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TO: 495/MetroWest Partnership Stakeholders
FROM: The 495/MetroWest Partnership
RE: Low Impact Development Toolkit Update

As part of Year 4 of the 495/MetroWest Partnership's Strategic Plan, the 495/MetroWest Partnership aims to curate and publish an online listing of contemporary resources to supplement the 2008 Low Impact Development (LID) Toolkit, ensuring access to up-to-date best practices and innovations in sustainable development. This document serves as a comprehensive overview of LID resources available to Massachusetts businesses, municipalities, and residents to aid in this effort.

Information/Guides

Low Impact Site Design Fact Sheet

Organization: MAPC

In 2010, the Metropolitan Area Planning Council (MAPC) provided design objectives for low impact site design, as well as an overview of design principles, site analysis, maintenance, cost, and additional references. Within site analysis, the source emphasizes locating development and roadways, creating a decentralized stormwater system, as well as potential benefits and limitations. The source notes that LID may require collaboration with qualified professionals and sometimes conflicts with local regulations and perceptions of development types. It highlights the potential cost savings and aesthetic benefits of LID designs. Maintenance requirements are generally reduced, and the overall cost may be higher for initial planning but often results in lower construction and maintenance costs with added property value.

Low Impact Development Technologies

Source: The Whole Building Design Guide (WBDG)

The Whole Building Design Guide outlines LID technologies and points to low impact development as an alternative to site design strategy. The WBDG notes the "greening" movement, as well as listing examples of profitable LID development sites. The source provides information on each mainstream LID practice, and refers viewers to federal directives, their [resource page](#), publications, organizations, training and research links, and tools of analysis and design.

Low Impact Development Toolkit

Source: City of San Antonio, Texas

The City of San Antonio released an updated guide to LID practices in 2019. The source includes helpful metrics and visuals depicting the best uses of practices such as bioretention basins, bioswales, vegetated swales, vegetated filter strips, permeable hardscapes, as well as other lesser-discussed methods of wetland restoration and pollinator planting. The toolkit adds planting considerations, a plant list to target certain pollinators, and a recommended tree list designed to intercept rainfall, direct precipitation into the ground, and absorb stormwater through roots. Each listed method in the toolkit factors in the initial cost and the maintenance costs required for successful implementation.

Rain Garden Guide

Organization: Massachusetts Watershed Coalition

The Rain Garden Guide from the Massachusetts Watershed Coalition provides a detailed overview of designing, constructing, and maintaining rain gardens, which are shallow, planted depressions that capture and treat stormwater runoff. These gardens use native vegetation and engineered soil layers to slow, infiltrate, and filter runoff, reducing pollution and easing pressure on conventional stormwater systems. The guide outlines site selection, plant choices, soil amendments, and construction steps, making it a valuable resource for homeowners, developers, and municipalities. Rain gardens can be incorporated into residential yards, commercial landscapes, and public spaces to enhance infiltration, support biodiversity, and mitigate urban flooding. By integrating rain gardens with other LID techniques—such as permeable paving, vegetated swales, and bioretention areas—communities can create more resilient, sustainable developments that improve water quality and ecosystem health.

Green Roof Best Management Practice Fact Sheet

Organization: United States Environmental Protection Agency

The EPA's Fact Sheet on the Best Management Practices for Green Roof projects outlines the concept, applications, limitations, and effectiveness of such initiatives. As detailed in the document, Green Roofs provide a wide range of benefits, including improved water quality, reduced sewer overflows, and the prevention of sewage from entering local waterways. These projects can be implemented in various ways: as part of an initial construction project or as a retrofit for existing structures with sufficient load-bearing capacity on their roofs. Each project requires a unique design, tailored to factors such as the roof's load capacity, project budget, local climate, and specific design goals, such as desired stormwater retention volume. Ultimately, Green Roofs can significantly reduce the total volume of stormwater discharge and decrease the export of pollutants often associated with traditional roofing systems. Although regular maintenance is necessary to maintain their efficiency, the long-term benefits of Green Roof implementation are substantial.

Bioretention Areas Fact Sheet

Organization: MAPC

In 2016, MAPC updated the management objectives, application and design principles, benefits, limitations, maintenance, and cost of bioretention areas. Bioretention utilizes soil, plants, and microbes to treat stormwater runoff. They're designed to manage water quality, reduce peak discharge rates, and improve site aesthetics. They can be retrofitted into various settings, including parking lots, median strips, and residential areas, and offer cost-effective, decentralized stormwater treatment compared to traditional methods. However, proper maintenance is crucial to prevent premature failure, and they may not be suitable for

stormwater hotspots with high pollutant loads. The source lastly offers additional references to a published EPA study, and the [Low Impact Development Center](#).

[Green and Complete Streets Guidebook](#)

Organization: Devens Enterprise Commission

The Devens Enterprise Commission, in partnership with Tufts University, published the Green and Complete Streets Guidebook as a resource for developers and planners seeking to implement sustainable street design. The guidebook explains how green streets manage stormwater onsite through natural systems, including vegetation, engineered soil, and permeable surfaces, to capture and clean runoff, and how complete streets shift away from auto-centric design to prioritize the safety and accessibility of all roadway users regardless of travel mode, age, or ability. The resource addresses common concerns through a frequently asked questions section and provides visual examples of successful implementation from urban, suburban, and rural contexts across North America. It additionally features a detailed case study of Devens' Grant Road project, which incorporates reduced travel lane widths, raised crosswalks, dedicated bike lanes, street trees, and low impact site design features. The guidebook provides links to additional tools and resources for communities interested in implementing green and complete streets.

[LID Fact Sheets](#)

Organization: Mass Audubon

Mass Audubon released a series of five fact sheets to aid community officials, residents, and others in understanding the benefits of Low Impact Development (LID), Green Infrastructure (GI), and sustainable design. The fact sheets cover information such as the connection between land use choices and water resource health, conservation design principles that preserve natural resources while accommodating growth, specifications for LID techniques (such as rain gardens, rain barrels and cisterns, green roofs, permeable pavement), and LID site design, including shared driveways, alternative cul-de-sacs, and narrower roads. Outside of the fact sheets, Mass Audubon also addresses how local zoning bylaws and land use regulations can affect LID implementation, offering guidance for analyzing and updating master plans, subdivision regulations, and bylaws to encourage sustainable development practices. They also provide case studies and cost comparisons for LID projects.

Grants/Technical Assistance Programs

[Urban Runoff: Low Impact Development](#)

Organization: United States Environmental Protection Agency

The Environmental Protection Agency gives information on Low Impact Development and its potential to improve habitat, flood protection, cleaner air, and cleaner water. The source provides an overview of LID benefits and practices including bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements.

[Stormwater Permitting](#) (provides grants)

Organization: MassDEP

MassDEP provides guidelines for what municipalities must follow to implement stormwater runoff infrastructure. The agency supports the implementation of the Municipal Separate Storm Sewer System (MS4) General Permit, Construction General Permit, and Multi-Sector General Permit, many of which are administered jointly with the EPA. State authorization for these permits, particularly near Outstanding Resource Waters, requires the submission of a WM15 application. MassDEP also offers educational materials, planning toolkits, and grant funding to

help municipalities meet MS4 permit requirements. In addition, local governments may have their own ordinances governing stormwater management, making coordination at all levels essential for effective implementation.

Central Massachusetts Regional Stormwater Coalition

The Central Massachusetts Regional Stormwater Coalition (CMRSWC) is an initiative formed by 13 municipalities which represents around 30 communities in Central MA, including 11 within the 495/MetroWest Partnership service area. It supports towns in meeting EPA MS4 stormwater permit requirements by developing shared resources like Stormwater Pollution Prevention Plan (SWPPP) templates, standard operating procedures, and model bylaws. The Coalition helps reduce costs by rotating equipment such as GPS/GIS tools and sampling kits among member communities. It also partners with Worcester Polytechnic Institute to enhance stormwater mapping and data collection. In addition, CMRSWC provides public education materials, training workshops, and a best management practices (BMP) toolbox to improve stormwater management across the region.

UNH Stormwater Center

Organization: University of New Hampshire, Durham

The Stormwater Center at the University of New Hampshire, Durham is dedicated to improving stormwater management through research, testing, and outreach, particularly in response to Clean Water Act Phase II regulations. Studies have shown that traditional stormwater systems often fail to meet water quality goals, emphasizing the need for scientifically tested, innovative approaches. The center conducts field research, technology comparisons, and targeted studies to evaluate stormwater treatment systems, including porous pavements and bioretention solutions. Through workshops, data reports, and partnerships with regulatory agencies, the center provides resources and training to engineers, municipalities, and industry professionals. This work directly supports Low Impact Development by advancing nature-based stormwater solutions that reduce runoff, enhance infiltration, and improve water quality. The center collaborates with public and private partners to design, implement, and maintain LID-friendly technologies, such as permeable paving, green infrastructure, and decentralized stormwater controls.

Soak Up The Rain: Permeable Pavement

Organization: United States Environmental Protection Agency

The EPA's "Soak Up the Rain" initiative supports Low Impact Development projects by promoting a number of sustainable, eco-friendly practices, including permeable pavements. These pavements allow stormwater to infiltrate the ground, reducing runoff and improving water quality. Thus, they are able to enhance environmental sustainability in urban areas by minimizing traditional drainage needs and filtering pollutants. Upon visiting the website linked above, various local initiatives and projects can be found in Rhode Island, Connecticut, Vermont, and New Hampshire (nothing to note in Massachusetts, although there was a similar project in [Provincetown](#)), highlighting the efforts being made throughout the Northeast region to utilize this avenue to promote improved stormwater control.

Stormwater Management Model (SWMM)

Organization: EPA

EPA's Storm Water Management Model (SWMM) can be used for decision support, emergency response, planning, analysis, and design related to stormwater, combined, and sanitary sewer systems. It can be used to evaluate gray infrastructure stormwater control strategies, such as pipes and storm drains, as well as creating cost-effective hybrid green/gray stormwater control

solutions. SWMM was developed to support local, state, and national stormwater management goals to reduce runoff through infiltration and retention and help to reduce discharges that could pose a threat to nearby bodies of water.

Rain Gardens

Organization: Neponset River Watershed Association

The Neponset River Watershed Association provides instructions for anyone looking to install a Rain Garden on their property. A rain garden is a depressed area or a “artificial puddle” in your landscape, planted with native plants, shrubs or trees (or even just grass), that collects rainwater from parking areas, driveways, walkways, or roof downspouts. During rainstorms, runoff enters the rain garden and slowly filters into the ground, where it can be cleaned naturally by the soil and plants before reaching our waterways. Allowing rainwater to slowly filter into the ground also allows more water to recharge our underground water supplies.

Complete Parking Lot Design

Source: PDH Online

Pages 29-44 of this 2020 document highlight green considerations and potential environmental impacts of parking lot design, with a focus on porous asphalt pavements to manage stormwater runoff. The document makes note of the environmental benefits of open pavement structure that porous asphalt provides. Porous asphalt likewise encourages the use of permeable paving. The source ties parking lot design to money-saving opportunities since improved runoff would place less pressure on sewer systems, and in turn reduce maintenance costs. There is also discussion of limitations, advantages, construction, lighting, and additional considerations.

Rain Barrels and Cisterns: Stormwater Control for Small Projects

Organization: Bay Area Stormwater Management Agencies Association

In 2012, the Bay Area Stormwater Management Agencies Association analyzed the impact of low-cost systems that enabled individuals to supplement their water supply with a sustainable source by capturing rainfall. The source includes metrics surrounding the necessary amount of storage, as well as information on roofing materials, gutters and downspouts, additional accessories, and foundation and overflow. The document concludes with a design checklist and an operations and maintenance checklist to ensure the system is taken care of.

Commercial Sources

Recover Green Roofs

Recover Green Roofs is a design-build firm specializing in the design, installation, and maintenance of green roofs, including rooftop gardens, farms, and amenity spaces. Recover has designed and constructed residential, commercial, and institutional buildings across New England, emphasizing the benefits that a green roof provides to its community, local ecosystems, and the environment at large. They aim to create roofs that aid in recovering nature in the built environment to support healthier communities and more resilient cities.

Weston & Sampson

Weston & Sampson is a Reading-based firm specializing in infrastructure engineering and environmental consulting with a strong focus on sustainable development. They integrate Low Impact Development (LID) practices and green infrastructure into their projects to improve stormwater management, enhance water quality, and increase climate resilience. This is seen in their dedication to implementing Green Stormwater Infrastructure, as seen [here](#). Notable projects include implementing bioswales, rain gardens, and infiltration basins in Massachusetts

communities like Waltham and Fitchburg. Their multidisciplinary team collaborates to design solutions that reduce flooding while supporting environmental and community benefits.

Horsley Witten Group

Horsley Witten Group is a multidisciplinary environmental consulting firm headquartered in Sandwich, Massachusetts, with additional offices throughout New England. They specialize in sustainable site design, water resources management, and Low Impact Development (LID) strategies. Their work includes designing stormwater systems such as bioretention areas, permeable pavements, and green streets to reduce runoff and improve water quality. Horsley Witten has supported numerous Massachusetts communities through planning, design, and implementation of LID practices to build resilience and restore ecological function. They are also active in technical training and policy development around stormwater and green infrastructure.

Nitsch Engineering

Nitsch Engineering is a Boston-based firm offering civil, transportation, and structural engineering. One of their core services is green infrastructure and resilience, designing green infrastructure and sustainable stormwater management systems. Their Resilience Planning & Design team emphasizes nature-based solutions, stormwater modeling, and resilience planning. Nitsch integrates LID techniques into their projects, including gravel wetlands, rainwater collection systems, rain gardens, water quality swales, and floodplain and buffer restoration.

VHB

VHB is a multidisciplinary civil engineering firm headquartered in Watertown offering green infrastructure and nature-based solutions, water resources services, floodplain management, wetlands delineation and mitigation, and stormwater services. VHB's projects have included pervious pavement parking lots, rain gardens, and stormwater basins designed to manage runoff while removing sediments and pollutants.

Beals + Thomas

Beals + Thomas is a multidisciplinary consulting firm that lists Low Impact Development and Green Infrastructure Techniques among their civil engineering services. The firm integrates LID design into projects to support LEED certification goals. Their environmental work extends to wetland and stream restoration projects that enhance tidal flow capacity and reduce flooding, demonstrating experience in nature-based approaches.

Kleinfelder

Kleinfelder is a firm with capabilities in stormwater infrastructure and green infrastructure. They design green infrastructure to mimic stormwater management processes that occur in natural environments pre-development. Their portfolio includes rain gardens and bioretention cells, ranging from small-scale installations to large watershed projects. They have also utilized low-impact techniques such as tree planters, porous paving, recycled materials specifications, and traffic-calming measures.

Low Impact Development Glossary

Bioretention Areas - Shallow, landscaped depressions that use soil, plants, and microbes to capture and treat stormwater runoff. These systems are designed to manage water quality, reduce peak discharge rates, and improve site aesthetics while providing cost-effective, decentralized stormwater treatment. Rain gardens are an example of a bioretention area.

Bioswales - Also known as vegetated swales, these are shallow channels covered with vegetation designed to slow and filter stormwater runoff while promoting infiltration into the ground.

Cisterns - Large partially or fully buried tanks that capture and store rainwater. Cisterns help reduce stormwater runoff volumes and can provide a water supply for both non-potable and, in some cases, potable uses.

Green Roofs - Vegetated roof systems that incorporate live plants on building rooftops. Green roofs can reduce stormwater discharge volumes, mitigate sewer overflows, improve water quality, minimize temperature fluctuations, and can be implemented as part of new construction or retrofitted onto existing structures with adequate load-bearing capacity.

Infiltration Basins - Shallow depressions that temporarily store stormwater and allow it to gradually infiltrate into the underlying soil, reducing runoff volumes and recharging groundwater supplies.

Permeable Pavements- Also referred to as porous asphalt and pervious concrete, these are pavement surfaces with an open structure that allows stormwater to infiltrate through the surface and into underlying layers. These systems reduce runoff, improve water quality by filtering pollutants, and minimize the need for traditional drainage infrastructure. (Toolkit 'Soak Up The Rain: Permeable Pavement' and 'Complete Parking Lot Design')

Pollinator Planting - Selection and placement of native plants within stormwater management features to provide habitat and food sources for pollinating insects. These plantings enhance biodiversity while maintaining the stormwater treatment functions of LID practices such as rain gardens, bioswales, riparian restoration, and vegetated filter strips.

Rain Barrels - Small-scale containers that collect rainwater from roof downspouts for later nonpotable use, often in gardens and landscaping. Rain barrels represent a low-cost entry point for residential stormwater management.

Rain Gardens - Shallow, planted depressions that capture and treat stormwater runoff using vegetation and soil layers. These gardens slow, infiltrate, and filter runoff, reducing pollution and easing pressure on conventional stormwater systems while supporting biodiversity.

Vegetated Filter Strips - Also known as grassed filters, these are areas of dense vegetation designed to treat shallow stormwater runoff. These filter strips slow runoff, filter sediments and pollutants, and allow for infiltration into the underlying soil.