

Stormwater Management Opportunities

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Defining LID (Low Impact Development)

The various stormwater management (SWM) techniques which mimic the natural water cycle have a variety of names. In Southern Ontario two names are typically used:

- ***Low Impact Development (LID)***
- ***Green Infrastructure (GI) / Green Stormwater Infrastructure (GSI)***

The objective of LID is to incorporate elements of the natural water cycle such as infiltration, interception, storage into the built environment to slow, absorb, and reduce volumes of stormwater runoff to limit our communal risk of flash flooding, and to preserve / restore water quality, natural habitat, and biodiversity. Thus, focus for stormwater management for the Community 20/20 project has been based on infiltration, rather than harvesting of precipitation.

Traditional urban stormwater management focuses solely on conveying stormwater away from our built environment. This has led to impaired water and habitat quality and fails to manage water volumes during extreme weather, which in some cases has increased the likelihood and occurrence of flooding and property damages. The results of a study by the US Environmental Protection Agency show that, over time, the use of LID can save hundreds of millions of dollars in flood losses.

Benefits of LID

The benefits of LID have spanned social, economical, as well as environmental arenas and has been credited with improvements to the mental and physical health of humans living in areas where LID exists. Surface features like rain gardens and bioswales increase the amount and quality of urban green spaces which has been linked to mental health benefits. Reduced rates of petty crimes and vandalism have also been documented in areas using Green Stormwater Infrastructure.

Economic Benefits

LID has a demonstrated ability to save developers money both in the immediate and long term. By working within the specific conditions and constraints within each site LID is able to save money on construction, maximize land value, and decrease flood risk. A summary of the top five economic benefits of LID has been outlined below. Source: Costs of Low Impact Development: LID Saves Money and Protects Your Community's Resources. USEPA, 2012.

1. Adding roadside bioswales, making roads narrower and designing smaller or porous parking lots with on-site runoff retention ***saves money by reducing the amount of pavement, curbs and gutters needed.***
2. Installing green roofs, disconnecting roof downspouts from impervious surfaces (driveways or streets), and incorporating bioretention areas to capture on-site runoff ***saves money by eliminating the need for costly***

runoff detention basins and pipe delivery systems.

3. Designing more compact residential lots **saves money by reducing site grading and building preparation costs, and can increase the number of lots available for sale.**
4. Preserving natural features in the neighborhood can **increase the value and sale price of residential lots.**
5. Using existing trees and vegetation **saves money by reducing landscaping costs and decreasing stormwater volume.**

Example:

Developers at the 55-acre Tellabs corporate campus preserved much of the site's natural drainage features and topography, reducing grading and earthwork costs. They used bioswales and other infiltration techniques in parking lots to manage stormwater. They maximized the amount of natural areas, eliminating the need for irrigation systems and lowering maintenance costs when compared to turf grass.

Total LID project costs were \$461,510 less than a conventional design would have been.

Sample Costs: Comparing Conventional Stormwater Controls with LID Techniques in a Corporate Development (Tellabs) in Naperville, Illinois

Construction Item	Cost of Conventional Development	Cost When Using LID Practices	Dollars Saved with LID
Site preparation	\$2,178,500	\$1,966,000	\$212,500
Stormwater management	\$480,910	\$418,000	\$62,910
Landscape development	\$502,750	\$316,650	\$186,100
Total	\$3,162,160	\$2,700,650	\$461,510

Source: Costs of Low Impact Development: LID Saves Money and Protects Your Community's Resources. USEPA, 2012.

The above table and two below tables compare construction costs using conventional and LID construction methods. As these comparisons demonstrate the three main areas where LID reduces costs are site preparations / earthworks, stormwater management, and landscape development. LID works within the constraints of the native site conditions, meaning less earth needs to be stripped, removed, exported, and/or imported. LID increases opportunities for stormwater to be absorbed into the landscape, which can reduce the necessary amount of underground sewer pipe. Native vegetation is preserved and enhanced where possible, reducing both initial and long term landscape costs.

Example: Cost comparison of conventional construction versus LID based construction

By: Michael Albanese
July 25, 2016

Table 1. Comparison of Material Unit Costs for Boulder Hills			
Item	Conventional Option	Low-Impact Development Option	Cost Difference
Site Preparation	\$23,200.00	\$18,000.00	(\$5,200.00)
Temporary Erosion Control	\$5,846.50	\$3,811.50	(\$2,035.00)
Drainage	\$92,398.00	\$20,125.00	(\$72,273.00)
Roadway	\$82,054.00	\$127,972.00	\$45,918.00
Driveways	\$19,722.00	\$30,108.00	\$10,386.00
Curbing	\$6,464.00	\$0.00	(\$6,464.00)
Permanent Erosion Control	\$70,070.00	\$50,610.00	(\$19,460.00)
Additional Items	\$489,700.00	\$489,700.00	\$0.00
Buildings	\$3,600,000.00	\$3,600,000.00	\$0.00
Project Total	\$4,389,454.50	\$4,340,326.50	(\$49,128.00)

Table 2. Comparison of Material Unit Costs for Greenland Meadows			
Item	Conventional Option	Low-Impact Development Option	Cost Difference
Mobilization / Demolition	\$555,500	\$555,500	\$0
Site Preparation	\$167,000	\$167,000	\$0
Sediment / Erosion Control	\$378,000	\$378,000	\$0
Earthwork	\$2,174,500	\$2,103,500	(\$71,000)
Paving	\$1,843,500	\$2,727,500	\$884,000
Stormwater Management	\$2,751,800	\$1,008,800	(\$1,743,000)
Additional Work-Related Activity (utilities, lighting, water & sanitary sewer service, fencing, landscaping, etc.)	\$2,720,000	\$2,720,000	\$0
Project Total	\$10,590,300	\$9,660,300	(\$930,000)

Source: Comparative costs of traditional stormwater management versus Green Stormwater Infrastructure / LID in two housing developments in Massachusetts. Source Cost Effective LID in commercial and residential sites, Houle et al., 2011.

Environmental Benefits

Low Impact Development has a wide breadth of environmental benefits. Below is a summary of the main environmental benefits associated with the wide scale use of LID features. Source: Benefits of Low Impact Development: How LID Can Protect Your Community's Resources. USEPA, 2012.

- **Improved Water Quality.** Stormwater runoff can pick up pollutants such as oil, bacteria, sediments, metals, hydrocarbons and some nutrients from impervious surfaces and discharge these to surface waters. Using LID practices can reduce pollutant-laden stormwater reaching local waters. Better water quality increases property values and lowers government clean-up costs.
- **Restored Aquatic Habitat.** Rapidly moving stormwater erodes stream banks and scours stream channels, obliterating habitat for fish and other aquatic life. Using LID practices reduces the amount of stormwater reaching a surface water system and helps to maintain natural stream channel functions and habitat.
- **Improved Groundwater Recharge.** Runoff that is quickly shunted through ditches and drains into surface waters cannot soak into the ground. LID practices retain more rainfall on-site, allowing it to enter the ground and be filtered by soil as it seeps down to the water table.
- **Enhanced Neighborhood Beauty.** Traditional stormwater management infrastructure includes unsightly pipes, outfalls, concrete channels and fenced basins. Using LID broadly can increase property values and enhance communities by making them more beautiful, sustainable, and wildlife friendly.
- **Mitigate the urban heat island effect.** By infiltrating water running off hot pavements and shading and minimizing impervious surfaces LID offered opportunities to naturally regulate local air temperature.
- **Mitigate climate change** by sequestering carbon in plants and absorbing water into surrounding soil.
- **Save energy and Reduce air pollution.** Increase energy efficiency via green roofs, tree shading, and reduced/avoided water treatment costs. Improves local air quality by capturing airborne particulate matter and by avoiding power plant emissions and reducing ground-level ozone.

Social Benefits:

Low Impact Development has been shown to provide health related benefits to inhabitant living in areas where LID is used. The following information has been adapted from a report by Kathleen L. Wolf, research social scientist at the University of Washington, College of the Environment, titled: Water and Wellness: Green Infrastructure for Health Co-Benefits.

- **Active Living.** Improving walkability of neighborhoods and increasing recreation access helps promote healthier weights for people of all ages, including the elderly. A study found that seniors with nearby parks, tree-lined streets, and walkable spaces showed higher longevity over a 5-year period.
- **Stress Reduction.** The experience of nature is an antidote to stress. Studies by Roger Ulrich and other environmental psychologists show that visual exposure to nature in the form of trees, grass, and flowers can effectively reduce stress, particularly if initial stress levels are high. Mental restoration also is gained from spending time in an urban green space, and increased visit duration improves the restorative effect.
- **Mental Health and Functioning.** Experiences with nature contribute to better mental health and improve one's capacity to be productive. Brief experiences with or even views of nature help to restore the mind from mental fatigue, as natural settings provide respite from high-focus tasks. This psychological response may contribute to higher workplace productivity as employees with a view of nature are better able to attend to tasks, report fewer illnesses, and have higher job satisfaction.
- **Healing and Therapy.** Natural experiences also are associated with healing and treatment of emotional and physical disabilities. Hospital patients with views of nature display less pain, shorter hospitalization, less anxiety, and higher hospital and room satisfaction. Participating in nature activities also can be used in

rehabilitation programs. A group of inmates in a horticulture program had a recidivism rate of 25%, compared to the 65% rate of the general prison population.

- **Social Capital.** Social capital is a critical condition for a host of community benefits and contributes to development of socially resilient communities. The mere presence of landscapes or trees appears to promote community connections. Views of green space from homes are linked to greater perceptions of well-being and neighborhood satisfaction. Active involvement in community greening and nature restoration projects also produces a range of social benefits, including strengthening of intergenerational ties and organizational empowerment.

LID examples in Burlington/Halton

Note: this is an area of research currently being investigated and will be included in the October, 2016 report

LID Opportunities for the Emshih Site

Stormwater management has been identified as the area of focus for the Community 20/20 project in 2016. Through researching examples and case studies it has been determined that incorporating Low Impact Development, or 'Green Stormwater Infrastructure' features into the site can play an active part in achieving the goals of developing a healthy, sustainable, and vibrant urban mixed use development.

The opportunity exists to create an example for the broader community on how to build sustainable communities with a triple bottom line approach including economic, environmental, and social benefits. Outlined below are four main goals for the Community 20/20 project from a stormwater management perspective.

1. **Lead by Example** - create an example for sustainable development within the context of stormwater management and encourage other developers and property owners to act similarly.
2. **Foster Innovation** - showcase innovative methods, techniques, and products which provide and/or facilitate ecologically and economically sustainable urban stormwater management.
3. **Manage Rain On Site** - reduce the amount of subsurface stormwater management infrastructure and manage stormwater on site at or near the land surface
4. **Prepare for the Future** – mitigate and adapt to the extremes of climate change; develop sustainably and responsibly to keep people and assets within and downstream from this development safe from the flooding.

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Six Possible Initiatives



Permeable
Surfaces



Green Walls &
Roofs



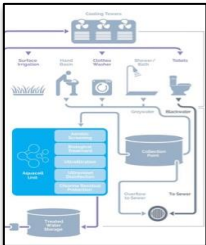
Central
Urban Park



Perimeter Walking
Trail



Landscape
Features



Greywater
Recycling

Some LID Opportunities for the Community 20/20 Emshih Site:

Feature	Economic Considerations	Environmental Considerations	Social / Health Considerations	Estimated Volume Reductions
Permeable Surfaces	<p>Longer lifespan versus asphalt, concrete.</p> <p>Can increase property values / aesthetics.</p> <p>Reduced flood risk.</p>	<p>Provide infiltration / replenish groundwater.</p> <p>Improve quality / quantity of nearby creeks and rivers.</p> <p>Reduce landscape irrigation demand.</p>	<p>Reduce urban heat island effect.</p> <p>Incorporate multiple surface types to serve as examples to large audience.</p>	<p>Runoff reductions estimated at 45-85% based on site conditions.</p>
Central Urban Park	<p>Drawing people into the development.</p> <p>Increased property values with close proximity to park.</p> <p>Reduced flood risk.</p>	<p>Urban park can control air, water, and noise pollution.</p> <p>Provide habitat for local wildlife.</p> <p>Control stormwater runoff volumes.</p>	<p>Social space for people to gather.</p> <p>Nearby urban green space provides mental health benefits.</p> <p>Encourages people to be outside.</p> <p>Reduced crime rates.</p>	<p>Variable</p> <p>Trees absorb roughly 30% of precipitation in their canopy.</p>
Landscape Features	<p>Reduced length of underground storm sewer pipe needed for drainage.</p> <p>Reduced / eliminated need for large stormwater pond.</p> <p>Create a unique</p>	<p>Provide infiltration / replenish groundwater.</p> <p>Improve quality / quantity of nearby creeks and rivers.</p> <p>Reduce landscape irrigation demand.</p> <p>Provide habitat for</p>	<p>Improved aesthetics.</p> <p>Bring the issue of water conservation to the forefront.</p> <p>Create a visible example of LID in Burlington.</p>	<p>Runoff reductions estimated at 45-85% based on site conditions.</p>

	<p>aesthetic.</p> <p>Demonstration potential in Halton Region.</p> <p>Increased property values.</p>	<p>local wildlife.</p>		
Green Walls & Roofs	<p>Provide enhanced building seal – increase energy efficiency.</p> <p>Longer lifespan versus other roof types.</p> <p>Reduced risk of flooding.</p>	<p>Control stormwater runoff volumes.</p> <p>Provide habitat.</p> <p>Filter air particulate matter.</p>	<p>Roof top gardens for enhanced aesthetics.</p> <p>Temperature regulation during extreme weather events.</p>	<p>Runoff reductions estimated at 45-55% based on site conditions.</p>
Perimeter Walking Trail	<p>Keep residents on site for exercising.</p> <p>Place for pet owners to use.</p> <p>Outside residents get drawn into development, enhance retail sales.</p>	<p>Avenue to display a permeable surface option ideal for light traffic options like walking and cycling.</p> <p>Bordering the creek can raise awareness and draw attention to local natural habitat.</p>	<p>Mental and physical health benefits of exercise.</p> <p>Communal space for all fitness levels.</p> <p>Avoids the intimidation factor associated with gym atmosphere.</p>	<p>Runoff reductions estimated at 45-85% based on site conditions.</p>
Greywater Recycling	<p>Reduce potable water usage.</p> <p>Increasing the 'self-sufficient' and sustainable nature of the development.</p>	<p>Reduce potable water usage.</p> <p>Place less load on municipal waste water treatment plants.</p>	<p>Create a culture of conservation.</p> <p>Conversation starter.</p>	<p>Variable</p>

Source: Runoff reduction statistics taken from Credit Valley Conservation (Mississauga, Ontario) Low Impact Development Stormwater Management Planning and Design Guide, 2010.

Conclusion

As evidenced by various field research and case studies the implementation of LID has been shown to yield economic, environmental, and social benefits. Cost reductions have been seen in site preparation / earthworks, stormwater management, and landscaping when LID techniques are used. As LID becomes more common throughout Southern Ontario in the coming decades there exists an opportunity to pioneer its implementation in Halton Region. The realities of climate change are creating a culture of sustainability that will attract well educated, forward-thinking people to areas where sustainability is prioritized. Creating a vibrant, socially focused, sustainable development has been noted as a goal of the Community 2020 development and LID offers a tool for helping to achieve that goal.

Additional References and Resources

One Planet Community | <http://www.oneplanetliving.com/index.html>

10 Goals towards healthy/sustainable communities

1. Zero Carbon
2. Zero Waste
3. Sustainable Transportation
4. Local and Sustainable Materials
5. Local and Sustainable Food
6. Sustainable Water
7. Land Use and Wildlife
8. Culture and Community
9. Equity and Local Economy
10. Health and Happiness

Literature:

Flood Loss Avoidance: Benefits of Green Infrastructure for Stormwater Management. US Environmental Protection Agency. <https://www.epa.gov/sites/production/files/2016-03/documents/flood-avoidance-green-infrastructure-12-14-2015.pdf>

Water and Wellness: Green Infrastructure for Health Co-Benefits. Written by Kathleen L. Wolf, research social scientist at the University of Washington, College of the Environment. Published by: Water Environment Federation. <http://stormwater.wef.org/2014/04/water-wellness/>

Vegetation and Crime in the Inner City: Does Vegetation Reduce Crime? Witten by Frances Kuo and William Sullivan, Human-Environment Research Laboratory at the University of Illinois, Urbana-Champaign. <http://www.outdoorfoundation.org/pdf/EnvironmentAndCrime.pdf>

Forging the Link: Linking the Economics Benefits of Low Impact Development with Community Decisions.

University of New Hampshire, 2011. <http://www.unh.edu/unhsc/forgingthelink>

Videos:

Sustainable Drainage Systems explanation video: <https://www.youtube.com/watch?v=LMq6FYiF1mo>

Case Study - IMAX theatre in Mississauga: <https://www.youtube.com/watch?v=i5MHNkfpSyU>

Potential Partners/Suppliers:

Aquafor Beech Ltd.: Offices in Mississauga, Guelph, and Kingston, Ontario.

<http://www.aquaforbeech.com>

An environmental Engineering firm whose principal focus is on watershed planning, environmental restoration, stormwater management, fluvial geomorphology, environmental assessment/permitting, water resources engineering and municipal infrastructure design. Services include planning, feasibility analysis, public consultation, detail design and contract administration services. A strong emphasis is placed on environmental considerations for all projects undertaken.

Green Infrastructure Foundation: Minneapolis, Minnesota.

<http://www.greeninfrastructurefoundation.org/programs/green-infrastructure-charrette>

They have a program called The Green Infrastructure Design Charrette, which is designed to help community leaders examine how living green infrastructure investment might work on the streets, roofs and walls of their own communities.

The program consists of the following elements:

1. Organizing a one-day Green Infrastructure Design Charrette with multi-disciplinary volunteers to redesign specific neighborhoods in need, with fifteen generic types of green infrastructure as their tools.
2. Customization of a Cost-Benefit Matrix of values to be tailored to your community and to be used to generate aggregate level financial analysis of the proposed designs emerging from the charrette process.
3. Production of a final report that combines images of the redesigned neighborhoods with customized cost-benefit valuations in order to encourage policy and program changes that will lead to better implementation.

West 5: London, Ontario

<http://west5.ca/community-story/sustainability/>

By: Michael Albanese
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Excerpt from their project promotions:

Live. Work. Play. Shop.

Smart. Healthy. Better.

"Building Ontario's most sustainable community is not about what you put into it, it's about what you get out of it. Through design and technology West 5 will maximize the potential of the natural elements to minimize the draw on resources needed for everyday life. For example, solar panels not only keep you dry, but they generate electricity, thus reducing energy costs. Similarly, solar parkades keep your car dry and cool, while powering the community. Electric Vehicle chargers make it easier to own an electric vehicle and reduce gasoline consumption. Utilizing high performance road surfaces help melt snow and ice faster, which means less salt."

Windmill Development Group Ltd.: Offices in Toronto and Ottawa.

<http://www.windmilldevelopments.com>

Windmill Development Group is a visionary company dedicated to transforming conventional development practices by using a triple bottom line approach to projects. This ensures that strong ecological, social, and financial returns are achieved in all projects. Everything that we do is conceived, designed, and constructed to protect and enhance the local community and its ecosystems. We harness innovations in land use, water, air, energy, design, waste management and smart building technologies to create healthy, high-performance green buildings and communities.

Zibi: <http://www.zibi.ca>

Zibi is an environmentally sustainable mixed used development in Ottawa, Ontario.