

Greening Your Community

Cost-effective LID solutions



conserve



restore



protect



save money

#3

Fact Sheet #3:

Low Impact Development Best Management Practices

Engineered + Nature Based Systems = Successful Solutions

Preserving the existing capacity of the natural land is the absolute best bang for your buck in terms of reducing stormwater and improving community character. However, it's not always possible to preserve large areas of land, especially in urban settings. When communities need to grow, they can incorporate smart growth techniques and layouts like those discussed in Fact Sheet #2 that ensure engineered systems and nature based solutions work together.

Engineered systems include underground piping, outfalls, and catch basins to intercept and transport stormwater. Nature-based solutions include Low Impact Development (LID) best management practices such as rain gardens and vegetated filter strips. Together, these systems offer a comprehensive approach to managing stormwater in a way that's smart for your budget and your community character.

Minimizing Imperviousness with BMPs

Best Management Practices (BMPs) can be installed in both new and redevelopment. Any time land will be disturbed, find ways to minimize impervious surfaces and keep stormwater at its source. Soil and vegetation break down pollutants and infiltrate water—whether by the side of a road or from rooftops. By slowing the rate of runoff, these BMPs also reduce flooding and associated financial and health-related costs.



Bioretention strips filter parking lot runoff

Trees and other plants also offer additional benefits such as air quality protection, improved aesthetics, reduced energy use, and cost savings.

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.

5 Tips for A Successful LID Project

1. Preserve the **natural vegetation** as much as possible and use native species that will need less maintenance
2. Keep **slopes** gentle to avoid erosion
3. Make sure the **subsurface** is highly permeable—this may mean installing a constructed subsurface
4. Get the **community** involved!
5. Visible, simple, and easily understood projects are those that will be **loved** and successful!

Low Impact Development Techniques

Green Roof

What is it?	Planting vegetation on a roof so that rain can be taken up by plants instead of running off. There are many types of green roofs and they can serve as additional recreation space or simply a stormwater storage area.
Cost	<ul style="list-style-type: none"> • \$10-30/ft² ^{1,2} • Becomes up to 50% cheaper by the square foot as the square footage exceeds 10,000 feet ³
Runoff	Reduces runoff by 30-86% ⁴
Additional benefits	<ul style="list-style-type: none"> • A 5,000 ft² green roof sequesters 170 lbs of carbon/yr ² • Reduces heating and cooling costs for buildings by \$6-8/ft² ³ • Can extend life expectancies of roof by more than double ^{1,2,3}
But what about...	Maintenance on green roofs entails general weeding and debris removal, but since they're watered by stormwater, which has nutrients, they usually don't need any fertilizer or irrigation.



U.S. General Services Administration
Boston, MA: John W. McCormack US Post Office and Courthouse. This 9,654 ft² green roof sits atop the EPA Region 1 Headquarters on a historic 1933 building.

Rain Barrel & Cistern

What is it?	A structure to store rooftop runoff and reuse it for landscaping and other non-potable uses. There are many different styles, including an above ground 50-gallon barrel or a below ground several hundred or thousand gallon cistern.
Cost	<ul style="list-style-type: none"> • Average 50-gallon rain barrel costs around \$100 • Cisterns can be more expensive, depending on the size
Runoff	At scale, cisterns can store 100% of rooftop runoff except in extreme storms
Additional benefits	<ul style="list-style-type: none"> • A 1" rainstorm generates 623 gallons of stormwater per 1,000 square foot of roof that can be collected • Water can be used to landscape in hot summer months, saving water costs.
But what about...	Installation is a cinch—simply attach a downspout elbow to divert rainwater from your lawn or driveway into the barrel. When you're ready to harvest the water, just attach a hose and go! Above ground cisterns can be just as easy, though below ground cisterns require more work for citing and installation.



EPA
A small, slanted green roof in Craftsbury, VT.



Great American Rain Barrel Company
An example of 60-gallon rain barrels. Some communities in MA offer a rain barrel program that offers significant discounts to residents.

Rain Garden

What is it?	A depression in the ground to filter stormwater and are filled with highly permeable subsurface and water-loving vegetation. May have an engineered overflow drain system as well.
Cost	<ul style="list-style-type: none"> • Costs about \$2-12/ft² ⁵ • Costs about \$200/yr in labor for maintenance ^{6,7}
Runoff	Reduces runoff by 90% ⁸
Additional benefits	<ul style="list-style-type: none"> • Reduces pollutants, including Nitrogen, Phosphorus, metals, and TSS by 65-90% ⁸ • Improved aesthetics
But what about...	Ownership and maintenance can be held by the individual residential property owners, homeowners associations, or by local public works. If outside entities need to be on private property to maintain bioretention such as rain gardens, be sure to include this in deeds so that homeowners understand what is their responsibility and what is the municipality's.



This rain garden in Devens, MA gathers runoff from a curb-less road and sidewalk to infiltrate stormwater back into the ground while also offering beautiful home landscaping. Rain gardens can be made in any size and shape to fit your location.

Permeable Pavement

What is it?	Permeable, or porous, pavement or concrete allow water to infiltrate the driving surface to reduce stormwater runoff, eliminate puddles, and increase groundwater recharge.
Cost	<ul style="list-style-type: none"> Costs range from \$10-12ft² installed⁷
Runoff	Can infiltrate as much as 70-80% of annual rainfall
Additional benefits	<ul style="list-style-type: none"> Reduces the amount of land needed for stormwater management Reduced flood risk may increase property value by 2-5%² Massachusetts communities typically spend over \$100,000 annually on salting.⁹ Areas with permeable pavement can reduce salt use by as much as 75%, leading to enormous cost savings¹⁰ and reduced salt pollution.
But what about...	Winter weather is no trouble for permeable pavement. In fact, a studies at the University of NH Stormwater Center have found that before icing, precipitation melts into the ground and unsalted porous pavement offers a shorter stopping distance than salted traditional pavement. This improves safety and can reduce salting by 75%, saving money as well.



Horsley Witten Group

This parking lot in Narragansett, RI shows traditional asphalt on the left, where puddles have formed, and permeable pavement on the right, where it has soaked through.



National Asphalt Pavement Association

This insert shows a University of NH parking lot one hour after plowing. The inset photo shows a close up of the permeable pavement section of the lot at the same time.

Stormwater Wetland

What is it?	A type of detention basin where runoff is diverted into an engineered, shallow wetland area to temporarily store water. Must be used with another BMP that filters sediment. Smaller, pocket wetlands fed only by stormwater can be used when less space is available.
Cost	<ul style="list-style-type: none"> Costs range from \$25,000-30,000 per acre of impervious area treated^{6,7} \$1,500-2,000/yr in labor for maintenance and vegetation control^{6,7}
Runoff	Can infiltrate 100% of peak flow when built to size
Additional benefits	<ul style="list-style-type: none"> Total Suspended Solids (TSS) - 80% with pretreatment⁸ Reduces pollutants, including Nitrogen (20-55%), Phosphorus (40-60%), metals (up to 85%), and pathogens (up to 75%)⁸
But what about...	Building near natural wetlands is regulated under the Wetlands Protection Act. However, constructed stormwater wetlands are not so strictly regulated and additional permits are not required for ongoing maintenance.



Devens Enterprise Commission

These Devens, MA homes have met the required 20' wide emergency vehicle access in a unique way. They installed 12' of pavement and 8' of permeable grass pavers to the left to minimize pavement without compromising safety.



Massachusetts Watershed Coalition

This stormwater wetland in Leominster uses the land's natural capacity to filter and infiltrate water.

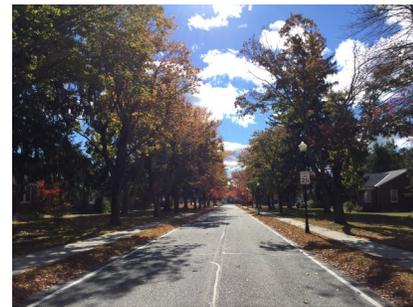
Other Bioretention Systems

Rain gardens and stormwater wetlands are just two types of bioretention systems, which allows the landscape to filter pollutants and infiltrate stormwater into the ground. These systems give excess water a place to go and reduce flooding and infrastructure damage.

Other systems include vegetated parking lot medians, roadside swales or "country drainage," and curb cuts, which take stormwater from streets and filter it into a roadside rain garden or tree box.

LID Site Design: Less Pavement, More Savings

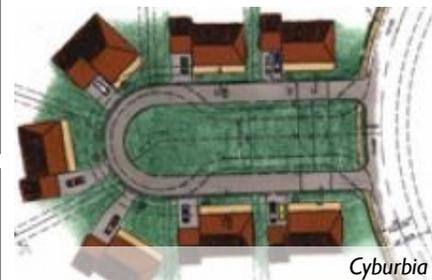
By reducing the amount of pavement, communities are not only reducing their impervious surface and allowing more space for stormwater infiltration, but it's also a huge cost savings. Traditional paving costs about \$6ft². Reducing a just a short two-mile road from 28' wide to 20' equates to a savings of over \$500,000. Less pavement also means reduced maintenance costs, including plowing, salting, and sweeping.



This narrow road in Devens, MA easily fits two lanes of traffic and offers room for a vegetated buffer, sidewalk, and street trees.

Narrower Roads

What is it & benefits	Designing and installing 10' or 12' lanes on neighborhood roads reduces the amount of impervious surface and enhances the land's ability to infiltrate water and pollutants.
But what about...	Safety should always be a top concern, which is why narrow roads are a smart idea. Studies have shown that 10' lanes are as safe as – if not safer than – wider lanes. ¹¹ When roads are narrower, drivers go slower, pay closer attention to the road, and have fewer accidents. Street-lined trees that provide a shaded lane and homes closer to the roadways also enhance these safety benefits.



Cyburbia

Alternative Cul-de-sacs

What is it & benefits	Instead of having a wide road with a large paved circle at the end, the circle can be vegetated to increase infiltration. Alternatively, the road could make a loop and be enclosed with vegetated area that's perfect for community spaces.
But what about...	Emergency vehicles and plow trucks need space to turn around, which narrower roads and alternative cul-de-sac options still provide. National Fire Protection Association requires a 20' wide passage for fire trucks. ¹² However, communities have met this requirement in innovative ways. Some homes in Devens, MA have rear garages on 12' of pavement bordered by 8' of grass pavers on the side. This structure is still heavy weight bearing and the combined 20' roadway was accepted by the local fire department. ¹³

An alternative cul-de-sac design that allows for recreational space as well as a place to improve stormwater infiltration.

Shared Driveway

What is it & benefits	Instead of each home having a separate driveway from the street, shared driveways that then split to each home offer access to homeowners while still reducing pervious surfaces and increasing stormwater infiltration.
But what about...	Marketable homes with shared driveways don't deter potential buyers. In fact, homes in Concord and Plymouth with shared driveways and parking still brought high value and sold quickly— including during the 2008 recession. ^{14, 15}



This shared driveway in the Pinehills in Plymouth, MA provides easy access to garages, plenty of parking, and less impervious surface. Retention of mature trees also offers privacy.

Learn More

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



This project was funded by an agreement (CE96184201) awarded by the Environmental Protection Agency to the New England Interstate Water Pollution Control Commission on behalf of the Narragansett Bay Estuary Program. Although the information in this document has been funded wholly or in part by the United States Environmental Protection Agency under agreement CE96184201 to NEIWPCC, it has not undergone the Agency's publications review process and therefore, may not necessarily reflect the views of the Agency and no official endorsement should be inferred. The viewpoints expressed here do not necessarily represent those of the NBEP, NEIWPCC, or U.S. EPA nor does mention of trade names, commercial products, or causes constitute endorsement or recommendation for use.

