

Clause 10 in Report No. 9 of Committee of the Whole was adopted, without amendment, by the Council of The Regional Municipality of York at its meeting held on May 25, 2017.

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Direct Purchase of Consulting Services for
Duffin Creek Plant Biosolids Treatment Replacement Project

Committee of the Whole recommends adoption of the following recommendation contained in the report dated April 21, 2017 from the Commissioner of Environmental Services:

1. Council authorize the Commissioner of Environmental Services to negotiate and execute agreements on behalf of the Region pursuant to the direct purchase provisions of the Purchasing Bylaw with:
 - a) Team Duffin (CH2M Hill Canada Inc. with AECOM Canada Ltd. as a sub-consultant) to complete the design, tender documents, site supervision and construction administration for the Duffin Creek Plant Biosolids Treatment Replacement Project for an estimated assignment not to exceed \$20,000,000.
 - b) Revay & Associates Limited to provide project planning and monitoring services for the Biosolids Treatment Replacement Project for an estimated assignment not to exceed \$1,000,000.
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Report dated April 21, 2017 from the Commissioner of Environmental Services now follows:

1. Recommendations

It is recommended that:

1. Council authorize the Commissioner of Environmental Services to negotiate and execute agreements on behalf of the Region pursuant to the direct purchase provisions of the Purchasing Bylaw with:
 - a. Team Duffin (CH2M Hill Canada Inc. with AECOM Canada Ltd. as a sub-consultant) to complete the design, tender documents, site supervision and construction administration for the Duffin Creek Plant Biosolids Treatment Replacement Project for an estimated assignment not to exceed \$20,000,000.

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- b. Revay & Associates Limited to provide project planning and monitoring services for the Biosolids Treatment Replacement Project for an estimated assignment not to exceed \$1,000,000.

2. Purpose

This report seeks Council authority for York Region to negotiate directly with and enter into agreements with Team Duffin and Revay & Associates Limited for consulting services pursuant to section 9.1 (a) of the Purchasing Bylaw where the compatibility of a purchase with existing equipment, facilities or service is the paramount consideration.

3. Background

Duffin Creek Plant expansion program is a product of a successful partnership between York Region and Durham Region

The Duffin Creek Plant treats wastewater generated in both York Region and Durham Region as part of the York Durham Sewage System that was conceived and initiated in the late 1960s by the Ministry of the Environment. Stage 1 of the Duffin Creek Plant became operational in 1977.

In 1997, the Regional Municipality of York and the Regional Municipality of Durham assumed the Duffin Creek Plant and lands from the provincial government.

Since its inception, the York Durham Sewage System has expanded in stages to service growth within both Regions. The most recent expansion at the Duffin Creek Plant is the Stage 3 Liquids and Solids Expansion Project that provides capacity for growth to approximately 2031. The Stage 3 Liquid Process Expansion was commissioned in 2011.

The Stage 3 Biosolids Process Expansion was commissioned in 2014 and increased the number of biosolids treatment trains from two to four. Each of the four trains is designed to process 90 dry tonnes of biosolids per day and each train includes an incinerator that is used to dispose of biosolids at the plant. Incinerators 3 and 4 were built as part of the Stage 3 Expansion Project. Incinerators 1 and 2 have been in operation since 1979 and now require replacement to ensure reliability and capacity requirements are met.

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Biosolids treatment process has provided disposal and beneficial energy savings for over 37 years but are near the end of their useful life

Incinerators are used for disposing of biosolids and producing steam used as a source of heat to significantly reduce overall energy requirements of the plant by providing both building heating and process heating. Incinerators 1 and 2 operate as part of a four unit fleet and are at or beyond their planned operational life.

In 2016, a condition assessment and life-cycle analysis, capacity analysis and conceptual design were completed. The life-cycle analysis considered age, condition, and the recent repair and maintenance activities of the biosolids equipment. This analysis concluded that Incinerators 1 and 2 had only a 50 per cent reliability rating. On this basis, further repair is not cost effective and replacement is warranted.

Biosolids disposal capacity is critical to service forecasted growth

Forecasts predict that peak biosolids generation will require three units to be in continuous operation in 2026. To ensure firm disposal capacity in 2026 and per regulatory requirements, four operable units must be available: three units will be operating with a fourth on standby for use when undertaking any maintenance and repairs on the three duty units.

In the 2026 time frame, Incinerators 3 and 4, in use since 2012, will require planned major maintenance work. This further supports the need to complete the replacement project over the next decade to ensure necessary capacity is available within the fleet.

Replacement strategy will ensure needed capacity and process enhancements

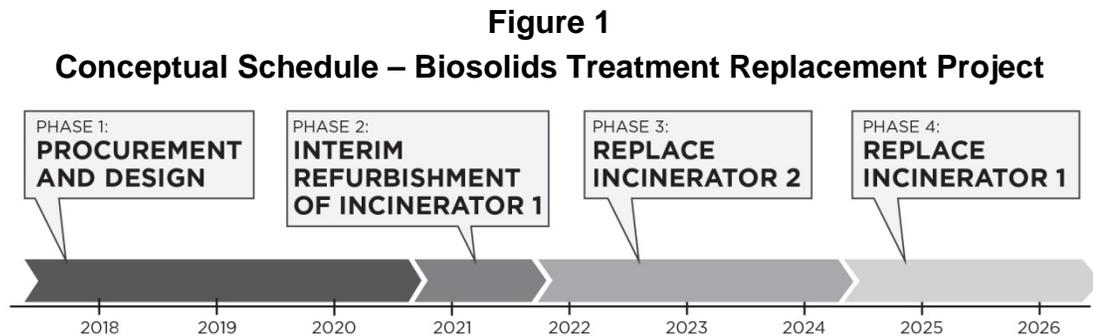
Current process demand dictates that the incinerators must be replaced one at a time while maintaining 24-hour-a-day operation. In 2016, a preferred four-phase replacement strategy was identified as follows:

- Phase 1: Engineering procurement, detailed design and acquisition of regulatory approvals (anticipated completion Q4 2020).
- Phase 2: Interim refurbishment and modification to Incinerator 1 to ensure operations can be maintained during Phase 3 of the replacement strategy. This effort will enable replacement of a single incinerator at a time, while maintaining all plant processes (anticipated completion Q4 2021).

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- Phase 3: Replace Incinerator 2 to ensure required firm capacity is achieved (anticipated completion Q2 2024).
- Phase 4: Replace Incinerator 1 to ensure required firm capacity is achieved (anticipated completion Q4 2026).

Figure 1 depicts the anticipated schedule to implement the four-phase replacement strategy.



Upon completion of Phase 4, the planned life-cycle maintenance of Incinerators 3 and 4, expected to be required in the 2026-2030 time frame, can proceed.

Operational knowledge of Duffin Creek Plant critical to interim refurbishment phase

Phase 2 Interim Refurbishment of Incinerator 1 is a critical step in relation to both operational risk and schedule risk. In this phase the complex integrated operating systems of Incinerator 1 will be modified to allow separation of the incinerator processes from one another and the integrated ancillary systems, which is required to enable the sequential replacement of both Incinerators 1 and 2. Team Duffin's intimate operational knowledge of the plant will serve to significantly reduce the operational and schedule risks that must be managed to accomplish this critical phase and ensure success of future replacement phases.

Replacement strategy relies on pre-purchasing of major specialized equipment and services to facilitate successful implementation

The replacement strategy includes pre-purchasing of major specialized equipment and services to facilitate successful implementation of an aggressive schedule. Pre-purchasing enables equipment and services with long lead times to be ordered and manufactured concurrent with the design phase of the project, yielding significant time savings that would not be realized if the general contractor procured these products after tender award. The benefits of equipment pre-purchasing were realized in the successes of the Stage 3 Expansion project and the Stages 1 and 2 Upgrades project.

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In addition to time savings, it allows for improved quality of engineering drawings and documentation subsequently used by contractors and consultants. For this project, incinerators and other major components, along with their vendors' specialized engineering services, will be pre-purchased in accordance with the Purchasing Bylaw.

4. Analysis and Implications

Timely delivery of the replacement project is of critical importance

Conceptual design confirmed that with aggressive scheduling, a 10-year sequential capital delivery program could deliver the works in time to align with 2026 capacity demand projections. Procurement, design and construction durations were considered when establishing the need to start replacement of Incinerators 1 and 2 immediately to assure reliable incineration capacity is maintained to the year 2026. This timeline is premised upon the recent successful installation of Incinerators 3 and 4, completed as part of the Stage 3 expansion.

This work will involve a major design to develop in excess of 2,000 engineering drawings. Delivery of this design effort within the next three years is necessary to meet process capacity projections.

Best-in-class High Temperature Fluidized Bed technology is supported by a limited pool of specialized expertise and experience

Using High Temperature Fluidized Bed incinerator technology for biosolids management at Duffin Creek Plant was confirmed in both the Durham Region Biosolids Master Plan (2004) and the Environmental Assessment for Stage 3 Expansion (2005). This technology is the preferred incineration technology with consideration to cost, energy recovery, capacity and emission criteria among others. An industry scan identified 30 High Temperature Fluidized Bed incinerator projects worldwide since the year 2000, 18 of which have been located in North America. Of the North American projects, six have used a High Temperature Fluidized Bed technology of similar size or complexity to the Duffin Creek Plant installation. Table 1 identifies the six incinerator installations and also identifies the engineering consultants associated with delivery of these complex and specialized engineering works.

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Table 1
High Temperature Fluidized Bed (HTFB) Installations
in North America Comparable to the Duffin Creek Facility*

Engineering Consultant	Number of North American HTFB Incineration Projects*	Location and Year of Installation
Team Duffin (CH2M Hill and AECOM)	1	Durham Region, 2008-2012
CH2M Hill	2	St. Paul, MN, 2000 Green Bay, WI, 2013
Black & Veatch with KMK (now AECOM)	1	Peel Region, 2002-2006
Black & Veatch	1	Cincinnati, OH, 2009
Malcom Pirnie	1	Cleveland, OH, 2010

*Denotes installations of High Temperature Fluidized Bed Incinerators since 2000.

Of the six comparable High Temperature Fluidized Bed incinerator installations that have been completed in North America including the Duffin Creek Plant installation, two occurred in Ontario (See Table 2). The Ontario installations include Incinerators 3 and 4 at the Duffin Creek Plant with associated consulting services by Team Duffin (CH2M Hill and AECOM) and Incinerators 1, 2, 3, and 4 at the Peel Region Lakeview Wastewater Treatment Plant with incineration consulting services provided by Black & Veatch in cooperation with KMK (now AECOM) as the prime consultant. In summary, of the six comparable North American installations, members of Team Duffin provided consulting services for four of them and Black & Veatch for two of them.

Table 2
High Temperature Fluidized Bed (HTFB) Installations
in Ontario Comparable to the Duffin Creek Facility*

Engineering Consultant	Number of Ontario HTFB Incineration Projects*	Location and Year of Installation
Team Duffin (CH2M Hill and AECOM)	1	Durham Region, 2008
KMK (now AECOM) and Black & Veatch	1	Peel Region, 2002

*Denotes installations of High Temperature Fluidized Bed Incinerators since 2000

Industry scan identified preferred practice to continue with an experienced vendor

The industry scan revealed that it is not uncommon for owners to continue with the services of a vendor with past experience in their facilities.

Team Duffin is identified as the only consulting team that has experience with the incineration facilities at the Duffin Creek Plant. This specialized incineration experience, and also the experience gained through the extensive works Team Duffin has provided at the Duffin Creek Plant on the Stage 3 Expansion and Stage 1 and 2 Upgrades projects since 2005, can provide unique efficiencies and schedule benefits to the Region. Team Duffin is best positioned to effectively deliver engineering consultant services for the Incinerators 1 and 2 Replacement project.

Complexity of the Duffin Creek Plant is one of the most challenging aspects of the project design effort

The incinerators and their ancillary systems are some of the most complicated processes to design within the Duffin Creek Plant. Residual solids from Stages 1, 2 and 3, the digester complex and the effluent water system all independently feed into the incineration facility via interconnected subsystems. During incineration, the facility feeds steam to the rest of the plant through its process and facility heating systems and deposits ash into the ash handling trains. Numerous process and supporting auxiliary systems must be harmoniously integrated with each other to achieve optimal and reliable operating efficiency.

Team Duffin is very knowledgeable, not only of the incineration facility's design criteria but also with every system within the incineration facility and across the entire plant. It is not reasonable to assume any new consulting team would readily or efficiently gain this needed intimate knowledge of the complexity and

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interconnectivity of each system within the plant and be able to perform at the same level as the team with this significant prior experience with this facility.

Knowledge and experience gained working with each system, especially with Incinerators 3 and 4, places Team Duffin in an invaluable position to provide full working knowledge of the entire plant to the Regions. Team Duffin is completely familiar with the Duffin Creek Plant site layout and operational constraints contained in the Environmental Certificate of Approval and process conditions.

Team Duffin is best positioned to deliver the design, tender documents and construction support services

Team Duffin possesses significant knowledge of existing incineration equipment and related systems, layouts and complexities, and has successfully delivered consultant services for major works at the Duffin Creek Plant including but not limited to:

- Stage 3 Expansion project, which encompasses Incinerators 3 and 4 that was awarded in 2005 by competitive bid (approx. \$700 Million in capital cost).
- Stages 1 and 2 Upgrades (approximately \$200 million in capital cost) that was a direct assignment via a negotiated proposal in 2010, and included work within the incineration facilities.
- Incineration Repair projects 2004-2007 and 2011.
- Incinerators 1 and 2 Replacement Conceptual Design 2016.

This experience provides Team Duffin with comprehensive knowledge of existing incineration processes, plant-wide facilities and operational demands that must be maintained when completing large capital projects within this operating facility. This experience will greatly assist and expedite the design of incineration systems without compromising regulatory compliance while working in a complex operating facility.

Team Duffin has gained unique and expert experience working at the Duffin Creek Plant

In 2004, the Region initiated a competitive procurement process to select the consulting team for Stage 3 Expansion projects. The Region issued a comprehensive pre-qualification proposal to determine qualified consulting companies capable of performing the large and complex design assignment to be accomplished in the Stage 3 Expansion effort. As a result of the evaluation of submittals, two teams consisting of multiple engineering companies were deemed appropriately qualified to accomplish design and administration of the

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Stage 3 Upgrades. Team Duffin, comprised of CH2M Hill Canada as prime consultant and AECOM as sub-consultant, was the successful proponent of the formal proposal procedure.

On [April 22, 2010](#), Council authorized execution of agreements with Team Duffin to provide further services for the currently ongoing Stages 1 and 2 Upgrade and Refurbishment project through provisions in the Purchasing Bylaw.

Team Duffin has ensured regulatory compliance, value and demonstrated effective cost control

With Team Duffin acting as contract administrator, no related compliance issues were incurred during the nearly \$1 billion capital expansion completed to date within the operating Duffin Creek Plant since 2005. Ratio of the cost of change orders to total capital cost of a construction contract is recognized as a key performance indicator of Team Duffin's design and contract administration. Construction contract change orders amount to less than three per cent of the total capital cost expenditure of the Stage 3 and Stages 1 and 2 construction projects combined, less than the generally accepted industry standard of five per cent change as percentage of contract value for large, complex mechanical construction projects.

Revay & Associates Limited assures schedule and cost control

Revay & Associates Limited has been an integral part of the on-time and on-budget delivery of the Duffin Creek Plant expansion program since 2005. Their main contribution to project delivery has been as an independent subject matter expert during design and construction contracts relating to claims and risk analysis as well as detailed schedule and earned value dissection. Revay & Associates Limited evaluates and analyzes variables and risks that cross the multiple concurrent contracts and project scopes to provide an overarching risk assessment to the Region. Revay & Associates Limited was retained under a competitive bid process as part of the Stage 3 Expansion project. The current Revay & Associates Limited assignment expires at the end of 2017.

Revay & Associates Limited is required to support complex projects and scheduling at Duffin Creek Plant

Revay & Associates Limited is currently retained for the Stages 1 and 2 Upgrades project and assists with overall Duffin Creek Plant capital scheduling and planning, specific contract scheduling, with an emphasis on earned value analysis, and engineering and construction cost controls and claims mitigation. Revay & Associates Limited assists in monitoring Team Duffin fees and evaluating contractor claims as part of the successful management of change orders to date. Revay & Associates Limited's specialized technical claims and schedule analysis through the Stage 3 and Stages 1 and 2 projects has provided

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value to the Region, realized as reduced and avoided claims. This value can be realized again during the complex Incinerators 1 and 2 Replacement project.

Successes of York-Durham partnership supported by direct purchases

The Duffin Creek Plant operates as a partnership between York and Durham Regions and provides treatment to over 1.1 million residents. The complexities of this partnership are many, and implications reach across many local municipalities and councils. Team Duffin's performance and capability has resulted in strong confidence in their ability. A direct purchase assignment leverages this confidence and will service the Regions through reduced operational risk.

5. Financial Considerations

Conceptual cost estimates for the Biosolids Treatment Replacement Project are shown in Table 3. There is adequate Capital Spending Authority for this engineering assignment in the Environmental Services 2016 10 Year Capital Plan. Construction cost estimates will be further refined as the project progresses through detailed design. Any required adjustments to the Capital Spending Authority or the budget would be brought forward as part of the annual approval process for future capital budgets.

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Table 3
Estimated Cost of Replacement Project

Description	Cost Estimate	York Region Share*	Durham Region Share*
Engineering (Current Request)			
Team Duffin	\$20,000,000	\$15,000,000	\$5,000,000
Revay & Associates Limited	\$1,000,000	\$750,000	\$250,000
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Sub-total Consultant Services	\$21,000,000	\$15,750,000	\$5,250,000
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Construction (Future Costs)			
Pre-purchase Equipment Contracts	\$80,000,000	\$60,000,000	\$20,000,000
Construction Contracts	\$71,000,000	\$53,250,000	\$17,750,000
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Sub-total Construction Contracts	\$151,000,000**	\$113,250,000	\$37,750,000
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Total	\$172,000,000	\$129,000,000	\$43,000,000

* Estimated funding split - 75% York, 25% Durham

**Class 3 Conceptual Capital Cost Estimate

Fee estimate is appropriate based on previous experience

Regional staff have gained significant experience during the design and construction of the Stage 3 biosolids treatment process, which also involved two new incinerator units. Based on this recent and directly applicable experience, staff have detailed knowledge of the specific requirements, scope and level of effort needed to successfully undertake this replacement project. Whereas Stage 3 was undertaken as a stand-alone project constructed while offline within a new building, this current assignment has the added complexity of individually staging the replacements within an existing building while ensuring continuous compliance with Ministry of Environment and Climate Change regulations.

Directly related experience on Stage 3 allowed staff to independently verify that the estimated effort and forecast costs are comparable and competitive with the successfully completed project. This fee estimate compares favourably with other recent Greater Toronto Area projects within an operating wastewater facility with similar durations for which fees averaged 17 per cent of estimated capital costs,

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which demonstrates fair market value for this undertaking. The design and construction engineering services breakdown is shown in Table 4.

Table 4
Replacement Project Design and Construction Services
Cost Estimate Breakdown

Description	Cost Estimate	% of Construction Cost
Predesign and Detailed Design	\$5.8M	3.8%
Construction Services (site and office support and SCADA, excluding Project Management)	\$8.9M	5.9%
Project Management Services	\$2.7M	1.8%
Pre-purchase Coordination and Installation Supervision	\$1.8M	1.2%
Total Disbursements (3% of Labour)	\$0.8M	0.5%
Grand Total Team Duffin (Fees and Disbursements)	\$20.0M	13.2%
Total Revey (Fees and Disbursements)	\$1.0M	0.7%

The project is rate funded and associated costs were included in the asset management requirements of the Council-approved Rate Model and are accounted for in the 10 Year Capital Program. Partial cost recovery will be realized from Durham Region as part of the existing Duffin Creek Plant joint ownership agreement between York and Durham Regions.

6. Local Municipal Impact

Replacement of the Biosolids Treatment Project will provide a robust and reliable biosolids disposal program for forecasted future growth of both Regions and thereby the local municipalities through 2031. This is the final major upgrade associated with ensuring the Stage 3 Expansion's firm treatment capacity of 630 MLD through the 2031 projection window. The 630MLD capacity is still subject to the Minister of the Environment and Climate Change's decision on the outfall environmental assessment.

7. Conclusion

Team Duffin has demonstrated that they have the specialized qualifications to design and deliver the Biosolids Treatment Replacement Project with local forces needed to effectively manage a highly complex multidisciplinary project that interfaces throughout an operating plant, and the capacity and adaptability to do so with fiscal prudence and responsibility.

It is recommended that an agreement be negotiated and executed with Team Duffin (CH2M Hill Canada Inc. with AECOM Canada Ltd. as a sub-consultant) to complete design, tender documents, site supervision and construction administration for the Duffin Creek Plant Biosolids Treatment Replacement Project for an estimated assignment not to exceed \$20,000,000.

It is recommended that an agreement be negotiated and executed with Revay & Associates Limited to provide project planning and monitoring services for the Biosolids Treatment Replacement Project for an estimated assignment not to exceed \$1,000,000.

For more information on this report, please contact Mike Rabeau, Director, Capital Planning and Delivery at 1-877-464-9675 ext. 75157.

The Senior Management Group has reviewed this report.

April 21, 2017

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