WATERSHED WATCH IN KENTUCKY

The Kentucky Green Infrastructure Action Plan

For Stormwater & Wet Weather Sewage Management

August 2012

About the Watershed Watch in Kentucky (WWKY):

WWKY is a statewide citizens monitoring effort to improve and protect water quality by raising community awareness, and supporting implementation of the goals of the Clean Water Act and other water quality initiatives. Formed in 1997, WWKY has trained nearly 4,000 volunteers to take water samples across Kentucky.

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Design and layout by Randy Strobo

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List of Abbreviations & Acronyms

BMP: Best Management Practice
CSO: Combined Sewer Overflow
CWA: Clean Water Act
EPA: United States Environmental Protection Agency
KDOW: Kentucky Division of Water
KPDES: Kentucky Pollution Discharge Elimination System
KWRRI: Kentucky Water Resources Research Institute
KyCAP: Kentucky Citizen Action Plan
LFUCG: Lexington Fayette Urban-County Government
MEP: Maximum Extent Practicable
MS4: Municipal Separate Storm Sewer System
MSD: Louisville Metropolitan Sewer District
NPDES: National Pollution Discharge Elimination System
NRC: National Research Council
NRDC: Natural Resources Defense Council
POTW: Publicly Owned Treatment Works
SD1: Northern Kentucky Sanitary District 1
SSO: Sanitary Sewer Overflow
SWMP: Storm Water Management Plan
TMDL: Total Maximum Daily Load
WWKY: Watershed Watch in Kentucky, Inc.

Watershed Watch in Kentucky, Inc. (WWKY) has adopted this Plan to equip Kentucky citizens with strategies to help mitigate the water quality and quantity impacts of stormwater runoff and wet weather sewage overflows. The primary goal of this Plan is to encourage communities to adopt “state of the art” practices that more closely replicate the hydrologic functions inherent to natural systems composed of plants and soils. These new approaches, commonly referred to as “green infrastructure,” are increasingly replacing the traditional “gray infrastructure” approach across the United States because they are proving to be more effective and more efficient, and because they improve the quality of life in a community.

The primary strategy proposed to accomplish that goal is to provide Kentucky citizens with the means to take effective action. This Plan will help individual citizens access environmental studies, technical manuals, and other resources that explain the benefits of green infrastructure, and provide the tools to promote and implement green infrastructure solutions in their communities. In addition, this Plan will identify actions that can be taken by an individual volunteer as well as larger neighborhood or community-wide efforts. WWKY invites citizens across Kentucky to become a part of the Watershed Watch in Kentucky program as it expands its water monitoring capabilities by developing and implementing a scientifically valid citizen-led water quality and quantity monitoring program to measure the effectiveness of green infrastructure solutions.

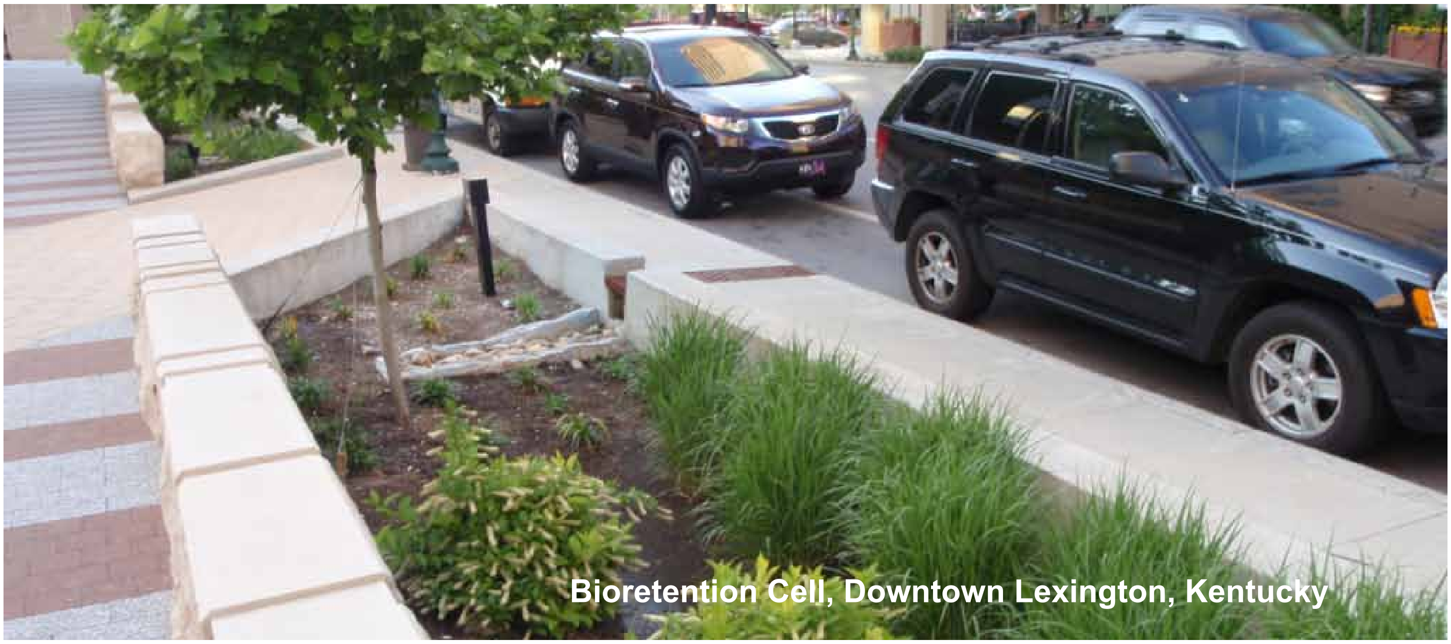
The Green Building, Louisville, Kentucky

Watershed Watch in Kentucky, Inc. (WWKY) has adopted this Plan to equip Kentucky citizens with knowledge and strategies to help mitigate the water quality and quantity impacts of stormwater runoff and wet weather sewage overflows. The primary goal of this Plan is to encourage communities to adopt “state of the art” practices that more closely replicate the hydrologic functions inherent to natural systems composed of plants and soils. These new approaches, commonly referred to as “green infrastructure” or “low impact development,” are increasingly replacing the traditional “gray infrastructure” approach across the United States because they are proving to be more effective and efficient for mitigating the impacts of stormwater runoff. The green infrastructure approach to stormwater management has demonstrated other benefits, such as improving the quality of life in communities.

The primary strategy proposed to accomplish this goal is to provide Kentucky citizens with the background knowledge and means to take effective action. This Plan will help individual citizens access environmental studies, technical manuals, and other resources that explain the benefits of green infrastructure, and provides the tools to promote and implement green infrastructure solutions in their communities. In addition, this Plan will identify actions that can be taken by an individual volunteer as well as larger neighborhood or community-wide efforts. WWKY invites citizens across Kentucky to become a part of the WWKY program as it expands its water monitoring capabilities by developing and implementing a scientifically valid citizen-led water quality and quantity monitoring program to measure the effectiveness of green infrastructure solutions.

The format for this Plan follows the format for Citizen Action Plans already in use by the Kentucky River Watershed Watch as part of its commitment to turn its data into action. The first step is research: what are the results of the investigations others have conducted? The next step is WWKY’s investigation: what do WWKY’s data tell us about watershed conditions? The third step is assessment: what are the conclusions of this investigation? Finally, based upon those informed conclusions, what actions will WWKY take from the suggested inventory of potential actions?

First, a dialogue was initiated with partners at the Kentucky Division of Water (KDOW) to learn what approach it is taking to advance the green infrastructure approach in Kentucky. The Natural Resource Defense Council (NRDC) was also contacted about the green infrastructure approach nationally. Next, an investigation was conducted by visiting green infrastructure projects in Covington, Louisville, Bowling Green and Lexington. This included an examination of projects undertaken by private citizens, businesses, schools, universities, and entire communities. Photographs of some these Kentucky examples are found throughout this Plan. These examples demonstrate that green infrastructure projects can work in Kentucky. However, these demonstration projects are not enough. Kentucky communities must make a comprehensive commitment to change the current approach to stormwater management, and such commitment must be driven by the calls for action by informed citizens. Citizen action is needed to help maintain and monitor these projects after they are constructed. Based upon these the conclusions, the first step is to prepare this Kentucky Green Infrastructure Action Plan for Stormwater and Wet Weather Sewage Management.


Bioretention Cell, Downtown Lexington, Kentucky

Each municipality in Kentucky contends with its own unique set of environmental, social, economic and political circumstances that influence how green infrastructure is perceived. Therefore, this Plan will not outline a single path for implementing green infrastructure, but will provide a range of strategies and important considerations that can be adapted to address unique local challenges. As part of its continuing efforts, WWKY intends to prepare targeted Citizen Action Plans (CAPs) for Louisville, Northern Kentucky, and Lexington, that will be written based upon the unique circumstances in those communities. In addition to these three areas, WWKY intends to prepare CAPS for communities all across Kentucky.

This Plan will help citizens develop an informed strategy to support green infrastructure implementation by providing the following:

- Basic Information about the function and purpose of green infrastructure
- Information to help volunteers evaluate municipal storm-water management plans and recognize where green infrastructure can provide a cost-effective alternative
- Information to help recognize the critical functions of green infrastructure to ensure it is being utilized to its full potential and effectively targeting specific storm-water impacts
- Information to help identify ordinances, laws and regulations that affect the implementation of green infrastructure, and to access policies, ordinances, laws and regulations in other jurisdictions (e.g. model GI ordinances)
- Information to help access municipal financing strategies that can be used by citizen groups and local agencies to fund green infrastructure projects

Citizens are invited to help develop the WWKY volunteer monitoring protocols with WWKY Science Advisors to collect qualitative and quantitative evidence of green infrastructure performance.

A recent report by the Natural Resources Defense Council (NRDC) states:

> *An estimated 10 trillion gallons a year of untreated stormwater runs off roofs, roads, parking lots, and other paved surfaces, often through the sewage systems, into rivers and waterways that serve as drinking water supplies and flow to our beaches, increasing health risks, degrading ecosystems, and damaging tourist economies.*[1]

Although stormwater impacts are most often attributed to larger cities, stormwater runoff poses a problem to any developed community with concentrations of impervious surfaces. As communities in Kentucky and across the nation continue to expand, the U.S. Environmental Protection Agency (EPA) has become ever more vigilant about addressing stormwater runoff issues. Currently, Louisville, Lexington, Northern Kentucky and Winchester are under federal consent decrees imposed by the EPA, and fourteen other communities[2] across Kentucky are under state consent decrees to enforce Clean Water Act requirements related to stormwater and wet weather sewage problems. These water quality enforcement actions will require the expenditure of very large sums of money to improve the inadequate state of existing stormwater infrastructure. The question for these communities must be whether to build tomorrow's infrastructure using old designs that have failed to prevent problems, or to build new innovative systems that are more effective, more efficient, and that improve the quality of life in our communities.

The stormwater impacts associated with urban growth are also being compounded by the increasing intensity and frequency of rainfall events. In 2007, the Intergovernmental Panel on Climate Change (IPCC) released a report with evidence that there has been an increase in precipitation intensity and variability over most land areas in the United States.[3] Its findings suggest that rainfall events that were once estimated to occur once every 100 years (commonly referred to as the 100-year flood event) are increasing in frequency. It is becoming more imperative for communities to consider innovative strategies to mitigate the water quality and flooding issues associated with an increase in impervious areas and rainfall volumes.

Many credit Mark Twain with famously saying, "I want to be in Kentucky when the end of the world comes, because it's always 20 years behind." Although this perception may have been apropos in the past, WWKY does not believe this sentiment applies to Kentucky's present or future. WWKY seeks to help Kentucky become a national leader in addressing water quality issues by implementing green infrastructure statewide.

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1 *Rooftops to Rivers GI Report II* (2011 Update), available at http://www.nrdc.org/water/pollution/rooftopsII/files/rooftopstoriversII.pdf, last visited May 15, 2012.

2 Those fourteen communities are: Ashland, Catlettsburg, Frankfort, Harlan, Henderson, Loyall, Maysville, Morganfield, Owensboro, Paducah, Pineville, Prestonsburg, Vanceburg, and Worthington.

3 Bindoff, Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2007: The Physical Science Basis* (2007), available at http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html, last visited July 26, 2012.

Section 1.2 | What Is Green Infrastructure?

The stormwater problem described above is the consequence of over a century long effort to construct of a system of concrete curbs, gutters, pipes and other impervious surfaces (known as “gray infrastructure”) in communities to quickly move stormwater runoff and the pollutants, nutrients, and contaminants it gathers out of developed areas and into sewers and streams.[4] In contrast, green infrastructure is a stormwater management approach that mimics the natural hydrologic cycle within a developed environment by utilizing the stormwater benefits of plants and soils. Soils help reduce runoff by allowing stormwater to infiltrate into the ground where it can either be used by plants, replenish groundwater aquifers or evaporate back to the atmosphere. Plants and beneficial microbial organisms living in the soil are capable of reducing contaminants to less harmful constituents by extracting vital nutrients for growth. These beneficial functions inherent to plants and soils can be adapted to a developed environment to improve water quality and reduce the volume of stormwater runoff.

Green Infrastructure Benefits and Practices

This section, while not providing a comprehensive list of green infrastructure practices, describes the five GI practices that are the focus of this guide and examines the breadth of benefits this type of infrastructure can offer. The following matrix is an illustrative summary of how these practices can produce different combinations of benefits. Please note that these benefits accrue at varying scales according to local factors such as climate and population.

Benefit	Reduces Stormwater Runoff											Improves Community Livability						
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding	Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO_2	Reduces Urban Heat Island	Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture	Improves Habitat	Cultivates Public Education Opportunities
Practice										CO_2								
Green Roofs	●	●	●	●	○	○	○	●	●	●	●	●	◒	●	◒	◒	●	●
Tree Planting	●	●	●	●	○	◒	○	●	●	●	●	●	●	●	●	◒	●	●
Bioretention & Infiltration	●	●	●	●	◒	◒	○	○	●	●	●	●	●	◒	◒	○	●	●
Permeable Pavement	●	●	●	●	○	◒	●	◒	●	●	●	○	○	●	○	○	○	●
Water Harvesting	●	●	●	●	●	◒	○	◒	◒	◒	○	○	○	○	○	○	○	●

● Yes ◒ Maybe ○ No

Figure 1. Source: Center for Neighborhood Technology. The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits (2010), available at www.cnt.org/repository/gi-values-guide.pdf.

4 *Green Infrastructure Handbook for Municipalities*, http://www.gray2greenky.com, last visited July 31, 2012.

In many areas, development has also disrupted the natural hydrologic cycle through the construction of impervious surfaces including buildings, roads, parking lots, and sidewalks. The goal of green infrastructure is to incorporate more pockets of plants and soil into the urban landscape to restore some of the benefits of the natural hydrologic cycle. Green infrastructure can be used to manage the quantity of stormwater runoff from almost any surface found within the urbanized landscape, while simultaneously providing superior water quality treatment compared to traditional gray infrastructure.

Municipalities often overlook land conservation and urban forestry as effective management strategies that provide similar benefits to green infrastructure. Preserving open spaces with vegetated landscapes not only provides the stormwater benefits associated with plants and soils, but also creates public recreation areas. Street trees are considered a form of green infrastructure due to their ability to intercept rainfall with their branches and leaves, while also providing shade that helps reduce the temperature of the surrounding area, including runoff.

Although the term green infrastructure is primarily used in this Plan in reference to stormwater benefits, the plants and microorganisms associated with green infrastructure also provide air quality benefits by filtering pollutants from air. Increasing the biodiversity in urban environments helps to improve local climates, make homes and buildings more energy efficient, and provides positive social benefits.[5] **Figure 1** summarizes the multiple benefits provided by green infrastructure.

Sanitation District No. 1 (SD1) Test Site, Ft. Wright, Kentucky

5 Nowak, D., Crane, D., and Stevens, J.. Air pollution removal by urban trees and shrubs in the United States. *Urban Forestry & Urban Greening*, Vol. 4 (2006): 115 – 123, available at http://www.fs.fed.us/ne/newtown_square/publications/other_publishers/OCR/ne_2006_nowak001.pdf

Today, the majority of the citizens living in the United States reside in urban and suburban areas. So, it may come as no surprise that contaminants associated with stormwater runoff from these areas is considered one of the major sources of surface water pollution in the United States.[6] Many of the pollutants responsible for degraded water quality originate from activities conducted in urban and suburban areas. Every time rain or snowmelt flows across parking lots, roads, lawns and many other surfaces within the urban landscape, it carries away the pollutants that collected on these surfaces. These pollutants include the oils and chemicals that leak from automobiles, trash and debris discarded along roadsides, nutrients from animal waste left by pet owners, and the fertilizers and pesticides applied to maintain verdant landscapes.

The impact of the urban environment on the water quality in local receiving waters has been corroborated by the National Research Council (NRC). On October 18, 2008, the NRC released a document entitled *Urban Stormwater Management in the United States*. The NRC states that nearly all of the stormwater problems associated with urbanization are the result of lost infiltration and evapotranspiration functions of the soil and vegetation removed from the urban landscape. Impervious surfaces prevent rainwater from infiltrating into the soil, where it could otherwise be used by plants or replenish local groundwater reservoirs. As a result, a much greater volume of stormwater leaves urban areas more rapidly, overwhelms the existing stormwater infrastructure, and leads to flooding that can threaten life and property. An increased volume of runoff from urban areas has also causes severe channel and bank erosion in natural streams, which were originally formed in response to the lower flow rates that characterized streams prior to urbanization.

Environmental regulations addressing water quality issues in the United States were most notably accomplished by the Clean Water Act of 1972.[7] The Clean Water Act established regulations that have substantially improved water quality impacts originating from point sources, such as end-of-pipe discharges from municipal wastewater treatment plants and industrial sources. However, there is still much to be done to reduce water quality impacts from nonpoint sources, which cannot be readily traced to a particular end-of-pipe discharge point. One of the largest contributors of nonpoint source pollution is contamination associated with urban stormwater runoff.

Addressing stormwater quality can have a positive impact on the natural surface waters we depend on for drinking water, outdoor recreation and that wildlife depends on for survival. Green infrastructure provides a stormwater management approach that can have many advantages over traditional gray infrastructure in terms of cost-effectiveness, ecological benefits, landscape aesthetics and stormwater management. The beneficial application of green infrastructure includes a broad spectrum of structural best management practices (BMPs). The ultimate goal of these BMPs is to keep the maximum amount of stormwater onsite and prevent pollutants from reaching local streams. Unlike the highly standardized design and construction approach for traditional gray stormwater infrastruc-

6 *Urban Stormwater Management in the United States* (National Research Council (2008), available at http://www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf

7 *Federal Water Pollution Control Act* (1972), available at http://cfpub.epa.gov/npdes/cwa.cfm?program_id=45.

Table 3: Costs of Source Control Technologies

SOURCE CONTROL	INCREMENTAL CAPITAL COST (PER SQ. FT. OR UNIT)	NET PRESENT VALUE (PER SQ. FT. OR UNIT)	LIFESPAN (YEARS)	COST PER YEAR	GALLONS* (PER SQ. FT. OR UNIT)	COST TO CAPTURE GALLON	ANNUAL COST PER GALLON
Blue Roof (2-inch detention)	$4.00	$4.00	20	$0.20	1.25	$3.21	$0.16
Rain Barrel (55-gallon tank)	$200	$200	20	$10.00	55	$3.64	$0.18
Sidewalk Biofiltration	$36.81	$39.68	20	$1.98	8.60	$4.61	$0.23
Porous Asphalt Parking Lane	$8.13	$10.33	20	$0.52	2.18	$4.74	$0.24
Porous Concrete Sidewalk	$6.83	$8.67	20	$0.43	1.82	$4.77	$0.24
Swale	$18.73	$22.50	40	$0.56	1.82	$12.39	$0.31
Blue Roof (1-inch detention)	$4.00	$4.00	20	$0.20	0.62	$6.42	$0.32
Cistern (500-gallon tank)	$3,700.00	$3,700.00	20	$185.00	500	$7.40	$0.37
Greenstreet	$42.67	$82.79	30	$2.07	5.24	$15.81	$0.53
Sidewalk Reservoir	$98.48	$110.41	20	$5.52	3.74	$29.52	$1.48
Green Roof	$24.45	$62.39	40	$1.56	0.47	$133.37	$3.33
REFERENCE CASES	**INCREMENTAL CAPITAL COST (PER SQ. FT. OR UNIT)**	**NET PRESENT VALUE (PER SQ. FT. OR UNIT)**	**LIFESPAN**	**COST PER YEAR**	**CSO GALLONS (PER SQ. FT. OR UNIT)**	**COST TO CAPTURE GALLON**	**ANNUAL COST PER GALLON**
Newtown Creek Tunnel	$1,299,000,000	$1,300,000,000	50	$26,000,000	40,000,000	$32.50	$0.65
Flushing Bay Tunnel	$1,038,000,000	$1,039,000,000	50	$20,800,000	25,000,000	$41.56	$0.83

* "Gallons" in the source control fields refers to gallons of stormwater runoff that can be retained or detained in those source controls. The exact relationship between those quantities and the corresponding reduction in CSOs is not yet established. See Appendix D.

Figure 2. Source: PlaNYC, *Sustainable Stormwater Management Plan 2008*, p. 50, available at http://www.nyc.gov/html/planyc2030/html/publications/publications.shtml.

ture, the organic nature of green infrastructure makes it highly adaptable to the physical constraints of the built environment of developed landscapes.

Shifting a stormwater management approach from gray infrastructure to green infrastructure can decrease the costs of dealing with stormwater in a community.[8] While there may be significant upfront costs associated with green infrastructure, the long-term costs are substantially less when one considers the social and economic benefits of green infrastructure – not to mention the cost of replacing aging gray infrastructure. For example, the city of Milwaukee compared the costs of green infrastructure to gray infrastructure to solve their stormwater problems.[9] For most projects, the upfront cost of green infrastructure strategies was less costly. For those projects with higher upfront costs (i.e. eco-roofs), the projects provided long-term cost-effectiveness, and had a better cost-benefit ratio because of the positive social and economic benefits of constructing such projects. The cost comparison chart (**Figure 2**) was developed by PlaNYC, and it compares the relative costs of different green infrastructure strategies in New York City.[10]

8 U.S. EPA, *Cost-Benefit Resources*, available at http://water.epa.gov/infrastructure/greeninfrastructure/gi_costbenefits.cfm.

9 Milwaukee Metropolitan Sewer District (MMSD) *Weaving Milwaukee's Green & Grey Infrastructure into a Sustainable Future* (2009), available at http://v3.mmsd.com/assetsclient/documents/sustainability/SustainBookletweb1209.pdf

10 *See also* U.S. EPA, Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices (2007), available at http://water.epa.gov/infrastructure/greeninfrastructure/gi_costbenefits.cfm.

The Gardens of Hartland Rain Garden,
Lexington, Kentucky,

Section 2.0 | Common Approaches for Mitigating Stormwater Impacts

There are three general courses of action that citizens can take to reduce stormwater impacts in their communities. One approach involves pursuing individual and/or neighborhood-wide actions such as implementation of small-scale green infrastructure projects at home, one-on-one and small group education, and individual public advocacy, such as letters to the editor and blogging. A second approach is to get involved in the municipal stormwater management planning and implementation efforts to ensure decisions made on the local government level will effectively target the most critical stormwater issues. Third, citizens can be engaged on a legal and public policy level to demand that cities implement green infrastructure in legally binding documents such as Municipal Separate Storm Sewer System (MS4) permits, National Pollution Discharge Elimination System (NPDES) construction permits, consent decrees, and Comprehensive Plans. This section summarizes a sampling of many strategies available to citizens concerned with addressing stormwater impacts in their community. More specific action recommendations are provided in Section 3.0 of this document.

Individual and Neighborhood Action

The first category of strategies involves individual and neighborhood action. [Note that these strategies may also become important parts of the community-wide strategies outlined below]. Such strategies include the following:

- **Implement Green Infrastructure:** Many of the green infrastructure strategies in this Plan can be easily implemented by an individual at his or her home and property. By installing a rain garden, bio-swale, or other projects, or even by lobbying a government representative, a homeowner can demonstrate to the community that green infrastructure does work and can contribute to the aesthetic of the area.

- **Neighborhood Cooperative Efforts**: Concerned citizens can also take it upon themselves to implement neighborhood-wide projects that reduce the stormwater impacts originating from their area's residential or commercial property. For instance, cooperative neighborhood initiatives to purchase and install rain barrels, build rain gardens or disconnect roof downspouts can have substantial benefits toward addressing stormwater impacts. Such cooperative efforts can also reduce the cost and labor of pursuing such projects on an individual basis.

- **Public Education and Outreach**: Changing the habits of citizens within the community can sometimes prove to be the most cost-effective approach to mitigating urban stormwater impacts. Reaching out to citizens and convincing them to be mindful of their lawn care practices, driving and car maintenance habits, and picking up after their pets are examples of citizen behavioral BMPs that can have a significant cumulative effect. Educating the public through blogs, letters to the editor, and other public forums can help communicate the benefits of green infrastructure to a larger audience.

- **Forestry Programs**: Trees not only help beautify our communities, they also provide many environmental benefits. Tree canopies are capable of intercepting a tremendous amount of rainfall, which prevents it from collecting on urban surfaces and becoming runoff. A typical urban forest of 10,000 trees can retain approximately 10 million gallons of rainwater per year. For every five percent of increased canopy cover, storm water drainage is reduced by two percent.[11]

Properly placed trees shade underlying paved surfaces from direct exposure to sunlight, which limits the amount of thermal energy that stormwater runoff can absorb when it flows across these otherwise sun-baked surfaces. Planting trees along stream corridors, called riparian zones, protects the water from direct solar inputs that increase water temperatures in local streams. Utilizing trees in this manner will benefit local stream ecology by helping to prevent thermal pollution attributed to urban stormwater runoff.

Trees can also reduce ambient air temperatures, reduce the heat island affect, absorb carbon dioxide emitted from motor vehicles, and reduce particulates and other pollutants in the air. In addition, the Center for Urban Forest Research estimates that properties with trees are valued five to fifteen percent higher than comparable properties without trees.[12] Therefore, there are multiple benefits provided by simply planting more trees.

- **Landscaping with Native Vegetation**: Residential, commercial and industrial properties within community boundaries can reduce their irrigation water needs by using native plants to landscape its property. Plants native to Kentucky are more tolerant of the local climatic extremes, such as drought and heat, and they require less maintenance. Native plants also drive their roots deeper into the soil than most ornamental plants, which helps break up compacted soils and increases the amount of rainwater that can infiltrate into the ground. With the wide variety of native plants available, property owners can create attractive, low impact, and low maintenance landscapes.

- **Volunteer Green Infrastructure Maintenance**: One of the recurring complaints about municipal green infrastructure projects is the additional cost of maintenance. Citizens can alleviate this burden and help promote future projects by organizing volunteer maintenance of existing green infrastructure projects. This could be carried out in the form of an "adopt-a-rain-garden" initiative similar to volunteer "adopt-a-highway" programs for road clean-ups.

- **Volunteer Monitoring**: The main focus of WWKY is the volunteer monitoring of

11 Xiao, Q. and McPherson, E.G. *Rainfall interception by Santa Monica's municipal urban forest. Urban Ecosystems* (2002), Vol. 6: pgs. 291-302, available at http://www.fs.fed.us/psw/programs/uesd/uep/products/cufr420_UrbanEosystems_RISMUF.pdf

12 U.S. Department of Agriculture (USDA) Forest Service, *Urban Forests, Environmental Quality, and Human Health*, available at http://nrs.fs.fed.us/units/urban

stream water quality. Similar efforts for existing green infrastructure projects can provide the necessary empirical evidence to support the continued implementation of such projects across Kentucky. Like water quality monitoring data currently collected by WWKY volunteers, green infrastructure monitoring data collection could inform government leaders and policy makers of the benefits and cost effectiveness of green infrastructure as a solution to stormwater problems.

The implementation of a comprehensive green infrastructure strategy within a community to address stormwater and wet wether sewage problems cannot be accomplished without the help and advocacy of the citizens of that community. By utilizing any or all of the green infrastructure strategies and designs outlined throughout this Plan, individuals have the tools to make a significant difference in the water quality in their community.

Community Planning and Implementation

The second approach is to get involved in municipal stormwater management planning, development and implementation efforts led by local governments. Some municipalities are contending with rapidly deteriorating sanitary and storm sewer systems that lack the capacity to properly convey flow increases from expanding development. Well-informed volunteers have the ability to build persuasive arguments to convince local governments to consider the practical benefits of green infrastructure. Gaining a better understanding of a municipality's particular stormwater management issues is critical for selecting the most effective green infrastructure design.

Regulatory, Permitting, and Legal Action

The third approach is to get citizens engaged on the legal and public policy level to demand that cities implement green infrastructure in legally binding documents such as MS4 permits, NPDES construction permits, consent decrees, and Comprehensive Plans. This involves attending public meetings, writing public comments, lobbying government officials and agencies, and educating the public about the economic, environmental, and social benefits of green infrastructure.

Stormwater permits for MS4s require regulated entities to address water quality impacts from newly developed and redeveloped areas. This requirement – which is included among the stipulations for small, medium-sized, and large MS4s – directly addresses the need to incorporate post-construction stormwater flow/pollutant control design standards into the construction plans for new development or redevelopment. This Plan will help regulated MS4s meet or exceed permit requirements for post-construction stormwater runoff by ensuring that knowledgeable citizens and informed local stormwater agency personnel can educate elected officials on the importance of implementing green development practices.

Evaluating the site conditions in the context of stormwater management goals is an essential step before deciding what type of green infrastructure design to use for a project. This will help to ensure the project will yield the greatest net benefit and properly target the most pressing stormwater impacts. This is especially important for pilot projects, because if a pilot project fails it could discourage future green infrastructure projects.

Although there are many variations amongst green infrastructure designs, fundamentally they should share the following attributes:

- Provides a means of capturing and temporarily storing stormwater while it infiltrates into the soil, is taken up by plants, or evaporates.
- Takes advantage of the natural ability of soils to absorb water and support the growth of microbial colonies capable of breaking down pollutants to less harmful constituents.
- Prioritizes native plant species that have high evapotranspiration rates, deep root systems, and relatively low maintenance requirements.
- Utilizes designs, locations, plants and soils that will be most effective for specifically targeting pollutants of concern.
- Creates an attractive landscape with designs that contribute to development aesthetics and community beautification goals.

Green infrastructure is essentially the incorporation of natural stormwater retention and bioremediation functions within a developed landscape. The multiple scales and organic nature of green infrastructure provide a design potential that is virtually limitless - depending on the ingenuity of the designer. However, most existing green infrastructure projects can be categorized into several categories that have been implemented in cities across the nation. The main categories of green infrastructure include: rain gardens, planter boxes, vegetated swales, rain barrels, cisterns, permeable pavements, green roofs, stream restoration/rehabilitation, and tree planting. The following list of green infrastructure approaches represent examples that have been used successfully in Kentucky and across the United States.

Raingardens (Bio-infiltration)

Rain gardens may be one of the most common forms of green infrastructure implemented across Kentucky, due to the relative ease of design and installation. A rain garden is essentially a small-scale depression in the landscape that can be constructed with basic tools, such as shovels, to capture and retain runoff from relatively small areas. These smaller, less technical designs provide a relatively easy opportunity to implement pilot projects that can be used to educate the public about green infrastructure. More technical designs offer the same opportunity, but may also require greater technical expertise and financial investment.

Rain gardens are sized to capture and retain stormwater runoff from impervious areas, such as roof tops and parking lots. The onsite soils should have the natural capacity to infiltrate the captured stormwater within 24 hours. If the soil has low infiltration capacity due to high clay content or other factors, then the soil may need to be amended to improve infiltration. Native plants are typically selected for their ability to resist drought conditions, deep roots that break up soil and reduced maintenance requirements. However, non-native plants can be selected for aesthetic preferences.

Rain gardens can vary greatly in complexity depending on the goals of the project. A study conducted in Maryland measured two well-designed rain gardens and found that they removed roughly 95 percent of copper, 98 percent of phosphorous, 20 percent of nitrogen, and 20 percent of calcium from stormwater.[13]

Examples of rain garden bio-infiltration projects in Kentucky are below:

Rain Gardens, Main Street, Lexington, Kentucky

13 University of Maryland, *Engineering Bioretention to Optimize Pollutant Removals*, available at http://www.ence.umd.edu/~apdavis/bio-columns-ciceet.htm.

Rain Gardens, Oleika Shriners Temple, Lexington, Kentucky


Residential Rain Garden, Lexington, Kentucky


Rain Gardens, Louisville MSD Office Building, Louisville, Kentucky

Useful Raingarden Links:

Center for Watershed Protection:[14] **Urban Subwatershed Restoration Manual Series**

Manual 3: Urban Stormwater Retrofit Practices Manual

http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html

(See pages 171 – 174)

University of Kentucky:

Residential Rain Gardens,

http://www.ca.uky.edu/gogreen/displays/rain_gardensRD.pdf

Planter Boxes (Bio-infiltration)

14 Although all of the Center for Watershed Protection documents are free downloads, a username and password registration will be required to access all Center for Watershed Protection documents.

Planter boxes are very similar to rain gardens, except cement walls or other structural materials are used to construct a raised bed containing a layer of soil for the plants and enough storage volume to capture the first inch or more of stormwater runoff. An under-drain system is typically installed to allow excess water to exit the planter box without overflowing onto streets or sidewalks. Planter boxes can be implemented in highly urbanized environments, such as downtown areas and commercial districts.

There are many commercial locations that already use planter boxes solely for landscaping purposes. With some added design considerations, these landscape features can also provide stormwater benefits. In some cases, existing landscape planter boxes can be retrofitted to provide stormwater treatment.

Examples of planter box bio-infiltration projects in Kentucky are below:

Street Planters,, Main Street, London, Kentucky

Planter Boxes, LFUCG Government Center, Lexington, Kentucky

Planter Boxes, LFUCG Government Center, Lexington, Kentucky

Center for Watershed Protection: Urban Subwatershed Restoration Manual Series

Manual 3: Urban Stormwater Retrofit Practices Manual

http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html (See pages 143 – 148)

Auckland Regional Council (NZ)

How to Build Your Own Stormwater Planter Boxes

http://www.arc.govt.nz/albany/fms/main/Documents/Environment/Water/Stormwater/How%20to%20build%20your%20own%20stormwater%20planter%20boxes.pdf

Vegetated Swales (Bio-swales or Bio-filtration swales)

Vegetated swales can be thought of as elongated rain gardens that allow stormwater runoff to flow through, rather than being captured and stored. Vegetated swales are one of many prescribed practices for conveying stormwater runoff for Low Impact Development (LID). Vegetated swales have been used to convey, treat and retain stormwater runoff from parking lots, roads and sidewalks.

Swales are not only a relatively inexpensive approach for conveying stormwater, but they also provide significant water quality benefits in comparison to piped stormwater conveyance systems. The advantages of using vegetated swales to convey stormwater rather than storm pipes is that they slow the runoff flow rate, filter out pollutant-laden sediments and reduce runoff volume through infiltration.

The versatility of vegetated swales makes them highly adaptable to space limitations and other site constraints. Vegetated swales can be planted effectively with a number of species including traditional grasses that can be maintained with typical lawn care methods. Erosion prevention will need to be considered to protect the bottom of the swale from the force of concentrated flows. In many cases, the middle portion of the swale will be lined with river rocks to prevent erosion and encourage more infiltration. The plants are then situated along either side of the rocky portion of the swale for stormwater uptake and bioremediation.

Examples of vegetated swales in Kentucky are below:

Grassy Vegetated Swale, St. Elizabeth's Hospital, Covington, Kentucky

Bio-swale, Kosair Children's Medical Center, Louisville, Kentucky


Bioswale, Turkey Foot Middle School, Edgewood, Kentucky


Bioswale,Turkey Foot Middle School, Edgewood, Kentucky

Useful Bio-swale Links:

Center for Watershed Protection: Urban Subwatershed Restoration Manual Series

Manual 3: Urban Stormwater Retrofit Practices Manual

http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html

(See pages 185 – 188)

EPA: Menu of BMPs (Grassed Swales)

http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=75

Rain Barrels (and cisterns)

Rain barrels and cisterns provide a means of collecting and storing rain water that drain from residential, commercial or industrial roof areas. Capturing and storing roof runoff prevents that volume of water from entering the storm sewer system. Captured rain water can be used to irrigate landscaping between rain events along with many other uses for non-potable water, such as flushing toilets.

Examples of rain barrels and cisterns in Kentucky are below:

Rain Barrel, LFUCG Government Center, Lexington, Kentucky

Rain Barrel, City Hall, Russellville, Kentucky


Underground Cistern, Turkey Foot Elementary , Edgewood, Kentucky

Cisterns, The Green Building, Louisville, Kentucky

<u>Useful Rain Barrel/Cistern Links:</u>

Center for Watershed Protection: Urban Subwatershed Restoration Manual Series

Manual 3: Urban Stormwater Retrofit Practices Manual
http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html
(See pages 125 – 134)

Manual 8: Pollution Source Control Practices
http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html
(See pages 91 – 93)

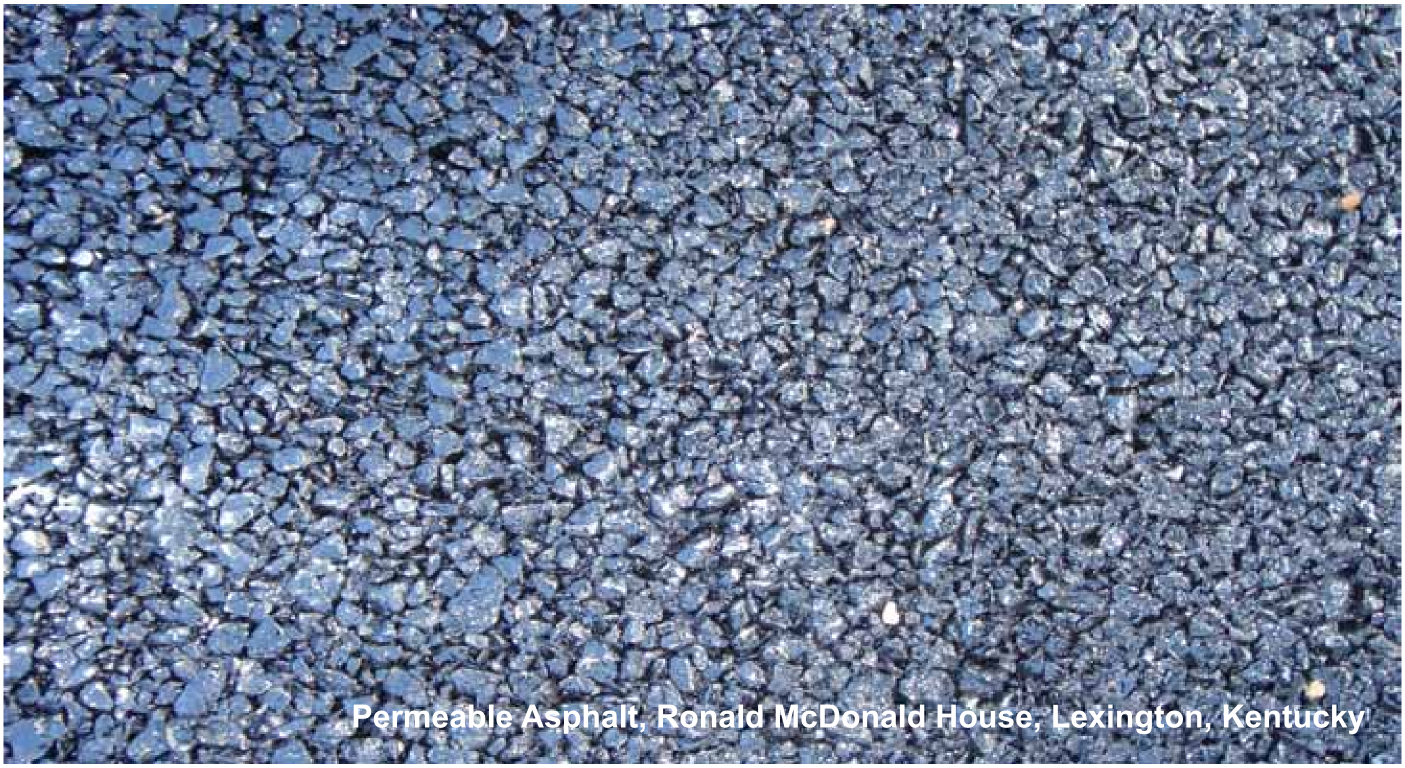
Organization of American States: Rainwater Harvesting
http://www.oas.org/usde/publications/Unit/oea59e/ch10.htm

Permeable Pavements and Pavers

Most roads, driveways, sidewalks and other paved surfaces use concrete or asphalt mixtures that are impervious to water infiltration, which is the primary reason stormwater runoff volumes and flow rates are much higher in urbanized areas. Permeable pavements are constructed with specialized mixtures of concrete or asphalt that create porous pathways for stormwater to infiltrate into the pavement rather than draining directly off of the surface. Concrete and brick pavers are often used to construct more aesthetically appealing driveways and sidewalks, but they also provide stormwater benefits by allowing stormwater to seep into the spaces between pavers.

Examples of permeable pavements and pavers in Kentucky are below:

Permeable Pavers, Main Street , Flemingsburg, Kentucky



Permeable Asphalt, Ronald McDonald House, Lexington, Kentucky

Permeable Asphalt Parking Lot, Ronald McDonald House, Lexington, Kentucky

Permeable Concrete, Campbellsville, Kentucky

Permeable Concrete Parking Lot, Campbellsville, Kentucky

Permeable Pavers, Versailles, Kentucky

Permeable Pavers Parking Lot, Versailles, Kentucky

Permeable Grass Pavers Parking Lot,
Thomas Jefferson Unitarian Church,
Louisville, Kentucky

<u>Useful Permeable Pavement and Pavers Links:</u>

Center for Watershed Protection: Urban Subwatershed Restoration Manual Series

Manual 3: Urban Stormwater Retrofit Practices Manual

http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html

(See pages 143 – 148)

National Association of Home Builders (NAHB):

Permeable Pavement

http://www.toolbase.org/Technology-Inventory/Sitework/permeable-pave

Green and Blue Roof Systems (aka EcoRoofs, Green Walls)

Green roof systems entail a structurally sound method of implementing a layer of soil and plants that can retain the rain water that falls on building roofs. Green roofs reduce the volume of stormwater runoff originating from rooftops by replacing the traditional impervious rooftop material with permeable soils that can store rain water. The captured rain water is either returned to the atmosphere through evaporation or used by the plants. Green roofs are most effective on flat commercial roofs, but innovative design approaches are allowing them to be planted on steep slopes and even vertical walls.

Blue roofs are non-vegetated roofs that detain stormwater. Weirs at the blue roof drain inlets and along the roof can create temporary ponding and gradual release of stormwater. Blue roofs are less costly than green roofs, but may require additional structural reinforcement compared to traditional roofs to support the weight of the detained water.

The traditionally flat roofs of commercial buildings can absorb a tremendous amount of solar heat during the day, which forces air conditioning systems to work hard to keep the building interior cool. Both green and blue roofs add a layer of thermal insulation that can help improve thermal efficiency during summer and winter months.

Examples of eco-roofs and green walls in Kentucky are below:

Grass Green Roof, Fire Station No.16, Lexington, Kentucky

Green Roof, American Life Insurance Co. Building, Louisville, Kentucky

Green Roof, American Life Insurance Co. Building, Louisville, Kentucky

Green Roof, UK Chandler Medical Center, Lexington, Kentucky

Green Roof, UK Chandler Medical Center, Lexington, Kentucky

Green Wall, The Green Building, Louisville, Kentucky

Useful Eco-roof/Green wall Links:

Center for Watershed Protection: Urban Subwatershed Restoration Manual Series
Manual 3: Urban Stormwater Retrofit Practices Manual
http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html
(See pages 125 – 134)

National Association of Home Builders (NAHB):
Green Roofs
http://www.toolbase.org/Technology-Inventory/Roofs/green-roofs

Green Roofs.com:
Green Roof and Green Wall Database
http://www.greenroofs.com

Low Impact Development (aka Smart Growth, Sustainable Growth)

Low Impact Development (LID) is a land development and redevelopment approach that focuses on site layouts and incorporation of natural landscaping to minimize stormwater runoff. The LID approach utilizes as many of the aforementioned forms of green infrastructure as possible, but also carefully selects site layouts that balance land conservation with housing density goals. In some cases, developments that take advantage of LID can save money by reducing or eliminating the need for traditional underground stormwater infrastructure. These practices can also dramatically reduce the size of detention pond that might be necessary to control excess runoff, which can free up additional space for more buildings.

LID is very similar to conservation development. However, conservation development focuses on the overall environmental health of a development.

Useful LID Links:

EPA: Low Impact Development (LID)
http://water.epa.gov/polwaste/green/index.cfm

Low Impact Development Center
http://www.lowimpactdevelopment.org/publications.htm

Stream Restoration/Rehabilitation/Daylighting

Stream restoration is the process by which a stream is returned to its pre-disturbance condition. This is very difficult to accomplish, especially in urban settings. Instead, most urban stream restoration engineers attempt to rehabilitate streams by restoring the ecosystem functions of a stream, but not necessarily making the stream exactly as it was pre-disturbance. By restoring the stream ecosystem functionality, the hydrological function of a stream improves, and problems such as increased water flow rates, channelization, and poor infiltration are corrected.[15]

Stream daylighting is the process of re-opening or redirecting a buried stream to an exposed above ground channel. Liberating streams from their former confines in underground culverts can reduce the cost of culvert replacement, provide flood control, and help manage the frequency of combined sewer overflows (CSO). Communities such as Yonkers, New York, have daylighted streams to improve the riparian environment for those streams that had been previously diverted into a culvert, pipe, or a drainage system.[16] Daylighted streams in urban areas can revitalize these areas by creating a park atmosphere that draws people to the water and surrounding shops.

15 For more information, visit the University of Louisville Stream Institute at https://louisville.edu/speed/civil/si/home.html.

16 Daylight Yonkers, available at http://www.daylightyonkers.com.

Although expensive, daylighting streams provides essential services to a watershed by reducing the volume and flow rate from unmoderated stormwater and by providing increased infiltration rates of pollutants from runoff and other urban sources.

Examples of stream reconstruction and rehabilitation in Kentucky are below:


McConnell Springs, Lexington, Kentucky

Useful Daylighting Link:

Virginia Water Resources Research Center: Urban Stream Daylighting
http://vwrrc.vt.edu/pdfs/specialreports/sr352007.pdf

Tree Planting

One of the simplest, and often overlooked, green infrastructure strategies is to plant more trees and/or prevent the cutting of trees in communities. As mentioned above, forests provide essential services to a community in the form of water uptake, pollutant filtering, energy efficiency, carbon sequestration, increased biodiversity, and social benefits, among others. The development of an urban tree inventory database utilizing geographical information systems (GIS) and global positioning satellite (GPS) data will help to better define, detect, and predict the health and status of the urban forest. Such analysis will inform where trees would be most beneficial to the community in regards to green infrastructure.

Tree restoration projects are especially useful in areas of Kentucky that are surface mined. In Kentucky, there are up to 1 million acres of mined land that can be reforested.[17] The loss of forests has resulted in decrease infiltration, increased stormwater runoff, and increased flooding. By planting trees and restoring forests on surface mine sites, runoff and flooding will decrease and water quality will improve.

Examples of tree planting projects in Kentucky are below:

Riparian Zone Tree Plantings, Veterans Park, Lexington, Kentucky

17 Appalachian Regional Reforestation Initiative (ARRI), *Green Forest Works for Appalachia* (2009), available at http://arri.osmre.gov/Partnerships/green_forest_works/gfw.shtm.

Riparian Zone Tree Plantings, Veterans Park, Lexington, Kentucky

Riparian Zone Tree Plantings, Pimlico Pkwy, Lexington, Kentucky


Riparian Zone Tree Plantings, Veterans Park, Lexington, Kentucky

Useful Tree Planting Links:

Center for Watershed Protection: Urban Subwatershed Restoration Manual Series

Urban Watershed Forestry
http://www.cwp.org/your-watershed-101/urban-watershed-forestry.html

Manual 3: Urban Stormwater Retrofit Practices Manual
http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html (See pages 143 – 148)

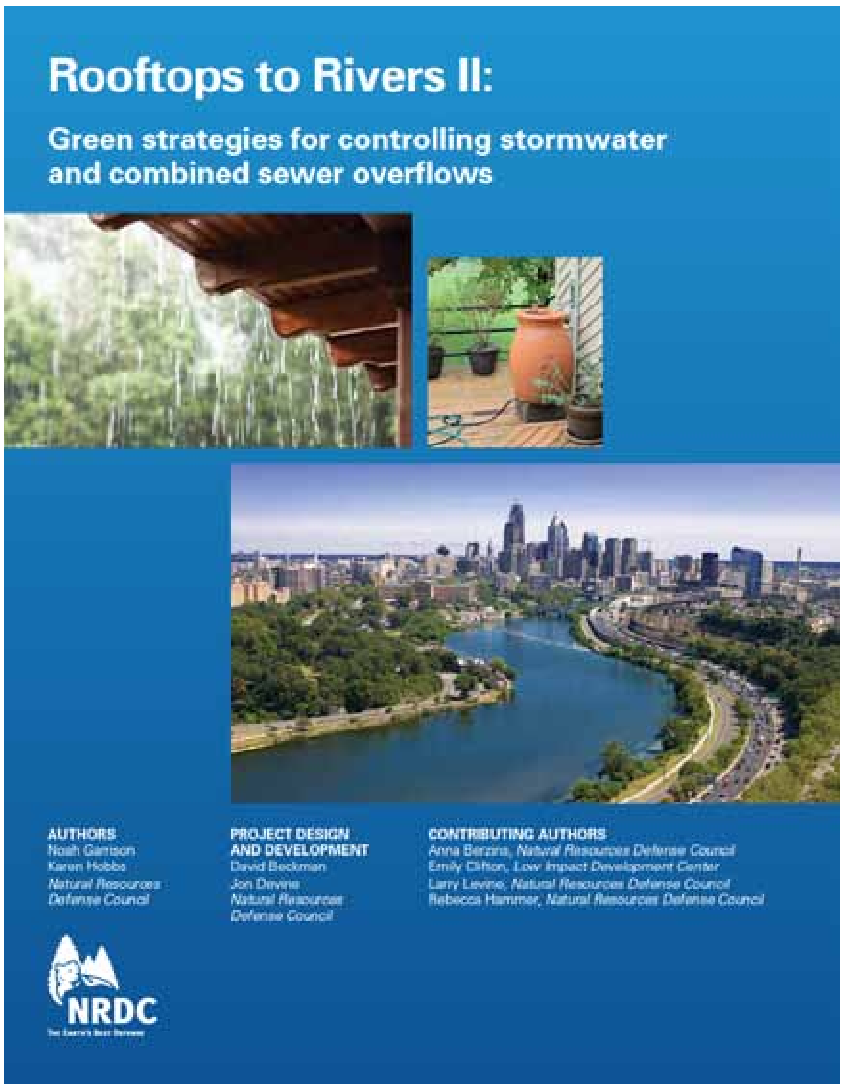
Manual 8: Pollution Source Control Practices
http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html (See pages 65 – 67)

Kentucky Division of Forestry:

Urban and Community Forestry Program
http://forestry.ky.gov/Urban%20Forestry%20and%20Community%20Programs/Pages/default.aspx

Section 2.2 | Examples of Green Infrastructure Outside of Kentucky

The NRDC's "Rooftops to Rivers" Reports Part I[18] and II[19] outline case studies of green infrastructure implementation efforts in a variety of municipalities across the United States. The municipalities examined include Washington, D.C., Chicago, Philadelphia, Syracuse, New York City, Pittsburgh, Nashville, Seattle, Portland, Milwaukee, among others. Green infrastructure is being implemented through a variety of strategies as outlined in this Plan including Consent Decrees, MS4 Permits, Comprehensive Plans, local ordinances and regulations, loans, grants and other funding mechanisms, and Stormwater Management Plans and fees. The municipalities have also implemented public/private partnerships to help purchase, finance, develop, and manage properties and for stormwater mitigation, and provided incentives to local developers to implement green infrastructure in new and existing development. Almost universally, each municipality has cited the economic, social, and environmental benefits of green infrastructure as the basis for implementation. For more information, see section 5.0 below.



18 Available at http://www.nrdc.org/water/pollution/rooftops/contents.asp.

19 Available at http://www.nrdc.org/water/pollution/rooftopsII/default.asp.

Rain Garden, Lexington Financial Center, Lexington, Kentucky


Gainesway Park, Lexington, Kentucky

In this section, Watershed Watch in Kentucky invites the public to get involved, to become a part of a Citizens Action Plan team in your community. The WWKY wants to hear from you. There are many citizens already working to make these changes across Kentucky and WWKY can help you connect with other concerned citizens in your community.

Citizens can start by taking advantage of the information that has already been developed. The Environmental Protection Agency (EPA) has found that green infrastructure can effectively restore some function of the natural hydrologic cycle within urbanized environments. On April 20, 2011 the EPA released a memorandum entitled *Protecting Water Quality with Green Infrastructure in EPA Water Permitting and Enforcement Programs*.[20] In this memorandum, the EPA "strongly encourages" the green infrastructure approach for wet weather management. This memorandum encourages the use of green infrastructure to the "maximum extent possible" for stormwater runoff and sewer overflow management. The EPA states:

> *Green infrastructure can be a cost-effective, flexible, and environmentally sound approach to reduce stormwater runoff and sewer overflows and to meet CWA requirements. Green infrastructure also provides a variety of community benefits including economic savings, green jobs, neighborhood enhancements and sustainable communities. The benefits of green infrastructure are particularly enhanced in urban and suburban areas where green space is limited and environmental damage may be more extensive.*

The Kentucky Division of Water (KDOW) has also recommended green infrastructure projects as appropriate BMPs for stormwater management.[21] The resources available through the EPA and KDOW provide excellent and easily accessible information for volunteers advocating for green infrastructure projects.

However, despite the encouragement from state and federal agencies, many cities in Kentucky are reluctant to integrate green infrastructure as a stormwater management approach. Some of the most common barriers include:

- Existing ordinances and development codes that discourage or prohibit some of the structural elements associated with green infrastructure.

- Reluctance by city engineering and planning staff to undertake green infrastructure projects due to negative perceptions of excessive cost, lack of familiarity and experience with the designs and techniques, concerns about unreliable performance, and long-term maintenance requirements.

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20 *Protecting Water Quality with Green Infrastructure in EPA Water Permitting and Enforcement Programs* (U.S. Environmental Protection Agency (EPA)), Memorandum: Protecting Water Quality with Green Infrastructure in EPA Water Permitting Enforcement Programs, April 20, 2011, available at http://www.epa.gov/npdes/pubs/gi_memo_protectingwaterquality.pdf.

21 *See* Kentucky DOW, http://water.ky.gov.

- Challenges associated with finding funding resources to pay for green infrastructure especially operation and maintenance costs.

There is no single approach to advocate for green infrastructure since each community has unique circumstances and stormwater issues to address. This section provides general information and strategies to help municipalities overcome the legal and financial obstacles to green infrastructure projects.[22]

UK Chandler Medical Center, Lexington, Kentucky

22 For specific guidance of how to evaluate your community's green infrastructure needs and potential, see Section 4.2.

Every community is different. In order to adequately plan and implement green infrastructure and design for a particular community, there must be an assessment of the stormwater and wet weather sewage needs of a community. If there are stormwater or wet weather sewage issues in a community, those problems may have already been identified. If not, citizens in a community will have to identify and document those problems themselves. The first step is to determine what has already been done to evaluate the water resources and stormwater management problems in a community. Examples include:[23]

- KRS Chapter 100 (concerning local planning and zoning) Comprehensive Plans[24] that incorporate stormwater and sanitary sewage management into their plans.

- Municipal sewage and water companies that make data on CSOs, SSOs, other outfalls, and water usage readily available to the public through their websites as part of their facility planning process;[25]

- The Kentucky Geological Survey maintains a database of GIS maps including water, sewer, well, and waterbody data.[26]

If there are no available resources for a particular community, or if there are gaps in the data, it may be necessary to gather data and engage local residents in a thoughtful, place-based planning exercise, focusing on short-term actions and long-term vision to guide future green infrastructure planning. The initial assessment and planning will determine which green infrastructure strategies are best for a particular site in a particular community. This may include personal and anecdotal reports of flooding events and sanitary sewage overflows into streets and homes.

Recommended Action: **Conduct an assessment of all available stormwater management reports, plans and data in your community. If none exist or if there are gaps in the data, take steps to gather your own data and engage local residents to determine what are the stormwater problems and how green infrastructure will best suit a particular community. Become a volunteer monitor to gather current data regarding the effectiveness of stormwater controls through site inspection.**

23 *See also* Section 3.3 (Coordinating Overlapping Wastewater and Water Resource Goals) below.

24 *See* http://www.lrc.ky.gov/krs/100-00/CHAPTER.HTM. Comprehensive Plans are usually available at a municipality's website or administrative offices.

25 For example, Louisville MSD is required to maintain and provide stormwater infrastructure GIS layers and the inventory of post-construction stormwater controls as part of its MS4 permit requirements.

26 The database is located at http://kygeonet.ky.gov.

Section 3.2 | Identifying Applicable Ordinances, Laws and Regulations

Identifying the local, state and federal laws affecting local stormwater management decisions is also important for green infrastructure implementation. Stormwater pollution has a direct environmental impact on streams, rivers and lakes, but also affects the quality of drinking water resources. In many communities, stormwater causes problems with wastewater treatment infrastructure, particularly cities experiencing CSO and SSO problems. These are issues that are or should be addressed through regulation. Therefore, it is important to identify the legal requirements related to the quantity and quality of stormwater, wastewater and drinking water resources. This information can be used to justify the use of green infrastructure to mitigate stormwater impacts.

Federal Regulations

Environmental advocacy organizations, such as the NRDC, interpret the "maximum extent practicable" (MEP) standard for MS4 permits to require permittees to use green infrastructure. WWKY agrees with this interpretation. However, this interpretation has not been accepted (yet) in the Commonwealth of Kentucky. Nevertheless, municipalities are encouraged by the EPA to voluntarily implement green infrastructure as a means of meeting their obligations under the National Pollution Discharge Elimination System (NPDES) Program.

State Regulations

In Kentucky, the federal NPDES program is implemented by KDOW through the Kentucky Pollution Discharge Elimination System (KPDES) program. All point source discharges to the waters of the Commonwealth require either an Individual or a General KPDES permit. Individual KPDES permits are required for activities that may occur within urban boundaries including: discharges from combined stormwater and sanitary sewer systems (CSO), industrial wastewater discharges, municipal discharges from Publicly Owned Treatment Works (POTW), and point source stormwater discharges from Municipal Separate Storm Sewer Systems (MS4). Point source discharges from certain temporary construction or maintenance activities may require coverage under a KPDES General Permit.

The KPDES MS4 permitting program is promulgated through Phase I and Phase II permits.[27] In Kentucky, a Phase I MS4 requires an individual permit for stormwater discharges from large and medium urban areas serving a population of 100,000 residents or more. Urban areas covered by Phase I MS4 permits are required to develop BMPs that reduce stormwater pollution impacts to the "maximum extent possible" (MEP). As stated before, WWKY interprets the MEP standards to require green infrastructure implementation. Cities under Phase I permits are also required to develop a stormwater management plan (SWMP), conduct monitoring, and submit compliance reports.

27 Kentucky Division of Water (KDOW) Regulations, available at http://water.ky.gov/Pages/Regulations.aspx.

The following minimum control measures are used to measure the performance of a Phase I municipal SWMP:

- Public Education and Outreach
- Public Participation/Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Pollution Prevention in Residential and Commercial Areas
- Pollution Prevention for Municipal Operations
- Industrial/Municipal Waste Facility Stormwater Pollution Prevention
- Water Quality Monitoring
- Record Keeping and Reporting

LFUCG Government Center, Lexington, Kentucky

Municipalities with MS4s serving a population greater than 50,000 but less than 100,000 residents are required to maintain a Phase II permit. Like Phase I permittees, urban areas covered by Phase II MS4 permits are also required to develop BMPs that reduce stormwater pollution impacts to the "maximum extent possible." Although monitoring is not required, the permittees must comply with the following six minimum control measures:

- Public Education and Outreach
- Public Participation/Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post-Construction Runoff Control
- Pollution Prevention/Good Housekeeping

Although the state retains the legal authority to require such permits, they give latitude to local entities in delegating how their program should be implemented within the general state guidelines. However, self-regulation (where permittees are allowed to determine their own programs to meet MEP without permitting authority review), has been ruled illegal by the Federal Courts in the 2^{nd} and 9^{th} Circuits.[28] For examples of MS4 Permits see Section 5.0.

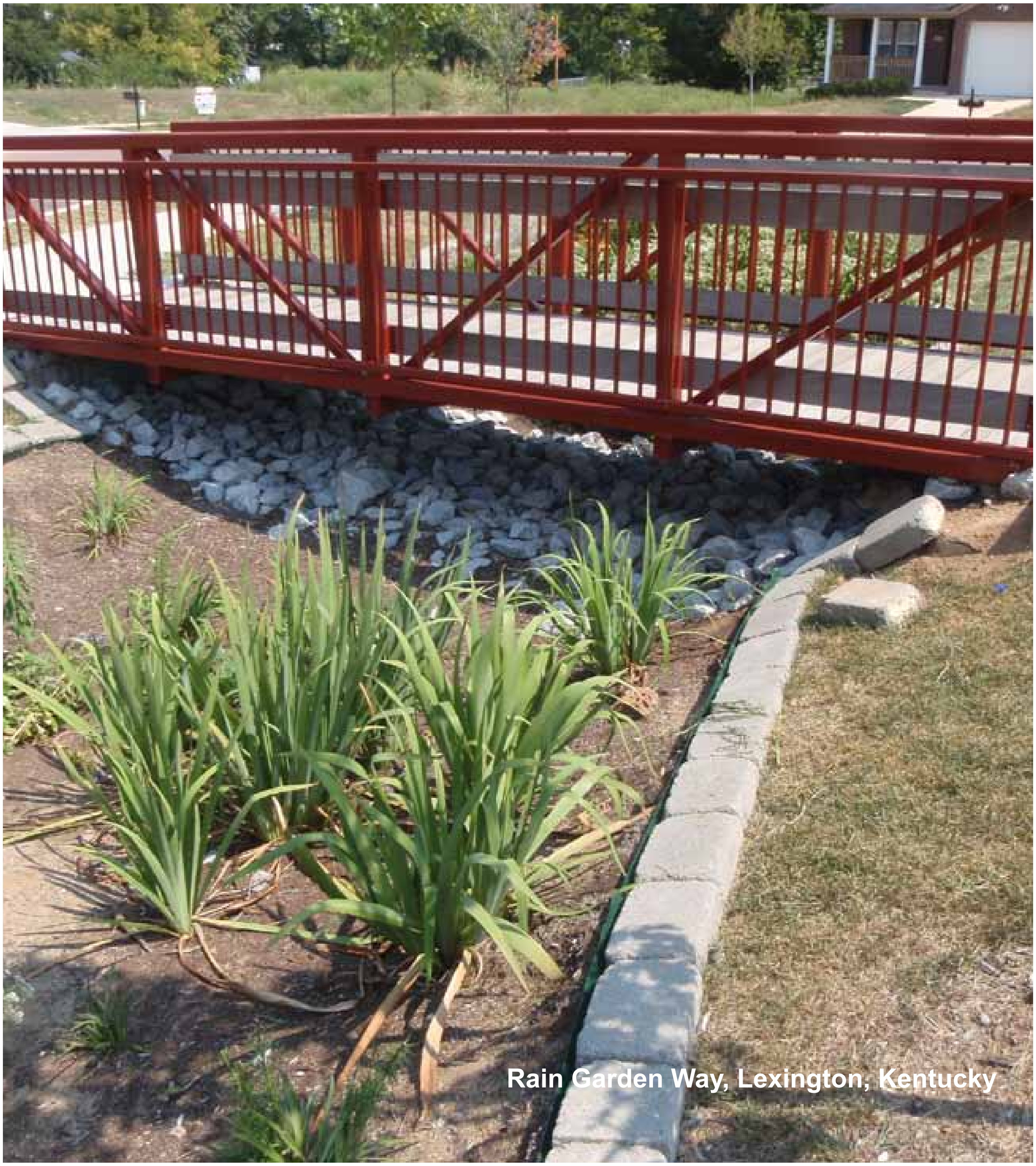
Consent Decrees

Consent decrees are settlement agreements between a federal and/or state regulatory agency such as the EPA and the KDOW (as the plaintiff) and a city or municipal utility (as the defendant) to resolve a Clean Water Act enforcement action. Consent decrees typically require a municipality to fix problems with its storm and sanitary sewer systems within an allotted time period. If the municipality fails to take those steps in a timely fashion, it can be fined, or other corrective measures could be taken.

Consent decrees can also provide the necessary incentive to implement green infrastructure in a community. For example, consent decrees can require a municipality to commit a fixed amount of money dedicated to green infrastructure projects, and can require a municipality to implement ordinances that promote green infrastructure such as stormwater retention standards. The implementation of a consent decree typically requires public participation and should generate widespread discussion within a community. Volunteers and concerned citizens are able to attend public meetings and submit comments related to the consent decree to encourage green infrastructure.

28 The Louisville MS4 permit employs self-regulation. The U.S. Court of Appeals for the Sixth Circuit holds jurisdiction over Louisville.

In Kentucky, there are four municipalities that are parties to a consent decree with the EPA and Commonwealth of Kentucky, including Louisville MSD, Lexington, Winchester and Northern Kentucky SD1. In addition, fourteen communities are parties to a consent decree with only the Commonwealth of Kentucky.[29]


Rain Garden Way, Lexington, Kentucky

29 For more information and for examples of consent decrees *see* Section 6.0.

Total Maximum Daily Loads (TMDLs)

Existing or proposed Total Maximum Daily Loads (TMDLs) for local waterbodies can provide useful information for substantiating the need for green infrastructure projects. TMDLs are established for waterbodies that do not meet federal water quality standards due to excessive amounts of particular pollutants. This CWA tool establishes the maximum amount of a pollutant that can be discharged from point or nonpoint source discharges without exceeding the water quality standards of each State. If a municipality discharges stormwater with pollutant loads exceeding its wasteload allocation, then that municipality may be required to implement structural and/or non-structural BMPs to mitigate these impacts.

Volunteers need to be sure the municipality is aware of opportunities where green infrastructure could be added to the suite of BMPs to target the pollutants of concern identified in the TMDL. The SWMP required by their MS4 permit may need to be updated to include certain green infrastructure BMPs. Green infrastructure BMPs used for TMDL compliance will require monitoring to ensure they are providing the intended benefit.

Local government officials may be reluctant to use green infrastructure due to concerns about performance, cost and maintenance. Local governments should be reminded that the EPA strongly encourages cities to utilize green infrastructure to mitigate stormwater runoff impacts. The EPA recognizes the challenges associated with accurately characterizing pollutants loads associated with stormwater discharges, so they provide municipalities the flexibility of choosing BMPs that effectively mitigate water quality impacts. Since the EPA and KDOW both support the use of green infrastructure solutions, local governments should be encouraged to take advantage of this new direction to demonstrate their commitment to compliance with stormwater regulations.

Local Ordinances

Volunteers should review local ordinances and development codes to identify barriers and restrictions to green infrastructure projects or opportunities for requiring aspects of green development practices. If certain ordinances are inconsistent with green infrastructure development, citizens can insist that those ordinances be changed. For example, a responsible developer may be interested in using vegetated roadside swales to convey and treat stormwater, but their design intentions may be prevented if the city has a development ordinance requiring curb and gutter systems.

One of the most effective methods of implementing green infrastructure in a community is to implement a retention standard for new developments to be met through infiltration, plant evapotranspiration, and/or reuse.[30] Cities like Philadelphia, Washington D.C., Pittsburgh, and Aurora, IL, and states such as California and New Jersey, have already approved and implemented ordinances and statutes to improve retention standards for their communities to support green infrastructure.

30 For example, in Philadelphia, the first inch of rainfall must be managed on site through infiltration (if feasible) in all new development and redevelopment projects with at least 15,000 square feet of earth disturbance.

Local ordinances that typically have water quality implications include those relating to stream buffers, open spaces, stormwater BMP operation and maintenance, and erosion and sediment control measures. There are many online resources that may be helpful for volunteers undertaking a review of municipal ordinances and development codes. Online resources that may be useful for evaluating existing ordinances for deficiencies and obstacles to green infrastructure have been provided below.

***Recommended Action*: Identify federal, state and local laws and ordinances affecting local stormwater management decisions. Take advantage of opportunities to participate in public meetings and other forms of discourse with local decision-makers. When appropriate, recommend the green infrastructure approach as practical and cost-effective means of complying with these laws. Recommend revisions to local development requirements that may prevent green infrastructure design approaches.**

<u>Useful Regulatory Links:</u>

U.S. EPA:

Model Ordinances
http://www.epa.gov/owow/NPS/ordinance

Water Quality Scorecard
http://www.epa.gov/dced/water_scorecard.htm

Center for Watershed Protection*:*

The Codes and Ordinances Worksheet
http://www.cwp.org/documents/cat_view/81-audits.html

Watershed Protection Program Audit
http://www.cwp.org/documents/cat_view/81-audits.html

Section 3.3 | Coordinating Overlapping Wastewater and Water Resource Goals

Stormwater management is a complex enterprise. Long-term success of any stormwater management program depends on forging cooperative relationships with citizens, private industry and other stakeholders within the municipality. Yet, it can also be beneficial to reach out to neighboring municipalities within the region to coordinate stormwater management efforts. Such alliances could lead to more comprehensive strategies and provide economies of scale opportunities.

Municipalities developing comprehensive stormwater plans should be encouraged by citizens to identify opportunities to coordinate with other parallel water resource management efforts. Public drinking water and sanitary sewer and stormwater maintenance operations sometimes operate independently without recognizing opportunities where their efforts could be combined to achieve overlapping goals.

Look for other water management plans (such as drought response and flood response plans) that address broader issues beyond municipal boundaries. Such plans may include watershed plans, Regional Facility Plans,[31] source water protection plans or groundwater protection plans. Be sure any existing or proposed plans that target water quality or quantity issues are identified, analyzed and understood. These plans could provide volunteers the opportunity to promote green infrastructure as a means of contributing to such comprehensive planning efforts.

Developing these cooperative relationships could create cost-sharing or grant funding opportunities that lead to more cost-effective and comprehensive watershed improvements. If these cooperative opportunities are identified, they can be used to support the case for adding green infrastructure to the list of BMP options.

***Recommended Action*: Coordinate green infrastructure planning with interested stakeholders. Identify existing or proposed planning for water quality and quantity. Determine opportunities for cost-sharing.**

31 *See KDOW Regional Facility Plan Guidance*, available at http://water.ky.gov/Documents/WMPS/Facility Plan Guidance Document Feb 2011.pdf.

Identifying efforts by other groups or agencies engaged in surface water and groundwater protection efforts could provide opportunities to coordinate and leverage limited resources to meet common goals. These may include industry, community and agricultural groups involved in watershed protection, energy conservation, smart growth planning, economic development, drinking water protection, groundwater protection, wetlands and habitat protection, nonpoint source protection, wastewater treatment, solid waste management, pesticide management, forestry and wildlife management, and air quality interests.

Identify all of the potential stakeholders and determine what is driving their interest. Some may have political or economic interests at stake such as developers or private industries serving public infrastructure. Once proponents of green infrastructure are identified, identify the opponents and skeptics. Find out why they're against certain measures. Prepare your response using EPA and KDOW information, and NRDC, WWKY, and River Network expertise. Use the expertise at the University of Kentucky, University of Louisville, and other universities and colleges across Kentucky.

***Recommended Action*: Identify proponents and opponents of green infrastructure in the community. Approach experts in fields relevant to green infrastructure for advice and consulting.**

Green infrastructure can reduce project costs, improve water quality treatment, and address city beautification goals. However, not many municipalities have readily available funding for stormwater management projects. The following examples provide a sampling of funding methods that have been used for financing stormwater infrastructure projects. Identifying and offering funding outside of general fund resources for green infrastructure can be the impetus necessary to persuade city administrators to pursue particular projects.[32]

Stormwater Utility Fees

This option is a popular approach for municipalities because it provides a sustained, long-term funding mechanism to maintain stormwater infrastructure and mitigate chronic water quality issues. For this type of funding, users of the municipal stormwater system or those who impact water bodies within the governing jurisdiction are required to pay a user fee. This fee may be based on footprint, impervious cover, or specific type of structure or use within a jurisdiction. Under this approach, the properties that have more impervious surface area, and thus contribute the most volume to local water bodies, are required to pay a proportionally higher fee. This creates an incentive for customers to reduce the amount of impervious surface on their properties.

For example, Louisville MSD provides different service rates and credits depending on the amount of impervious surface on a property and efforts by property owners to use green infrastructure BMPs.[33] The City of Lexington does not have a credit program, but they do use a portion of the revenue generated from stormwater utility fees to offer the Stormwater Incentive Grant Program. This grant program provides a funding opportunity to encourage local property owners to pursue green infrastructure projects that help mitigate stormwater impacts. Revenues collected with the user fee can be dedicated to efforts to help improve water quality including stormwater infrastructure improvements, operations and maintenance of existing facilities, street cleaning, public education and outreach and other strategies to support green infrastructure. However, such programs also require financial resources for administration, human resources and legal services.

The fees paid by citizens are based on services that meet the stormwater management goals set by the municipality. These services should have measurable results in order to maintain public confidence in the benefits of these services. For instance, stormwater fees are often used to pay for street sweeping, so it is important that these activities take place on a regular basis and are visible to the public. A public education effort is highly recommended to inform citizens about the beneficial activities that are less apparent, in order to maintain public confidence.

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32 For an in-depth review of different funding mechanisms and incentives see the NRDC's *Rooftops to Rivers II*, pp.22-30, available at http://www.nrdc.org/water/pollution/rooftopsII/default.asp.

33 Louisville MSD Rates, Rentals, and Charges, available at http://www.msdlouky.org/pdfs/MSDRateScheduleAugust2011.pdf.

Green infrastructure projects have the ability to provide a tangible product of stormwater user fees. Projects such as rain gardens can also provide an opportunity to educate the public about stormwater issues while demonstrating the city's commitment to improving water quality.

Bond Financing

Another common method of financing municipal initiatives is derived from bond measures adopted by city administrators. Bond financing is a method of borrowing money that is eventually paid back by the city through established and traditional tax and fee revenues. When choosing to pursue bond financing, city administrators are making a decision that could require increasing taxes for their constituents. Therefore, it is critical to have a strong argument for the project financed by a bond measure to ensure the need is fully understood and the debt can be repaid in a reasonable amount of time. Public education plays a critical role in informing the public and the administrators about the benefits of green infrastructure projects, which may help increase support for such projects.

Development Fees

Several municipalities have adopted development fees that are charged to property owners pursuing construction activities.[34] Revenue collected from development fees can be used to finance on site or off-site stormwater management projects to help address stormwater impacts caused by the development. Since development fees are usually a one-time fee associated with a particular development activity, this funding method is not suitable for long-term maintenance of stormwater management programs. But, this method can be used to implement green infrastructure projects during the construction phase or long-term management post-construction that can potentially add value to the development. Developers are finding that green infrastructure can be implemented in ways that provide amenities to property owners, thus increasing property values.

Development Incentives

Development incentives are similar to development fees, since they are authorized by municipalities usually through mechanisms in the zoning or land development code. These incentives offer developers certain benefits for including green infrastructure in their plans and designs. For example, an incentive may allow a developer to build a residential property at a higher density than what is normally allowed if the developer incorporates a green infrastructure project in the development's design.

Grants and Loans

There are several grant programs available for green infrastructure projects, but anyone who has ever pursued such funding knows that it can be competitive. Citizens should identify funding sources that are most closely related to green infrastructure or the stormwater management goals that can be achieved with green infrastructure. However, many grants may also indirectly apply to green infrastructure projects and should be carefully investigated.

34 Campbell, C. Warren. *Stormwater Utility Survey 2012.,* Western Kentucky University, available at http://www.wku.edu/engineering/documents/swusurveys/swusurvey-2012.pdf.

State and federal agencies frequently offer matching grants that can be used to fund a portion of a green infrastructure project. There are also some non-profit organizations that offer grants. Some grants can be used to fund a portion of a project, while others may be used to fully fund a project.

Green infrastructure projects have the advantage of offering multiple benefits that can meet a range of criteria required for certain grants. Green infrastructure projects not only provide stormwater management, but they can also offer public education opportunities, meet city beautification goals, improve water efficiency, improve wildlife habitat, and other benefits as described above. Green infrastructure is also an innovative stormwater management approach that is easier to publicize than conventional gray stormwater structures.

Green infrastructure can be useful for pursuing a range of grant opportunities, but it's important to consider long-term maintenance and ownership of such facilities. To demonstrate understanding of these implications, be sure to describe the long-term strategy for operation and maintenance of these facilities after the project is completed. A list of some federal sources of grant funding is provided below. Individuals, neighborhoods, businesses, organizations, and communities may all be eligible to receive these grants and loans.

Recommended Action: **Identify funding opportunities for green infrastructure projects including bond financing, development fees, development incentives, stormwater utility user fees, and grants. The following website links may be useful for researching the aforementioned information. .**

Useful Funding and Incentive Links:

319 Grants

EPA Nonpoint Source Implementation Grants (319 Program):
http://water.epa.gov/polwaste/nps/contacts.cfm
EPA 319(h) Application Process:
http://water.epa.gov/polwaste/nps/319hfunds.cfm

Clean Water State Revolving Funds

EPA Clean Water State Revolving Fund:
http://water.epa.gov/grants_funding/cwsrf/cwsrf_index.cfm
KDOW Green Project Reserve:
http://water.ky.gov/Funding/Pages/CWSRFGPR.aspx
KDOW Green Project Reserve 2010 List:
http://water.ky.gov/Funding/Pages/DWSRFGPR.aspx
Using CWSRF funding:
http://www.epa.gov/owow/NPS/natlstormwater03/05Butler.pdf

Redevelopment Projects

EPA Brownfields Grants & Funding:
www.epa.gov/brownfields/grant_info/index.htm

HUD Community Development Block Grants:
portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

Stream Corridor Restoration (including Riparian Zones, Wetlands & Floodplains)

EPA Five-Star Restoration Program:
http://www.epa.gov/owow/wetlands/restore/5star/

U.S. Army Corps of Engineers Aquatic Ecosystem Restoration (CAP Section 206):
www.nae.usace.army.mil/pservices/206.htm

EPA Wetlands Program Development Grants:
http://water.epa.gov/grants_funding/wetlands/grantguidelines/index.cfm

NRCS Wetlands Reserve Program:
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/easements/wetlands/?&cid=nrcs143_008419

Urban Forestry Programs

USDA Forest Service Department of Agriculture Urban and Community Forestry Challenge Cost-Share Grants:
http://www.fs.fed.us/ucf/nucfac

EPA - Green Infrastructure Funding Opportunities:
http://cfpub.epa.gov/npdes/greeninfrastructure/fundingopportunities.cfm

St. Elizabeth's Hospital, Covington, Kentucky

Section 4.0 | Building Accountability – Does It work?

Water quality has improved substantially since the Clean Water Act was put into effect in 1972. However, there is still a long way to go to address watershed impacts resulting from stormwater runoff. Citizens need to be diligent in their own actions and in demanding that local governments pursue effective stormwater management strategies that will provide measurable results. Although green infrastructure strategies have demonstrated tremendous promise for mitigating issues associated with urban stormwater runoff, there is still a need for more data to convince skeptics that green infrastructure is an effective approach for Kentucky.

One purpose of this Plan is to help the eight local basin Watershed Watch groups in Kentucky to develop local Green Infrastructure CAPs for the communities within their basin. This Plan provides Watershed Watch volunteers and all concerned citizens with the tools to evaluate a municipality's stormwater policies, recognize what green infrastructure strategies and policies would best benefit the municipality, and determine how to implement them. In addition, WWKY volunteers can be trained to monitor and maintain those green infrastructure stormwater control projects.

The data collected from those projects can inform public policy and regulation. The quantitative and qualitative performance data will help identify the BMPs most suitable for targeting particular stormwater impacts, and further demonstrate green infrastructure as a viable technology. Ultimately, the results of this monitoring data may encourage other municipalities to pursue similar projects and policies.

Section 4.1 | Volunteer Monitoring of Green Infrastructure Performance

WWKY has sampled stream water quality across Kentucky since 1997. WWKY has had success in identifying water quality issues and, in some cases, identified the cause of the pollution that led to mitigation efforts. Now that more green infrastructure projects are being implemented across Kentucky, it is becoming increasingly important to ensure they are achieving the intended treatment goals. Developing performance goals for green infrastructure and demonstrating performance with monitoring data will help convince local governments and citizens that green infrastructure is effective and their money is being spent wisely. However, monitoring green infrastructure projects in a manner that produces scientifically significant data can be complex depending on the monitoring goals.

The grab sample method that WWKY volunteers currently use to collect stream samples for analysis may be suitable for sampling pollutant concentrations from green infrastructure. However, the resulting concentration data will not be an accurate measure of the overall percent removal of pollutants. The grab sample method could be used as a loose indicator that water leaving the green infrastructure BMP has pollutant concentrations within the regulatory range of values, but it will not provide accurate data to evaluate the treatment performance. In order to collect data to accurately gauge the performance goals of green infrastructure it will be necessary to determine the concentration of pollutants and the volume of water prevented from exiting the facility - including pre-construction, post-construction, and retrofit monitoring. WWKY will work with its science advisors at the Kentucky Water Resources Research Institute (KWRRI) and KDOW to develop a new water sampling module for green infrastructure.

The first phase of sampling green infrastructure is expected to utilize the same grab sampling method to gather preliminary data in a cost-efficient manner. Samples can be collected at the inflow and outflow points respective to the stormwater control feature. These samples can be evaluated as an preliminary indicator of proper performance. If pollutants of concern are identified that exceed acceptable levels for protecting designated uses or complying with TMDLs for the receiving waters, then more scientifically diligent and costly sampling methods may need to be employed.

There are three proposed approaches to monitoring the performance of green infrastructure listed below in order of increasing complexity:

- **Visual Monitoring**: This would be a qualitative measure of green infrastructure performance that would be relatively simple for volunteers to perform. Volunteers would need to be assigned to a project site that could be visited within 30 minutes following a significant rain event. If it appears that the peak of the stormwater inflow has occurred, then photos should be taken to document the amount of water captured and the amount overflowing. Measurements of pool depth and rain gauge data should also be collected. This monitoring approach would be a simple way to provide qualitative observations of performance and preliminary quantitative measurements that can be tracked over the course of time. If there are indications of poor performance, then the volunteers may decide a Citizen Action Plan may be necessary to further evaluate or improve the BMP.

- **Water Quality Grab Samples:** This method would employ the same approach that Watershed Watch volunteers are currently using to sample streams. Grab samples could be collected at designated inlet and outlet points for the green infrastructure BMP. Comparison of the pollutant concentrations from the inlet and outlet samples could provide a preliminary indicator of the water quality treatment performance; however, these values may undervalue the treatment performance since this method does not account for the volume runoff retained by the BMP.

- **Quantitative Monitoring**: Stormwater volume reduction is a key indicator of BMP performance. The volume of polluted stormwater captured by the BMP prevents that pollutant load from reaching the local stream. Measuring the paired volumes of incoming and outgoing stormwater, in addition to the previous monitoring methods, will provide a more accurate indicator of overall performance. However, collecting volume data requires the added expense of installing more sophisticated equipment and measurement techniques. Such equipment might include the installation and calibration of weirs, flumes and automated sampling equipment.

  Once these data are collected, the incoming and outgoing mean pollutant concentrations (e.g. milligrams/liter) could be multiplied by the corresponding volumes (e.g. liters) to provide the pollutant load (e.g. milligrams) removed by the BMP. This would provide a more accurate measure of BMP performance, since this method accounts for the volume removed. Calculating the load in this manner may indicate improved levels of treatment performance compared to inlet/outlet grab sample concentration comparisons. Statistical analysis would be necessary to assure the reliability of the sampling data.

If these monitoring methods indicate that the green infrastructure BMP is not achieving the intended standard of performance, then additional monitoring and testing may be necessary. This testing may help pinpoint the causes of the poor performance and help identify the best course of action to improve performance.

***Recommended Action*: Work with WWKY Science Advisors to develop a WWKY water sampling training module for green infrastructure. Utilize and improve the monitoring methodologies already employed by the WWKY to most effectively monitor green infrastructure BMPs and projects.**

Section 4.2 | Use of Citizen Action Plans (CAPs)

WWKY has developed the Citizen Action Plan (CAP) as a tool for local watershed groups to address the sources of water pollution identified through water quality sampling efforts. Volunteers have used the CAP process to coordinate actions necessary to address impacts to watersheds. Watershed groups can also use the CAPs as a model for the development of their Green Infrastructure Implementation Plans.

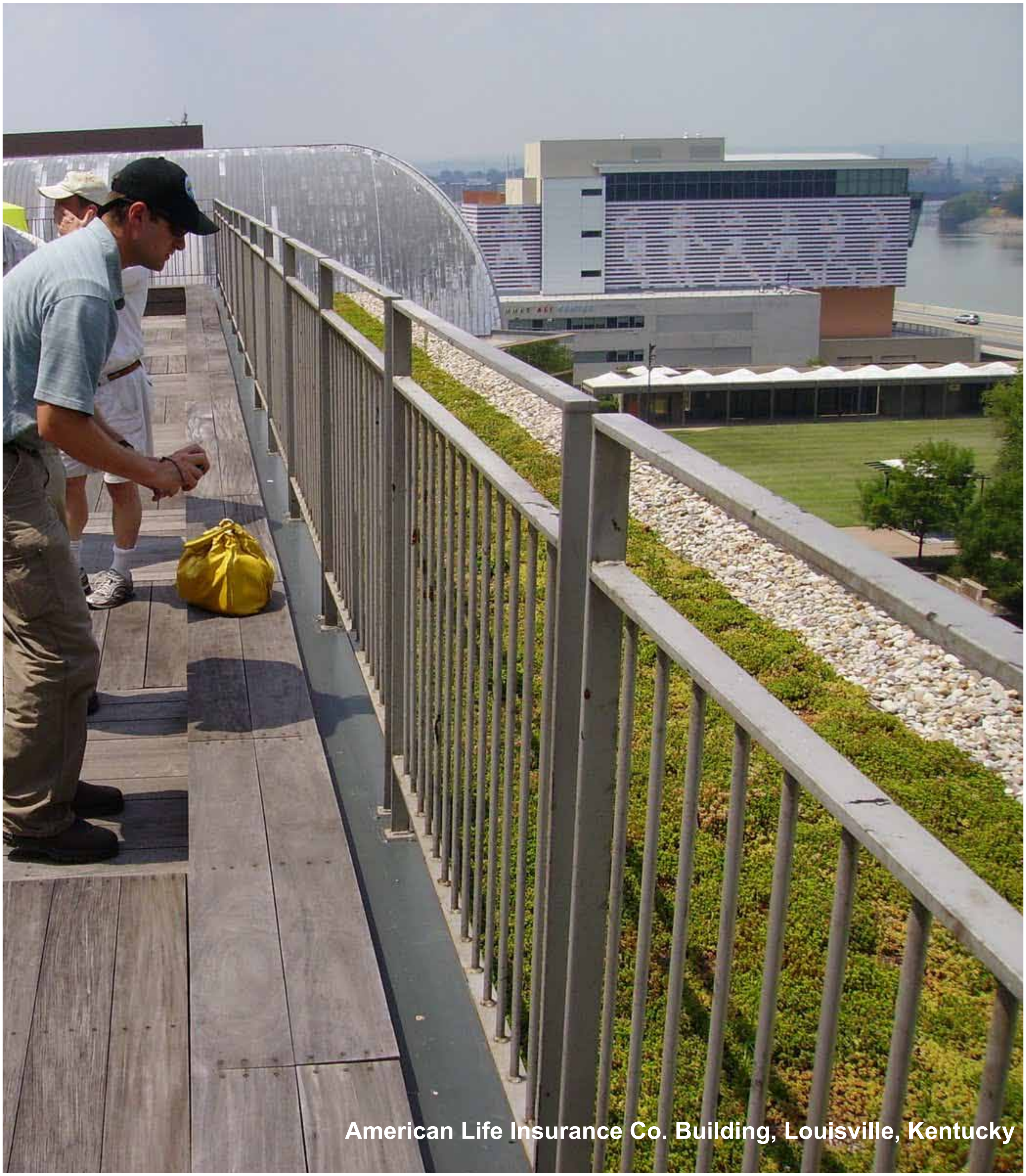
Initially, watershed groups are encouraged to utilize a Green Infrastructure Assessment such as the Water Quality Scorecard developed by the EPA,[35] to assess a municipality's commitment to green infrastructure implementation. The Green Infrastructure Assessment provides a means of evaluating a community for their green infrastructure planning, policies, and designs, as defined throughout this Plan. After that initial assessment is complete, a watershed group can use that information to inform the CAP process.

The KRWW CAPs consist of four main sections: environmental and cultural history, citizen/scientific examination, assessment, and action items. The local Green Infrastructure CAPs can follow the same rubric. By evaluating the environmental and cultural history of a watershed with green infrastructure in mind, the local Green Infrastructure CAPs can address the historical locations of streambeds and wetlands and determine the historical species composition of an area. This can inform where green infrastructure projects should be located and what species should be utilized. The Citizen/Scientific examination and the Assessment sections can also be used to determine where green infrastructure projects and BMPs would be most effective, what green infrastructure policies a municipality can most readily adopt, and what green infrastructure monitoring protocols will be most effective. Lastly, watershed groups can incorporate those green infrastructure BMPs, projects, policies, and monitoring protocols into their Action Items that would have the most significant impact on mitigating the water quality and quantity issues in a particular area.

The CAP process provides volunteers with a model to take action based on the sampling data for green infrastructure projects. This includes which green infrastructure BMPs, projects, and policies will work best for a specific community and which monitoring and maintenance protocols give the most effective results. The action items should take the form of re-evaluating potential structural retrofits or adding treatment devices to improve the performance of the green infrastructure BMP or project. After the best green infrastructure BMPs, projects sites, and policies are determined along with the most effective monitoring and maintenance protocols, then the Green Infrastructure Implementation Plans can be revised by implementing the most beneficial policies and projects for a given community.

***Recommended Action*: Using the WWKY CAP program as a model, develop local Green Infrastructure CAPs for municipalities within a local basin. Use the WWKY CAP's environmental and cultural history, citizen/scientific examination, assessment, and action items sections. Utilize the WWKY's water monitoring and maintenance resources to determine the most beneficial GI strategies for a community.**

35 *Water Quality Scorecard*, available at http://www.epa.gov/dced/water_scorecard.htm.


American Life Insurance Co. Building, Louisville, Kentucky

Bernheim Forest Visitors' Center, Clermont, Kentucky

The green infrastructure approach to stormwater management is a practical and cost-effective strategy that can work in Kentucky. Kentucky communities must make a more comprehensive commitment to change the current approach to stormwater management, and that commitment must be driven by the calls for action by informed citizens. WWKY has prepared this Plan to empower citizens across Kentucky to take it upon themselves to advocate for the green infrastructure approach in their communities.

The Plan will help individual citizens access the technical information to help them promote and implement effective green infrastructure strategies for their communities. The Plan also provides information to help identify local laws and policies that create unnecessary obstacles to the development of green infrastructure. The Plan provides information to help citizens identify municipal financing strategies and grant opportunities that can be used to fund green infrastructure projects.

The Plan has outlined multiple strategies for promoting, funding, and implementing green infrastructure, which can be tailored to address unique local challenges. However, more empirical data is necessary to convince detractors that green infrastructure is an effective stormwater treatment approach for Kentucky. Therefore, WWKY is expanding current stream water quality monitoring capabilities to include measuring the effectiveness of green infrastructure solutions.

Watershed Watch in Kentucky will use this Kentucky Green Infrastructure Action Plan to help change stormwater management across Kentucky from “gray” to “green.” Using this Plan as a basis, WWKY’s immediate goal is to prepare and implement Green Infrastructure CAPs for the Louisville, Lexington, and Northern Kentucky areas. WWKY’s extended goal will be preparing and implementing Green Infrastructure CAPs in the smaller cities and communities across Kentucky. The information and instructions contained in this Plan will serve as the impetus to make those goals a reality.

Each community in Kentucky contends with their own unique set of environmental, social, economic and political circumstances that influence how green infrastructure is perceived. The research, advocacy and data collection strategies provided in this Plan can be used to assess the most effective course of action for a particular community. WWKY invites citizens across Kentucky to become a part of the WWKY program as it empowers citizens to influence local decisions about stormwater management and ensure that green infrastructure is a critical part of the discussion.

Section 6.0 | Partners & Resources

The following websites offer resources and support in Kentucky and around the country. WWKY recommends partnering with these organizations and exploring what they offer in regard to green infrastructure support, guidance, design, implementation, and monitoring. Though far from an exhaustive list, these websites include (in alphabetical order):

Bluegrass PRIDE:
http://www.bgpride.org
Kentucky Green Infrastructure Website:
www.Gray2GreenKY.com

City of Bowling Green – Public Works:
http://www.bgky.org/publicworks
Best Management Practices Manual:
http://www.bgky.org/stormwater/bmpmanual.php

City of Owensboro – Engineering:
http://www.owensboro.org/engineering
Regional Water Resource Agency (Owensboro-Daviess County):
http://www.rwra.org
Owensboro Stormwater Quality Management Plan (SWQMP):
http://www.owensboro.org/sites/default/files/engineering/SWQMP%202nd%20permit%20cycle.pdf
Owensboro Combined Sewer System Information:
http://www.rwra.org/?page_id=51

Environmental Defense Fund – Scorecard:
http://scorecard.goodguide.com/index.tcl

International Council for Local Environmental Initiatives (ICLEI) USA:
http://www.icleiusa.org

Kentucky Division of Water:
http://water.ky.gov

Kentucky Institute for the Environmental and Sustainable Development:
http://louisville.edu/kiesd

Kentucky River Watershed Watch (KRWW):
http://www.uky.edu/OtherOrgs/KRWW
KRWW Citizen Action Planning:
http://www.uky.edu/OtherOrgs/KRWW/CitizenActionPlans.htm
Lexington Herald Leader Article (1/20/2012):
http://www.kentucky.com/2012/01/20/2035829/hank-graddy-board-member-kentucky.html
KRWW - Water Sampling Results:
http://www.uky.edu/OtherOrgs/KRWW/DataAnalysisRep.htm

Kentucky Waterways Alliance:
http://www.kwalliance.org

Lexington Division of Water Quality:
  http://www.lexingtonky.gov/index.aspx?page=665
    LFUCG Consent Decree Information:
      http://www.lexingtonky.gov/index.aspx?page=840
    LFUCG MS4 Permit:
      http://www.lexingtonky.gov/index.aspx?page=2598

Louisville MSD:
  http://www.msdlouky.org
    Louisville's 2011 Final MS4 Permit:
      http://www.msdlouky.org/insidemsd/wwwq/ms4/MS4_Permit20110611.pdf
    Louisville's Consent Decree with EPA:
      http://www.msdlouky.org/projectwin/docs.htm

Natural Resources Defense Council (NRDC):
  www.NRDC.org
    Rooftops to Rivers Green Strategies Report I:
      http://www.nrdc.org/water/pollution/rooftops/contents.asp
    Rooftops to Rivers Green Strategies Report II (2011 Update):
      http://www.nrdc.org/water/pollution/rooftopsII/default.asp

Northern Kentucky Sanitation District No. 1:
  http://www.sd1.org
    SD1's Integrated Approach:
      http://www.sd1.org/NewsArticle.aspx?id=58
    SD1 Consent Decree:
      http://www.sd1.org/Resources.aspx
    SD1 MS4 Permit:
      http://www.sd1.org/Resources.aspx

River Network:
  http://www.rivernetwork.org

Sustainable Sites Initiative:
  http://www.sustainablesites.org

UK Kentucky Water Resources Research Institute (KWRRI):
  http://www.uky.edu/WaterResources

U.S. EPA:
  http://water.epa.gov/infrastructure/greeninfrastructure

Watershed Watch in Kentucky:
  http://www.wwky.org

Virginia Environmental Endowment (VEE):
  http://www.vee.org

WATERSHED WATCH IN KENTUCKY