PRAIRIE RIVERS NETWORK

GUIDE BOOK SERIES

STORMWATER MANAGEMENT

// A Guide to Managing Stormwater with Green Infrastructure

GUIDE BOOK SERIES

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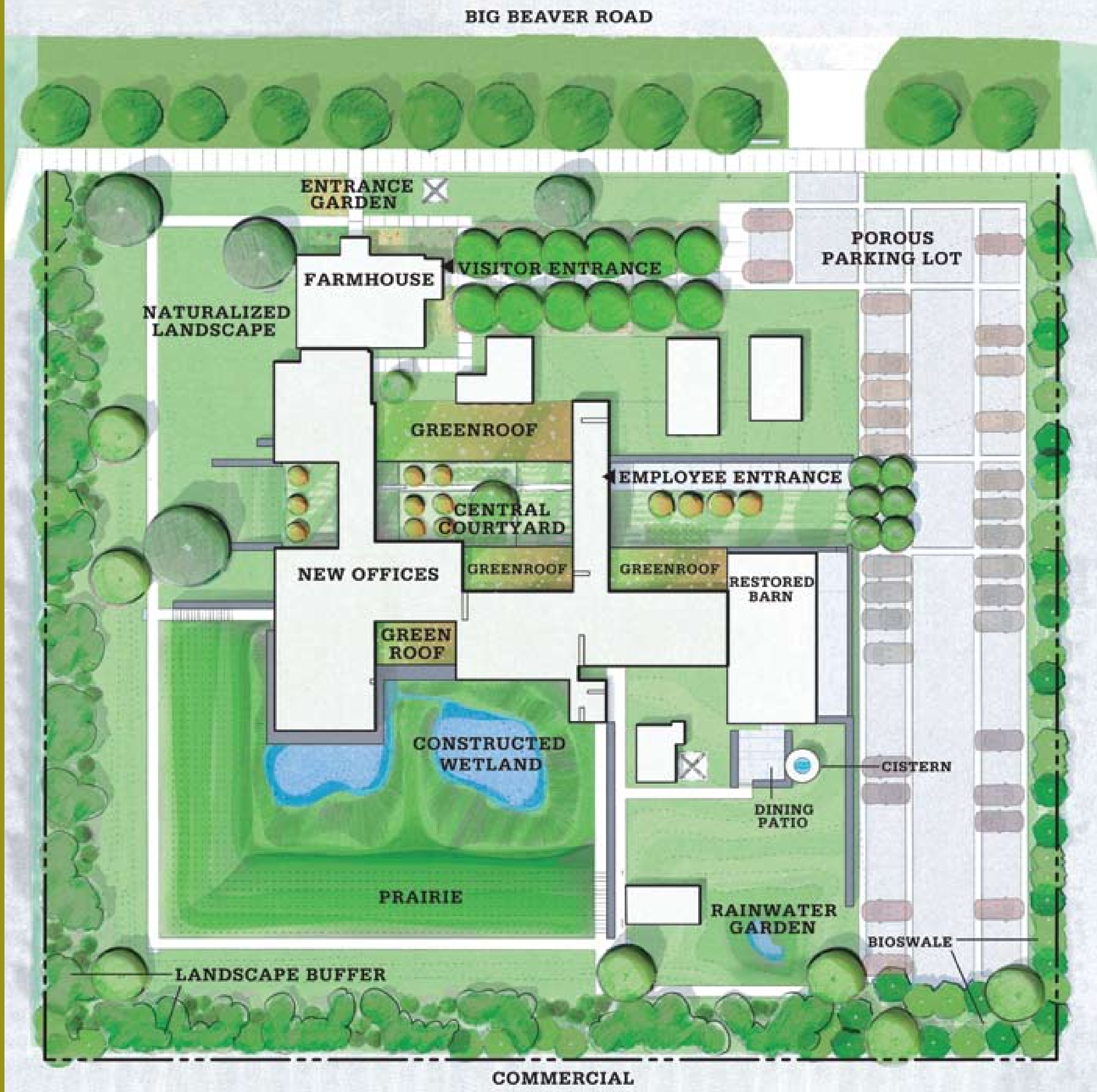
Right: Green Development



THE BENEFITS OF USING GREEN INFRASTRUCTURE | "Green infrastructure" refers to a number of stormwater management practices that **REDUCE RUNOFF AND FLOODING BY PRESERVING, RESTORING, OR MIMICKING NATURAL HYDROLOGICAL PROCESSES.** The strategic use of aquatic habitat, soil, vegetation, and other materials to absorb rainfall and snowmelt can be a more economical and aesthetic alternative to gutters, curbs, and sewers. **GREEN INFRASTRUCTURE MAY BE USED FOR NEW DEVELOPMENT, REDEVELOPMENT, AND MAINTENANCE OR REPAIR PROJECTS.** Many examples of green infrastructure, such as wetlands and riparian buffers, may already be present on an undeveloped site and could be preserved during construction to utilize their stormwater control benefits.

Left from Top: Urban Trash in Storm Drain; Stormwater Discharge Pipe.

The environmental impacts of development reach beyond the borders of a subdivision or commercial complex and include increased flooding and water pollution. The large areas of impermeable surface created by new roads, roofs, and parking lots means more stormwater runs off these surfaces instead of soaking into the ground. As stormwater collects fluid leaked from cars, landscaping fertilizers and herbicides, and pet wastes, these pollutants enter nearby streams and rivers via storm drains. Increased flooding and contamination negatively affect property values, fishing and swimming opportunities, wildlife, and drinking water supplies.

Green infrastructure can reduce these environmental impacts of development by keeping more stormwater on site and filtering the pollutants stormwater contains. Some types of green infrastructure not only manage stormwater but also provide wildlife habitat and recreational opportunities. Nature creation and protection increase property values, lower crime, and foster healthier communities.

HOW TO USE **GREEN INFRASTRUCTURE** TO COMPLY WITH PERMITTING REQUIREMENTS

Numerous regulations protect waterways from impacts related to development, and incorporating green infrastructure into site designs is one way to comply with the following regulations:

U.S. Army Corps of Engineers permits

Under the federal Clean Water Act, the U.S. Army Corps of Engineers (Corps) has the responsibility to protect wetlands and other "waters of the U.S." from pollution caused by dredging and filling. Projects that impact rivers, lakes or wetlands under the Corps' jurisdiction must have a Section 404 permit (individual, nationwide, or regional). Corps regulations state that permanent destruction or impacts to waterways on the project site must be avoided or minimized to the extent practicable, and impacts that cannot be avoided or minimized must be mitigated.

Developers can reduce complexity of permit requirements or avoid Corps permits altogether by incorporating existing waterways into the site plan and using green infrastructure to minimize impacts. For example, if developers minimize impacts on aquatic resources, protect water quality, and preserve natural hydrology they may be eligible for regional Section 404 permits rather than individual ones at substantial time and cost savings.

Illinois Environmental Protection Agency permits

According to the stormwater regulations of the federal Clean Water Act, developers of sites one acre or larger must obtain a NPDES permit for stormwater discharges from construction site activities. Developers must minimize stormwater impacts on nearby waterways, and can do so using green infrastructure. The permit, issued by the Illinois Environmental Protection Agency, lists vegetative buffers, tree protection, and the preservation of mature vegetation as examples of site stabilization practices. Implementing green infrastructure may also help developers meet pollution control requirements if the receiving water is listed as impaired or if the project is located within a Total Maximum Daily Load (TMDL) watershed.

Muncipalities can use green infrastructure to meet the post-construction minimum control measure of the NPDES Permit for Discharges from Small Municipal Separate Storm Sewer Systems (MS4s). By encouraging practices that reduce the amount of stormwater reaching streets and waterways, municipalities will safeguard their communities against flooding and property damage.

County stormwater ordinances

Several Illinois counties have or are developing stormwater ordinances that include provisions for wetland and stream preservation. Some ordinances protect waterways such as isolated wetlands that do not fall under the jurisdiction of the Corps. County ordinances cite green infrastructure as a way to meet stormwater requirements and reduce flooding.

Clockwise from Top: Infiltration Island; Bioswale; Bioswale Curb Cut; Redbud Tree; Porous Pavement; Rain Garden.

INFILTRATION PRACTICES | The volume and peak flow rate of stormwater runoff leaving a residential or commercial property can be reduced by making the property more permeable to water infiltration. **HARD, IMPERVIOUS SURFACES SUCH AS ROOFS, DRIVEWAYS, AND PARKING LOTS TYPICALLY ABSORB LESS THAN 10% OF RAINFALL.** Properties can absorb much more water if developers use porous building materials and engineer naturalized stormwater collection areas. **BENEFITS OF INCREASING ON-SITE PERMEABILITY INCLUDE LESS FLOODING, REDUCED NEED FOR TRADITIONAL STORMWATER INFRASTRUCTURE, AND THE CREATION OF ATTRACTIVE LANDSCAPING FEATURES.**

INFILTRATION PRACTICES

BIOSWALES

Description

A vegetated, open channel designed to slow down and infiltrate stormwater. Vegetation can vary from mown turf grass to natural plantings. Bioswales differ from ditches in their tendency to be wider and contain slower, less erosive flows.

Placement

Swales can be used in long corridors along roads, parking lots, and buildings. Swales are good for directing stormwater from impervious surfaces to detention/retention areas.

Maintenance

The vegetation in bioswales must be periodically cut or pruned so that water flow is not impeded. Trash and sediment may collect and need to be removed. The sides and bottom should be inspected annually for erosion.

Installation Cost

Approximately $0.5-$20/sq. ft.

Where to Find this Practice in Illinois

- Chicago Center for Green Technology, *Chicago*
- Mill Creek Subdivision, *Geneva*
- Tellabs, Inc., *Naperville*
- University of Illinois Research Park, Chesterbrook Academy, *Champaign*

More Technical Information

See sources 1-4 on page 20

Tellabs, Inc. Bioswale

INFILTRATION PRACTICES

LEVEL SPREADERS

Description

A device that disperses concentrated stormwater flow from impervious surfaces into surface sheet flow, thereby reducing erosion.

Placement

Level spreaders should intercept stormwater coming off of impervious surfaces and be positioned at the edge of a field or filter strip where the water can spread out and infiltrate. These devices can also be placed at the end of water diversions.

Maintenance

Check for erosion upstream, downstream, and around the level spreader, and clear debris against the level spreader.

Installation Cost

Approximately $3-$10/ft.

Where to Find this Practice in Illinois

- Tellabs, Inc., *Naperville*
- The Morton Arboretum, *Lisle*

Above from Left: **Level Spreader; Level Spreader at Tellabs, Inc.**

More Technical Information

See source 1 on page 20

INFILTRATION PRACTICES

POROUS PAVEMENT

Description

A permeable pavement often overlying a stone subgrade that allows water to drain into the underlying soil. Porous pavement has very little “fine” materials and instead contains voids which cause infiltration to approach as much as 80%. Examples include permeable asphalt, concrete, pavers, and interlocking grids.

Placement

Porous pavement can be used for parking lots, driveways, sidewalks, streets, alleys, and patios.

Maintenance

Porous pavement must be clear of debris so voids do not become clogged. Vacuum sweeping is typically needed up to 4 times annually. Special plowing equipment or settings may be needed during winter.

Installation Cost

Approximately $2-$12/sq. ft.

Where to Find this Practice in Illinois

- Autumn Trails Adult Living Community, *Moline*
- Faith United Methodist Church, *Champaign*
- U.S. Cellular Field, *Chicago*
- Villa Park Police Station, *Villa Park*

More Technical Information

See sources 1, 2, 4 on page 20

From Left: **Autumn Trails Permeable Pavers; U.S. Cellular Field.**

INFILTRATION PRACTICES

RAIN GARDENS (Bioretention)

Description

A shallow, vegetated depression that temporarily stores water as it infiltrates into the ground.

Placement

Rain gardens are typically placed at the end of downspouts or in natural low spots adjacent to impervious surfaces. Rain gardens should not be located in areas of concentrated flow.

Maintenance

Trash and dead vegetation will need to be removed periodically, and mulch replenished annually.

Installation Cost

Approximately $2-$17/sq. ft.

Where to Find this Practice in Illinois

- Land of Lincoln Legal Assistance Foundation, *Champaign*
- Public Works Department Administration Building, *Rock Island*
- St. Margaret Mary Church, *Chicago*
- Touhy Avenue Community Rain Garden, *Niles*

More Technical Information

See sources 2-5 on page 20

Above: **Land of Lincoln Rain Garden.**

NATURE PROTECTION AND CREATION PRACTICES | In many of Illinois' communities, storm sewers discharge polluted, high-velocity water into nearby streams. Consequently, streambanks are subject to greater erosion, downstream properties are more prone to flooding, and fish health is threatened by contamination. **DEVELOPERS CAN REDUCE, SLOW DOWN, AND PURIFY STORMWATER BEFORE IT ENTERS STREAMS BY CREATING OR PROTECTING NATURAL HABITAT.** These practices typically involve diverting stormwater through vegetation or holding areas before it reaches storm sewers or streams.

Above: Fox Development Stream Buffer
Credit: Prairie Rivers Network

FILTER STRIPS/RIPARIAN BUFFERS

Description

An area of natural or planted vegetation consisting of grasses, forbs, shrubs, or trees. Filter strips and riparian buffers slow down and absorb water and sediment, capturing pollutants and reducing the amount and velocity of sheet flow runoff.

Placement

Filter strips should be placed downslope of areas that generate sheet flow, such as roads and parking lots. Filter strips can be in upland areas or abut against riparian buffers along stream banks. Wider buffers are more protective and offer more habitat for wildlife.

Maintenance

Maintenance may include weed and pest control, mowing, pruning, and sediment removal. Filter strips and riparian buffers should be inspected at least annually for plant health and erosion.

Installation Cost

Approximately $200-$15,000/acre

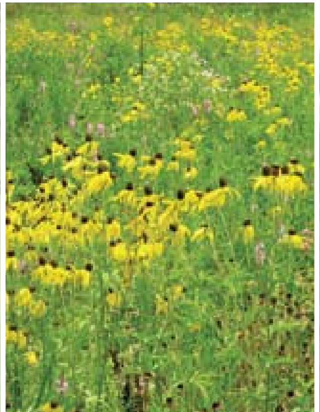
Where to Find this Practice in Illinois

- Chicago Center for Green Technology, *Chicago*
- Mill Creek Subdivision, *Geneva*
- The Grove on Kickapoo Creek Subdivision, *Bloomington*

More Technical Information

See sources 1-4 on page 20

Opposite: **Wetland**
From Left: **Riparian Buffer; Prairie Plants; Riparian Buffer.**



NATURE PROTECTION & CREATION PRACTICES

GREEN ROOFS

Description

A roof with vegetation and growing medium that absorbs rainwater and snowmelt. Green roofs produce far less runoff than conventional roofs, while simultaneously trapping pollutants, keeping buildings cooler in summer and warmer in winter, and providing a unique, park-like setting.

Placement

Green roofs can be placed on new or retrofitted residential, commercial, and industrial buildings with less than 20% slope. The roof must be strong enough to support the growing medium, vegetation, and absorbed water.

Maintenance

Maintenance needs are similar to other landscaped areas, and include watering during dry periods and monitoring plant health. Generally, detecting and fixing leaks is no more difficult than it is for conventional roofs.

Installation Cost

Approximately $5-$30/sq. ft.

Where to Find this Practice in Illinois

- Chicago Center for Green Technology, *Chicago*
- Evelyn Pease Tyner Interpretive Center, *Glenview*
- University of Illinois College of Business Instructional Facility, *Champaign*
- University of Illinois Founders Residence Hall, *Springfield*

More Technical Information

See sources 2, 6 on page 20

Below from Left: **Tyner Interpretive Center Green Roof; Chicago Center for Green Technology Green Roof.**

NATURE PROTECTION & CREATION PRACTICES

STORMWATER WETLANDS

Description

A constructed wetland designed to hold and treat stormwater runoff. Many design options exist, but fundamentally these engineered systems are simpler than natural wetlands and strategically located to capture stormwater with little or no pretreatment.

Placement

Stormwater wetlands can be constructed on shallow slopes of almost all soil types. There should be sufficient drainage into the wetland to ensure the maintenance of hydrology. Avoid areas with shallow water tables if the wetland will receive highly polluted water that could contaminate groundwater.

Maintenance

Periodically inspect inflows and outflows for blockage and erosion. Sediment may need to be removed occasionally from the forebay or main pool.

Installation Cost

Approximately $40,000-$80,000/acre

Where to Find this Practice in Illinois

- Chicago Center for Green Technology, *Chicago*
- Harbor Springs Subdivision, *Aurora*
- Weaver Park, *Urbana*

More Technical Information

See sources 1-4, 7 on page 20

Top from Left: **Weaver Park Stormwater Wetland; Harbor Springs Stormwater Wetland.**

POLLUTANT REMOVAL PRACTICES | Urban and suburban stormwater runoff is often highly contaminated with pollutants. Rain and snow may already be contaminated before hitting the ground due to air pollution. **WHILE TRAVELLING OVERLAND, STORMWATER PICKS UP FERTILIZERS, PESTICIDES, PET WASTE, ROAD SALTS, OIL, SOIL, AND TRASH.** This pollution can harm fish and other life, and make water unsafe for human consumption or recreation. In communities with combined sewer overflows (CSOs), sewage treatment plants bear the burden of removing this pollution, a cost that is then passed on to local residents. **FORTUNATELY, THERE ARE MANY BEST MANAGEMENT PRACTICES THAT EFFECTIVELY REMOVE POLLUTANTS BEFORE STORMWATER LEAVES A DEVELOPMENT.** Like the practices discussed below, the infiltration and nature protection/creation practices also have pollutant removal capabilities.

UNH Stormwater Center Sand Filters

POLLUTANT REMOVAL PRACTICES

SAND FILTERS

Description
Typically a two-chambered practice consisting of an initial settling chamber and a second chamber filled with sand or some other filtering material. Many variations of this basic principle exist.

Placement
Place in a location that intercepts contaminated runoff from a small (≤10 acres) drainage area. The sand filter should be below the frost line and above the water table. Because sand filters take up very little surface space, they are good for highly urbanized areas.

Maintenance
Conduct at least annual inspections to check for structural cracking and erosion, remove material from the settling chamber, and ensure that the filtering surface is not clogged and stormwater flow is reaching the sand filter. Some filters will be ineffective during winter and should be shut down.

Installation Cost
Approximately $2,000-$30,000/impervious acre treated

More Technical Information
See sources 2, 4 on page 20

POLLUTANT REMOVAL PRACTICES

STORM DRAIN INLET PRODUCTS

Description

A product placed in a storm drain to capture pollution. There are many different manufacturers that produce products with various functionalities and designs. Common names for this practice include catch basin inserts and hydrodynamic, swirl, and oil and grit separators.

Placement

Products are placed in storm drain inlets or catch basins according to specific manufacturer instructions.

Maintenance

Products must be checked and cleaned regularly, and the contents properly disposed of. Some products can be cleaned by hand, whereas others require a vacuum truck.

Installation Cost

Approximately $100-$35,000

Where to Find this Practice in Illinois

- Coler Avenue, *Urbana*
- Condell Medical Center, *Libertyville*
- Courthouse Square, *Wheaton*
- International Union of Operating Engineers Local 399 Training Facility, *Chicago*

More Technical Information

See sources 2, 4 on page 20

Coler Avenue Inlet Product

GREEN DEVELOPMENT

IN FOCUS

PRAIRIE CROSSING DEVELOPMENT

The Burnham Building
977 Harris Road, #113
Grayslake, IL 60030
847.548.4062
www.prairiecrossing.com

Green Infrastructure Practices On Site:

- Rain Gardens
- Stormwater Wetlands

Other Conservation Practices:

- Community Gardens and Farm
- Narrowed Streets
- Native Landscaping
- Porous Walkways
- Prescribed Burns

Rain Garden

THE MORTON ARBORETUM

4100 Illinois Route 53
Lisle, IL 60532
630.719.2425
www.mortonarb.org

Green Infrastructure Practices On Site:

- Bioswales
- Level Spreaders
- Porous Pavement
- Stormwater Wetlands

Other Conservation Practices:

- Native Landscaping
- Perforated Storm Sewers with Water Level Control Structure
- Porous Walkways
- Prescribed Burns

Bioswale and Porous Pavement

Green Development

ADDITIONAL RESOURCES

Factors to Consider when Selecting Green Infrastructure Practices:

- Soil type
- Drainage area and slope
- Water table
- Receiving waters
- Neighboring development and open space
- Existing stormwater management structures
- Peak stormwater flow
- Existing natural features
- Available surface area for green infrastructure
- Watershed plans, permits, ordinances

Online Stormwater Planning Tools:

1. Green Values Calculator (greenvalues.cnt.org)
2. Long-Term Hydrologic Impact Assessment: L-THIA (engineering.purdue.edu/~lthia)

Sources of More Technical Information:

1. Illinois Urban Manual
2. U.S. Environmental Protection Agency, Post-Construction Stormwater BMP website
3. U.S. Environmental Protection Agency, "Stormwater Best Management Practice Design Guide" report
4. U.S. Environmental Protection Agency, "The Use of Best Management Practices (BMPs) in Urban Watersheds" report
5. Wisconsin Department of Natural Resources, "Rain Gardens" manual
6. National Roofing Contractors Association, "Green Roof Systems" manual
7. U.S. Environmental Protection Agency, "Stormwater Wet Pond and Wetland Management Guidebook" report

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This brochure is a product of Prairie Rivers Network, Illinois' statewide river conservation organization and the state affiliate of National Wildlife Federation. Prairie Rivers Network works to protect clean water and river habitats, helping to make our communities better places to live.

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