Evaluation of Climate Resilient Stormwater Management Practices for the Mid-Atlantic Region

Jaison Renkenberger¹, Jennifer Dindinger², Amanda Rockler², Christopher Obropta, Ph.D., P.E.³, Jessica T. R. Brown, P.E.³, Eric Buehl², Jacqueline Takacs², Krisztian Varsa²

¹University of Maryland Fischell Department of Bioengineering; ²University of Maryland Sea Grant Extension, Watershed Protection and Restoration Program; ³Rutgers University, Rutgers Cooperative Extension Water Resources Program & New Jersey Sea Grant Consortium

Problem Statement
Mid-Atlantic States are required to manage nonpoint source pollution. Bays, estuaries, rivers, and ponds are becoming eutrophic from excess nutrients, and the contribution from urban stormwater is growing. Further exacerbating this eutrophication are increases in rainfall intensities, droughts, and severe storm events associated with a changing climate. Current stormwater management technologies will be inadequate to deal with these changes unless design specifications are updated.

What We Accomplished
Assembled a list of relevant research and design manuals on current and established science for infiltration and nitrogen removal in urban bioretention and rain gardens, and drafted a Design Manual for climate resilient specifications for urban bioretention systems:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>% Removal</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSS</td>
<td>77</td>
<td>2000+</td>
</tr>
<tr>
<td>TR</td>
<td>30-44</td>
<td>love et al., 2006; huton et al., 2006</td>
</tr>
<tr>
<td>TN</td>
<td>20-44</td>
<td>love et al., 2006; huton et al., 2006</td>
</tr>
<tr>
<td>NO₃</td>
<td>50</td>
<td>2000+</td>
</tr>
<tr>
<td>PO₄</td>
<td>40</td>
<td>2000+</td>
</tr>
<tr>
<td>Sediment</td>
<td>50</td>
<td>2000+</td>
</tr>
</tbody>
</table>

Conducted research on potential design changes to enhance denitrification:

Urban stormwater examples in Maryland

Proposed Approach
- Conduct a literature review of the current science related to designs for enhanced nitrogen removal in bioretention, designs for climate resilience, and costs associated with enhanced resilient designs.
- Develop design standards and specifications for bioretention systems modified for climate resiliency and enhanced nitrogen removal.
- Conduct a design workshop for the proper use of the design standards and specifications.
- Produce and implement a survey to document the attitude toward altered or enhanced systems and identify barriers to implementing advanced nitrogen removing systems.

Preliminary Findings
- Removal of nitrogen, phosphorus, and sediment from effluent was dependent on a number of factors, some of which were mutually exclusive:
  - increasing the infiltration rate can help improve phosphorus removal but hinder nitrogen removal.
- Impacts from climate change are still difficult to predict at the scale of localized practices, due to a lack of downscaled data.
- Changes in distribution and intensity of precipitation are important design considerations for managing nutrient pollution.
- No studies were found that did not use an underdrain in the practice, thus none of the studies could provide efficiency estimates for rain gardens (only bioretention).

What’s Next?
- Technical memorandum with a summary of results from the literature review
- Fact sheet/design manual for mid-Atlantic states
- Workshop to introduce design standards and survey participants about ease of use and cost feasibility

Funding for this project was provided by Maryland Sea Grant and the New Jersey Sea Grant Consortium

Example of modifying the garden design to accommodate a higher volume 2-year storm (treating 3.3” over 24 hrs instead of 1.25” in the same time period). Graphic and research by Christopher Obropta, Ph.D., P.E.