LID Case Studies & Tools

Phil James, P. Eng
Credit Valley Conservation

Presentation Overview

- Overview of LID demonstration projects;
- Key lessons learned related to design, construction, operation & maintenance, monitoring;
- LID Implementation & Support Tools

IMAX Video

IMAX Corporation
Parking Lot Expansion & Redevelopment

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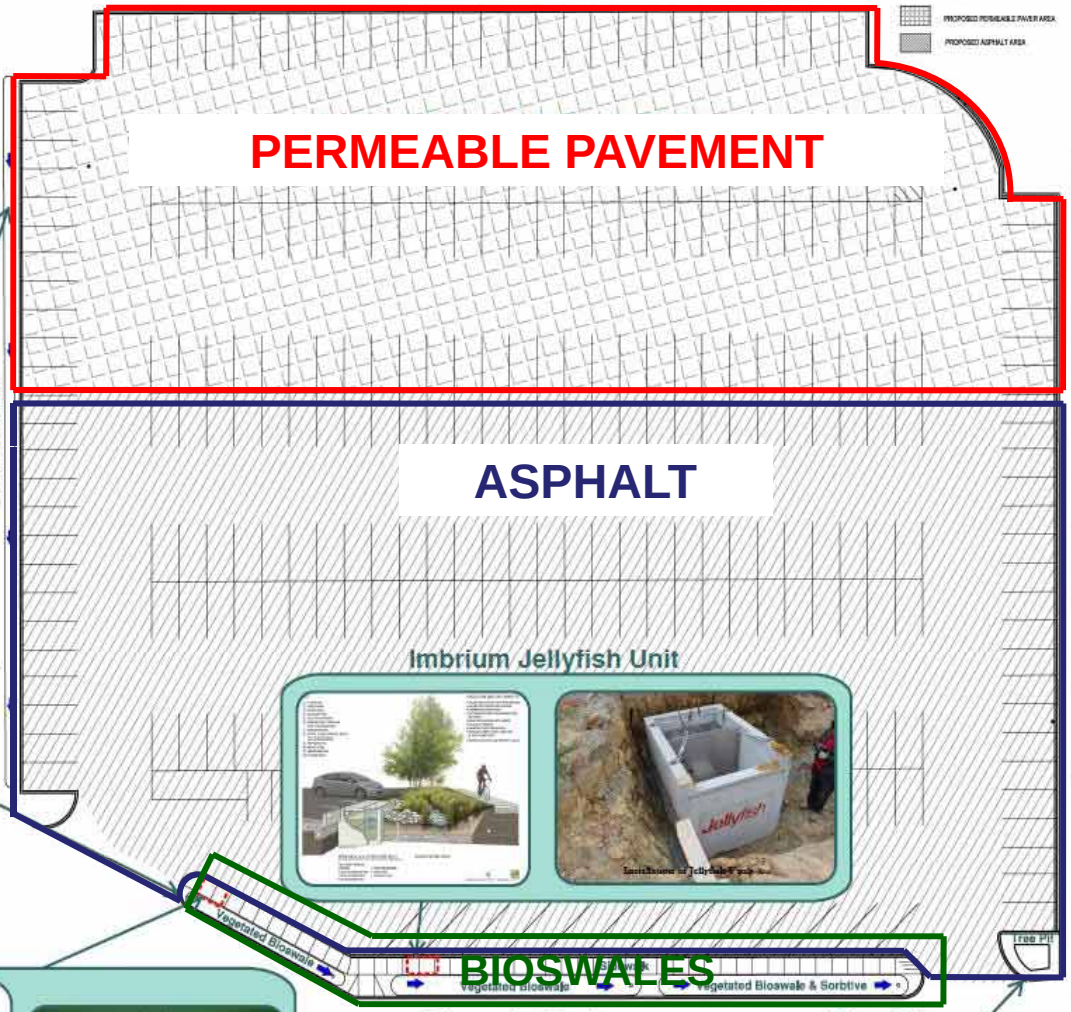
Aquafor Beech Limited



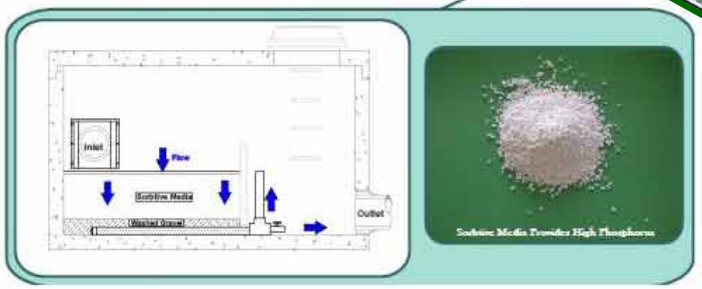
Sod Covered Bioswale

Permeable Pavers

Vegetated Bioswales

Asphalt Parking

Imbrium Sorbtive Vault
&
Sorbtive Media



Bioswale Media

Tree Pit

Vegetated Bioswales &
Sorbtive Media

Permeable Pavement & Bioretention

Applied a variety of innovative technologies;

Treatment Trains ***to build resilience & robustness***;

Permeable Pavement with different granular bases (Granular 'O' & ¾" clear);

Permeable Pavement with impermeable Liner;

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Oct 26, 2012

Nov 7, 2012


Nov 14, 2012


Nov 20, 2012


Nov 22, 2012


Nov 26, 2012


Dec 21, 2012


Nov 14, 2012
FIRE ROUTE
RESERVED
PARKING


Nov 20, 2012
CAT


Nov 21, 2012
STEPS
STEPS


Nov 21, 2012
STEPS
STEPS
105
5
PC
2


Nov 21, 2012
STEPS
105
5
PC
2


Nov 26, 2012
STEPS


Dec 5, 2012


Dec 10, 2012


Dec 12, 2012


Dec 14, 2012


Dec 21, 2012


24 to 48 hrs later
Parking lot runoff is filtered, cooled and slowly released to Sheridan Creek


2013/ 9/19 9:05

Treatment Train #1

<u>Treatment Train #1</u>
Asphalt to Jellyfish unit to Bioretention

Jellyfish
-Cartridge filters
-Oils & Greases
-Large & small sediment particles

Bioretention
- Further polishing & Cooling

Treatment Train #2

Asphalt to Bioretention to Sorbtive Media Vault

Bioretention
-Primary treatment

Sorbtive Media Vault
- Dissolved nutrient removal

Overflow by-passes Sorbtive Media Vault

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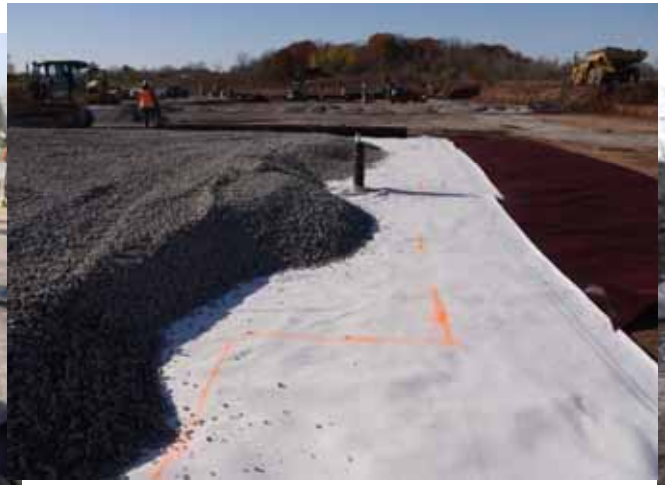
Why do LID Projects Fail?

- Plans without enough detail and instruction;
- Designers who do not understand the complexities of construction;
- Contractors who do not understand the technology or importance of certain procedures;
- Lack of effective erosion and sediment control during construction.

Full Time Construction Inspection



As-built survey

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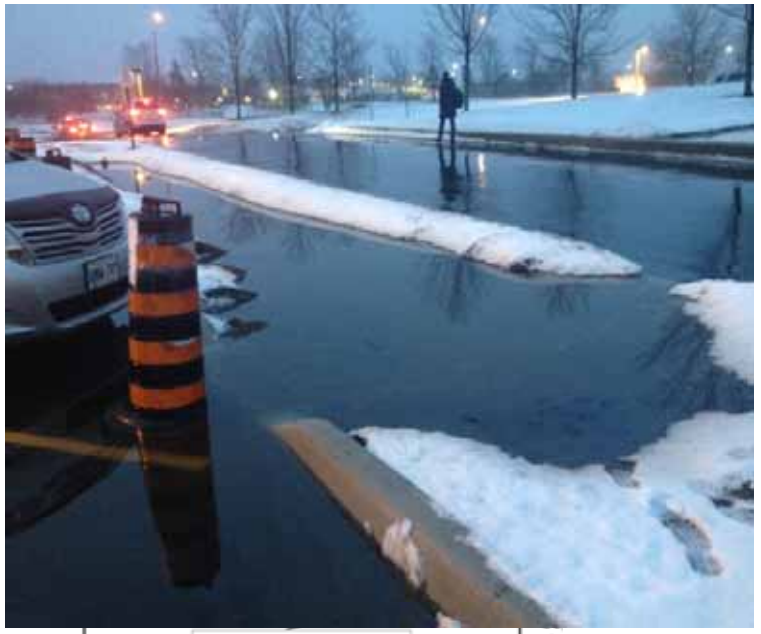
Erosion & Sediment Control

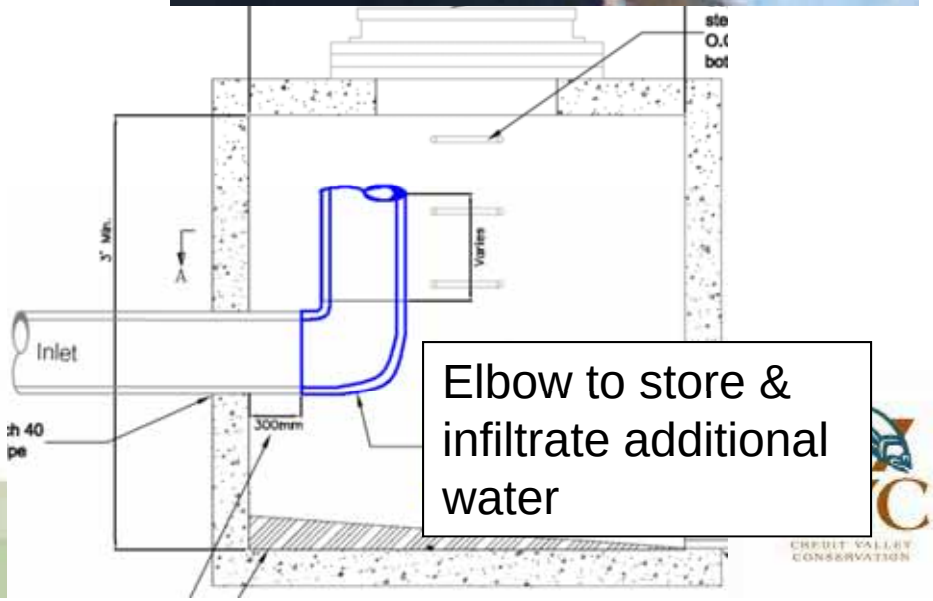
Need to protect infiltration practices!

During construction, access to the permeable pavers was limited to a single location so that conditions could be monitored, and maintained more efficiently.

Design

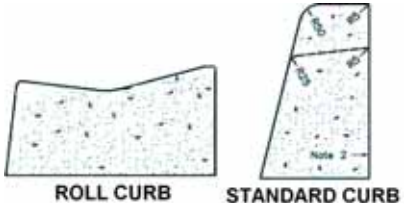
- Integrate monitoring infrastructure into the engineering design!
- Incorporate optimization features;
- Add additional surface inlets to minimize the chance of excessive ponding;





Elbow to store & infiltrate additional water

Operation & Maintenance



Roll curb allows contractor to push snow completely off the parking lot

Meltwater does not flow back across asphalt surface creating icy conditions

Contractor pushes snow to perimeter of the parking lot

Risk of hitting curbs if curb markers are not in place

Construction

Compaction around light standards

Fine grading of bioretention areas after planting to stop short circuiting

Small & Medium Sized Businesses

Outdoor Fueling & Spill Preparedness

Snow & Ice Management

Outdoor Storage

Illegal Dumping

Pollution Prevention (P2) Eliminate sources of pollutants that come into contact with stormwater

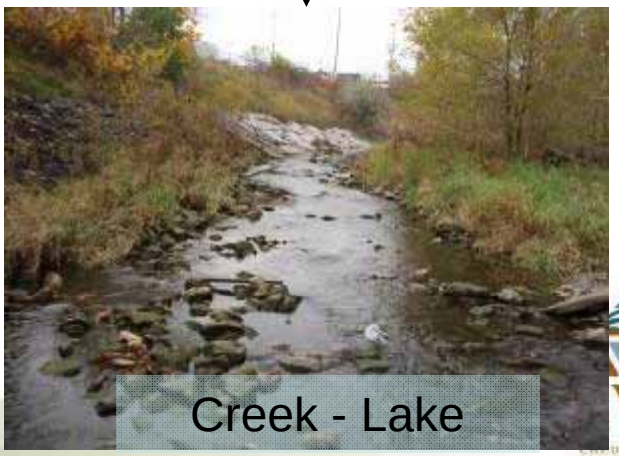
Outdoor Material Storage

Parking Lot Maintenance

Dumpster Management

Outdoor Auto Repair

Why is Pollution Prevention Important to LID?



P2 Best Management Practices

Replace dumpsters

Fuel station spill pad

Waste oil drums with spill pallets

Covered storage

Approved paint & solvent storage shed

Landowner installed fencing to prevent illegal dumping, and improper storage of materials

With P2 under control look at Low Impact Development (LID) techniques

- Vegetated buffers
- Placed a deep layer of topsoil
- Plant native trees & shrubs with mulch

Protection!!
Installed large boulders and wooden posts to prevent encroachments

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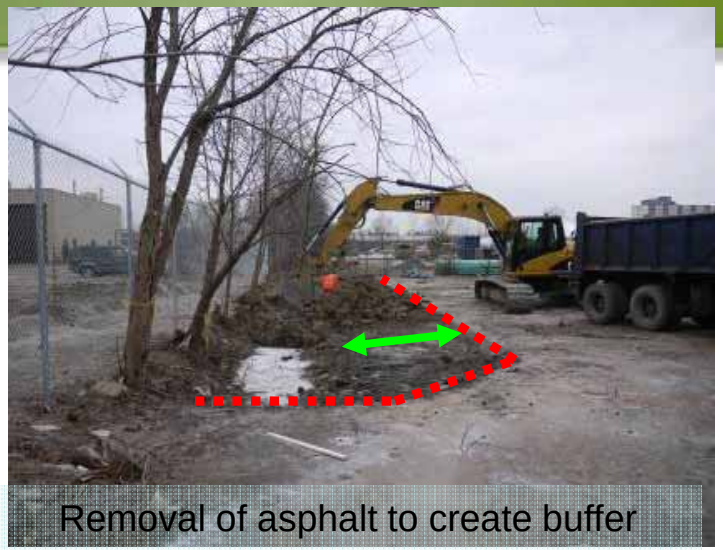
Enhanced Swales & Sediment traps

August 2009



Removal of asphalt to create buffer

December 10, 2010

September 20, 2011

August 2013

Removal of invasive species

Remove asphalt to create buffer

Plant Native species

Sediment traps to capture large particles and debris

Soil amendments

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Vegetated Buffers and Enhanced Grass Swales

Before Construction (2009)

After Construction – after rain event

2012

<u>Swale Design</u>

Wide bottom width - 0.75 m

Gentle Side slopes - 2.5:1 to 3:1

Gentle Velocity – less than 0.5 m/s for **25 mm storm**

Shallow Flow – less than 100 mm for **25 mm storm**

Flat Longitudinal slope – 0.5 to 2.0 %

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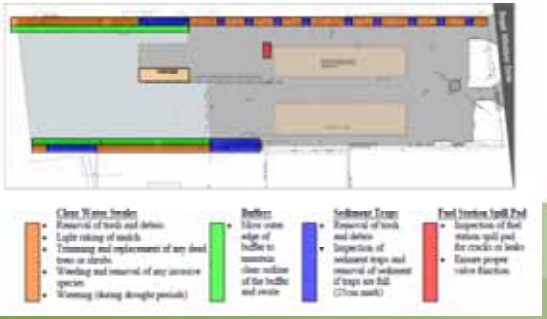
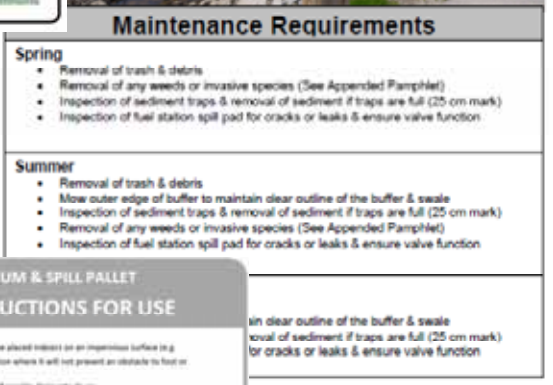
Operation & Maintenance Guidance Critical!!

Bernardi Building Supply Maintenance Locations

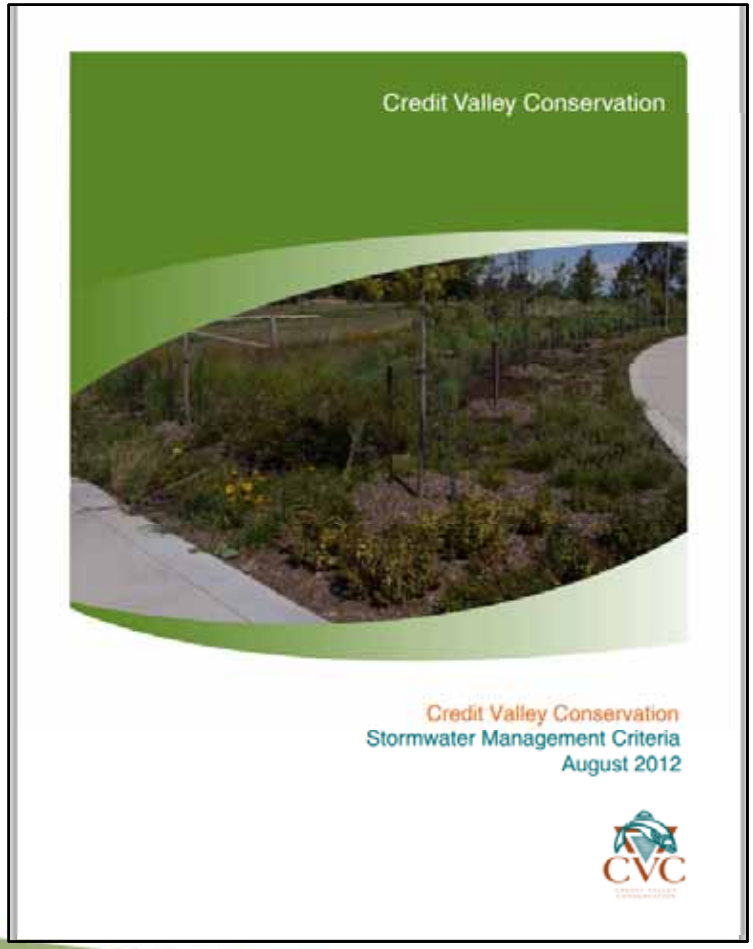




Lessons Learned

- Most small and medium sized businesses do not have staff resources for sustainability teams;
- Know where the buried utilities are located to avoid costly delays;
- Solving multiple issues were good selling points (i.e. Flooding issues, illegal dumping, etc.).

SWM Criteria



	CVC SWM Criteria
Water Quality	Enhanced Treatment 80% removal
Flood Control	Post to Pre for 2 to 100 yr design storm to the appropriate watershed flood control criteria
Erosion Control	As a minimum, on site detention of 5mm. For sites with a SWM pond detain the 25mm event for 48 hrs
Water Balance	Min of 3mm of groundwater recharge per event

Methodologies, guidance and data for geomorphic analysis, water balance to protect natural features, etc.

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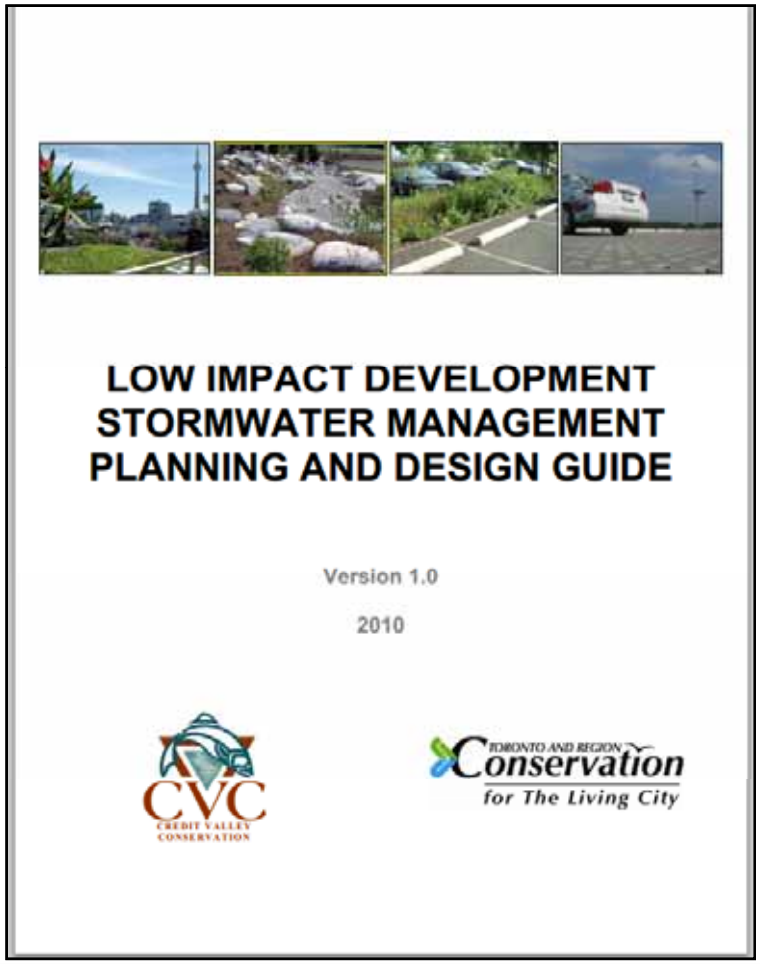
Planning & Design Guidelines



Provides engineers, ecologists and planners with information and direction on LID planning & design.

- Rainwater Harvesting
- Green Roofs
- Roof Downspout Disconnection
- Soakaways, Trenches, Chambers
- Bioretention
- Vegetated Filter Strips
- Permeable Pavement
- Enhanced Grass Swales
- Dry Swales
- Perforated Pipe Systems

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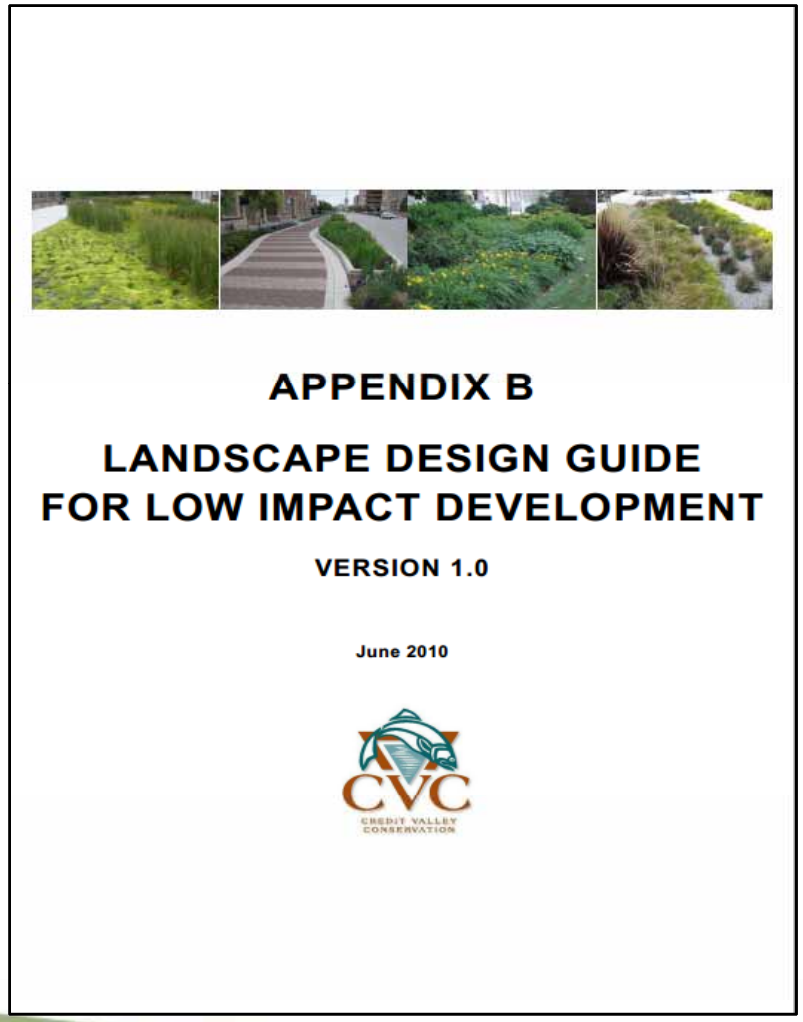
Landscape Design Guide



- LID practices are predominately located on private property or within the right-of-way and will often be maintained by the property owner.
- Plants play an integral part in supporting the treatment, evapotranspiration and infiltration functions.
- Plant selection and design are essential both for function and for the public perception and acceptance of LID!

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Aesthetics is Critical!

Bad

Good

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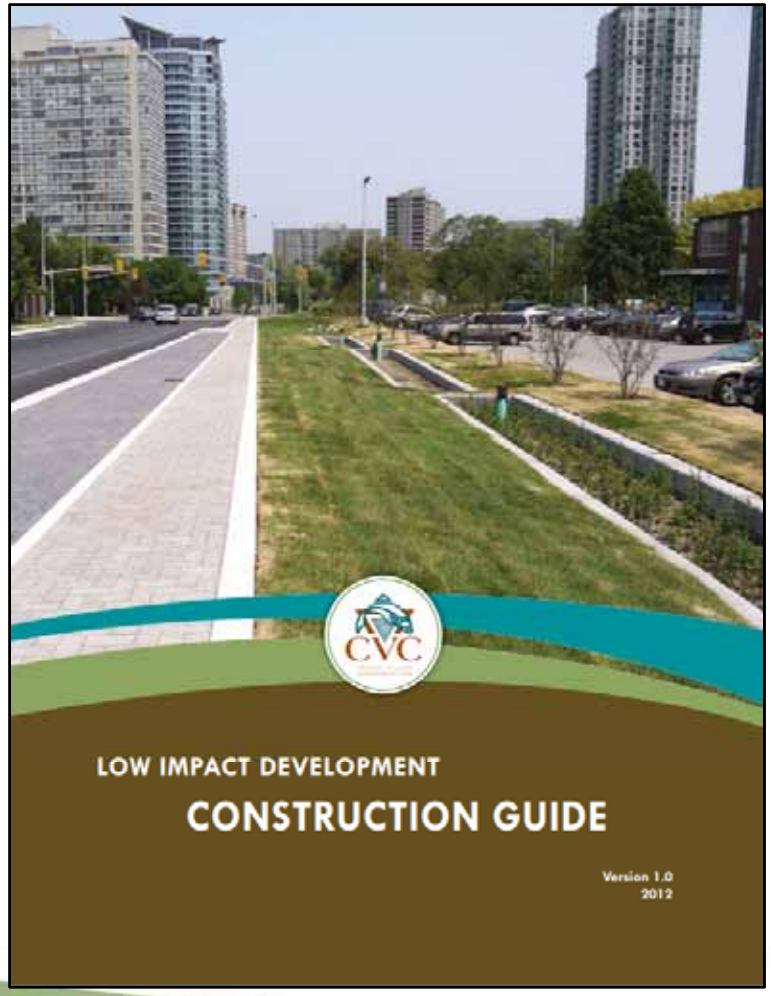
LID Construction Guide & Courses



Highlights common LID oversights during construction and discusses: proper planning, contractor communication, ESC protection, and material specification guidance.

LID Construction Courses

Upcoming Courses

May 28th Mississauga

May 30th Kingston

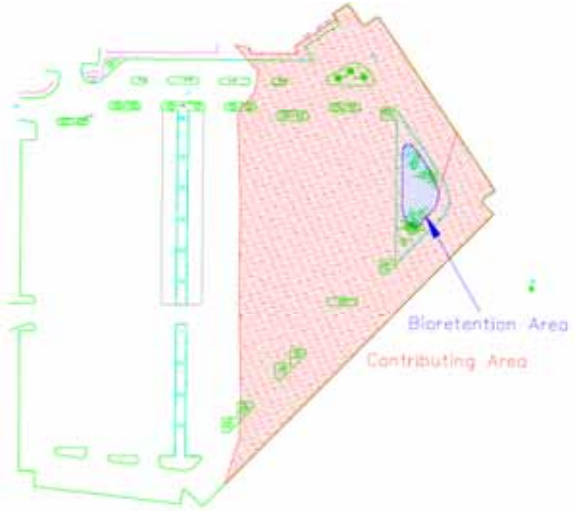
- How LID construction differs from the construction of a conventional stormwater management site
- Roles and responsibilities of the LID construction team members
- Methods for constructing common LID practices and their materials
- Methods and considerations for final stabilization and vegetation establishment

Certification Protocols

Visual Inspections

Vegetation Surveys

As Built Survey



Soil Analysis

Water Level monitoring

Infiltration Testing

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Certification Protocols

	Level 1: Visual Inspection	Level 2: Capacity Testing	Level 3: Water Level Monitoring	Level 4: High Intensity Monitoring
Checklist Inspection	✓	✓	✓	✓
Vegetation Surveys (for vegetated practices)	✓	✓	✓	✓
Soil Testing	✓ (optional)	✓	✓	✓
As-Constructed Survey		✓	✓	✓
Infiltration Testing / Synthetic Runoff Test		✓	✓ (optional)	✓ (optional)
Water Level Monitoring			✓	✓ (optional)
Water Flow & Quality Monitoring				✓

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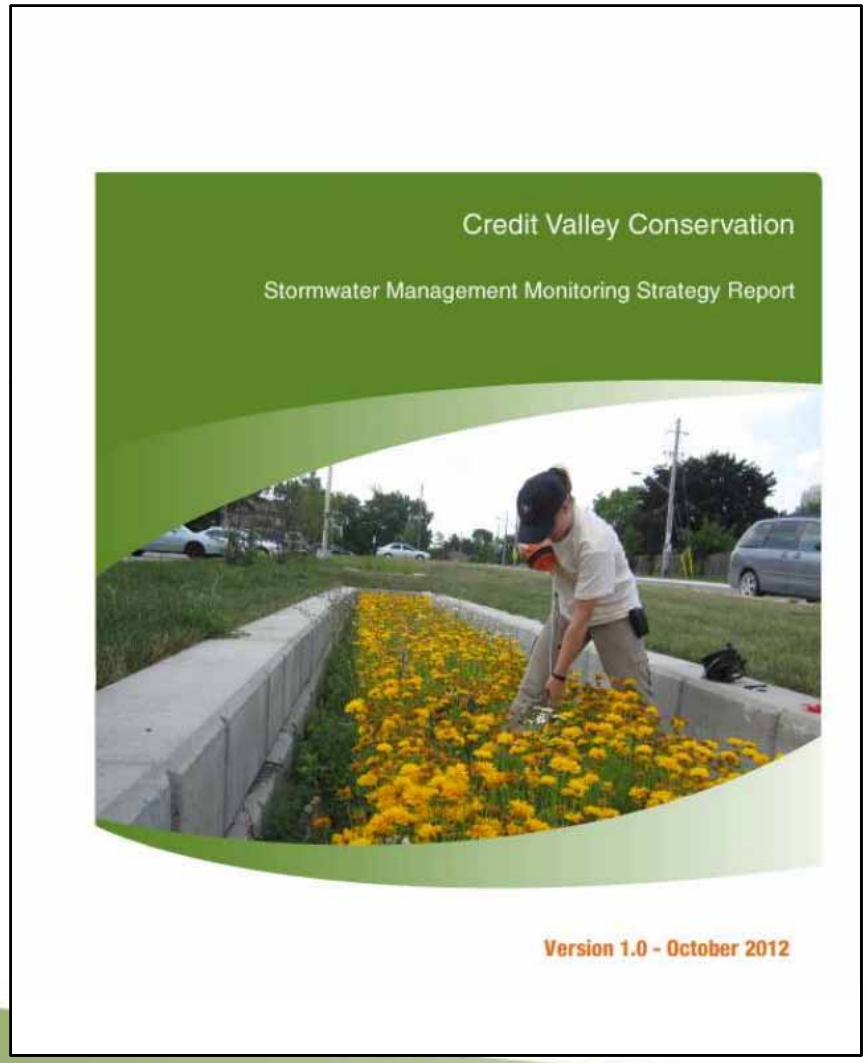
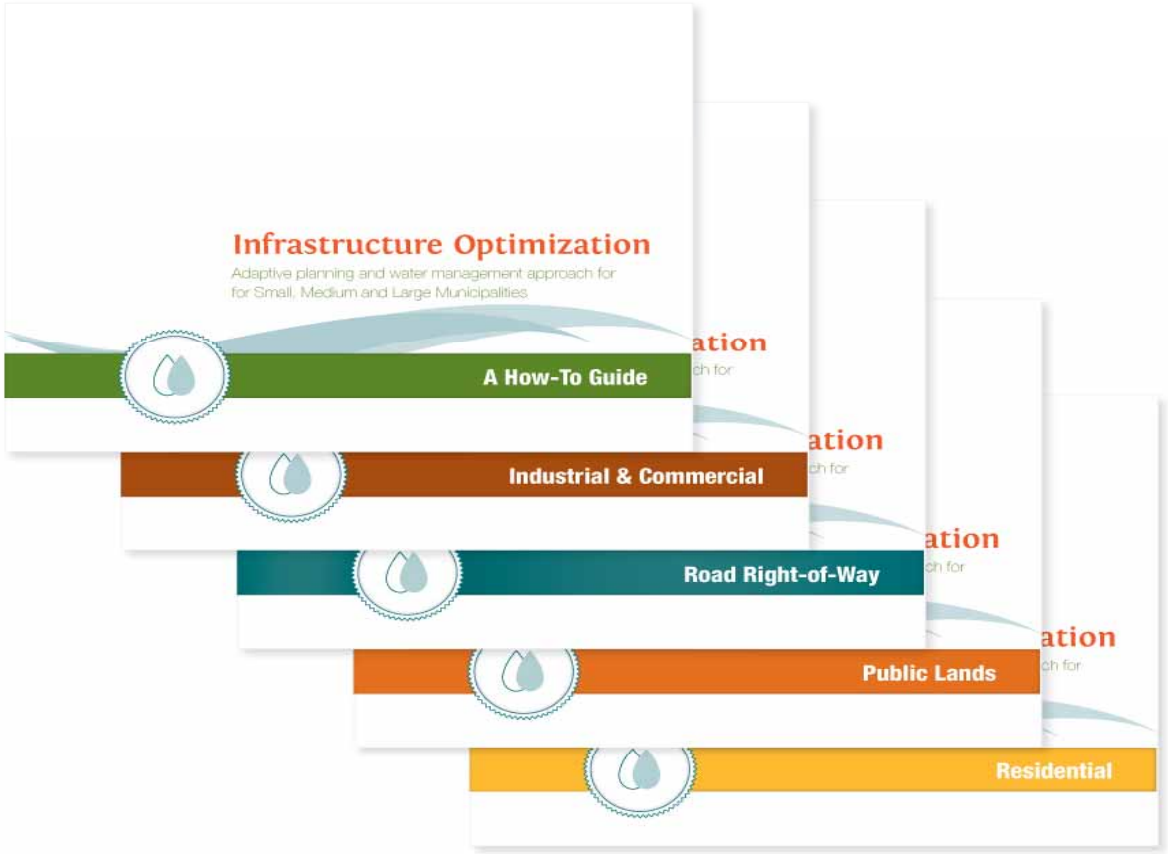
LID Monitoring Strategy



Infrastructure Performance Risk Assessment Program

Answer key stakeholder questions

LID Retrofit Guidance Documents



Funding support through the Showcasing Water Innovation Project

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SWM Retrofit Guide

- Small, medium & large municipalities;
- Answers the question, “where do I begin?
- Provides tools to assist with identifying the best area(s) and land use type(s) to focus LID retrofit activities.

SWM Retrofit Guide

- Help municipalities define levels of service for SWM;
- Use of SWM findings to optimize infrastructure;
- Provide guidance consistent with the Water Opportunities Act & Ministry of Infrastructure.

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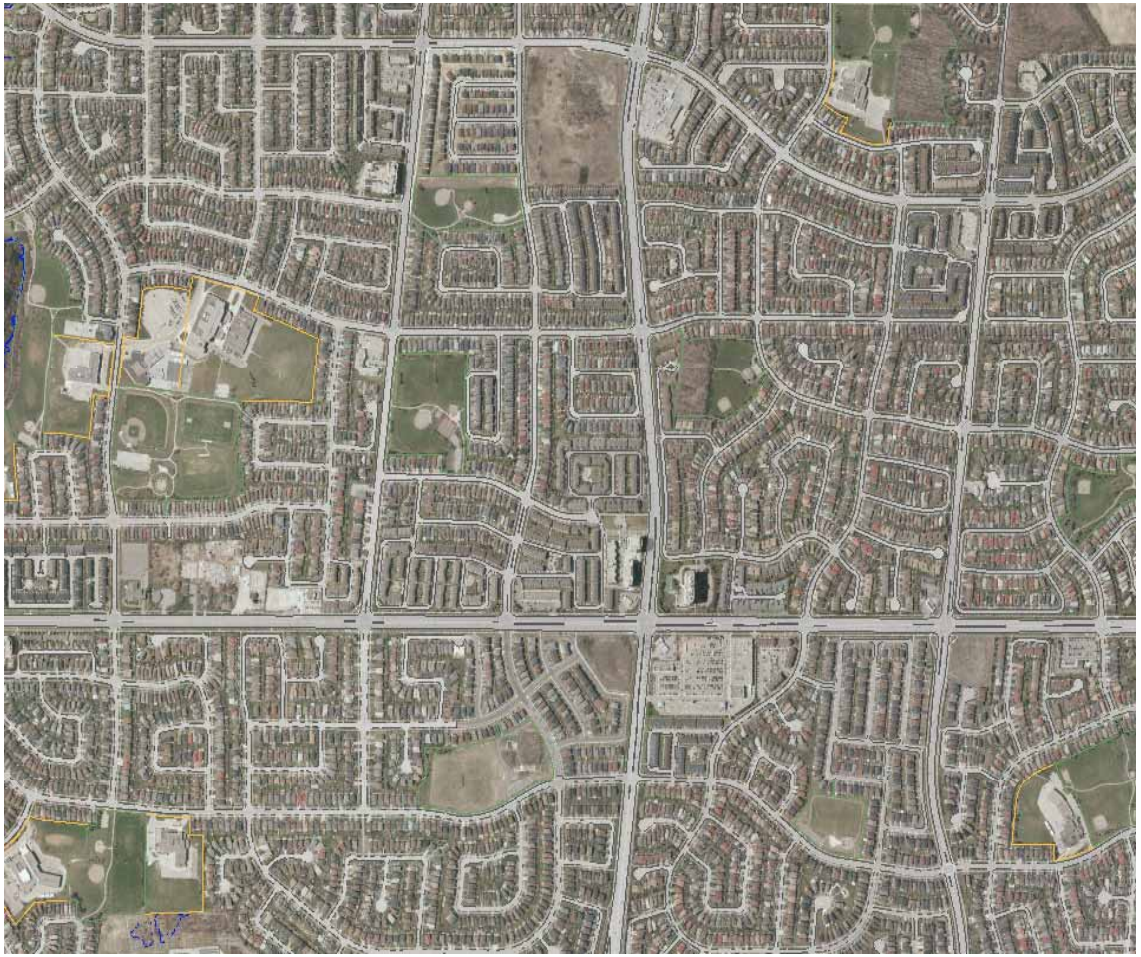
Opportunities within the Road Allowance



Up to 70% of pollutant loads comes from roadways;

Municipally owned and operated

Monitoring results have shown that LID captures pollutants from 90% of rainfall events

Big Bang for your Buck!!!!

Business Case

- Consistent with Ministry of Infrastructure's Building Together: Guide for Municipal Asset Management Plans;
- Provides overview of all relevant direct and indirect costs & benefits associated with LID;
- The business case framework can be modified to reflect the context of other regions across Ontario.

1.0 The Business Case for Grey to Green Road Retrofits

The Dixie Road underpass in Mississauga, Ontario, was one of many infrastructure assets damaged following the July 8, 2013 storm event. (Source: Fred Lum, Mississauga News)

Business case → Screen Options→ Case study

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The Right Landscape For the Right Location

Provide in the field lessons learned

Opportunities within Business & Multi-residential Areas

Industrial Commercial (IC) sector, generally comprised of 20-30% of the typical urban area;

Typically contribute pollutant loads such as:

TSS (12-16%);

Total phosphorous (17-22%);

High impervious cover ranging from 75-95% total impervious area.

Leading municipalities that are implementing SWM rates are targeting I/C lands.

Grey to Green Business and Multi-Residential Retrofits: Optimizing your Bottom-line Through Low Impact Development

- Audience: Property owners & managers;

- Land types: High and mid-rise residential buildings, low rise buildings, large commercial, small commercial, institutional and light industrial;

Business Case

- Minimizing your risk;
- Protecting your assets (diversify);
- Create a competitive advantage.

Opportunities within Residential Areas

Generally comprise 50-60% of urban areas

Contribute 51-57% total phosphorus

Help to reduce basement flooding.

Grey to Green Residential Lands: Engaging Residents to adopt Low Impact Development on their Properties

- Audience: Municipalities
- Make the case for why municipalities need to target residential lands
- Provide guidance on marketing strategies as conventional approach (rebates) has low uptake (< 5%).

Opportunities within Public Lands Areas

Schools, parks, places of worship represent the few remaining open areas within urban landscapes;

Opportunities to treat both public and private lands to take pressure off existing infrastructure.

Grey to Green Public Lands: Optimizing Parks, Public Buildings and Places of Worship through Low Impact Development

- Audience: Parks planners and managers, facility managers, property owners and managers

Public Lands/Institutions Adopting LID

Schools
- educational opportunities

Churches
- environmental stewardship

Parks
- easy demonstration opportunities

Share Lessons Learned: Case Studies

Elm Drive

Location: Mississauga
Constructed: May 2011

Case Study

Road Right-of-Way Retrofit

Project Objectives, Design and Performance

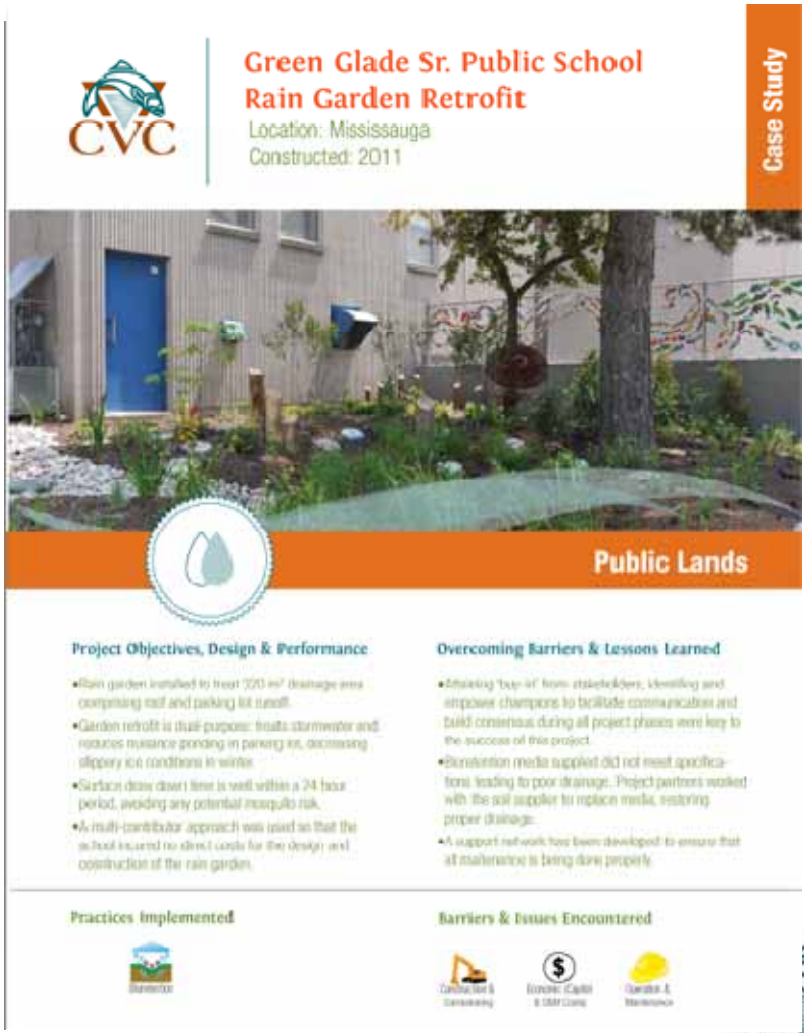
- Road retrofit comprised of six bioretention planters and permeable pavement that treats and infiltrates road runoff on adjacent school property.
- Retrofit aimed at improving stormwater management within the Cooksville Creek watershed by providing enhanced erosion control, quantity control, and water balance.
- Ongoing performance assessment had found that LID practices are exceeding all design expectations, providing 99% total suspended solids removal and reducing peak flows for 2-year events by 70-100%.

Overcoming Barriers and Lessons Learned

- To provide additional clarity and reduce the potential for error, drawings should include a profile view of the storm services through the bioretention cells, and detailed dimensions of any non-standard items.
- Warranty provisions need to be more specific with respect to LID features (i.e. plant watering and weeding) and need to be adhered to by all parties.
- Aesthetics are key - original landscaping had to be supplemented with additional plantings, including trees, to improve aesthetics and add seasonal variety to cells.

Practices Implemented

Barriers & Issues Encountered



Green Glade Sr. Public School
Rain Garden Retrofit

Location: Mississauga
Constructed: 2011

Case Study

Public Lands

Project Objectives, Design & Performance

- Rain garden installed to treat 320 m² drainage area comprising roof and parking lot runoff.
- Garden retrofit is dual-purpose: treats stormwater and reduces nuisance ponding in parking lot, decreasing slippery ice conditions in winter.
- Surface draw down time is well within a 24 hour period, avoiding any potential mosquito risk.
- A multi-contributor approach was used so that the school incurred no direct costs for the design and construction of the rain garden.

Overcoming Barriers & Lessons Learned

- Attaining "buy-in" from stakeholders, identifying and empower champions to facilitate communication and build consensus during all project phases were key to the success of this project.
- Bioretention media supplied did not meet specifications, leading to poor drainage. Project partners worked with the soil supplier to replace media, restoring proper drainage.
- A support network has been developed to ensure that all maintenance is being done properly.

Practices Implemented

Barriers & Issues Encountered

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Media & Events

mississauga livinggreen

August 30, 2012

Parking lot retrofit protects Lake Ontario

Credit Valley Conservation (CVC) and its partners are installing innovative water technology at IMAX Corporation, a motion picture provider, in Mississauga. The new parking lot design will help prevent flooding and stormwater contaminants from flowing into Sheridan Creek, Rattray Marsh and Lake Ontario. The Great Lakes are a source of drinking water for more than 80 per cent of Ontarians. One of the best parts of this good news story is that IMAX plans to make their site accessible to future potential customers that are interested in learning more about how they can use similar technologies on their own properties. For more information on the water quality project, see the CVC press release:

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September 17, 2012

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August 28, 2012

IMAX uses experimental parking lot design to reduce stormwater contamination in Mississauga, Ontario

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Jan Dean | Aug 24, 2012 - 4:19 PM | 1 | Report a Typo or Correction

Green parking lot protects drinking water

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NEWS, ONTARIO

Ontario Helps IMAX Protect the Great Lakes

Posted on August 27, 2012

Ontario is investing in solutions in Peel Region to help protect Great Lakes water quality.

IMAX Corporation is using new permeable pavement and stormwater treatment technology to retrofit its parking lot to reduce contaminated runoff. This green infrastructure will help prevent flooding and reduce contaminants entering Sheridan Creek and Lake Ontario.

The project is part of the McGuinty government's Showcasing Water Innovation program that supports projects that demonstrate innovative and cost effective approaches to improve drinking water, wastewater treatment, and stormwater systems that can be used by communities across the province.

The project is part of the Credit Valley Conservation Authority collaboration with public and private sector partners to implement low impact approaches for managing stormwater and conserving water.

Front L-R: Jim Tovey, Joan Robson, Jim Bradley, Christine Zimmer. Back L-R: Nancy Cole, Dave Laurie, Dave Maunder, Leanne Geisthorpe, Jackie Ward.

Conferences

Oct. 4th & 5th 2012 Conference (**Sold Out**) to over 270 participants from various organizations!

Bus Tours & Other Events

Bus Tour

Groundbreaking Ceremonies

Neighbourhood BBQ hosted by CVC and Councillor

Official SWI announcement with MPP Dipika Damerla

Interpretive Signage

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