

# Glendale Public School Rain Garden: Design and Build Overview



## EXECUTIVE SUMMARY

### Design Objectives and Key Outcomes

- Responded to a strategic opportunity involving a dual challenge – addressing an existing drainage concern at Glendale Public School and improving water quality in Fletchers Creek, a regulated Redside Dace habitat.
- Showcased the benefits of Green Infrastructure Low Impact Development (GI LID) solutions.
- Successfully engaged key stakeholders in identifying and prioritizing objectives of the project.
- The rain garden was designed to capture and infiltrate 200m<sup>3</sup> (27mm) of runoff. During construction approximately 800m<sup>3</sup> of soil volume was removed from the floodplain, reducing the risk of flooding downstream.
- An innovative approach was used where existing topsoil was amended on site to increase the absorption capacity and infiltration rate instead of transporting it off-site and bringing in pre-made bioretention media; reducing hauling costs significantly and associated GHG emissions as well as the purchasing cost of pre-made material.



Glendale P.S. student volunteers

### Featured practices:

- Rain garden with underdrain
- Outlet control

### Groups involved:

- Glendale Public School
- Fletchers Creek SNAP Team
- City of Brampton
- Region of Peel
- Ecosystem Recovery Inc.
- Into The Woods
- Canon Canada Inc.
- Clean Water Wastewater Fund
- Federation of Canadian Municipalities
- Habitat Stewardship Fund
- The Toronto Zoo

### Budget:

- \$183,000

### Construction:

- Summer 2019

## OVERVIEW

Glendale Public School (P.S.) is located in the City of Brampton, within the Fletchers Creek SNAP (Sustainable Neighbourhood Action Plan) (Figure 1). The study region is in a regulated CVC area where any development requires a permit from CVC's Planning & Development Services. Urbanization and the lack of stormwater controls have impacted the health of Fletchers Creek's aquatic organisms, particularly Redside Dace, which is an endangered fish species. In addition to this problem, Glendale P.S. had existing draining issues on their property that needed to be addressed (Figure 2). As such, Glendale P.S. was selected as a prime site to initiate a GI LID Stormwater Management project to respond to these two challenges while achieving several other co-benefits.

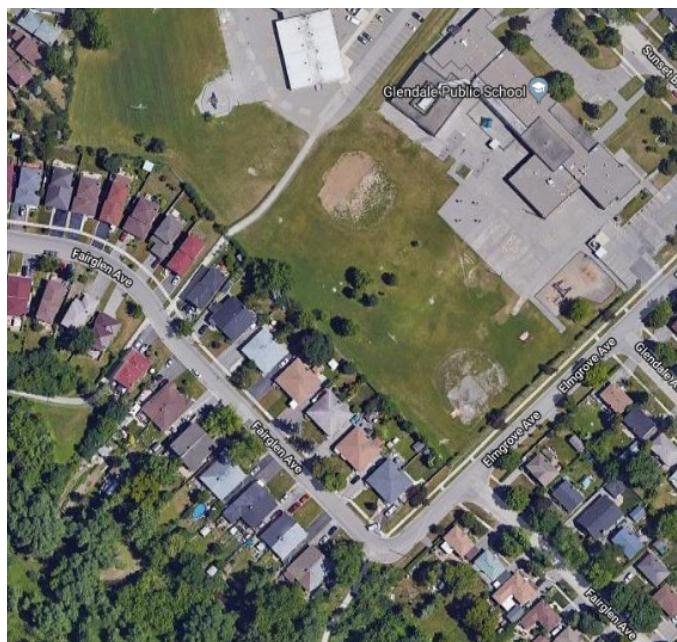


Figure 1. Site location



Figure 2. Pre-existing site drainage problems

## GOALS AND DRIVERS

During consultations among the relevant stakeholders (City of Brampton, Glendale P.S., Peel District School Board and Credit Valley Conservation (CVC)) the following objectives, listed in order of priority, were identified:

1. Address existing drainage concerns, especially on the old baseball diamond and around the edge of the asphalt play area behind school.
2. Improve water quality in Fletchers Creek by treating stormwater runoff on school property.
3. Enhance aesthetics of school property through plantings and landscaped features, as well as providing food and habitat for pollinators and birds.
4. Create additional learning opportunities for students and the community.
5. Utilize this project as a model to showcase stormwater management initiatives for future projects on similar sites in the City of Brampton.
6. Use this project to inspire neighbours to create similar stormwater initiatives on their properties.
7. Engage the community to use the property, particularly during after-school hours, weekends and summer months.
8. Create more shade on the property.
9. Maintain an area on the property that could accommodate future use of portables.

## PLANNING AND REGULATIONS

The SNAP for the Fletchers Creek neighbourhood is a partnership between CVC, the City of Brampton and the Region of Peel and was launched in 2016. A strategic opportunity exists through the implementation of LID retrofits to provide stormwater quantity, quality and erosion control to improve environmental outcomes, increase sustainability and enhance resilience to climate change. The Glendale P.S. site was identified as a priority retrofit site. Planning, design, construction, maintenance and knowledge transfer for the project was secured through several funding sources including the Clean Water Wastewater Fund, Federation of Canadian Municipalities, Habitat Stewardship Fund, the Toronto Zoo and other corporate sponsors.

During the development and conceptual design stage it was highlighted that the Glendale rain garden project would require:

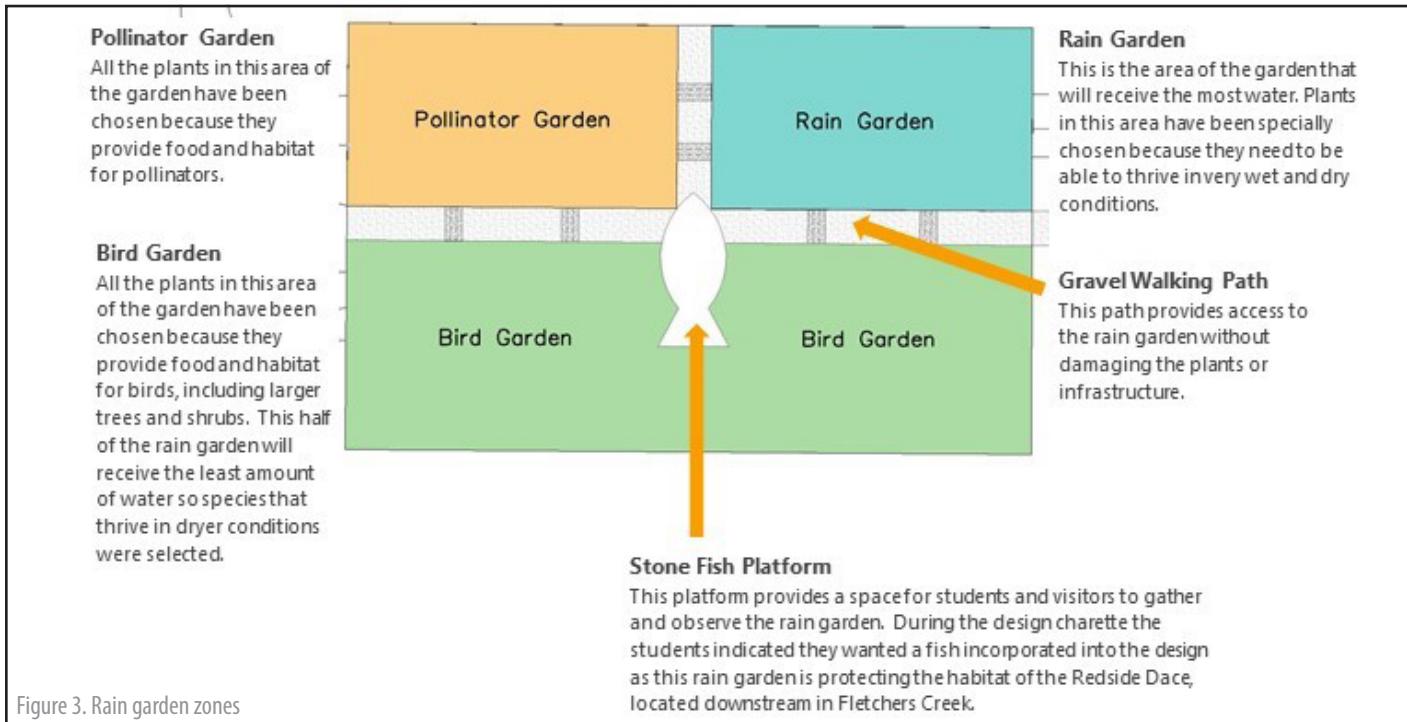


Figure 3. Rain garden zones

- A contract between CVC and the Peel District School Board
- Site inventory and background information, including survey
- Permit issued by CVC for the construction of an LID feature within a regulated floodplain, and a regulated area (Fletchers Creek)

## DESIGN

The design concept for a rain garden that would address the drainage issues on site and water quality issues in nearby Fletchers Creek was developed by CVC in collaboration with Ecosystem Recovery Inc., Into The Woods and City of Brampton staff. After an initial site visit, a “treatment train” approach was taken and included the following features (Figure 3 and 4):

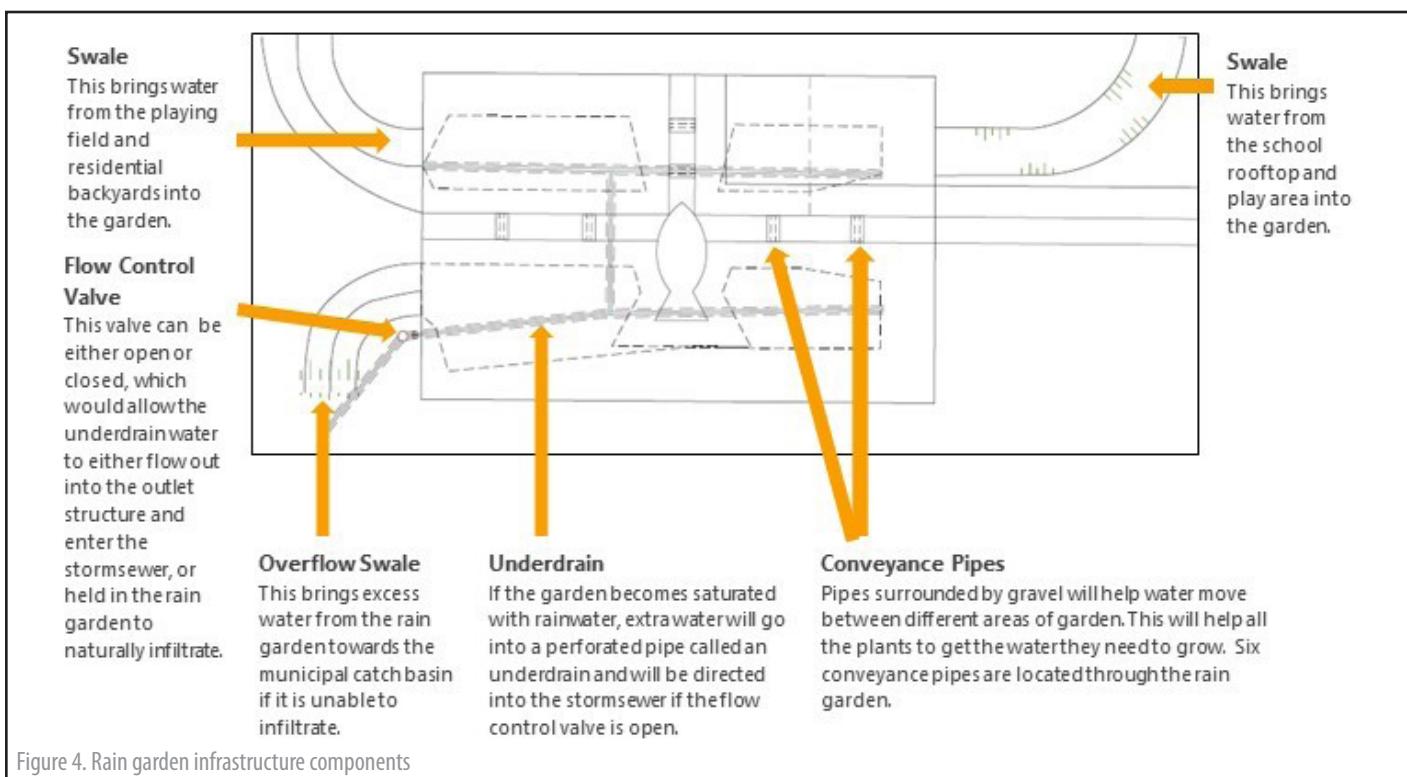


Figure 4. Rain garden infrastructure components

1. Swales would direct surface runoff from the pavement and surrounding field towards a rain garden.
2. A rain garden would be placed in the southern corner of the property, removing an old unused baseball diamond where the elevation is lowest. This feature would incorporate trees, shrubs and native plantings as well as soil amendments and micro-topographic features to encourage infiltration and support plant growth.
3. The garden would include three (3) distinct sections:
  - a. The first section (rain garden) would receive the most drainage and therefore plants were selected that can thrive in very wet and dry conditions.
  - b. The second section (pollinator garden) would include plants that would provide food and habitat for pollinators.
  - c. The third section (bird garden) would include larger plants, such as trees and shrubs, that will provide food and habitat for birds.
4. Pathways would be created to allow students, staff and community members to access the naturalized area. Drain pipes under the pathways would allow the water level to equalize between garden cells.
5. Perforated underdrain pipes, placed under the planted area, would be used to drain the facility.

Table 1. Design Charette Summary

Design Aspect	Results
Shape	Fish
Plants	Core → Nannyberry, Swamp Milkweed Buddy → Cardinal Flower, Blue Flag Iris, New England Aster Edge → Little Bluestem Anise Hissop, Butterfly Milkweed
Amenities	Pathways



Figure 5. Design charette results

A flow control valve would be placed at the underdrain outlet of the facility to control the amount of water draining from the garden into the municipal system located on Elmwood Avenue. During normal operation, this valve would be closed to maximize storage and infiltration into the native soils. Under extreme rainfall events the valve can be opened to release water. Even with the valve closed, the system would still have a back up overflow weir into the municipal system.

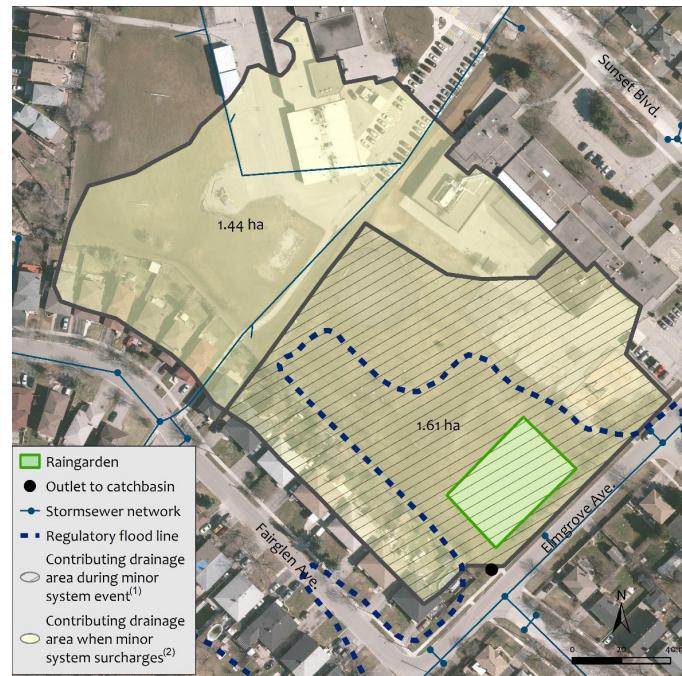


Figure 6. Study area

A design charette was held with students from Glendale P.S. where choices for the shape of the garden (Figure 5), the plants used, and the amenities included were selected. Some of the results of the design charette are provided in Table 1.

Through analysis of the site it was decided that the garden would be placed in the southern corner of the property to be able to capture most of the runoff from the site (Figure 6). The surface area available according to the topographical and physical infrastructure constraints was 965m<sup>2</sup>. The total drainage area during a minor system event is 1.61ha (the hatched area in Figure 6). Of this drainage area, 29% is impervious. For larger storms that cause the minor system to surcharge, the total drainage area is 3.05ha (1.44ha + 1.61ha). The garden was designed to capture at least 27mm of rainfall from the 1.61 ha, which translates to 200m<sup>3</sup>. The maximum volume that can be retained by the garden is around 210m<sup>3</sup>, exceeding the minimum requirement.

During the geotechnical investigations, no groundwater or seasonally high groundwater table was found within 2.6m from the surface, thus interaction with the water table was not a concern. Using the Guelph Permeameter, the native

soil infiltration rate was determined to be approximately 15-20mm/hr. The garden was designed to have a maximum surface ponding depth of 300mm above the surface of the naturalized area (see Figure 7 for overflow structure) which is within the values recommended by the LID SWM Planning and Design Guide Wiki (STEP 2019). The ponded water would drain down over a maximum period of 30 hours (using a factor of safety of 2, the infiltration rate would be 10mm/hr), which is less than the recommended amount of 48 hours in the LID SWM Planning and Design Guide Wiki.

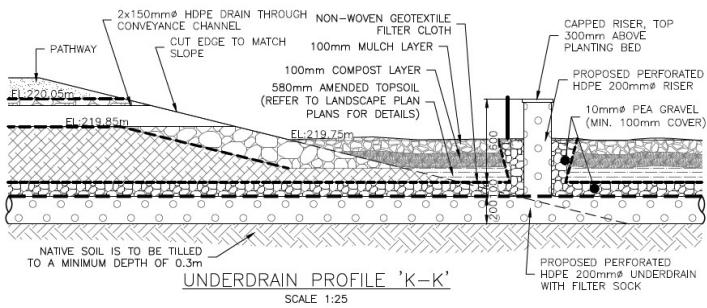


Figure 7. Underdrain and overflow riser detail

## CONSTRUCTION & COMMISSIONING

Construction of the rain garden took approximately two months to complete. The initial step was to remove existing vegetation, sod and topsoil from the rain garden site, which included the removal of an old baseball diamond. After the site was cleared, ditches were excavated for the underdrain pipes (Figure 8) followed by the installation of infrastructure including cleanouts, monitoring wells, overflows and the outlet catchbasin. The bioretention area was further excavated then graded along with conveyance pipes (connecting pipes between rain gardens) being put in place.

Once this work was completed, some of the native top soil (initially piled in the nearby yard) was mixed with compost and horse manure to increase the organic content, allowing for increased absorption and infiltration, and the rain garden area was filled with this mix (Figure 9). The remaining soil was spread on the land adjacent to the rain garden (outside of the regulated floodplain) and hydroseeded. Pathways and a fish shaped platform in the middle of the rain garden were built (Figure 10). A flow control valve was placed at the underdrain outlet to control the amount of water draining from the garden into the municipal system (Figure 11). The connecting overflow swale from the rain garden catchbasin outlet (Figure 12) to the storm sewer was constructed and covered with grass (Figure 4).

Planting of the garden took place in a one-day planting event organized by CVC. Students from Glendale P.S. and corporate volunteers from Canon Canada participated in the event (Figure 13). Throughout the day, over 2000 plants were planted.



Figure 8. Vegetation removed, underdrain trench excavated



Figure 9. Soil amendment



Figure 10. Laying the pathway and fish outline



Figure 11. Control valve



Figure 12. Rain garden catchbasin outlet



Figure 13. Canon Canada volunteers

## ECONOMICS (CAPITAL AND O&M COSTS)

The approximate costs of the rain garden project can be seen in Table 2. Please note *Construction* costs includes soil amendments and the cost of landscaping. *Operation & Maintenance* costs are estimated for the first year (Table 2).

The total cost saving that resulted from spreading the excess fill soil and amending some of the top soil instead of bringing in new bioretention media was approximately \$15,200 (Table 3).

## OPERATIONS AND MAINTENANCE

During rain events runoff from the surrounding land will flow through the swales towards the rain garden. Each inlet to the rain garden has energy dissipation stones to slow down the water and reduce scouring of the mulch and soil. Conveyance pipes exist between the cells of the garden to equalize the water level. Water will infiltrate into the native soil below the garden while being filtered and cooled. Overflow pipes ensure the water does not pond above 300mm during large events. The shut off valve can be used to close the garden's outlet so that water is retained and allowed to infiltrate. When required, the valve can be opened to allow outflow. There is also a back up overflow weir at the end of a overflow swale that allows water to flow

out even when the shut off valve is closed, if it reaches a certain depth.

Once the garden was operational, observations were made following a 25mm-rainfall event in October 2019. Sheet flow over the impermeable pavement was successfully conveyed to the rain garden through the grass swale (Figure 14). There was some ponding on the surface of the receiving cell (Figure 15) while no water ponding was observed in the pollinator and bird garden sections. All the connecting pipes were monitored to ensure they allowed for clear water flow. Using the cleanout points as an observation port, flow was also observed in the perforated underdrain pipes, confirming successful performance. Monitoring the flow paths through the garden outlet to the catchbasin, which ultimately drains to the City's sewer network is also

Table 2. Overall Project Costs

Item	Cost Estimate (\$CAD)
<b>Design</b>	
Design LID and Naturalized Area	\$29,455
<b>Construction</b>	
Construction Administration	\$6,720
Construction	\$15,773
Site Preparation (such as mobilization, demobilization, site fence)	
Civil Works (such as excavation, grading, protecting existing infrastructure)	\$41,067
Materials (such as gravel screening, stone conveyance channel, cut flagstone, geotextile)	\$13,890
Sub-surface Drainage System (such as HDPE drains, perforated pipe, valve, monitoring wells)	\$26,212
Additional works (such as leaf litter compost, temporary fencing, additional earthworks)	\$9,770
Soil Amendment Materials (such as compost and manure)	\$9,500
Landscaping	\$21,376
<b>Outreach and Education</b>	
Presentations, Signage and Videos	\$3,653
<b>Operation and Maintenance</b>	
Establishment maintenance	\$5,000
<b>Total</b>	<b>\$182,416</b>

Table 3. Cost Savings from Soil Amendment

	Volume (m <sup>3</sup> )	Cost/m <sup>3</sup> (\$)	Total
Cost to amend native soil (includes labour)			\$12,000
Cost for temporary fencing around the extra native soil that was spread on site			\$1,000
Cost saving from not hauling away material	320	25	\$8,000
Cost saving from not purchasing bioretention media	320	60	\$19,200
<b>Total Savings</b>			<b>\$15,200</b>



Figure 14. Conveyance of sheet flow via grass swale to the cell of the rain garden

of great importance. In order to get a clearer picture, CVC's Integrated Water Management group intends to investigate flow through the underdrains and flow at the outlet following large rainfall events using in-pipe inspection devices.

The rain garden plants will require regular maintenance during establishment. After the initial planting, any plants that did not establish over the first growing year will need to be replaced. Weeding will be required as well as watering in periods of extended drought. Pruning of shrubs and trees will be required over time as growth matures in the rain garden.



Figure 15. Ponding water over the surface of the first cell of the rain garden

## SUCCESSES

### **Designed to achieve several environmental goals**

including 1) managing the runoff from a 27mm storm, covering up to the 90th percentile of the annual rain events in the area, 2) improving stormwater runoff water quality by reducing total suspended solids (TSS) by 80% before entering Fletcher's Creek, and 3) providing heat mitigation by cooling runoff before discharging it to the receiving waterbody and 4) increased floodplain storage by a total of 800m<sup>3</sup>, reducing flooding potential during large storm events.

### **Reduced overall project costs and environmental impact**

by amending excavated soil and reusing it on site. Using an innovative approach, excavated soil was saved and amended with horse manure and compost to increase its organic content and infiltration ability. This offset the need to bring in bioretention media. Excess soil was strategically spread on site instead of being removed, further reducing transportation requirements and the associated GHG emissions.

**Multi-stakeholder collaboration** was achieved by involving the relevant stakeholders in the identification of project objectives and the implementation of the design.

**Provided an experiential learning opportunity** for students and volunteers that assisted during the design process and planting stage. There were over 40 volunteers from Canon Canada and about 305 students from Glendale P.S. that planted over 2000 plants.

## CHALLENGES AND LESSONS LEARNED

The barriers and issues encountered with the project included:

- There was more native fill than originally anticipated which was spread over the field and seeded.
- Finding the correct compost blend was initially a challenge. Compost was used to amend the topsoil to achieve an organic content of 15%:
  - A contractor was hired to find an appropriate compost blend. The existing topsoil was amended with manure and leaf compost to enhance the quality so it could be used as bioretention media to filter and treat stormwater.
- The side slopes of the garden were supposed to remain bare to allow for planting but were accidentally hydroseeded when the area adjacent to the garden was

hydroseeded. This required extra weeding during the planting phase and will require extra maintenance to remove the grass over time.

- Having a landscape architect on site during hydroseeding would have ensured correct placement.
- Beyond the technical requirements of developing such a rain garden, additional considerations are required when it comes to building a rain garden on a school property. The visual appearance of the rain garden, student safety and accessibility, level of maintenance required, and the number and type of plants were all key elements considered in this project.

## REFERENCES

LID Stormwater Planning and Design Guide Wiki, (STEP, 2019)  
<https://wiki.sustainabletechnologies.ca/wiki/Bioretention>



Figure 16. Glendale rain garden during construction

*This communication has been prepared by the Sustainable Technologies Evaluation Program. Funding and support for this study was provided by our partners Clean Water Wastewater Fund, Federation of Canadian Municipalities (Green Municipal Fund), Department of Fisheries & Oceans (Habitat Stewardship Fund), Toronto Zoo, Glendale Public School, City of Brampton, Ecosystem Recovery Inc., Into The Woods and Canon Canada Inc. The contents of this report do not necessarily represent the policies of the supporting agencies and the funding does not indicate an endorsement of the contents.*

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