Green Infrastructure, Greenways, and Trail Planning:
Frameworks for Sustainability in Maryland

David. N. Myers, PhD, PLA, ASLA
University of Maryland College Park, Department of Plant Science and Landscape Architecture

Introduction

The State of Maryland has been a leader in a number of state-wide environmental efforts. As part of the work published by the Maryland Greenway Commission in 2000, a green infrastructure (GI) assessment was included to provide a greater "*emphasis on the ecologic network*" (Maryland Greenway Commission, 2000, p. 3). This inclusion, while building off of decades of land conservation and greenway planning, recognized the need to provide a more science-based approach to integrated and comprehensive land conservation. In addition to this recognition, this GI assessment was also intended to identify the best ecological lands in Maryland for potential protection as well as potential areas for restoration. The GreenPrint program that evolved from this original GI assessment was reorganized in 2008 and became a first-in-the-nation web-enabled map showing the relative ecological importance of every parcel of land in the State (Maryland Department of Natural Resources, 2012a). In addition to these efforts that focused on land conservation, other efforts in the state included the evolution of environmental site design (ESD) to include low impact development (LID) methods and innovative site design practices. Maryland, in part as the result of new EPA water quality requirements has established some of the most stringent statewide regulations that are impacting the land development process. These ESD and stormwater interventions have been popularized as *green infrastructure* as well. Thus, the term *green infrastructure* serves as a robust but diffuse term capturing both broad scale land conservation as well as micro-scale storm water practices.

In 2000, the Maryland Greenway Commission defined *greenways* as

> "*natural corridors set aside to connect larger areas of open space and to provide for the conservation of natural resources, protection of habitat, movement of plants and animals, and to offer opportunities for linear recreation, alternative transportation, and nature study. Maryland has over 1,500 miles of protected greenways corridors, including over 600 miles of trails*." (p.1)

Thus while trail planning played a central role in both greenways and initial green infrastructure developments, more recent trail efforts have been less connected with green infrastructure (and the term *greenways*) and more focused on the recreation and economics benefits. The current trails web page at Maryland Department of Natural Resources states:

> *"[t]rails provide many economic benefits to local communities and create a wide range of jobs, from B&B's to bike shops. They also help tell the wonderful stories of Maryland and its rich history. And hiking and bicycle trails are for the whole family. They make us all healthier and happier while opening up the natural world around us. The Maryland Department of Natural Resources (DNR) is*

> *currently working closely with the National Park Service, the Maryland Department of Transportation, State Highway Administration, Department of Planning, Office of Tourism, local governments, trail groups, and volunteer citizens on a wide assortment of trails throughout the state*." (Maryland Department of Natural Resources, 2012b)

How do greenways now relate to green infrastructure? Is the term *greenway* still useful in the Maryland context and if so, why. This paper explores the benefits and issues related to greenways and GI. This presentation is organized into four sections. First, I will present a framework for GI in the state of Maryland. The proposed conceptual framework may have applicability for other settings. Second, I will provide examples from Maryland for this GI framework. These examples, from different scales, include policy and regulatory programs from land conservation, forest parcel conservation, stream restoration, and stormwater interventions. Third, I will explore the integral role that greenways could and should play at various scales for GI. How do greenways benefit the proposed GI framework? Last, where this framework is applicable to other settings, I will argue the need to recommit to collaborative holistic approaches that support economic, ecological, and cultural sustainability.

A Green Infrastructure Framework

Green infrastructure is now a widely used term that is advocated to address a variety of environmental problems. Government agencies, non-profit entities, academia, and private companies are promoting green infrastructure to solve problems from land conservation to water quality. As a practice, a plan, a set of principles, a philosophy, or all-of-the-above, green infrastructure has become a defining umbrella for organizing the critical component or toolbox kit for addressing old and new urbanization, land conservation, and dispersed site-scale stormwater hydrology interventions. As the term green infrastructure becomes more widely adopted, it might be helpful to organize different scales and types of green infrastructure approaches into a framework in order to communicate the complexity and interrelationships. In one sense the need for a framework stems from the following question: *How can the complexities of green infrastructure approaches being described at vastly different scales be conveyed?*

The following simple framework is used to define green infrastructure on the basis of scale and focus of intervention:

Land	**Water**
GI	**gI**
Gi	**gi**

GI: Broad scale efforts at a national, state or county planning scales that focus on land

conservation and broad land use policy;

Gi: Landscape scale efforts that focus on conservation or restoration of vegetation patches;

gI: Landscape scale efforts that focus on linear systems, especially riparian and linear stream wetland systems and the adjacent vegetation;

gi: Finer scale interventions at the habitat or site level that focus on addressing hydrological vegetation benefits .

While the acronyms and their variations all define a type of green infrastructure in the framework, all the efforts above are currently being defined by many entities as green infrastructure. This framework is further explored by using programs and practices from the State of Maryland. While not exhaustive, the examples from Maryland provide examples of each of the four defined types of green infrastructure GI, Gi, gI, and gi. In addition, this exercise provides an opportunity to provide a snapshot across scales to explore the interconnectedness or lack of interconnectedness between these various green infrastructure practices and approaches.

Framework Examples

GI

Like other urbanizing states on the eastern seaboard of the United States, the State of Maryland is undergoing continuing long term land use reallocation. Two important drivers of this land use reallocation include continuing population growth and increasing per capita land utilization for primarily low-density residential housing. The Maryland Department of Planning (MDP) and DNR classifies landscapes into two broad categories: 1) resource lands and 2) non- resource lands. Like other urbanizing states, historical land used trends indicate that resource lands (e.g., agriculture, forest, and mining) are declining while non-resource lands (e.g., urban, etc.) are increasing.

> *"If Trends Continue: By 2035, MDP's analysis estimates that an additional 404,000 acres of land will be developed, and Maryland will lose an additional 226,000 acres of farmland and 176,000 acres of forest. More than 87 percent of these acres will be converted to low or very-low density residential development." (Maryland Department of Planning, 2011, p. 2-4)*

Maryland has a long history of greenway development. This long term effort provided the backbone for current land conservation efforts in the state. In the late 1990's efforts integrated greenway planning and landscape ecology in land conservation efforts. Weber and Wolf (2000) document the ongoing effort in the development of the Green Infrastructure Assessment (GIA) tool that was developed to assist in helping to identify and prioritize landscapes for land conservation and restoration. One of the most critical aspects of this program was the use of science-based criteria to develop a GIS based model and the utilization of landscape ecology principles to develop a hub and corridor framework. Using the GIA as a guiding tool and as part broader Smart Growth efforts, the GreenPrint was established in 2001 with a state budget of 35 million to protect landscapes using the green infrastructure framework approach. This was primarily through outright acquisition purchase or the purchase of conservation easements (i.e.,

paying the owner to restrict development on the property in perpetuity). The Green print program was "aimed at protecting Maryland's most valuable remaining ecological lands -- two million acres of which have already been identified by DNR -- which are quickly becoming fragmented, or are disappearing altogether, particularly in developing areas." (Maryland Department of Natural Resources, 2001). In 2003, green infrastructure was institutionalized into land conservation planning efforts by expanding the criteria used to evaluate land preservation purchases to include a comprehensive set of ecological indicators. Through this initiative, state land conservation programs such as Rural Legacy and Program Open Space prioritized their conservation activities on areas identified as green infrastructure. In 2008, the state re-launched the GreenPrint program (http://www.greenprint.maryland.gov). The resultant map continued to identify 33% of Maryland's total land area that was considered the most important ecological landscape of the state. The program continues to employ a hub and corridor based system to provide guidance for land conservation decisions at state and county scales. The managers of the GreenPrint program recently incorporated new criteria recognizing global climate change.

Gi

The Forest Conservation Act (FCA) provides an example of Gi where the outcome of the intervention is the conservation or restoration of a forest patch. While not initially discussed as green infrastructure when the law was created, the cumulative addition of these protected landscape patches have contributed to the overall forest creation and protection in counties, particularly those under development pressure. The State of Maryland enacted the FCA in 1991 (Natural Resources Article Section 5-1601 through 5-1613). The purpose of the FCA was not to stop all forest loss due to development but to conserve and provide for the creation of forests in the development process. The FCA requires a developer to provide two documents during the planning and site design approval process. The first is the documentation of the site condition prior to development. The identification of forest stands, specimen trees, and an ecological description of the site is documented in a Forest Stand Delineation (FSD) or as part of a Natural Resource Inventory (NRI). This critical information provides a baseline for design decision and regulatory approvals. The FSD/NRI serves to provide guidance where development will have the least impact on existing forested areas and important environmental features. The second document, a Forest Conservation Plan (FCP), is required establishing both the proposed design, the area for clearing, areas for saving existing forest in easements and, if needed, the reestablishment of forest in easements (Galvin, M. F., et. al. 2000).

While the outcome of the FCA has mitigated forest loss as a result of new exurban and suburban development, it has not stopped the significant estimated annual loss of forest at the state level (DNR, 2004). A new state effort coordinated by the Sustainable Forestry Council defines the no-net-loss of forest policy as the stabilization of the rate of loss by 2020 with the goal of maintaining the state's existing 40% forest coverage. The target year of 2020 is intended to provide enough time to develop proposed statutory and planning requirements. It is likely that both GI (land conservation) and Gi (development forest retention and creation) will be needed to accomplish this goal.

gI

Almost twenty percent of streams of Maryland stream are channelized, primarily as a result of damage from agriculture and urbanization. Most of these streams are geographically located in the Coastal Plain province in eastern Maryland. Stream restoration, while an important ongoing tool utilized by county manager, is slated to be an important tool as part of the set of green infrastructure tools to clean up the Chesapeake Bay.

gi

The effects of urbanization on hydrological systems have been well documented. Major impacts due to the increase in impervious cover include increased flooding, decreased lag time for flooding, and reduced base flow due to a lack of infiltration. In 2008, spurred by Environmental Protection Agency (EPA) law, the state developed Environmental Site Design (ESD) to address these issues. The new ESD regulations, at the site scale, incorporate low impact development (LID) principles to provide for distributed hydrology and attempts to mimic nature by infiltrating and retaining water. Existing built areas are significant in area are unregulated in terms of stormwater and will be addressed over time with capital improvement projects. New stormwater laws have led to the promulgation of new stormwater laws at the county scale where they have been implemented in the development plan review process. The EPA recently issued National Pollutant Discharge Elimination System (NPDES) and Municipal Separate Storm Sewer Systems (MS4) permits. Maryland counties have modified their development guidelines to meet the requirements of these new permits with the goal of improving water quality. The new regulations promote green infrastructure practices that can infiltrate, retain, and evapotranspirate rainwater on or within the site. The EPA has defined green infrastructure at the site scale as "stormwater management systems that mimic nature by soaking up and storing water."

Greenways and Green Infrastructure

How do greenways now relate to green infrastructure? Is there a benefit of maintaining and promoting a connection between the use of the term *greenway* and *green infrastructure* in policy and programs in MD? While recent trail efforts have been less connected with green infrastructure and more focused on the recreation and economics benefits of trails, there is a need to reassess the utility of the term greenway to encompass green infrastructure practices ***across*** scales. Greenways still have an important role as a term to encompass a landscape as connector between park systems. This corresponds to GI and the benefits of broad land conservation and state-wide trail development efforts. The use of the term greenway in these efforts defines both green infrastructure and associated human activities that can be compatible in some of these landscapes. gI and gi both have direct involvement with water within the landscape. With gI, greenways provide opportunities to see stream restoration, to provide stakeholder support, and to provide for educational opportunities. Here the use of the term greenway defines linear green infrastructure interventions that are enhanced by multiple benefits with the addition of human interaction through exposure to restored environmental features. For gi, similarly, greenways provide opportunities to see community-based ESD practices. Where possible, greenways can provide connections between various hydrologic interventions. The educational opportunities to improve awareness are also likely benefits of greenways that connect restored landscapes. Gi

provides an opportunity to increase the buffering of greenways, thus providing a more natural experience for the user.

Land	Water
GI Greenways as connectors between parks	**gI** Greenways provide opportunities to see stream restoration
Gi These landscape have the potential to improve buffers for greenways	**gi** Greenways provide opportunities to see community base ESD practices

Conclusion

The term green infrastructure is likely to play a continuing role in helping define and promote interventions that provide environmental benefits at many scales. In addition, the most recent focus on defining green infrastructure as water-related interventions will likely continue. The term greenway provides an opportunity to integrate many of the features that are being defined as green infrastructure. The need for stakeholder interaction and educational integration between water-related intervention and trail-related improvements suggests that the term greenway is still important and useful in conceptualizing a holistic approach that supports economic, ecological, and cultural sustainability.

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