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Green > Grey: Challenges, Opportunities, and Policy Implications for Delaware Green Infrastructure Landscape

OVERVIEW

Beginning in fiscal year 2021, the University of Delaware's Institute for Public Administration (IPA), in partnership with the Delaware Department of Transportation (DelDOT), began a year-long work plan devoted to green infrastructure. Applied research and public service components included outreach to various stakeholders, facilitation of a virtual workshop, and the development of resources designed to provide information on the challenges, opportunities, policy implications, and best practices of green infrastructure approaches in Delaware.

THE CHALLENGES

Delaware is acutely vulnerable to flooding, and the situation is expected to worsen due to the impacts of climate change and sea level rise (SLR). With the lowest mean elevation of any state in the country, Delaware is positioned in a mid-Atlantic location that bears the brunt of tropical storms and nor'easters. Flooding after a precipitation event is already a persistent problem in many locations around the state, and "sunny day" flooding that results from high tides is a nuisance for many residents, visitors, and businesses.[1] Delaware is also a hotspot for SLR with rates that are approximately double the global average.[2] SLR exacerbates the impacts of the waves and surge from coastal storms, erodes

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beaches and wetlands, negatively impacts tourism, damages critical infrastructure, inundates residences, and threatens the state's multi-billion dollar coastal economy. [3,4]

As climate changes occur, the intensity and frequency of flooding in Delaware are projected to increase. By 2040, the state's average annual precipitation is projected to increase by five percent.[5] Within 30 years—the length of a typical mortgage—communities adjacent to the coast could experience a ten-fold increase in the number of sunny day flood events, experiencing 100 or more such floods annually.[6] Combining the effect of increased precipitation and SLR, and looking further into the future, the current once-in-a-hundred year flood event may become so common that it is an annual occurrence by the end of the century.[7]

WHAT IS GREEN INFRASTRUCTURE?

Delaware's stormwater management systems are currently ill-equipped to meet projected challenges. Known as "grey infrastructure," the aging and engineered water conveyance network of curbs, gutters, pipes, sewers, bulkheads, riprap, and other materials lacks the capacity to handle expected impacts of climate change. Moreover, grey infrastructure offers few, if any, value-added benefits other than water management. As the climate continues to change, state and local municipal stormwater and coastal management systems can be reimagined to be more resilient and functional.

One option is to take a "green infrastructure" approach to water management. The varying definitions shown in the next column share several common elements. They all speak to using "natural" materials (*such as plants, soils, ecosystems*) and processes (*infiltration, transpiration, absorption*)—and contrast with grey infrastructure's "unnatural" materials (*concrete, steel*) and processes (*impervious surface runoff, sewer conveyance, shoreline hardening to attenuate wave action*).

VARYING DEFINITIONS OF GREEN INFRASTRUCTURE

- Use of natural materials and processes to reduce erosion, wave damage, and flood risks, serving as alternatives to, or ecological enhancements of, traditional shoreline stabilization and infrastructure protection techniques.[8]

- A nature-based approach to address environmental challenges such as stormwater runoff, flooding, erosion, and water and air pollution. Green infrastructure uses natural processes to manage water and improve environmental quality.[9]

- A strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem values and functions and provides associated benefits to human populations.[10]

- An approach to water management that protects, restores, or mimics the natural water cycle. Green infrastructure is effective, economical, and enhances community safety and quality of life.[11]

The above definitions also reference co-benefits derived from green infrastructure systems, which may include improvements to environmental quality, ecosystem function, and community aesthetics and services. They also point to an intentional human-design aspect to green infrastructure, which distinguishes it from untouched nature, such as an existing and undisturbed wetland or marsh.

Green infrastructure is recognized as a modern, resilient, and potentially lower-cost approach to managing 21st century storms and seas.[12] Examples of green infrastructure include rain gardens, vegetated swales, tree boxes and trenches, green roofs, urban trees, riparian buffers, and living shorelines.[13] Consistent with the above definitions, these systems all use natural materials (*vegetation, sands, soils*) and processes (*on-site infiltration, evapotranspiration, shoreline stabilization*), provide valuable co-benefits (*greening, ecosystem services, environmental quality improvements*), and are designed and implemented by people as opposed to nature.

THE OPPORTUNITIES

National investments in green infrastructure are increasing. In March 2021, President Joe Biden introduced a $2 trillion infrastructure and climate change bill that calls for $50 billion in dedicated investments to improve infrastructure resilience.[14]

The Senate version of the 5-year surface transportation reauthorization bill includes dedicated funding for resilient green infrastructure.[15] Additionally, the Federal Emergency Management Agency (FEMA) released a new, $500 million grant program entitled Building Resilient Infrastructure and Community (BRIC) that prioritizes projects using nature-based solutions.[16] Given the increasing threat of climate change and the mobilization of political and financial capital to advance green infrastructure as an adaptation strategy, Delaware should seek to build its green infrastructure capacity.

POLICY IMPLICATIONS IN DELAWARE: ENVIRONMENTAL, ECONOMIC, AND WORKFORCE DEVELOPMENT OPPORTUNITIES

In conducting applied research and interviews with green infrastructure experts and stakeholders, IPA found that investing in green infrastructure has the potential to create a host of opportunities in Delaware, related to the environment, economy, and workforce. These opportunities vary and span across the state, from urban areas such as the City of Wilmington, to coastal communities and rural towns in Kent and Sussex Counties.

Environmental

Green infrastructure builds resilience and mitigates environmental threats in coastal, rural, and urban settings. Examples include reduced runoff volume and energy use. Rain gardens and permeable pavements are great solutions to help manage flooding, and living shorelines, buffers, dunes, and marsh restoration can help reduce the impact of storm surges.[17] Vegetation-based green infrastructure practices can also sequester carbon, while tree plantings and the creation of green roofs mitigate urban heat island effect, which would be especially beneficial in the City of Wilmington.[18] Air quality improvements can also support public health.[19]

Economic

In some cases, green infrastructure has lower operating costs when compared to grey infrastructure.[20] Green infrastructure has the ability to increase water storage and filtration in the landscape—therefore reducing risks of costly damage to water infrastructure from heavy rains.

Communities also benefit from the beauty and aesthetics of green infrastructure projects, thus enhancing property values and community character.[21]

The Ramble in Laurel, Delaware is a community plan linking downtown revitalization with green infrastructure practices and design features.[22]

Resulting from a Town of Laurel and University of Delaware collaboration, this project aims to improve connectivity among local parks while supporting the town's history, style, and ecological restoration values. Unveiled in 2014, The Ramble promotes the nature-based features and tourism opportunities affiliated with the Broad Creek, while supporting new businesses aligned with the town's planning activities and long-term vision.

Workforce Development

Green infrastructure projects have the potential to create jobs for workers who contribute to the management, design, planning, permitting, finance, regulatory compliance, installation, maintenance, monitoring, and inspection of green infrastructure.[23] Jobs in this sector are well-paying, with mean hourly wages at least $2 per hour above the national average.[24]

Implementing green infrastructure projects across the state requires a capable workforce. Specialized skills are needed for the initial design and installation of practices such as bioretention and permeable pavements, but also for long-term operation and maintenance.

This is an important consideration and means that green infrastructure job training programs will be necessary to satisfy the growing demand for green infrastructure in Delaware.[25]

Despite the need for specialized skills, many occupations within the green infrastructure economy tend to have lower educational requirements. This provides opportunity for those with no more than a high school degree to earn competitive wages.

The Delaware Center for Horticulture's Branches to Chances program offers horticultural job training for unemployed, underemployed, and/or previously incarcerated individuals. Training is aimed at connecting participants with entry-level positions in the horticulture industry, such as landscaping, tree maintenance, and park maintenance. Activities include hands-on training with daily tasks such as weeding, planting, mulching, staking plants, watering, pruning, harvesting, and trash collection, and are reinforced

with a basis of knowledge in plant/weed identification, basic botany, equipment use, and safety.[26]

Delaware Technical Community College and Delaware Sea Grant are partnering to build another green infrastructure workforce training program. The program provides internships to students from Delaware Tech and includes seven, one-day field-based experiences. The green infrastructure interns learn practical skills related to:

- Living shoreline design-build
- Riparian buffer functions and installation
- Rain garden design-build
- Native plant nursery care and management of native plants[27]

ADDITIONAL BEST PRACTICES AND RESOURCES FOR DELAWARE COMMUNITIES

The Delaware Department of Natural Resources and Environmental Control's Green Infrastructure Primer for Delaware explores green infrastructure benefits, types, and considerations for Delaware communities—for both site and landscape scales. This document provides resources for regulatory, permitting, and planning and technical assistance, as well as information on funding and mapping resources.

IPA's GIS Storymap highlights the economic and environmental benefits of green infrastructure in various geographic areas and climates and showcases best practice examples of projects throughout Delaware.

Aimed at linking listeners with IPA's ongoing applied research on infrastructure conducted in partnership with the Delaware Department of Transportation, IPA's student-led Green Infrastructure podcast series explored specific trends and issues related to Delaware's green infrastructure landscape.

The series provided IPA students the opportunity to speak with public and nonprofit program directors about current partnerships and emerging

technologies related to the design, implementation, and maintenance of green infrastructure projects in Delaware.

Held in March 2021, IPA's virtual Zoom workshop provided attendees with information about the influences of stormwater management and other natural-infrastructure-related projects on the state's environment, workforce, and economy. Local government attendees were able to talk with and forge partnerships with technical experts and state agencies to advance green infrastructure projects in their communities.

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