CVC
CREDIT VALLEY CONSERVATION

Riverwood

Low Impact Development Infrastructure Performance and Risk Assessment
May 2016

Monitoring Plan

Public Lands

Credit Valley Conservation Proposal: Monitoring of a Innovative Multi-Functional Green Infrastructure Project

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BACKGROUND

Municipalities across Canada are struggling to address a number of issues, from aging infrastructure to insufficient stormwater management, to prevent the degradation of receiving streams and the Great Lakes, and damage to property and infrastructure from erosion and flooding.

Credit Valley Conservation (CVC) in partnership with The Riverwood Conservancy is pleased to submit a proposal for consideration by the Ministry of the Environment (MOE). This unique project will help educate urban municipalities on how to manage stormwater and the environment in light of climate change; providing a template which municipalities can employ to cost-effectively address environmental and development issues.

The purpose of the study is to evaluate the effectiveness of a parking lot bioswale in managing parking lot runoff, with respect to: catchment hydrology, and surface water quality. This project is unique in that it will be incorporated into The Riverwood Conservancy's environmental education programming for high school students. Students will have the opportunity to receive hands on experience assisting with the collection and analysis of monitoring data. In addition, the project will provide insight into how infiltration performs in tight soils to support future direction in stormwater management.

PROJECT DELIVERABLES

1. To support MOE initiatives such as source protection and municipal stormwater management in light of climate change.

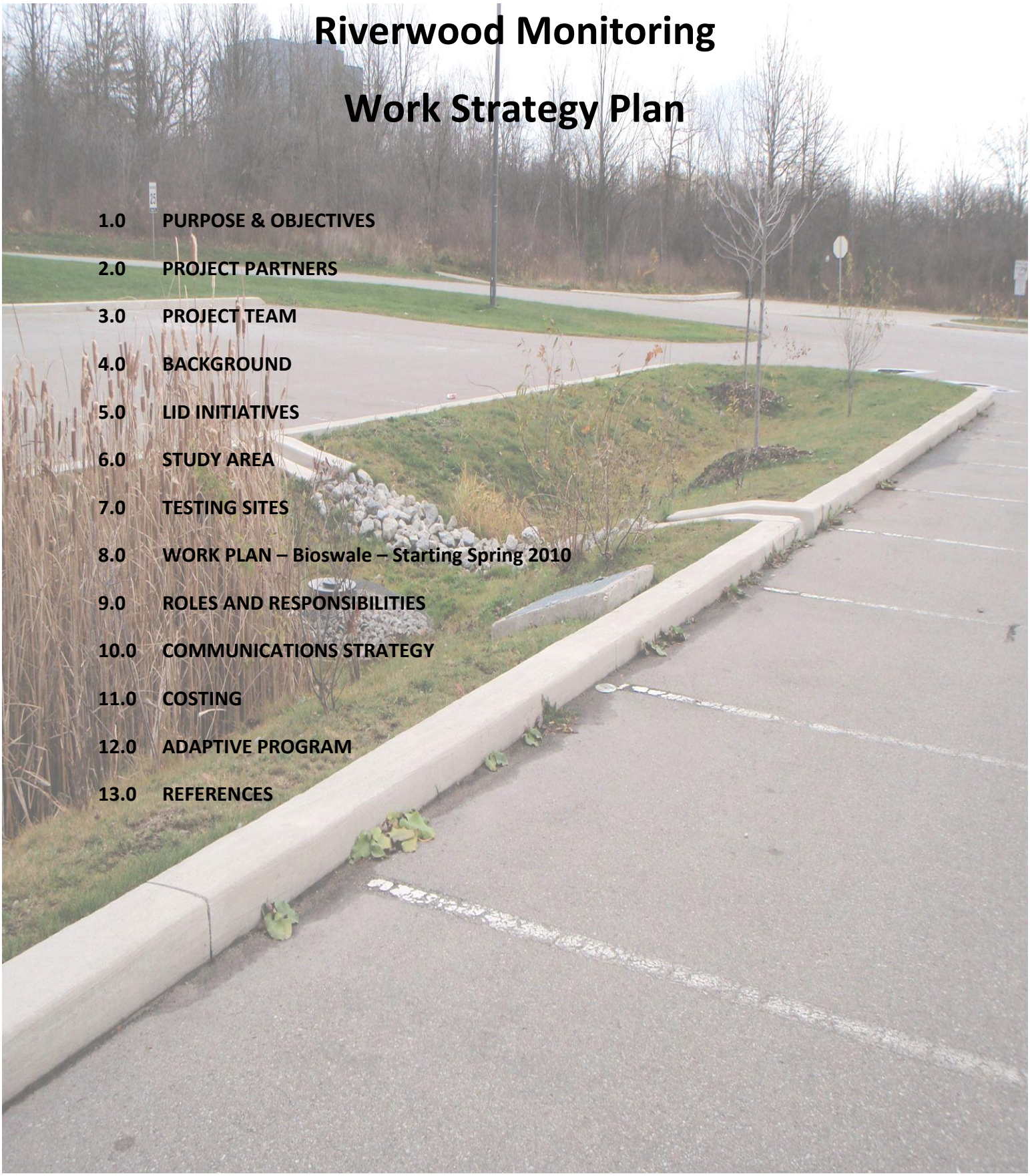
2. "Innovative" stormwater management demonstration site
   This stormwater treatment approach is "above and beyond" the standard practices in place pertaining to stormwater management in Ontario, using a bioswale as source control for innovative parking lot stormwater treatment and management. There is also little performance data currently available to support design initiatives of such practices.

3. Template for Municipalities Across Ontario
   Comprehensive effectiveness monitoring of performance data will be conducted to provide municipalities across Ontario with a template for LID implementation.

4. Integration in The Riverwood Conservancy's environmental education programming.

PROJECT SCHEDULE

1. Initiation of Environmental Monitoring – Spring 2010
2. End of Project – Late Fall 2013



Riverwood Monitoring

Work Strategy Plan

1. Monitoring Purpose and Objectives

The purpose of the study is to evaluate the effectiveness of a bioswale, a Low Impact Development (LID) method, used in a parking lot. To monitor the parking lot bioswale's performance with respect to catchment hydrology, water quality, hydrogeology, and ecology.

Objectives:

- Evaluate the pollutant removal capabilities compared to the Provincial Water Quality Objectives (PWQO) and flow reduction capabilities of the bioswale.
- Sample the soils and tissue of the plants in the bioswale to see if they are accumulating toxic substances.
- Add to The Riverwood Conservancy's public education programming. This project is an effective medium for public education as well and a way to get Credit Valley Conservation (CVC) and The Riverwood Conservancy (TRC) messages out to the community, making the connections between a healthy environment, economy, and society.

This monitoring plan is based the protocols and practices being used on other CVC monitoring programs.

2. Project Partners

1. The Riverwood Conservancy (TRC)
2. Credit Valley Conservation Authority (CVC)
3. City of Mississauga

3. Project Team

- The Riverwood Conservancy Staff
- Christine Zimmer, Senior Water Resources Engineer, CVC
- Jennifer Dougherty, Water Quality Engineer, CVC
- Phil James, Water Resources Engineer, CVC
- Neelam Gupta, Water Resources Engineer - Hydrology, CVC
- Robb Lukes, Water Resources Specialist, CVC
- Andrew O'Rourke, Water Resources Specialist, CVC
- Jakub Wrobel, Water Resources Assistant, CVC

4. Background

Our communities are supported by functions provided by our environment such as abundant, safe drinking water, and clean air. Studies conducted on the Credit River Watershed have found that we need to integrate how we build our communities with how we manage our stormwater to support a sustainable environment. This is known as Low Impact Development (LID). The parking lot for TRC includes a bioswale that will help reduce storm water runoff and improve water quality discharging into the Riverwood Wetland and eventually into the Credit River.

Since LID attempts to mimic natural processes, its performance depends on local conditions including, climate, soils, and drainage. Individual LID measures should be examined with respect to basic hydrological cycle components: evapotranspiration, infiltration, and runoff. Stormwater infiltration occurs on natural soils with pervious cover and at special facilities (bioretention and swales) located throughout the catchment area. At Riverwood, it is expected that most infiltration will occur in the parking lot bioswale. CVC would like to work with TRC to assess if the LID practices put in place do indeed lead to a more natural site hydrology and water quality than in conventional parking lots.

This monitoring project can act as a model to other sites contemplating bio-retention systems and a point of comparison to other locations with similar systems already in place.

5. LID Initiatives

The most commonly used method of stormwater drainage in parking lots is curb and gutter. It is a very effective method for draining stormwater; however, it may be too effective. With curb and gutter drainage, storm water is quickly brought to receiving watercourses in impervious pipes. Very little of the water therefore soaks into the ground to be naturally filtered before it reaches these watercourses. This can lead to a number of problems in local streams including flash flooding, a decline water quality, and a reduction of stream baseflow and groundwater levels. **Biofilters** are very beneficial for stormwater management. They can reduce pollutant and sediment concentrations, and can have significant reduction time of flow to local creeks and storm drain systems. **Biofilters** or bioretention cells are a stormwater management technique that uses the chemical, biological, and physical properties of plants and soils to treat stormwater runoff. They are designed to mimic natural conditions promoting infiltration, retention, and the slow release of stormwater runoff.

6. Study Area

The subject site for the study is located in Mississauga, Peel Region, Ontario (figure 1). Located in central Mississauga and nestled predominantly along the east bank of the Credit River, the 60-hectare (150-acre) Riverwood property is a special place where history, nature, beauty and peace blend together to create an enjoyable and lasting outdoor experience (figure 2).

The stormwater drainage for the main parking lot of TRC is served by a combination of catchbasins with internal storm sewers, and a bioswale, which drain directly to a wetland pond. Most of the parking lot drainage sheet flows to a central bioswale. The overflow catchbasin has been identified as ideal for installing monitoring equipment (Figure 3 & 4). Since the bioswale drains the majority of the parking lot, it is possible to equip the catchbasin with monitoring equipment to measure flow and take water samples during a rainfall or snowmelt event. The TRC has a weather station located on the property that could provide precipitation data (Figure 5) or an Isco Model 674 rain gauge could be attached to the auto sampler for more accurate rainfall measurements.

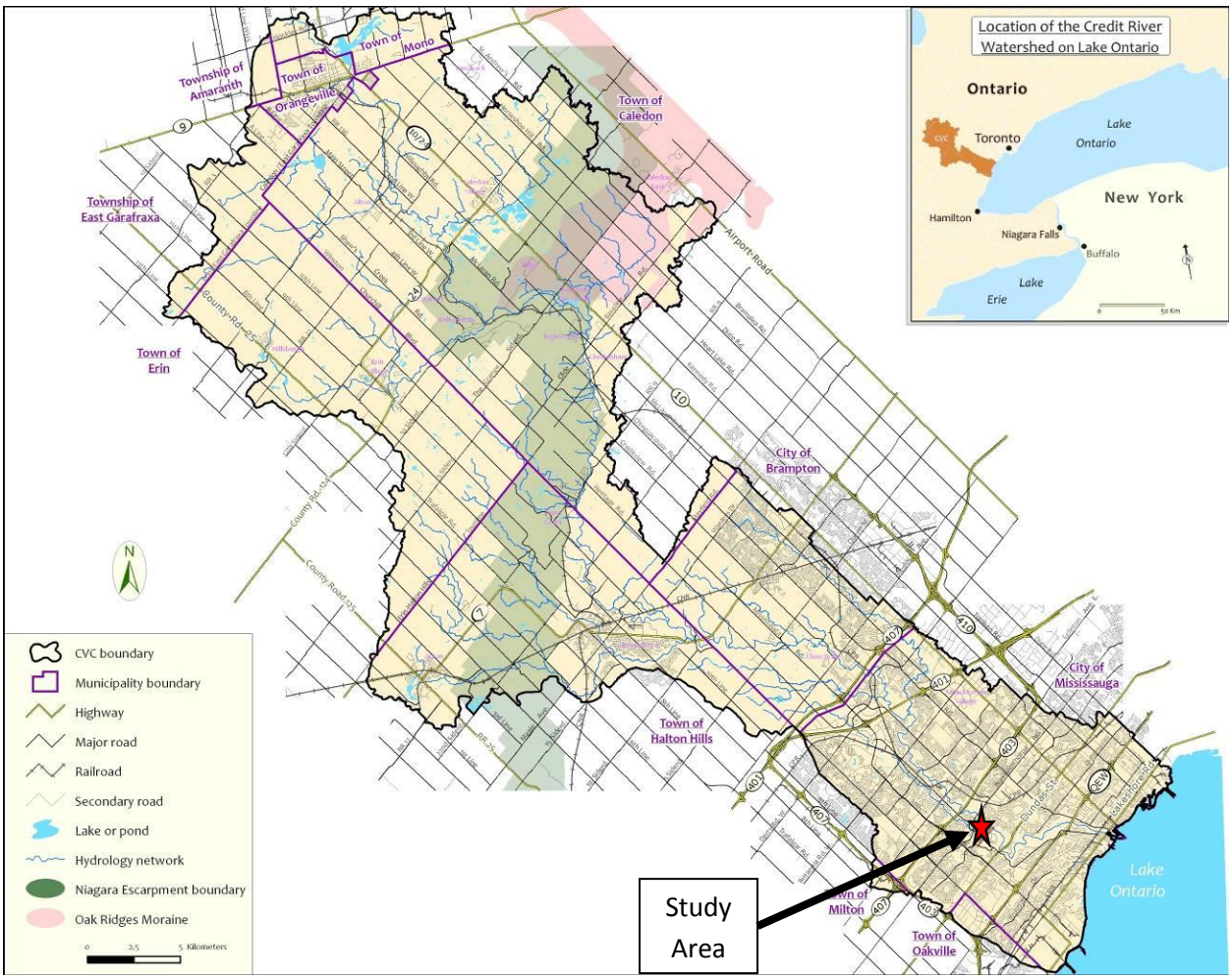


Figure 1: TRC within the Credit River Watershed.

Figure 2: Ariel View of parking lot, bioswale and Riverwood Wetland.

Figure 3: Bioswale overflow catchbasin monitoring location

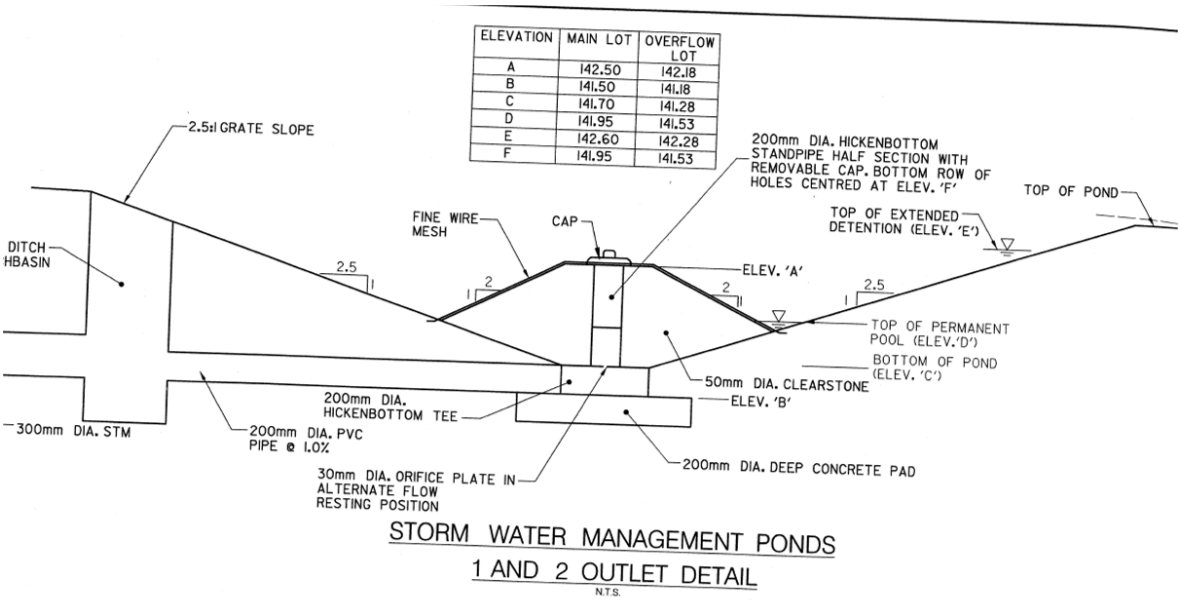


Figure 4: Cross section of the Riverwood Bioswale.

Figure 5: TRC weather station

Figure 6: TRC main parking lot bioswale

Figure 7: Riverwood Wetland

7. Individual Testing Sites

Monitoring is proposed in the overflow catchbasin of the bioswale in the main parking lot of TRC to see the effectiveness of the LID practice (Figure 3).

8. Work Plan – Bioswale – Starting Spring 2010

8.1 Instrumentation

A site visit was conducted to review the existing drainage infrastructure and assess suitable types of equipment for the monitoring program.

The equipment located at this site is proposed as follows:

- Isco 6712 sampler
- Isco 750 area velocity flow module for 6712 sampler
- Solar panel and battery
- Box for secure onsite equipment storage
- Isco 674 rain gauge

All equipment will be set to log every 10 minutes. Data will be stored in the auto sampler's memory and downloaded either remotely or in person biweekly as a minimum using ISCO Flowlink 5 software (or equivalent). The software will automatically summarize and plot the data together graphically, which can then easily be exported to a program like Microsoft Excel.

The site will be visited at a minimum of every two weeks to check battery power, inspect equipment, and make sure everything is operational.

Figure 7: Equipment

8.2 Hydrology

A flume or weir may be installed for accurate level and flow measurements. An area velocity level and flow meter will be connected to the Auto Sampler and will be set to record water level and flow at 10-minute intervals.

8.3 Water Quality

Five (5) precipitation events will be sampled per year with the Isco Auto sampler. Samples will be analysed for:

- Chloride
- Conductivity

- pH
- Total Suspended Solids (TSS)
- Nutrients:
    - Total Phosphorus
    - Total Ammonia
    - Nitrate & Nitrite
- Metals
- PAH (only 2 events, June-July)
- E.Coli Bacteria (only 2 events, June-July)

Each sampler holds twenty-four (24) one (1) litre bottles. Event sampling will be conducted as follows:

- Two (2) samples will be submitted per event.
- 1 initial grab sample will be collected in the samplers first 6 bottles and submitted for analysis.
- The remaining 18 bottles will then be filled 500 mL every 10 minutes. Therefore, 1 bottle will be filled every 20 minutes and the program will last for 6 hours. The 18 bottles will then be mixed into 1 flow weighted composite sample and submitted for analysis.
- Samples will be brought to an accredited Canadian Laboratory for laboratory analysis.

8.4 Soil Sampling

Three soil samples will be collected from the bioswale in the first year of the monitoring program, to see if toxic substances are accumulating in the bioswale's soils. Samples will be collected by hand using a soil auger and submitted for analysis of trace metals, oil & grease, and PAHs. Results from the first year of sampling will be analysed and a decision will be made as to whether soil sampling should be continued in subsequent years. Soil sampling protocols found in the Ministry of the Environment's "Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario" will be followed. Samples will be brought to an accredited Canadian Laboratory for laboratory analysis.

8.5 Vegetation Sampling (Only if the MOE agrees to provide laboratory analysis)

Three tissue samples will be collected from the cattails growing in the bioswale in the first year of the monitoring program, to see if toxic substances are accumulating in the plants. Samples will be submitted for analysis of trace metals, and PAHs. Results from the first year of sampling will be analysed and a decision will be made as to whether plant tissue sampling should be continued in subsequent years. Samples will be brought to an accredited Canadian Laboratory for laboratory analysis.

9. Roles and Responsibilities

CVC will be responsible for the bioswale monitoring component of the monitoring program including equipment purchases, equipment maintenance, fieldwork, data management and analysis, and

reporting. CVC will provide TRC staff regular updates (likely bimonthly) of the monitoring data in Excel format for use in Riverwood's educational programming.

10. Communications Strategy

Signage will be created for the bioswale that will contain interpretive content for the general public. The City of Mississauga is developing protocols and the look for a "family of signs" for Riverwood.

11. Costing

A table outlining monitoring costs for the research project is summarized in Appendix 2.

12. Adaptive Program

The program is intended to be adaptive in nature, implying that the program will be continually reviewed and changes may be made to the sampling protocols, methods, and locations as needed.

13. References

Ontario Ministry of the Environment and Energy, Standards Development Branch. 1996. Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario.