however this strategy does little for Toronto Water's long term plan to eliminate reliance on out of province landfills.

In light of the above, management options for hauling biosolids from the HCTP are limited to the following:

- Haul and dispose of Highland Creek biosolids at a variety of landfill sites including Green Lane; and/or
- Construct a biosolids processing facility at a City owned or private site. As no such facility currently exists, plans and funding would need to be put in place to design and construct such a facility. The facility may be subject to an environmental assessment process depending on technology and location.

An on-site truck loading facility would need to be constructed at the HCTP to accommodate 4 to 5 large tractor trailers per day, increasing to 6 or 7 loads after long weekends. Due to potential odours during loading of the trucks, and the need for short-term storage (for weekends, holidays) etc., a covered facility that allows trucks to be filled from the storage hoppers in an enclosed and controlled environment would be required. Air collected from this facility would need to be directed to an odour control facility before it could be released to the environment.

The capital cost to construct a truck loading facility was assumed in the BMP to be in the range of $20 to $25 million. A more detailed review has determined that the capital costs identified in the BMP were significantly underestimated as no conceptual designs were in place to confirm these figures. The capital cost to construct a truck loading facility, an odour control facility and additional digester capacity to ensure compliance with regulations for land application is now estimated at $97.2 million. Details of this revised estimate are discussed later in this report.

The time frame required to construct such a facility is estimated at four (4) years depending on the conditions of approval required by the Ministry of the Environment. It is not clear whether such a facility would require the completion of further Environmental Assessments; this would require confirmation from the Ministry of Environment.

(b) Feasibility of Biosolids Haul Route Selected by Council and Potential Impacts on the Surrounding Community

Toronto Water retained AECOM to perform a cursory assessment of Coronation Drive the haul route directed by Council for biosolids trucks entering and leaving the HCTP. The Truck Route Review report dated April 4, 2011, is included as Attachment 1. The report examines two options - in one case, Manse Road is assumed for north bound access to Lawrence Avenue and in the other case Morningside Avenue is assumed. The review focuses on general pavement conditions, road geometry, potential school safety

concerns and potential neighbourhood impacts. This is not intended to be an exhaustive assessment of Coronation Drive.

The findings of the AECOM Truck Route Review can be summarized as follows:

- Pavement on Beechgrove Drive east and south of Coronation Drive shows clear signs of pavement base failure. Mitigation may require reconstruction of Beechgrove Drive (east and south of Coronation Drive).
- Coronation Drive from Beechgrove Drive to Manse Road appears designed for light industrial truck loading. There is little evidence of pavement structural failure.
- For Morningside Avenue, Manse Road, and the portion of Coronation Drive between the two, the pavement displays reflective cracking, a number of utility cuts and patches, as well as some potholes (mainly in the surface layer of asphalt). The pavement does not display widespread base failure. A five to ten percent increase in truck volumes would not likely impact pavement structure on these roads. Resurfacing of a few areas would improve ride quality and decrease noise generated by the trucks at utility cut patches, cracks and partial depth potholes.
- Trucks observed did not exhibit any significant problems negotiating the roadway network leading from the HCTP to Lawrence Avenue. However, to make the right turn from westbound Coronation Drive to northbound Morningside Avenue, this does require trucks to occupy the left-turn lane of the oncoming southbound Morningside traffic in order to complete the turn.
- Four schools are located along the two route options; two on each route. Both junior public schools are expected to close in September of 2012 with students moving to the Joseph Brant Senior Public School. In this neighbourhood, students, including very young students, walk to school. Also, many are dropped off by parents with vehicle line-ups forming at the schools during both the morning and afternoon. As most of the daily biosolids haulage would ideally take place during morning hours, a potential for conflict in the vicinity of the schools will develop. For example, the half-day kindergarten at Heron Park Junior Public School begins at 8:15 AM. Mitigation measures may include restricted operating hours for biosolids trucks.
- For Coronation Drive to Morningside Avenue, biosolids trucks would add between 13 to 30 percent more daily truck traffic. Based on observations of the ABTP haulers, the added truck traffic would likely be concentrated in the morning hours, as early as 4:00 AM (heading to the Plant empty) to midmorning (last truck for the day departing from the Plant).
- On Manse Road, the added trucks per day would range from 5 to 13 percent, again, concentrated in the morning hours.
- Truck activity will generate noise and residual odour implications – mitigating measures would be required and the details of these and their effectiveness are beyond the scope of the study.
- Morningside Avenue south of Lawrence Avenue and Coronation Drive between Morningside Avenue and Manse Road currently have truck restrictions – no trucks from 7 PM to 7 AM. This would need to be reviewed with Transportation Services as a broader haulage window would be required.

- A significant change in traffic, including truck traffic, and the associated noise, odour, air quality, and concern for public safety, typically requires examination within the Environmental Assessment (EA) process. Since the BMP resulted in a recommendation which did not involve daily trucking of biosolids through neighbourhood streets, re-examination of the trucking implications through additional public consultation and a BMP amendment would likely be required.

The issues identified with the existing road condition can be mitigated with pavement reconstruction and minor resurfacing or patching. The school conflict could potentially be mitigated with restrictions on truck departure times.

If the desired haul route follows Morningside Avenue and Coronation Drive, a change in restricted truck times along Morningside Avenue (south of Lawrence Avenue) and Coronation Drive (between Morningside Avenue and Manse Road) would be required. Without a change to road restrictions, biosolids trucks would reach the westbound Highway 401 on their way to the Green Lane landfill during the morning rush hour. This is not desirable as it would add to both the cost and environmental impacts of the trucking option.

(c) Legal Issues that Arise Should the City Ignore the Recommendations of the Biosolids Master Plan

This matter has been referred to staff of the City's Legal Service Division for review. A separate companion report has been prepared to address the concerns related to the Environmental Assessment process and the implications of changing the preferred option and recommendation of the BMP.

(d) Area Impacted by Air Transportation of Contaminants as a Result of Thermal Reduction On-Site at Highland Creek

Significant information is provided in the BMP on the Fluidized Bed incineration option. Since the 1990's, this technology has replaced the older Multiple Hearth technology and in most facilities also includes advanced emission control equipment. For the HCTP, this option would produce lower greenhouse gas emissions, lower operating costs and a more reliable biosolids management approach, relative to the existing technology.

The capital cost estimate for two incinerators – one duty and one standby – was reported as $70 million (2010 dollars) in the BMP; but has since been updated to $119.4 million (2010 dollars) given new information from recent tenders for similar facilities at the Duffin Creek plant in Durham Region and the addition of Advanced Air Pollution Control Systems. The recommendation is to construct the first unit by 2015 and the second unit by 2020. This plan maximizes the remaining useful life of the existing infrastructure and ensures replacement infrastructure is in place by 2020 when more stringent emissions requirements take effect.

In March 2010, staff reported on an opportunity to realize savings if an accelerated implementation schedule were adopted for the construction of two Fluidized Bed units simultaneously. Staff are no longer recommending an accelerated schedule as the

available savings have diminished (window of opportunity to realize these savings has been reduced) and given the current capital funding pressures across Toronto Water.

The March 2010 staff report also details options and costs to achieve higher air emission control standards than those assumed in the BMP. This analysis and corresponding costs remain valid. The following Table 1 from the March 2010 staff report summarizes the available options and the corresponding costs. Although a combination of Alternatives 1 and 2 were previously recommended and remain viable, the current analysis of the Fluidized Bed option assumes Alternative 4. The environmental impacts and corresponding costs of Alternative 4 have been included in the analysis contained within this report.

Table 1. Innovative APC Technologies and their Pollutant Removal Efficiency (% Removal) Compared to BMP Recommended Strategy

Pollutants	**Base Case** ***BMP Recommended Strategy (% Removal)***	**Alternative 1** ***Wet System***	**Alternative 2** ***NO_x and N_2O Control***	**Both Alternative 1 and 2 in combination**	**Alternative 3** ***Dry System***	**Alternative 4** ***Enhanced Wet System***
Particulates/metals	>99.9%	>99.9%	> 99.9%	> 99.9%	>99.998%	>99.998%
NOx	0%	0%	30% to 50%	30% to 50%	40 - 60%	40 - 60%
N_2O	0%	0%	80%	80%	80%	80%
SO_2	0%	50 - 70%	0%	50 - 70%	50 - 60%	90%
HCl	70%	91%	70%	91%	94 - 95.5%	99.7%
Mercury	95%	95%	95%	95%	90%	95%
Dioxin/furans	92%	92%	92%	92%	90%	92%
Incremental Capital Cost Relative to Base Case	**N/A**	**$2.5 M**	**$5.0 M**	**$7.5 M**	**$10.0 M**	**$11.0 M**
Incremental Annual Operating Cost Relative to Base Case	**N/A**	**$30,000**	**$130,000**	**$160,000**	**$270,000**	**$400,000**

The current and/or any future incineration facility at the HCTP is governed by Ontario Regulation 419/05 (Air Pollution – Local Air Quality). This regulation includes a move to "effects-based" air standards, some of which are up to 100 times more stringent than previous standards; more accurate dispersion models that can more realistically assess the concentrations of contaminants under a range of weather related conditions; and more detailed emissions reporting to demonstrate compliance.

The regulation includes the phase in of increasingly more stringent standards for a wide range of contaminants. The current applicable standards, Schedule 2, took effect on

February 1, 2010 and will remain in effect until January 31, 2020, after which a more stringent Schedule 3 will apply. At any time, the Ministry of Environment (MOE) can amend or introduce new standards for any contaminant of concern.

The major refurbishment work that is currently underway will ensure the facility reliably meets the requirements under Schedule 2 of the regulation. It is uncertain whether the current Multiple Hearth incinerators and the existing emissions control equipment can meet the Schedule 3 requirements that take effect on February 1, 2020, even after major refurbishments are completed. Fluidized Bed incinerators equipped with only moderate scrubbing technology will have no difficulty achieving and/or exceeding the standards that take effect in 2020.

Recent changes being phased in during the coming years by the United States Environmental Protection Agency (EPA) are worth noting. The EPA estimates that 24% of existing sewage sludge incinerators in the US will require modifications to comply with their new standards. In addition to upgrading emissions monitoring and control, it is expected that municipalities will use more stringent Sewer Use By-Laws and other source control programs to reduce the presence of certain metals in the influent sewage as a potential alternative to costly and elaborate emissions scrubbing technologies.

The EPA standard includes a number of operational practices, emissions testing and continuous monitoring requirements – most of which are already standard practice at the newer Fluidized Bed facilities in Ontario and most are now routinely included by the MOE in new Certificates of Approval.

Although there is no indication of impending regulatory change in Ontario, both the existing Multiple Hearth incinerators at HCTP, and/or a future Fluidized Bed facility, could therefore require additional emissions control modifications in the future if similar standards are adopted in Ontario. The added cost and net benefit of such changes, if they were to occur in Ontario, would produce further emission reductions beyond the levels assumed in computing the environmental index score within the BMP. Air emission impacts to the surrounding community, if any, would be further reduced.

Within the BMP, Appendix D presents data from 2006 air emissions testing at HCTP and compares actual data against the MOE's Ontario Ambient Air Quality Standards and the MOE Point of Impingement Criteria. Appendix F demonstrates further emission reductions that are expected through a conversion from Multiple Hearth Incinerators to Fluidized Bed Incinerators. This information has been updated in a Technical Memo prepared by AECOM dated April 4, 2011, and is listed as Attachment 2 of this report.

As discussed in Attachment 2, emissions are regulated at both the stack tip and at the nearest ground level receiver, referred to as the Point of Impingement. The ground level emissions experienced by a receiver are based on a model that takes a variety of factors into account including height of stack, weather conditions, wind patterns, etc. The Point of Impingement must meet the ground level standards and is defined as the nearest point

where contaminants emitted will impose (or impinge) on a building or other receiver beyond the property line.

For the HCTP, the ground level concentration of contaminants as a percentage of the MOE limits is summarized in Table 2 below. The table compared ground level contamination as a percent of the MOE limit for four different scenarios – starting with the existing Multiple Hearth incinerators.

Table 2: Ground Level Concentrations as Percent of MOE Allowable Limits

Contaminant	Existing Multi-Hearth	New Fluidize Bed	Option 1 & 2 Wet System and NOx Control	Enhanced Wet Scrubber
Particulates/metals	2.6%	0.31%	0.31%	0.006%
NOx	15%	4.5%	2.7%	2.2%
SO_2	27%	10%	4.0%	1.0%
HCl	1.3%	0.41%	0.12%	0.004%
Mercury	0.13%	0.006%	0.006%	0.006%
Dioxin/furans	0.08%	0.006%	0.006%	0.006%

In addition, the Green House Gas (GHG) emissions assumed in the BMP were reviewed as part of this report in light of the increased level of emission scrubbing being recommended as well as the new tools and methodologies that are now available for the calculation of GHGs. Another AECOM Technical Memo dated April 5, 2011, on this matter is included as Attachment 3 to this report. The current GHG estimates for Fluidized Bed incineration with advanced emissions control, landfilling (assuming Green Lane) and agricultural land application are as summarized in Table 3:

Table 3: Green House Gas Emissions of Selected Alternatives

Category	Fluidized Bed Incineration t CO_2e/year	Digestion/Landfill t CO_2e/year	Digestion/Land Application t CO_2e/year
Scope 1 Nitrous oxide stack emissions; Natural gas for digester heat; Fugitive methane emissions associated with biogas boilers/flares; Vehicle emissions; Landfill Fugitive Emissions; Tractor emissions (spreading).	1,097	4,074	2,688
Scope 2 Electricity	1,124	745	745
Scope 3 Polymer production; Emission from land spread with Biosolids; Less: Fertilizer offset.	1,868	1,234	2,063
Total Emission	**4,089**	**6,053**	**5,496**

In this analysis the Category columns definitions are as follows:

- **Scope 1**: All direct GHG emissions.
- **Scope 2**: Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.
- **Scope 3**: All other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the City.

The preferred option based on greenhouse gas emissions is therefore Fluidized Bed incineration with advanced emissions control technology.

(e) Implications of Thermal Reduction On-Site at Highland Creek with respect to Canada-Ontario Agreement respecting the Great Lakes; the renegotiation of the Canada-United States Great Lakes Water Quality Agreement; and the Ontario Clean Water Act and Associated Source Water Protection Plans

The Canada-United States Great Lakes Water Quality Agreement ("GLWQA"), first signed in 1972 and renewed in 1978, expresses the commitment of both countries to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem. It reaffirms the rights and obligation of Canada and the United States under the Boundary Waters Treaty and has become a major focus of the International Joint Commission.

The Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem outlines how the governments of Canada and Ontario will cooperate and coordinate their efforts to restore, protect and conserve the Great Lakes basin ecosystem. It is the means by which the federal partners of the Canadian Federal Great Lakes Program interact with the provincial ministries to help meet Canada's obligations under the GLWQA.

The role of these agreements is to spur research and other activities whose aim is to protect the quality of the Great Lakes. Work done in accordance with these agreements in turn informs the provincial environmental regulations by which the City must abide.

While all options for biosolids management have associated air emissions, all options under consideration by the City are covered by current provincial regulatory standards. The existing incinerator meets regulatory requirements, and the proposed new Fluidized Bed incinerator would surpass them. Air emissions from biosolids trucks are less closely regulated and would be more diffuse. None of the options under consideration have air emissions that would have any known impact on Lake Ontario water quality.

It is noted that the Ministry of the Environment has recently approved Fluidized Bed incinerators in Mississauga (Peel Region), Pickering (serving York and Durham Regions) and the City of London.

The Ontario Clean Water Act and associated source water protection plans focus on protecting water treatment intakes from the effect of liquid releases associated with spills from pollution sources. The two key substances being assessed from HCTP are E. Coli

and ammonia as the Horgan Water Treatment Plant is the nearest intake of concern. Any potential liquid releases from incinerators at the HCTP have been accounted for in the analysis and have no effect. Potential emissions from the incineration units have no measurable effect on the Horgan Water Treatment Plant intake. Hence, there are no Clean Water Act implications from the on-site incineration facility at HCTP.

(f) Trucking Options Which Include Enclosed Van Dumpsters or Tanker Trucks

The City's contracted service providers haul biosolids from the Ashbridges Bay Treatment Plant using 4 axle or 5 axle dump trailers. The typical overall length of a truck and trailer combination is between 20 and 23 metres depending on the configuration of the truck and type of trailer. The combinations can be as long as 24 metres if a set of trains is used (double smaller trailers hooked together).

A biosolids truck was taken to the HCTP to assess the required on-site turning radius and clearances necessary to accommodate truck traffic. With some modifications, the on-site road access can be configured to accommodate biosolids haulage trucks. Off-site challenges were previously mentioned and are detailed in an Attachment 1 - Truck Route Review prepared by AECOM.

Each biosolids truck typically hauls approximately 30 to 32 tonnes depending on the configuration of the trailer and truck. Most of the trailers currently hauling biosolids from ABTP use full cover tarp systems. These are heavy gauge waterproof vinyl tarps that are secured along the entire length of the trailer on one side and lock down on the opposite side once the tarp is rolled over the trailer side walls. These side roll style tarps have an attached front and rear section to minimize odours. A recent improvement used by one of the City's contractors is to use a light weight frame to support the tarp and deploy the tarp mechanically.

The City's contracted service providers have spoken to manufacturers and have failed to locate a suitable solid enclosure that is readily available for dump trailers. Any hydraulic or pneumatic driven closure to seal the trailer would need to be custom built to the City's specifications based on a suitable trailer configuration. Given the level of customization that would be required, it is believed that the City would need to purchase and modify a fleet of trailers. The cost to purchase and modify the trailers is estimated at between $160,000 and $200,000 per trailer and could escalate based on added regulatory requirements - plus the ongoing cost to maintain, certify and insure the trailers.

The City would still contract with private sector haulers for haulage services and only a modest reduction in haulage costs would be expected as the bulk of the costs involve truck depreciation, maintenance, fuel, insurance and labour. In addition, as owner of the trailers, the City would assume certain liabilities with respect to haulage that is currently fully allocated to the contractors. The City could find itself sharing the liabilities with the hauler in case of a spill on route.

In addition, the fixed covers would add weight to the trailer thereby reducing the biosolids load capacity for each trailer and increasing fuel requirements. Also, fixed

covers interfere with the loading and dumping operations and may disrupt the weight distribution. Finally, it is not clear that an air tight seal is desirable as this could create an explosive atmosphere due to the concentration of methane gas under the cover necessitating the use of explosion proof equipment/mechanisms to open and close the fixed cover. Some air flow may therefore be necessary, thereby mitigating any benefits that a fixed cover may have over the existing tarp type system.

Therefore, given the cost and liability issues, the purchase and modification of a fleet of trailers is not recommended. The existing tarp type systems used by existing service providers are deemed sufficient.

Haulage by sealed tanker trucks is not possible as the biosolids is produced in dewatered cake form and has the general consistency of a moist loam.

(g) Cost Comparison Between Land Application and the Fluid Bed Technology Recommended for Highland Creek

Given the recent tender of Fluidized Bed Incineration facilities in the Region of Durham, and new information obtained through the ongoing refurbishment of the existing Multiple Hearth Incinerators, updated costing has been developed (all figures in 2010 dollars). The Capital cost of the first Fluidized Bed incinerator is now estimated at $57.7 million and the second unit is estimated at $61.7 million (see Attachment 2). Included in these costs is $11 million per incinerator for advanced air emissions scrubbing as per Alternative 4 in Table 1 of this report.

The truck loading facility to be built adjacent to the current incinerator building is now estimated at $97.2 million. The updated cost breakdown is provided in Attachment 4, another Technical Memo from AECOM dated April 4, 2011. The updated cost represents a substantial increase from the original estimates. The original assumption included in the BMP was that the ABTP facility (concept and costs) could be scaled down (approx. 50%) for the HCTP application. This assumption could not be substantiated when reviewed in greater detail.

The operating costs to beneficially use and/or dispose of biosolids generated at the HCTP have been reviewed and updated. The following table presents the financial implications of three haulage options – haul biosolids to agricultural land application, haul biosolids to a third party (alkaline stabalization) facility, and haul to Green Lane for disposal. The operating cost of a fluidized bed incinerator was previously estimated to be $3.4 million and is now being adjusted to $3.72 million to capture increased maintenance costs, added operational costs for the advanced air emissions equipment and a credit for no longer having to operate digesters (all figures in 2010 dollars).

Therefore using 2011 as the base year, the Table 4 below summarizes the best and most recent available information regarding the financial implications of each alternative. Note the following adjustments have been incorporated:

- 2010 base year costs including operating costs have been escalated at 3% per year to account for inflation.

- $97.2 M for Truck Loading escalated to $109.4 to capture an average of four years of inflation
- First incinerator escalated to $64.4M (2014 dollars); second incinerator escalated to $78.2M (2019 dollars) – to capture inflation.
- 2015 Operating Costs are for half year only.

Table 4: 2011 NPV and Cash Flows for Each Alternative Based on 20 Years of Operation Starting in 2015

	Biosolids Haulage Options				Fluidized Bed	
Year:	Capital Cost	Land App	Third Party Processing	Green Lane	Capital Cost	Operating Cost
2011	$0.50				0.50	
2012	$1.50				2.00	
2013	$20.00				20.00	
2014	$45.00				27.00	
2015	$35.00	$3.87	$5.22	$3.03	14.90	$2.30
2016	$7.42	$7.97	$10.75	$6.23	1.00	$4.73
2017		$8.21	$11.07	$6.42	10.00	$4.87
2018		$8.45	$11.40	$6.61	25.00	$5.02
2019		$8.71	$11.74	$6.81	30.00	$5.17
2020		$8.97	$12.10	$7.02	12.18	$5.32
2021		$9.24	$12.46	$7.23		$5.48
2022		$9.52	$12.83	$7.44		$5.65
2023		$9.80	$13.22	$7.67		$5.82
2024		$10.10	$13.61	$7.90		$5.99
2025		$10.40	$14.02	$8.13		$6.17
2026		$10.71	$14.44	$8.38		$6.35
2027		$11.03	$14.88	$8.63		$6.55
2028		$11.36	$15.32	$8.89		$6.74
2029		$11.70	$15.78	$9.16		$6.94
2030		$12.05	$16.26	$9.43		$7.15
2031		$12.42	$16.74	$9.71		$7.37
2032		$12.79	$17.24	$10.00		$7.59
2033		$13.17	$17.76	$10.30		$7.82
2034		$13.57	$18.30	$10.61		$8.05
2011 NPV(5%, I=3%)		**$187.68**	**$222.04**	**$166.22**		**$163.54**
Total Cashflow		**$313.45**	**$384.55**	**$269.03**		**$263.64**

The 20 year Net Present Value (3% inflation, 5% interest) of the capital and operating costs for Fluidized Bed incineration is estimated at $163.54 million compared to a range of $187.7 million to $222.04 million for the beneficial use options and $166.2 million for disposal at Green Lane. Total estimated cash flow to 2034 for the Fluidized Bed facility is $263.6 million compared to a range of $313.5 million to $384.6 million for the

beneficial use options and $269 million for disposal at Green Lane. It should be noted that current biosolids production volumes were assumed through to 2034 – this assumption has no impact on the Fluidized Bed option but under estimates the haulage and disposal costs for the other three alternatives.

This analysis confirms that on a cash flow basis over 20 years of operation, the Fluidized Bed incineration option is between $5.4 million and $120.9 million less expensive than the other three options.

(h) Environmental Impacts of Land Application and Fluid Bed Technology

As part of the triple bottom line methodology used in the BMP to assess the biosolids management options, Environmental impacts were given a 40% weighting to the total score. Specific environmental issues associated with Land Application and Fluidized Bed Incineration options are shown in Table 5:

Table 5: Summary of Environmental Impacts

Alternative	Benefits	Environmental Considerations	Mitigating Measures
Land application	• Provides nutrient and soil conditioning benefits to agricultural farm fields. • Offsets need for farmers to purchase manufactured fertilizers • Reuse of key resources such as Phosphorous	• Potential for presence of wide range of contaminants from industrial sources • Presence of "emerging contaminant of concern" such as pharmaceuticals and personal care products that are not currently regulated • Odour issues at source, in transit and at application sites • Large amount of suitable agricultural land needed for application. Application rates relatively low requiring large amounts of land • Application sites far away resulting in	• Active enforcement of Sewer Use By-Law. • Research on level of risk and mitigating measures is on-going by wastewater industry and regulators. • Odour at source can be mitigated by using a truck loading bay ventilated through a dedicated odour control facility. In transit odours are inevitable. Odours at land application site are mitigated through direct injection. • Landfill capacity needed to dispose of biosolids when insufficient quantities of agricultural land is available • Set geographic boundaries on land

		increased trucking costs and carbon footprint • Demand and reliability of end market can be inconsistent thereby creating the risk of excess biosolids retention in the Plant	application. Use landfill disposal to backstop the program. • Maintain landfill as contingency. Hold some excess biosolids in the Plant – however Plant odours will escalate within 24 hours. • Heavily regulated through the Nutrient Management Act. Fields are inspected by both the City's representative and the regulator.
Fluidized Bed Incineration	• Full on-site management of biosolids with limited off-site impacts • No reliance on external service providers • Potential for energy recovery that can be used to offset other energy demands • Little energy input needed as the biosolids serves as the fuel source. • Proven technology. • Can be used as part of a diversified biosolids program • demonstrated reliable, consistent year round biosolids management solution • Closed loop system (only ash needs to disposed off site. • Low potential for odours	• Combustion produces contaminants such as particulate matter, carbon monoxide, total hydrocarbons, dioxins, furans, sulphur oxides and nitrous oxides. • Produces ash	• Air emissions heavily regulated through O,Reg. 419 and routinely inspected by MOE. • Fluidized Bed incinerators less emissions than Multiple Hearth • Emission levels further reduced by pollution control equipment customized to the application. • Ash is primarily made up of metals such as iron (from the ferrous chloride added in wastewater process). Material is odourless, relatively inert and is disposed in landfill. • Potential for beneficial use of ash through partnerships with industry

An important additional consideration is that no further Environmental Assessment studies would be required since the Fluidized Bed technology would simply replace the existing Multiple Hearth technology, with no increase in capacity. This eliminates scheduling and implementation risks associated with a potential EA process that may be necessary to construct certain facilities for a beneficial use haulage program.

CONTACT

Frank Quarisa
Director, Wastewater Treatment
Toronto Water
Phone: 416-392-8230
Email: fquaris@toronto.ca

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Lou Di Gironimo
General Manager
Toronto Water

ATTACHMENTS

1) Truck Route Review for Highland Creek WTP Biosolids Options – April 4, 2011
2) HCTP New Incinerator Air Pollution Equipment Upgrade Options – April 4, 2011
3) Green House Gas Emissions HCTP Biosolids Options – April 5, 2011
4) Biosolids Truck Loading and Odour Control Facility for HCTP – April 4, 2011