

Town of
Winchendon



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Berkshire Design Group

Best Development Practices



Version 1, March 2010

Guidebook

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Introduction

The Winchendon Best Development Practices Guidebook (BDP Guidebook) is a set of guidelines for developers, designers and project reviewers intended to improve the quality of development in Winchendon. The Guidebook describes the preferred design and construction practices in Winchendon for stormwater management, erosion and sedimentation control, landscape design, and site planning.

None of the practices in the Guidebook are new, and many have been used extensively in Massachusetts. The Guidebook also provides a consistent reference book for designers and reviewers working in Winchendon. Recognizing that many best development practices are site-dependent, the Guidebook identifies a range of practices that are relevant to development and redevelopment projects on a variety of sites.

Applicants for a Low Impact Development Permit, or who seek approval under Subdivision, Site Plan or other regulations, will find the Guidebook a helpful reference on low impact practices. **Projects falling under the requirements of Winchendon's Low Impact Development Bylaw and Regulations, Subdivision, Site Plan or other regulations, are required to meet all of the specifications of those regulations. While this Guidebook accords with the above-referenced documents, it is not a substitute for meeting their procedures and requirements. Applicants who are required to meet the specifications of the Winchendon Low Impact Development Bylaw and Regulations must comply with the most recent version of the MA Department of Environmental Protection's Stormwater Management Standards and Handbook in the design and construction of stormwater management devices.**

The Guidebook is divided into five sections. Section I is a **checklist for designers** to help them determine which best development practices are likely to be applicable to their project. Project reviewers may also use this checklist to assess the project's conformity with the objectives set forth in the BDP Guidebook. Sections II through V discuss best development practices related to **stormwater management, erosion and sedimentation control, landscape design, and site planning**. These four sections describe the best development practices that are applicable in different situations and some technical details of the practices. References are provided for those who seek more information and design specifications for the various practices.

Thank you for taking the time to read this Guidebook. With your participation the Town of Winchendon will become a model for attractive and environmentally responsible community development.

We are grateful to the Town of Franklin, MA for providing their Best Development Practices Guide, upon which this Guide is based.

I. Checklist for Designers

The Checklist for Designers is a summary of the best development practices that this Guidebook recommends, and when they should be used. Prior to submitting an application for review, the applicant is encouraged to fill out this checklist to verify that he or she has complied with Winchendon's development objectives and planned the development or redevelopment site in a way that furthers the goals discussed below. The checklist may be submitted with the application. The Planning Board and their technical consultants may use the checklist to evaluate whether the application conforms with this Guidebook.

Stormwater Management

GOALS and NEEDS addressed:

1. Protect local and regional wetlands and water bodies
2. Maximize groundwater recharge to retain a viable local groundwater supply and reduce flooding

WINCHENDON OBJECTIVES:

- (A) All new development projects in Winchendon should meet the following three stormwater management performance objectives. All redevelopment projects should meet the objectives to the maximum feasible extent, and, if they fail to meet the objectives, should retrofit or expand existing stormwater management systems to improve existing conditions.
1. Post-development peak discharge rates from the site should not exceed pre-development peak discharge rates from the site.
 2. Annual groundwater recharge from the post-development site should approximate annual recharge from the pre-development site.
 3. The stormwater management system should remove at least 80% of the average annual load of total suspended solids (TSS) from the post-development stormwater created on the developed site.
- (B) Low impact, non-structural stormwater management systems should be used wherever site conditions allow, as outlined in the Guidebook. Drain pipe/catch basin systems may be used, in part or in whole, if the applicant can demonstrate that other systems are not feasible due to site conditions.

BEST DEVELOPMENT PRACTICES One or more of the following may be used to meet the above objectives.	Incorporated into Project?
Vegetated water quality swales (Dry & Wet) (<i>recommended to collect runoff from roadways & parking lots</i>)	<input type="checkbox"/>
Vegetated filter strips (<i>recommended to filter and infiltrate runoff from roadways, parking lots, and driveways; use with vegetated swales along roadsides and parking lots</i>)	<input type="checkbox"/>
Constructed wetlands (<i>preferred method for stormwater retention & pollutant removal</i>)	<input type="checkbox"/>
Bioretention cells (Rain Gardens) (<i>recommended on residential lots and parking lot islands</i>)	<input type="checkbox"/>
Porous pavement (<i>recommended in overflow parking and low-traffic areas</i>)	<input type="checkbox"/>
Tree box filter (<i>recommended in urbanized locations</i>)	<input type="checkbox"/>
Green roofs (<i>encouraged on flat commercial and industrial rooftops</i>)	<input type="checkbox"/>
Wet basins (<i>less preferred method for stormwater retention & pollutant removal</i>)	<input type="checkbox"/>
Dry detention basins (<i>less preferred, but may be used in series with other practices, such as constructed wetlands, to provide pre-treatment</i>)	<input type="checkbox"/>
Deep sump catch basin (<i>discouraged, unless other stormwater collection and conveyance systems have been demonstrated not to be feasible due to site conditions</i>) Have you evaluated the feasibility of other systems?	<input type="checkbox"/>

Erosion and Sedimentation Control

<p>GOALS and NEEDS addressed:</p> <ol style="list-style-type: none"> 1. Minimize erosion 2. Prevent sedimentation of water bodies and its attendant environmental impacts 	
<p>WINCHENDON OBJECTIVES:</p> <p>(A) Any proposed project on a previously undeveloped site should accommodate the development program in a way that minimizes clearing and regrading, especially in areas of steep slopes, erosion-prone soils, or sensitive vegetation. For redevelopment projects, the site plan should concentrate development in previously-disturbed areas to the extent possible.</p> <p>(B) Proposed projects should submit and adhere to a construction management plan that addresses soil stabilization, sediment retention, perimeter protection, construction scheduling, traffic area stabilization and dust control.</p>	
<p>BEST DEVELOPMENT PRACTICES The applicant should comply with the following:</p>	<p>Incorporated into Project?</p>
<p>Clearing and regrading have been minimized</p>	<input type="checkbox"/>
<p>Development is focused in previously disturbed areas (<i>for redevelopment projects</i>)</p>	<input type="checkbox"/>
<p>A construction management plan has been prepared</p>	<input type="checkbox"/>
<p>The construction management plan addresses:</p> <ul style="list-style-type: none"> Soil stabilization (<i>cover or stabilize erodible surfaces not in immediate use</i>) Sediment retention (<i>runoff interceptors and sediment traps/ponds</i>) Perimeter protection (<i>vegetated buffers or silt fences at the limit of work</i>) Construction scheduling (<i>minimize disturbed area at any given time</i>) Traffic area stabilization (<i>crushed rock or similar at construction vehicle entrance and parking areas</i>) Dust control (<i>plan for stabilizing dusty surfaces when necessary</i>) 	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Landscape Design

<p>GOALS and NEEDS addressed:</p> <ol style="list-style-type: none"> 1. Minimize demand for irrigation water 2. Maximize groundwater recharge from landscaped areas 3. Preserve native biodiversity by retaining habitat and defending against invasive species 4. Maximize the value to wildlife of human-managed landscapes 	
<p>WINCHENDON OBJECTIVES:</p> <p>(A) Site plans and landscape plans for all proposed projects should take appropriate steps, as outlined in the Guidebook, to minimize water use for irrigation and to allow for natural recharge of groundwater.</p> <p>(B) Landscape plans should follow the guidelines in the Guidebook for selecting species that are most appropriate to the site conditions. Native species and habitat-creating species should be used in all landscape plans to the maximum extent possible while still meeting the site's landscaping needs. Invasive species identified in this Guidebook should not be planted in Winchendon under any condition.</p>	
<p>BEST DEVELOPMENT PRACTICES The applicant should comply with the following:</p>	<p>Incorporated into Project?</p>
<p>Clearing and regrading have been minimized (<i>natural vegetation should be retained to the maximum extent possible, given the development program</i>)</p>	<input type="checkbox"/>
<p>Irrigation, if present, is water efficient (<i>if an in-ground irrigation systems is proposed, it is a water efficient system with automatic sensors to prevent overwatering</i>)</p>	<input type="checkbox"/>
<p>Landscaped areas retain water (<i>gardens are mulched and designed for water infiltration</i>)</p>	<input type="checkbox"/>
<p>No invasive species are used (<i>species from the invasive species list should not be used</i>)</p>	<input type="checkbox"/>
<p>Native and habitat-creating species are used (<i>species from these lists have been incorporated into the landscape design whenever possible</i>)</p>	<input type="checkbox"/>
<p>Species are appropriate to the soil, site, and microclimate conditions (<i>select appropriate species from the lists of salt-tolerant, urban-tolerant, wetland, moist-tolerant and drought-tolerant species</i>)</p>	<input type="checkbox"/>

Site Planning

GOALS and NEEDS addressed:

1. Protect Winchendon’s natural environment, including habitat, water resources, and ecosystem services
2. Create a visually appealing community
3. Preserve the Town’s historic and cultural heritage
4. Stabilize and increase property values
5. Encourage sustainable development

WINCHENDON OBJECTIVES:

Subdivision plans and site plans for all forms of development should adhere to the principles of *environmental compatibility, aesthetic compatibility, and energy-efficient design.*

BEST DEVELOPMENT PRACTICES The site plan should address the following principles:	Incorporated into Project?
Unique natural features have been preserved (<i>the development program should avoid or else showcase significant natural features</i>)	<input type="checkbox"/>
Historic and cultural resources have been preserved (<i>the development program should avoid or else showcase significant historic and cultural features</i>)	<input type="checkbox"/>
Clearing, grading, and building placement consider viewsheds	<input type="checkbox"/>
Cut and fill have been minimized	<input type="checkbox"/>
Buildings blend into the natural topography	<input type="checkbox"/>
Buildings are oriented to the sun and wind for maximum energy efficiency Vegetated protection from northwest (winter) winds is provided Deciduous species planted or retained close to the E, S and W building edges	<input type="checkbox"/> <input type="checkbox"/>

II. Stormwater Management

a. Overview and Objectives

The need for strong and innovative stormwater management practices is based on Winchendon's attempt to address several challenges:

- Winchendon has numerous streams, ponds and wetlands, and is at the headwaters of the Millers River, all of which are affected by polluted runoff.
- The Town's hilly topography contributes to stormwater runoff and flooding in developed areas. Better groundwater recharge will reduce flooding and help maintain base flows of rivers and streams.
- The U.S. Environmental Protection Agency (EPA) and MA Department of Environmental Protection (DEP) are creating more stringent requirements for communities to manage polluted runoff effectively.¹ (Notes and references are provided in the endnotes.)

In order to attain a minimum level of stormwater management for development and redevelopment projects, Winchendon has adopted the following stormwater management performance objectives.² The performance objectives allow the design engineer to select one or more stormwater management systems that are most appropriate and cost-effective for the particular site.

WINCHENDON OBJECTIVES: All new development projects in Winchendon should meet the following three stormwater management performance objectives. All redevelopment projects should meet the objectives and if they fail to meet the objectives, should retrofit or expand existing stormwater management systems to improve existing conditions.

1. Post-development peak discharge rates from the site should not exceed pre-development peak discharge rates from the site.
2. Annual groundwater recharge from the post-development site should approximate annual recharge from the pre-development site.
3. The stormwater management system should remove at least 80% of the average annual load of total suspended solids (TSS) from the post-development stormwater created on the developed site.

There is a growing realization among water resource professionals that conventional systems of stormwater collection, conveyance, and end-of-the-pipe dry-basin detention are not sufficient to improve the water quality of surface water bodies. Therefore, the Town's preference is that stormwater be conveyed and treated in natural and vegetated systems such as vegetated swales, filter strips, constructed wetlands, and bioretention cells (rain gardens). While some of these practices may be new to the Town of Winchendon, they have been used successfully in other towns and states and have gained support from the EPA because of their generally superior performance in attenuating peak runoff rates, filtering

WINCHENDON OBJECTIVES: Low impact, non-structural stormwater management systems should be used wherever site conditions allow, as outlined in the Guidebook. Drain pipe/catch basin systems may be used, in part or in whole, if the applicant can demonstrate that other systems are not feasible due to site conditions.

pollutants, recharging groundwater, and allowing retention of the natural landscape. Recognizing that non-structural systems are not appropriate in all situations, the Guidebook also discusses other practices that can be used in certain situations.

This section of the Guidebook discusses ten stormwater management practices that can be used, alone or in combination, to meet the performance objectives. Other systems not discussed in this guidebook may also be appropriate if the applicant can demonstrate their fulfillment of the above objectives. Table 2-1 provides a summary of the practices discussed in this chapter and when each practice is encouraged.

Table 2-1: Use of Stormwater Management Practices in Winchendon

Practice	Winchendon's Objective	Appropriate Uses
Vegetated Water Quality Swales (Dry & Wet)	Strongly encouraged	Roadsides, parking lots
Vegetated Filter Strips	Strongly encouraged	Roadsides, residential frontage areas, parking lots, perimeter protection
Constructed Wetlands	Strongly encouraged	Commercial and industrial sites, office campuses, subdivisions
Bioretention Cells (Rain Gardens)	Strongly encouraged	Residential lots, parking lot islands, urban & suburban locations; retrofits
Porous Pavement	Encouraged	Parking overflow areas, driveways, walkways
Tree Box Filter	Encouraged	Along streets and sidewalks in urbanized locations
Green Roofs	Encouraged	Office/industrial buildings
Wet Basins	Neutral	Subdivisions, office developments
Dry Detention Basins	Can be used in combination with other practices or when other systems are not practical due to site constraints	All areas of development, if necessary
Deep Sump Catch Basin	Can be used when other systems are not practical due to site constraints	All areas of development, if necessary

There are several factors to consider when deciding on which practice(s) to implement in any given project. Among these factors are the space required, soils and slopes on site, depth to the water table, maintenance requirements, pollutant removal efficiencies, cost, and ability to meet Winchendon's stormwater performance objectives.

b. Summary of Practices

Table 2-2 provides a summary of design and site considerations for selected stormwater management systems.

Table 2-2: Design and Site Considerations for Stormwater Practices³

	Vegetated Water Quality Swales (Dry & Wet)	Vegetated Filter Strips	Constructed Wetlands	Bioretention Cells (Rain Gardens)	Porous Pavement	Tree Box Filter	Wet Basins	Dry Detention Basins
Space Required	Bottom width: 2 ft. min. 8 ft. max.	Minimum length, 25 feet. Minimum width should be 20% of the length of flow path or 8 ft., whichever is greater	1% to 2% of watershed drainage area. Generally a watershed contributing area >10 to 25 acres is needed	Device size should be 5% to 7% of the area draining to it. Devices perform best with contributing area <5 acres	Not a factor	Not a factor	Min. pool surface area: 0.25 acres. Require drainage area from 20 acres to 1 sq. mi.	1 acre foot per 4 acres drainage area
Soils	Permeable soils perform better, but wet swales can be used in less permeable soils	Permeable soils perform best. Avoid using in soils with high clay content or soils that cannot sustain grass cover	Preferred soils are medium-fine textured soils such as loams and silt loams	Man-made soil mix is used consisting of sand, topsoil and compost. Under-drains allow for less permeable soils.	Soils with permeability of at least 0.17 inches per hour	Man-made soil mix is used. Under-drains allow for less permeable soils.	Soils should allow permanent pool of water. Where soils are highly permeable, a liner may be used	Highly impermeable soils may not allow water to drain
Slope of Catchment Area	Longitudinal slope of swale should be <5%. Slope should allow non-erosive flow rate	Slope of contributing area should be between 2% and 6%	Max. 15% for forested; 5% for shrubs/ herbs	Devices perform best on slopes of ~5%. Do not site on slopes >20%	Use on slopes <5%	Not a factor	Maximum 15%	Maximum 15%
Water Table and Bedrock	The bottom of Dry Swales should be separated by 2 to 4 ft. from the seasonal high water table	Filter strips should be separated by 2 to 4 feet from the seasonal high water table	Water table should be at or near soil surface, or else a liner can be used to retain water	Separate bottom of device from groundwater to avoid groundwater contamination	Minimum of 3 ft. vertical separation of bottom of storage layer from seasonal high groundwater level	Not a factor	Not a factor	Bottom of basin should not intercept groundwater table
Proximity to Building Foundations	Min. 10 ft. down-gradient from buildings & foundations recom'd	Min. 10 ft. down-gradient from buildings & foundations recom'd	Min. distance 10 ft.	Min. 10 ft. downgradient from buildings & foundations recom'd	Not a factor	Not a factor	Min. distance of 10 ft	Min. distance of 10 ft.
Max. Depth	For Dry Swales maintain at least 1 foot of freeboard above volume expected for 10-year storm	N/A	4 to 6 ft.	2 to 4 ft.. of soil media	2.5 to 4 ft. for filtering and storage beds beneath surface	N/A	8 ft. 3 to 6 ft. pool depth preferred	3-12 ft.
Maintenance Requirement	Low: routine landscape maint.	Low: routine landscape maint.	Moderate; depends on sediment'n rate	Low: property owner can include in normal site landscape maint.	Low: routine sweeping to reduce clogging of pores	Low: rake soil media to maintain filtration; check tree	Moderate; depends on sediment'n rate	Moderate: routine sediment removal

Table 2-3 may be used for comparison with Winchendon’s 80% TSS removal standard. Other systems not discussed in this Guidebook may also be used if the applicant can demonstrate that they meet Winchendon stormwater management performance standards detailed in the LID Regulations.

If more than one practice is used to achieve the required 80% TSS removal, the removal efficiency rates must be multiplied together, not added. For example, if the first practice has a 60% TSS removal rate and the second practice has a 20% removal rate, a total of 68% of TSS would be removed. (60% of the total, plus 20% of the remaining 40% of TSS.)

Table 2-3: TSS Removal Rates for Stormwater Management Practices⁴

Practice	Design Rate for TSS Removal (use this number to calculate compliance with the 80% TSS removal requirement)	Range of Average TSS Removal Rates
Vegetated water quality swales (Dry & Wet)	70%, when provided with pre-treatment device such as sediment forebay with check dam	60-80%
Vegetated filter strip	10% if filter strip is 25 ft. wide; 45% if filter strip is 50 ft. wide	10-65%, depending on width
Constructed wetland ^a	80% with sediment forebay for pre-treatment	30-80%
Bioretention cells (Rain Gardens)	90% ^b with appropriate pre-treatment such as a vegetated filter strip	65-90%
Porous pavement	80%	65-90%
Tree box filter	80%, presumed	Insufficient data
Wet basin ^a	80%, when provided with pre-treatment sediment forebay	60-80%
Dry detention basins ^c	MA DEP does not give credit for TSS removal	Insufficient data
Deep sump catch basin	25%, only if used for pretreatment and designed as off-line systems	25% w/cleanout

^a Must have sediment a forebay or pre-treatment.

^b If an underdrain is used, the water must be conveyed to a secondary treatment device such as a constructed wetland or a wet basin.

^c Post-treatment is required (e.g., by a constructed wetland or wet basin).

c. Discussion of Practices

Each of the ten stormwater management practices is discussed in more detail below. Most of the information has been taken from the MA DEP Stormwater Management Handbook. References in the endnotes provide additional information on the use, design, and construction of these practices.

Persons who are required to meet the specifications of the Winchendon Low Impact Development Bylaw and Regulations must comply with the most recent version of the MA Department of Environmental Protection's Stormwater Management Standards and Handbook in the design and construction of stormwater management devices. Consult that document to meet regulatory requirements and for details about stormwater management practices.

1. Vegetated Water Quality Swales (Dry & Wet)



Figure 2-1 Dry water quality swale

Swales are earthen channels most commonly covered with a dense growth of grass or other vegetation, and are designed primarily to control water quantity and quality from a 10-year storm without causing erosion.⁵ The design of vegetated swales has improved over the years, enabling engineers and hydrologists to implement them for a variety of different purposes. Depending on hydrological conditions and design, swales can be dry or wet:

- **Dry swales** Dry swales are designed to temporarily hold the water quality volume of a storm in a pool or series of pools created by permanent check dams at culverts or driveway crossings. The soil bed consists of native soils or highly permeable fill material, underlaid by an underdrain system..
- **Wet swales** Wet swales also temporarily store and treat the required water quality volume. However, unlike dry swales, wet swales are constructed directly within existing soils and are not underlaid by a soil filter bed or underdrain system. Wet swales store the water quality volume within a series of cells within the channel, which may be formed by berms or check dams and may contain wetland vegetation. The pollutant removal mechanisms in wet swales are similar to those of stormwater wetlands, which rely on sedimentation, adsorption, and microbial breakdown.

Design Considerations

Swales are easily implemented on large lot residential sites (½ to 1 acre or larger), office and industrial campuses, roadways where right-of-way widths are adequate, and parking lot medians and edges (Figure

2-1). Ideally, stormwater should flow from the impervious surface through a vegetated filter strip before entering the swales (see Figure 2-2). Typically, dry swales are used for low density residential projects or very small impervious areas and require soils that have infiltration rates of 0.27-0.50 inches per hour. Wet swales, on the other hand, are convenient for treating highway runoff in low lying or flat terrain areas and need to be planted with water tolerant vegetation.

Swales should be built at a gentle slope so that water flows at a relatively low velocity. The minimum slope should be ½%, while the maximum slope is based on velocity. Water velocity in the swale should generally not exceed 3 feet per second, which typically corresponds to a maximum slope of about 5%. If necessary, the swale may be steeper in places, provided that riprap or other stabilization is used to prevent scouring and erosion within the swale. The side slopes should be at a maximum of 3:1, and the length of the swale should be calculated to accommodate the entire calculated runoff volume from a 10-year storm. Regular maintenance such as mowing, sodding, and repair of eroded areas is necessary for swales. In addition, the accumulated sediment may need to be periodically removed, particularly during the construction and early site stabilization periods.

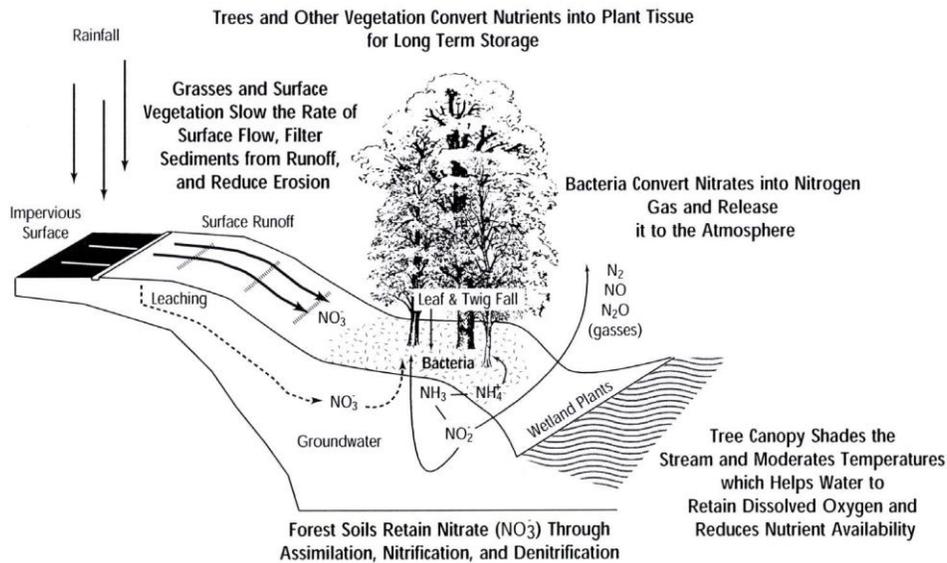


Figure 2-2 Processes by which vegetated filters remove pollutants

2. Vegetated Filter Strips

Filter strips are typically bands of close-growing vegetation, placed between pollutant source areas and the receiving water body (either a natural water body or a constructed swale). To protect natural water



bodies (e.g., streams or wetlands), filter strips should consist of natural buffer strips already existing on the site. Not only do filter strips protect sensitive areas such as wetlands, woodlands and erodible soils; they also reduce runoff impacts by trapping sediment and sediment-bound pollutants, provide some infiltration, and slow and disperse stormwater flow over a wide area.⁶ Figure 2-2 illustrates some of the biochemical processes by which filter strips remove pollutants.⁷

Figure 2-3 Vegetated filter strip

Design Considerations

Treatment of stormwater in filter strips is accomplished physically by a combination of filtration through the standing vegetation and infiltration into the underlying soils. In order to treat stormwater effectively, filter strips must be designed to function as overland flow systems where stormwater is evenly distributed. Because there is a high potential for short-circuiting of the filter strips and reduced pollutant removal, grading must be designed carefully to provide uniform flow into the filter strips, via devices such as a level spreader.

If filter strips are wide enough and planted with appropriate plant species, they will provide wildlife habitat as well as visual amenities in the landscape. It is important to note that filter strips are usually implemented in combination with other stormwater management devices that specifically control stormwater volume. Finally, for a filter strip to be efficient, a minimum width of 15 to 30 feet is recommended. Upkeep of filter strips should be incorporated into routine landscape maintenance, which would include raking the filter strip, removing large trash or debris, and regularly cleaning up sediment.

3. Constructed Wetlands



Constructed wetlands (or stormwater wetlands) are shallow pools that create growing conditions suitable for marsh plants. These systems are designed to maximize pollutant removal through retention, settling, and uptake by wetland plants.⁸ Stormwater wetlands serve several benefits simultaneously. The primary purpose of constructed wetlands is to improve water quality by removing sediment and pollutants. However, these wetlands can also

Figure 2-4 Constructed stormwater wetland

provide excellent habitat for wildlife and waterfowl. In general, a constructed wetland would be a suitable stormwater management practice for residential subdivisions and commercial developments. Constructed stormwater wetlands do not create additional, regulated water resource or buffer areas.

Design Considerations

Constructed wetlands must be designed with consideration to the size of the contributing watershed area, amount of baseflow, soil type, and available space. A contributing drainage area should be at least 10 acres. While the contributing watershed may be as small as 1 acre., the smaller the watershed area, the more difficult it is to create sufficient drainage and runoff to keep the wetland perpetually wet. Since wetlands need to maintain soil moisture throughout the year, it is important to have a dry-weather baseflow or a groundwater supply. The preferred soil types for constructed wetlands are less-permeable soils that have relatively small pores and are less prone to evaporation.

The surface area of constructed wetlands should be at least 1% of the contributing drainage area, and the wetlands should have a length to width ratio of at least 2:1.⁹ In order to increase the efficiency of the retention pond, a sediment forebay must be incorporated as a pretreatment device.

As with all stormwater management practices, stormwater wetlands require ongoing maintenance to retain maximum effectiveness. However, several design features can decrease the amount of maintenance that a wetland needs. For example, a reverse-slope pipe or a weir outlet with a trash rack should be used to prevent clogging of the outlet; orifices should have diameters no less than 3"; and direct maintenance access should be provided to the forebay to allow for sediment removal. Selection of plant species is one of the most important parts of creating a stormwater wetland, as the plants are largely responsible for the pollutant and sediment retention and uptake. Please refer to Figure 2-5¹⁰ for a sample wetland layout and **Section IV** for a list of plant species suitable for planting in constructed wetlands.

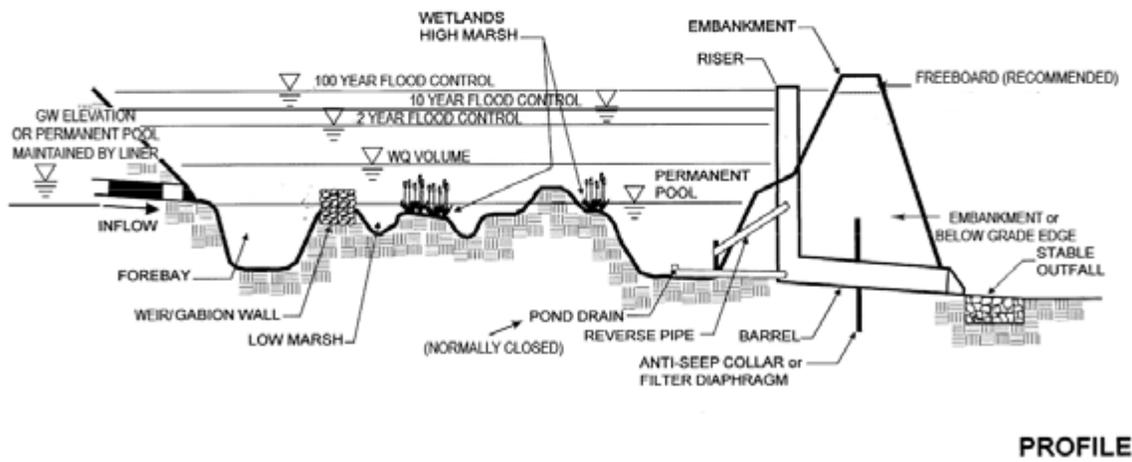
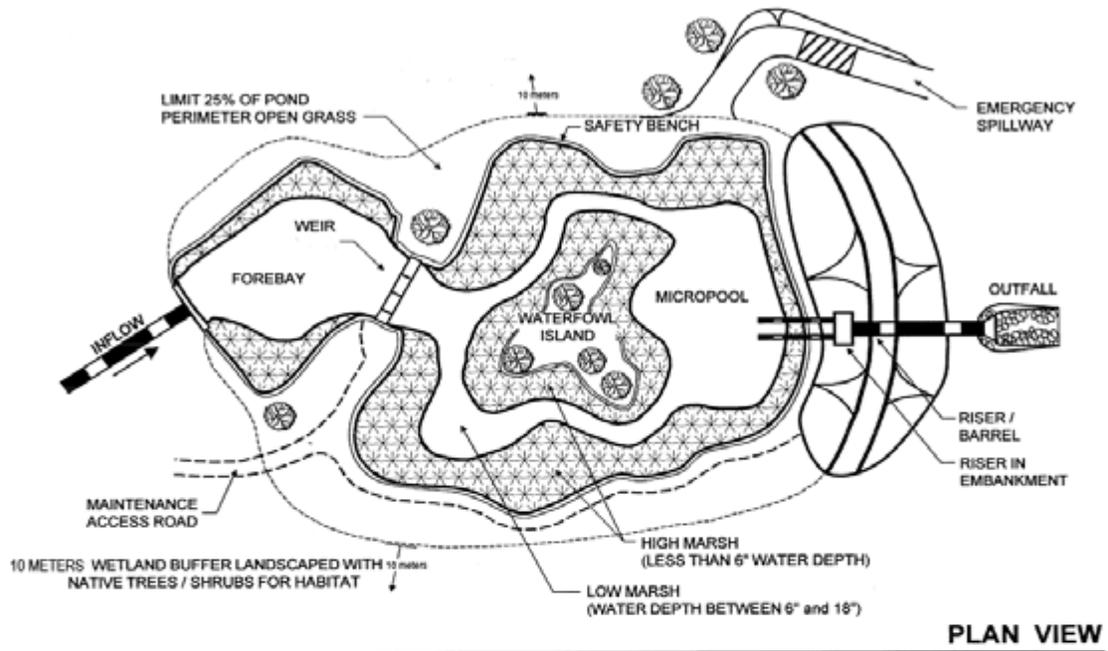


Figure 2-5 Example of constructed stormwater wetland, shallow marsh type

4. Bioretention Cells (Rain Gardens)

Bioretention is a technique that uses soils, plants, and microbes to treat stormwater before it is infiltrated and/or discharged. Bioretention cells (also called rain gardens in residential applications) are shallow depressions filled with sandy soil topped with a thick layer of mulch and planted with dense native vegetation. Stormwater runoff is directed into the cell via piped or sheet flow. The runoff percolates through the soil media that acts as a filter. There are two types of bioretention cells: those that are designed solely as an organic filter filtering bioretention areas and those configured to recharge groundwater in addition to acting as a filter exfiltrating bioretention areas. A filtering bioretention area includes an impermeable liner and underdrain that



Figure 2-6 Rain garden on a residential lot

intercepts the runoff before it reaches the water table so that it may be conveyed to a discharge outlet, other treatment practices, or the municipal storm drain system. An exfiltrating bioretention area has an underdrain that is designed to enhance exfiltration of runoff into the groundwater.

Runoff is conveyed to the treatment area, which consists of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants (see Figure 2-8¹¹). Runoff passes first over or through a sand bed, which slows the runoff and distributes it evenly along the ponding area. The ponding area is made up of a surface organic layer, ground cover and the underlying planting soil. The ponding area is graded so that there is a depression in the middle where water remains until it infiltrates or evaporates. The depression should be designed to hold 6 to 8 inches of water.¹² An overflow structure should be provided for situations where the ponding area is not sufficient.

Bioretention cells can be used in both residential and commercial projects. In residential areas, rain gardens are used to retain and infiltrate stormwater locally so that it does not need to be conveyed and treated by means of a more extensive stormwater management system. Each residential lot would typically have one or more rain gardens that receive stormwater from the roof and driveway and infiltrate it to the ground. Homeowners are responsible for maintaining the rain gardens on their property, just as they would maintain their garden.



Figure 2-7 Bioretention cell at a commercial site
Photo courtesy Berkshire Design Group

Each residential lot would typically have one or more rain gardens that receive stormwater from the roof and driveway and infiltrate it to the ground. Homeowners are responsible for maintaining the rain gardens on their property, just as they would maintain their garden.

In commercial projects, bioretention cells are installed as depressed islands in the parking lot. Stormwater is directed to these islands, where it is treated and infiltrates into the ground.

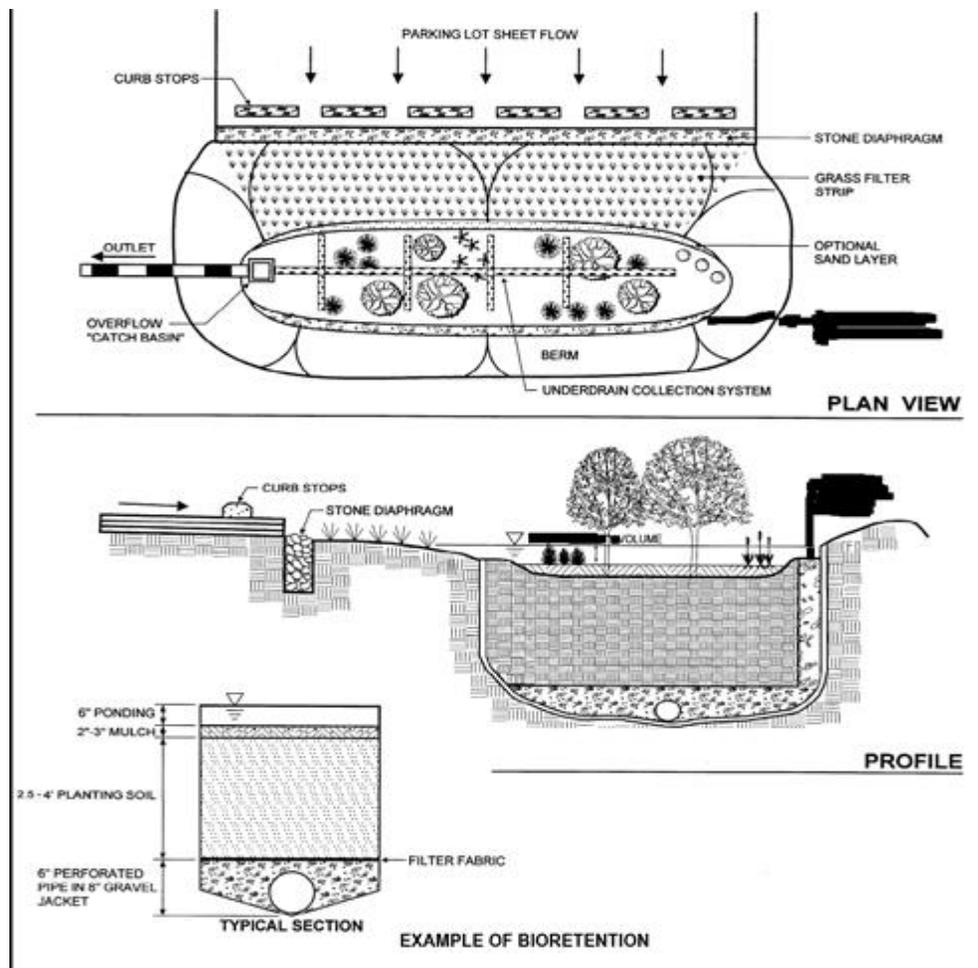


Figure 2-8 Example of bioretention

Design Considerations

The design of bioretention cells must consider the site area, slope, soils, groundwater, and maintenance needs. Bioretention cells should be designed to occupy 5 to 7 percent of the drainage area. Bioretention cells receiving parking lot runoff are recommended to have minimum dimensions of approximately 15 feet by 40 feet. Rain gardens on individual house lots can be much smaller, on the order of 10 feet by 15 feet.

The site should have shallow slopes (approximately 5% or less) so that water flow is guaranteed but velocity is not too high. An underdrain should be used in situations where soils are less permeable and there is a concern about the cell backing up or flooding. (Bioretention cells may be constructed by importing more permeable soils for the cell itself, in combination with an underdrain which prevents water from ponding above a less permeable natural soil layer.) An underdrain should also be used where the water table is close to the surface and there is a concern about groundwater pollution. In other situations, an underdrain generally is not needed.

Bioretention cells need to be maintained regularly to ensure the presence of mulch and good soil, attend to any diseased or dead plants, and remove collected sediment, litter and debris.

5. Porous Pavement

Porous pavement typically consists of a permeable surface with an underlying crushed/broken stone



reservoir to temporarily store runoff before it infiltrates into the ground. The main purposes of this application are to reduce the amount of stormwater runoff from paved areas and to infiltrate stormwater into the underlying soils. By reducing the amount of stormwater runoff, pervious paving surfaces reduce the cost of stormwater management. Porous pavement may be used for walkways, patios, plazas, driveways, parking stalls, and overflow parking areas.

Porous pavement that is now available includes porous asphalt, pervious concrete and grass pavers. Porous asphalt and pervious concrete appear to be the same as traditional pavement from the surface, but incorporate void spaces to

Figure 2-9 Porous asphalt

allow infiltration. These systems have been applied successfully in New England locations where soils consist of well-drained sands and gravels that allow the pores to drain rapidly. Porous pavement can be successfully installed in cold climates as long as the design includes features to reduce frost heaving.



Grass pavers (Figure 2-10) consist of concrete interlocking blocks or a synthetic fibrous gridded system with open areas designed to allow grass to grow. The design should allow for infiltration into the underlying soils so that stormwater does not pond near the surface.

Design Considerations

Grass pavers are most suitable for low-traffic areas such as the overflow areas of commercial or office parking lots, residential driveways, and service areas that will be subject to light traffic. Winchendon recommends their use in these situations. If these systems are used, stormwater calculations should account for the reduced amount of runoff generated by areas with grass pavers. In general, grass paver systems should not be salted in the winter because this will threaten the viability of the plants. However, salting will not typically be required in the low-traffic areas where

Figure 2-10 Grass pavers

grass pavers are recommended.

6. Tree Box Filter



Figure 2-11 Tree box filter

A tree box filter is a small bioretention system that provides effective water quality treatment for stormwater in urban settings where space is limited. It consists of a concrete barrel, usually with an open bottom, that contains a porous soil mix, a crushed gravel underdrain and a tree or shrub. Stormwater is directed from the sidewalk and street into the tree box where sediment and other pollutants are filtered through the soil mix. Treated stormwater overflow from the tree box filter is directed to the underdrain and may then enter a storm drain or other stormwater treatment device.

Tree box filters are effective pretreatment devices which also reduce stormwater volume and rate of runoff. They can be

useful as retrofits in urban settings and at redevelopment sites. Tree boxes, however, treat relatively small volumes of water. The contributing area for a tree box should not exceed 0.1 acre.

7. Green Roofs



Figure 2-12 Green roof

Green roofs are a permanent rooftop planting system containing live plants in a lightweight engineered soil medium designed to retain precipitation where the water is taken up by plants and transpired into the air. As a result, much less water runs off the roof compared to conventional rooftops. Green roofs provide several benefits such as reducing stormwater runoff volume and pollutant load, increasing the energy efficiency of buildings, improving air quality by removing particles in the air and by photosynthesis, and increasing the aesthetic value of the area. Green roofs can be built on almost any rooftop, from a residential building to a commercial or industrial building. Figure 2-12 shows a typical application.¹³ The Town of Winchendon recommends that green roofs be used in large commercial, office, and institutional buildings that have flat or gently sloping roofs.

Green roofs with a restricted variety of plants (resistant to frost, wind and drought: sedum, herbs and grasses) require minimal long-term maintenance. During the initial stage some watering might be required; however, within

six months the plants are usually able to sustain themselves. Since the soil layer is not deep, it will not support tall vertical growth or large plants; therefore, cutting or mowing is not required. Load reserves of at least 15 pounds per square feet beyond snow load requirements are needed to install a roof garden.¹⁴ If properly built over a suitable roofing membrane, roof gardens do not present a leaking problem.

8. Wet Basins



Figure 2-13 Wet basin

Wet basins are constructed to have a permanent pool of water to treat stormwater. The pool allows settling of sediments, removal of soluble pollutants by algal uptake, and some groundwater recharge as shown in Figure 2-13¹⁵. The basins are designed to include additional storage capacity to control peak discharge rates. The primary component of a wet basin is a deep, permanent pool, and the basin must also include a shallow marsh or a sediment forebay to increase sediment and nutrient removal.¹⁶ In general, the Town of Winchendon does not recommend that

wet basins be used as the primary means of attenuating peak runoff rates or removing pollutants. Constructed wetlands are generally a preferred system since they have greater pollutant uptake functions. However, wet basins may be used in subdivisions as well as commercial and industrial areas when other stormwater management systems are not feasible or sufficient because of site conditions or the nature of the development program. Wet basins may also be used in series with constructed wetlands as a sediment trap, particularly during construction.

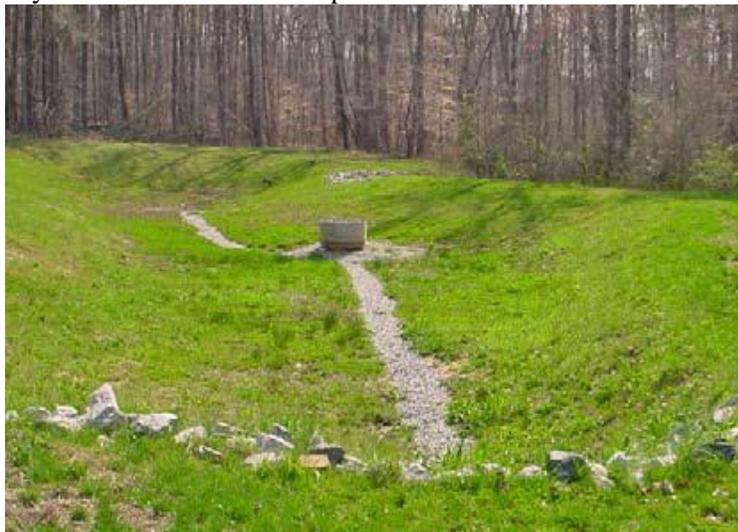
Design Considerations

Wet basins must drain a sufficiently large area to maintain a permanent pool of water. The minimum recommended area is 20 acres, assuming impervious surface percentages typical of suburban developments.¹⁷ Within the watershed area that drains to the wet basin, the slopes and the stormwater conveyance system must result in a metered flow of stormwater that does not flood the basin all at once. The use of filter strips and swales can help slow and infiltrate water on its way to the basin.

Wet basins can be constructed in a wide range of soil types. However, when native soils have a rapid percolation rate, soils should be compacted or supplemented sufficiently so that the pond does not dry up during the dry season. The soils should retain sufficient infiltration potential so that the pond also continues to play a role in groundwater recharge. In order to increase the efficiency of the wet basin, a sediment forebay must be incorporated as a pretreatment device. As with constructed wetlands, wet basins should use non-clogging outlets and large orifices (not less than 3 inches in diameter), and should provide easy dredging access to reduce long-term maintenance requirements and difficulties.

9. Dry Detention Basins

Dry detention basins are depressed areas whose outlets have been designed to detain stormwater runoff



for some minimum time to allow particles and associated pollutants to settle. Since the aim of dry detention basins is mainly to control flooding and remove sediments, they do not need to have a permanent pool and therefore can be dry during non-flood conditions. Typically, they are used as a primary treatment in conjunction with other stormwater management systems such as wet basins or constructed wetlands.

The Town of Winchendon discourages the use of detention basins as the primary means of flood control. Instead, dry water quality swales, vegetated

Figure 2-14 Dry detention basin

filter strips and bioretention should be used whenever possible to attenuate peak runoff rates. When site characteristics do not allow use of such practices, however, detention basins may be considered as part of the stormwater management system. In addition, detention basins may be used as a pre-treatment device to settle out particulates prior to discharge to a constructed wetland or wet basin, where additional treatment and infiltration will occur.

Design Considerations

Dry detention basins are most practical for use on sites of at least 10 acres, which allows for the use of larger outlet orifices that are less likely to clog. Detention basins can be used on sites with slopes up to 15 percent. To provide drainage, make the minimum slope of the bottom 2 percent. If soils on site are relatively impermeable (such as Soil Group D), a dry detention basin may experience problems with standing water. On the other hand, if the soils are highly permeable, such as well-drained sandy and gravelly soils (Soil Group A), it will be difficult to establish a shallow marsh component in the basin. Dry detention basins should be designed with sediment forebays which allow sediment to be trapped prior to entering the detention basin. This feature also reduces maintenance requirements for the detention basin. As with constructed wetlands, detention basins should use non-clogging outlets and large orifices (not less than 3 inches in diameter), and should provide easy dredging access to reduce long-term maintenance requirements and difficulties.

Any dry detention basin in the Town of Winchendon must provide landscaping and planting to minimize its visual impacts. The plants selected for the ponding area should be able to withstand both wet and dry periods. Along the perimeter of the basin, however, the plants should be adapted to dry conditions and should create a visual vegetated buffer.

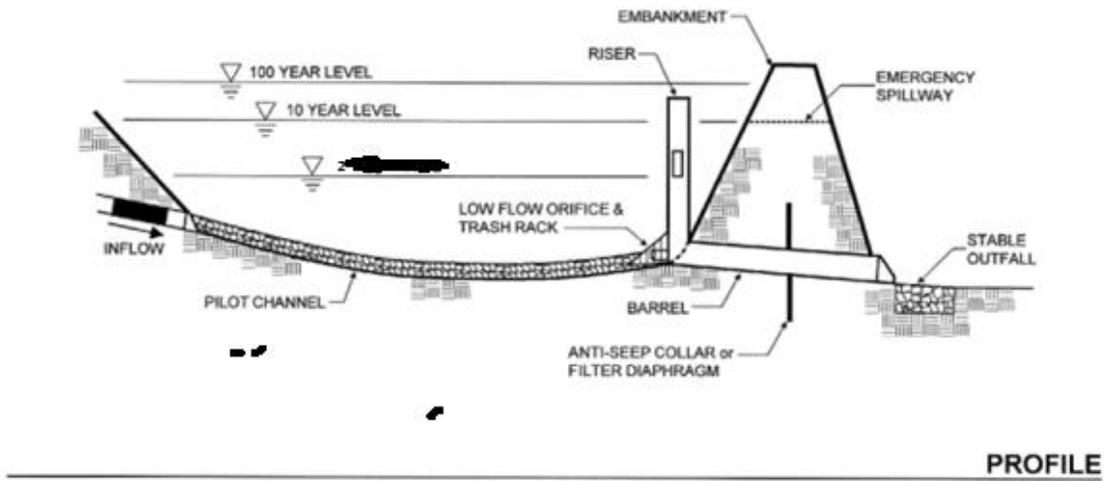
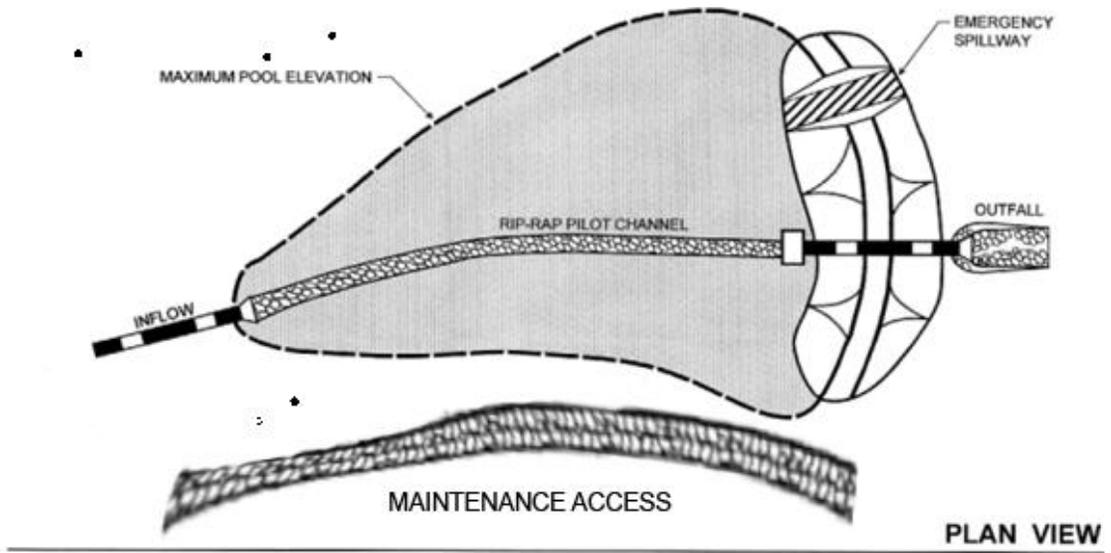


Figure 2-15 Dry detention basin schematic

10. Deep Sump Catch Basin



Catch basins are storm drains that capture and roughly filter stormwater through a grate or curb inlet and capture sediment, debris and associated pollutants in a deep sump (Figure 2-16¹⁸). In most cases a hood is also included to separate oil and grease from the stormwater. The essential function of a catch basin is to act as a pretreatment device for other structures incorporated into a storm sewer system. The performance of a catch basin in removing sediment and pollutants will depend greatly on the size of the drainage area, the size of the sump, and the amount of maintenance it receives. Although catch basins are currently used in virtually all circumstances, they typically cannot remove pollutants as well as most of the

Figure 2-16 Deep sump catch basin inlet

other practices described in this section, and they require frequent maintenance. Catch basins should be used only when other practices discussed in this section prove unfeasible.

When catch basins are used, the Town will consider it preferable if they discharge individually or in pairs to nearby swales, constructed wetlands, or bioretention cells, rather than carrying runoff further to a larger retention/infiltration system. Lengthy catch basin-piped drain-manhole networks are discouraged. In general, the goal is to use vegetated, low-velocity channels to hold and infiltrate stormwater locally, not to efficiently capture and deliver stormwater to watercourses.

Design Considerations

The contributing drainage area to any deep sump catch basin should not exceed 1/4 acre of impervious cover. Catch basins should have sumps that are at least four feet deep. The inlet openings must not allow flows greater than 3 cfs to enter the deep sump catch basin. Flow from the catch basin/drain pipe system should be directed to another stormwater management device, such as a constructed wetland, for further treatment. Catch basin inlets should be cleaned regularly (at least twice a year) and after large storms. Removed sediment should be disposed of in accordance with applicable local, state and federal guidelines and regulations.

III. Erosion and Sedimentation Control

Erosion and sedimentation control practices should be incorporated into the planning, construction, and operation of any project in Winchendon. Specific measures should be presented for review prior to construction. For more detailed information please consult the MA DEP *Erosion and Sediment Control Guidelines*.

a. Site Planning

The most important erosion control practice is to minimize clearing and regrading, as discussed in **Section V**, Site Planning.

WINCHENDON OBJECTIVES: Any proposed project on a previously undeveloped site should accommodate the development process in a way that minimizes clearing and regrading, especially in areas of steep slopes, erosion-prone soils, or sensitive vegetation. For redevelopment projects, the site plan should concentrate development in previously-disturbed areas to the extent possible.

The initial step to control erosion and sedimentation lies in developing a plan that is appropriate to the site features including topography, soils, drainage ways, and natural vegetation. The site planning process should begin with a thorough evaluation of sensitive areas requiring protection as well as less sensitive areas suitable for development. The site plan should delineate a limit of work that limits clearing and regrading and protects the most sensitive areas, based on the criteria in Table 3-1. For example, in residential subdivisions, native vegetation should be retained on individual house lots to the extent possible, rather than creating larger lawns.

Table 3-1: Guidelines for identifying sensitive site features¹⁹

Topography	Drainage	Soils	Natural vegetation
<p>Slopes that are steeper and/or longer typically create more erosion. Slopes that exceed the following thresholds are likely to be sensitive and erosion-prone:</p> <ul style="list-style-type: none"> • Slopes of 5-7% longer than 300 feet • Slopes of 7-15% longer than 150 feet • Slopes of more than 15% longer than 75 feet 	<p>Where possible, retain natural drainage ways and depressions and utilize for stormwater conveyance</p>	<p>Consider factors such as erodibility, permeability, depth to water table and bedrock, and soils with shrink/swell potential or slippage tendencies. The most erodible soils contain high proportions of silt and very fine sand. The presence of clay or organic matter tends to decrease erodibility.</p>	<p>This is the most important factor in preventing erosion. Vegetated buffers filter runoff, decrease runoff velocity, and increase infiltration capacity.</p>

b. Construction Period Impacts

Prior to the commencement of construction, the limit of clearing and limit of work identified on the site plan should be suitably marked with survey tape or plastic fences. These markers are in addition to any fences that the Conservation Commission may require for sensitive areas such as wetlands, streams and their buffers. Construction activities and construction traffic should be limited to the area identified on the site plan, and no stockpiling of materials, soils, or debris or other activity should occur outside of the limit of work.

WINCHENDON OBJECTIVES: Every proposed project should adhere to a construction management plan that addresses soil stabilization, sediment retention, perimeter protection, construction scheduling, traffic area stabilization and dust control.

1. Soil Stabilization

The builder/developer should create a plan for cover and/or stabilization of erodible surfaces that are not the immediate focus of construction activity. The Town's objective is to minimize soil erosion and sedimentation in the Town's water bodies and storm sewer system. Cover measures should be implemented on areas that have already been disturbed but will not be worked on during the next 7 days during dry conditions or next 2 days during wet conditions. Cover methods may include, but are not limited to, the use of mulch, erosion control nets and blankets, plastic covering, seeding and sodding. These are described in the following paragraphs.

Mulching is generally considered to be a suitable short-term protective measure. The main purpose of mulching is to protect the site from erosion by stabilizing soils and reducing stormwater runoff velocity. Mulch can also enhance plant establishment by conserving moisture, holding fertilizer, seed and topsoil in place, and moderating soil temperature. The most commonly used mulches include straw, wood fiber or cellulose, compost and wood chips. The effectiveness of mulching depends on site characteristics and maintenance: if the site is prone to high winds or has steep slopes, additional steps should be taken to anchor the mulch, such as planting vegetation or providing netting or blanketing. The thickness of the cover should be maintained at all times and any area that has eroded should be re-mulched and anchored until it has been stabilized.

Similar to mulching, plastic covering is also acceptable as a short-term protective measure. This technique simply involves covering the area of concern with a plastic sheet and using tires or sandbags to weight the plastic down. Plastic covering is generally used on cut and fill slopes and stockpiles. Plastic covering should not be used if there is a sensitive area located downslope, because of the rapid runoff created by the plastic covering. Although this is a fairly easy technique to apply, it requires careful maintenance. The plastic cover can easily be torn or damaged by the sun and can clog drainage systems if not removed properly. Therefore, regular maintenance should be provided to ensure that the plastic is undamaged at all times and fully removed after it is no longer needed.

Seeding, sodding and erosion nets and blankets are usually more appropriate as long-term solutions for areas that will remain unworked for months. **Section IV** lists recommended species to plant for erosion control purposes. A well-designed



Figure 3-1 Geotextiles used for stabilizing a hill

landscaping plan can easily incorporate areas of planting for permanent erosion control. If the area must be stabilized immediately, then the use of sodding is more appropriate since it can provide immediate erosion protection. Sodding is appropriate for use on residential or commercial lawns, steeply-sloped areas, waterways and channels carrying intermittent flow, and areas around drop inlets that require stabilization.²⁰ Sod maintenance is essential during the establishment period. Sod should be provided with adequate moisture and fertilizer. If the sod does not root and stay healthy, it should be replaced by new sodding or a different technique.

Erosion control nets or blankets, also referred to as geotextiles, are another suitable long-term stabilization technique (see Figure 3-1²¹). Geotextiles are used for preventing erosion and holding seed and mulch in place on steep slopes, as well as in channels to aid vegetation establishment. Geotextiles can be made of synthetic materials such as polypropylene, polyester, polyethylene, nylon, and polyvinyl chloride as well as biodegradable materials such as mulch matting, jute, coconut fiber and other wood fibers. For effective stabilization, good contact with the ground must be maintained and no erosion should occur beneath the net or blanket. Synthetic geotextiles can be sensitive to light and wind; therefore, they should be inspected regularly and any problematic areas should be repaired immediately.

2. Sediment Retention

Sediment retention from construction sites is a three-step process. First, all surface runoff from disturbed areas should be intercepted since this runoff contains high sediment loads. Second, the runoff should be conveyed to a sediment trap or pond where sediment removal will occur. Finally, the cleaned runoff should be discharged downslope of any disturbed areas. Typically, interceptor dikes and swales are used to intercept runoff; check dams are used to reduce flow velocity and remove sediment; ditches and pipes are used to convey the runoff; and riprap or level spreaders are used to dissipate runoff velocity in a non-erosive manner. As shown in Figure 3-2²², interceptor dikes can collect the runoff and direct it to pipes and/or ditches which can convey the runoff to a sediment pond. The outflow from the pond can be connected to a stream (as shown in this case) or to a vegetated area. Riprap may be used to stabilize outlets. Check dams can be incorporated into the design to reduce the velocity of the runoff. Typically, check dams are installed in swales or ditches and consist of small gravel, rock, sandbag, log or straw dams.

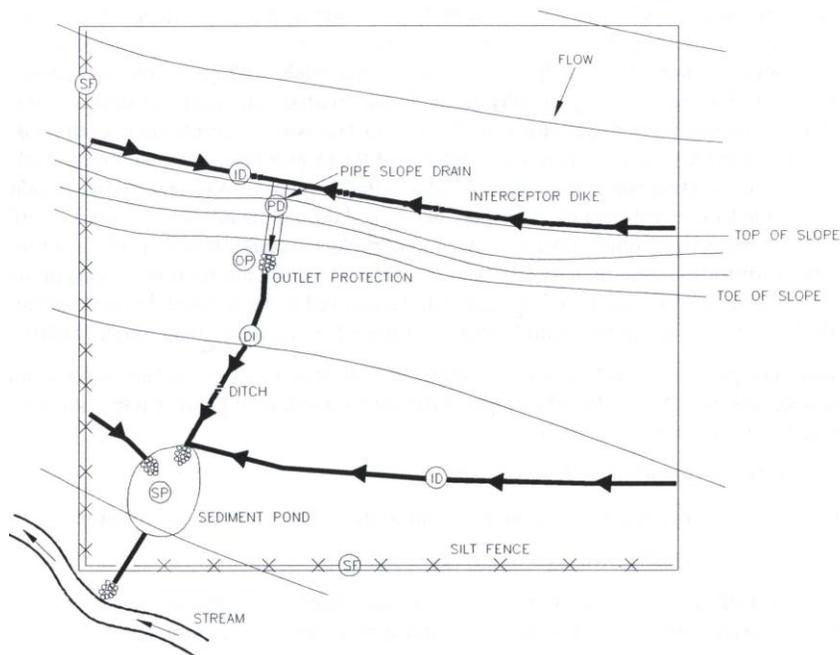


Figure 3-2 Sample sediment retention plan

As mentioned above, sediment should be conveyed to sediment traps or ponds prior to being discharged. Sediment traps should be used for areas less than about three acres, and sediment ponds should be used for larger areas. Stormwater runoff is conveyed through these structures, where sediment is settled (mostly small particles of 0.02 mm or so) and turbidity is slightly reduced.²³ When sediment reaches one foot in depth, the trap or the pond should be cleaned. Any embankments or slopes should also be routinely checked and any damage properly repaired. The construction management plan

should explain how surface runoff will be intercepted and settled before it is released into the ground or off-site.

3. Perimeter Protection

While interceptors and sediment traps/ponds discussed above will provide the primary sediment retention on construction sites, perimeter protection is also necessary to prevent residual sedimentation of adjacent lands and waters. The construction management plan should identify measures to prevent sediment from being transported off of the site. Again, the purpose is to minimize sedimentation in the Town's water bodies, storm sewer system, and adjacent properties. Measures such as vegetated filter strips, silt fences, or brush barriers should be provided at the limit of work to filter runoff and capture sediment. In places where the limit of work is not near the edge of the site, a natural vegetation buffer of 40 feet is generally considered to be an acceptable retention system, except where the natural vegetation is a wetland, a wetland buffer or otherwise sensitive landscape feature, in which case a silt fence or similar device should generally be used. Figure 3-3²⁴ illustrates proper installation of hay bales for sediment retention.

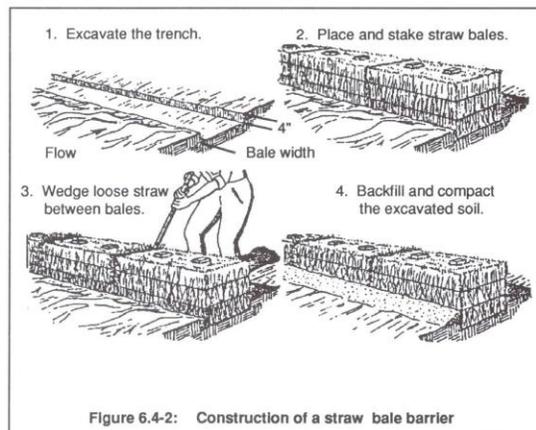
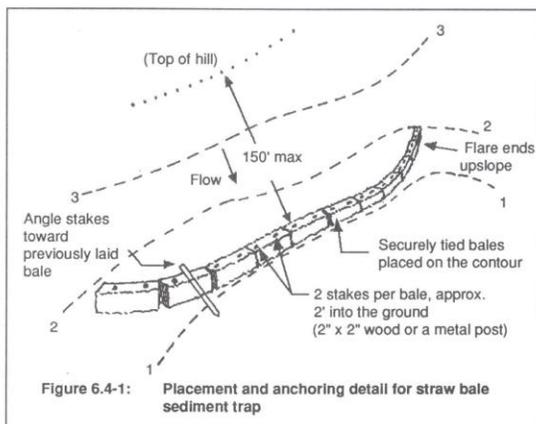


Figure 3-3 Installation of hay bales for sediment retention

4. Other Practices

Scheduling of Operations

The construction management plan should state when clearing, grubbing, grading, construction, and replanting will occur on each section of the site. Construction should be phased by area so that the smallest practical area of land is exposed for the shortest possible time.

Traffic Area Stabilization

To reduce the amount of sediment transported off site by construction vehicles and to reduce the erosion of areas disturbed by vehicle traffic, roads and parking areas should be stabilized immediately after initial grading. Not only will this stabilization reduce amount of sediment transported out of the site; it will also reduce the amount of easily erodible mud that forms on site. Stabilization can be achieved by use of a 6 inch deep layer of crushed rock, gravel base, or crushed surfacing base on the area of construction entrances or roads and parking areas. For any area that will be subject to long-term or high-volume construction vehicle traffic, a truck wash should be implemented, with dirty water channeled through sediment traps or ponds prior to discharge.

Dust Control

The construction management plan should commit to minimizing wind transport of dust from exposed soil surfaces onto roadways, drainage ways, and surfaces waters by spraying exposed soils with water until they are sufficiently damp so as to not produce dust, but not so wet as to produce runoff, whenever weather conditions are dry and windy.

IV. Landscape Design

This section of the Guidebook addresses three critical goals for the Town: stabilizing water use at a sustainable level; creating landscapes that minimize natural habitat destruction and maximize habitat value; and encouraging the development of landscapes that provide environmental quality and visual relief.

a. Water-Sensitive Landscaping

Development in Winchendon and the attendant rise in impervious surfaces alters the natural hydrological cycle, reduces recharge to the groundwater and increases flooding in the Town. Careful attention to water use and hydrologic systems will provide more stable water resources for the community.

On previously undeveloped (“greenfield”) sites, the most important water-sensitive practice is to

WINCHENDON OBJECTIVES: Site plans and landscape plans for proposed projects should take appropriate steps, as outlined in this section, to allow for natural recharge of groundwater and minimize water use for irrigation.

minimize the disturbance and clearing of natural vegetation. Guidelines to meet this objective are provided in **Section III** and **Section V** of this Guidebook. Typically, this will mean preserving some portion of the site as open space, plus reducing the area of lawn and garden in favor of native vegetation in both residential and commercial/industrial projects. In places where native vegetation is cleared, at least some of the area should function as a groundwater recharge system. For example, a landscaped garden could function as a bioretention cell through appropriate subsurface design and selection of species, or portions of a lawn could serve as a vegetated filter strips for driveway runoff if properly graded. In general, the landscape design should aim to:

- Retain and recharge water onsite;
- Preserve existing vegetation to the maximum extent possible;
- Preserve soil permeability during development; and
- Minimize the use of turf grass in landscaping, opting instead for a variety of native species.

To keep the water onsite, impervious areas need to be reduced to the maximum extent practical. Planting beds should be designed to conserve the water they receive. This can be achieved by grading the beds so that slope is gradual and stormwater runoff will have more time to percolate into the soil, and by using plant species that do not require large amounts of water.

To meet water conservation objectives, Winchendon discourages in-ground irrigation systems. However, if irrigation systems are used, they should be water-efficient drip systems or soil soakers equipped with automatic sensors that prevent watering when soils are already wet, or when it is raining. Drip irrigation is defined as the frequent slow application of water to a very small area in the root zone of the plant. Water slowly drips through either porous plastic pipes or emitters located below the soil surface. Drip systems have been found to reduce water use by 20-50%.²⁵ Soil soakers consist of long plastic or canvas tubes perforated with tiny holes through which the water seeps as a fine mist. Soil soakers are connected to a garden hose and can be left in place on the surface of the planting bed or buried under the mulch.

For garden areas, landscape plans should specify the use of a suitable mulch. Use of mulch is beneficial for several reasons. Mulch layers:

- Help capture moisture for vegetation that would normally be lost through evaporation;

- Prevent erosion by protecting the soil surface from raindrop impacts and by reducing the velocity of overland flow;
- Help prevent crusting, sealing and compaction of the surface, thereby preserving the infiltration rate;
- Protect seeds by forming an insulating layer against extreme heat and cold and by creating a suitable microclimate for seed germination; and
- Reduce weed growth and the need for herbicide application.²⁶

Good mulching materials include compost, pine bark, pine straw (pine needle bales), leaf mold, rotted manure, lawn clippings, aged and shredded hardwood bark, aged wood chips, and straw or chopped hay.

b. Plant Species

In the interest of striking an appropriate balance between community development and conservation, the Town of Winchendon is committed to retaining natural habitats and habitat functions on developed sites to the maximum extent possible. In addition, drought-tolerant species should be used in appropriate situations.

Landscape designers working on Winchendon projects should use the following lists to select the most appropriate species for each portion of their site. Recognizing that many species are well-suited to several circumstances, there is much overlap among the nine lists of species provided below. Each list is also divided into different forms of plants, such as shade trees, ornamental trees, evergreen trees, deciduous

WINCHENDON OBJECTIVE: Landscape plans should follow the guidelines in this section for selecting species that are most appropriate to the site conditions. Native species and habitat-creating species should be used in landscape plans to the maximum extent possible. Invasive species identified in this section should not be planted in Winchendon.

shrubs, groundcovers, and flowers. The lists are not all-inclusive, and landscape designers may suggest the use of other species not included here, provided they are not invasive species. However, these lists are intended to provide a sufficiently wide range of species that the Town considers generally acceptable under different circumstances. Information in this list is based on several sources including 974 CMR 3.05,²⁷ a wetlands creation manual,²⁸ landscaping catalogs,^{29,30} and professional landscape architects and biologists.

1. Native Species

The following species are native to Winchendon and well-adapted to the area's climate. Many of the species also provide good wildlife habitat.

Shade Trees

<u>Botanical Name</u>	<u>Common Name</u>
<i>Acer rubrum</i>	Red Maple
<i>Acer saccharum</i>	Sugar Maple
<i>Betula lenta</i> ^F	Sweet Birch ^F
<i>Betula alleghaniensis</i> ^F	Yellow Birch ^F
<i>Betula papyrifera</i>	Paper Birch
<i>Carya ovata</i> ⁺	Shagbark Hickory ⁺
<i>Castanea dentate</i>	American Chestnut
<i>Fagus grandifolia</i>	American Beech
<i>Fraxinus americana</i>	White Ash
<i>Fraxinus pennsylvanica</i>	Green Ash
<i>Juglans cinerea</i> ⁺	Butternut ⁺
<i>Liquidambar styraciflua</i> ^F	Sweetgum ^F
<i>Liriodendron tulipifera</i> ^F	Tulip Tree ^F
<i>Nyssa sylvatica</i>	Black Tupelo
<i>Platanus occidentalis</i>	American Sycamore
<i>Quercus alba</i> ^{+F}	White Oak ^{+F}
<i>Quercus bicolor</i> ^{+F}	Swamp White Oak ^{+F}
<i>Quercus coccinea</i> ^{+F}	Scarlet Oak ^{+F}
<i>Quercus palustris</i> ^{+F}	Pin Oak ^{+F}
<i>Quercus rubra</i>	Northern Red Oak
<i>Salix nigra</i>	Black Willow
<i>Sassafras albidum</i>	Common Sassafras

Notes:

⁺ Recommended for planting on the portions of the site away from walks or roads.

^F These trees need extra care if they are planted during the fall season.

[^] Canadian Hemlock is currently under attack by an insect that has no predator.

Tilia americana 'Redmond' Redmond Linden

Ulmus americana, disease-resist. var. American Elm

Evergreen Trees

Botanical Name

Ilex opaca

Juniperus virginiana

Pinus rigida

Pinus strobus

Thuja occidentalis

Tsuga canadensis

Common Name

American Holly

Eastern Red Cedar

Pitch Pine

Eastern White Pine

American Arborvitae

Canadian Hemlock^

Ornamental Trees

Botanical Name

Alnus rugosa
Amelanchier canadensis
Amelanchier laevis
Betula nigra^F
Betula papyrifera^F
Carpinus caroliniana^F
Cercis canadensis
Cornus alternifolia^F
Cornus florida^{^F}
Crataegus punctata
Hamamelis virginiana
Larix laricina
Larix decidua
Ostrya virginiana
Prunus pennsylvanica^F
Prunus virginiana^F
Salix discolor
Viburnum lentago

Common Name

Speckled Alder
Shadblow Serviceberry
Allegheny Serviceberry
River Birch^F
Paper Birch^F
American Hornbeam^F
Eastern Redbud
Pagoda Dogwood^F
Flowering Dogwood^{^ F}
Dotted Hawthorn
Common Witchhazel
American Larch
European Larch
Hop Hornbeam
Pin Cherry^F
Common Chokecherry^F
Pussy Willow
Nannyberry Viburnum

Notes:

[^] *Cornus florida* has been adversely affected by an anthracnose epidemic in the Northeast U.S. in the past two decades. Anthracnose spreads rapidly to other flowering dogwoods. Before using this species, check with local agricultural extensions for the status of anthracnose.

^F These trees need extra care if they are planted during the fall season.

Deciduous Shrubs

Botanical Name

Arctostaphylos uva-ursi
Aronia melanocarpa
Clethra alnifolia
Comptonia peregrina
Cornus alterniflora
Cornus amomum
Cornus racemosa
Cornus rugosa
Ilex verticillata
Lindera benzoin
Myrica pennsylvanica
Azalea nudiflorum
Rhododendron roseum
Rhododendron viscosum
Rhus glabra
Rhus typhina
Rosa carolina
Rubus odoratus
Sambucus canadensis
Vaccinium corymbosum
Viburnum acerifolium
Viburnum cassinoides
Viburnum dentatum
Viburnum trilobum

Common Name

Bearberry
Black Chokeberry
Summersweet Clethra
Sweetfern
Pagoda Dogwood
Silky Dogwood
Gray Dogwood
Redleaf Dogwood
Common Winterberry
Common Spicebush
Northern Bayberry
Early Deciduous Pink Azalea
Roseshell Azalea
Swamp Azalea
Smooth Sumac
Staghorn Sumac
Carolina Rose
Flowering Raspberry
American Elder
Highbush Blueberry
Mapleleaf Viburnum
Witherod Viburnum
Arrowwood Viburnum
American Cranberrybush Viburnum

Evergreen Shrubs

Botanical Name

Juniperus communis 'Compressa'
Kalmia angustifolia
Kalmia latifolia
Taxus canadensis

Common Name

Common Juniper
Sheeplaurel
Mountainlaurel
Canadian Yew

Groundcovers

Botanical Name

Cornus canadensis
Gaultheria procumbens
Mitchella repens
Vaccinium angustifolium
Vaccinium macrocarpum

Common Name

Bunchberry Dogwood
Checkerberry Wintergreen
Partridgeberry
Lowbush Blueberry
Cranberry

Meadow Grasses/Wildflowers

Botanical Name

Festuca elatior
Lolium perenne
Sorghastrum nutans
Panicum
Andropogon gerardii Vitman
Schizachyrium scoparium
Calamagrostis canadensis
Antennaria alpina
Aristida dichotoma
Aster linariifolius
Eragrostis spectabilis
Houstonia caerulea
Juncus bufonius
Senecio aureus

Common Name

Tall Fescue
Palmer II Perr. Ryegrass
Indian Grass
Blackwell Switchgrass
Big Bluestem
Little Bluestem
Blue Joint Reedgrass
Alpine Pussy-Toes
Poverty Grass
Bristly Aster
Purple Lovegrass
Bluets
Toad Rush
Golden Ragwort

2. Salt Tolerant Species

These species are well-suited to roadsides and other locations that are likely to collect salty winter runoff.

Shade Trees

Botanical Name

Acer campestre
Aesculus hippocastanum
*Betula lenta**^F
*Betula alleghaniensis**^F
*Fraxinus americana**
Gleditsia triacanthos inermis
*Nyssa sylvatica**
*Quercus alba**+
Quercus macrocarpa+
Quercus robur+
Quercus rubra
Ulmus glabra
Ulmus pumila

Common Name

Hedge Maple
Horse-chestnut
Sweet Birch*^F
Yellow Birch*^F
White Ash*
Thornless Honeylocust
Black Tupelo*
White Oak*+
Bur Oak+
English Oak+
Red Oak
Scotch Elm
Siberian Elm

Notes:

* Native Plants

+ Recommended for planting on portions of the site away from walks or roads.

^F These trees need extra care if they are planted during the fall season.

Ornamental Trees

Botanical Name

*Amelanchier canadensis**
*Betula papyrifera**^F
*Betula populifolia**^F
*Prunus pennsylvanica**^F
*Prunus virginiana**^F
Pyrus calleryana^F
Pyrus calleryana 'Bradford'
*Salix discolor**

Common Name

Shadblow Serviceberry*
Paper Birch*^F
Gray Birch*^F
Pin Cherry*^F
Common Chokecherry*^F
Callery Pear^F
Bradford Pear
Pussy Willow*

Evergreen Trees

Botanical Name

*Juniperus virginiana**
Picea pungens 'glauca'
Pinus nigra
Pinus ponderosa
*Pinus rigida**

Common Name

Eastern Red Cedar*
Blue Colorado Spruce
Austrian Pine
Ponderosa Pine
Pitch pine*

Deciduous Shrubs

Botanical Name

*Arctostaphylos uva-ursi**
*Aronia melanocarpa**
*Aronia prunifolia**
Hippophae rhamnoides
*Lindera benzoin**
*Myrica pennsylvanica**
*Rhus glabra**
*Rhus typhina**
*Salix humilis**
*Salix lucida**
Shepherdia argentea
Tamarix ramosissima

Common Name

Bearberry*
Black Chokeberry*
Purplefruit Chokeberry*
Common Seabuckthorn
Common Spicebush*
Northern Bayberry*
Smooth Sumac*
Staghorn Sumac*
Prairie Willow*
Shining Willow*
Buffaloberry
Five Stamen Tamarisk

*Vaccinium corymbosum**
*Viburnum cassinoides**
*Viburnum dentatum**

Highbush Blueberry*
 Witherod Viburnum*
 Arrowwood Viburnum*

Notes:

* Native Plants
 + Recommended for planting on portions of the site away from walks or roads.

^F These trees need extra care if they are planted during the fall season.

Evergreen Shrubs

Botanical Name

Pinus mugo
*Taxus canadensis**

Common Name

Mugo Pine
 Canadian Yew*

Groundcovers

Botanical Name

*Vaccinium angustifolium**
Vaccinium palladium

Common Name

Late Lowbush Blueberry*
 Early Lowbush Blueberry

3. Urban Tolerant Species

These species are suitable for planting in “high-stress” environments where there will be pavement within the tree’s drip line, high levels of pedestrian or vehicular traffic, vehicle exhaust and air pollution, or other urban stressors. For example, most of these species are generally well-suited to being planted in parking lot islands or other narrow landscaped areas.

Shade Trees

Botanical Name

Acer campestre
*Acer rubrum**
*Acer saccharum**
Carpinus betulus fastigiata^F
Celtis occidentalis
Cladastris lutea
Corylus colurna
Eucommia ulmoides
*Fraxinus pennsylvanica**
Ginkgo biloba
Gleditsia triacanthos inermis
*Liquidambar styraciflua**^F
Maclura pomifera inermis 'Park'
*Nyssa sylvatica**
Platanus acerifolia^F
Sophora japonica
Tilia cordata
Zelkova serrata^F

Common Name

Hedge Maple
 Red Maple*
 Sugar Maple*
 Pyramidal European Hornbeam^F
 Hackberry
 Yellowwood
 Turkish Hazelnut
 Hardy Rubber Tree
 Green Ash*
 Maidenhair Tree (female +)
 Thornless Honeylocust
 Sweet Gum*^F
 Park Osage Orange
 Black Tupelo*
 London Plane Tree^F
 Scholartree
 Littleleaf Linden
 Japanese Zelkova^F

Notes:

* Native Plants
 + Recommended for planting on portions of the site away from walks or roads.

^F These trees need extra care if they are planted during the fall season.

Ornamental Trees

Botanical Name

*Betula nigra**^F
Cercidiphyllum japonicum
Chionanthus virginicus
Cornus kousa^F
Crataegus phaenopyrum
Magnolia stellata^F
*Ostrya virginiana**
Oxydendron arboreum^F
Prunus sargentii^F

Common Name

River Birch*^F
 Katsuratree
 White Fringetree
 Kousa Dogwood^F
 Washington Hawthorn
 Star Magnolia^F
 American Hophornbeam*
 Sourwood^F
 Sargent Cherry^F

Pyrus calleryana^F
Syringa reticulata

Callery Pear^F
Japanese Tree Lilac

Deciduous Shrubs

Botanical Name

Cornus sericea
*Ilex verticillata**
Ilex verticillata 'Nana'*
Rhus aromatica 'Gro-low'
Spiraea bumalda varieties
*Vaccinium angustifolium**

Common Name

Red Osier Dogwood
Common Winterberry*
Dwarf Winterberry*
Dwarf Fragrant Sumac
Spirea
Lowbush Blueberry*

Groundcovers

Botanical Name

Cotoneaster horizontalis
Hedera helix
Juniperus chinensis sargentii
Juniperus horizontalis varieties
Vinca minor
Pachysandra terminalis

Common Name

Rockspray Cotoneaster
English Ivy
Sargent Juniper
Creeping Juniper
Periwinkle
Japanese Pachysandra

4. Species for Erosion Control

These species can be used for stabilizing the ground and preventing erosion, and should be considered for planting in areas with steep slopes or unstable, erodible soils.

Botanical Name

Aegopodium podagraria 'Variegatum'
Celastrus scandens
Clematis paniculata
Cornus, shrubby types
Cotoneaster, low types
Cytisus spp.
Erica spp.
Euonymus fortunei 'Colorata' and cvs.
Forsythia suspensa and cvs.
Genista x 'Lydia'
Hedera helix and cvs.
Hemerocallis, all
Houtuynia cordata 'Chameleon'
Itea spp.
Juniperus, low types
Ligustrum, all
Myrica pennsylvanica
Parthenocissus spp.
Polygonum aubertii
Rhus aromatica and cvs.
Rosa, most
Salix purpurea
Stephanandra incisa
Symphoricarpos x chenaultii 'Hancock'
Vinca minor and cvs.
Yucca filamentosa

Common Name

Variegated Snow-on-the-Mountain
American Bittersweet
Clematis
Dogwood (Silky, Gray-stemmed, Gray, Redleaf)
Cotoneaster
Scotch Broom
Heath
Wintercreeper
Weeping Forsythia
Genista Lydia
English Ivy
Daylilly
Chaeleon Houtuynia
Sweetspire
Juniper
Privet
Northern Bayberry
Ivy
Silver-vine Fleeceflower
Fragrant Sumac
Most roses
Purpleosier Willow
Cutleaf Stephanandra
Chenault Coralberry
Periwinkle
Yucca

5. Wetland Species

This list of species is generally well-suited for planting in constructed wetlands, wet swales, and other stormwater management areas that will typically be wet. Plantings in each section of the wet area must be selected according to the hydrological conditions in that area.

Herbaceous Plants

<u>Botanical Name</u>	<u>Common Name</u>	<u>Water Depth (see below)</u>
<i>Osmunda cinnamomea</i>	Cinnamon fern	Transitional
<i>Osmunda regalis</i>	Royal fern	Transitional
<i>Symplocarpus foetidus</i>	Skunk cabbage	Transitional
<i>Scirpus cyperinus</i>	Woolgrass	Shallow
<i>Thelypteris palustri</i>	Marsh fern	Shallow
<i>Caltha leptosepala</i>	Marsh Marigold	Shallow
<i>Polygonum coccineum</i>	Pennsylvania smartweed	Shallow
<i>Lobelia cardinalis</i>	Cardinal Flower	Shallow
<i>Lobelia siphilitica</i>	Great Lobelia	Shallow
<i>Iris versicolor</i>	Blue Flag Iris	Medium
<i>Acorus calamus</i>	Sweet flag	Medium
<i>Calla palustris</i>	Water arum	Medium
<i>Sparganium eurycarpum</i>	Burreed	Medium
<i>Scirpus americanus</i>	Three-square	Medium
<i>Scirpus fluviatilis</i>	River bulrush	Medium
<i>Sagittaria latifolia</i>	Arrowhead	Medium
<i>Ponederia cordata</i>	Pickerelweed	Medium
<i>Peltandra cordata</i>	Arrow arum	Medium
<i>Potamogeton pectinatus</i>	Sago pondweed	Deep
<i>Vallisneria americana</i>	Tapegrass	Deep
<i>Ranunculus flabellaris</i>	Yellow water buttercup	Deep
<i>Ranunculus aquatilis</i>	White water buttercup	Deep
<i>Scirpus validus</i>	Bulrush	Deep
<i>Nymphaea odorata</i>	Fragrant white lily	Deep
<i>Nuphar luteum</i>	Spatterdock	Deep
<i>Brasenia schrebrri</i>	Watershield	Deep

Transitional: seasonally flooded; Shallow: seasonally flooded to permanently flooded to 15 cm; Medium: 15 to 50-cm water depths; Deep: 50 to 200-cm water depths.

Shrubs

<u>Botanical Name</u>	<u>Common Name</u>
<i>Clethra alnifolia</i>	Summersweet Clethra
<i>Cornus amomum</i>	Silky Dogwood
<i>Ilex verticillata</i>	Winterberry
<i>Kalmia angustifolia</i>	Sheep Laurel
<i>Lindera benzoin</i>	Spicebush
<i>Rhodendron viscosum</i>	Swamp Azalea
<i>Viburnum recognitum</i>	Northern Arrowwood
<i>Vaccinium corymbosum</i>	Highbush Blueberry

Trees

Botanical Name

Nyssa sylvatica
Quercus bicolor
Fraxinus americana⁺
*Fraxinus pennsylvanica**
Acer rubrum⁺
Quercus bicolor[^]
Betula nigra[^]

Common Name

Black gum
Swamp oak
White ash⁺
Green Ash*
Red Maple⁺
Swamp oak[^]
River birch[^]

Notes:

*Species that will tolerate flooding for more than 1 year
⁺Species that will tolerate flooding for one growing season
[^]Species that will tolerate flooding for less than 30 days during the growing season

Woody Wetland Plants

Botanical Name

*Salix nigra**
*Cephalanthus occidentalis**
*Cornus stolonifera**
Sambucus canadensis⁺
Vaccinium corymbosum⁺
Chamaecyparis thyoides⁺
Alnus rugosa⁺
Nyssa sylvatica[^]
Ilex opaca[^]

Common Name

Black Willow*
Buttonbush*
Red-osier Dogwood*
Elder⁺
Blueberry⁺
Atlantic white cedar⁺
Spackled Alder⁺
Black gum[^]
American Holly[^]

6. Moist Tolerant Species

These species require significant moisture, and many are adapted to survive periods of standing water. In general, these species should be planted only where local soil and topography produce moist conditions. Landscape designers should not rely upon irrigation to sustain these species.

Woody Plants

Botanical Name

Acer negundo
Acer rubrum
Alnus rugosa
Amelanchier
Andromeda polifolia
Aralia spinosa
Aronia arbutifolia
Azalea arborescens
Azalea vaseyi
Azalea viscosum
Betula nigra
Calluna vulgaris
Calycanthus floridus
Campsis radicans
Cephalanthus occidentalis
Chamaecyparis thyoides
Clethra acuminata
Clethra alnifolia
Cornus spp.
Erica carnea
Gymnocladus dioicus
Halesia diptera

Common Name

Box Elder
Red Maple
Speckled Alder
Serviceberry
Bog Rosemary
Devil's Walkingstick
Chokeberry
Sweet Azalea
Pinkshell Azalea
Swamp Azalea
River Birch
Heather
Common Sweetshrub
Trumpet Creeper
Buttonbush
Atlantic White Cedar
Mountain Pepperbush
Summersweet
Dogwood (Silky, Shrub, Gray)
Heath
Kentucky Coffee Tree
Two-winged Silverbell

<i>Hamamelis virginiana</i>	Witchhazel
<i>Ilex spp.</i>	Holly
<i>Ilex verticillata</i>	Winterberry
<i>Kalmia latifolia</i>	Mountain Laurel
<i>Larix spp.</i>	Larch
<i>Leucothoe fontanesiana</i>	Drooping Leucothoe
<i>Lindera benzoin</i>	Spicebush
<i>Magnolia virginiana</i>	Sweetbay Magnolia
<i>Malus</i>	Crabapple
<i>Myrica pennsylvanica</i>	Bayberry
<i>Nyssa sylvatica</i>	Black Gum
<i>Rhododendron canadense</i>	Rhodora (for bogs only)
<i>Rhododendron maximum</i>	Rosebay Rhododendron
<i>Rhus aromatica</i>	Fragrant Sumac
<i>Salix</i>	Willow
<i>Sambucus canadensis</i>	American Elder
<i>Sassafras albidum</i>	Common Sassafras
<i>Vaccinium</i>	Blueberry, Cranberry
<i>Zenobia pulverulenta</i>	Dusty Zenobia

Perennials

Botanic Name

Aconitum carmichaelii
Amsonia hubrechtii
Aruncus dioicus
Clathra palustris
Chelone lyonii
Cimicifuga
Epimedium
 Ferns
Filipendula ulmaria
Gillenia trifoliata
Helleborus niger
Hemerocallis
Hibiscus moscheutos
Iberis sempervirens
Iris ensata
Iris siberica
Kirengeshoma palmate
Liatris spicata
Limonium latifolium
Lobelia cardinalis
Lobelia siphilitica
Monarda didyma
Petasites
Phlox divaricata
Platycodonj grandiflorus
Polygonatum
Tradescantia x andersonianan
Trillium
Trollius

Common Name

Monkshood
 Star Flower
 Goatsbeard
 Marsh Marigold
 Turtlehead
 Snakeroot
 Bishops' Cap
 Ferns
 Meadowsweet
 Bowman's Root
 Christmas Rose
 Daylilly
 Rosemallow
 Candy Tuft
 Japanese Iris
 Siberian Iris
 Yellow Waxbells
 Gayfeather
 Sea Lavender (for salt marsh only)
 Cardinal Flower
 Big Blue Lobelia
 Beebalm
 Butterbur
 Woodland Phlox
 Balloon flower
 Solomon's Seal
 Spiderwort
 Wakerobin
 Globeflower

Grasses

<u>Botanical Name</u>	<u>Common Name</u>
<i>Carex muskingumensis</i>	Palm Sedge
<i>Miscanthus sacchariflorus Giganteus</i>	Giant Silver Banner Grass
<i>Pennisetum alopecuroides</i>	Fountain Grass
<i>Sisyrinchium</i>	Blue-eyed Grass
<i>Typha angustifolia</i>	Cattail

7. Drought Tolerant Species

These species require relatively little water, can survive longer periods without water, and/or are adapted to grow in well-drained soils. In the interest of minimizing the demand for irrigation water, these species should be considered in sunny areas with well-drained soil that are likely to experience dry conditions.

Woody Plants

<u>Botanical Name</u>	<u>Common Name</u>
<i>Abies concolor</i>	White Fir
<i>Acer truncatum</i>	Shantung Maple
<i>Aesculus x carnea</i>	Ruby Horsechestnut
<i>Aesculus pavia</i>	Red Buckeye
<i>Aralia spinosa</i>	Devil's Walkingstick
<i>Arctostaphylos uva-ursi</i>	Bearberry
<i>Buddleia alternifolia</i>	Fountain buddleia
<i>Calluna vulgaris</i>	Heather
<i>Campsis radicans</i>	Trumpet Creeper
<i>Caragana microphylla</i>	Littleleaf Caragana
<i>Carpinus betulus</i>	European Hornbeam
<i>Carpinus caroliniana</i>	American Hornbeam
<i>Chaenomeles speciosa</i>	Flowering Quince
<i>Chamaecyparis thyoides</i>	Atlantic White Cedar
<i>Comptonia peregrina</i>	Sweet Fern
<i>Cornus racemosa</i>	Gray Dogwood
<i>Corylus colurna</i>	Turkish Filbert
<i>Cotinus coggygria</i>	Smoke Tree
<i>Crataegus crusgalli</i>	Cockspur Hawthorn
<i>Fraxinus pennsylvanica</i>	Green Ash
<i>Gleditsia tricanthos inermis</i>	Honeylocust
<i>Gymnocladus dioicus</i>	Kentucky Coffee tree
<i>Hamamelis</i>	Witchhazel
<i>Hybiscus syriacus</i>	Rose-of-Sharon
<i>Hydrangea</i>	Hydrangea
<i>Indigofera gerardiana</i>	Himalayan Indigo
<i>Jasminum nudiflorum</i>	Winter Jasmine
<i>Juniperus</i>	Juniper
<i>Kerria japonica</i>	Japanese Kerria
<i>Koelreuteria paniculata</i>	Golden Rain Tree
<i>Kolkwitzia amabilis</i>	Beautybush
<i>Microbiata decussata</i>	Siberian Carpet Cypress
<i>Myrica pensylvanica</i>	Northern Barberry
<i>Pinus banksiana</i>	Jack Pine
<i>Pinus mugo</i>	Mugo Pine
<i>Pinus nigra austriaca</i>	Austrian Pine
<i>Pinus strobus</i>	Eastern White Pine

<i>Platanus x acerfolia</i>	London Planetree
<i>Potentilla fruticosa</i>	Potentilla
<i>Prunus maritima</i>	Beach plum (especially back and scarlet)
<i>Quercus</i>	Oak
<i>Rhus</i>	Sumac
<i>Rosa rugosa</i>	Rugosa Rose
<i>Salix</i>	Willow
<i>Sambucus canadensis</i>	American Elder
<i>Sassafras albidum</i>	Common Sassafras
<i>Shepherdia argentea</i>	Buffalo Berry
<i>Sophora japonica</i>	Scholar tree
<i>Stephanandra incisa</i>	Cutleaf Stephanandra
<i>Vitex agnus-castus</i>	Chastetree

Perennials

Botanical Name

Anthemis tinctoria
Artemisia
Armeria maritima
Asclepias tuberosa
Aubrieta deltoidea
Aurinia saxatilis
Callirhoe involucrata
Campanula carpatica
Centaurea Montana
Cerastium tomentosum
Echinacea purpurea
Echinops ritro
Eryngium planum
Eupatorium
Gaillardia x grandiflora
Geranium dalmaticum
Geranium macrorrhizum
Gypsophila
Helianthus grosse-serratus
Hemerocallis fulva
Lamium maculatum
Lewisia cotyledon
Nepera x faassenii
Oenothera
Opuntia humifusa
Papaver orientale
Perovskia atriplicifolia
Phlox subulata
Polemonium caereum
Rudbeckia
Salvia verticillata
Santolina chamaecyparissus
Sedum
Sempervivum
Stachys byzantina
Stokesia laevis
Thymus serpyllum
Yucca

Common Name

Golden Marguerite
 Wormwood
 Thrift
 Butterfly Milkweed
 False Rock Cress
 Basket-of-Gold
 Poppy Mallow
 Carpathian Bellflower
 Mountain Bluet
 Snow-in-Summer
 Coneflower
 Globe Thistle
 Sea Holly
 Hardy Ageratum
 Blanket Flower
 Cranesbill
 Bigroot
 Baby's Breath
 Sawtooth Sunflower
 Daylilly
 Spotted Dead Nettle
 Bitter Root
 Persian Catmint
 Evening Primrose
 Prickly Pear
 Poppy
 Russian Sage
 Moss Pink
 Jacob's Ladder
 Coneflower
 Purple Rain
 Lavender Cotton
 Stonecrop
 Houseleek
 Lamb's Ears
 Stoke's Aster
 Mother-of-Thyme
 Desert Candle

Grasses

<u>Botanical Name</u>	<u>Common Name</u>
<i>Bouteloua gracilis</i>	Blue Gramma
<i>Elymus arenarius</i>	Blue Lyme Grass
<i>Festuca cinerea</i>	Blue Fescue
<i>Schizachyrium scoparium</i>	Little Bluestem

8. Habitat Creating Species

Habitat creating species provide food or home sites for birds and other animals.

The following plants provide good habitat for birds and animals.

Trees

<u>Botanical Name</u>	<u>Common Name</u>
<i>Acer rubrum</i>	Red Maple
<i>Acer saccharinum</i>	Sugar Maple
<i>Amelanchier canadensis</i>	Serviceberry
<i>Betula nigra</i>	River Birch
<i>Betula papyrifera</i>	White Birch
<i>Celtis occidentalis</i>	Hackberry
<i>Cornus, most</i>	Dogwoods
<i>Crataegus, most</i>	Hawthorn
<i>Malus, most</i>	Crabapple
<i>Nyssa sylvatica</i>	Black gum
<i>Picea glauca</i>	White spruce
<i>Picea pungens</i>	Blue Spruce
<i>Pinus strobus</i>	White Pine
<i>Populus, most</i>	Poplars
<i>Quercus alba</i>	White Oak
<i>Quercus palustris</i>	Pin Oak
<i>Quercus rubra</i>	Red Oak
<i>Sorbus aucuparia</i>	Mountain Ash
<i>Tsuga canadensis and cvs.</i>	Eastern Hemlock

Shrubs

<u>Botanical Name</u>	<u>Common Name</u>
<i>Amelanchier canadensis and cvs.</i>	Serviceberry
<i>Aralia spinosa</i>	Devil's Walking Stick
<i>Aronia spp. And cvs.</i>	Chokeberry
<i>Cornus, most</i>	Dogwoods
<i>Cotoneaster spp. and cvs.</i>	Cotoneaster
<i>Ilex glabra</i>	Inkberry
<i>Juniperus virginiana and cvs.</i>	Eastern Red Cedar
<i>Myrica pensylvanica</i>	Bayberry
<i>Rosa rugosa</i>	Rugosa Rose
<i>Salix discolor</i>	Pussy Willow
<i>Viburnum dentatum</i>	Arrowwood

The following plant species provide persistent fruit that lasts into the late fall and winter, thus providing food for wildlife during the critical months when food is most difficult to find.

Trees

Botanical Name

Cornus mas
Crataegus phaenopyrum
Malus spp., most

Common Name

Cornelian Cherry Dogwood (Golden Glory)
 Washington Hawthorn
 Crabapple

Shrubs

Botanical Name

Aronia arbutifolia
Ilex glabra
Juniperus spp. and cvs.
Myrica pennsylvanica
Pyracantha coccinea and cvs.
Rhodotypos scandens
Rhus spp.
Rosa rugosa and cvs.
Rosa wichuriana and cvs.
Viburnum dilatatum
Viburnum setigerum

Common Name

Red Chokeberry
 Inkberry
 Juniper
 Bayberry
 Firethorn
 Black Jetbead
 Sumac
 Rugosa Rose
 Memorial Rose
 Linden Viburnum
 Tea Viburnum

9. Invasive Species

Invasive plants are introduced species that tend to spread into natural habitats and outcompete native species because of their superior reproductive ability, aggressive growth pattern, or (most commonly) lack of native competitors, herbivores, parasites, or diseases. Invasive species are a serious threat to native biodiversity because they compete with native species for limited land, water and sunlight. **Plants on the following list should not be planted in Winchendon.**

Shade Trees

Botanical Name

Acer ginnala
Acer platanoides
Acer pseudoplatanus
Populus alba
Robinia pseudoacacia

Common Name

Amur Maple
 Norway Maple
 Sycamore Maple
 White Cottonwood
 Black Locust

Deciduous Shrubs/Vines

Botanical Name

Ampelopsis brevipedunculata
Berberis thunbergii
Berberis vulgaris
Celastrus orbiculata
Cynanchum louiseae
Elaeagnus umbellata
Elaeagnus angustifolia
Euonymus alatus
Euphorbia cyparissias
Hesperis matronalis
Ligustrum obtusifolium
Ligustrum vulgare

Common Name

Porcelain Berry
 Japanese Barberry
 Common Barberry
 Oriental Bittersweet
 Black Swallow-wort
 Autumn Olive
 Russian Olive
 Winged Euonymus
 Cypress Spurge
 Dame's Rocket
 Blunt-leaved Privet
 Privet

<i>Lonicera japonica</i>	Japanese Honeysuckle
<i>Lonicera maackii</i>	Amur Honeysuckle
<i>Lonicera morrowii</i>	Morrow's Honeysuckle
<i>Lonicera tatarica</i>	Tatarian Honeysuckle
<i>Lonicera xbella</i>	Morrow's x Tatarian Honeysuckle
<i>Polygonum cuspidatum</i>	Japanese Knotweed
<i>Pueraria lobata</i>	Kudzu
<i>Rhamnus cathartica</i>	Common Buckthorn
<i>Rhamnus frangula</i>	Shining Buckthorn
<i>Rosa multiflora</i>	Multiflora Rose

Meadow Grasses/Wildflowers

<u>Botanical Name</u>	<u>Common Name</u>
<i>Achillea millefolium</i> var. <i>millefolium</i>	Common Yarrow
<i>Aegopodium podagraria</i>	Goutweed
<i>Alliaria petiolata</i>	Garlic Mustard
<i>Cabomba caroliniana</i>	Fanwort
<i>Centaurea maculosa</i>	Spotted Knapweed
<i>Cirsium canadense</i>	Field or Canada Thistle
<i>Coreopsis lanceolata</i>	Lance-leaved Coreopsis (Tickseed)
<i>Cytisus scoparius</i>	Scotch Broom
<i>Daucus carota</i>	Queen Anne's Lace
<i>Egeria densa</i>	Giant Waterweek
<i>Epilobium hirsutum</i>	Hairy Willow-herb
<i>Euphorbia cyparissias</i>	Cypress Spurge
<i>Galium mollugo</i>	Field Madder
<i>Glaucium flavum</i>	Sea Poppy
<i>Glechoma hederacea</i>	Gill-over-the-ground (Ground Ivy)
<i>Holcus lanatus</i>	Velvet Grass
<i>Hypericum perforatum</i>	Common St. John's Wort
<i>Iris pseudacorus</i>	Yellow Iris
<i>Linaria vulgaris</i>	Butter and Eggs
<i>Lysimachia nummularia</i>	Moneywort
<i>Lythrum salicaria</i>	Purple Loosestrife
<i>Myosotis scorpioides</i>	True Forget-me-not
<i>Myriophyllum heterophyllum</i>	Variable Water-milfoil
<i>Myriophyllum spicatum</i>	Spiked Water-milfoil
<i>Najas minor</i>	Lesser Naiad
<i>Nasturtium officinale</i>	Watercress
<i>Phalaris arundinace</i>	Reed Canary Grass
<i>Phragmites australis</i>	Phragmites
<i>Plantago lanceolata</i>	Ribgrass (Lance-leaved Plantain)
<i>Poa compressa</i>	Canada Bluegrass
<i>Potamogeton crispus</i>	Curly or Crisped Pondweed
<i>Ranunculus acris</i>	Tall Buttercup
<i>Ranunculus bulbosus</i>	Bulbous Buttercup
<i>Ranunculus repens</i>	Creeping Buttercup
<i>Ribes rubrum</i>	Garden Red Currant
<i>Rumex acetosella</i>	Sheep Sorrel
<i>Rumex crispus</i>	Curled Dock
<i>Rumex obtusifolius</i>	Bitter or Broad-leaved Dock
<i>Solanum dulcamara</i>	Bittersweet Nightshade
<i>Trapa natans</i>	Water Chestnut
<i>Tussilago farfara</i>	Coltsfoot
<i>Verbascum thapsus</i>	Flannel-leaved Mullein

Lawn Grasses

Botanical Name

Agrostis gigantea
Festuca longifolia
Festuca ovina

Common Name

Redtop, Upland Bentgrass
Hard Fescue
Sheep Fescue

V. Site Planning

Winchendon's site planning objectives are intended to further the Town's goals of:

- **Protecting the environment**, including wildlife habitat, water resources, and “ecosystem services” such as groundwater recharge, flood attenuation and pollutant removal;
- **Creating a visually appealing community**;
- **Preserving the Town's cultural heritage**, including historic sites, view corridors, trees and other noteworthy features;
- **Stabilizing and increasing property values**; and
- **Encouraging sustainable development** that minimizes energy use and pollution.

WINCHENDON OBJECTIVE: Subdivision plans and site plans for all forms of development shall should adhere to the principles of *environmental compatibility*, *aesthetic compatibility*, and *energy-efficient design*.

Applicants for a LID Permit must follow the five-step planning process described in Section 7.2.1 of the Winchendon LID Regulations. This process can also be useful for smaller projects, through which creative designers will usually be able to find many cost savings related to a reduction in clearing, cut and fill, replanting, and stormwater management.

Guidelines for site planning include the following:

- **Refrain from disturbing unique natural features of the site to the maximum extent possible.** Depending on the site, such features could include wooded areas, specimen trees, knolls, and rock outcroppings as well as the more typically conserved streams, wetlands and ponds. These features should be identified early in the site planning process (for example, in the survey or an early site visit) and incorporated into the site plan either as “focal points” for the development or as protected areas. In general, clearing of vegetation and alteration of topography should be limited to the maximum percent lot coverage stated in the zoning bylaw (structures plus paving) plus 10%. Native vegetation should be planted in disturbed areas as needed to enhance or restore wildlife habitat. Disturbance should be limited to construction areas only. Preservation of groups of trees (e.g., beech, oak, hickory, etc.) is encouraged.
- **Refrain from disturbing sites of historic and/or cultural significance.** Significant sites could include old buildings, cellar holes or graveyards, as well as historic trees that have a diameter at breast height of 20” or greater.
- **Preserve views and vistas both into and out of the site.** A visual analysis should be conducted to identify any scenic “windows” into the site and preserve the aesthetic value of these views whenever possible.
- **Minimize cut and fill.** Roads should follow the natural contours whenever possible, taking a steeper path only if necessary. Steep areas on individual house lots should generally be left as natural vegetation, not regraded to allow for a sloping lawn. This approach can reduce grading costs and stormwater control costs because it often results in less land being disturbed, thereby creating fewer erosion or runoff problems. In addition, future homeowners will have fewer expenses and hassles related to maintaining steep lawns and landscaped areas, which are often costly to maintain and have low utility as yards.

- **Locate houses and buildings in a way that blends into the natural topography.** Buildings should not be set high up on a hill where they will be an eyesore or a focus of attention. Generally buildings should be situated near the grade of the road, unless this would require extensive regrading, in which case they may be higher or lower. For buildings located much above the road, an extra effort should be made to recess these buildings into the treeline to reduce their visual impact.
- **Conserve energy by orienting buildings to the sun and wind for maximum efficiency.** Buildings should be aligned to be protected from cold winter winds, shaded from summer sun, and open to winter sun. Protection from cold winter winds can be achieved by retaining natural vegetation at a building's northwest edge or by planting evergreen species such as white pine (*Pinus strobus*) in this location. For summer shading and winter heating, deciduous species can be planted close to the building, along the east, south and west exposures. Winter sunlight will penetrate the empty branches and provide heat. Home interiors should be laid out with time-of-day occupancy in mind.³¹ Living and high-activity rooms should be placed on the south side where they are heated by the low winter sun and shaded from the high summer sun. Garages, utility rooms and closets can be positioned to provide insulating barriers on the northeast and northwest sides.

Endnotes

¹ Overall, these practices will aid Winchendon in meeting future stormwater requirements. The EPA's goals are to minimize polluted stormwater entering rivers and streams by reducing the discharge of pollutants to the maximum extent practicable; to protect water quality; and to satisfy the appropriate water quality requirements of the Clean Water Act. Phase I of EPA's plans was initiated in 1990 and regulated municipal separate storm sewer systems (MS4s) that were defined as "large" and "medium." Phase II, which was recently finalized, focuses on "small" MS4s. To comply with the Phase II requirements, the EPA requires that towns set in place regulations and programs that include public education and outreach, public involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control and pollution prevention/good housekeeping. Winchendon operates a small MS4, but has been exempted from the Phase II requirements. Future state or federal regulations could affect the Town.

² These stormwater management practices are adapted from the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards and Handbook. The DEP standards already apply to any project that falls under the jurisdiction of the Wetlands Protection Act. Winchendon has incorporated by reference the DEP's Stormwater Management Standards and Handbook in the Town's Low Impact Development Bylaw and Regulations. The Stormwater Management Standards and Handbook may be downloaded from the DEP's website at <http://www.mass.gov/dep/water/laws/policies.htm#storm>.

³ Adapted from the *MA DEP Stormwater Management Handbook* (2008), <http://www.mass.gov/dep/water/laws/policies.htm#storm>. Additional information from the *Low Impact Development (LID) Design Strategies: An Integrated Design Approach*, Department of Environmental Resources, Prince George's County, Maryland, June 1999, <http://www.epa.gov/OWOW/nps/lidnatl.pdf>. and *EPA NPDES National Menu of Stormwater Best Management Practices*, <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm>

⁴ Based on the *DEP Stormwater Management Handbook*, with additional information from *EPA Stormwater NPDES National Menu of Stormwater Best Management Practices*.

⁵ Based on the *DEP Stormwater Management Handbook*, with additional information from the *Low Impact Development (LID) Design Strategies: An Integrated Design Approach*, Department of Environmental Resources, Prince George's County, Maryland and the *EPA Stormwater NPDES National Menu of Stormwater Best Management Practices*.

⁶ *MA DEP Stormwater Management Handbook*.

⁷ *Northern Virginia Planning District Commission (NVPDC) Nonstructural Urban BMP Handbook*, Department of Conservation and Recreation/Division of Soil and Water Conservation, December 1996, www.novaregion.org.

⁸ *MA DEP Stormwater Management Handbook*.

⁹ *MA DEP Stormwater Management Handbook*.

¹⁰ *MA DEP Stormwater Management Handbook*.

¹¹ *MA DEP Stormwater Management Handbook*.

¹² *MA DEP Stormwater Management Handbook*.

¹³ *MA DEP Stormwater Management Handbook*.

¹⁴ *Green Roofs: Stormwater Management From the Top Down*, Katrin Scholz-Brath, www.edcmag.com, January/February 2001.

¹⁵ *MA DEP Stormwater Management Handbook*.

¹⁶ *MA DEP Stormwater Management Handbook*.

¹⁷ *MA DEP Stormwater Management Handbook*.

¹⁸ *MA DEP Stormwater Management Handbook*.

¹⁹ *Low Impact Development (LID) Design Strategies: An Integrated Design Approach*, Department of Environmental Resources, Prince George's County, Maryland.

²⁰ *EPA NPDES National Menu of Stormwater Best Management Practices*.

- ²¹ Geotextiles and other erosion control and stormwater management products may be purchased from numerous commercial vendors. Vendors include Synthetic Industries, www.fixsoil.com; Pinelands Nursery, www.pinelandsnursery.com; North American Green, www.nagreen.com; and the American Excelsior Company, www.amerexcel.com/erosionindex.htm.
- ²² *Surface Water Design Manual*, King County, Washington, Department of Natural Resources, September 1998.
- ²³ King County, WA, *Surface Water Design Manual*.
- ²⁴ *Best Management Practices for Minnesota: Protecting Water Quality in Urban Areas*, Minnesota Pollution Control Agency, 1991.
- ²⁵ *NVPDC Nonstructural Urban BMP Handbook*.
- ²⁶ *NVPDC Nonstructural Urban BMP Handbook*.
- ²⁷ Devens Enterprise Commission list of native species, invasive species, and other species for use in project landscaping. See www.devensec.com.
- ²⁸ *Creating Freshwater Wetlands*, Donald A. Hamoner, Lewis Publishers, Michigan, 1992.
- ²⁹ Lake County Nursery, Inc. Catalog, Perry, OH, 1995
- ³⁰ Weston Nurseries Catalog, Hopkinton, MA, 1999, www.westonnurseries.com.
- ³¹ *Best Development Practices*, Reid H. Ewing *et al.*, Planners Press, 1996.