Greening Your Community

Cost-effective LID solutions

#5

Fact Sheet #5:
Urban Water Quality Improvements

Impaired Waters and LID

The majority of Massachusetts' urban waterways are impaired—meaning they don't meet state water quality standards and are not providing ideal habitat for fish and wildlife, and may also be leading to beach closures and other negative economic effects. Pollution from stormwater runoff from impervious surfaces contributes to 55% of the water quality impairments in MA.[1]

This fact sheet will review how LID Best Management Practices (BMPs) are also cost effective in removing nutrients and other pollutants compared to traditional stormwater systems in an urban environment.

Monoosnoc Brook: A Success Story of Urban Water Retrofits

Beginning in 2008, a series of projects were undertaken to address the sediments, nutrients, and bacteria from stormwater flowing into Monoosnoc Brook and the North Nashua River.

The brook stretches 6.1 miles through the city of Leominster and is an important downtown feature and place for outdoor recreation and aquatic habitat. This densely developed area encompasses residential, industrial, and commercial zoning that all contributed to polluted runoff entering the waterway. It was therefore critical to the success of the project to engage a wide variety of stakeholders, including schools, businesses, church groups, and residents throughout the restoration process.

After mapping the location of catch basins and outfalls along the Monoosnoc watershed, the pollutant loading was calculated from the impervious areas draining to the waterbody. This identified areas in which to focus restoration, while mapping soils pinpointed the best locations for stormwater infiltration.

What are Green Infrastructure (GI) and Low Impact Development (LID)?

Green Infrastructure (GI) includes both natural features such as forests and wetlands as well as engineered landscapes that mimic these natural processes like a rain garden.

Low Impact Development (LID) works to preserve the natural landscape and minimize impervious surfaces to keep stormwater close to the source and use it as a resource rather than a waste product.

Together, LID and GI not only manage stormwater and improve groundwater supplies, but also offer many free ecosystem services including cleaner air and water, flood control, shade and energy savings, recreational opportunities, and enhanced property values and quality of life.

Preserving our existing GI is our first line of defense against climate impacts such as increased storm intensities as well as achieving long-term cost savings.

Massachusetts Watershed Coalition

Through community involvement and the installation of BMPs, the pollutant loading into Monoosnoc Brook was significantly reduced to create a healthy and productive waterbody for the ecosystem and the community.

Mass Audubon
Protecting the Nature of Massachusetts

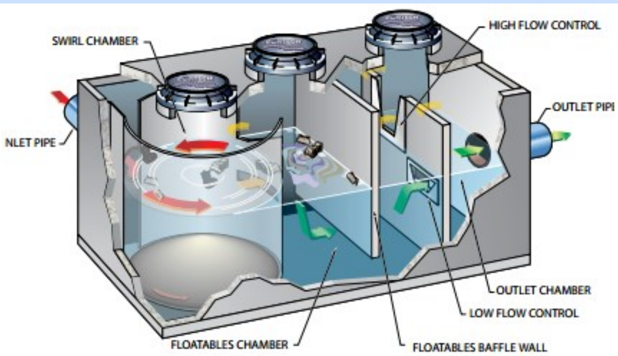
SHAPING the Future of YOUR COMMUNITY

Costs, Benefits, and Effectiveness of BMPs in Leominster

Numerous BMPs were installed to improve water quality by increasing infiltration and reducing the amount of polluted runoff discharged to the brook. These included bioretention areas, gravel wetlands, deep sump catch basins, a hydrodynamic separator, and infiltration trenches and sediment vaults. Below is an overview of their effectiveness in reducing nitrogen (N), phosphorus (P), and total suspended solids (TSS).

BMP	% Reduction	0	10	20	30	40	50	60	70	80	90	100
Hydrodynamic Separator	TSS				35%							
Deep Sump Catch Basin	TSS			25%								
Gravel Wetlands	N								75%			
	P						58%					
Bioretention	N				30-50%							
	P				30-50%							
	TSS									90%		
Infiltration Trench	N					40-70%						
	P					40-70%						
	TSS									80%		

Hydrodynamic Separator



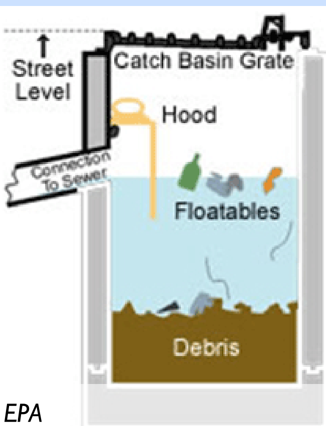
Contech—Vortechs System

Benefits ✓ Cost effective $ Solids reduction

TSS is removed before it enters the stormwater drainage system. The separator can fit underground in small areas where available surface land is limited and also works to reduce oil and grease. In Leominster, the system was placed under a parking lot to collect stormwater from residential and industrial areas.

- Total P removal of 10-30% [7]
- Fine particle removal down to 50 microns [8]

Deep Sump Catch Basins



EPA

Benefits ✓ Cost effective $ Solids reduction Flood control

These basins trap sediment (e.g. sand and dirt) before it enters the stormwater treatment systems or waterways. Nine sump catch basins were installed from 2008 to 2014.

- Costs about $5,000-6,000 to install [4,5]
- Costs about $200/yr in labor for sediment removal & disposal [4,5]
- 25%TSS removal credit when used for pretreatment [6]

Gravel Wetland


Massachusetts Watershed Coalition

Benefits ✓ | Cost effective $ | Curb appeal | Habitat creation | Nutrient reduction N P | Increased awareness | Groundwater recharge | Flood control

Water flows through a series of cells with plants and saturated soils where microbes break down nutrients and other pollutants. The gravel wetland is installed with pretreatment BMPs to capture stormwater sediments.

- Costs about $25,000-30,000 per acre of impervious area treated [4,5]
- Costs about $1,500-2,000/yr in labor for maintenance and vegetation control [4,5]
- 80% TSS removal credit with adequate pretreatment [6]
- Varied % removal of nutrients, metals & pathogens [6]

Bioretention


Massachusetts Watershed Coalition

Benefits ✓ | Cost effective $ | Curb appeal | Habitat creation | Nutrient reduction N P | Increased awareness | Groundwater recharge | Flood control

Soil and native plants filter and reduce stormwater contaminants – including up to 90% of metals – allowing the purified water to soak into the ground and replenish the groundwater that sustains streamflow during dry times. Examples include tree filters, bioswales, and rain gardens.

Tree Filter

- Costs about $20,000-25,000 [4,5]
- Costs about $200/yr in labor for maintenance [4,5]
- Presumed to remove 80% TSS [6]

Bioswale

- Costs about $20,000/acre impervious area treated
- Costs about $300-500/yr in labor for maintenance (varies by size of swale)[4,5]
- 70% TSS removal credit with adequate pretreatment [6]

Rain Garden

- Costs about $2-12/ft^2 [3]
- Costs about $200/yr in labor for maintenance [4,5]
- Reduces runoff by up to 90% [3]
- Reduces pollutants, including N, P, metals, and TSS by 65-90% [3]

Sediment Vault & Infiltration Structures (Trench or Chamber)


Massachusetts Executive Office of Energy and Environmental Affairs

Benefits ✓ | Cost effective $ | Nutrient reduction N P | Groundwater recharge | Flood control

Stormwater passes through a sediment vault (an oil and grit separator) that allows coarse sediment to settle before flowing to the infiltration trench or chamber. This section is a shallow, excavated area filled with crushed stone and provides underground storage that allows the stormwater to soak into the ground as well as remove up to 90% of pathogens. This method was installed in the Granite Stormwater Park and on Mill St.

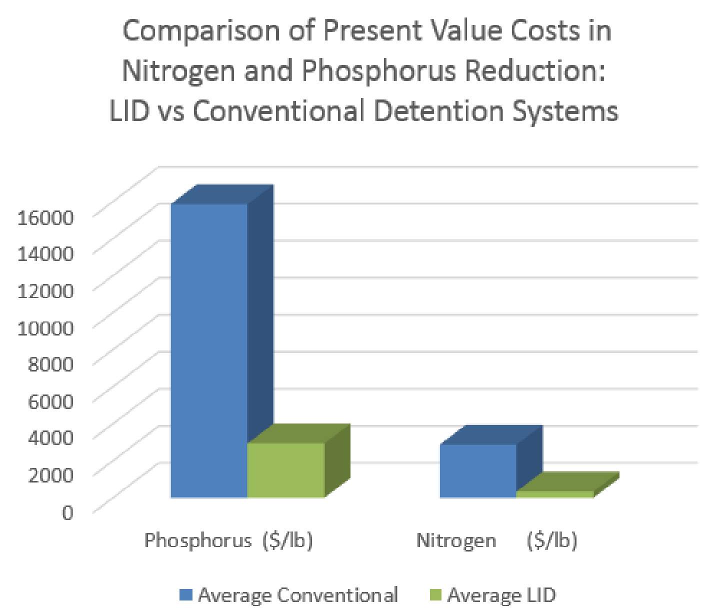
- Costs about $15,000-20,000 per acre of impervious area treated [4,5]
- Costs about $400-600/yr for sediment removal & disposal [4,5]
- 80% TSS removal credit with adequate pretreatment [6]
- Varied % removal of nutrients, metals and pathogens [6]

By the Numbers...

The Leominster LID project was significantly less expensive compared to how much it would have cost to remove the amount of N and P by conventional stormwater practices (represented by dry detention basins) in addressing nutrient reduction requirements.

Using Leominster's Rockwell Pond and Lower Monoosnoc projects, the Horsley Witten Group, Inc. calculated a cost comparison of conventional vs. LID methods. The Rockwell Pond represented a cost savings of 79% for P reduction and 85% for N reduction. Similarly, the Lower Monoosnoc project represented a cost savings of 83% for P reduction and 69% for N reduction.

These cost comparisons are represented in the graph to the right.



Cost comparison by Scott Horsley, Horsley Witten Group, Inc. based on comparison between a conventional detention basin vs. gravel wetland and bioretention. See supplemental information online for more details on how this was calculated.

Location of BMPs in relation to catch basins and the impervious areas draining into Monoosnoc Brook and Rockwell Pond in Leominster. Map by Massachusetts Watershed Coalition

Conclusion

The BMPs installed in Leominster demonstrate that LID solutions can offer the best of both worlds. They're not only cost-effective solutions to stormwater management, but also address several social and ecological concerns. Urban stream restoration improves local water quality, re-establishes aquatic ecosystems, reduces public health risks such as flooding and infrastructure damage, and renews community enjoyment of local waters.

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Learn More

See our website for more information, including guidance, tools, and document references:
www.massaudubon.org/shapingthefuture or www.masaudubon.org/LIDCost

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