

APPENDIX E

LANDSCAPING

VERSION 1.0
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SECTION E-1: DESCRIPTION OF PRACTICE

Landscaping is the placement of vegetation in and around stormwater management BMPs. The purpose of landscaping is to help stabilize disturbed areas, enhance the pollutant removal capabilities of a stormwater BMP and improve the overall aesthetics of a stormwater BMP.

SECTION E-2: PERFORMANCE CRITERIA

Not applicable.

SECTION E-3: PRACTICE APPLICATIONS AND FEASIBILITY

A landscape plan is an integral part of any land development project. It provides guidance and specifications for the type, location, and number of planting units according to the various requirements of the development project. Landscaped areas can provide significant reductions in pollutant export from developed sites through biological uptake of nutrients, sediment trapping, filtering, and infiltration. A landscape plan may need one or all of the following:

1. Minimum green space or other requirements per local zoning or stabilization ordinances.
2. Natural and manmade vegetative buffer requirements between differing land uses or between developed land and natural resources.
3. Landscaping and stabilization requirements for stormwater management BMPs.

This minimum specification focuses on landscaping and stabilization requirements for stormwater management BMPs and their associated buffer areas. This standard may also be appropriate for other landscaping applications used in plan and specification preparation.

Certain BMPs, such as constructed wetlands, retention basins with an aquatic bench, *enhanced* extended detention basins with a shallow marsh, bioretention facilities, etc., require very specific plant materials and handling specifications. Refer to the minimum standards found on this web site for additional criteria applicable to specific BMP designs.

For stormwater management purposes, landscaping is considered an integral component of a structural BMP. While the benefit realized from landscaping may be difficult to measure, it is widely accepted that the biological processes occurring in detention and retention BMPs are greatly enhanced by using vegetation. **The target pollutant removal efficiencies assigned to BMPs approved for use in Virginia are based on the use of vegetative practices within the BMP buffer areas and the various BMP planting zones.** The vegetative practices should be specified in a landscape plan as part of the overall BMP and site construction documents.

SECTION E-4: ENVIRONMENTAL AND COMMUNITY CONSIDERATION

Not applicable.

SECTION E-5: DESIGN APPLICATIONS AND VARIATIONS

Not applicable.

SECTION E-6: SIZING AND TESTING GUIDELINES

Not applicable.

SECTION E-7: DESIGN CRITERIA

The landscape plan for a stormwater BMP depends on the BMP being used. However, there are key components to any landscape plan that help assure its overall success. The following section describes these components.

A landscape plan for a stormwater management BMP should contain the following, at a minimum:

Plant Species Selection

Plants selected for a stormwater BMP must tolerate urban stresses such as pollutants, along with variable soil moisture and ponding fluctuations, climate, soils, and topography. Virginia has three distinct physiographic regions that reflect changes in soils and topography: Coastal Plain, Piedmont, and Appalachian and Blue Ridge regions. See **Figure E-1**.

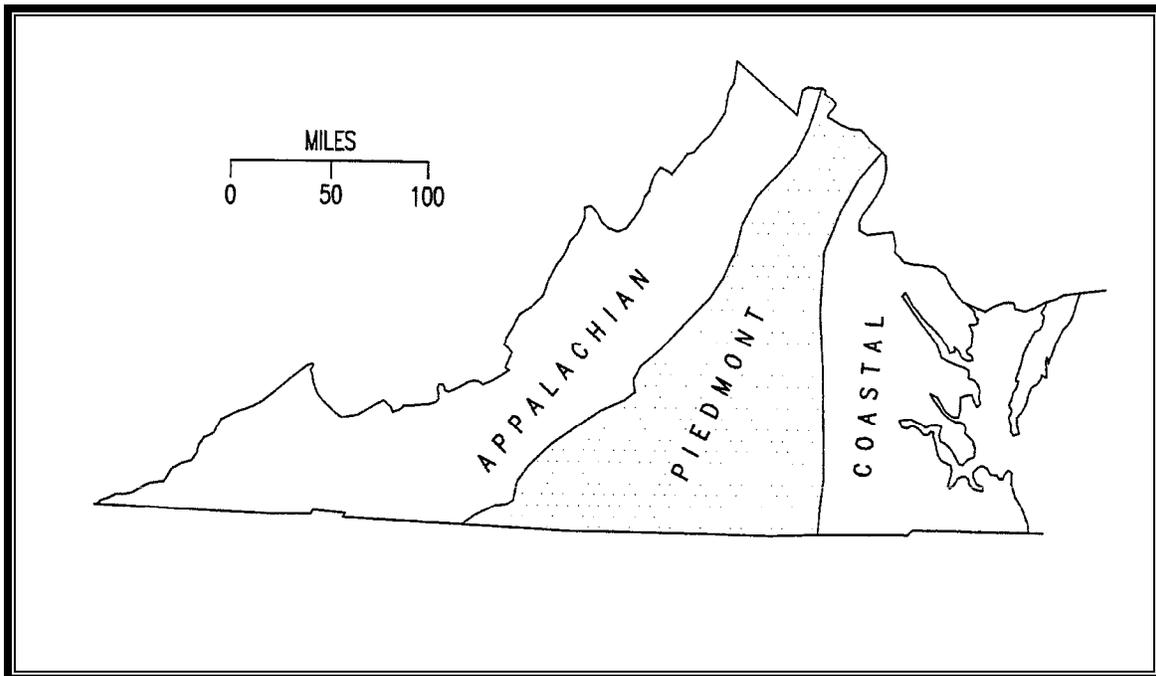


Figure E-1. Virginia Physiographic Regions

Plant selection should also be based on the planting zones within the BMP. Various zones exist within and around a stormwater impoundment and each represents a different inundation frequency and soil moisture condition. **Figure E-2** shows a schematic cross-section of the six planting zones. Designers should select appropriate plant and tree species based on the characteristics of each zone, local soil conditions, sun and wind exposure levels, and intended secondary uses of the buffer area. The planting zones can be classified as follows:

Zone 1: Deep Water Areas: This zone is submerged beneath 18 inches to 6 feet of water. It supports submerged aquatic vegetation such as pondweed, coontail, wild celery, etc., and floating vegetation such as duckweed. Plants can actively remove metals from the water and provide food and habitat for invertebrates at the bottom of the food cycle. This zone may be present in retention basins, constructed wetlands, and in sediment forebays and micro-pools of extended-detention and *enhanced* extended-detention basins.

Zone 2: Shallow Water Area: This zone is 0-18 inches in normal depth and is the primary area for the establishment of emergent wetland plants. It may be present in retention basins, constructed wetlands, and *enhanced* extended-detention basins. This zone is divided into **low-marsh** and **high-marsh** sub-zones. The low-marsh extends from 6-18 inches in depth below the

normal water surface. The high-marsh ranges from 6 inches below the normal water surface to the normal water surface. Vegetation in this zone can serve the following purposes:

- Enhances nutrient uptake,
- Reduces flow velocities to increase the rate of sediment deposition,
- Reduces resuspension of bottom sediments,
- Provides food and cover for wildlife,
- Provides habitat for predatory insects and to serve as a check for mosquitoes,
- Reduces shoreline erosion, and
- Improves aesthetics

Suggested plants for this zone include common three-square, soft-stem bulrush, pickerelweed, arrow arrum, sedges, and others.

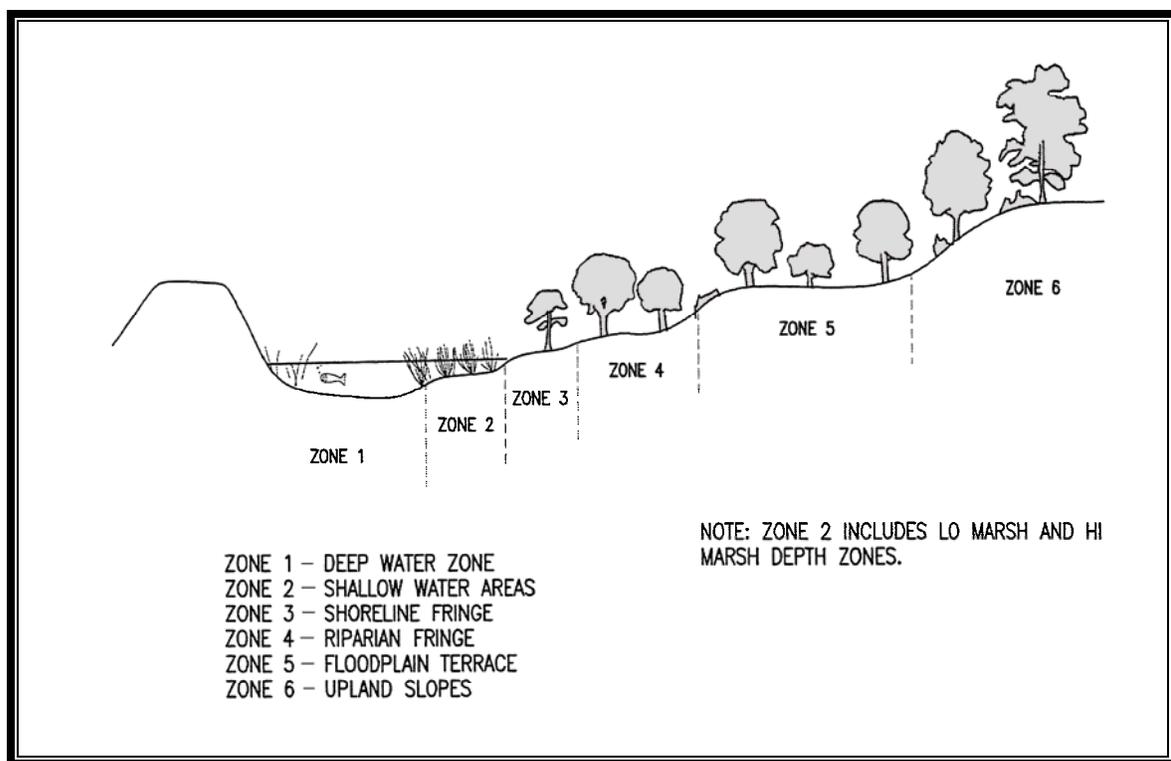


Figure E-2. Planting Zones for Typical Stormwater BMPs

Zone 3: Shoreline Fringe: This zone is regularly inundated during runoff-producing storm events and may remain saturated due to the proximity of the permanent pool. However, plants must be tolerant of periodic drying, especially during the summer months. This zone extends from the normal water surface to about 1 foot above the normal water surface for retention basins and constructed wetlands. It also continues up to the maximum extended-detention volume elevation for extended-detention and *enhanced* extended-detention basins. The vegetation in this zone may serve the following purposes:

- Stabilizes the shoreline,
- Improves aesthetics,
- Limits shoreline access by people and animals (geese),
- Provides food, cover, and nesting for wildlife, and
- Provides shade



Figure E-3. Rough shoreline edge and aquatic bench

Recommended species for this zone include herbaceous vegetation such as soft-stem bulrush, pickerelweed, rice cutgrass, sedges, and others. It also includes trees such as black willow and river birch and shrubs such as chokeberry.

Zone 4: Riparian Fringe Area: This zone is only briefly inundated during storms. It generally includes the upper storage areas of extended-detention basins (above the water quality or channel erosion control volume) and the lower basin areas of dry detention basins. It experiences both wet and dry soil conditions and periodic inundation. The vegetation in this zone may serve the following purposes:

- Reduce resuspension of newly deposited sediments,
- Prevent erosion, and
- Provide habitat and food for wildlife,

A variety of trees, shrubs, and ground covers can be used in this zone, including black willow, river birch, red chokeberry, green ash, sweetgum and others.

Zone 5: Floodplain Terrace: This zone experiences inundation only during large storms. It is generally between the 2-year and 100-year water surface elevations. Plant species native to floodplains usually grow well in this zone. Plants selected for the floodplain terrace should have the following traits:

- Ability to provide erosion control on steep slopes,
- Ability to survive periodic mowing,
- Ability to withstand exposure and compacted soil, and
- Require minimal maintenance

Zone 6: Upland Areas: This zone seldom, if ever, experiences inundation and may include any buffer areas required for stormwater basins. Selection of plant species in this zone typically depends on local soil conditions and the intended secondary uses of the area. Refer to **Table E-4** for a plant guide.

Preservation of Existing Vegetation

Although there are many reasons to minimize land disturbance associated with development, one of the greatest benefits may be the reduced runoff associated with undisturbed ground. Existing vegetation helps prevent erosion, filters runoff, and allows stormwater to filter into the ground, which ultimately results in lower stormwater management costs. As for the economics of site development, planning for the selective preservation of vegetation on a site **before land disturbance** is much less costly than trying to reestablish it once it has been removed. This holds true for both labor and replacement costs. In addition, studies conducted by the U.S. Forest Service and others indicate that preserving mature vegetation on residential sites can increase property values by 30% (NVPDC, 1996).

For guidance on non-structural BMPs and vegetative practices in general, refer to the following references:

- *Piedmont Provinces Vegetative Practices Guide*, NVPDC, 1996.
- *Nonstructural BMP Handbook: A Guide to Nonpoint Source Pollution Prevention Measures*, NVPDC, 1996.
- *Vegetative Practices Guide for Nonpoint Source Pollution Management*, HRPDC, 1992.
- *Chesapeake Bay Local Assistance Manual*, CBLAD, 1989.
- *Riparian Buffer Modification & Mitigation Guidance Manual*, 2003
- *Virginia Erosion & Sediment Control Handbook (VESCH)*, 1992.*

* The *VESCH*, 1992 edition, also provides details for tree preservation during construction.

Choose Native Plants

When selecting plants, native plant species should be used, if possible. Nonnative plants may require more care to adapt to the hydrology, climate, exposure, soil and other conditions. Also, some nonnative plants can become invasive, especially those used for stabilization, and may ultimately choke out the native plant population. See **Tables E-1a and E-1b** for native plant recommendations.

**Table E-1a. Native Tree/Shrub Guide for Stormwater Management
Areas in the Mid-Atlantic -- USA Trees and Shrubs**

Tree/Shrub	*Zone	Form	Available	Inundation Tolerance	Wildlife Value	Notes
American Beech (<i>Fagus grandifolia</i>)	5,6	Dec. Tree	No	no	High, mammals and birds.	Prefers shade and rich, well-drained soils.
American Holly (<i>Ilex opaca</i>)	5,6	Dec. Tree	Yes	some	High, songbirds, food, cover, nesting.	Coastal plain only. Prefers shade and rich soils.
American Hornbeam (<i>Carpinus caroliniana</i>)	4,5	Dec. Tree	Yes	yes	Moderate, food, browsing.	Most common in flood plains and bottom land of Piedmont and mountains.
Arrowwood Viburnum (<i>Viburnum dentatum</i>)	2,3,4	Dec. Shrub	Yes	no	High, songbirds and mammals.	Grows best in sun to partial shade.
Bald Cypress (<i>Taxodium distichum</i>)	3,4	Dec. Tree	Yes	yes	Little food value but good perching site for waterfowl.	Forested Coastal Plain wetlands. North of normal range. Tolerates drought.
Bayberry (<i>Myrica pensylvanica</i>)	4,5,6	Dec. Shrub	Yes	no	High, nesting, food cover. Berries last into winter.	Coastal Plain only. Roots fix N. Tolerates slightly acidic soil.
Bitternut Hickory (<i>Carya cordiformis</i>)	3,4,5	Dec. Tree	No	yes	High, food.	Moist soils or wet bottom land areas.
Black Cherry (<i>Prunus serotina</i>)	5,6	Dec. Tree	Yes	yes	High, fruit is eaten by many birds.	Temporarily flooded forested areas. Possible fungus infestation.
Black Walnut (<i>Juglans nigra</i>)	5,6	Dec. Tree	Yes	yes	High, food.	Temporarily flooded wetlands along flood plains. Well drained, rich soils.
Blackgum or Sourgum (<i>Nyssa sylvatica</i>)	4,5,6	Dec. Tree	Yes	yes	High, songbirds, egrets, herons, raccoons, owls.	Can be difficult to transplant. Prefers sun to partial shade.
Black Willow (<i>Salix nigra</i>)	3,4,5	Dec. Tree	Yes	yes	High, browsing and cavity nesters.	Rapid growth, stabilizes stream banks. Full sun.
Buttonbush (<i>Cephalanthus occidentalis</i>)	2,3,4,5	Dec. Shrub	Yes	yes	High, ducks and shorebirds. Seeds, nectar and nesting.	Full sun to partial shade. Will grow in dry areas.
Chestnut Oak (<i>Quercus prinus</i>)	5,6	Dec. Tree	No	no	High. Cover, browse and food.	Gypsy moth target. Dry soils.
<p>*Zone 1: Submergent Aquatic Vegetation *Zone 2: Shallow Water Bench - 6-12 inches Deep *Zone 3: Shoreline Fringe - Regularly Inundated Area *Zone 4: Riparian Fringe - Periodically Inundated Area, Wet Soils *Zone 5: Floodplain Terrace - Infrequently Inundated, Moist Soils *Zone 6: Upland Slopes - Seldom or Never Inundated, Moist To Dry Soils</p>						

Table E-1a (cont.)						
Tree/Shrub	*Zone	Form	Available	Inundation Tolerance	Wildlife Value	Notes
Common Choke Cherry (<i>Prunus virginiana</i>)	5,6	Dec. Tree	no	some	High, birds, mammals. Fruit and cover.	Prefers drier conditions.
Common Spicebush (<i>Lindera benzoin</i>)	4,5	Dec. Shrub	yes	no	Very high, songbirds.	Shade and rich soils. Tolerates acidic soils. Good understory species.
Eastern Cottonwood (<i>Populus deltoides</i>)	4,5	Dec. Tree	yes	yes	Moderate, cover, food.	Shallow rooted, subject to windthrow. Invasive roots. Rapid growth.
Eastern Hemlock (<i>Tsuga canadensis</i>)	5,6	Conif. Tree	yes	yes	Moderate. Mostly cover and some food.	Tolerates all sun/shade conditions. Tolerates acidic soil.
Eastern Red Cedar (<i>Juniperus virginiana</i>)	4,5,6	Conif. Tree	yes	no	High. Fruit for birds. Some cover.	Full sun to partial shade. Common in wetlands, shrub bogs and edge of streams.
Elderberry (<i>Sambucus canadensis</i>)	4,5,6	Dec. Shrub	yes	yes	Extremely high for food and cover, for birds and mammals.	Full sun to partial shade.
Flowering Dogwood (<i>Cornus florida</i>)	4,5,6	Dec. Tree	no	yes	High, birds, food.	Prefers rich, moist soils. Dogwood anthracnose possible problem.
Fringe Tree (<i>Chionanthus virginicus</i>)	3,4,5	Dec. Shrub or small tree	yes	some	Moderate. Food and cover.	Full sun to partial shade. Tolerates acidic soil.
Green Ash, Red Ash (<i>Fraxinus pennsylvanica</i>)	4,5	Dec. Tree	yes	yes	Moderate, songbirds.	Rapid growing stream bank stabilizer. Full sun to partial shade.
Hackberry (<i>Celtis occidentalis</i>)	5,6	Dec. Tree	yes	yes	High, food and cover.	Full sun to partial shade.
Ironwood/ Hophornbeam (<i>Ostrya virginiana</i>)	5,6	Dec. Tree	yes	yes	Moderate, food and browse.	Tolerant of all sunlight conditions.
Larch, Tamarack (<i>Larix laricina</i>)	3,4	Conif. Tree	no	yes	Low, nest tree and seeds.	Rapid initial growth. Full sun, acidic boggy soils.
Loblolly Pine (<i>Pinus taeda</i>)	5,6	Conif. Tree	yes	yes	Moderate, food, nesting, squirrels.	Coastal Plain only. Tolerant of extreme soil conditions.
*Zone 1: Submergent Aquatic Vegetation *Zone 2: Shallow Water Bench - 6-12 inches Deep *Zone 3: Shoreline Fringe - Regularly Inundated Area *Zone 4: Riparian Fringe - Periodically Inundated Area, Wet Soils *Zone 5: Floodplain Terrace - Infrequently Inundated, Moist Soils *Zone 6: Upland Slopes - Seldom or Never Inundated, Moist To Dry Soils						

Table E-1a (cont.)						
Tree/Shrub	*Zone	Form	Available	Inundation Tolerance	Wildlife Value	Notes
Mountain Laurel (<i>Kalmia latifolia</i>)	6	Evergreen	no	some	Low, cover, and nectar. Foliage is toxic to cattle and deer.	Partial shade, acidic soils.
Persimmon (<i>Diospyros virginiana</i>)	4,5,6	Dec. Tree	yes	no	Extremely high, birds, mammals.	Not shade tolerant. Well-drained soils.
Pin Oak (<i>Quercus palustris</i>)	4,5,6	Dec. Tree	yes	yes	High, mast. Tolerates acidic soil.	Gypsy moth target. Prefers sun to partial shade.
Red Chokeberry (<i>Pyrus arbutifolia</i>)	3,4,5	Dec. Shrub	no	yes	Moderate, songbirds.	Bank stabilizer. Partial sun.
Red Maple (<i>Acer rubrum</i>)	4,5,6	Dec. Tree	yes	yes	High, seeds and browse. Tolerates acidic soil.	Rapid growth.
Red Oak (<i>Quercus rubra</i>)	5,6	Dec. Tree	yes	no	High, food and cover.	Gypsy moth target. Prefers well drained, sandy soils.
River Birch (<i>Betula nigra</i>)	3,4	Dec. Tree	yes	yes	Low, but good for cavity nesters.	Bank erosion control. Full sun.
Scarlet Oak (<i>Quercus coccinea</i>)	3,4	Dec. Tree	no	no	High, food and cover.	Gypsy moth target. Difficult to transplant.
Shadbush, Serviceberry (<i>Amelanchier canadensis</i>)	5,6	Dec. Tree	yes	yes	High, nesting, cover and food. Birds and mammals.	Prefers partial shade. Common in forested wetlands and upland woods.
Silky Dogwood (<i>Cornus amomum</i>)	5,6	Dec. Shrub	yes	yes	High, songbirds, mammals.	Shade and drought tolerant. Good bank stabilizer.
*Zone 1: Submergent Aquatic Vegetation						
*Zone 2: Shallow Water Bench - 6-12 inches Deep						
*Zone 3: Shoreline Fringe - Regularly Inundated Area						
*Zone 4: Riparian Fringe - Periodically Inundated Area, Wet Soils						
*Zone 5: Floodplain Terrace - Infrequently Inundated, Moist Soils						
*Zone 6: Upland Slopes - Seldom or Never Inundated, Moist To Dry Soils						

Source: *Native Plant Pondscaping Guide - Watershed Restoration Sourcebook, Natalie Karouna, MWCOC*

<p align="center">Figure E-1b. Native Wetland Plant Guide for Stormwater Management Areas in the Mid-Atlantic -- USA Wetland Plants</p>						
Wetland Plants	*Zone	Form	Available	Inundation Tolerance	Wildlife Value	Notes
Arrow arum (<i>Peltandra virginica</i>)	2	Emergent	yes	up to 1 ft.	High, berries are eaten by wood ducks.	Full sun to partial shade.
Arrowhead/Duck potato (<i>Sagittaria latifolia</i>)	2	Emergent	yes	up to 1 ft.	Moderate, tubers and seeds eaten by ducks.	Aggressive colonizer.
Broomsedge (<i>Andropogon virginianus</i>)	2,3	Perimeter	yes	up to 3 in.	High, songbirds and browsers. Winter food and cover.	Tolerant of fluctuating water levels and partial shade.
Cattail (<i>Typha spp.</i>)	2,3	Emergent	yes	up to 1 ft.	Low, except as cover.	Aggressive. May eliminate other species. Volunteer. High pollutant treatment.
Coontail (<i>Ceratophyllum demersum</i>)	1	Submergent	no	yes	Low, food, good habitat and shelter for fish and invertebrates.	Free floating SAV. Shade tolerant. Rapid growth.
Common Three Square (<i>Scirpus pungens</i>)	2	Emergent	yes	up to 6 in.	High, seeds, cover, waterfowl, songbirds.	Fast colonizer. Can tolerate periods of dryness. Full sun. High metal removal.
Duckweed (<i>Lemna sp.</i>)	1,2	Submergent /Emergent	yes	yes	High, food for waterfowl and fish.	May biomagnify metals beyond concentrations found in water.
Lizard's Tail (<i>Saururus cernuus</i>)	2	Emergent	yes	up to 1 ft.	Low, except wood ducks.	Rapid growth. Shade tolerant.
Marsh Hibiscus (<i>Hibiscus moscheutos</i>)	2,3	Emergent	yes	up to 3 in.	Low, nectar.	Full sun. Can tolerate periodic dryness.
Pickerelweed (<i>Pontederia cordata</i>)	2,3	Emergent	yes	up to 1 ft.	Moderate, ducks, nectar for butterflies.	Full sun to partial shade.
Pond Weed (<i>Potamogeton pectinatus</i>)	1	Submergent	yes	yes	Extremely high, waterfowl, marsh and shore-birds.	Removes heavy metals.
Rice Cutgrass (<i>Leersia oryzoides</i>)	2,3	Emergent	yes	up to 3 in.	High, food and cover.	Full sun, although tolerant of shade. Shoreline stabilization.
Sedges (<i>Carex spp.</i>)	2,3	Emergent	yes	up to 3 in.	High, waterfowl, songbirds.	Many wetland and several upland species.
<p>*Zone 1: Submergent Aquatic Vegetation *Zone 2: Shallow Water Bench - 6-12 inches Deep *Zone 3: Shoreline Fringe - Regularly Inundated Area *Zone 4: Riparian Fringe - Periodically Inundated Area, Wet Soils *Zone 5: Floodplain Terrace - Infrequently Inundated, Moist Soils *Zone 6: Upland Slopes - Seldom or Never Inundated, Moist To Dry Soils</p>						

Table E-1b (cont.)						
Wetland Plants	*Zone	Form	Available	Inundation Tolerance	Wildlife Value	Notes
Sedges (<i>Carex spp.</i>)	2,3	Emergent	yes	up to 3 in.	High, waterfowl, songbirds.	Many wetland and several upland species.
Soft-stem Bulrush (<i>Scirpus validus</i>)	2,3	Emergent	yes	up to 1 ft.	Moderate, good cover and food.	Full sun. Aggressive colonizer. High pollutant removal.
Smartweed (<i>Polygonum spp.</i>)	2	Emergent	yes	up to 1 ft.	High, waterfowl, songbirds, seeds and cover.	Fast colonizer. Avoid weedy aliens such as <i>P. Perfoliatum</i> .
Spatterdock (<i>Nuphar luteum</i>)	2	Emergent	yes	up to 1.5 ft.	Moderate, for food but high for cover.	Fast colonizer. Tolerant of fluctuating water levels.
Switchgrass (<i>Panicum virgatum</i>)	2,3,4, 5,6	Perimeter	yes	up to 3 in.	High, seeds, cover. Waterfowl, songbirds.	Tolerates wet/dry conditions.
Sweet Flag (<i>Acorus calamus</i>)	2,3	Perimeter	yes	up to 3 in.	Low, tolerant of dry periods.	Tolerates acidic conditions. Not a rapid colonizer.
Waterweed (<i>Elodea canadensis</i>)	1	Submergent	yes	yes	Low.	Good water oxygenator. High nutrient, copper, manganese and chromium removal.
Wild Celery (<i>Valisneria americana</i>)	1	Submergent	yes	yes	High, food for waterfowl. Habitat for fish and invertebrates.	Tolerant of murky water and high nutrient loads.
Wild Rice (<i>Zizania aquatica</i>)	2	Emergent	yes	up to 1 ft.	High, food. Birds.	Prefers full sun.
*Zone 1: Submergent Aquatic Vegetation						
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*Zone 5: Floodplain Terrace - Infrequently Inundated, Moist Soils						
*Zone 6: Upland Slopes - Seldom or Never Inundated, Moist To Dry Soils						

Source: *Native Plant Pondscaping Guide - Watershed Restoration Sourcebook*, Natalie Karouna, MWCOG

The plant material should conform to the *American Standard for Nursery Stock*, current issue, as published by the American Association of Nurserymen. The botanical (scientific) name of the plant species should be in accordance with the landscape industry's standard nomenclature. All plant material specified should be suited for USDA Plant Hardiness zones 6 or 7 (**Figure E-4**).

For more detail, see the Plant Hardiness Zone map for the Northeastern U.S. at the National Arboretum web site, at <http://www.usna.usda.gov/Hardzone/hzm-ne1.html>.

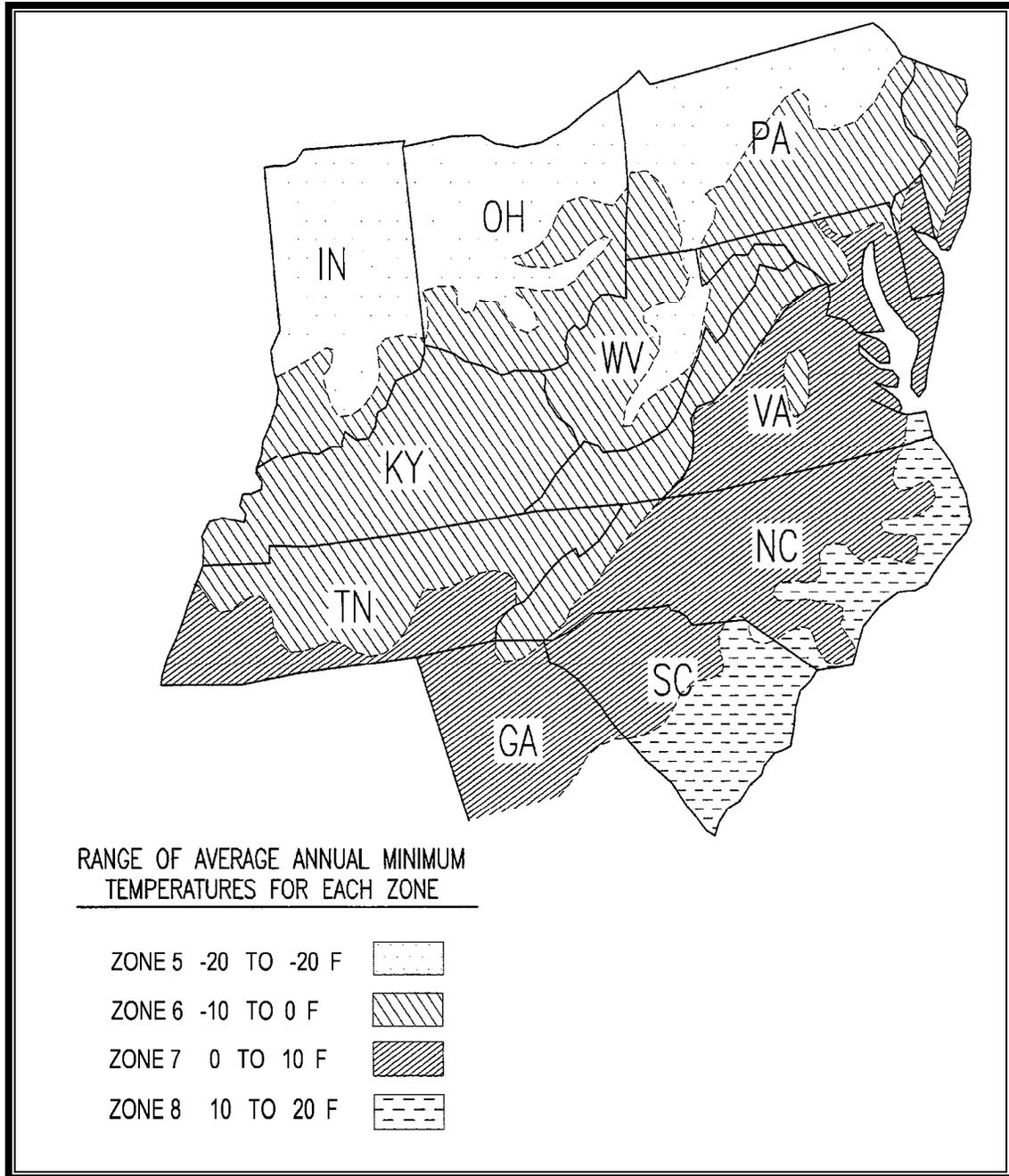


Figure E-4. USDA Plant Hardiness Zones

Newly constructed stormwater BMPs will be fully exposed for several years before the buffer vegetation becomes adequately established. Therefore, plants which require full shade, are susceptible to winter kill, or are prone to wind damage, should be avoided.

Transport and Storage of Plant Material

Specifications may be required for the handling and storage of certain plant materials. Aquatic or emergent plants, for example, require very precise instructions for the contractor. Depending on the time of year and the sequence of construction, it may not be prudent to deliver the plants to the site until the project is ready for landscaping.

Sequence of Construction

The *sequence of construction* describes the site preparation activities such as grading, addition of soil amendments, and any preplanting requirements. It also addresses the installation of erosion and sediment control measures, which should be in place until the entire landscape plan is implemented and the site is stabilized.

Installation of Plant Material

The success of any landscape plan depends on the selection of the proper specifications that are subsequently implemented by the contractor. The specifications should include procedures for installing the plants. They should also provide details for the steps to be taken before and after installation, such as any special instructions for the preparation of the planting pit and fertilization requirements. Any seasonal requirements for installation should also be specified. Typically, containerized or balled and burlapped trees or shrubs should be planted between March 15 - June 30, or between September 15 - November 15.

The placement of trees or shrubs on an embankment is prohibited. The root system of large trees and shrubs can threaten the structural integrity of the embankment and possibly cause its failure.

The side slopes of detention and retention BMPs are usually compacted during the construction process to ensure stability. The density of these compacted soils is often such that plant roots cannot penetrate to an adequate depth, leading to premature mortality or loss of vigor. Therefore, it is advisable to excavate oversized holes around the proposed planting sites and backfill with uncompacted topsoil. In general, planting holes should be 3 times deeper and wider than the diameter of the root ball (B&B stock) and 5 times deeper and wider for container-grown stock (MWCOG, 1992).

Contractor Responsibilities

The contractor should conform to any specifications that directly affect his aspect of the work. He should be aware that there may be penalties for unnecessarily delayed work, minimum success rate of plantings, etc.

For projects involving bio-retention basins or constructed wetlands, it may be advisable to utilize a subcontractor who specializes in aquatic landscaping. The plant specifications, handling, and installation procedures can be unusual compared to traditional landscaping requirements.

SECTION E-8: REGIONAL AND CLIMATE DESIGN VARIATIONS

Plant materials should be selected based on the Plant Hardiness Zone (**Figure E-3**) within which the BMPs are located.

SECTION E-9: TYPICAL GRAPHICAL DETAILS

Not applicable.

SECTION E-10: MATERIAL SPECIFICATIONS

Not applicable. (?)

SECTION E-11: CONSTRUCTION SEQUENCE AND INSPECTION

Not applicable. (?)

SECTION E-12: OPERATION AND MAINTENANCE

A maintenance schedule should be provided in the project plans and/or specifications. This is particularly important for BMPs that have a vegetative component that is integral to the pollutant removal efficiency. The schedule should include guidance regarding methods, frequency, and time of year for landscape maintenance and fertilization.

Specific plant communities may require different levels of maintenance. Upland and floodplain terrace areas, grown as meadows or forests, require very little maintenance, while aquatic or emergent vegetation may need periodic thinning or reinforcement plantings. Note that after the first growing season it should be obvious if reinforcement plantings are needed. If they are, they should be installed at the onset of the second growing season after construction.

Research indicates that for most aquatic plants the uptake of pollutants are stored in the roots, not the stems and leaves (Lepp 1981). Therefore, aquatic plants should not require harvesting before winter plant die-back. There are still many unanswered questions about the long term pollutant storage capacity of plants. It is possible that aquatic and emergent plant maintenance recommendations may be presented in the future.

SECTION E-13: REFERENCES

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