

watershed best management  
practices toolbox

4

## 4 stormwater best management practices toolbox

This section presents a brief illustrated overview of a variety of policy/regulation, site planning, and stormwater/landscaping best management practices (BMPs). Each of the BMPs were integrated into the Dead River Watershed management action items and recommendations presented in Chapter 6. Policies and standards BMPs provide the legal framework for conservation development, while planning process BMPs are on-site strategies that preserve natural features and facilitate conservation stormwater BMPs. Stormwater BMPs are individual practices that achieve on-site stormwater management objectives. Common to many of the techniques is the use of native plants that function not only as a part of an effective stormwater management system but also as native landscapes. Following the brief descriptions, more detailed information is provided including guidance on applicable scale and land use, benefits & effectiveness, and design considerations. A more detailed toolbox is included in Appendix F.

### 4.1 POLICIES AND STANDARDS

Policies and Standards serve as the first step to establish and then enforce minimum standards for natural resource preservation and stormwater management. Policies express goals for natural resource, water quality, habitat, and open space preservation. Standards (along with zoning described below) are the tools used to implement the policies. Policy actions or standards may include acquisition of Conservation Easements, Stream/Wetland Restoration and Management, and adoption of Watershed Development Ordinances.

**Conservation Easement:** Legal mechanism for landowners to place voluntary restrictions on the future use of their land, generally requires landowner to sell, permanently relinquish, or donate the rights of development.

**Conservation and Floodplain Standards:** Standards established to preserve stream corridors and floodplains from urban development and other encroachments.

**Watershed Development Ordinance:** Ordinance to regulate development for the purpose of minimizing on-site and off-site impacts to flooding and water quality.

**Wetland/Stream Management and Restoration:** Practices that restore and/or create healthy aquatic ecosystems. Activities include stream corridor restoration, hydrologic restoration, and vegetative management. In some cases, creation of wetland banks and fee-in-lieu of wetland mitigation can be used as funding mechanisms for wetland creation and enhancement.



Bioswales along streets (Portland, OR)

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## 4.2 PLANNING PROCESS BMPS

Planning practices are also used to implement policy goals of maintaining high environmental quality as a watershed develops. Significant natural features and other areas to be preserved are identified using environmental planning processes. Many of these areas can then be preserved by open space requirements and other standards. Open Space/Natural Greenway delineation, Riparian Buffers, and Floodplain Standards are tools used to preserve natural resource areas from development. Conservation Development and Impervious Area Reduction are critical site-level planning and design strategies to create environmentally sensitive developments to achieve stormwater management and watershed goals.



Filter Strips/ Level Spreaders (Chesterton, IN)

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**Conservation Development:** Site planning and design approaches that preserve existing natural areas and utilize naturalized drainage and detention measures for stormwater management, energy consumption, transportation efficiency, and habitat enhancement.

**Impervious Area Reduction:** Impervious area reduction can be achieved in a number of ways, such as: narrower streets; shorter streets in lower density residential neighborhoods; creative driveway design; shared parking facilities; and designing roads, walkways, and trails for multiple uses as an integrated system.



Green Roof (Portland, OR)

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**Open Space/Natural Greenway:** Designation of open spaces and/or natural areas as greenways, in order to preserve and connect significant natural features and accommodate aesthetic, recreational and/or alternative transportation uses.

**Riparian Buffer:** A buffer of native vegetation along lakes, streams, and wetlands that provides water quality and habitat benefits.

## 4.3 ON-SITE STORMWATER BMPS

On-site stormwater BMPs are site-specific practices that can minimize onsite and off-site hydrologic and water quality impacts derived from stormwater runoff via methods of incorporating and re-establishing natural hydrologic process into an urbanized environment. These measures can be designed and implemented into new development as well as retrofitted into existing development in cost effective ways.



Naturalized Detention (Bolingbrook, IL)

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**Bioswales:** Filtration and infiltration systems planted with grasses and forbs, and designed to filter, retain and evapotranspire stormwater. Vegetation enhances filtration, cooling, and cleansing of water to improve water quality and prevent sealing of subsoils. The bioswales typically include an infiltration trench below the vegetated swale to provide temporary storage to increase the volume of runoff water infiltrated.

**Filter Strips/Level Spreaders:** Filter strips are an area of dense, preferably native, vegetative cover used to filter and absorb runoff. Level spreaders are often used in conjunction with filter strips and are laid on the contour to distribute runoff over filter strip areas. Filter strips/level spreaders can be used within stream and wetland buffers to diffuse stormwater prior to discharge to streams and wetlands.

**Green Roofs:** Vegetated roof system designed to capture, temporarily store, and evapotranspire rainwater on the top of roofs. Typically, green roofs are planted with drought and wind tolerant vegetation. Green roofs can be designed as simple, lightweight systems that provide stormwater benefits, or as more elaborate rooftop gardens that also provide outdoor space.

**Naturalized Detention:** Naturalized detention basins are used to temporarily store runoff and release it at a rate allowed by ordinances. Native wetland and prairie vegetation improves water quality and habitat benefits. Naturalized detention basins can be designed as either shallow marsh systems with little or no open water or as open water ponds with a wetland fringe and prairie side slopes.

**Porous Pavement:** Permeable or perforated paving materials with spaces that allow for the infiltration of rainwater and the transmission of water to aggregate base and subsoils. Runoff is temporarily stored in the base for infiltration into the subsoils and/or slow release to a bioswale or stormwater system.

**Rain Barrels/Cisterns:** A vessel used to capture and temporarily store rainwater for various uses, including landscape irrigation, reuse for graywater purposes, etc.

**Rain gardens:** A landscaped garden designed to retain, detain, infiltrate and evapotranspire stormwater runoff from individual lots and roofs.

**Vegetated Swales:** Vegetated stormwater features that convey, retain, infiltrate and cleanse stormwater. Native vegetation enhances infiltration and retention of stormwater.



Porous Pavement (Elmhurst, IL)

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Rain Barrel (Chicago, IL)

© Conservation Design Forum



Rain garden (Maplewood, MN)

© Conservation Design Forum



Vegetated Swales (Madison, WI)

© Conservation Design Forum





Native Landscaping (Geneva, IL)

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## 4.4 LANDSCAPING BMPS

Landscaping, as a BMP, stands alone in its own category due to the importance of vegetation in biodiversity, aesthetics, habitat, cooling of ambient air, and stormwater management. Native landscapes, including native prairies and wetlands, can improve water quality through infiltration and cleansing of stormwater runoff. Properly designed landscapes that incorporate native plants and hydrologically and ecologically appropriate vegetation can not only facilitate effectiveness of stormwater management but also provide wildlife habitat and quality open space.

**Native Landscaping:** Native vegetation in either large restoration or smaller garden projects. Native vegetation uses plants that are endemic to a specific geographic region prior to European settlement. Native landscapes can serve a variety of purposes, including habitat, infiltration, filtering, and evapotranspiration of stormwater, and wildlife habitat.

**Stream/Wetlands Management and Restoration:** Landscape restoration practices that maintain existing remnant landscapes and/or restore them to their natural state.

## 4.5 FLOOD REDUCTION BMPS

**Structural Flood Control:** Structural measures control or contain water and are generally designed to prevent floodwaters from reaching buildings. Structural alternatives generally include reservoirs, levees and floodwalls, diversions, stream channel conveyance improvements and drainage and storm sewer improvements. Because of their size and cost, structural projects are often implemented with help from state or federal flood control agencies such as the Illinois Department of Natural Resources - Office of Water Resources, or the U.S. Army Corps of Engineers.

**Non-Structural Flood Control:** In addition to structural controls for flood remediation, flooding problems can also be addressed using non-structural means. Some of the non-structural flood control techniques include floodproofing, acquisition of floodplain buildings, building elevation and building relocation. More communities and county-wide agencies could get involved in non-structural programs such as acquisition by helping to identify repetitively flooded properties.

Tables 4.1 and 4.2 summarize the stormwater management tool applicability and effectiveness for each of the best management practices described in this toolbox. Following these tables is a vignette for each of the BMPs that begins with its definition and continues with its range of applicability, associated benefits, and finally some potential design considerations, as described below.

**Definition** - A brief description of the BMP relative to stormwater management.

**Applicability** - Where and how each BMP is the most applicable is addressed in three aspects: scale, applicable applications, and effectiveness:

#### Scale

- **Watershed/County:** Applied at a regional scale in watershed or county-wide.
- **Town/Village:** Applied at municipal or other scale with common zoning authority.
- **Neighborhood:** Applied at development or other sub-municipal scale.
- **Lot:** Applied within individual residential lot or commercial parcel.

#### Applications

- **Retrofit:** Applied to existing developed areas, infill, and redevelopment.
- **New:** Applied to new development.
- **Roofs:** Applied on roofs or used to treat roof runoff.
- **Streets:** Applied on or used to treat runoff from public/private streets and roads.
- **Driveways:** Applied on or used to treat runoff from driveways.
- **Parking Lots:** Applied on or used to treat runoff from parking lots.
- **Lawns:** Applied on or used to treat runoff from existing open lawns that are generally planted with turfs, such as parks, campuses, individual yards, etc.
- **Sensitive Areas:** Applied on ecologically sensitive areas such as remnant habitats, floodplains, wetlands, steep slopes, and highly erodible soils.

#### Effectiveness

- **Runoff Rate Control:** Practices that can control or reduce runoff rates.
- **Runoff Volume Control:** Practices that can control or reduce runoff volumes.
- **Physical Habitat Preservation/Creation:** Practices that can preserve, introduce, or provide wildlife habitats.
- **Sediment Pollution Control:** Practices that can remove suspended solids from runoff.
- **Nutrient Control:** Practices that have the ability to reduce or remove nutrients such as nitrogen and phosphorus from runoff.
- **BOD Control:** Practices that can remove constituents that exert a Biological Oxygen Demand (BOD) in runoff.
- **Other Pollutant Control:** Practices that can reduce and remove other pollutants such as heavy metals and petroleum-based hydrocarbons.

**Benefits** - Other positive effects that the individual or system of practices performs. Benefits can be specific to stormwater management or be more general to various functions and values for the quality of life.

**Design Considerations** - Design recommendations and suggestions that should be considered when implementing the specific BMP. Drawings are not illustrated for construction, but rather as a general guidance on the components of the practice.

**Table 4.1 Stormwater Management Tool Applicability**

Tools	Scale					Applications							
	Watershed/ County	Town/ Village	Neighborhood	Lot		Retrofit	New	Roofs	Streets	Drive- ways	Parking Lots	Lawns	Sensitive Areas
<b>Policies / Standards</b>													
Conservation Easement	X	X	X	X		X	X						X
Wetland / Stream Management and Restoration	X	X	X	X		X	X						X
Watershed Development Ordinance	X	X				X	X	X	X	X	X	X	X
<b>Planning</b>													
Conservation Development	X	X	X				X		X	X	X	X	X
Conservation and Floodplain Standards	X		X			X	X						X
Impervious Area Reduction		X	X	X			X	X	X	X	X		
Open Space/Natural Greenway	X	X	X			X	X						X
Riparian Buffer	X	X	X			X	X					X	X
<b>Site Stormwater BMPs</b>													
Bioswale			X	X		X	X		X		X		
Filter Strips/Level Spreader			X	X		X	X			X	X	X	X
Green Roof				X		X	X	X					
Naturalized Detention	X	X	X			X	X	X	X	X	X	X	X
Porous Pavement			X	X		X	X		X	X	X		
Rain Barrels/Cistern				X		X	X	X					
Rainwater Garden				X		X	X	X		X		X	
Vegetated Swale			X	X		X	X	X	X	X	X	X	X
<b>Landscaping</b>													
Native Landscaping			X	X		X	X	X	X	X	X	X	X

\*X = practices that are applicable to corresponding scale and applications

Table 4.2 Stormwater Management Tool Effectiveness

Tools	Effectiveness						
	Runoff Rate Control	Runoff Volume Control	Physical Habitat Preservation/Creation	Sediment Pollution Control	Nutrient Control	BOD Control	Other Pollutant Control
<b>Policies / Standards</b>							
Conservation Easement	--		H	--		-	-
Wetlands / Stream Management and Restoration	-	-	H	H	M	-	-
Watershed Development Ordinance		H	H	H	H		H H
<b>Planning Process</b>							
Conservation Development	H	H	H	H	H	H	H
Conservation and Floodplain Standards	H <sup>1</sup>	-	H	-	-	-	-
Impervious Area Reduction	H	H		-H	H	H	H
Open Space/Natural Greenway	-	-	H	-	-	-	-
Riparian Buffer	M	-	H	M M M			M
<b>Site Stormwater BMPs</b>							
Bioswale	H	H	-	H	H	H	H
Filter Strip/Level Spreader	M	M	-	H	H	H	H
Green Roof	H	H	-----				-
Naturalized Detention	H	H	-	MH	H	H	H
Porous Pavement	H	H	-	H	M	M	H
Rain Barrel/Cistern	-	M	-----				-
Rainwater Garden	M	M	----			-	-
Vegetated Swale	M	M	-	M	M	M	M
<b>Landscaping</b>							
Native Landscaping	-		MM	M	M	M	M

<sup>1</sup> Prevents food damage as a result of high flow rates

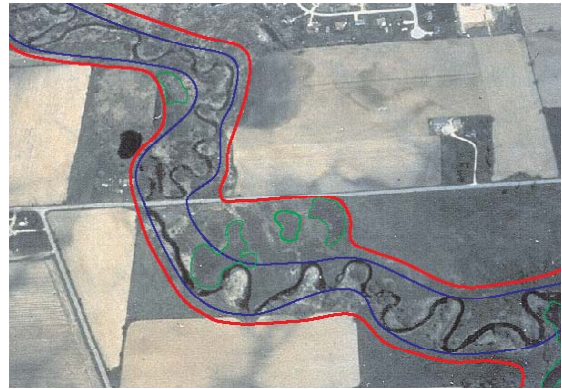
"H" = High effectiveness; "M" = Moderate effectiveness; "-" = Not Applicable



# Conservation Easement

## Definition

- Legal mechanism for landowner to place voluntary restrictions on the future use of their land. Generally requires landowner to sell, permanently relinquish, or donate the rights of development.



conservation easements provide mechanism for long term preservation of morphologically-based corridors

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications Retro
  - ft
  - Preventive
  - Roofs
  - Parking Lots
  - New
  - Remedial
  - Streets
  - Lawn
  - Ongoing/ Maintenance
  - Driveways
  - Sensitive Areas
- Effectiveness
  - Runoff Rate Control
  - Runoff Volume Control
  - Nutrient Control
  - BOD Control
  - Physical Habitat Preservation/ Creation
  - Sediment Pollution Control
  - Other Pollutant Control

## Benefits

- Preserves significant natural features and open space.
- Preserves created/restored natural areas from development and other disturbances.
- Provides opportunity to preserve morphologically and ecologically-based corridors that may be more difficult to preserve with fixed width buffers in many stormwater ordinances.
- Can be used as a tool to create interconnected network of open space to improve ecological functioning of overall system.

## Design Considerations

- Conservation easements, along with floodplain/open space zoning, ordinance buffer requirements, and conservation design should be used to preserve and create natural resource networks.
- Conservation easements are best suited to areas not subject to land use change and therefore cannot readily be preserved through the development process.
- Conservation easements may also be used to preserve high quality uplands and other areas not readily preserved through zoning and/or stormwater ordinances.



one's backyard may be wildlife's treasure habitat

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# Wetland / Stream Management & Restoration Management

## Definition

- Practices that maintain a healthy ecosystem and/or restore a deteriorated ecosystem to its natural state.



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Coffee Creek streambank restoration (Chesterton, IN)  
(Conservation Design Forum)

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retro
  - New
  - Preventive
  - Remedial
  - Ongoing/ Maintenance
  - Roofs
  - Streets
  - Driveways
  - Parking Lots
  - Lawn
  - Sensitive Areas
- Effectiveness
  - Runoff Rate Control
  - Runoff Volume Control
  - Physical Habitat Preservation/Creation
  - Sediment Pollution Control
  - Nutrient Control
  - BOD Control
  - Other Pollutant Control

## Benefits

- Preserves significant natural features and their habitat, runoff moderation, and water quality benefits.
- Reduces the impact to natural systems by floods and other natural perturbations and improves recovery from these disturbances by preserving natural processes and functions.

## Design Considerations

- Conduct a thorough analysis of existing and historic conditions of the restoration site, surrounding area, and watershed to understand system processes and functions.
- Establish stewardship program with local governments, stakeholders, interest groups, and communities to ensure sustained management and monitoring efforts on managed/restored ecosystems.
- Management and stewardship activities should be recognized as ongoing activities. Intensity of stewardship activities will decrease as system health and processes are restored.



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a successful wetland restoration ensures the healthiness of ecosystems and improves quality of life for both human and wildlife

# Watershed Development Ordinance

## Definition

- Ordinance to regulate development for the purpose of minimizing on-site and off-site impacts to flooding and water quality.



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watershed development ordinances are designed to preserve and enhance natural site features and protect downstream areas from stormwater impacts

## Applicability

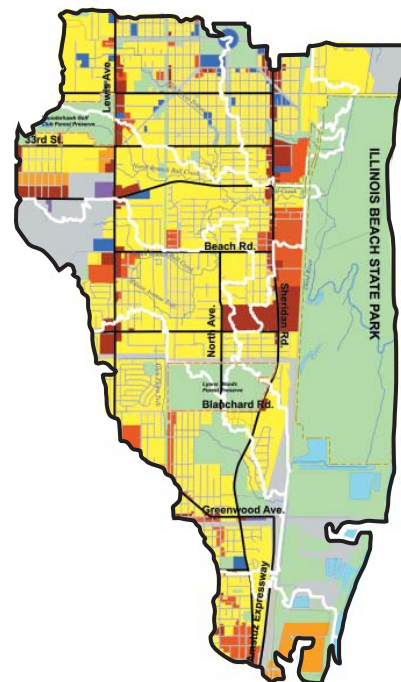
- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications Retro
  - ft
  - Preventive
  - Roofs
  - Parking Lots
  - New
  - Remedial
  - Streets
  - Lawn
  - Ongoing/ Maintenance
  - Driveways
  - Sensitive Areas
- Effectiveness
  - Runoff Rate Control
  - Nutrient Control
  - Runoff Volume Control
  - BOD Control
  - Physical Habitat Preservation/Creation
  - Other Pollutant Control
  - Sediment Pollution Control

## Benefits

- Provides consistent standard throughout watershed.
- Prevents/minimizes degradation of watershed resources.
- Establishes orderly rules and procedures for development activities.

## Design Considerations

- Ordinances should comprehensively address stormwater management, floodplain management, stream and wetland preservation, and soil erosion and sediment control.
- Ordinances should include standards to address runoff volumes, runoff rates, and water quality.
- Ordinances should provide flexibility in methods of meeting standards.
- Ordinances should facilitate watershed resources restoration activities.



comprehensive land use plan

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the watershed development ordinance is a critical element of the Dead River Watershed Management Plan (Conservation Design Forum)



# Conservation Development

## Definition

- Site planning and design approach that preserves existing natural areas and utilizes naturalized drainage and detention measures for stormwater management, energy consumption, transportation efficiency, and habitat enhancement.



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residential conservation development  
(Grayslake, IL)

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retrofit
    - ft
    - Preventive
    - Roofs
    - Parking Lots
  - New
    - Remedial
    - Streets
    - Lawn
    - Runoff Volume Control
    - BOD Control
  - Ongoing/ Maintenance
    - Ongoing/ Maintenance
    - Driveways
    - Sensitive Areas
    - Physical Habitat Preservation/Creation
    - Other Pollutant Control
- Effectiveness
  - Runoff Rate Control
  - Runoff Volume Control
  - Nutrient Control
  - BOD Control
  - Sediment Pollution Control

## Benefits

- Preserves significant natural features and open space.
- Minimizes changes in runoff volumes, rates, and water quality typically associated with urban development.
- Improves views and site aesthetics, while at the same time providing site drainage and water quality functions.

## Design Considerations

- On-site natural areas should be identified and preserved.
- Existing natural drainageways should be incorporated into site plan.
- Roadway should generally follow ridge lines. Impervious runoff should be routed through naturalized drainage systems integrated into the site plan.
- Use of native vegetation adapted to expected hydrologic conditions will improve runoff reduction and water quality benefits.
- Naturalized drainage systems should be preserved from construction site runoff during establishment.



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conservation moderate density residential site plan  
(Conservation Design Forum)

# Floodplain Zoning

## Definition

- Zoning regulations established to preserve stream corridors and floodplains from urban development and other encroachments.



floodplain zoning prevents development from occurring in floodprone areas

## Applicability

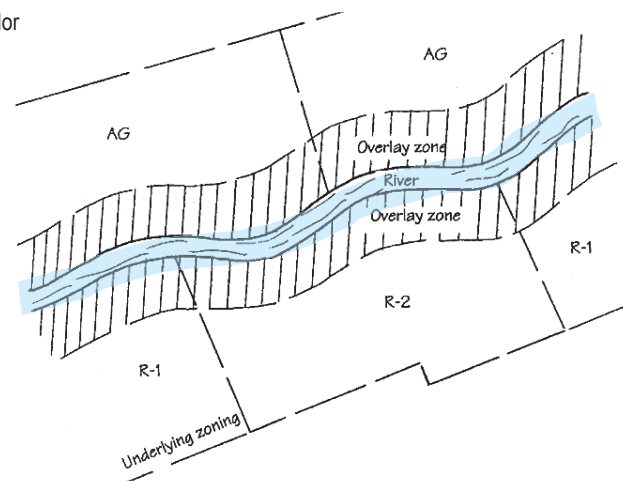
- Scale
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  - Town/Village
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  - Lot
- Applications Retro
  - ft
  - Preventive
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  - Parking Lots
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  - Driveways
  - Sensitive Areas
  - Physical Habitat Preservation/Creation
  - Sediment Pollution Control
  - Other Pollutant Control
- Effectiveness
  - Runoff Rate Control
  - Nutrient Control

## Benefits

- Preserves stream corridors and riparian wetlands and provides natural buffer.
- Enhances safety and quality of life.
- Protects properties from flood damages.
- Preserves natural floodplain functions.

## Design Considerations

- Zoning regulations should allow for and encourage riparian corridor restoration.



floodplain zoning overlays underlying zoning (source: SEMCOG)

# Impervious Area Reduction

## Definition

- Impervious area reduction can be achieved by reducing street widths and building setbacks, examining parking lot requirements, and through building design alternatives.



reduce impervious areas by reducing street width (Seattle, WA)

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retro
  - New
  - Preventive
  - Remedial
  - Ongoing/ Maintenance
  - Roofs
  - Streets
  - Driveways
  - Parking Lots
  - Lawn
  - Sensitive Areas
- Effectiveness
  - Runoff Rate Control
  - Runoff Volume Control
  - Physical Habitat Preservation/Creation
  - Sediment Pollution Control
  - Nutrient Control
  - BOD Control
  - Other Pollutant Control

## Benefits

- Reduces runoff volumes and rates and associated pollutants.
- Reduces urban heat island effect and thermal impacts to waterbodies.
- Reduces development and maintenance costs.

## Design Considerations

- Impervious area reductions can be achieved through reduced road widths, shared parking, reduced setbacks, and other measures. These reductions will often require changes in subdivision code. Street length can often be reduced by clustering development onto portions of the site.
- Benefits of impervious area reduction are enhanced when combined with methods to “disconnect” impervious surfaces, e.g. vegetated swales, bioswales, filter strips/level spreaders, etc.



impervious areas reduced by lessening road length through clustering of development (Plano, IL) (Conservation Design Forum)

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# Open Space / Natural Greenway

## Definition

- Designation of linear open space and/or natural areas as greenways to preserve and connect significant natural features and to accommodate aesthetic, recreational, and/or transportation uses.



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open space greenways can provide recreational as well as habitat and water quality benefits

## Applicability

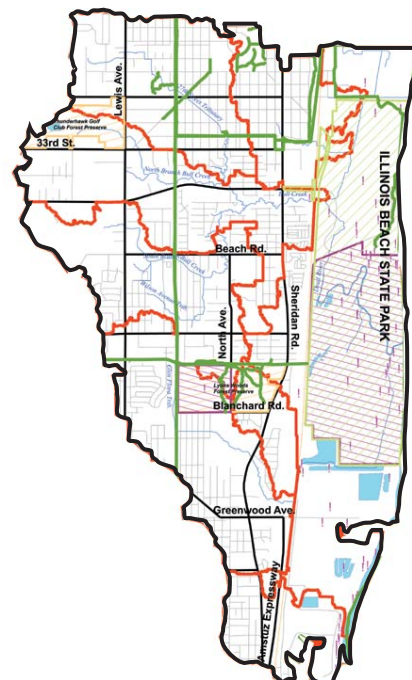
- Scale
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  - Runoff Rate Control
  - Runoff Volume Control
  - Physical Habitat Preservation/Creation
  - Sediment Pollution Control
  - Nutrient Control
  - BOD Control
  - Other Pollutant Control

## Benefits

- Preserves large contiguous natural areas and resources.
- Provides opportunity for wildlife movement and habitat within an ecological network.
- Provides alternative and connected passive recreation and transportation opportunities.

## Design Considerations

- A natural resources inventory should be completed to identify significant natural features and functioning ecological networks.
- Significant cultural features should also be integrated into the network.
- Buffer requirements, open space/ floodplain zoning, conservation easements, and conservation design should be used together to implement greenway networks.



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an open space/natural greenway system is designated to preserve key natural resources in the Dead River Watershed Area (Conservation Design Forum)

# Riparian Buffer

## Definition

- A buffer of native vegetation along lakes, streams, and wetlands that provides water quality and habitat benefits.



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buffers of native vegetation along streams and wetlands provide natural stabilization and pollutant filtering

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Preventive
  - Remedial
  - Ongoing/ Maintenance
  - Roofs
  - Streets
  - Driveways
  - Parking Lots
  - Lawn
  - Sensitive Areas
- Effectiveness
  - Runoff Rate Control
  - Runoff Volume Control
  - Physical Habitat Preservation/Creation
  - Sediment Pollution Control
  - Nutrient Control
  - BOD Control
  - Other Pollutant Control

## Benefits

- Preserves natural functions of lakes, streams, and wetlands. Naturally attenuates flow rates.
- Provides filtering of lateral surface and groundwater inflows.
- Helps stabilize streambanks and shorelines against erosion.

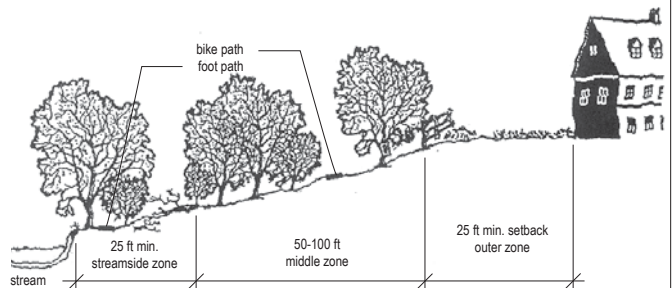


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riparian buffers preserve riparian habitat

## Design Considerations

- Riparian buffer width should be dependent on lake, stream, or wetland quality, ground slope, and size of feature.
- Buffer should be planted with native riparian vegetation.
- Buffers are often established/ preserved through a watershed development ordinance.



the three-zone urban stream buffer system (source: Center for Watershed Protection)

# Bioswale

## Definition

- Vegetated swale system with an infiltration trench designed to retain and temporarily store stormwater. Bioswales are planted with native grasses and forbs that enhance filtration, cooling, and cleansing of water in order to improve water quality and prevent sealing of subsoils.



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bioswale in a parking lot (Tellabs, Naperville, IL)  
(Conservation Design Forum)

## Applicability

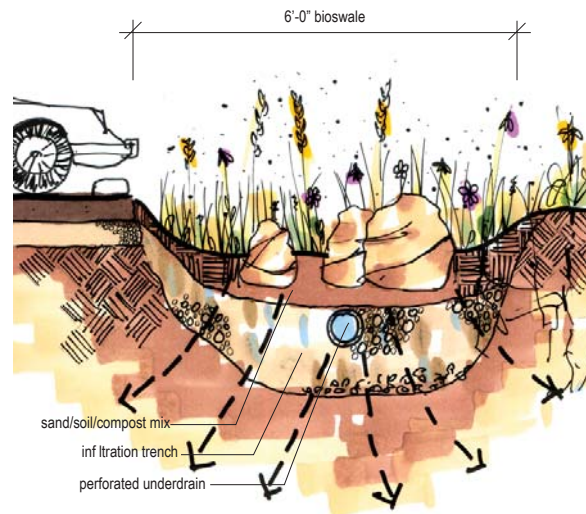
- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retrofit  New
  - Preventive  Remedial
  - Roofs  Streets
  - Parking Lots  Lawn
  - Ongoing/ Maintenance
  - Driveways
  - Sensitive Areas
  - Physical Habitat Preservation/Creation
  - Sediment Pollution Control
  - Other Pollutant Control
- Effectiveness
  - Runoff Rate Control  Runoff Volume Control
  - Nutrient Control  BOD Control

## Benefits

- Reduces impervious runoff volumes and rates.
- Recharges groundwater and sustains base flows.
- Reduces sediment and nutrient runoff.
- Can reduce detention needs.

## Design Considerations

- Bioswales must be sized and designed to account for drainage area and soils.
- Filtration benefits can be improved by planting native deep-rooted vegetation.
- Infiltration storage should be designed to drain in 24 hours to prevent sealing of subsoils.
- Topsoil should be amended with compost and/or sand to improve organic content for filtering and to achieve adequate infiltration rates.
- Bioswales should be protected from construction site runoff to prevent sealing of topsoil and/or subsoils.
- Direct entry of stormwater runoff into infiltration trench should be prevented to preserve groundwater quality and to prevent sealing of subsoils.
- Underdrain should be sufficiently low in the trench to provide adequate drainage of aggregate base of adjacent paved areas but sufficiently high to provide infiltration storage.



© Conservation Design Forum

cross section of bioswale (Conservation Design Forum)



# Filter Strip/ Level Spreader

## Definition

- A **filter strip** is an area with dense, preferably native, vegetative cover used to filter and absorb runoff from impervious areas. A **level spreader** is a trench laid on the contour to distribute runoff over filter strip areas.



© Conservation Design Forum

Coffee Creek Center level spreader installation (Chesterton, IN)  
(Conservation Design Forum)

## Applicability

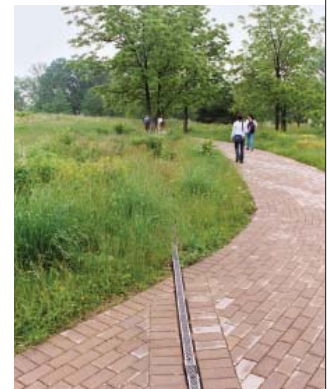
- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  -
- Applications
  - Retrofit  New
  - Preventive  Remedial
  - Roofs  Streets
  - Parking Lots  Lawn
  - Ongoing/ Maintenance
  - Driveways
  - Sensitive Areas
- Effectiveness
  - Runoff Rate Control  Runoff Volume Control
  - Nutrient Control  BOD Control
  - Physical Habitat Preservation/Creation
  - Other Pollutant Control

## Benefits

- Reduces runoff volumes and rates by allowing runoff to infiltrate over a large area.
- Recharges groundwater and sustains base flows.
- Reduces sediment and nutrient runoff.
- Deconcentrates storm sewer and detention basin discharges to dissipate energy, reduce scour, and better mimic historic runoff patterns to receiving waterbody.
- Can reduce detention needs.

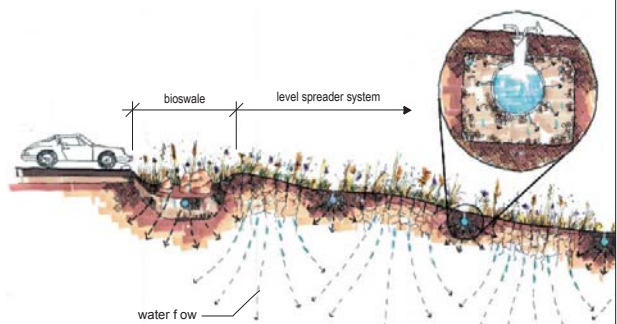
## Design Considerations

- Filter strips/level spreaders must be sized and designed to account for drainage area, slope, and soils. Chronic hydraulic overloading of filter strips may cause erosion.
- Filtration benefits can be improved by planting native deep-rooted vegetation and by minimizing the slope.
- Infiltration storage within the level spreader trench should be designed to drain in 24 hours to prevent sealing of subsoils.
- Compaction of filter strips should be avoided and/or topsoil should be amended with leaf compost and coarse sand to improve filtration, infiltration, and plant establishment.
- Runoff should be diverted away from filter strips during construction until vegetation is established.



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filter strip/level spreader



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cross section of level spreader (Conservation Design Forum)

# Green Roof

## Definition

- Vegetated roof system designed to retain and slow rainwater runoff on the top of roofs. Green roofs are generally planted with drought and wind tolerant vegetation.



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green roof on City Hall (Chicago, IL) (Conservation Design Forum)

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retrofit  New
  - Preventive  Remedial
  - Roofs  Streets
  - Parking Lots  Lawn
  - Ongoing/ Maintenance
  - Driveways
  - Non-Buildable
- Effectiveness
  - Runoff Rate Control  Runoff Volume Control  Sediment Pollution Control
  - Nutrient Control  BOD Control  Other Pollutant Control  Physical Habitat Preservation/Creation

## Benefits

- Significantly reduces runoff volumes and rates as well as thermal impacts (50 - 90% reduction in annual runoff).
- Can reduce detention needs.
- Contributes to reduction in urban heat island effect.
- Can reduce energy requirements associated with heating and cooling.
- Creates opportunities for outdoor space as roof top gardens.

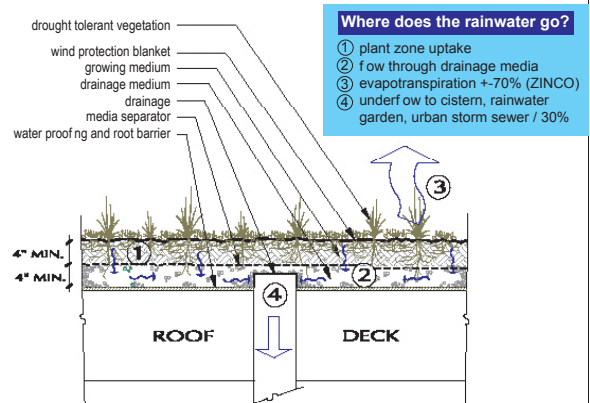
## Design Considerations

- Structural load capacity of existing roof system must be evaluated.
- Plant material, such as succulents, that are drought tolerant, should be used on lightweight "extensive" green roof systems.
- A wider range of vegetation may be used on heavier, "intensive" green roof systems with deeper growing medium.
- Use of a granule drainage layer will improve retention and detention benefits relative to drain boards.



© Conservation Design Forum

green roof can be applied on various roofs and scales



cross section of an extensive green roof systems (Conservation Design Forum)

# Naturalized Detention

## Definition

- Naturalized detention basins are used to temporarily store runoff and release it at a rate allowed by ordinances. Native wetland and prairie vegetation improves water quality and habitat benefits. Naturalized detention may also be used as a retrofit to achieve water quality benefits.



© Conservation Design Forum

Site Stormwater BMPs

naturalized wetland detention on Tellabs industrial campus (Bolingbrook, IL)  
(Conservation Design Forum)

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retrofit
    - Preventive
    - Roofs
    - Parking Lots
  - New
    - Remedial
    - Streets
    - Lawn
  - Ongoing/ Maintenance
    - Driveways
    - Sensitive Areas
- Effectiveness
  - Runoff Rate Control
  - Runoff Volume Control
  - Nutrient Control
  - BOD Control
  - Physical Habitat Preservation/Creation
  - Sediment Pollution Control
  - Other Pollutant Control

## Benefits

- Reduces runoff rates.
- Recognized by virtually all stormwater agencies as approved method of controlling stormwater runoff.
- Very effective at removing sediment and associated pollutants.
- Provides attractive site amenity when properly designed and not used as sole BMP on sites with high pollutant/nutrient runoff.

## Design Considerations

- Should be sized to control release to allowable rate.
- Size should reflect use of upstream BMPs.
- Water level fluctuations should be limited to 3-4 feet (during 100-year storm) to maximize plant diversity.
- Shallow water entry angles will minimize shoreline erosion, improve water quality benefits, increase aquatic habitat and plant diversity and provide safety ledge.
- May be used as retrofit along stream corridors to prevent direct discharge of stormwater runoff.



© Conservation Design Forum

a well designed naturalized wet detention pond provides open space and passive recreation opportunities



# Porous Pavement

## Definition

- Permeable or perforated paving materials or pavers with spaces that allow transmission of water to aggregate base and subsoils. Runoff is temporarily stored in the base for infiltration into the subsoils and/or slow release to storm drain system.



© Conservation Design Forum

porous pavement driveway

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retrofit  New
  - Preventive  Remedial  Ongoing/ Maintenance
  - Roofs  Streets  Driveways
  - Parking Lots  Lawn  Sensitive Areas
- Effectiveness
  - Runoff Rate Control  Runoff Volume Control  Physical Habitat Preservation/Creation  Sediment Pollution Control
  - Nutrient Control  BOD Control  Other Pollutant Control

## Benefits

- Reduces runoff volumes and rates.
- Recharges groundwater and sustains base flow.
- Filters sediments and associated pollutants from runoff.
- Can reduce detention needs.

## Design Considerations

- Base and subbase materials should be coarse aggregate with no fines to allow adequate drainage and to prevent frost heave.
- Subgrade should be graded at minimum 1% slope to allow drainage when water entry rate exceeds infiltration capacity of subsoils.
- Subsoils should be compacted to the minimum level necessary to achieve structural stability.
- Geotextiles should be used between base and subgrade to improve structural stability and separate base from subgrade.
- Underdrains should be placed at edge of pavement to provide drainage as necessary to prevent ponding in the base for periods greater than 24 hours.



porous pavement allows infiltration through the paving material

© Conservation Design Forum



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porous pavement in parking lot

# Rain Barrel/ Cistern

## Definition

- A vessel used to capture and temporarily store rainwater for various uses, including graywater reuse and irrigation.



rain barrels in back yard (Conservation Design Forum)

© Conservation Design Forum

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retro  ft
  - Preventive
  - Roofs
  - Parking Lots
  - Effectiveness
    - Runoff Rate Control
    - Nutrient Control
- New
  - New
  - Remedial
  - Streets
  - Lawn
  - BOD Control
- Ongoing/ Maintenance
  - Ongoing/ Maintenance
  - Driveways
  - Sensitive Areas
  - Physical Habitat Preservation/Creation
  - Other Pollutant Control
- Sediment Pollution Control
  - Sediment Pollution Control

## Benefits

- Reduces runoff volumes.
- Conserves water for reuse.
- Provides irrigation water during watering restrictions.

## Design Considerations

- At the residential scales, rain barrels located at downspouts will typically be used.
- One inch of rainfall over 1,000 square feet of roof area is equivalent to 625 gallons of rainwater.
- Rain barrels can be used in combination with rainwater gardens, green roofs, and other stormwater BMPs to increase stormwater benefits.
- Larger cisterns in some settings may be used to provide graywater for use in toilet flushing and other non-potable uses.



a cistern system collects rainwater from Kresge Foundation Headquarters (Toy, MI)  
(Photo: Conservation Design Forum)

© Conservation Design Forum

# Rainwater Garden

## Definition

- A landscaped garden designed to retain and detain stormwater runoff from individual lots and roofs.



© Conservation Design Forum

rainwater garden planted with vegetation that attracts butterflies

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retro  ft
  - Preventive
  - New
  - Remedial
  - Ongoing/ Maintenance
  - Roofs
  - Streets
  - Driveways
  - Parking Lots
  - Lawn
  - Sensitive Areas
- Effectiveness
  - Runoff Rate Control
  - Runoff Volume Control
  - Physical Habitat Preservation/Creation
  - Sediment Pollution Control
  - Nutrient Control
  - BOD Control
  - Other Pollutant Control

## Benefits

- Reduces runoff volumes and rates from lawns, roofs, and driveways.
- Recharges groundwater and sustains base flows.
- Reduces sediment and nutrient runoff.
- Can reduce detention needs.
- Can increase aesthetic value for the properties.
- Can provide wildlife habitat.

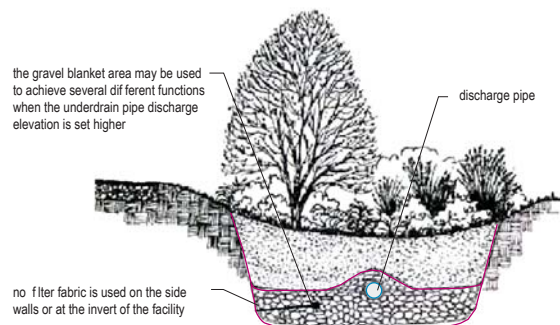


© Conservation Design Forum

roof downspout connects to rainwater garden (Glen Ellyn, IL)

## Design Considerations

- Rainwater gardens must be sized and designed based on drainage area, soils, and desired runoff volume reduction.
- Filtration and nutrient control benefits can be improved by planting native vegetation.
- The soils in the top 18" to 24" should be amended with leaf compost and coarse sand to enhance organic content and improve permeability.
- Where subsoil infiltration rates are low (less than 0.5 to 1.0 in/hr), a gravel trench with underdrains should be used to encourage drainage between events.
- Maximum ponding depths should generally be limited to 6" to 12" unless underdrains are used.



rainwater garden cross section (Low Impact Development Center)



# Vegetated Swales

## Definition

- Vegetated swales are planted stormwater features that convey, retain, infiltrate, and cleanse stormwater.



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vegetated swales planted with native grasses and forbs along the street

## Applicability

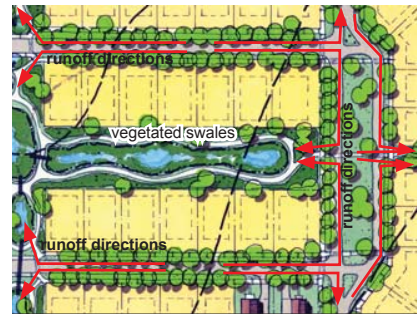
- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retrofit  New
  - Preventive  Remedial
  - Roofs  Streets
  - Parking Lots  Lawn
  - Runoff Rate Control  Runoff Volume Control
  - Nutrient Control  BOD Control
  - Ongoing/ Maintenance
  - Driveways
  - Sensitive Areas
  - Physical Habitat Preservation/Creation
  - Sediment Pollution Control
  - Other Pollutant Control

## Benefits

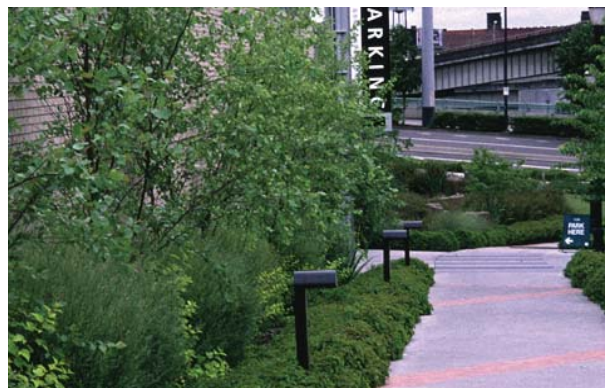
- Reduces runoff volumes and rates.
- Provides conveyance and water quality benefits in one stormwater feature.
- Reduces sediment and nutrient runoff.
- With proper design, can reduce detention needs.

## Design Considerations

- Vegetated swales must be sized to convey design runoff rate (typically 10-year storm).
- Filtration benefits can be substantially improved by planting native deep-rooted grasses and forbs and by minimizing the slope.
- Topsoil may be amended with compost and/or coarse sand to improve organic content for filtering and to improve infiltration and retention of runoff.
- Vegetated swales should be protected from construction site runoff to prevent sealing of topsoil and/or subsoils.



schematic plan of back yard vegetated swale system (Conservation Design Forum)



© Conservation Design Forum

urban bioswale

# Native Landscaping

## Definition

- Establishment of native vegetation in either large restoration projects or smaller gardening projects. Native landscaping is often a component of other BMPs such as detention, filter strips, bioswales, and rainwater gardens.



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prairie planted in residential development area (Mill Creek, IL)

## Applicability

- Scale
  - Watershed/County
  - Town/Village
  - Neighborhood
  - Lot
- Applications
  - Retrofit
  - Preventive
  - Roofs
  - Parking Lots
  - New
  - Remedial
  - Streets
  - Lawn
  - Ongoing/ Maintenance
  - Driveways
  - Sensitive Areas
- Effectiveness
  - Runoff Rate Control
  - Nutrient Control
  - Runoff Volume Control
  - BOD Control
  - Physical Habitat Preservation/Creation
  - Other Pollutant Control
  - Sediment Pollution Control

## Benefits

- Reduces runoff volumes.
- Increases infiltration rates.
- Increases ability to remove nutrients.
- Increases organic content of soils.
- Increases permeability of compacted soils.
- Reduces irrigation and fertilization requirements.
- Reduces use of fossil fuels and air pollution relative to turf landscapes that require regular mowing and maintenance.
- Provides wildlife habitat.



comparison of root structure between lawn and various native plants in the Illinois and Mid West Region (Conservation Research Institute)

© Conservation Research Institute

## Design Considerations

- Some local "weed" ordinances may need to be amended to allow native and taller vegetation.
- Plant diversity and health is maximized by annual burning. Plots may be mowed and then burned to prevent spread of fire on small sites. Fall burning will select for prairie wildflowers.
- On compacted soils, amendment may be necessary to increase organic content, improving success of establishment.



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Tellabs Bolingbrook (Bolingbrook, IL)