Green Infrastructure Planning Design Guidelines

A resource for planning boards in Monroe County

September 2016

GENESEE/FINGER LAKES
Regional Planning Council

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FINGER LAKES - LAKE ONTARIO WATERSHED PROTECTION ALLIANCE

Stormwater Coalition of MONROE COUNTY

Green Infrastructure Planning Design Guidelines

September 2016

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Introduction – What is Green Infrastructure?

Stormwater runoff is generated when precipitation from rain and snowmelt events flows over land or impervious surfaces and does not soak into the ground. As the runoff flows over paved streets, parking lots, and building rooftops, it accumulates debris, chemicals, sediment or other pollutants that could adversely affect water quality. Green infrastructure maintains or restores stormwater's natural flow pattern by allowing the water to slowly saturate into the ground and be used by plants. At the largest scale, it is the preservation and restoration of natural landscape features such as forests, floodplains, and wetlands. Green infrastructure practices, on a smaller scale, include rain gardens, porous pavements, green roofs, infiltration planters, trees and tree boxes. Altogether, green infrastructure is a set of management approaches and technologies that utilize, enhance, and/or mimic the natural hydrologic processes of infiltration, evapotranspiration, and water reuse.

In New York State, the Department of Environmental Conservation (DEC) administers a federal program to regulate stormwater runoff called the State Pollutant Discharge Elimination System (SPDES) Permit Program. There are two SPDES General Permits that govern how and when stormwater runoff is managed. The SPDES "General Permit for Construction Activity" authorizes eligible stormwater discharges from construction projects that disturb 1 or more acres of land. Developers must first obtain stormwater permit coverage before any activity begins, which includes construction activities involving soil disturbances of one (1) or more acres **and** *disturbances less than one acre that are part of a larger common plan of development that will ultimately disturb one or more acres of land* (Permit No. GP-0-15-002).

Certain cities, towns, villages, counties and other types of public and quasi-public government units that own or operate small-scale storm sewer systems that discharge into New York State waters have been designated by DEC as Municipal Separate Storm Sewer Systems (MS4s). MS4 communities and certain covered entities wishing to discharge stormwater from their sewer systems must obtain coverage under the DEC SPDES "General Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems." They do so by submitting a Notice of Intent and indicating that they have developed and implemented a stormwater management program (SWMP). Under the General Permit, MS4 communities that have traditional land use regulations must enact a local law or ordinance requiring developers

to prepare a Stormwater Pollution Prevention Plan (SWPPP). SWPPPs are technical documents that prescribe how stormwater will be managed during construction and post-construction. The *New York State Stormwater Management Design Manual* (updated January, 2015) provides design standards that incorporate green infrastructure techniques to protect New York State waters from the adverse impacts of urban stormwater runoff.

In an MS4, the municipality is responsible for reviewing, approving, and ensuring compliance for all construction projects that require a SWPPP. If the Planning Board is reviewing a proposed site plan, subdivision plat, or special use permit, they should know about the SWPPP and understand its role in the site's intended design, arrangement, and use in addition to its physical, social, and economic effects on the community. Questions or comments should be discussed with the Stormwater Management Officer (SMO).

In non-MS4 areas, applicants must still prepare a SWPPP but the municipality does not sign off on it. Planning Boards in non-MS4 areas are also encouraged to review the SWPPP with the SMO as part of their site plan or subdivision review. While the non-MS4 community does not have to provide approval on an official form, it should be aware of the SWPPP as part of the overall development considerations of the site. The approval of stormwater practices is especially important if the practices will be operated and maintained by the municipality upon project completion.

The SMO accepts and reviews all SWPPPs; can engage the services of a registered professional engineer to review the plans, specifications and related documents; and/or can accept a plan certified by a licensed professional. The Planning Board provides review of all land development activities subject to approval under subdivision, site plan, and/or special permit. This document encourages a dialogue between the SMO and the Planning Board in order to achieve the best solutions for stormwater runoff while guiding appropriate development in the community.

The following are examples of green infrastructure techniques:

I. Planning Practices

A. Preservation of natural features

1) Preservation of undisturbed areas – Delineate and place into permanent conservation undisturbed forests, native vegetated areas, riparian corridors, wetlands, and natural terrain.
2) Preservation of buffers – Define, delineate and preserve naturally vegetated buffers along perennial streams, rivers, shorelines and wetlands.
3) Reduction of clearing and grading – Limit clearing and grading to the minimum amount needed for roads, driveways, foundations, utilities and stormwater management facilities.
4) Locating sites in less sensitive areas – Avoid sensitive resource areas such as floodplains, steep slopes, erodible soils, wetlands, mature forests and critical habitats by locating development to fit the terrain in areas that will create the least impact.
5) Conservation design – Use clustering, conservation design or open space design to reduce impervious cover, preserve more open space and protect water resources.
6) Soil restoration – Restore the original properties and porosity of the soil by deep till and amendment with compost to reduce the generation of runoff and enhance the runoff reduction performance of post construction practices.

Conservation design (*above*)

Preservation of buffers (*below*)

Cul-de-sac reduction retrofit with bioretention

Atlee Drive, Town of Greece (*above*)
Rochester Museum and Science Center (*below*)

B. Reduction of impervious cover

1) Roadway reduction – Minimize roadway widths and lengths to reduce site impervious area.
2) Sidewalk reduction – Minimize sidewalk lengths and widths to reduce site impervious area.
3) Driveway reduction – Minimize driveway lengths and widths to reduce site impervious area.
4) Cul-de-sac reduction – Minimize the number of cul-de-sacs and incorporate landscaped areas to reduce their impervious cover.
5) Building footprint reduction – Reduce the impervious footprint of residences and commercial buildings by using alternate or taller buildings while maintaining the same floor to area ratio.
6) Parking reduction – Reduce imperviousness on parking lots by eliminating unneeded spaces, providing compact car spaces and efficient parking lanes, minimizing stall dimensions, using porous pavement surfaces in overflow parking areas, and using multi-storied parking decks where appropriate.

II. Treatment Practices for Water Quality Volume

A. Area reduction practices (*conserved areas subtracted from the total site area that reduces stormwater runoff volume*)

1) Conservation of natural areas, streams and wetland buffers – Retain the pre-development hydrologic and water quality characteristics of undisturbed natural areas, stream and wetland buffers by restoring and/ or permanently conserving these areas on a site.
2) Vegetated buffer, filter strip and riparian reforestation – Undisturbed natural areas such as forested conservation areas and stream buffers or vegetated filter strips and riparian buffers can be used to treat and control stormwater runoff from some areas of a development project.
3) Vegetated open channel – The natural drainage paths, or properly designed vegetated channels, can be used instead of constructing underground storm sewers or concrete open channels to increase time of concentration, reduce the peak discharge, and provide infiltration.
4) Tree planting/tree box – Plant or conserve trees to reduce stormwater runoff, increase nutrient uptake, and provide bank stabilization. Trees can be used for applications such as landscaping, stormwater management practice areas, conservation areas and erosion and sediment control.
5) Rooftop and overland disconnection – Direct runoff from residential rooftop areas and upland overland runoff flow to designated pervious areas to reduce runoff volumes and rates.
6) Stream daylighting – Stream Daylight previously-culverted/piped streams to restore natural habitats, better attenuate runoff by increasing the storage size, promoting infiltration, and help reduce pollutant loads.

Vegetated open channel (*above*)

Street trees and stormwater planters (*below*)

Porous pavement
Monroe Avenue, Town of Brighton

B. Volume reduction practices (*practices that provide storage capacity where runoff is temporarily stored until it can be infiltrated, evapotranspirated, or reused*)

1) Rain garden – Manage and treat small volumes of stormwater runoff using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression.
2) Green roof – Capture runoff by a layer of vegetation and soil installed on top of a conventional flat or sloped roof. The rooftop vegetation allows evaporation and evapotranspiration processes to reduce volume and discharge rate of runoff entering conveyance system.
3) Stormwater planter – Small landscaped stormwater treatment devices that can be designed as infiltration or filtering practices. Stormwater planters use soil infiltration and biogeochemical processes to decrease stormwater quantity and improve water quality.
4) Rain tank/Cistern – Capture and store stormwater runoff to be used for irrigation systems or filtered and reused for non-contact activities.
5) Porous pavement – Pervious types of pavements that provide an alternative to conventional paved surfaces, designed to infiltrate rainfall through the surface, thereby reducing stormwater runoff from a site and providing some pollutant uptake in the underlying soils.

Green infrastructure can have many benefits other than improving water quality and stormwater runoff management, such as:

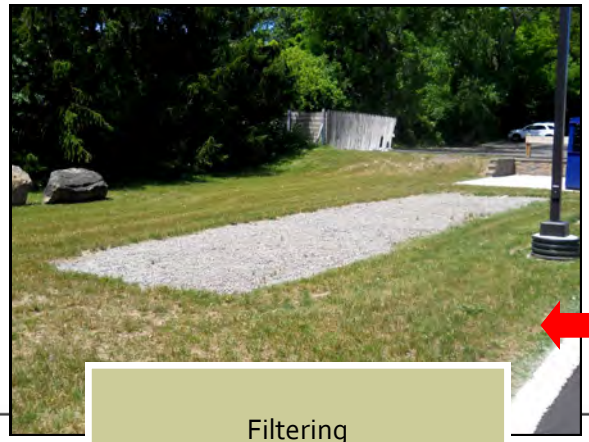
- ⇒ more aesthetically pleasing and naturally attractive landscape
- ⇒ reduced long-term operation and maintenance costs
- ⇒ effectively counteracts urban heat island effect
- ⇒ plays an insulation role in the winter
- ⇒ improves air quality
- ⇒ directly supports carbon capture
- ⇒ more open space for recreation
- ⇒ increased property values
- ⇒ more pedestrian-friendly neighborhoods

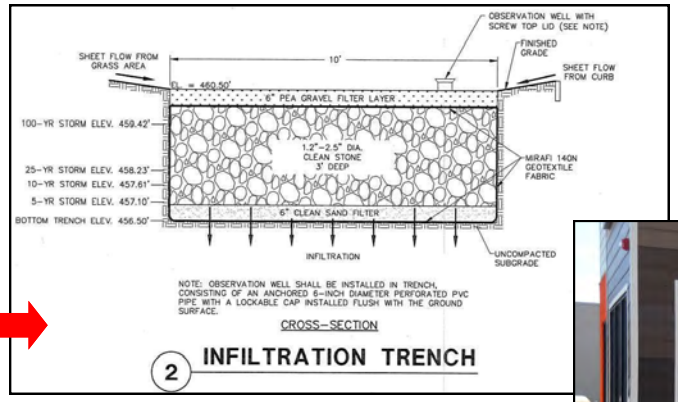
Photos courtesy of
Thomas M. Robinson, RLA, LEED AP

Stormwater pond (*above*) and wetlands (*below*)

Sometimes the specific conditions of a site cannot fully accommodate green infrastructure for stormwater management. In those cases, standard stormwater management practices (SMP) are acceptable for water quality treatment. These structural practices are designed to capture and treat the water quality volume (the portion infeasible to retain onsite using runoff reduction techniques) through one or more pollutant removal pathway(s). The standard SMPs are often cited as "end-of-the-pipe" treatment systems and designed to function as storage or flow-through systems. Some of the standard SMPs listed below are illustrated on the site plan on page 13.

1) Stormwater Ponds – Practices that have either a permanent pool of water or a combination of permanent pool and extended detention capable of treating the water quality volume.
2) Stormwater Wetlands – Practices that include significant shallow marsh areas, and may also incorporate small permanent pools and extended detention storage to achieve the full water quality volume.
3) Infiltration – Practices that capture and temporarily store the water quality volume before allowing it to infiltrate into the soil.
4) Filtering – Practices that capture and temporarily store the water quality volume and pass it through a filter bed of sand, organic matter, soil, or other acceptable treatment media.
5) Open Channels – Practices explicitly designed to capture and treat the full water quality volume within dry or wet cells formed by check dams or other means.





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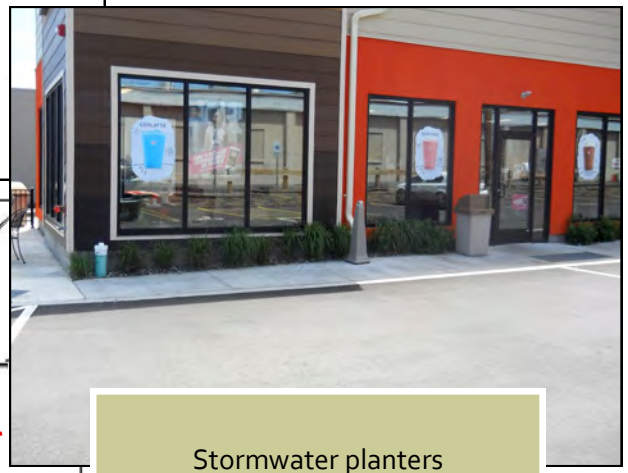
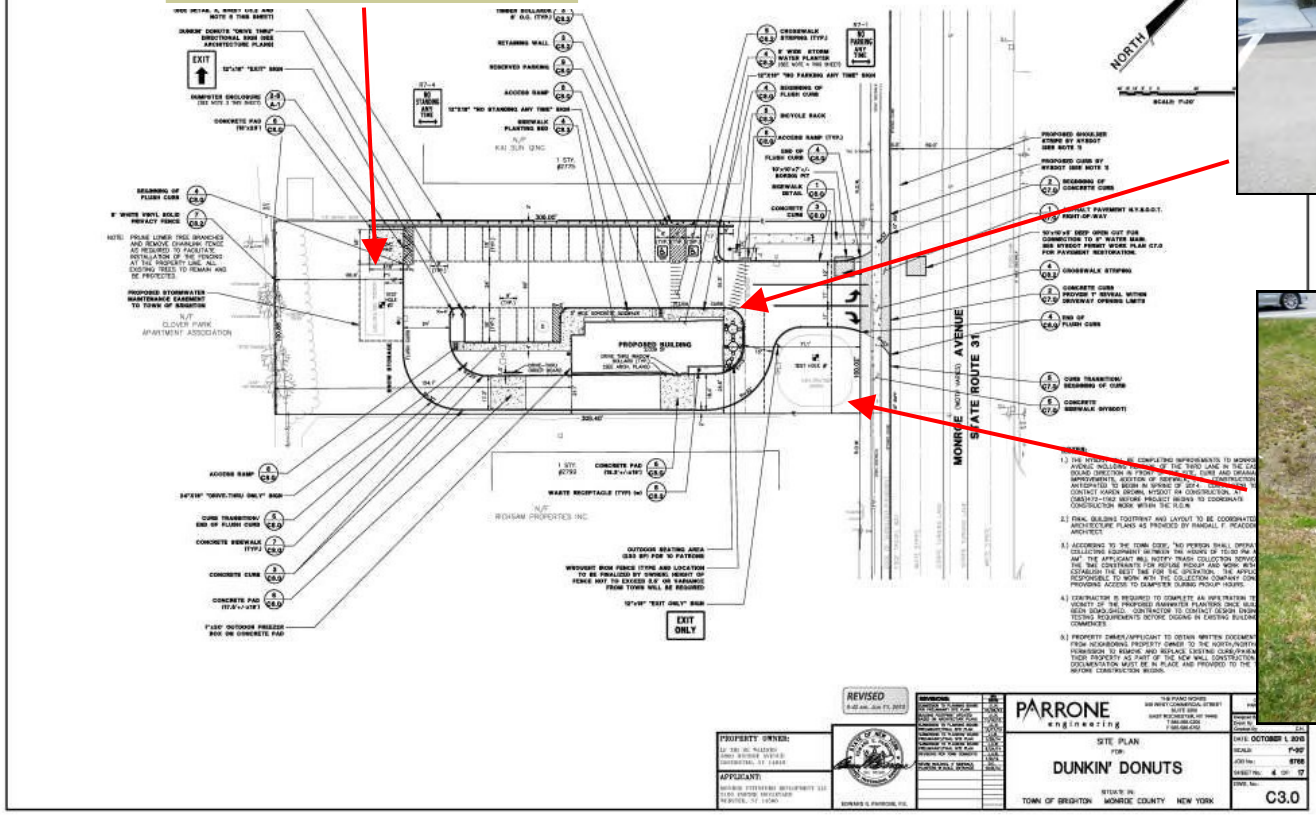
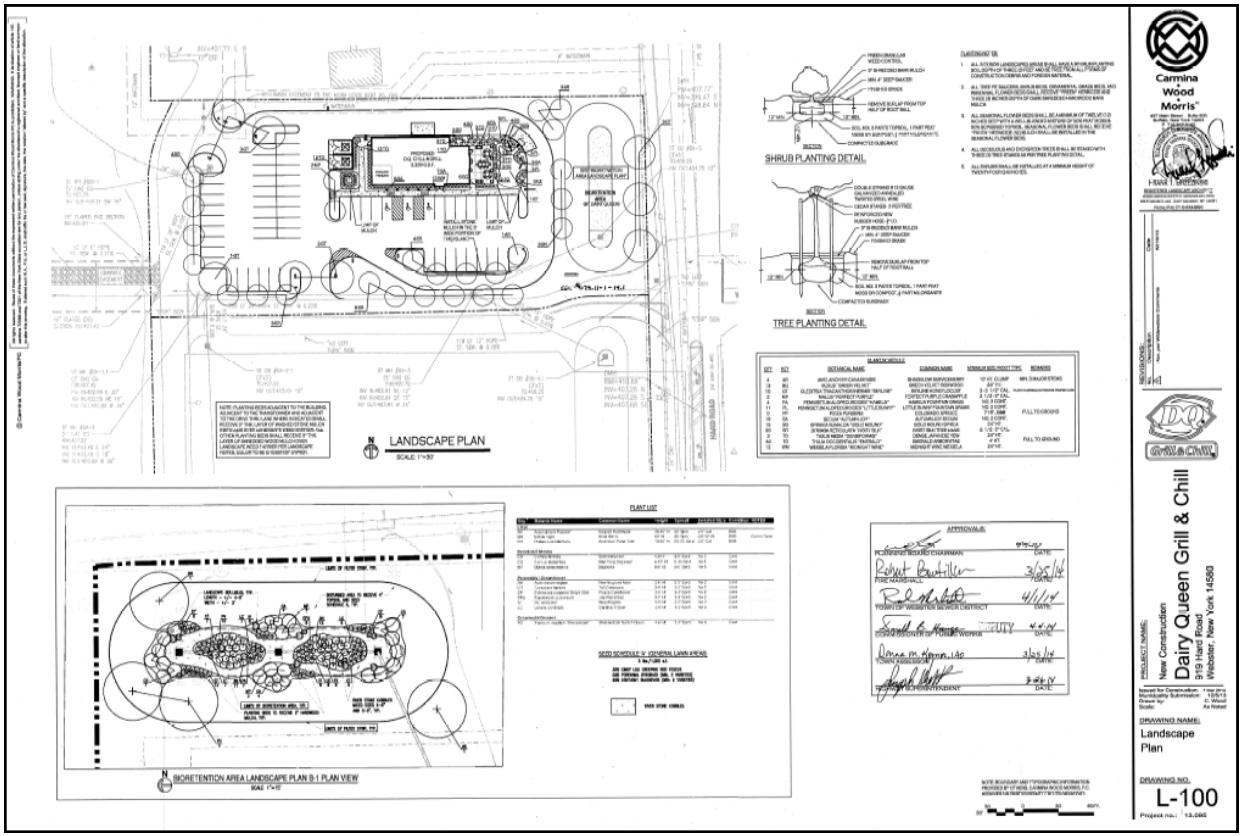


Stormwater planters



Infiltration

Landscape plan illustrating bioretention area.
Town of Webster



Chapter 1 – Role of Planning Board

Planning Boards have two types of powers: advisory and regulatory. Advisory powers come from either State statute or the local governing board. Planning Boards may offer advice on the following items:

⇒ **Comprehensive plans and plan amendments** – The governing board may create a special board that includes some members of the Planning Board, or they may assign the task of developing the municipal comprehensive plan to the Planning Board. Even if the Planning Board does not have a formal role in the process, it may still offer its comments and recommendations.

⇒ **Land use regulations** – State statues authorize the Planning Board to recommend to the governing board regulations relating to any subject matter over which the Planning Board has jurisdiction. Adoption of regulations must be by local law or ordinance.

⇒ **Land use studies, maps, and reports** – The Planning Board has the authority to make investigations, maps, reports, and recommendations relating to the planning and development of the municipality as appropriate. The governing board establishes the budget for the Planning Board, which may limit the number of studies it can conduct.

⇒ **Capital budgets** – The Planning Board may assist in creating an asset inventory, prioritizing capital projects, assessing budgetary impacts, financing capital acquisitions, and monitoring capital assets.

⇒ **Referrals or proposed actions by other boards** – The governing board may provide by resolution for the reference of any matter to the Planning Board before final action is taken on it by an office or officer of the municipality. The office or officer of the municipality with jurisdiction can be prevented from acting until the Planning Board has submitted its recommendation, or until a reasonable amount of time has passed in which the Planning Board could have made a recommendation.

⇒ **Area variance requests** – When one or more features on a subdivision plat does not comply with the physical or dimensional restrictions in zoning regulations, an area variance is necessary in order for the Planning Board to approve the application. When reviewing the area variance request, the Zoning Board of Appeals must request that the Planning Board provide a written recommendation concerning the proposed variance.

⇒ **As "lead agency" under SEQRA –** The State Environmental Quality Review Act (SEQRA) requires State and local government agencies to consider the environmental impacts of their actions before deciding to undertake them (Environmental Conservation Law Article 8). The purpose of having a lead agency is to coordinate the SEQRA process so that when an action is to be carried out, funded or approved by two or more agencies, a single environmental review is conducted. The lead agency is responsible for making key SEQRA determinations during the review process. The review of subdivision plats by local planning boards is an action that triggers the application of SEQRA.

Butterfly and bird habitat, located in residential rear yard.
Chapter 289. Wildlife Habitats, Henrietta Town Code

The three regulatory powers of the Planning Board are:

⇒ site plan review,
⇒ review of subdivision plats, and
⇒ special use permits.

The review of site plans is frequently assigned to Planning Boards. A site plan shows the arrangement, layout, and design of the proposed use of a single parcel of land. Site plan review can include both small and large-scale proposals, ranging from gas stations, drive-through facilities and office buildings, to complex ones such as shopping centers, apartment complexes, and industrial parks.

The green infrastructure approach for stormwater management should be incorporated into the early stages of development review/site plan review and approval. This approach has three primary components that mitigate the effects of stormwater runoff from development:

1) Avoid or minimize disturbance by preserving natural features and using conservation design techniques.
2) Reduce the impacts of development by decreasing impervious cover.
3) Manage the impacts of development by using natural features and runoff reduction practices to slow down the runoff, promote infiltration and evapotranspiration, and minimize the need for structural "end-of-pipe" practices.

The checklist on pages 18-23 provides a variety of frequently encountered review considerations. Although not all of the factors will apply in all cases, the checklist can serve as a guide to help Planning Boards consider green infrastructure as an alternative approach for meeting stormwater requirements, whether through the preservation of natural features, reduction of impervious cover, or area/volume reduction practices. Additional environmental protection recommendations are included in *italics*.

Sample Planning Board Checklist for Site Development Review

Item Number	Site Plan Review Checklist	Green Infrastructure Techniques
1.	Existing natural/environmental features (e.g., geologic features, historic and archaeological considerations, soil characteristics, topography, vegetation, and hydrologic features).	☐Preservation of undisturbed areas – Delineate and place into permanent conservation undisturbed forests, native vegetated areas, riparian corridors, wetlands, and natural terrain. ☐Preservation of buffers – Define, delineate and preserve naturally vegetated buffers along perennial streams, rivers, shorelines and wetlands. ☐Locating sites in less sensitive areas – Avoid sensitive resource areas such as floodplains, steep slopes, erodible soils, wetlands, mature forests and critical habitats by locating development to fit the terrain in areas that will create the least impact. ☐Stream daylighting – Stream Daylight previously-culverted/ piped streams to restore natural habitats, better attenuate runoff by increasing the storage size, promoting infiltration, and help reduce pollutant loads.
2.	Grading and drainage plan, showing existing and proposed contours.	☐Reduction of clearing and grading – Limit clearing and grading to the minimum amount needed for roads, driveways, foundations, utilities and stormwater management facilities. ☐Vegetated open channel – The natural drainage paths, or properly designed vegetated channels, can be used instead of constructing underground storm sewers or concrete open channels to increase time of concentration, reduce the peak discharge, and provide infiltration.

Item Number	Site Plan Review Checklist	Green Infrastructure Techniques
3.	Location, design, type of construction, proposed use and exterior dimensions of all buildings.	☐Building footprint reduction – Reduce the impervious footprint of residences and commercial buildings by using alternate or taller buildings while maintaining the same floor-to-area ratio. ☐Rooftop and overland disconnection – Direct runoff from residential rooftop areas and upland overland runoff flow to designated pervious areas to reduce runoff volumes and rates. ☐Green roof – Capture runoff by a layer of vegetation and soil installed on top of a conventional flat or sloped roof. The rooftop vegetation allows evaporation and evapotranspiration processes to reduce volume and discharge rate of runoff entering conveyance system. ☐Rain tank/Cistern – Capture and store stormwater runoff to be used for irrigation systems or filtered and reused for non-contact activities.

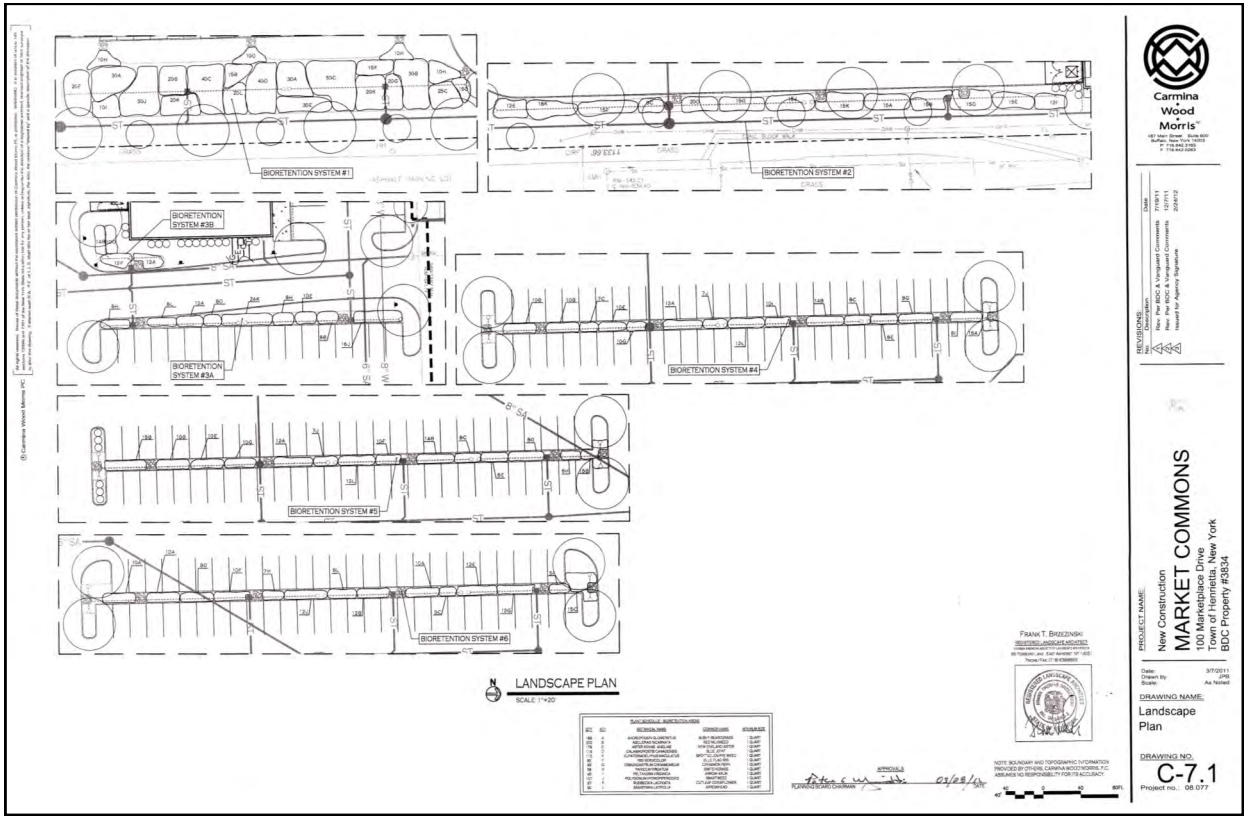
Item Number	Site Plan Review Checklist	Green Infrastructure Techniques
4.	Location, design and type of construction of all parking and truck loading areas, showing access and egress.	☐ Roadway reduction – Minimize roadway widths and lengths to reduce site impervious area. ☐ Driveway reduction – Minimize driveway lengths and widths to reduce site impervious area. ☐ Cul-de-sac reduction – Minimize the number of cul-de-sacs and incorporate landscaped areas to reduce their impervious cover. ☐ Parking reduction – Reduce imperviousness on parking lots by eliminating unneeded spaces, providing compact car spaces and efficient parking lanes, minimizing stall dimensions, using porous pavement surfaces in overflow parking areas, and using multi-storied parking decks where appropriate. ☐ Porous Pavement – Pervious types of pavements that provide an alternative to conventional paved surfaces, designed to infiltrate rainfall through the surface, thereby reducing stormwater runoff from a site and providing some pollutant uptake in the underlying soils.
5.	Provision for pedestrian access.	☐ Sidewalk reduction – Minimize sidewalk lengths and widths to reduce site impervious area.

Item Number	Site Plan Review Checklist	Green Infrastructure Techniques
6.	Location of accessory structures, such as detached garages, storage sheds, small boathouses, carports, gazebos, picnic pavilions, and pole barns.	*Whenever practical, accessory structures should not be located in the 100-year floodplain (e.g. 1% annual chance flood zone) or in a drainageway. Accessory buildings that are located in these areas should be wet-floodproofed, which involves using flood-resistant materials and elevating items subject to flood damage.*
7.	Location, design and construction materials of all existing or proposed site improvements including drains, culverts, retaining walls and fences.	☐ Stormwater planter – Small landscaped stormwater treatment devices that can be designed as infiltration or filtering practices. Stormwater planters use soil infiltration and biogeochemical processes to decrease stormwater quantity and improve water quality.
8.	Description of the method of sewage disposal and location, design and construction materials of such facilities.	*Consider whether utilities can be placed under the paved section of the right of way (ROW) to reduce impervious cover or if reserve septic field areas need to be cleared of trees at the time of development to preserve natural features. Avoid the installation of new septic systems in the 100-year floodplain (e.g. 1% annual chance flood zone).*
9.	Description of the method of securing public water and location, design and construction materials of such facilities.	*Infrastructure costs for subdivision road construction, utility installation, and drainage systems are usually less expensive for cluster developments than conventional subdivision design, which in turn creates fewer impervious surfaces and more natural drainage to reduce stormwater runoff, flooding, and soil erosion.*

Item Number	Site Plan Review Checklist	Green Infrastructure Techniques
10.	Location of fire and other emergency zones, including the location of fire hydrants.	*New streets in the 100-year floodplain (e.g. 1% annual chance flood zone) should be at or above the base flood elevation to provide access for emergency vehicles during a flood.*
11.	Location, design and construction materials of all energy distribution facilities, including electrical, gas and solar energy.	*Encourage on-site renewable energy sources, such as wind or solar, and energy efficient boilers, heaters, furnaces, incinerators, or generators and high-efficiency HVAC systems.*
12.	Location, size and design and type of construction of all proposed signs.	*Consider visual compatibility with surroundings.*
13.	Location and proposed development of all buffer areas, including existing vegetative cover.	☐ Conservation design – Use clustering, conservation design or open space design to reduce impervious cover, preserve more open space, and protect water resources. ☐ Conservation of natural areas, streams, and wetland buffers – Retain the pre-development hydrologic and water quality characteristics of undisturbed natural areas, stream, and wetland buffers by restoring and/or permanently conserving these areas on a site. ☐ Vegetated buffer, filter strip, and riparian reforestation – Undisturbed natural areas such as forested conservation areas, buffers, or vegetated filter strips can be used to treat and control stormwater runoff from some areas of a development project.

Item Number	Site Plan Review Checklist	Green Infrastructure Techniques
14.	Location and design of outdoor lighting facilities.	*Promote efficient, directed exterior lighting.*
15.	Identification of the location and amount of building area proposed for retail sales or similar commercial activity.	*Consider the relationship to adjacent and nearby land uses, both public and private.*
16.	General landscaping plan and planting schedule.	☐ Soil restoration – Restore the original properties and porosity of the soil by deep till and amendment with compost to reduce the generation of runoff and enhance the runoff reduction performance of post construction practices. ☐ Tree planting/tree box – Plant or conserve trees to reduce stormwater runoff, increase nutrient uptake, and provide bank stabilization. Trees can be used for applications such as landscaping, stormwater management practice areas, conservation areas and erosion and sediment control. ☐ Rain garden – Manage and treat small volumes of stormwater runoff using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression.

Pages 24-26 illustrate various types of landscape plans with bioretention facilities (Town of Henrietta, pages 24-25, and Town of Greece, page 26).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BIORETENTION SYSTEM #4
BIORETENTION SYSTEM #5
BIORETENTION SYSTEM #6
LANDSCAPE PLAN
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MARKET COMMONS
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Town of Henrietta, New York
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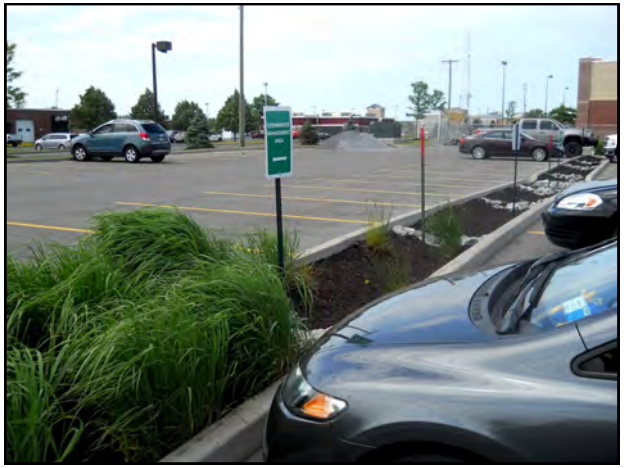
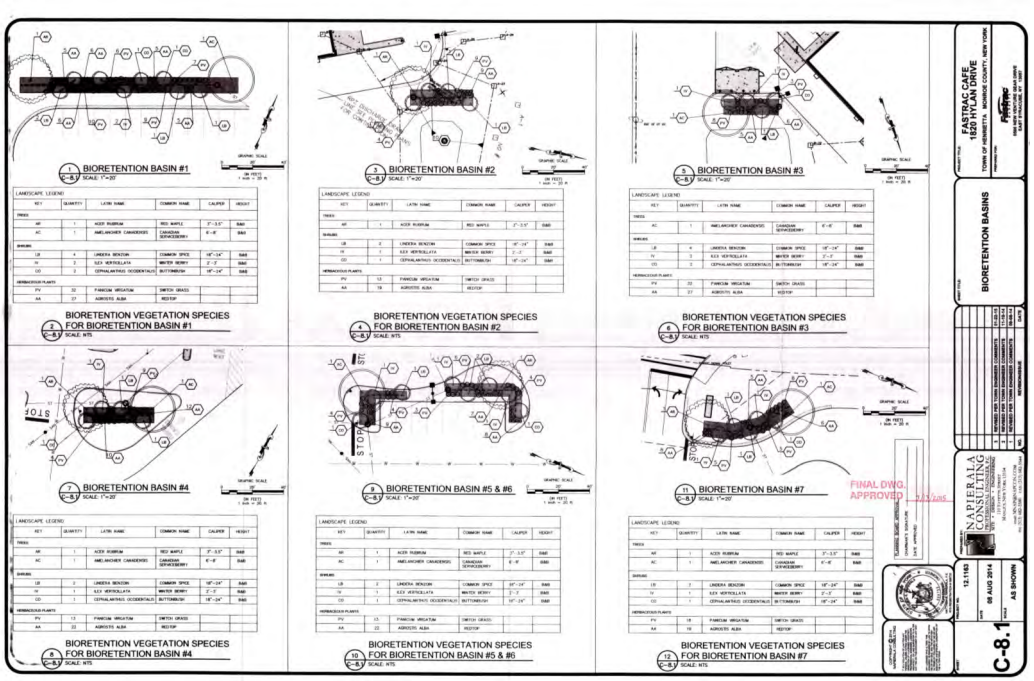
STORMWATER MANAGEMENT AREA

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BIORETENTION BASIN #4
BIORETENTION BASIN #5 & #6
BIORETENTION BASIN #7
BIORETENTION VEGETATION SPECIES FOR BIORETENTION BASIN #4
BIORETENTION VEGETATION SPECIES FOR BIORETENTION BASIN #5 & #6
BIORETENTION VEGETATION SPECIES FOR BIORETENTION BASIN #7
FASTRAC CAFE
1820 HYLAN DRIVE
TOWN OF HENRIETTA, MONROE COUNTY, NEW YORK
BIORETENTION BASINS
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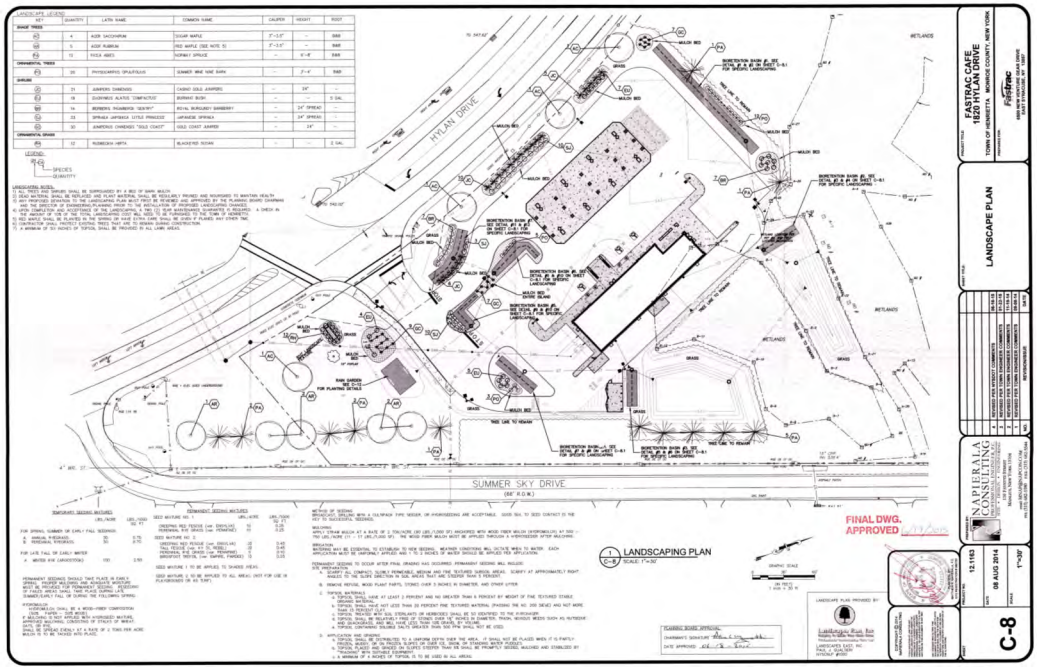
HYLAN DRIVE
SUMMER SKY DRIVE
WETLANDS
LANDSCAPING PLAN
FASTRAC CAFE
1820 HYLAN DRIVE
TOWN OF HENRIETTA, MONROE COUNTY, NEW YORK
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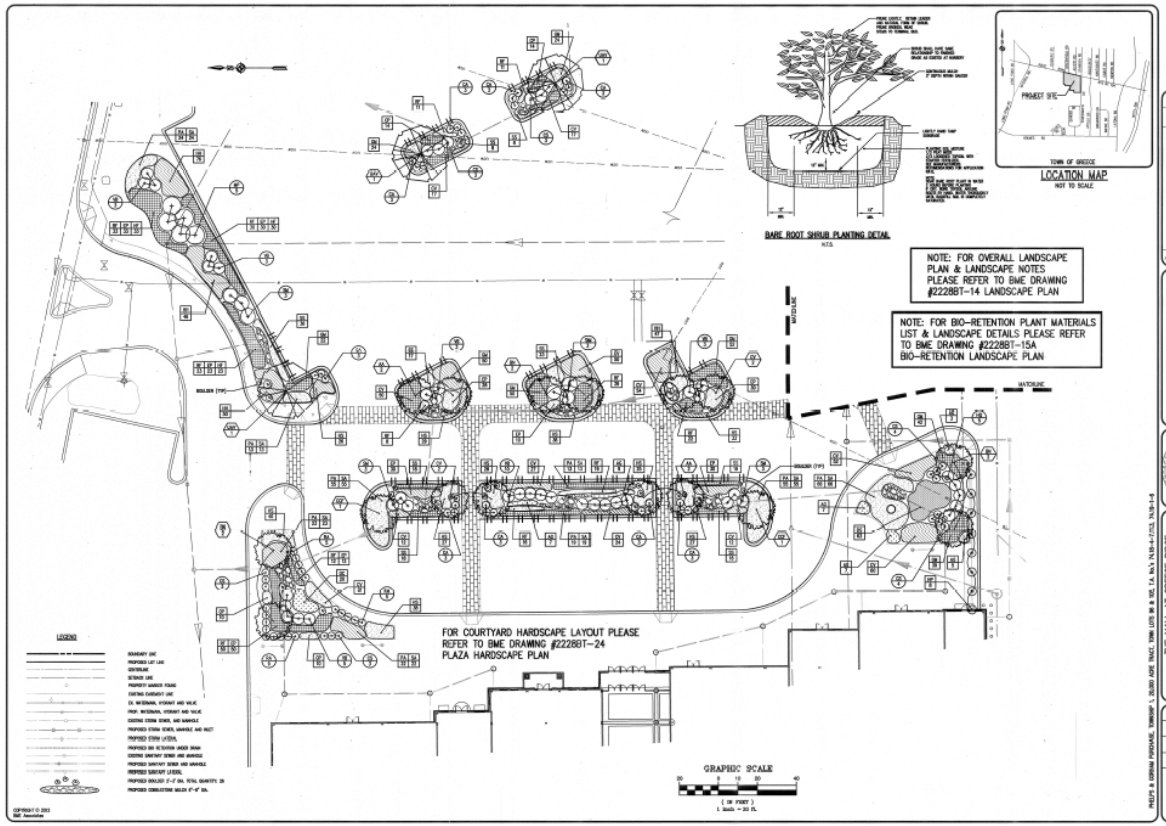
BARE ROOT SHRUB PLANTING DETAIL
LOCATION MAP
NOTE: FOR OVERALL LANDSCAPE PLAN & LANDSCAPE NOTES PLEASE REFER TO BME DRAWING #2228BT-14 LANDSCAPE PLAN
NOTE: FOR BIO-RETENTION PLANT MATERIALS LIST & LANDSCAPE DETAILS PLEASE REFER TO BME DRAWING #2228BT-15A BIO-RETENTION LANDSCAPE PLAN
FOR COURTYARD HARDSCAPE LAYOUT PLEASE REFER TO BME DRAWING #2228BT-24 PLAZA HARDSCAPE PLAN
GRAPHIC SCALE
BME ASSOCIATES
THE MALL AT GREECE RIDGE
2012 REDEVELOPMENT PLANS
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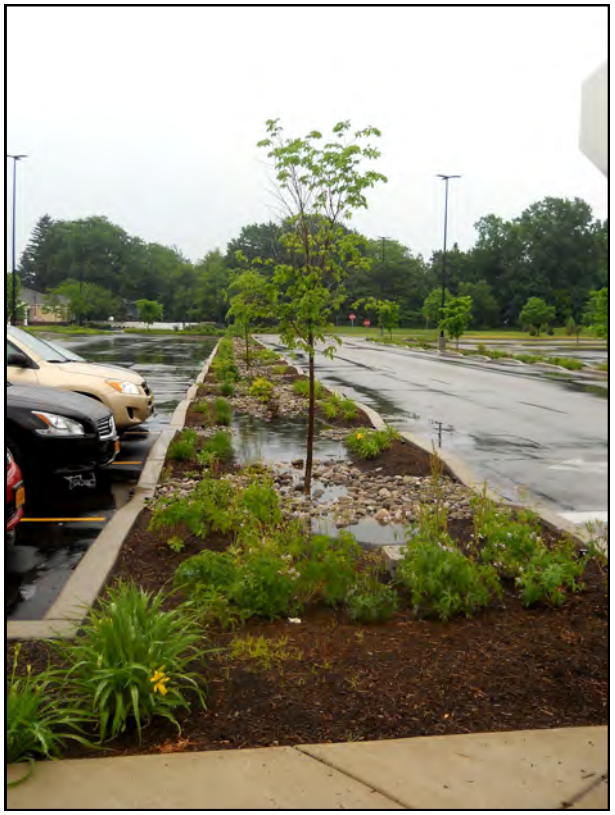


Chapter 2 – Municipal Comprehensive Plan

A comprehensive plan—known also as a master plan, land use plan, or comprehensive master plan—can be considered a blueprint to create zoning and other land use regulations. It gives direction and meaning to all other planning activities. It is the foundation that gives a strong base to land use decisions communities make that have a profound impact on what the community will be in the future. Most comprehensive plans include elements addressing land use and growth, open space and recreation, natural environment, community facilities and services, public safety, transportation, economy, and housing.

The statutes which address local comprehensive planning are Town Law § 272-a, Village Law § 7-722, and General City Law § 28-a.

The planning process begins with the identification, assessment, and mapping of the municipality's most important environmental assets, which may include:

- ⇒ natural resource areas such as forests, open fields, and scenic vistas;
- ⇒ critical habitats such as conservation corridors, buffer zones, and wildlife preserves;
- ⇒ critical areas such as wetlands, floodplains, streams, ponds, and estuaries; and
- ⇒ groundwater resources such as primary or principal aquifers.

Green infrastructure can then be defined and incorporated into a municipal comprehensive plan through the following elements and actions (*next page*).

Natural Environment

☐ Provide a natural resource protection element with goals calling for the preservation of identified critical natural resource areas.

☐ Promote zoning/subdivision regulations to permit the use of cluster development and/or conservation subdivisions.

☐ Provide a water quality protection element with goals calling for the protection of identified waterbodies and other water resource areas such as wetlands and floodplains.

Preservation of natural features with trail system component.
Bird Sanctuary Trail, Town of Webster

Stream restoration with riparian buffer zone and native trees and shrubs.
Veterans Memorial Park, Town of Henrietta

☐ Provide an open space/parks element that recognizes the role of open space in sustainable stormwater management.

☐ Recommend zoning/subdivision regulations require a minimum number of connections between new project and surrounding developments and neighborhoods.

☐ Encourage zoning/subdivision regulations to specifically permit green infrastructure facilities.

Public Safety

☐ Encourage green infrastructure approaches at the site, community, and regional scales to increase resilience to natural hazards and better manage stormwater runoff.

☐ Promote green infrastructure assets to accommodate projected risks from extreme weather events, localized flooding problems, sea-level rise, and erosion.

☐ Identify vulnerable shorelines and riparian areas and promote acquisition, rolling easements, living shorelines, buffers and setbacks, or site-level green infrastructure/low impact development (LID) stormwater management practices.

Traditional parking lot landscaping versus bioretention islands/basins (at or below the grade of the parking area) with curb cuts.

Port of Rochester (*above*)
CityGate, photo courtesy of Andy Sansone (*bottom*)

Transportation

☐ Identify appropriate areas for higher-density mixed-use developments (e.g., at transit stops) and recommend policies to encourage their development.

☐ Emphasize alternative modes of transportation (walking, biking, and transit) to reduce vehicle miles traveled and width and prominence of roads/streets.

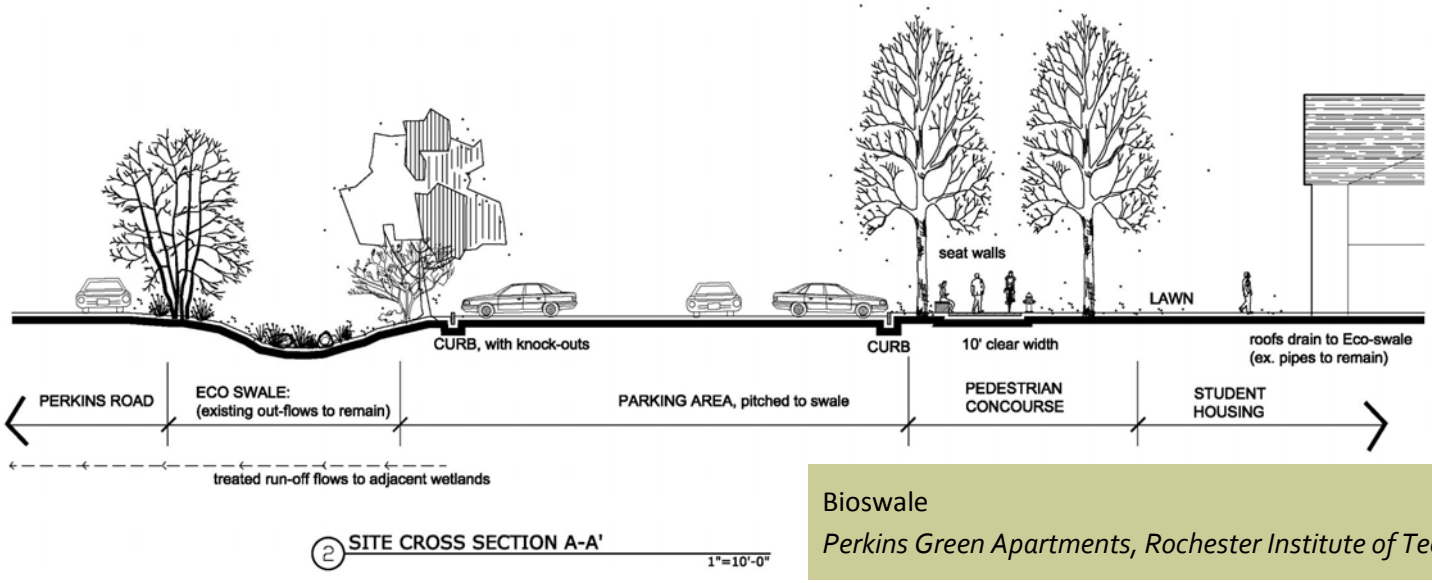
☐ Endorse context-sensitive street design with narrower streets in appropriate locations.

☐ Recognize the advantages to reduced parking requirements generally and specifically for mixed-use and transit-oriented developments.

☐ Recommend alternative, flexible approaches to meeting parking demands (e.g., shared parking, counting on-street spaces towards site parking requirements).

☐ Promote landscaping in parking lots to help reduce stormwater runoff.

☐ Encourage two-track driveways through technical street/ subdivision specifications.



Bioswale

Perkins Green Apartments, Rochester Institute of Technology

Chapter 3 – Zoning

Land use planning and zoning are tools that provide balance to public and private concerns. They work to ensure that one person's activities do not adversely affect others or the general public. Zoning regulates development by dividing a community into zones or districts and setting development criteria for each zone or district.

The following green infrastructure practices may better complement these zoning uses:

Residential

⇒ Permeable/grass pavers

⇒ Soil restoration

⇒ Rain gardens *Keep in mind location to source—wet basements may result*

⇒ Rooftop disconnection *May not be applicable in high-density residential districts*

⇒ Swales in rear yards *Consider access for drainage maintenance*

Commercial

⇒ Bioretention areas *Suitable for retail strip plazas and redevelopment projects*

⇒ Tree planting

⇒ Planters

⇒ Rain gardens *Require a maintenance plan because rain gardens will not function effectively if not maintained*

Rooftop disconnection (*above*)

Permeable/grass pavers (*below*)

Green roof

Rochester City Hall (*above*)
Monroe County Civic Center (*below*)

Industrial

⇒ Blue roofs (e.g., rooftop detention systems)

Institutional

⇒ Green roofs

⇒ Porous pavement

The standard SMPs on the next page are best suited for the following proposed land uses:

⇒ Rural – Very low density areas (e.g., typically at a density of less than ½ dwelling unit per acre).

⇒ Residential – Medium to high density residential developments.

⇒ Roads and Highways – Major roadways and highway systems.

⇒ Commercial Development – New commercial development.

⇒ Hotspot Land Uses – Vehicle fueling stations, fleet storage areas, industrial sites, marinas, commercial container nursery, etc.

⇒ Ultra-Urban Sites – Where space is limited and original soils have been disturbed.

Table 7.1 Land Use Selection Matrix

2015 Stormwater Management Design Manual

SMP Group	SMP Design	Rural	Residential	Roads and Highways	Commercial/ High Density	Hotspots	Ultra-Urban
Pond	Micropool Extended Detention (ED) Pond	❍	❍	❍	◗	①	●
	Wet Pond	❍	❍	❍	◗	①	●
	Wet ED Pond	❍	❍	❍	◗	①	●
	Multiple Pond	❍	❍	◗	◗	①	●
	Pocket Pond	❍	◗	❍	◗	●	●
Wetland	Shallow Wetland	❍	❍	◗	◗	①	●
	ED Wetland	❍	❍	◗	◗	①	●
	Pond/Wetland	❍	❍	●	◗	①	●
	Pocket Wetland	❍	◗	❍	◗	●	●
Infiltration	Infiltration Trench	◗	◗	❍	❍	●	◗
	Shallow Infiltration Basin	◗	◗	◗	◗	●	◗
	Dry Well	◗	❍	●	◗	●	◗
Filters	Surface Sand Filter (SF)	●	◗	❍	❍	②	❍
	Underground SF	●	●	◗	❍	❍	❍
	Perimeter SF	●	●	◗	❍	❍	❍
	Organic SF	●	◗	❍	❍	②	❍
	Bioretention	◗	◗	❍	❍	②	❍
Open Channels	Dry Swale	❍	◗	❍	◗	②	◗
	Wet Swale	❍	●	❍	●	●	●

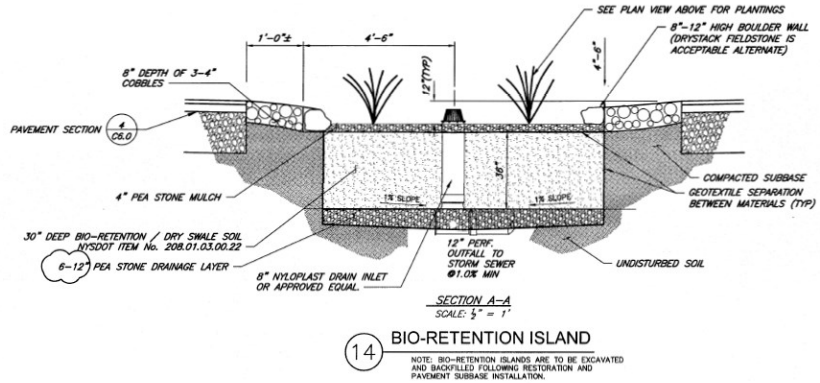
❍: Yes. Good option in most cases.

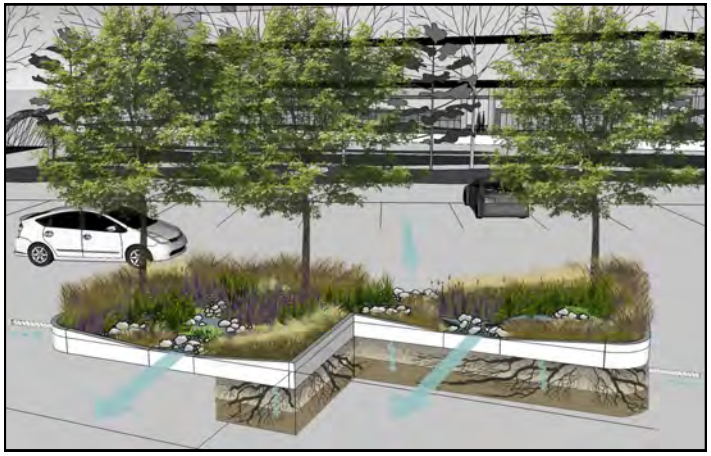
◗: Depends. Suitable under certain conditions, or may be used to treat a portion of the site.

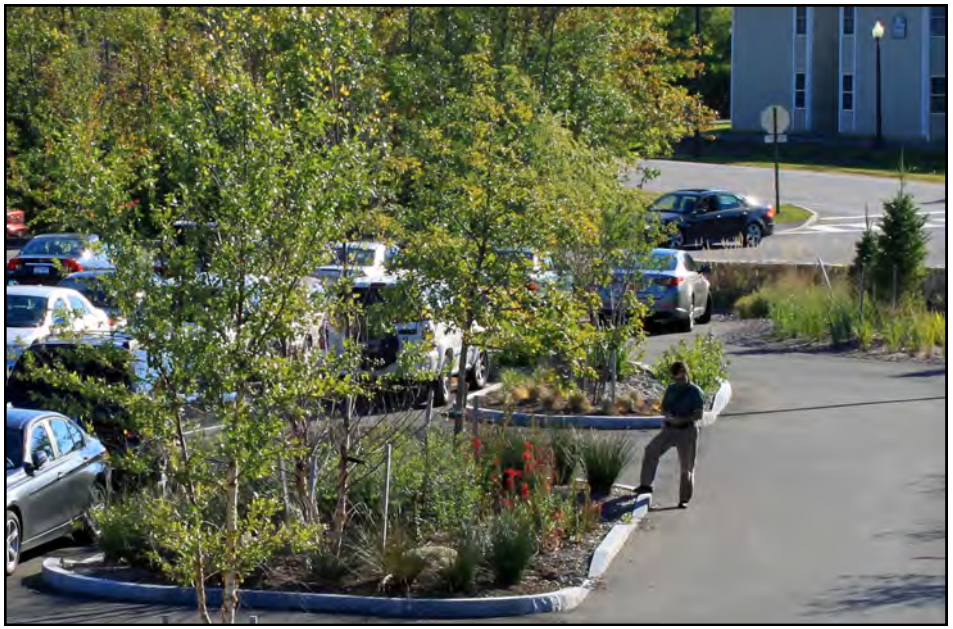
●: No. Seldom or never used.

①: Acceptable option, but may require a pond liner to reduce the risk of groundwater contamination.

Design versus Installation







Bioretention facility
Regional Green Infrastructure Showcase at the Rochester Museum and Science Center (*above*)
Town/Village of East Rochester Municipal Lot (*below*)

Chapter 4 – Subdivision of Land

The only regulatory power specifically delegated to Planning Boards is the power to review subdivision plats. However, that power may not be exercised unless the local governing board formally adopts a resolution, local law or ordinance authorizing the Planning Board to do so.

Subdivision regulations govern how land will be subdivided into individual lots and set the construction and location standards for the infrastructure the developer builds to serve those lots. This infrastructure includes the new roads, sidewalks, utility lines, storm sewers, and drainageways that a community usually maintains after the subdivision is approved. Properly conducting subdivision review is critical to any community interested in planning for its future. The Planning Board's role is important in applying the criteria in the New York State subdivision standards as well as any locally adopted subdivision regulations.

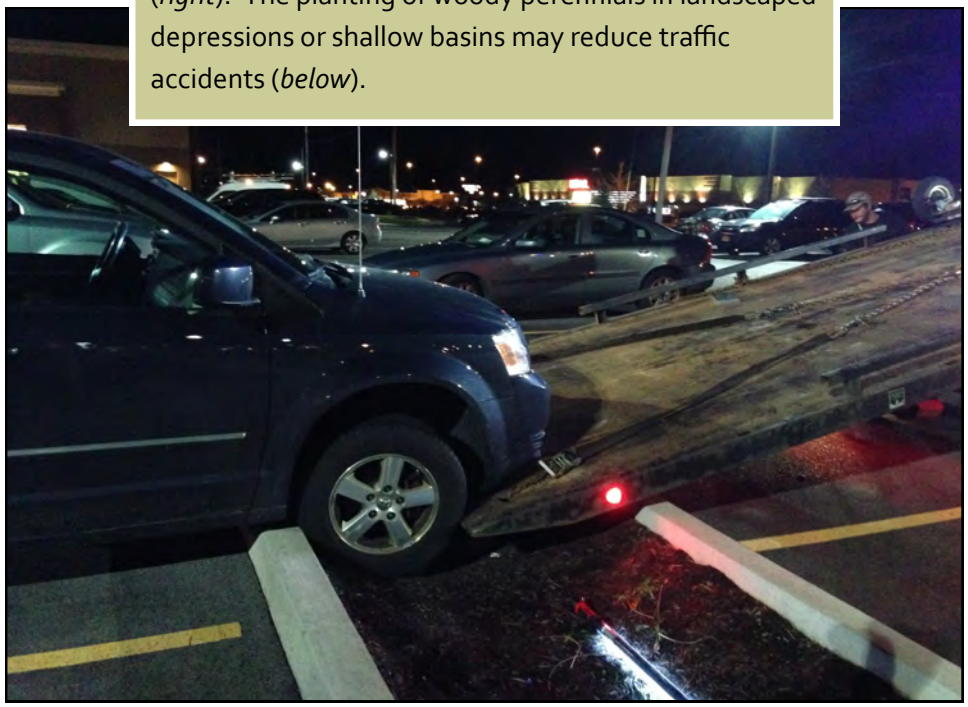
The Planning Board's role is to consider the following features when reviewing applications for subdivision plat approval:

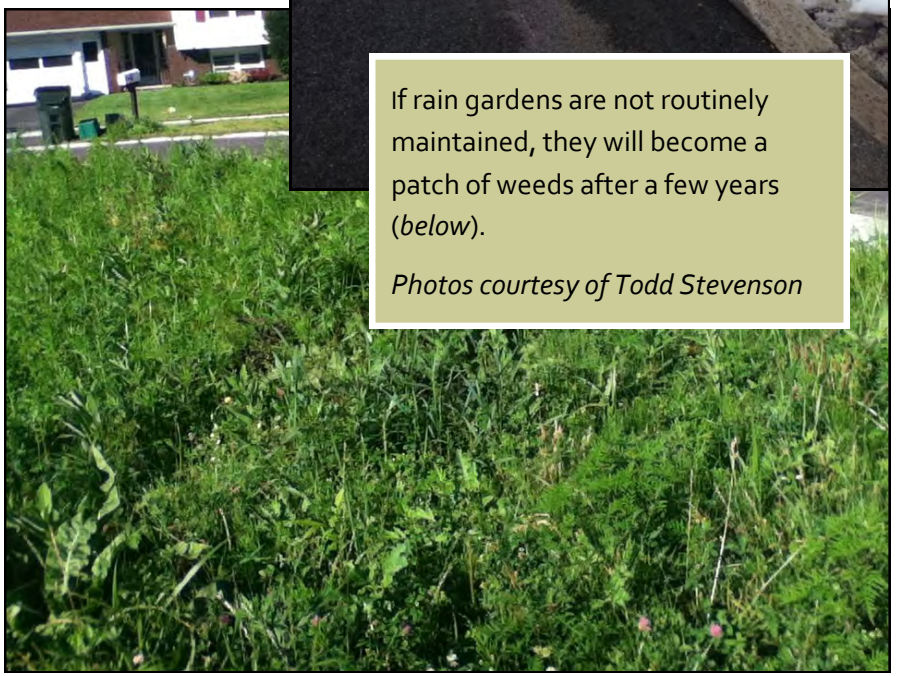
- ⇒ Lot layout
- ⇒ Physical character of the land
- ⇒ Environmentally sensitive lands
- ⇒ Street layout
- ⇒ Interconnected network of streets
- ⇒ Utilities
- ⇒ Bicycle lanes
- ⇒ Sidewalks and curbs
- ⇒ Water supply and sewage disposal systems
- ⇒ **Stormwater runoff**
- ⇒ Building design
- ⇒ Other improvements such as lighting

The creation of a subdivision changes the topography of a construction site, which can alter the flow of stormwater. Stormwater runoff can result in flooding and erosion as well as significant pollution of lakes, streams, rivers, and estuaries. The Planning Board should ensure that stormwater runoff is kept on-site to reduce non-point source pollution. Developers must manage stormwater runoff during and after construction of a subdivision where an acre or more of land will be disturbed. In the subdivision regulations, the SWPPP is available for Planning Boards to review but stormwater management is usually well-represented in the subdivision plat and any questions or comments are encouraged to be clarified with the SMO.

Design Challenges

Pollutants in plowed urban snow can easily clog or overwhelm bioretention basins or porous pavements (*right*). The planting of woody perennials in landscaped depressions or shallow basins may reduce traffic accidents (*below*).





If rain gardens are not routinely maintained, they will become a patch of weeds after a few years (*below*).

Photos courtesy of Todd Stevenson

When reviewing the grading and drainage plan for stormwater runoff:

⇒ Consider the location of the site within a watershed. What stream, lake, wetland, or drainage system does it flow into? Are there particular water quality concerns or flooding issues that should be considered in that watershed?

⇒ Were natural areas preserved? Looking at the site in a landscape or watershed context, are the most important natural areas preserved? If so, be sure the property lines of all Conservation Easements and/or Municipal Open Space Regulations are well-marked on the site development plan or subdivision plat. How will the municipality uphold its monitoring and enforcement responsibilities of the deed covenant, restriction or easement, especially in the long-term (e.g., five to ten years)?

⇒ Was an effort made to reduce impervious cover? Has runoff from all impervious cover been directed to a green infrastructure practice? Note that some reductions may require a variance from the Zoning Board of Appeals, such as minimizing stall dimensions and eliminating unneeded spaces in parking lots.

⇒ Are there opportunities to consolidate stormwater management practices (e.g., low impact development) or connect with other uses such as trails and trail systems, open space areas, recreational resources, or agriculture?

⇒ Are the soils appropriate for the practices selected? For example, soils are generally categorized into four Hydrologic Soil Groups (HSG): A, B, C, and D. HSGs are widely used as an efficient method for determining the approximate amount of direct runoff from a rainfall event in a particular area. A and B soils are well-drained and absorb much of the water that drains on or over them. C and D soils drain more poorly. Consider how this will affect neighboring properties and water resources including streams and wetlands.

USDA Web Soil Survey

You can explore soil maps at the USDA Web Soil Survey. First, click Start Web Soil Survey (WSS).

1. Search for your site.
2. Define an AOI (area of interest).
3. Go to the Soil Map tab to view soils.
4. Click on a soil name.
5. Scroll down to Properties and Qualities

⇒ Do the proposed green infrastructure practices comply with the Fire Code of New York State (2010) and Manual on Uniform Traffic Control Devices, 2009 Edition (MUTCD)? The Fire Code provides minimum unobstructed widths for access roads and driveways while the MUTCD (NYS Supplement, effective March 16, 2011) provides recommendations for minimum stall widths and lengths for standard parking spaces.

⇒ Look for the maintenance plan for the green infrastructure practices. Is there an operations strategy? Who will be responsible for maintenance? For example, the owner of a post-construction stormwater management practice must have a visible sign (18" x 24" or 10" x 12" for footprints smaller than 400 sf) posted nearby the practice. The sign must identify the practice, provide the project identification number, and state the following (refer to Section 3.5 of the *2015 Stormwater Management Design Manual*):

- Must Be Maintained In Accordance With O&M Plan
- DO NOT REMOVE OR ALTER

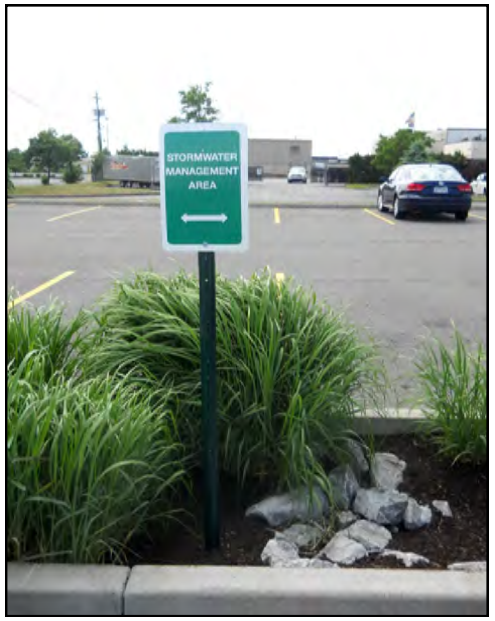
For example:

Stormwater Management Practice – Rain Garden

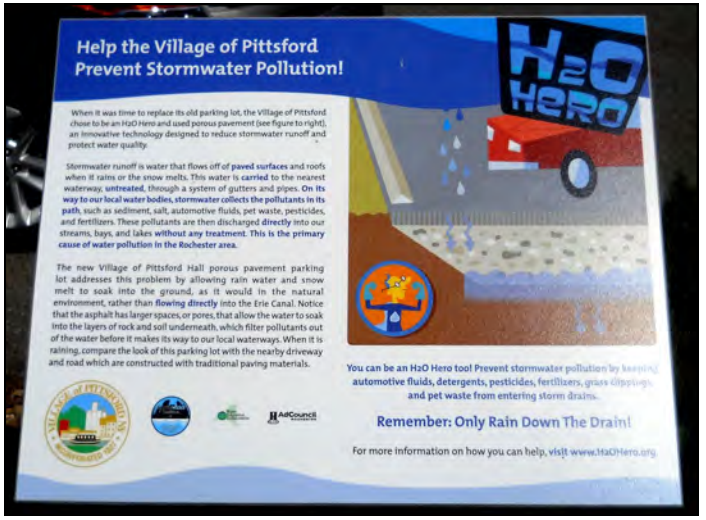
Project Identification - SPDES NYR10K123

Must Be Maintained In Accordance With O&M

DO NOT REMOVE OR ALTER



Stormwater signage
LA Fitness, Town of Henrietta (*above*)
Pittsford Village Hall Parking Lot (*below*)



Chapter 5 – Conservation Advisory Councils and Conservation Boards

Conservation Advisory Councils (CACs) and Conservation Boards are established by a municipality under Article 12-F Section 239-x of NYS General Municipal Law to advise on the development, management, and protection of local natural resources. CACs and Conservation Boards advise Planning Boards and Zoning Boards of Appeals with its open area planning and the preservation of natural and scenic resources. CACs and Conservation Boards can contribute to preserving the most valuable natural areas in their communities by administering an official open areas inventory and map. Avoiding or minimizing land disturbance by preserving natural areas is the first step in the stormwater management process.

In their municipal roles, CACs and Conservation Boards identify and collect needed data regarding the community's natural resources, open areas, and historic and scenic assets; help prioritize the importance of open areas; provide recommendations for protecting open areas including acquisition, cluster development, overlay zoning, and critical environmental area designation; review development proposals; conduct site visits; deliver education programs; and implement stewardship projects.

CACs and Conservation Boards may consider creating an inventory of green infrastructure practices currently operational in their municipality, such as:

- ⇒ bioretention areas (includes vegetated open swales and rain gardens)
- ⇒ constructed wetlands
- ⇒ green roofs
- ⇒ natural areas/riparian buffers
- ⇒ porous pavement
- ⇒ rain tanks/cisterns
- ⇒ tree plantings/tree boxes
- ⇒ stormwater planters

Bioretention with outlet control structure and curb cut.

City of Rochester

The inventory of known, existing green infrastructure strategies provides a baseline measure as to the current stormwater runoff capture volume and quantities of green infrastructure presently in use. From here, Planning Boards and municipal staff will be able to plan for increases in green infrastructure implementation and gauge progress in meeting stormwater capture goals.

For example:

SMP ID:	
Type of Practice	
Description of Practice	
Receiving Waterbody	
Date Installed	
Ownership of Practice	
Land Use Contributing to Practice	
Drainage Area to Practice (acres)	
Drainage Area to Practice Percent Impervious	
Maximum Treatment Volume of Practice (cubic feet)	
Is the Practice a Retrofit?	

Resources

American Rainwater Catchment Systems Association - http://www.arcsa.org/

Center for Green Roof Research, Penn State University - http://plantscience.psu.edu/research/centers/green-roof

Center for Watershed Protection - http://www.cwp.org/

Context Sensitive Design, Federal Highway Administration - http://contextsensitivesolutions.org/?

Green Infrastructure, The Conservation Fund - http://www.greeninfrastructure.net/

Green Infrastructure, U.S. Environmental Protection Agency - http://www.epa.gov/green-infrastructure

Green Infrastructure for Wet Weather, NYS Department of Environmental Conservation - http://www.dec.ny.gov/chemical/68199.html

Green Roofs for Healthy Cities - http://www.greenroofs.org/

Green Values® Stormwater Toolbox - http://greenvalues.cnt.org/

Jordan Cove Urban Watershed Project, University of Connecticut - http://www.jordancove.uconn.edu/index.html

The Low Impact Development Center, Inc. - http://www.lowimpactdevelopment.org/

Water, Natural Resources Defense Council - http://www.nrdc.org/water/

National LID Clearinghouse - http://www.lid-stormwater.net/clearinghouse/

National Ready Mixed Concrete Association / The Portland Cement Association - http://www.perviouspavement.org/

Rain Garden Network - http://www.raingardennetwork.com/

Save the Rain - http://savetherain.us/

Stormwater Case Studies by State, American Society of Landscape Architects - https://www.asla.org/stormwatercasestudies.aspx

Stormwater Manager's Resource Center - http://www.stormwatercenter.net/

Sustainable Cities Institute - http://www.sustainablecitiesinstitute.org/

University of New Hampshire Stormwater Center - http://www.unh.edu/unhsc/

Urban Design Tools, Low Impact Development - http://www.lid-stormwater.net/index.html

WaterSense, An EPA Partner Program - http://www3.epa.gov/watersense/index.html