

## A Short History of the Term Green Infrastructure and Selected Literature

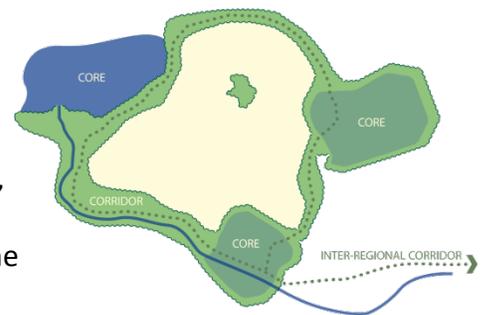
by Karen Firehock, January 2010

Green infrastructure planning is a strategic landscape approach to open space conservation, whereby local communities, landowners, and organizations work together to identify, design, and conserve the land network essential for maintenance of healthy ecological functioning. This is essentially the definition employed by Benedict and McMahon in their book on green infrastructure (see bibliography). As defined by Benedict and McMahon “Green infrastructure is a strategically planned and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value that supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for America’s communities and people” (2006).

However, green infrastructure planning is not an entirely new concept and the principles that form the basis for the concept have arisen from multiple disciplines. The term itself was first coined in Florida in 1994 in a report to the governor on land conservation strategies and was intended to reflect the notion that natural systems are equally, if not more important, components of our “infrastructure.” Since it is generally accepted that we have to plan for grey infrastructure, the idea of also planning to conserve or restore our natural resources, or “green infrastructure,” helped people to recognize its importance to community planning.

There are several disciplines that have addressed green infrastructure including planning, landscape architecture, ecology and conservation biology, forestry, and more recently, transportation. Within the field of landscape ecology/architecture Hellmund, Smith and Somers (2006) provide a useful description of the field that builds upon the greenways movement in their book Designing Greenways: Sustainable Landscapes for Nature and People. Their book also brings in notions of landscape ecology from earlier work by noted landscape ecologist R.T.T. Forman. The greenways movement -- conserving green corridors, often along river systems -- was popularized by the book Greenways for America (Little, 1995).

Green infrastructure planning includes the corridor notion of greenways as critical connection for habitats but **also** includes larger blocks of intact habitat types such as un-fragmented forests, wetlands or dune systems. It moves from the notion of river greenways to also include distinct habitat types such as fens, and recognizes the importance of ecological services provided by forest and wetland habitats, such as cleaning the air or filtering the water.



For case study review, an excellent early book that does not use the term green infrastructure, but applied the concept, is [Nature Friendly Communities](#) by Duerksen and Snyder (2005). They include several detailed case studies in their book. What is useful in their approach is that they provide a detailed critique of each case, along with the pros and cons of the approach taken. For example, they laud one state parks agency for developing a detailed green infrastructure map but they criticize them for not first gaining agreement from end users that it would be applicable; the result was a plan that was nice to look at but never actually used across the state. Other books, such as [Green Infrastructure](#) by Benedict and McMahon, list the concept and benefits of green infrastructure and positive examples from across the United States.

In seeking to understand green infrastructure, it is important to avoid confusing **green building** and **green infrastructure**. In 2007, the term "green infrastructure" became confused with built engineered structures for stormwater management when the U.S. Environmental Protection Agency began to apply the term to best management practices that are used in concert to achieve a low impact development strategy (LID). Low impact development is a *design strategy* with a goal of maintaining or replicating the pre-development hydrologic regime through the use of design techniques to create a functionally equivalent hydrologic site design" (*Low Impact Development DRAFT Technical Bulletin*). LID operates at the site scale to offset practices of the built environment. For example, a biofilter, also known as a raingarden, is a wonderful way to slow and filter stormwater within recessed planting beds that break down pollutants. Localities and builders are encouraged to employ raingardens in new building sites or, they can be utilized in watershed planning efforts to retrofit developed urban areas with better stormwater management.



Example of a biofilter installed to clean parking lot runoff

In the context of building "green," certification programs such as LEED (leadership in environment, energy and design) promoted by the [U.S. Green Building Council](#), or [Earthcraft](#), a rating system applied to energy efficient standards for homes are used for individual buildings. LEED has recently expanded to include Neighborhood LEED. However, these programs do not require that a development seek to connect wildlife corridors or necessarily maximize tree cover on a site. Landscape scale approaches are often missed as each developer protects some green space, but they often do not connect habitat across multiple parcels. Within sites, developers may build on inappropriate areas of a site that should instead be preserved for groundwater recharge or other "green infrastructure" functions.

Green infrastructure operates **first** at a landscape scale, looking across parcels and ownerships. Ideally, green infrastructure planning occurs before development begins. Land can be designated appropriately for protection and/or restoration to provide wildlife habitat, recreation, stormwater treatment, energy savings, aesthetic values, improved community health, and sustainable economies. In urban areas, green infrastructure approaches focus on citywide tree canopy, assessments of public tree conditions, riparian habitats and stream corridors, connected blocks of habitat such as larger city parks, trail systems and more recently, good soils for community gardens and opportunities for habitat restoration. At the site scale,

we can then focus on whether we need to have raingardens, green rooftops, permeable paving or a host of other best management practices that can help to infiltrate water.

In the past five to ten years, there has been a renewed interest in landscape scale planning and in making linkages between ecological services and community needs. Increasingly, localities are recognizing that creating livable and healthy communities requires the conservation and restoration of healthy forests, accessible open space, and connected landscapes in order to provide for clean air, clean water, public fitness, wildlife diversity and aesthetic benefits, such as scenic views and natural beauty. The economics of taking a green infrastructure approach have also gained increasing recognition. For example, a national study of the value of urban tree cover for reducing stormwater problems and improving air quality show that the trees in our cities are worth more than \$400 billion in money saved from not having to build structures, such as stormwater ponds or biofilters, to clean our air and water (Benedict and McMahon, 2006).

In 2006, federal agencies collaborated on a national publication called Ecological: An Ecosystem Approach to Developing Infrastructure Projects. This publication was developed primarily to promote green transportation approaches in recognition of the fact that road building has a great potential to fragment habitats, but can be conducted so as to avoid or minimize these impacts. This book includes some case examples.

As far as restoring green infrastructure, streams can often be restored by taking them out of pipes and returning them to the surface -- also called daylighting. Riparian restoration, a critical link for creating habitat, is covered by Riley in her research book, Restoring Streams in Cities (2001). The Green Infrastructure Center is currently working on an assessment of green restoration potential for vacant and underdeveloped parcels in Richmond Virginia.

The Trust for Public Lands has published a number of studies on green infrastructure (see bibliography). They have published several issue specific reports that investigate the benefits of public green infrastructure, such as parks and trail networks and suggest strategies for the siting and design of parks. They also deal with issues of social equity by examining disparities in park location and access by income and propose approaches for planning for parks that ensures equal access for all.

There are several web portals that can be useful starting places for locating case examples for green infrastructure planning. The Conservation Fund created the web survey portal [greeninfrastructure.net](http://greeninfrastructure.net). This is a self-reporting database, so data are entered only if the project submits its own report. Another new web tool is LandScope America. This site exists primarily to promote land conservation planning and serves as a portal for finding potential sources of data and highlighting unique and special places of biodiversity, such as Lake Wales Ridge in Florida or the Clinch River in southwestern Virginia. Lastly, a web site that links green infrastructure to watershed conservation is the EPA Healthy Watersheds Initiative. This site makes the case that green infrastructure conservation is important to healthy watersheds and clean water and includes a number of project links.

Increasingly, green infrastructure planning is also being linked to the field of public health. According to the US Centers for Disease Control, in 2007, 57 million Americans were at risk of getting diabetes. But the good news is that diabetes can be prevented by weight loss and exercise. Green infrastructure planning can help communities link people to trails and parks that reduce stress while getting them fit and healthy. Doctors are beginning to prescribe walking to lower risk from lack of fitness and weight gain by ordering trail walks for their patients (Washington Post, 2009). However, while there are new populist books promoting engagement with nature such as Last Child in the Woods, (Louve, 2005) that synthesize earlier academic research, these books do not make the direct link to landscape level planning per se or specifically green infrastructure.

There are many publications that link to issues of public health in cities and show that lower income neighborhoods have higher rates of health problems. In the early 1900s, planning and public health professionals worked together to protect public health and prevent the spread of disease by developing zoning laws to influence the built environment. However, the disciplines followed different paths with public health focusing on a clinical model, and planning on policy development and physical form. These two fields are re-connecting now as many chronic diseases are associated with the built environment and the individual behaviors that cumulatively lead to negative health outcomes. Examples of texts on this subject are Urban Sprawl and Public Health by Frumkin, Frank and Jackson, Neighborhoods and Health by Kawachi and Berkman, and Integrating Planning and Public Health by Morris, R Duncan, Hannaford, et.al Public health journals have published the majority of research in this area and supported special issues on this topic; planning-related journals have begun to do so recently.

The following bibliography is not comprehensive but does provide a snapshot of the diversity and age of relevant titles. There are many case studies that have been published individually and links to those are provided on the Green Infrastructure Center's website at [www.gicinc.org](http://www.gicinc.org).

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