George Richardson
Stormwater Management Pond Retrofit

Location: Newmarket
Constructed: 2010-2012

Case Study

Public Lands

Project Objectives, Design & Performance

- Reduce phosphorus loadings to Lake Simcoe in accordance with the Lake Simcoe Environmental Management Strategy.
- Construct a demonstration site incorporating innovative red sand filtration to evaluate its effectiveness at reducing and trapping phosphorus.
- Improve water quality by reducing annual phosphorus loading into Lake Simcoe by 23 kilograms per year.

Overcoming Barriers & Lessons Learned

- Careful consideration had to be put into the design, including how to preserve fisheries, maintain the creek's base flow, and capture the majority of rain events through the treatment train.
- Including appropriate buffer time in the project for unexpected issues such as delays in the permit approval process and weather conditions is key to success.
- To avoid interrupting use of adjacent soccer fields construction was completed outside soccer season

Practices Implemented

Innovative SWM

Pollution Prevention

Barriers & Issues Encountered

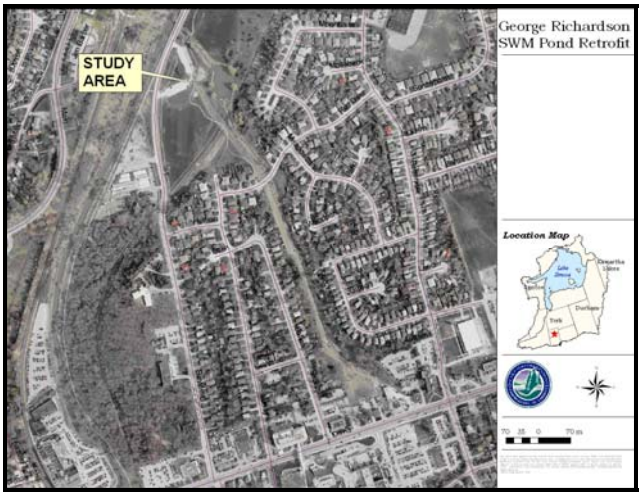
Planning & Regulations

Design

Construction & Comissioning

Overview

The George Richardson stormwater management pond retrofit is located in George Richardson Park, Newmarket. Eastern Creek traverses through the pond, and is a tributary of the East Holland River. The East Holland River is the most populated and polluted river in the Lake Simcoe Watershed.



George Richardson stormwater management pond location

Prior to the retrofit, the George Richardson stormwater pond was negatively impacting cold water fish habitats, water quality and oxygen levels. It was also a major source of pollutants (including phosphorus and suspended solids) entering through Cook's Bay at Lake Simcoe.

The George Richardson stormwater management pond was chosen as an ideal retrofit site as water quality was not incorporated into the original design. An innovative red sand filter was installed to capture the soluble phosphorus in the system as part of the treatment train.

Goals and Drivers

There were several goals and drivers that prompted the retrofit of the George Richardson stormwater management pond. These included:

- Improving stormwater management within the East Holland River watershed using innovative technologies
- Providing a low maintenance system
- Improving the existing natural riparian buffer around the pond to discourage edge disturbance and waterfowl access
- Creating a demonstration site using innovative technology and educate the community through signage
- Creating a by-pass channel to have base flow provide a means to create functional fish habitat and avoid creating a fish barrier with an online stormwater management pond
- Cleaning out the existing online pond to create a functional stormwater management pond but limit intrusion into the other park functions.
- Creating a berm to allow for extended detention of a small runoff event and minimize flooding in the park
- Monitoring the performance of the red sand filter as a pilot project for removal of phosphorus

Successes

The successes achieved thorough this project include:

Innovative technologies – The George Richardson Stormwater Management Pond Retrofit project is the first retrofit in Ontario to incorporate a red sand filter system.

Reduced phosphorus loading – This retrofit is aimed at improving stormwater quality by reducing phosphorus loading by 23 kg/year. Improvements were also made to water quality in overland flow through the installation of the enhanced riparian buffer.

Multi-partner collaboration – Lake Simcoe formed many partnerships to ensure the success of this project, including: the Regional Municipality of York (Landowner Environmental Assistance Program); the Lake Simcoe Conservation Foundation, the Town of Newmarket, Environment Canada and the RBC Blue Water Program.

Overcoming Barriers & Lessons Learned

A number of barriers were encountered over the course of this project. They included:

- Obtaining approval from some of the review agencies was difficult as innovative retrofits did not follow the typical guideline criteria
- As this project was an on-line pond, the design needed to include a fisheries component. Coming up with an ideal concept that would recognize the creek systems' base flow, while trying to capture the majority of rain events through the treatment train was challenging
- Accommodating construction works and maintaining recreational needs was a concern for the municipality due to the adjacent soccer fields

- Working under various weather conditions was problematic and involved dewatering the site frequently

The following approaches were used to overcome these barriers:

- Additional meetings were required with stakeholders to deal with and overcome these challenges by incorporating minor design changes through review team recommendations
- To isolate the old online pond, a bypass channel was constructed and vegetation allowed to become established for a full growing season. This step allowed the clean-out of the stormwater management pond and construction of the new pond to be completed primarily under dry conditions
- Temporary bypass channel became the ultimate low flow bypass channel for fisheries by the completion of the retrofit. A rock flow splitter was installed to accommodate creek base flow, while diverting storm events through the treatment train system (addressing the fisheries component of the project)
- The majority of challenges due to construction within a park were discussed at the beginning stages of the project and addressed in advance with the assistance of the consulting firm. Recreational disruption concerns were addressed by having all works completed outside of the soccer season and outside of the soccer fields' footprint
- Including appropriate buffer time in the project for unexpected issues such as delays in the permit approval process, weather conditions, and funding partner's time constraints are critical to ensuring the project's success

Lessons learned:

- A team comprised of partners working together to achieve the same goals and objectives was key to the success of this project
- Frequent on-site meeting with all partners was a key factor to the success of this project
- It is important to look one step ahead of the project and identify solutions to upcoming barriers or issues

Planning & Regulations

The municipality has retained a consulting firm to analyze the current conditions of all stormwater management ponds within their jurisdiction. The George Richardson stormwater management pond was identified as a priority site due to the large amount of sediment accumulated over the years. The treatment train approach implemented in the retrofit design extended the maintenance intervals along with a naturalized buffer that appealed to the municipality in the long term. Overall, the municipality was very receptive to the project and assisted with in-kind support during the community planting event. As well, the Town recognized a "no mow" vegetative buffer around the pond and by-pass channel.

The consulting firm assisted in the creation of a Feasibility Study which was used in the Environmental Assessment and public consultation process. The consulting firm also assisted in the creation of the final report and plans that were circulated to all approval agencies for review. All project partners provided input in the report and final design drawings.

Some of the review agencies found the application to be challenging as it was a retrofit project using new technologies (red sand filter). Additional meetings were required with stakeholders to deal with and overcome these challenges by incorporating minor design changes through review team recommendations. One of these challenges was to address the fisheries issue as the existing pond was considered on-line. To address this, the design incorporated a by-pass channel with a riparian buffer that allowed for base flow and fish migration along with a flow dissipater to allow for larger events to de directed through the treatment train. Proper planning and communication allowed these concerns to be addressed and resolved in a timely manner.

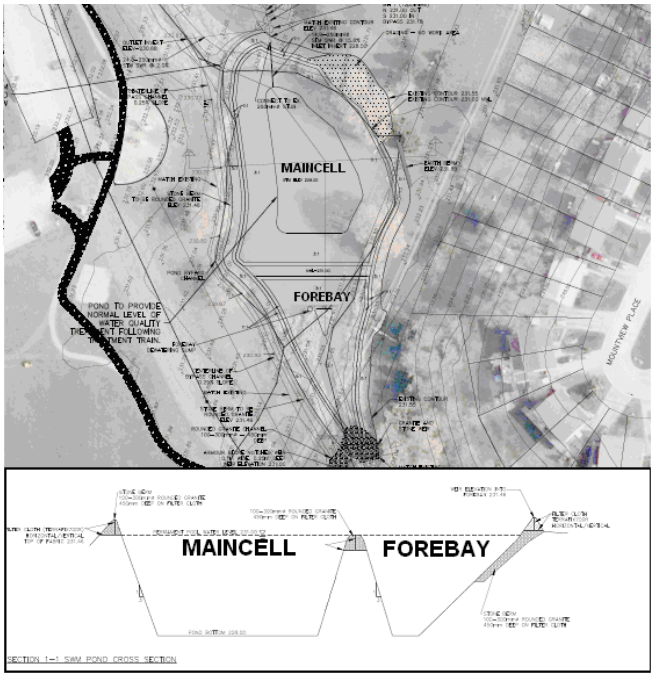
The Ministry of the Environment required an Application for Approval of Municipal and Private Sewage Works submitted in October 2009. The Certificate of Approval was issued on February 12th, 2010, outlining the terms and conditions which were subject to the approval. The Certificate of Approval outlines the owner's responsibilities towards the proper operation and maintenance activities that are required including inspections and record keeping of all activities. The Certificate of Approval also outlines the need for performance monitoring that the owner shall establish and carry out upon commencement of operation.

Design

The stormwater management pond retrofit was designed to capture stormwater runoff through a treatment train system, while recognizing the potential environmental impacts on the adjacent watercourse, Eastern Creek. A naturalized by-pass channel with flow splitter was constructed in order to maintain fisheries in the pond. As part of the treatment train, a forebay and main cell were created. After travelling through that part of the system, the storm water would then go through an oil/grit separator and finally through a polishing agent, the red sand filter.

Forebay and Main Cell

Both the forebay and main cell were excavated from an existing depth of 30cm down to 3 metres. The excavated soil was considered contaminated and had to be transported to a licensed treatment facility at a cost of $250,000, which was included in the contruction costs.



Stormwater management pond forebay and main cell

Key Facts

Issues

- Delays in construction due to weather conditions and continuous dewatering

Solutions & Lessons Learned

- Frequent on-site meeting with all partners was a key factor to the success of this project
- Continuing to look one step ahead of the project with possible solutions available for any upcoming issues

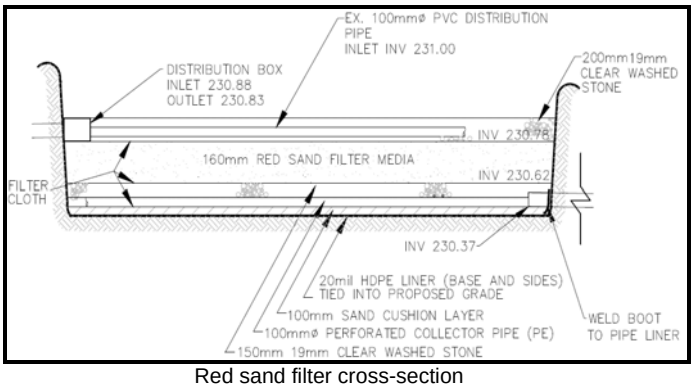
Oil/grit Separator

This unit was placed downstream of the forebay and main cell to capture the smaller particulates before water enters the red sand filter for extensive phosphorus removal.

Red Sand Filter

Through testing of numerous sand mixes, the red sand was found to have adequate percolation and phosphorus retention capability, allowing it to reduce greater than 99% of total phosphorus and other minerals. This technology was installed as the last part of the treatment train to function as a final polishing unit. The underground system was first lined with a Bentonite liner to minimize groundwater exchange, with various layers of clear stone and red sand sandwiched between nonwoven geotextile fabrics.

The water is distributed via a system of perforated piping covering the top layer of the underground system just above the red sand filter media. Collector pipes are located near the bottom. The cross section of the underground system with the red sand filter is shown below. The system is estimated to have a reduction in phosphorus of 23 kg/year.



Red sand filter cross-section

Design Issues

A key component in the design was to recognize the existing features surrounding the pond. All large trees remained untouched and were incorporated into the design.

Also considered when designing this stormwater management pond was the very slight grade change at the site. In order to use gravity to maintain flows without having to rely on any pumping system, the final grading needed to follow the plans, allowing little tolerance. To minimize loss of recreational opportunity at the George Richardson Park, the project was designed so that the pre and post construction water levels and grades did not change. This required careful consideration in design as the entire area is within the regional storm floodplain

Construction & Commissioning

Construction took place over a two year period in two separate phases during which time several issues were encountered by the contractor.

Excavating the main cell of the stormwater management pond

Construction Phases

The first phase of this project was finished in March 2010 and included the installation of a red sand filtration system. The final steps involved retrofitting the stormwater management facility on town-owned lands. In September 2011, construction began on the creation of a sediment forebay (permanent pool) and main cell, the creation of a flow splitter to connect the by-pass stream channel and extensive landscape restoration.

Excavated underground System

Construction Drawings

Several minor changes were made to the drawings in reference to the rock flow splitter and final berm elevations in order to address some fisheries issues and backflow concerns. These changes were fairly minor in nature and simple for the contractor to accommodate.

Creating a stone covered berm between sections of the pond

Sediment and Erosion Control

Sediment and erosion control measures were monitored daily and repaired when required. These measures included:

- Reducing topsoil stripping as much as possible and seeding individual lots as soon as possible
- Placing silt fencing downstream of all excavated material to prevent sediment transport
- Maintaining the existing grassland vegetation/wooded areas along the development limits to provide a natural barrier to filter potentially sediment loaded overland flow
- Providing conveyance protection by placing rock check dams and straw bales at intervals along constructed ditches and at the outlet culvert prior to construction.
- Using a mud-mat that consists of large diameter rip-rap at the entrance to control mud tracking from construction traffic.

Protection of existing grassland vegetation/wooded areas during construction

Dewatering

The pond area was dewatered during the excavation process while maintaining base flow of the creek system. The discharge was connected to filter bags which were replaced on a weekly basis.

Economic (Capital and O&M Costs)

The approximate capital costs for the stormwater management pond retrofit are provided in the table below.

Item	Approximate Costs
Design/consultant fees	~$70,000
Construction final grading and riparian buffer installation	~$1,000,000

The cost of hauling the contaminated soil to an appropriate facility was a key factor that influenced the price of the project, accounting for approximately $250,000 of the $1 million spent on construction.

Proper planning and the ability to foresee potential problems is the key to a successful project. The creation of detailed site plans and obtaining soil samples assisted in determining how much fill material needed to be taken off site and depending on the soil results, where the material could go. Through the Environmental Assessment process, the public was invited to an open house. Further to advertising the open house in the local papers, an invitation was delivered to all homes within a one kilometer radius of the subject project. Every effort was made on this project to be cost effective. This included the project partners providing both cash and in-kind contributions and the community assisting with an Earth Day event, planting over 1,000 trees and shrubs at the project site.

Operations and Maintenance

With proper monitoring, operation and maintenance times should be kept to a minimum. The project was designed to be low maintenance, allowing long time intervals between any clean out or dredging.

The installation of native plants around the perimeter of the project requires no maintenance or watering, reducing staff time at the park for the municipality. Regular inspections will be performed to remove any accumulated litter or debris by hand.

Grass cutting is not recommended in order to maintain a natural environment and increased water quality benefits. Weed control is not anticipated or recommended for this facility. The use of herbicides and insecticides is prohibited because of potential water quality concerns in the downstream areas. The use of fertilizer is limited in order to prevent nutrient loading to downstream areas.

Long-Term Performance

As the George Richardson Stormwater Pond retrofit project was completed in 2012, long-term performance data is currently unavailable.

Pre- and post-construction monitoring is in place and early data indicates a reduction in total suspended solids and phosphorus after going through the system. The monitoring program plans to operate for three years in non-winter months, during and after typical rain events. Six samples will be collected annually to get comparative seasonal readings, dry weather flow and several wet weather flow conditions. The water quality samples will be collected from the upstream and downstream manholes of the red sand filter as well as at the inlet of the stormwater management pond forebay and downstream of the extended detention outlet.

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