Appendix E

Common Perceived Barriers LID and How to Overcome Them

Appendix E – Common Perceived Barriers to LID and How to Overcome Them

Demonstration projects and technical case studies currently account for the majority of LID practices in Ontario. These projects and case studies will help to identify and address the barriers associated with LID. As well, the benefits of LID practices need to be identified in order to promote the wide-scale adoption of LID. Below is a list of several commonly perceived barriers, along with explanations and examples of how they have been overcome.

"LID interferes with utilities"

LID practices can be effectively implemented in areas with existing utilities. LID practices are generally shallow, non-structural elements consisting mostly of aggregate, plant, and soil components and often a flexible, perforated discharge pipe, allowing other utilities to traverse LID practices without adverse impacts. Major utility conduits may require special provisions for construction and ongoing operation and maintenance activities. Proper site investigation will allow LID practices to be located to avoid existing utilities where possible, and, where this is not possible, designers have the ability to adapt the shape, depths, and cross-sections to fit the site requirements. The detailed design of LID practices is provided in Chapter 6.

"LID does not work in cold climates"

LID practices have been implemented in cold climates in Canada, the US, and Europe for over 20 years. In fact, Ottawa has an LID perforated pipe system that has been in operation for more than 25 years[1]. Canadian cold-climate cities that have constructed LIDs which accept road and parking lot drainage include Montreal, Edmonton, Calgary, Ottawa, and Thunder Bay, among others. These cities routinely receive 125–200 cm of snow per year and experience January temperatures ranging from -3°C to -15°C, with extremes reaching below -36°C.

"LID can't be implemented on roads where roads are being de-iced using salts"

LID practices can be implemented on roads receiving lower rates of de-icers, or on roads being de-iced with lower proportions of salt vs. sand (i.e., 95/5 sand to salt mix). Roads near drinking water wells having an identified risk relating to salt can be designed with additional safety features, such as impermeable liners and inlet gates which can be closed in the winter, as was done by the City of Kitchener's road retrofit on King Street. By selecting salt tolerant plants, LID practices can continue to provide many years of enhanced street aesthetics and community benefit.

"The 2003 MOE Stormwater Management Planning and Design Manual prohibits LID practices in soils with an infiltration rate of less than 15mm/hr"

The 2003 Ministry of the Environment *Stormwater Management Planning and Design (SWMPD) Manual* does not prohibit LID practices in soils with lower infiltration rates. In fact, the SWMPD manual predominately deals with end-of-pipe controls. It does, however, provide guidance for stormwater management facilities that employ infiltration, including lot level and conveyance controls. More specifically, it provides guidance that relates to "physical constraints which could limit the use of lot level, conveyance and end-of-pipe controls" (Section 4.2, Table 4.1, SWMPD manual), but does not, in any way, indicate that area soil with lower relative infiltration rates be excluded from infiltration practices. The infiltration rate of soils has an effect on the drawdown-time of the facility between events and, therefore, should be sized accordingly, based on design guidance from sources such as the *Low Impact Development Stormwater Management Planning and Design Guide*[2]. For further information, refer to Chapter 7 Approvals.

"LID can't be implemented in clay/ low permeability soils"

LID practices can be implemented in clay/ low permeability soils. LID practices in soils with lower infiltration capacities can use multiple mechanisms (beyond simply infiltration) such as, but not limited to filtration, retention, evaporation, and/or transpiration. Provided that the proposed LID practices incorporate the appropriate runoff storage volumes, empty between events, and are otherwise appropriately sited, designed, monitored and maintained (similar to all other stormwater management facilities), there should be no impediment to the application of infiltration technologies in all soil types.

Table 1 lists various LID practices implemented in Ontario relative to their sub-soil type, contributing drainage area and other design characteristics.

Table 1: LID practices in various soils.

Location	LID Practices Implemented	Sub Soil	Drainage Area	Inlet/ Flow Type	Sub-drain
O'Connor Park, Mississauga, ON	• Bioretention	Clay	parking lot	sheet flow and b/w curb stops	yes
Lakeview Road Reconstruction, Mississauga, ON	• Boulevard bioretention • permeable pavement	Clay	road runoff, driveways and lots	curb cuts	yes
IMAX Parking lot Retrofit, Mississauga, ON	• Bioretention • permeable pavement	Clay	parking lot	Sheet flow/ curb cuts	yes
Lakeside Park, Mississauga, ON	• Bioswale • pervious concrete	Clay	parking lot	sheet flow/ through grass	no
Elm Drive/ Mississauga Adult Education Center Mississauga, ON	• Bioretention planter • permeable pavement	Clay / broken shale	road runoff	concentrated/ Open pipe	yes
Portico Church, Mississauga, ON	Bioretention	Clay	parking lot	concentrated/ curb openings	yes
Green Glade Sr Public School, Mississauga, ON	Bioretention	Loamy sand/ Sand	rooftop and parking lot	concentrated/ roof leader & curb opening	no
Terra Cotta Conservation Area Halton Hills, ON	Bioretention	Clayey silt / broken shale	rooftop	concentrated/ roof leader	no
Unitarian Church Mississauga, ON	Bioretention	Loamy sand	parking lot	sheet flow/ & b/w curb stops	no

"There is no room for LID in the Road ROW"

LID practices can be integrated into almost any road width or configuration because of its inherent flexibility, including:

- multiple types of LID practices to choose from (e.g., bioretention, bioswales, bioretention planters, permeable pavement, green gutters and modular units)
- design of the LID practices including size, shape, location and depth

LID practices can be located:

- under pavement surface within the pavement itself as a bump-out
- within the boulevard
- as part of a roadway surface itself (i.e., permeable pavement, concrete, or asphalt)

Refer to Chapter 2 for a comprehensive list of the various types of LID practices that can be implemented within the road ROW. Chapter 4 provides a detailed screening process to determine the LID practices best suited to a particular road retrofit project.

"LID is too costly"

In many cases, LID practices can be constructed at less expense compared to conventional drainage infrastructure for both new developments and retrofits, including road ROW retrofits. A recent study by the U.S. EPA *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*[3] examined seventeen greenfield and redevelopment case studies from the U.S. and Canada and provides a comparison of the construction costs of LID versus conventional stormwater management design. On average, the EPA found a construction cost savings ranging from 15% to 60%, with an average of 25%, using LID practices as compared to conventional stormwater management. Table 2 provides a summary of the EPA study, including additional case studies from Canada and the United States, with ROW project costs highlighted.

Table 2: Summary of construction cost comparison for selected LID case studies[4,5,6].

Project	Project Type	LID Practices	Construction Costs			Cost Savings
			Traditional stormwater manage-ment	LID	Cost Difference	
SEA Street Retrofit, WA **(ROW)**	ROW Retrofit	1,3,4,6	$868,803	$651,548	$217,255	25%
Crown Streets, BC (ROW)	ROW Retrofit	1,6	$364,000	396,000	$-32,000	-9%
Lakeview ROW Retrofit, ON (ROW)	ROW Retrofit	1,5A, 9	$1,090,000**	$895,000	$195,000	18%
Elm Dr ROW Retrofit, ON– (ROW)	ROW Retrofit	1, 5A	$650,000	$585,000	$65,000	10%
Boulder Hills - Roadway, sidewalk & driveway, NH **(ROW)**	New ROW	5B	$4,389,454	$4,340,326	$49,128	1%
Bellingham , WA	Institutional Parking Lot Retrofit	1	$27,600	$5,600	$22,000	80%
Tellabs Corp. Campus, IL	New Commercial	1,4,6,7	$3,162,160	$2,700,650	$461,510	15%
Greenland Meadows, NH	New Commercial	5B	$10,590,300	$9,660,300	$930,000	9%
Bellingham Donovan Park	New Commercial	1	$52,800	$12,800	$40,000	76%
Prairie Glen, IL	New residential & commercial	1,2,3,4,6, 7	$1,004,848	$599,536	$405,312	40%
Auburn Hills, WI	New Residential	1,3,4,6,7	$2,360,385	$1,598,989	$761,396	32%
LID Subdivision – Frederick, MD	New Residential		$unknown *	$ -360,000	$360,000	n/a
Somerset, Maryland	New Residential	1,4	$2,456,843	$1,671,461	$785,382	32%
Gap Creek, ARK	New Residential	6, 10	$4,620,600	$3,942,100	$678,500	15%
Laurel Springs, WA	New Residential	1,2,3,4	$1,654,021	$1,149,552	$504,469	30%
Popular Glen, NC	High Density Residential	1,4,7	$unknown *	$unknown	$175,000	72%
Mill Creek, IL	New Mixed use Residential	2,3,4	$12,510	$9,099	$3,411	27%

1-Bioretention, 2-Reduced lot area, 3-Reduced Impervious Area, 4- Swale, 5-Permeable Pavements (A – pavers, B- asphalt, C-concrete), 6-Vegetative Landscaping, 7-Wetlands, 8- Green roofs, 9 – Perforated Pipes, 10 – Reduced Roadway width (non-standard)

* Cost unknown or not published.

**Assumes construction of end-of-pipe facility to provide equivalent level of stormwater treatment.

"Operation and maintenance costs are too high"

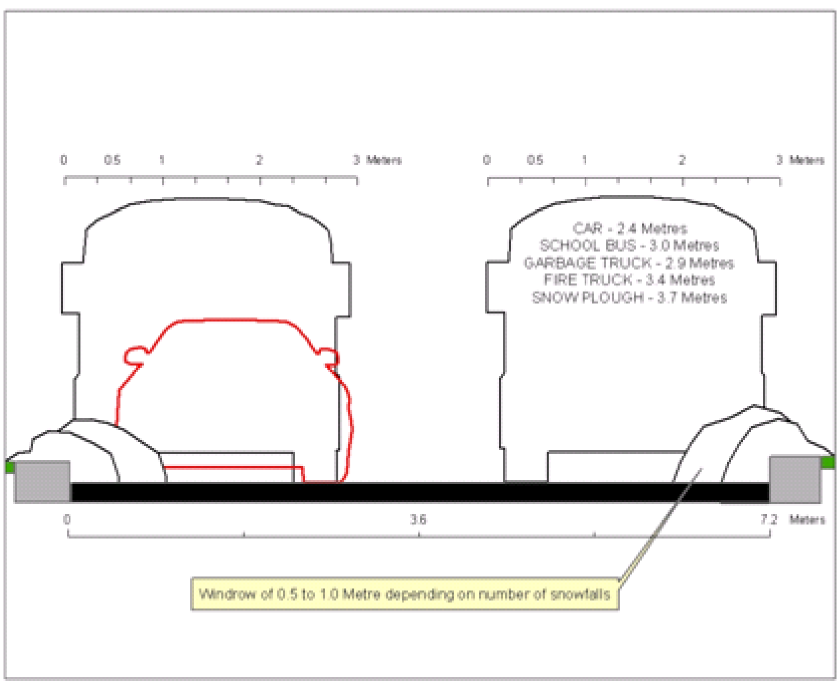
In fact, LID practices generally have lower long-term life cycle costs, perform better, and provide additional community benefits than conventional stormwater infrastructure. LID practices usually have a lower initial cost, with operation and maintenance costs determined by the extent and type of vegetation incorporated into the design.

LID practices vegetated with perennials, shrubs, and trees will typically require more ongoing maintenance than turf grass areas in the early years of establishment. After establishment, the maintenance requirements of most LID practices will differ little from most turf, landscape, or natural areas, and do not require new or specialized equipment.

LID practices using perforated pipe systems and permeable pavements typically have the lowest operation and maintenance costs. In fact, a substantial benefit of porous asphalt is the reduced need for de-icing in winter. Winter maintenance of porous asphalt requires between 0% and 25% of the salt routinely applied to impervious asphalt to achieve equivalent, or better, de-icing and traction[7], and the maintenance cost of permeable concrete sidewalks in Olympia, Washington was found to be 9% less than traditional concrete sidewalks[8]. Refer to Chapter 10 for further details on the lifecycle costs of LID.

"I can't build non-standard designs"

Many urban roadways are designed to comply with current code requirements for emergency service vehicles (fire, ambulance), maintenance vehicles (snow ploughs, waste collection) and public transportation. These roadways provide a free flow of traffic, but are oversized for their day-to-day use. Several Ontario municipalities have implemented LID practices within the ROW which incorporated non-standard elements and roadway widths, including the City of Mississauga (see the Lakeview case study in Appendix C) and the City of Toronto. An example road width reduction, from the standard of 8.0 m to 7.2 m, as part of LID ROW retrofits, is presented in Figure 1, showing how the reduced width can accommodate all necessary vehicle types, even during winter months.



Effect of Winter Operations on a 7.2m Road Width

Figure 1: Reduced ROW width as part of LID retrofits in Mississauga & Toronto. (Source: Aquafor Beech)

"I don't need to do a pilot or demonstration project prior to full scale municipal implementation"

The most successful municipal programs that have implemented LID features have all started with well-documented and monitored demonstration projects. Demonstration projects are often at least partially funded by grants, and, as a result, can have benefits to the municipal revenue stream, when compared to conventional stormwater management solutions. These projects often include public participation, and can help form strong, lasting relationships between the stakeholders, such as neighbourhood or watershed groups, and municipality, providing opportunities for public education and training.

From the perspective of municipal infrastructure managers, demonstration projects are essential to demonstrate that LID techniques can be implemented within the framework of existing stormwater infrastructure and can work in the local environment. Findings from demonstration projects can be used to develop and/or update municipal standards for design, construction, operations, and maintenance. Additional benefits of demonstration projects include:

- Identify conflicts with municipal standards, safety objectives and by-law conflicts
- Provide a controlled environment with less outside pressure and imposed timelines
- Reduced project scale and cost
- Resolve existing issues (e.g., poor drainage, flooding, water quality issues, poor aesthetics, lack of public safety)
- Demonstrate local feasibility
- Establish connections between municipality and community groups, creating local buy-in
- Provide funding opportunities
- Provide education and training to staff, residents and the business community
- Address concerns

"LID practices are unattractive and messy"

Actually, LID practices that utilize vegetation can add value and beauty to private and public spaces, including the municipal ROW, by adding a park-like aesthetic to local neighborhoods. A large selection of native and ornamental flowering perennials, grasses, shrubs, and trees can be incorporated into the design to achieve the desired aesthetic, be it formal, cottage, modern, classical, or native landscape.

Commercial districts that are enhanced with LID features tend to show similar benefits, enjoying higher occupancy rates and enhanced property values. Neighbourhoods with green spaces tend to draw people outside to use recreational features that would otherwise be underappreciated. Studies have shown increases in outdoor recreational activities, such as walking and jogging, after the implementation of LID in communities[9]. Communities that have implemented LID are often described as more cohesive and livable.

"LID bioretention and bioswale media will become quickly contaminated"

In fact, recent studies have been conducted to examine this issue in light of the growing popularity of bioretention, bioswales and other LID infiltration controls that use media to treat stormwater runoff. One study found that an LID practice representing 5% of the drainage area, made of a mix of 20% organic leaf compost, and 70% sand (with less than 5% clay content), has the capacity to accept 750 mm of annual stormwater runoff containing cadmium from a 1 hectare site that is 80% impervious, for 337.5 years[10].

"LID will contaminate the underlying soil"

No, in fact studies performed by TRCA in 2008 on seven older permeable paver installations and five older swales and or ditches suggest that "long term accumulation of contaminants in soils beneath the pavement and swales was not a significant concern[11]." Contaminant levels were generally below Ontario soil 'background' concentrations for non-agricultural land uses, with the few exceptions having concentrations well below levels which would trigger the need for remediation.

"Permeable pavements are not handicap-accessible"

Actually, aside from generally having a slightly rougher surface, permeable concrete and asphalt, as well as some permeable concrete pavers, can be accessible to all users through product research and careful selection. In fact, many manufacturers produce permeable interlocking pavers that are *Accessibility for Ontarians with Disabilities Act* (AODA) and *Americans with Disability Act* (ADA) compliant in that "the opening shall not allow passage of a sphere 13 mm in diameter."[12]

---

[1] J.F. Sabourin and Associates Incorporated. 2008. 20 Year Performance Evaluation of Grassed Swale and Perforated Pipe Drainage Systems. Prepared for the Infrastructure Management Division of the City of Ottawa. Ottawa, ON.

[2] Toronto and Region Conservation Authority and Credit Valley Conservation Authority. 2011. Low impact development stormwater management planning and design guide.

[3] United States Environmental Protection Agency. 2007. Reducing stormwater costs through low impact development (LID) strategies and practices. EPA 841-F-07-006. 37 p.

[4] United States Environmental Protection Agency. 2007. Reducing stormwater costs through low impact development (LID) strategies and practices. EPA 841-F-07-006. 37 p.

[5] Aquafor Beech Limited. 2013. As-constructed costs of Lakeview project and cost estimates for conventional road reconstruction, including stormwater management pond land acquisition and construction costs.

[6] Tom Wenzel, City of Mississauga. 2014. Correspondence with City of Mississauga regarding costs of constructing conventional stormwater management infrastructure at Elm Drive project.

[7] University of New Hampshire Stormwater Center. 2007. 2007 Annual Report. http://ciceet.unh.edu/unh_stormwater_report_2007/SC_Report_2007.pdf.

[8] United States Environmental Protection Agency. 2008. Managing Wet Weather with Green Infrastructure (EPA-833-F-08-009). http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_munichandbook_green_streets.pdf

[9] Center for Neighbourhood Technology. 2010. The value of green infrastructure: a guide to recognizing its economic environmental and social benefits. http://www.cnt.org/repository/gi-values-guide.pdf.

[10] Morgan, J. et al. 2010. When Do We Need to Replace Bioretention Media?. University of Minnesota, Minneapolis. http://stormwater.safl.umn.edu/sites/stormwater.safl.umn.edu/files/080410morgan_paper.pdf.

[11] Toronto and Region Conservation (TRCA). 2008. Performance Evaluation of Permeable Pavement and a Bioretention Swale.

[12] Interlocking Concrete Pavement Institute. 2008. Permeable Interlocking Concrete Pavers – A Comparison Guide to Porous Asphalt and Pervious Concrete. http://www.expocrete.com/pdf/heavy-vehicle/PICP_Comparison_Brochure.pdf.