

SCHEDULE E - FINAL

GMF Reporting Submissions

Pilot Project Completion Report Template

Please do not hesitate to contact your project officer to receive an electronic copy of the Pilot Project Completion Report template.

Upon completion of the Pilot Project, a copy of the Final Pilot Project Report must be submitted along with this Pilot Project Completion Report.

FCM will post your report at its Green Municipal Fund website¹ because one of FCM's mandates is to help municipal governments share their knowledge and expertise regarding municipal environmental projects, plans and studies. Therefore, before you submit a report to FCM, make sure that you hold the copyright in the report (i.e. you own all the rights in the report and can decide who is allowed to reproduce and distribute the report).

Confidentiality

If your report contains any confidential information that you would prefer not be made available to the public (e.g. through a case study or other materials produced by FCM that relate to your project), please submit two versions of the report:

- 1. Complete report including confidential information:** Please clearly label this report with the word "**Confidential**". FCM will treat it as confidential.
- 2. Abridged report excluding confidential information:** This report may be posted on the FCM website and otherwise made available to interested third parties.

Instructions to complete the Pilot Project Completion Report

The objective of asking applicants to submit a Pilot Project Completion Report is to share the story of a community's experience in undertaking a Pilot Project with others seeking to address similar issues in their own communities.

For this reason, please write the report in plain language that can be understood by people who are not specialists on the subject. A Pilot Project Completion Report is typically in the range of 5-10 pages, but may be longer or shorter, depending upon the complexity of the Pilot Project.

GMF grant recipients must enclose **final** copies of the Final Pilot Project Report as completed for the municipality usually by a consultant and this Pilot Project Completion Report as completed for and/or by the municipality in electronic formats with their final Request for Contribution. The electronic copies of the reports, including all attachments and appendices, must be submitted in MS Word format (.doc or .docx) or PDF (searchable) format.

Portable Document Format (PDF). Reports that are not clearly identifiable as final reports, such as those displaying headers, footers, titles or watermarks containing terms such as "draft" or "for internal use only", will not be accepted by GMF. Additionally, reports must be dated.

If you have questions about completing this report, please consult GMF staff.

¹ <http://www.fcm.ca/home/programs/green-municipal-fund.htm>

Pilot Project Completion Report

GMF number	15179
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Name, title, full address, phone, fax, e-mail of lead technical contact for this Pilot Project	Jessica Kellerman, P.Eng. Senior Project Engineer – Water Resources Engineering Services, Design & Construction City of Waterloo 100 Regina St. S. PO Box 337, Station Waterloo Waterloo, ON, N2J 4A8 P: 519-886-1550 x78243 F: 519-747-8523 TTY: 1-866-786-3941 E: Jessica.Kellerman@waterloo.ca
Date of the Report	December 15, 2021

1. Introduction

- a) Who was involved in doing the Pilot Project, and what are their affiliations? Please include name, title and contact information. Those involved could include municipal staff, engineering and other consultants, a representative from a nongovernmental organization, and others.

Company /	Name / Role	Contact Information
City of Waterloo	Jessica Kellerman, P.Eng. Project Manager	Jessica.kellerman@waterloo.ca
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Greenland Consulting Engineers	Jim Hartman, P. Eng. Technical Advisor / Project Manager	jhartman@grnland.com
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Greenland Consulting Engineers	Andrew Palmer, BES (Hons) Assistant project Manager / Site Inspector	apalmer@grnland.com
Greenland Consulting Engineers	Brad Parker, P.Eng. Contract Administration	bparker@grnland.com
Clearflow Group	Jerry Hanna Project Advisor	jerry.hanna@clearflowgroup.com
Jacobs Engineering Group (formerly CH2M Hill Canada)	Francine Kelly-Hooper, PhD Senior Soils Scientist - Beneficial Reuse Lead	Francine.KellyHooper@stantec.com
WOOD PLC	Randy Knudsen Geotechnical Lead	randy.knudsen@woodplc.com
RM Construction	Harry Reinders	harry@rmconstruction.ca

Please note that this project was approved by Council on August 22, 2016. The appendix lists the relevant excerpt of the meeting minutes from that date. The full minutes can be found at: <https://events.waterloo.ca/meetings/Detail/2016-08-22-1400-Council-Meeting-Televised/cc1ee3e2-0634-4af2-9fa3-aa1600b4ee08>

2. The Pilot Project

- a) Please describe the project objectives and the approach used to meet these objectives. Include details on what technology or solution was tested during the Pilot Project. (Indicate relevant sections/pages of the Final Pilot Project Report)

This particular project was a two-part initiative undertaken by the City of Waterloo (City) in partnership with Greenland International Consulting (GIC), Clearflow Group Inc. (Clearflow) and Jacobs Engineering Group (formerly CH2M Hill Canada). Assistance was also provided by the Green Municipal Fund for this Project.

The Creekside Stormwater Management Area (Pond 53) is located in the Laurelwood Basin B and feeds to the Laurel Creek Reservoir. The stormwater management facility (SWMF) had accumulated over 3,000 m³ of sediment since its installation in 2003, which indicated a very high sediment accumulation rate that can be partially attributed to upstream development.

The objective of the First Stage of this pilot project was to therefore remove this accumulated sediment (including using the sediment binding agent, Clearflow SoilLynx product) and re-design/retrofit the SWMF itself to improve the ability to maintain the SWMF, improve the inlet and outlet structures, improve function through the use of new innovative technologies (Clearflow WaterLynx) and increase flow influent stormwater flow path for improved sediment removal.

During sediment removal in 2018, the Soil Lynx product was applied as a binding agent to reduce the amount of water held in the sediment, thereby improving efficiencies in handling the material during removal activities and significantly reducing the time and cost requirements associated with these activities. Activated through moisture, this product was observed to bond with the surrounding soils and greatly reduced the impact water had on the consistency of the sediment material (behaving more like a solid than a liquid) and thereby allowing for more efficient loading and removal activities undertaken by the Contractor. Using the Clearflow SoilLynx product also eliminated the need for a drying area within the SWMF Block, which beneficially impacted staging throughout the construction process.

The “Bio Clear” design approach aimed to combine traditional forebay design with influence from Low Impact Development techniques (LID) to improve the function and maximize available space. To achieve this goal, the Water Lynx product was placed upstream of the incoming stormwater inlet infrastructure (3 inlet points in total) to increase sedimentation during normal operation of the SWMF. This task was completed in late-October and upon completion of all construction activities within the SWM Block lands.

Water Lynx excites very fine particles to coagulate/ bind the sediment together thus allowing the finer sediment to settle out more precipitously in the forebay. The new Pond 53 inlet and forebay design allowed for sufficient contact time with the WaterLynx product to improve the

project objective of enhanced sedimentation efficiencies in the SWMF. Monitoring activities are to soon be undertaken as per the requirements of the amended Environmental Compliance Approval issued by the Ministry of Environment, Conservation and Parks (MECP) and include:

Undertake “surface water sampling at five (5) distinct locations; within the Pond #53 permanent pool, the three (3) inlet locations and immediately downstream of the one (1) outlet location. As requested by the MOECC during a Pre-consultation Meeting undertaken (June 22, 2017), the monitoring plan will include a provision to monitor a variety of parameters which could potentially be elevated downstream of Pond #53 with the application of Clearflow products. These parameters include the following:

- *Chemical Oxygen Demand –Potential contributions by Water Lynx block 494, Water Lynx block 360, and Soil Lynx 398.*
- *Sodium – Potential contributions by Water Lynx block 494, Water Lynx block 360, and Soil Lynx 398.*
- *Aluminum – Potential contributions by Water Lynx 494 block as the inorganic coagulant Alum.*
- *Sulfur/Sulphate – Potential contributions by Water Lynx 494 block as the inorganic coagulant Alum.*

In addition, CBOD, TSS and TRC will also be monitored as per the requirements of this Project’s GMF Application.

This pilot project is expected to reduce long-term City costs associated with regular maintenance of the SWMF, and other facilities if implemented elsewhere in the future. In addition to the expected cost savings for maintenance activities, reducing / removing accumulated sediment in the SWMF is expected (along with the enhanced sedimentation provided by the WaterLynx product and inlet/forebay improvements) to improve the overall function of the SWMF by increasing permanent pool capacity and thereby improve water quality of stormwater discharged from the SWMF. This in turn will subsequently provide benefits to the Laurel Creek Reservoir, Silver Lake, the Grand River and further downstream to Lake Erie. As previously stated, a monitoring initiative (outlined in **Section 2a**) as per the amended ECA for this SWMF will quantitatively confirm the above expectations.

Finally, this pilot project also looked at the beneficial re-use of the removed sediment from Pond #53 (360m³ total) for use within a targeted local Municipal Right of Way (ROW). The purpose of this component of the project was to ascertain the suitability of using ‘contaminated’ sediment material from SWMFs as a growing medium in ROW areas. In addition, for this aspect of the project, our Project Team was also interested in developing a tested and proven methodology (proof of concept) for preventing disposal of all future sediment removed from SWMFs at certified landfill sites (where possible). Prior coordination with the MECP was successful in obtaining approvals for reuse of this sediment material within City limits. The City of Waterloo hopes to replicate this process and methodology for future SWMF cleanouts (depending on contaminant profiles / Table exceedances of subject sediment) in full cooperation with necessary MECP approvals. We expect this proven process will have very significant financial and social impacts for Municipalities across Canada (Landfill disposal of sediment can cost \$200+/m³). Currently, sediment removed from SWMFs is being transported to landfill sites

which not only places onerous disposal costs on Municipalities, but also reduces valuable landfill capacity that could otherwise be utilized for more traditional forms of waste.

- b) Did the pilot project include a methodology or approach for verifying or testing the performance of the technology or solution? Please respond Yes or No.

Yes [X]

No []

If you answered yes to Question #3, which methodology did you use in this pilot project for testing the performance of the technology or solution?

- Environmental Technology Verification Program
- Engineering Consultant
- Other (please specify) 2-year monitoring period.

As previously presented in **Section 2a**, it is too soon to begin monitoring activities as per the requirements of the amended Environmental Compliance Approval issued by the MECP. They do however include the following requirements as it relates to Water Quality determination:

Undertake “surface water sampling at five (5) distinct locations; within the Pond #53 permanent pool, the three (3) inlet locations and immediately downstream of the one (1) outlet location. As requested by the MOECC during a Pre-consultation Meeting undertaken (June 22, 2017), the monitoring plan will include a provision to monitor a variety of parameters which could potentially be elevated downstream of Pond #53 with the application of Clearflow products. These parameters include the following:

- Chemical Oxygen Demand – Potential contributions by Water Lynx block 494, Water Lynx block 360, and Soil Lynx 398.
- Sodium – Potential contributions by Water Lynx block 494, Water Lynx block 360, and Soil Lynx 398.
- Aluminum – Potential contributions by Water Lynx 494 block as the inorganic coagulant Alum.
- Sulfur/Sulphate – Potential contributions by Water Lynx 494 block as the inorganic coagulant Alum.

In addition to the above, CBOD, TSS and TRC will also be monitored as per the requirements of this Project’s GMF Application. This 2-year monitoring program will be initiated and undertaken by the City of Waterloo.

3. Pilot Project Results:

- a) What are the Pilot Project’s recommendations? (You may point to the relevant sections/pages of the Final Pilot Project Report if relevant.)

Please refer to **Section 5a** for a number of recommendations as it relates to this project.

- b) Is the Pilot Project *technically feasible* for full-scale implementation? Please comment on why or why not.

The Pilot Project is technically feasible given the completion of the sediment removal and retrofit project by the Contractor (utilizing Soil Lynx) and field adherence to all design specifications mandated by Greenland Consulting Engineers Ltd. Implementation of all SWMF retrofit features as per the design specifications was completed by the Contractor with the final SWMF as-builts matching those proposed in the initial GMF application.

Due to the recent completion of the retrofit portion of this project (September 2019) and installation of the Water Lynx blocks (late October 2019), the beneficial impacts associated with improved water quality (mainly TSS, CBOD and TRC reduction) still require time to verify through field monitoring as per the monitoring requirements outlined in **Section 2a** of this report. This 2-year monitoring period is required to quantitatively report on impacts associated with the SWMF Design towards reductions of the above listed parameters as per the innovative design and expected performance of this facility.

- c) What were the financial results of the Pilot Project and is the Pilot Project *financially feasible* for full-scale implementation? Please comment on why or why not.

The Pilot Project is financially feasible based final tallied costs for the constructed facility. It is fully expected that, given future contractors do not default on work (as was the case for the first contractor on this project), that this process could be implemented at other appropriate facilities on time and on budget. The project exceeded the initial cost estimate due to unforeseen site conditions that were accounted for through site instructions and change orders. A full breakdown of costs and all invoices is provided as a separate document.

- d) Please complete the following table that was part of your pilot project application with the actual results from your pilot project. Please also provide the page numbers where the environmental results of the pilot project can be found in the final report.

Wastewater indicators and projected performance

Project parameter (energy, water, waste, other)		Units	Baseline performance before project	Anticipated performance after project completion
Primary	Add Primary Indicator			
	Wastewater Quality(CBOD, TSS, TRC) <input type="text"/>	mg/l	0.26	0.06
Remove	Waste Diverted from Landfill(volume) <input type="text"/>	m ³	0	3,000
Remove	Total Suspended Solids Eliminated from Stormwater Runoff (% by we <input type="text"/>	%	70	97
Other	Add Other Indicator			

For the monitoring results, please refer to the following files:

- Memo for FCM Final Claim on Monitoring.pdf
- Monitoring Lab Results 2020 – Pond 53.pdf

These two attachments address this matter comprehensively.

- e) Please describe all of the environmental results including any potential negative results or trade-offs that need to be considered.

As per the recent installation of Water Lynx blocks upstream of the three (3) inlet points at the SWMF to comply with the prescribed design specifications, water quality monitoring will continue throughout the next 2-years as per the Amended ECA requirements prescribed by the MECP and further outlined in **Section 2a** of this report. The City will follow-up with FCM once sufficient data has been collected to quantitatively compare expected SWMF function to the above anticipated performance results. If any issues are noted during the upcoming monitoring period FCM will be immediately informed.

Additionally, 360m³ of sediment was removed from the SWM Block for use in the subject site ROW as specified in the associated GFM Application. This material was mixed with compost and hydroseeded in the ROW. The growth was monitored through the 2019 growing season and growth was successful on all plots. There is potential in the future to divert all tested sediment that meets MECP criteria away from landfills in future SWMF cleanout projects.

- f) Based on the experience gained in the pilot, please update the anticipated social and economic outcomes (community benefits) of full-scale implementation of the pilot project. Column B of the following tables shows the anticipated economic and social benefits you noted in your application.

Please complete the table below by describing in Column C the anticipated economic benefits of the pilot project at full scale implementation. Please complete for all that apply in the list below. If there are additional economic benefits, please describe these in the last row of the table.

Figure 1 – Economic benefits

A	B	C
Economic benefit	As described in your GMF application	Anticipated economic benefits of the pilot project at full scale based on pilot experience. If the result is different than what was expected in the application form, please indicate why .
Increased return on investment		
Deferred or avoided capital expenditures	Minimizing sediment accumulation in pond to defer cleanout frequency. Municipalities currently pay hundreds of thousands to millions of dollars to dispose of sediments at landfill facilities. Alternative beneficial reuse options would conserve municipal	Deferred capital expenditure will result from concentrating sediment accumulation in the sediment forebay area of the Pond #53 SWMF. Maximizing sediment accumulation to this area will allow for targeted and

	funds so they can be used to meet community needs.	less invasive / intensive maintenance practices undertaken by the City for associated removal tasks. Municipalities currently pay hundreds of thousands to millions of dollars to dispose of sediments at landfill facilities. Alternative beneficial reuse options (such as those implemented for this project) conserve municipal funds so they can be used to meet other community needs.
Decrease in facility operating or maintenance costs	Less frequent cleanout required	No change from initial expectation.
Extended lifespan for facility	Increases the usable life of the facility	No change from initial expectation.
Increased municipal revenue streams (e.g. property tax, user fees, etc.)	Sediment reuse to 3rd party sites could eventually provide a revenue stream for SWM.	No change from initial expectation.
Lower taxes		
Stimulus for local economy (use of local business, capacity for local business development)	Sediment reuse on 3rd party sites that are short on soil amendment suppliers could have positive impacts for local businesses.	No change from initial expectation.
Increased employment options or job retention		
Increased transit ridership		
Attraction of new businesses		
Other (please specify)		

g) Please complete the table below by describing in Column C the anticipated social benefits of the pilot project at full scale implementation. Please complete for all that apply in the list below. If there are additional social benefits, please describe these in the last row of the table.

Figure 2- Social benefits

A	B	C
Social benefits	As described in your GMF application	Anticipated social benefits of the pilot project at full scale implementation based on pilot experience If the result is different than what was expected in the application form, please indicate why .
Improvements to public health	Improvements to downstream water quality	To be determined as per the 2-year monitoring approach outlined in Section 2a of this report. Results

		expected to be good.
Improvements to public safety		
Improvements to community quality of life	A pond area that will provide good aesthetics and greater sediment removal efficiency	No change from initial expectation.
Increased opportunities for community engagement	Community will be involved throughout the process. Opportunities for planting events.	No change from initial expectation.
Increased public education or awareness	More public awareness and education on SWM features by virtue of completing the project.	No change from initial expectation.
Community revitalization		
New housing and infrastructure		
New or enhanced public space or public facilities		
Improved access to recreation and physical activities		
Reduced urban sprawl		
Increased civic pride, ownership and participation	The ultimate objective of the sediment beneficial reuse initiative is to create positive change for all Canadian communities.	No change from initial expectation.
Improved quality and efficiency of service provision to residents		
Reduced opportunities for crime		
Other (please specify)		

4. Lead Applicant's Next Steps

- a) What next steps does your municipality plan to take based on the findings and recommendations of the Pilot Project?

The City of Waterloo will evaluate future facilities for beneficial reuse and innovative retrofit designs based on their existing design, water quality, sediment quality and overall impact to the SWM system in Waterloo.

This would allow the City to develop a more effective system to improve downstream water quality and lower costs by diverting material from landfills.

The City of Waterloo is currently finalizing a Stormwater Management Master Plan which will prioritize facility cleanouts and retrofits based on need and we will subsequently evaluate each facility based on the results of the pilot study and the facilities net impact to the system. This will be completed through modeling and staff/agency observation.

5. Lessons Learned

In answering the questions in this section, please consider all aspects of the Pilot Project —from the initial planning through each of the essential task until the Final Report of the Pilot Project was prepared.

- a) What would you recommend to other municipalities interested in doing a similar Pilot Project?

The City would recommend that Municipalities first undertake a SWMF Condition Assessment Plan for all Municipal owned and operated facilities. Understanding, documenting and prioritizing long-term maintenance activities associated with each SWMF will assist Municipalities in maximizing each facility's life expectancy and aid in developing both short and long-term implementation programs for specific SWMF maintenance cycles as well as identify a capital works roadmap to ensure funding for maintenance activities is in place when the need arises. A part of this task would also include identifying and prioritizing SWMFs best suited for retrofit projects based on their current designs and reoccurring maintenance issues identified (including frequent sediment accumulation). Undertaking bathymetric survey analysis' as a part of this SWMF Condition Assessment Plan is would be quite helpful in quantitatively determining both the amount of sediment buildup within each SWMF, associated reductions in permanent pool capacity and negative impacts to overall SWMF function (water quality and quantity).

Municipalities should also be completing detailed watershed modeling to determine the current state of the receiving watershed areas impacted by stormwater (from a total suspended solids and nutrient perspective). By using tools, such as CANWET, municipalities can develop realistic targets for new development SWMF design, SWMF retrofit and water quality improvement projects in their watersheds and also develop metrics to assess successful projects.

What would you do differently if you were to do this again?

The City of Waterloo would first ensure that appropriate geotechnical investigations are undertaken for future SWMF retrofit and sediment removal projects. The City recognizes the importance of proactively undertaking such investigations for each associated SWM Block area, as varying soil compositions and groundwater levels can affect sediment removal and construction activities in a variety of ways. This would include undertaking a sediment sampling and survey analysis in advance of tendering to determine the composition/type of underlying materials within the SWM Block area (if not already completed in the aforementioned SWMF Condition Assessment Plan). Enhancing the understanding of each site's conditions would mitigate a great number of unknowns, each of which that could have associated impacts on the design of certain maintenance access features and site construction activities.

Additionally, and due to the detailed design element of this project, Municipalities should also consider undertaking an initial pre-qualification bidding round for interested Contractors. This would aid in best determining the skill and suitability of the applicant pool and their potential to complete the project on-time, on-budget and adhere to all recommended retrofit design modifications.

- b) What barriers/challenges (if any) did you encounter in doing this Pilot Project? How did you overcome them?

During the initial stages of the project, we had to complete extensive consultation with MECP with regards to the ECA approval for beneficial reuse. As this was the first approval of its kind in Canada, there was no precedent to follow. This involved many discussions and a large amount of data was required prior to obtaining approval. This data included many years of SWM monitoring data (provided in partnership with Francine Kelly-Hooper) and multiple risk assessments. Ultimately the approval was given and we were able to complete the first beneficial reuse study within municipal boundaries.

As previously mentioned, we encountered some challenges with geotechnical conditions on site. We overcame these challenges by conducting a thorough investigation of the subsurface conditions by a qualified consulting team and issued new site instructions/design changes to account for these unforeseen conditions.

6. Knowledge Sharing

- a) Is there a website where more information about the Pilot Project can be found? If so, please provide the URL.

There is no dedicated website.

In addition to the Pilot Project results, has your Pilot Project led to other activities that could be of interest to another municipality (for example, another pilot project, sharing of the results of this pilot project with other municipalities formally or informally, changes to existing policies and/or practices etc.)? If so, please list these outcomes and include copies of the relevant documents (or website links).

Due to the recent completion of this Pilot Project, the City of Waterloo is currently unaware of any other municipalities interested in replicating this Project for SWMFs within their own jurisdictional boundaries. The City of Waterloo will remain open to all future Municipal requests related to this Project however, including the methodologies utilized herein and associated efforts to replicate across the Province and Canada.

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