Storm Water Basins

Using natural landscaping for water quality & esthetics

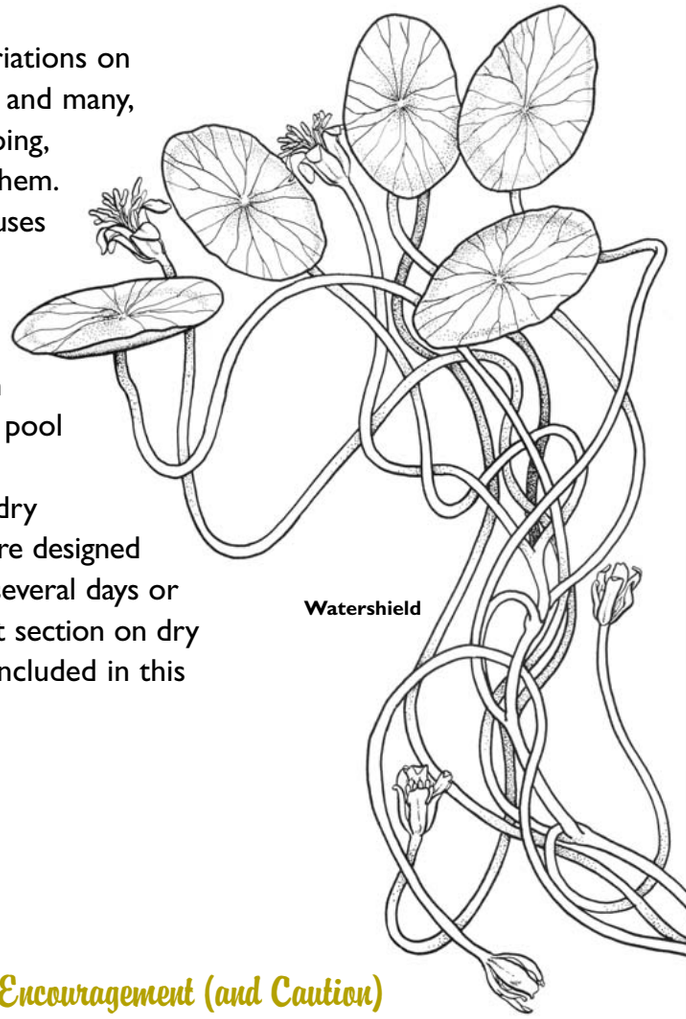
A primer on planting and managing native landscaping for storm water basins.

Water has been used as an esthetic element in gardens since early times. Today, water-gardens are still created for purely esthetic reasons. But, as the caretakers of the earliest water gardens gradually came to realize, these artificial environments can also provide utilitarian functions. Eventually, water gardens were constructed to raise fish, provide drinking water for livestock, supply food and shelter for wildlife, and filter water naturally. Modern water gardens (or storm water basins) serve yet another role: they are constructed to hold, and in some cases treat, storm water runoff from developed areas. Storm water basins have become so common that they represent an integral part of our growing urban and suburban landscape. Landscaping these storm water basins with native plants can increase their value and improve their water treatment functions.

Many landscape architects and storm water engineers are also beginning to look at smaller design practices that work in conjunction with, and in some cases replace, larger storm water basins. Rain gardens, designed to capture and infiltrate storm water from home roofs, are becoming more widely used and might help reduce the need for larger storm water structures.

Similarly, developers are being encouraged to incorporate "green" building practices that minimize the extent of impervious surfaces such as streets and parking lots, and set aside natural areas to keep storm water on-site and allow it to infiltrate. However, until these practices become more widespread, storm water basins remain a practical way of retaining and treating storm water runoff from developed areas.

There are many variations on storm water basins and many, sometimes overlapping, terms to describe them. This publication focuses primarily on what are frequently referred to as "wet basins," which retain a permanent pool of water. Extended storage basins (or "dry detention basins") are designed to store water for several days or weeks. Only a short section on dry detention basins is included in this publication.



Watershield

A Few Words of Encouragement (and Caution)

This publication is a primer on planting and managing native landscaping for storm water basins. It provides important information on how to get started and then carry through with a native plants landscaping plan for the basin. It also provides useful information for local governments, landscape professionals, neighborhood and condominium associations and even local volunteer groups who have an interest in new or existing storm water basins.

However, every site presents unique problems and opportunities. Before embarking on a native landscaping plan for a storm water basin, the reader is encouraged to refer to additional, specialized sources of information. Some are listed at the back of this publication.

The Benefits of Landscaping with Native Plants

Native landscaping means using plants, trees, and shrubs known to exist in the project area during pre-settlement times. Although landscape professionals are still learning about native plants and their functions, it is clear these plants have a number of advantages over their non-native counterparts when used as landscaping for a storm water basin. The goals of the landscaping plan range from an improvement in water quality to provision of wildlife food and habitat. If wisely chosen, native plants are also esthetically pleasing and blend well with most surrounding developments and landscapes.

Water Quality

A growing body of research has documented how native wetland plants can be used to remove nutrients and other pollutants from water. In fact, the use of native wetland plants to absorb excess nutrients in storm water basins has led to using them in other places, for example, in the treatment of tertiary effluent in sewage treatment. This research has opened the door for using these plants to treat polluted runoff in storm water basins. By improving the water quality in storm water basins, the quality of the water in our streams and lakes also improves.

Native plants help "treat" storm water entering them by:

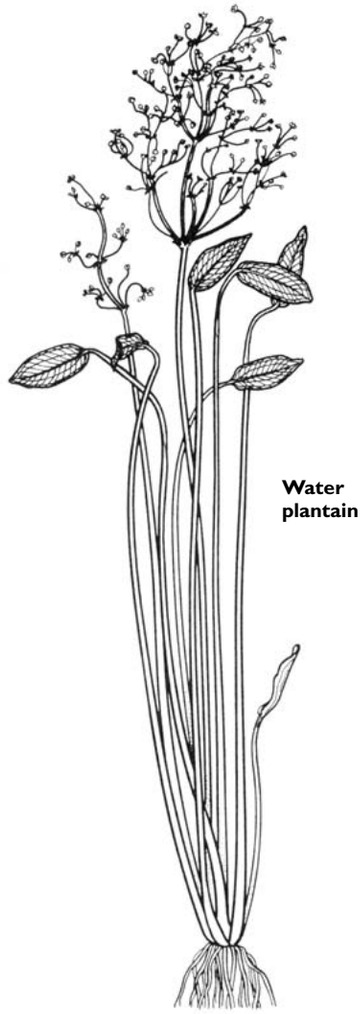
- Removing nutrients (nitrogen and phosphorus)
- Improving water filtration through the diverse vertical structure of plantings
- Reducing the velocity of water flowing through the several layers of vegetation, which allows more water to infiltrate.

Hardiness

Since native plants evolved locally, they are ideally suited to thrive in the climate and precipitation of the project area. Native plants are often resistant to common pests and pathogens that plague non-native species, and their value as food and habitat for wildlife is well known.

Ease of Management

In addition to the water quality benefits, landscaping a storm water basin with native species reduces maintenance costs because mature native plants require less management than traditional non-native plants. In fact, mature wetland natives require only minimal management twice a year, in the spring and fall, to fulfill the goals of the native landscaping plan. Perhaps the greatest maintenance savings are achieved when grass is replaced with wet meadow and prairie plantings which greatly reduce the need for costly mowing and which preserve, and perhaps improve, the ability of these zones to filter runoff water.



Water plantain

Esthetics and Wildlife Habitat

Use of native plants in the several landscaping zones around a basin can provide a rich visual environment. The combination of wetland plants with flowering prairie plants and, in some cases, trees and shrubs in upland areas provides far more visual appeal throughout the year than large areas of mowed lawn to the water's edge.

Native plants also offer food and shelter for wildlife. This benefit is particularly important as suburban growth replaces historic wood-lots and fields. In the upland areas of a storm water basin, for example, tall grasses, trees and shrubs provide habitat for a variety of song birds and other wildlife.

Native Landscaping Snapshot

Quick Cable Business Development

This project was professionally planned, designed and planted during 1998 and 1999. Landscaping planning began early in the design process with the property owner and construction team. Native Wisconsin seeds, root stock and plants were used. More than 10,000 plants and 63 pounds of seed were used to vegetate the basin and surrounding prairie. The site was hand mulched after seeding.

Construction site in summer of 1999.

Emergent edge 2 years after planting.

Wet meadow 2 years after planting.

Planting Zones of Wet Basins

A storm water wet basin is actually an orderly succession of four plant habitats or "zones." Water availability and depth are the main features that distinguish the zones and determine which species of plants they can support. The four zones are similar to the habitats one can find in common marshes or wetlands, which are the native habitat for many of the plants this guide recommends.

The wettest zones are the "deep water" and "submergent" zones where a permanent pool of water exists. The driest zone is the "upland zone" surrounding the basin's wet areas. Between the bed of the basin and the upland zone are the emergent and wet meadow zones. Planting each zone is based on our knowledge of the plant species that grow in wetlands. A landscape plan should recognize the unique features of each of the zones and select native plant species accordingly.

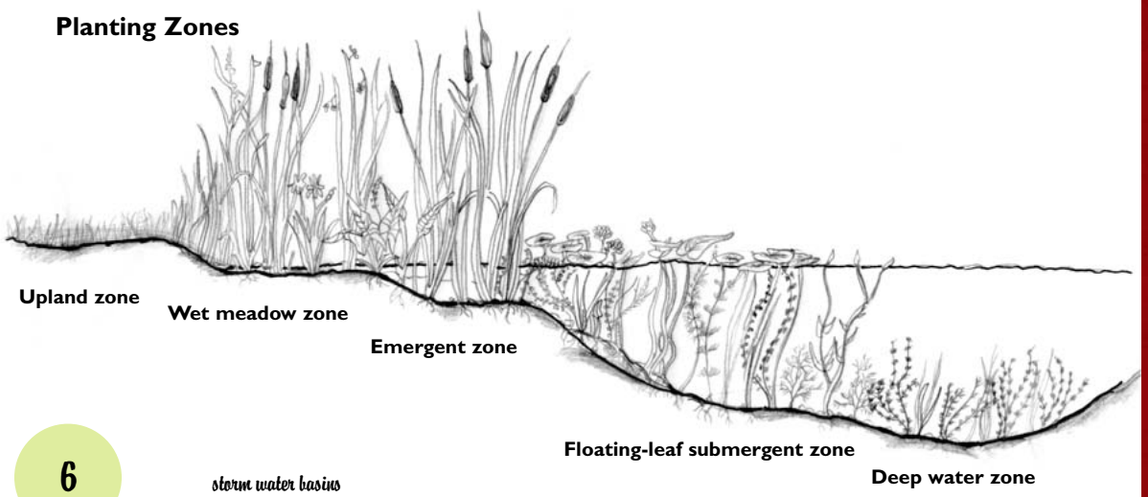
Keep in mind that state standards administered by the Department of Natural Resources require the deep pool of a new wet basin to be at least five feet deep. Very few plants can tolerate these depths so the deep pool will normally be an open water zone.

Deep Water and Floating-Leaf Submergent Zones

Since newly constructed wet basins begin with no vegetation, the landscaping design process begins by considering whether the bed of the basin should be vegetated or left to nature's design. If the choice is made to vegetate the bed of the basin, it is best to choose plants that will oxygenate the water, create habitat, and colonize the area to keep algae growth to a minimum. A good species that meets these qualifications is Water celery (Vallisneria). The plant species should exist in proper equilibrium with all other plant materials. Avoid species that are likely to clog the water, such as many Smartweeds (Polygonum sp.) and Pondweeds (Potamogeton sp.).

Floating-leaf and submergent plants are anchored in the bed of the basin, while their leaves and flowers are located at or above the surface of the water. The number, size, and depth of these plants are determined by the size of the wet basin. No more than 25% of the surface area of the basin should be planted. With time some of the plants will mature and cover much more of the area than when they were planted. For example, a mature water lily will cover 4 to 6 square feet of the surface. Water lilies (Nymphaea ordorata), Water shield (Brasenia), and Pickerel weed (Pontederia cordata) are some of the species that could be planted in this area.

Planting Zones



Emergent Zone

The next area of vegetation is the emergent zone. It is the most diverse area of the landscaping plan. Plants in this zone will perform many more functions than those in other areas of the landscaping design and must be able to tolerate a range of moisture conditions as the basin fluctuates between wetter and drier periods. The number of plants used is determined by measuring the perimeter of the basin. At a minimum, if plants are planted one foot apart, one plant should be used per one foot of perimeter. (For example, if the perimeter measures 3,000 feet, then at least 3,000 plants should be used.) All plants chosen should be hydrophytic (water loving). Wetland plants should be rigid, linear, and generally grow to a height of two feet or more. Selected species should perform all the functions in the basin that they do in a wetland – holding back water in times of flooding, slowly releasing water in times of drought, stopping sediment from entering the basin, decreasing erosion, providing food and shelter for wildlife, creating areas for fish to spawn, removing nutrients and esthetically enhancing the basin.

Grass leaf arrowhead

Each ring of vegetation serves several functions.

The wetland plants that grow in the shallow water areas along the basin's edge are particularly valuable because they:

- Enhance pollutant removal by providing an environment for micro-organisms that remove nutrients dissolved in the water
- Improve the basin's appearance by disguising water level changes and floating debris
- Provide habitat for insects such as dragonflies that eat mosquitoes
- Discourage resident flocks of geese
- Make the basin less attractive for wading or swimming

In addition, if properly planted, native species can compete successfully with more invasive, weedy species.

The emergent plants are planted up against the shoreline, usually in the area that comprises the shelf. Common species are rushes, sedges, and native grasses. The depth of water in which the plants will survive determines the species of plants that can be used. Emergents grow and multiply quickly. Keep this fact in mind when designing the basin. Along with rigid, linear plants, some short and broad leaf species should be used for both diversity and function. Arrowhead (Sagittaria latifolia) and Water plantain (Alisma Plantago aquatica) are common examples.

Wet Meadow Zone

Behind the emergent edge is the wet meadow or mesic prairie zone. Although the plants recommended for this zone should do well in wet soils, they should also be able to tolerate both inundation and dry-down/draw-down conditions. Appropriate species include flowers, native grasses, and sedges such as the Fox sedge (Carex vulpinoidea), New England aster (Aster nova anglicae), Helen's flower (Helenium autrmaie) and Blue joint grass (Calamagrostis canadensis). These function much like the species in the emergent zone, and serve as a buffer for the emergent edge by intercepting the first flush of runoff water. Selected species should also be esthetically pleasing because they add more color to the design as well as providing form and function for the planting. These plants can be planted in beds above the emergent edge or in bands extending all the way around the basin (see page 16).

When positioning a wet meadow area, leave 3 to 6 feet of open land between the wet meadow planting and the emergent edge planting. The open area between the two plantings can be seeded with a native grass seed mix so that water leaving the wet meadow zone is additionally filtered before it reaches the emergent edge. The wet meadow will slow down the velocity of the runoff water, filter out a high portion of the sediment it carries, and help remove or "take-up" a percentage of the nutrients in the water.

Upland Zone

The management of the upland portion of the basin depends on its function. For example, will it become a walking path around the basin or merely a grassy area that blends into the surrounding landscape? The uplands above the wet meadow zone and extending to the top of the basin can be seeded with so called "support vegetation." Prairie or native grass mixes can be used, with the final choice based on site conditions and individual preference. The soil in this area can range from dry to medium moist.

If the choice is to plant grass seed instead of prairie, the same horticultural grass seed species used in the surrounding areas should be appropriate. If the choice is to keep the area totally native, a prairie seed mix should be used. The height of the plants should also be taken into consideration. Will it be a short or tall grass prairie?

A prairie seed mix should consist of 10 lbs. native seed per acre. The ratio of flower seeds to grasses should be approximately 40% flower species to 60% grass species per acre. Good cover or "nurse" crops that will fill in bare areas are annuals such as seed oats or winter wheat, depending on time of planting. Seed oats are better planted in the spring and winter wheat is better planted in the fall. The native seed mix should be suspended in the horticultural nurse crop at the rate of 50 lbs. per acre.

Using a prairie planting above the wet meadow zone completes the native look of the landscaping design, lowers maintenance costs and is esthetically pleasing in many settings. Trees or shrubs, if desired, should be kept to a minimum because leaf litter entering the basin can add additional, unwanted nutrients to the water. Trees can provide a perch for birds as they hunt for insects, small fish or amphibians in the water. Suggested native tree species are Silver maple (Acer saccharinum), Black willow (Salix nigra), River birch (Betula nigra), or Green ash (Fraxinus pennsylvanica). Evergreen trees such as White cedar (Thuja occidentalis) and White pine (Pinus strobus) are good choices because they produce less shade and relatively little leaf litter compared to deciduous varieties.

Assessing the Site

Part of a native landscaping project for a storm water wet basin is deciding who will develop the landscape plan. If seeking professional help for the planning phase, try to choose a landscaping firm that has experience working with native plants. Whether done professionally or by a volunteer group, the first step in planning is assessing the site. This means identifying the following basic features of the planned or existing storm water basin:

- basin type
- location
- size
- shape
- slope
- water depth
- existing vegetation

For an existing basin, the assessment involves a site visit to inventory the plants in and around the storm water basin.

It is much easier to plan and install a native landscape in a new (nonvegetated) storm water basin than in an existing (vegetated) basin. The new site is ready for plants and seed, but sites with existing vegetation require decisions about which existing species to keep and which to remove. Re-vegetating an existing storm water basin requires extra time and money to remove weedy species, as well as troublesome birds and animals that might compete with or destroy the new native plants.

For a newly constructed basin, or one still in the design phase, the plant inventory step will be less involved. It is still a good idea, however, to make a visit to learn if any invasive species are present on the site. If they are, they could be a management issue down the road if dormant seeds successfully sprout.

How Do I Get a Blueprint for an Existing Basin?

You can find the name of the company that designed and built your storm water basin by visiting the planning department of the municipality where the basin is located.

Designing the native landscape begins with a scaled site diagram. Accurate measurements are necessary to visualize how the plantings will look when they mature, and to determine the number of plants needed. Blueprint drawings might be available from the engineering and construction firms that designed and built the basin. Otherwise they can be prepared at the site using graph paper.

Assessing the site with a field inventory yields valuable information for the design phase of the project. In this phase, plants are selected, ordered and planted. Maintenance and management in the future will be based on the initial observations, as will restoration of the planting as needed.

Storm Water Basin Types

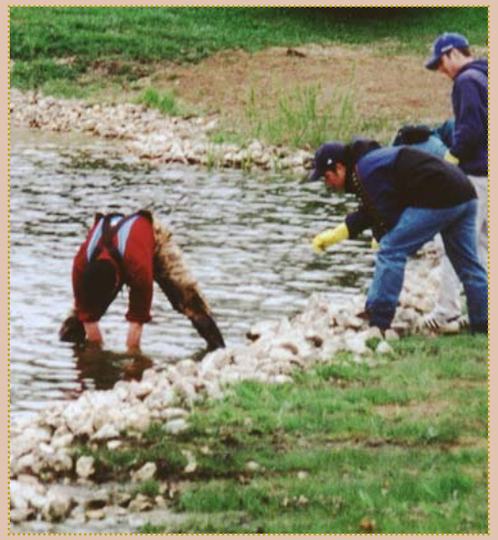
Storm water basins can be divided into two major categories: wet basins that "retain" storm water indefinitely and dry detention basins that store storm water for a day or two. Because wet basins contain a permanent pool they can support a greater variety of native plants including emergent, floating, and submergent varieties. Dry detention basins, for obvious reasons, will not support floating or submergent plants but can usually sustain some drought tolerant emergent species such as Bulrushes (Scirpus sp.) and Soft rushes (Juncus sp.). A short section on dry detention basins is included on page 20.

Native Landscaping Snapshot

Lake Point Residential Subdivision

This project in a residential subdivision was professionally designed, and funded by the Root-Pike Watershed Initiative Network and the homeowners' association. Planting was professionally supervised, but the actual planting was done by more than 40 volunteers, including City of Franklin residents and students and teachers from Whitefish Bay High School.

Volunteers did all the planting.



Planting the emergent zone.

Native Landscaping Snapshot

St. Leonard's School

The St. Leonard's School site was professionally designed in 2002. Students and teachers at the school did the planting. Construction of an addition to the school led to removal of an existing prairie. The area was reconstructed as an infiltration basin and landscaped with native plants.

Infiltration trench during construction and seeding.

Students planting and preparing to transplant native plants.

Physical Characteristics

Take note of the following physical features when assessing a storm water basin:

• Location

The golden rule with location is to develop a landscape plan that integrates the basin into its natural surrounding as much as possible. For basins in highly visible locations (such as the entrance to a housing development), esthetic consideration will have a greater influence on plant selection than for secluded basins. In either case, it is generally best to take design cues from the existing landscape as much as possible so mature plants will complement their surroundings.

• Size

The size of the designed area will depend on the size and character of the undeveloped land surrounding the basin, as well as the size of the project's budget. If the basin is tightly tucked into a developed area with little upland available for landscaping, limit planting to the basin and its shoreline area. If the basin is surrounded by sizeable undeveloped areas, the landscaping plan could encompass the upland areas if the budget allows for the added costs in plant materials and installation labor.

• Shape

Basin shape is the next item to consider. Depth, location, and function come into play when deciding what plants to select and where to put them. Many ponds are round or oval; others are rectangular or kidney shaped.

Some basins have a peninsula or island feature that serves as a design element, but which can also function as a nesting/resting place for waterfowl, and might also help keep resident Canada geese and ducks away from the basin's main slopes.

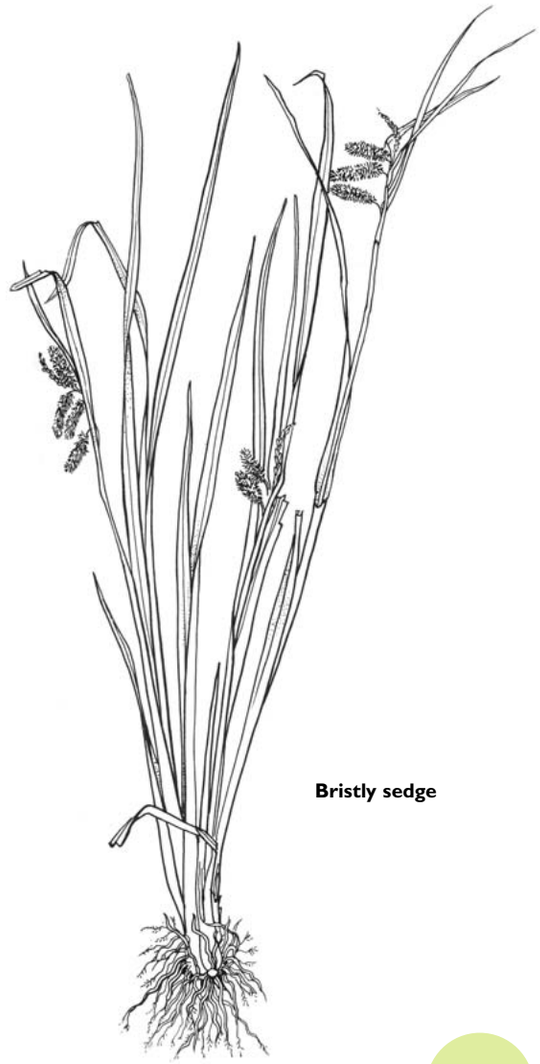
Another important shape consideration that will influence plant selection is the basin's cross sectional profile. Most basins have a shallow ledge or safety shelf along their perimeter designed to reduce the risk of someone falling into the basin and drowning. This can also serve as a wonderful shallow water habitat for native plants. Ideally, to provide the best conditions for establishing a variety of floating and rooted aquatic plant species, the shelf should be planted at least eight feet out from the shore with a 10:1 slope and a maximum depth of 1.5 feet.

• Slope

The gradient of the basin from the edge of the shelf to the deepest spot in the basin should be a very gentle one. The deepest spot in the basin is usually the center. Most wet basins are usually 6 to 8 feet deep in the middle. If fish are desired in the basin, the basin's minimum depth should be eight feet, and the sides should have a gentle gradient to create an area for fish to spawn.

• Existing Vegetation

Most existing storm water basins were landscaped without native plants and receive little or no management. If management does occur it usually involves mechanical mowing of the perimeter and the use of chemicals or aerators to control nuisance algae blooms. If the basin is becoming overgrown with nuisance vegetation, has shoreline erosion problems, or would simply benefit from the addition of native plants, begin the native landscaping project by compiling an inventory of the plants on the site. A native wetland consultant can be a great help in identifying and evaluating the current species composition. A cost-efficient method for undertaking a native landscaping project is hiring a consultant to assess the site and draw up a plan and design, and then purchasing and installing the plants yourself.



Bristly sedge

Plants and Planting

Types of Plants

• Rhizomes or "root stock"

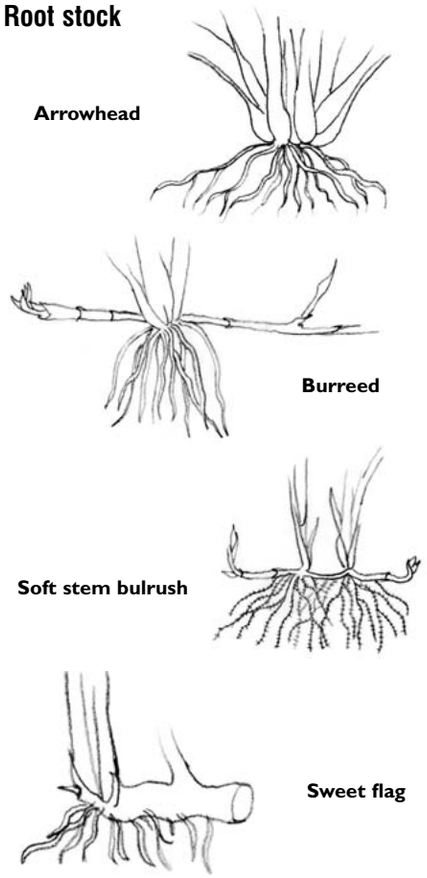
Most hobby landscapers are unfamiliar with hydrophytic plants (plants that live with their roots submerged) or how these plants look when they arrive from the suppliers. Most hydrophytic plants have rhizomes. A rhizome is a horizontal stem with scaly leaves that give the plant an unusual appearance. Nurseries sometimes refer to rhizomes as "root stock."

When installing plants with rhizomes be sure the planting hole is wide enough to lay the rhizomes out flat. Also leave a space of 4 to 6 inches between plants. Methods of planting bouquets, drifts, or lines in the emergent zone (see illustration on page 20) are based on the functions of this part of a design. Density is also important. In some cases the planting can act as a natural fence against Canada geese and ducks. If this is the case, be sure to plant 2 or 3 rows of the plants to create an effective barrier.

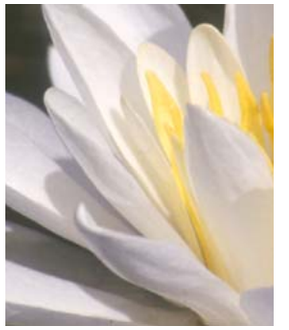
Root stock is considerably less expensive than seedlings and the savings can really add up since most basins are anywhere from 1 to 8 acres and, therefore, require large volumes of plants. Root stock is typically sold as bare root and in quantities of 50, 100, 500, and 1,000 plants. These plants usually arrive in clear plastic bags with names of plants and number of plants per bag. Root stock plants should be planted within 24 hours of arrival. If plants must be stored longer than a day, place them in a container with enough water to cover the roots, or leave them in their shipping bags and place them in cold storage (like a refrigerator). Plants can be stored refrigerated for up to two weeks.

• Seedlings

Seedling plants can arrive either as bare root or in flats of damp soil or damp sphagnum moss. Note that both the common and Latin names are listed on the label.





• Wetland Plants

The most commonly used wetland plants belong to different families and have unique characteristics that help identify them. For example, most all rushes, including Bulrush, Needle rush and Spike rush, have tubular stems. Iris, Sweet flag, Burreed, and Cattail have slim, lance-like leaves and round stems. Arrowhead and Arrow arum have heart shaped leaves, whereas Water plantain has oval leaves. Some plants, such as Arrowhead (Sagattarius latifolia), are delivered as tubers.

Nurseries that harvest and sell plants either own land of their own on which to harvest or have a permit to do so. They also have trained personnel who know how to correctly harvest the plants without over-thinning the populations from which they are taken. The table on page 18 lists the most common plants used in aquatic planting, the zones where they should be planted, and the water depths they prefer. All the plants in are perennials with rhizomes for roots. In addition, all are native to Wisconsin and the Midwest and most can be found and used throughout the United States.

Planting Methods

Prepare the soil by removing all the vegetation. Prepare a 6 to 8 foot band of soil all the way around the basin edge or perimeter leaving three feet open between the wet meadow and the emergent zone. Rubber hip boots are recommended to keep feet and legs dry, warm and protected from sharp rocks.

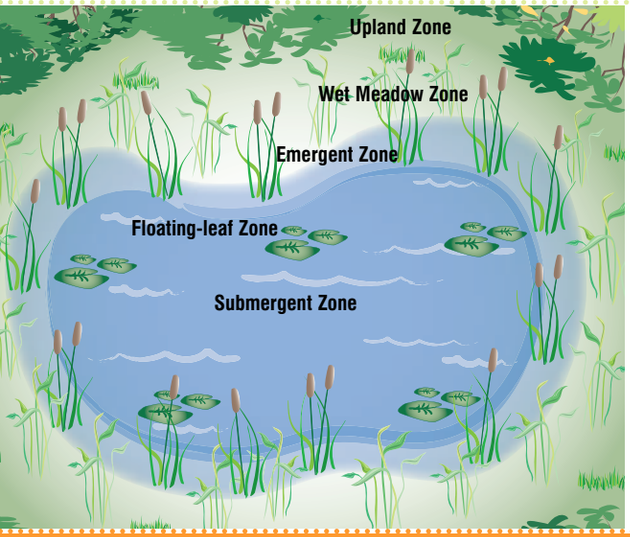
To make planting the bed of the basin easier, request plants, mesh bags, and stones from the nursery. Wrap one or two plants in each bag with a few small pebbles to anchor the plant. Place a rubber band around the top to secure the plant and drop it into the water in a concentric design. If either emergent or floating-leaf plants cannot be planted immediately, store them in buckets of water until planting time.

To plant floating-leaf plants (for example, water lilies) reach down into the water and plant roots into the bed of the basin. If the water is too deep, plant the floating-leaf species into bucket-sized containers and lower these with a rope onto the bed of the basin. Another method of planting is to lower the lilies in pails with a pole (with a hook on the end) onto the bed of the basin. An advantage of planting lilies in buckets is you can change their location if the initial location is not appropriate. Water lilies do not like to be planted in moving water so find a protected spot with little or no water movement.

The emergent zone should be planted next, followed with the wet meadow planting and seeding. When planting the emergent zone, dig into the soil with a spade or trowel. Hold soil back and down. Place a plant in the hole and allow soil to cover the plant roots. Pat the soil down.

The wet meadow should be cultivated before planting. Choose to either seed or plant root stock or seedlings, or a combination of both. If combining both seeding and planting, hand broadcast the seed and rake

Sample Native Landscaping Design for New Detention Basin Plants



Planting Instructions

1. Plant floating-leaf submergent area first.
2. Plant emergent zone next.
3. Seed wet meadow zone. Supplement with wet meadow zone plants. Plant at random.
4. Seed prairie zone next. Supplement with prairie zone plants.
5. Plant perch trees, species of your choice.
6. Remember to hand broadcast both wet meadow and prairie zones. Bring seed in contact with soil by raking.
7. Mulch if possible.
8. Plant supplemental plants last.

Plants

Floating-Leaf Submergent Zone

3 Nymphaea odorata - White water lily
25 Pontedaria cordata - Pickerel weed

Emergent Zone

300 Scirpus schoenoplexus - Softstem bulrush
200 Acorus calamus - Sweet flag
200 Iris versicolor - Blue flag iris
200 Sparganium eurycarpum - Burreed
100 Sagittaria latifolia - Arrowhead
100 Alisma Plantago-aquatica - Water plantain
10 Peltandra virginica - Arrow arum

Wet Meadow Zone

100 Andropogon gerardi - Big bluestem grass
50 Verbena hastata - Blue Vervain
50 Eupatorium maculatum - Joe Pye Weed
50 Eupatorium perfoliatum - Boneset
50 Asclepias incarnata - Swamp Milkweed
50 Scirpus atrovirens - Bluegreen Bulrush

Upland Zone (Medium soil)

50 Aster nova anglicae - New England aster
50 Rudbeckia hirta - Blackeyed susan
50 Echinaceas purpurea - Purple coneflower
50 Liatris aspera - Rough blazingstar
50 Asclepias tuberosa - Butterfly milkweed
50 Andropogon gerardii - Big bluestem grass
50 Andropogon scoparium - Little bluestem
50 Bouteloua curtipendula - Side oats gramma
50 Sorghastrum nutans - Indiangrass
50 Sporobolus heterolepsis - Prairie dropseed

Seed Mixes

Wet Meadow Zone

Use same species of seed that are used as plants.
Use 10 lbs of native seed per acre suspended in nurse or cover crop.

1 lb Verbena hastata - Blue vervain
1 lb Eupatorium maculatum - Joe pye weed
1 lb Eupatorium perfoliatum - Boneset
1 lb Asclepias incarnata - Swamp milkweed
2 lbs Scirpus atrovirens - Bluegreen bulrush
2 lbs Andropogon gerardii - Big bluestem grass
1 lb Sorghastum nutans - Indian grass
1 lb Carex vulpinoidea - Fox sedge

Medium Soil

Use 10 lbs. native seed per acre (suspend in nurse or cover crop).

1 lb Aster nova anglicae - New England aster
1 lb Rudbeckia hirta - Blackeyed susan
1 lb Echinaceas purpurea - Purple coneflower
8 oz Liatris aspera - Rough blazingstar
8 oz Asclepias tuberosa - Butterfly milkweed
1 lb Andropogon gerardi - Big bluestem grass
1 lb Andropogon scoparium - Little bluestem
1 lb Bouteloua curtipendula - Side oats gramma
1 lb 8 oz Sorghastum nutans - Indiangrass
1 lb 8 oz Sporobolus heterolepsis - Prairie dropseed

it in before planting the seedlings. Add approximately 200 to 300 plants of the same species used in the seed mix. If planting seedlings and root stock only, determine the number of plants based on the number of feet in the perimeter of the wet meadow area placed in one foot squares. Follow up planting with a cover or "nurse" crop of seed oats or winter wheat. By planting both seeds and plants the landscaped area will fill faster than planting one or the other.

Plant Density

Plants should be arranged in a random fashion for esthetic purposes.

Floating-Leaf Submergent Zone: 1 plant every 3 to 4 square feet.

Emergent Zone: 1 plant per linear foot of shoreline.

Wet Meadow Zone: 1 plant per square foot.

Upland Zone (medium soil): 1 plant per square foot.

The density of plants in both the buffer zone and emergent edge is very important not only for the wetland functions they perform, but also because they discourage waterfowl and pedestrian traffic from the basin's edge. Heavy traffic on the edge can lead to erosion problems and create ragged edges with shallow pools where water stagnates and grows unwanted algae.

Seeding

Wetland seed, seed mixes or plants will only be successful if planted in the proper areas. Plants will do well in all the zones of basins. Seeds will do well only in the wet meadow zone or the prairie zone.

If seed is purchased as individual species they should be mixed together. Some species of native seeds are so fine that a sand filler is necessary to get equal distribution in the mix. The mix should then be manually broadcast or sown with a seed drill.

If a nurse crop (seed oats or winter wheat) is used, sow the native seed first, then the nurse crop on top of it and rake both into the soil. An alternative method is to mix the cover crop with the native seed mix and either hand broadcast it and rake it in or use a seed drill to disperse it. Leave about six inches between plants to allow room to grow.

After planting all the native plants and broadcasting the native seed, allow plants time to mature. Depending on the species, this can take from two months to a year or longer. After the plants flower and produce seed they are considered mature and the planting phase of the project can be considered successful.

Native Hydrophytic (Water Loving) Plant Species

The plant species listed here are the species most commonly used in the native landscaping of basins. Most of them are available from native nurseries listed in the back of this text.

Common Name	Scientific Name	Zone	Preferred Water Depth
Wild celery	Vallisneria	Submergent	0 – 6 ft.
Sago basin weed	Potamogeton pectinatus	Submergent	0 – 6 ft.
Musk grass	Chara species	Submergent	0 – 6 ft.
Water smartweed	Polygonum amphibium	Submergent	0 – 6 ft.
Large leaf basinweed	Potamogeton ampifolius	Submergent	0 – 6 ft.
Floating-leaf basinweed	Potamogeton natans	Submergent	0 – 6 ft.
White water lily	Nymphaea odorata	Floating-leaf submergent	0 – 4 ft.
Yellow water lily	Nuphar variegata	Floating-leaf submergent	0 – 4 ft.
Lotus	Nelumbo lutea	Floating-leaf submergent	0 – 4 ft.
Water shield	Brasenia schreberi	Floating-leaf submergent	0 – 6 ft.
Burreed	Sparganium eurycarpum	Emergent	0 – 1 ft.
Hard stem bulrush	Scirpus acutus	Emergent	0 – 1 ft.
Soft stem bulrush	Scirpus validus	Emergent	0 – 1 ft.
Three-square bulrush	Scirpus americanus	Emergent	0 – 1 ft.
Pickerel weed	Pontederia cordata	Emergent	6 in – 2 ft.
Broad leafed arrowhead	Sagittaria latifolia	Emergent	6 in – 2 ft.
Water plantain	Alisma plantago-aquatica	Emergent	0 – 6 in.
Wild rice	Zizania aquatica	Emergent	0 – 1 ft.
Giant mana grass	Glyceria grandis	Emergent	0 – 1 ft.
Sweet flag	Acorus calamus	Emergent	0 – 1 ft.
Narrow leaf cattail	Typha angustifolia	Emergent	0 – 1 ft.
Broad leaf cattail	Typha latifolia	Emergent	0 – 1 ft.
Lake sedge	Carex lacustris	Wet meadow-mesic prairie	0 – 1 ft.
Blue green bulrush	Scirpus atrovirens	Wet meadow-mesic prairie	0 to 6”
Needle rush	Eleocharis acicularis	Wet meadow-mesic prairie	0 – 6 in.
Water horsetail	Equisetum fluviatile	Wet meadow-mesic prairie	0 – 6 in.
Manna grass	Glyceria striata	Wet meadow-mesic prairie	0 – 6 in.
Blue flag	Iris versicolor	Wet meadow – emergent	0 – 1 ft.
Soft rush	Juncus effusus	Wet meadow	0 – 6 in.
Water arum	Calla palustris	Wet meadow	6 in – 2 ft.

Planting-Time Windows

The best times to plant or seed are commonly called the planting “windows.” Each time has its benefits. The emergent, submergent, and floating-leaf zones as well as the bed of the basin can be planted from spring through fall.

If the area is new construction it is best to plant and seed as soon as possible after construction is finished. This allows the new seeds to compete with the weed seeds in the soil. If planting occurs in the early spring the native seeds can compete with the cool-weather, non-native species, and will benefit from the spring rains to germinate properly.

When possible, fall planting is preferred. If planting takes place after the first frost, the native plants and seeds will benefit from snow and cold weather and improve germination by having a natural time of dormancy. When spring comes they will be ready to germinate and grow. Waterfowl heading south will not require much food or habitat from the new plantings. This will limit predation on the young plants.

Ordering Plants

Catalogs from nurseries are wonderful sources of information about the plants and seeds they sell. Plants are available in many forms. Most suppliers list not only how they sell their plants seedlings (bare root, root stock, and plugs), but also the cost per plant or plant-unit (i.e. 0 to 100 plants, 100 to 500 plants, 500 to 1,000 plants). Cost for seed is listed in fractions of a pound. Seed is sold by individual species, as pre-mixed species for a particular ecosystem or as custom made mixes. Some catalogues have pictures of what the plants look like when they are in flower; others show what a mature flowering ecosystem or habitat looks like.

Many of the catalogs offer information on planting, and some nurseries offer consulting services. Some wetland consultants work independently using native nurseries for plants and seeds. When ordering the plants and seeds, get seed-order catalogs three months or more in advance of ordering materials to become familiar with the plants.

A number of Wisconsin-based nurseries specialize in native wetland plants. Most of these companies offer catalogs with detailed information on each species, including pictures of mature plants and instructions on how and where to plant them. Be sure to coordinate plant delivery date with date of basin completion, or as soon after that date as possible. Getting planting done in a timely fashion will both discourage non-native plants from sprouting and minimize pre-installation mortality.

When plants arrive, check to make sure they are the right species and are in good condition. If you need help identifying them, use a field guide such as *Wetland Plants & Plant Communities of Wisconsin & Minnesota,* or *Through the Looking Glass*. Both titles are referenced at the end of the publication. In addition to properly identifying plants, it is also wise to rinse them off before planting because wetland plants have a tendency to carry “hitchhiker” seeds from invasive plants like Purple loosestrife, Reed canary grass, and Bladderwort.

Native Landscaping For a Dry Detention Basin

Dry detention basins are designed to hold water for only a limited time, so they differ considerably in their design from wet basins. The sides of a dry detention basin are either gently sloped or are constructed with no obvious slope at all. The bottom of the basin is level and only one depth throughout. When storm water enters the basin and travels through the plantings, the water is caught by the plants and some water infiltrates into the soil. The plant roots remove a considerable amount of the nutrients. Some water is absorbed and some continues to travel through the soil until it is all absorbed or runs out.

Because they fluctuate between being very dry and very wet, dry detention basins present a challenging landscaping environment. They require a choice of plants similar to those recommended for the wet meadow zone of a wet detention basin. Plant species are chosen that can tolerate inundation and water draw-down and still survive. Suitable plants have deep, vertical roots that can reach moisture a considerable distance into the soil. Recommended flowering species are New England aster (Aster nova anglicae), and Helen's flower (Helenium autumaie); grasses are Blue joint (Calamgrostis canadensis) and Big bluestem (Andropogon gerardi); and sedge species to consider are Blue green bulrush (Scirpus atrovirens) or Fox sedge (Carex vulpinoidea).

If the dry detention basin is seeded, the soil in the basin should be cultivated about six inches deep and worked over until soil particles are the size of a dime or smaller. Broadcast the seed mix into the basin and rake it until it all has come in contact with the soil. Covering the seed with a light mulch of straw will help the seedlings survive. Mulch can also be added to improve the infiltration capacity of the soil. Wetland plants can be planted from spring until the basin freezes in the fall. Fall plantings are usually scheduled after the first frost when growth ceases for the year, or in the early spring when growth begins.

Planting Methods for a Dry Detention Basin

drift bouquet linear

Planting can take three forms: a linear arrangement (straight line), a drift (a group of plants planted together), or a bouquet (groups of plants, arranged like a floral bouquet) with open spaces between bouquets.

Management and Maintenance

The Management Plan

Although management is something done after the basin is planted and growing, it actually begins in the design phase of the project. A carefully considered design will eliminate most of the problems in a new basin before they occur, and a bad design will create landscape and plant maintenance problems that can persist for years.

For landscaping professionals fortunate enough to have some influence over basin construction, the money and time spent in design is the first step toward a successful management plan. However, no matter how well the basin is designed, the native plants still need long-term care to ensure the establishment of healthy, long lasting populations. For example, management at the beginning of the project might include attention to removing pest plants (both native and exotic) and harvesting and removing existing plants to remove nutrients tied up in the plants. Those same considerations and others will need continued attention once the landscaping plan is mature.

A management plan should be based on a 5-year time frame. The early years are the busiest, involving monitoring plant success and replacing and supplementing failed and struggling populations. After the plants are in and seeds are sprouting, the first step in management is monitoring growth. Watch to see if the plants remain green and if they flower and produce seed. Observe whether the weather is affecting growth. In some years the growing season is hot and dry. In other seasons the weather may be wet and cold. If the weather is hot and dry it's a good idea to water wet meadow and prairie areas, especially in the first year. By the second year they should be able to tolerate most weather extremes. In the case of severe drought (less than 2 inches of rain per month during the growing season) supplemental watering of prairie and wet meadow plants is recommended.

If plants are growing well they should flower and produce seeds by the end of their first or second growing season. Do not pick seed after the first flowering. Let the plants acclimate themselves to the site. Second year seed, however, may be picked and used to populate nearby void areas or other basins. To ensure that the seed is mature, wait until the seed is falling from the plant. Only pick a portion (less than 50%) so the rest will be available to produce new plants in the coming year. After two years the plants should be fairly well established and management will start to shift to long term maintenance issues such as mowing in the spring and fall.

Management changes as plantings mature. Assess the management plan every year for the first four years. A good maintenance program will keep the native planting attractive and functioning for many years to come.

Problem Wildlife

Herbivores such as rabbits, deer, mice, muskrats and others can be very destructive to young plants. In some cases wildlife destroy plants by eating them. In other cases they trample plants as they move in and out of the basin.

Canada geese are perhaps the most common menace. Many methods of goose control are available. Recommended options include placing swan decoys on the surface of the basin, placing fishing line about two feet high around the basin between the emergent edge and the wet meadow to deter the geese from coming off the basin and onto the slopes, and using air cannons that automatically fire to scare away the birds. However, geese are a federally protected migratory species and should not be harmed without the necessary state and federal permits. Geese should never be fed because this will only encourage them to take up long-term residence.

Muskrats can also create a problem in some basins by eating wetland vegetation and undermining the basin banks with their tunnels. Trap nuisance muskrats with "Have-a-Heart®" traps and move them to another site at some distance from the basin. (Consult a local DNR biologist for tips on potential relocation sites).

Invasive Plant Species

Invasive species on the site can be removed while planting. Consult with municipal officials to see if they have a noxious weed ordinance. If so, follow the ordinances both for management and implementation of the planting program and for the removal and control of noxious species. Even though invasive plants might have been removed early in the project they probably weren't eliminated. Invasive seeds are likely to remain in the soil and will sprout if exposed to the right physical conditions (heat, light and moisture).

It is much easier to remove these plants when they are young. Always try to remove them before they produce seed. It's also a good idea to identify invasive species before removing them. This will help in control methods later if the invasives re-appear.

Although management does not usually begin until installation of the vegetation, keep management in mind once the site assessment has been completed. Looking at the vegetation that exists on a site will raise awareness of any noxious species present. Some native species of plants might be saved and incorporated into the landscape design. Although the plants might be destroyed during construction, the seed bank might germinate with proper conditions of light, heat, and moisture. Some of these native species are Willow (Salix), Dogwood (Cornus stolinifera), and Cattail (Typha latifolia). These species can be useful if properly controlled so that they do not out-compete the plants you have planted.

The invasive species most likely to occur in Wisconsin are Purple loosestrife (Lythrum salicaria), Reed canary grass (Phalaris arundinacae), Ragweed (Ambrosia artemisfolia), and Thistle (Cirsium sp.). Some invasive native species likely to occur are Willows (Salix sp.) and Cattails (Typha sp.). Part of the secret to avoiding problems with aggressive invasive and native species is to encourage plant diversity through the design of the project. For example, if cattails are allowed to grow wherever they germinate, they will out-compete other native plants and lower the overall diversity. As new plantings grow and mature they will begin to fill in the spaces between plant groupings. If one species out-competes the others, thin it out.

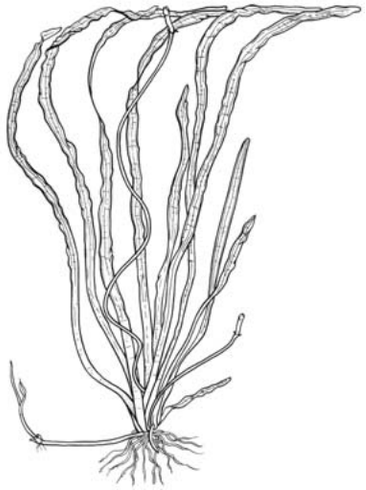
Also, watch open spaces between plantings in the emergent edge for signs of erosion. Fill open spots with soil and plant them immediately.

Thinning, Mowing and Burning

If the planting becomes too thick, thin it. Thinning techniques include burning (check with municipal officials and DNR and seek professional assistance with any burning), mowing or manual removal.

Burning can be used only in the prairie and wet meadow zones of the basin and only after two year's growth of the new plants. If the planting becomes too thin, supplemental plantings may be necessary. Check annually for invasive species and remove them.

Mow wet meadows in the spring and fall after the first year of growth has been completed. Mowing twice a year will be enough to control noxious weeds. It will also reduce the cost of mowing during the growing season.



Wild celery

Native Landscaping Snapshot

Muskego Regency Apartments

This project was part of a senior care complex. The 3.5 acre pond was professionally planned, designed and planted during 1998 using 6,000 plants and 12 pounds of seed. The project incorporated a handicapped accessible walking path.

The site was hand mulched after seeding and planting.

Basin edge as it looked 1 year after planting.

A Final Word

Undertaking a project to plant and manage native landscaping in and around a storm water basin can seem like a daunting task. However, following the principles and practices outlined in this manual will make the task manageable. As shown by our case examples, volunteers can often take on much of the work, with a bit of professional guidance. Once the landscaping matures, neighborhoods and communities can look back and know that they have contributed to cleaner water and a more sustainable and pleasurable landscape.

Suppliers

The suppliers listed below carry plants, root stock, plugs and seed for all or part of an aquatic planting program. Also, check with nurseries in your area to see what native plants and seeds they can provide. You may need to order from more than one nursery to get all the species of plants or seed needed for your project. Mention of specific suppliers does not constitute endorsement.

Native Nurseries

Ion Exchange
1878 Old Mission Drive, Harpers Ferry, IA 52146-7533
(800) 291-2143, (563) 535-7231
Email: sales@ionxchange.com
Web: www.ionxchange.com

J & J Transplant Aquatic Nursery, Inc.
P.O. Box 2274, Wild Rose, WI 54984-0227
(715) 256-0059, (800) 622-5055
Email: jmalchow@transplant.com

Kesters' Wildlife Nursery
P.O. Box 516, Omro, WI 54963
(920) 685-2929, (800) 558-8815

Marshland Transplant Aquatic Nursery
P.O. Box 1, Berlin, WI 54923
Tom Traxler (920) 361-4200, (800) 208-2842
Email: marshland.voyager.net

Prairie Future Seed Company, LLC
P.O. Box 644, Menomonee Falls, WI 53502-0644
(262) 820-0221
Email: pfsco@execpc.com

Prairie Nursery
P.O. Box 306, Westfield, WI 53964
(800) 476-9453
Web: www.prairienursery.com

Prairie Ridge Nursery
9738 Overland Rd., Mt Horeb, WI 53572-2832
(608) 437-5245

Taylor Creek Restoration Nurseries
1792 Smith Road, Brodhead, WI 53520
(608) 897-8641
Web: www.appliedeco.com

Wetland & Native Landscaping
S87 W18193 Wood Rd., #208, Muskego, WI 53150
(262) 679-8003

Wildlife Nurseries, Inc.
P.O. Box 2724, Oshkosh, WI 54903
(920) 231-3780

Consulting Services

Applied Ecological Services
1792 Smith Rd., Brodhead, WI 53520
(608) 897-8641
www.appliedeco.com

Prairie Ridge Consulting Restoration & Management Services
9738 Overland Rd., Mt. Horeb, WI 53572-2832
(608) 437-5245

Wetland & Native Landscaping
S87 W18193 Wood Rd., #208, Muskego, WI 53150
(262) 679-8003

A more complete listing of resources and consultants can be found at:
www.dnr.state.wi.us/org/land/er/invasive/info/nurseries.htm

Selected Resources

Aquatic Plants and Wetland Plants of Northeastern North America. University of Wisconsin Press, 2000.

A two volume set describing the vascular plants of aquatic and wetlands habitat in northeastern North America, including Wisconsin.

Creating Freshwater Wetlands, CRC Press, 1997

A step-by-step guide that demonstrates how to restore or create freshwater wetlands. It also provides practical advice on choosing sites, getting help, attracting and stocking wildlife, selecting plants, and wetland operation and maintenance.

The Natural Habitat Garden., Timber Press, 2004

Provides advice on how to transform land back to native habitats, including prairie, woodlands, and wetlands. A list of native plants is provided.

Through the Looking Glass – A Guide to Aquatic Plants. Wisconsin Lakes Partnership, 1997

A field guide to aquatic plants in North America. The guide is organized in sections on emergent, free-floating, floating-leaf, and submersed plants. Includes detailed illustrations.

Wetland Plants and Plant Communities of Minnesota & Wisconsin. U.S. Army Corps of Engineers, 1997.

Includes 185 color photos of 15 wetland types and 144 representative plant species. Brief descriptions of each plant species include taxonomic characteristics, habitat and notes on wildlife use and economic value.

Vegetation of Wisconsin: an Ordination of Plant Communities. University of Wisconsin Press, 1959

Contains a wealth of information on Wisconsin's native flora with a species list for each of the communities described in the book.

Wisconsin Manual of Control Recommendations for Ecologically Invasive Plants. Bureau of Endangered Resources, Wisconsin Department of Natural Resources, 1997.

Summarizes the morphological characteristics, habitat requirements, life history, and possible methods of control for common invasive plant species.

Invading Weeds: A Growing Threat to Wisconsin's Biological Diversity. Prinstar Books, 2001.

Detailed information and more than 80 color photos on identification and control of the most invasive plants in Wisconsin's natural areas.

Invasive Plants of the Upper Midwest: An Illustrated Guide to Their Identification and Control. University of Wisconsin Press, 2005.

Offers details of plant identification, control techniques, and suggestions for related ecological restoration and community education efforts. Includes more than 250 color photos.

Wisconsin Native Plant Sources. University of Wisconsin-Extension, 2004.

Provides lists of nurseries that sell native plants and seeds, and includes information about restoration and native ecosystems.

Wet Detention Basins. Wisconsin Department of Natural Resources, Conservation Practice Standard number 1001, 1999.

Specifies minimum criteria for the planning, design, operational expectations and maintenance of wet detention basins

http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm

Glossary

Algae	Primitive group of plants having chlorophyll but no vascular system.
Bare root	Plants that contain a part of stem and a rhizome.
Bed	Bottom of a basin.
Bouquet	Plants planted in a bunch of different species.
Broadcast	To scatter seed by hand while walking through the prepared area of soil.
Buffer zone	A zone of plants to limit the inflow of sediment and nutrients into a pond or water way.
Competitive exclusion	To use plants to crowd out other plants to the point that they can no longer grow.
Concentric	Planting plants in a circle, having a common center.
Cover crop	Annual seed in which native seed is dispersed for planting.
Drift	Plants planted together of different species.
Emergent plants	Plants whose roots are under water and leaves and flowers above water.
Erosion	To gradually wear away.
Hitchhiker	A plant that attaches itself to another plant to secure a free ride.
Hydrophytic	Water loving.
Impervious surfaces	Surfaces that rain water can't soak through
Indeterminate viability	Ability of seed to vary its germination in order to grow.
Indigenous	Naturally in a particular region.
Inundation	To overflow and flood.
Invasive species (aliens)	Plants that grow in an area but are not native.
Mesic prairie	Wet prairie.
Native landscaping	Using plant material that existed in the area from pre-settlement times.
Nutrients	Nourishing substances, typically nitrogen and phosphorus.
Perch tree	A tree used by birds to sit on while scouting for fish in a basin or basin.
Phytoentractrod	Plants that can extract and concentrate contaminants from the ground.
Phytofiltration	Plants used in hydroponic systems to extract contaminants from water.
Phytostabilization	Plants used to fix contaminants in place (e.g. vegetation caps over landfill).
Phytodegradation	Plants used to extract contaminants, such as hydrocarbons, and transform them to a less dangerous state.
Prairie	A large area of grassland with forbs.
Retention basin	A basin that holds water indefinitely.
Scale	The size of a sample in proportion to the size of an actual thing.
Sedges	Grass like plants with triangular stems.
Sedimentation	The solid materials that settles to the bottom of a liquid.
Seed bank	The seeds existing in the soil from previous plants which grew in the area.
Storm water	Rain that falls during a storm and runs over and off the land surface into a waterway.
Submergent	Plants that grow under the water.
Water shelf	A ledge built out into the water for planting vegetation and safety—also a safety shelf.
Wet meadow	An ecosystem consisting of plants that can withstand dry down/draw down and flooding.

Storm Water Basins
Using Natural Landscaping for Water Quality and Esthetics

Credits and Acknowledgements

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This publication can also be viewed and printed from PDF format on the web at clean-water.uwex.edu/pubs/basinlandscaping

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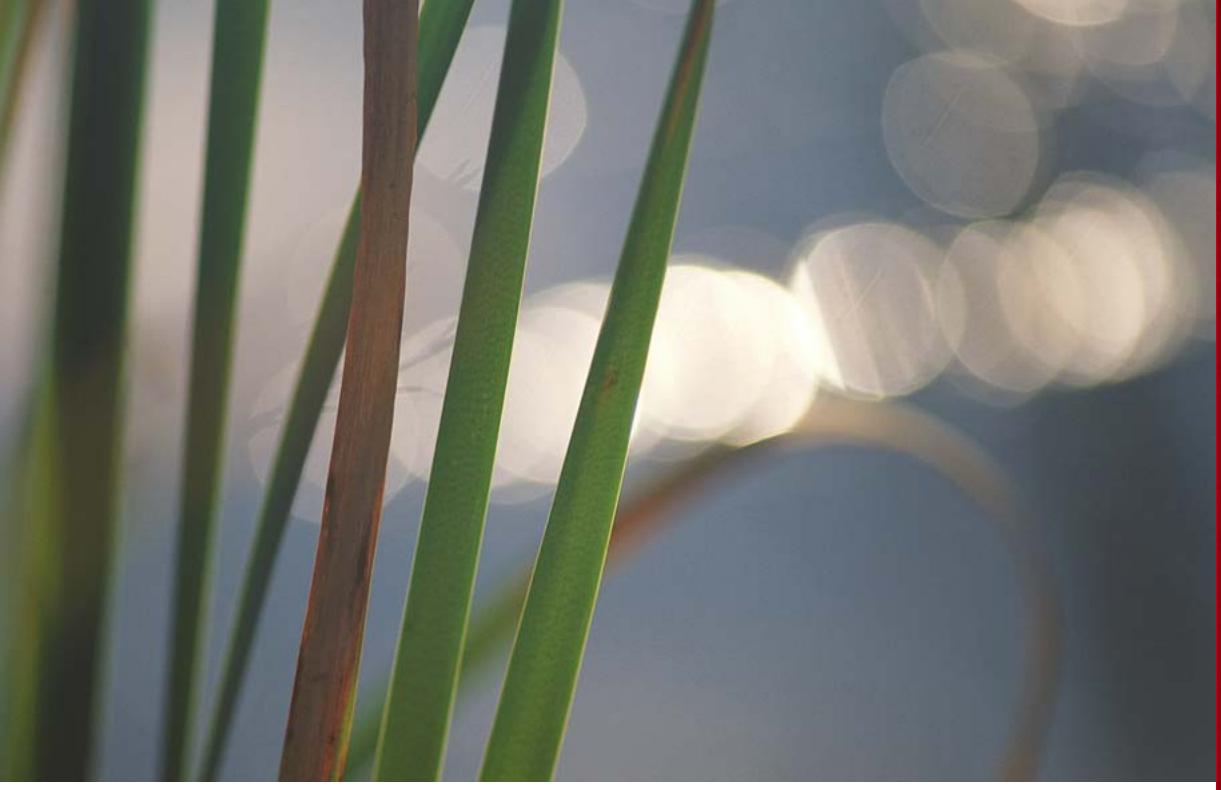

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