A Maryland Sea Grant Extension Brief

Urban and Stormwater Pond Management

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Introduction

Stormwater ponds have become a familiar sight in housing developments and suburban communities. Maryland alone has approximately 18,000 wet stormwater ponds that cover nearly 200,000 acres. The primary function of these ponds is to capture and treat runoff — the excess water from the surrounding area that is not absorbed directly into the ground during rain and storm events. This water can carry with it high amounts of nutrients and pollutants. Stormwater ponds are often edged with a variety of aquatic plants, which can absorb excess nutrients before they become bound to organic material in the soil.

Beyond nutrient reduction, stormwater ponds can serve as valuable habitat for local wildlife, including fish, frogs, turtles, birds and waterfowl. Such a productive ecosystem beautifies the neighborhood, providing a valuable resource for the entire community.

But proper management of stormwater ponds is crucial. If poorly managed, stormwater ponds can suffer from the overgrowth of algae or invasive plants, such as Phragmites, which detracts from their function for nutrient capture and aesthetic appeal. For this reason, wet ponds have fallen from favor for stormwater treatment options in new development. This fact sheet outlines good management practices for the tens of thousands of existing ponds, helping to optimize their role in nutrient capture and community aesthetics.

Stormwater ponds, like this one in Easton, Maryland, capture runoff and reduce nutrients in the water.

Ponds provide nutrient remediation and habitat for local wildlife. This pond features floating plant rafts that enhance nutrient uptake and make it an attractive feature of the community.

Stormwater Ponds Present Unique Management Challenges

Stormwater control ponds are designed to trap water running off the watershed. This water often carries with it sediment from surrounding areas as well as nutrients from fertilizer, animal waste, or failing septic systems. As sediment enters the pond, the pond fills and becomes shallower, allowing sunlight to penetrate to the bottom. Nutrients in the water and sediment help spur the growth of nuisance aquatic plants — microscopic algae

(phytoplankton) can reach high densities and cause oxygen depletion in the water, or filamentous algae can cover the pond with dense mats during the summer months.

A properly constructed stormwater pond reduces sediment and nutrients and can be a beautiful asset to the community. But many ponds do not achieve their optimal function and often fill in, becoming overgrown and unattractive. These problems can be avoided with proper design and management practices.

Optimizing Pond Design and Maintenance

Stormwater ponds can be designed for many uses. Some of these include:

- Runoff control (water, nutrients, sediment)
- Beauty, landscaping, aesthetics
- Fire fighting
- Irrigation (field, orchard, lawn, golf course, etc.)
- Wildlife attraction, habitat, breeding
- Recreation (fishing, boating, and picnicking)

Ponds designed for a specific purpose should include features that make them easier to manage for that purpose. Ponds for recreational fishing should have irregular shapes and depths and include brush or structure for fish habitat. Irrigation ponds should be deep, with steeply sloped sides to maximize water capacity while minimizing aquatic weed growth. Ponds that combine multiple uses necessarily trade off on design features.

An attractive and productive pond can enhance property values. One study showed that residents perceive the value of their property to be 15 to 25 percent higher because of their proximity to managed wet ponds. Proper maintenance is key to assure a pond's function and aesthetic appeal. When a community sees a pond as a valuable asset, homeowners are more likely to help support and even get involved with their maintenance. Homeowner associations and volunteers can carry out routine visual inspections, removal of debris and litter, minor sediment removal near inflow and outflows, and vegetation maintenance. Non-routine maintenance such as bank stabilization, structural repairs, mechanical maintenance, and removal of excess sediment requires professional assistance. Regular inspection of stormwater ponds will help identify maintenance needs early and help sustain proper function.

Ease of management should always be a prime consideration in design. A good management program requires determining the main goals for a particular pond, then targeting design appropriately. In the development of stormwater ponds, this decision process may benefit from the involvement of a community association. Often these groups develop very effective monitoring programs that keep ponds operating properly. Important factors to consider in designing a management program include the ability to:

- Control nuisance aquatic vegetation
- Maintain proper water quality
- Preserve storage capacity
- Maintain aesthetic appeal

Controlling Nuisance Aquatic Plants

Aquatic plants can provide ponds with many benefits, including habitat for spawning and nursery areas for fish, oxygen production during daylight hours, and settlement of suspended sediment. But if ponds are managed poorly, unwanted vegetation can inhibit pond function and reduce aesthetic appeal.

Specific design features can help minimize aquatic weed growth. Buffer strips can help trap nutrients, which will decrease the amount of food available to plants for growth. Steeply sloping sides of the pond, ones that rapidly drop to depths below 3-4 feet, can help limit sunlight penetration to prevent rooted aquatic plants from growing rapidly. However, safety regulations by state agencies require shallow "benches" or "shelves" around the edges to prevent children or non-swimming adults from slipping into the pond, sliding over their heads, and possibly drowning. Unfortunately, these shallow areas can create the perfect habitat for nuisance aquatic plants.

Controlling nuisance aquatic plants can be difficult and expensive. Controls consist of mechanical, biological, or chemical methods. Mechanical methods include the placement of barriers such as plastic mesh to block sunlight penetration into the pond, and physically pulling, raking, and cutting weeds. Biological control involves introduction of herbivorous fish to eat plants. Unfortunately for Marylanders, the fish most effective as a biological control is grass carp, whose introduction is not legal in Maryland waters. Regulations currently restrict its use because of its potential negative impact as a grazer on native vegetation. Chemical control involves the use of herbicides to kill or limit the spread of the plants. These chemicals can be expensive and often have specific restrictions on their use.

Over time, invasive species such as cattail or Phragmites can shrink pond area and build up organic matter.

Poor management can reduce pond function, lead to aesthetic problems like this algal bloom, and require costly renovations.

Once nuisance plants have been controlled, native plants can be planted in their place. It is important to consider the nutrient remediation needs of the community, as some plants have higher rates of nutrient uptake than others. Local aquatic plant nurseries can assist in choosing plants that suit the needs of each community.

Minimizing Waterfowl Use

Canada geese and ducks are beautiful to look at, but they can cause a host of problems in stormwater ponds. Waterfowl can bring in unwanted aquatic plant species on their feet and feathers. Their waste material can create nutrient problems when deposited in and around ponds. And while a few birds here and there may not cause problems, hundreds can quickly make even the most pristine pond a nightmare to manage. In most areas, people cannot hunt waterfowl, since most ponds are located within residential communities. In addition, resident goose flocks stay throughout the year and raise young that add to local populations. In many instances, property owners feed waterfowl in order to attract them. Homeowner associations should discourage such feeding practices.

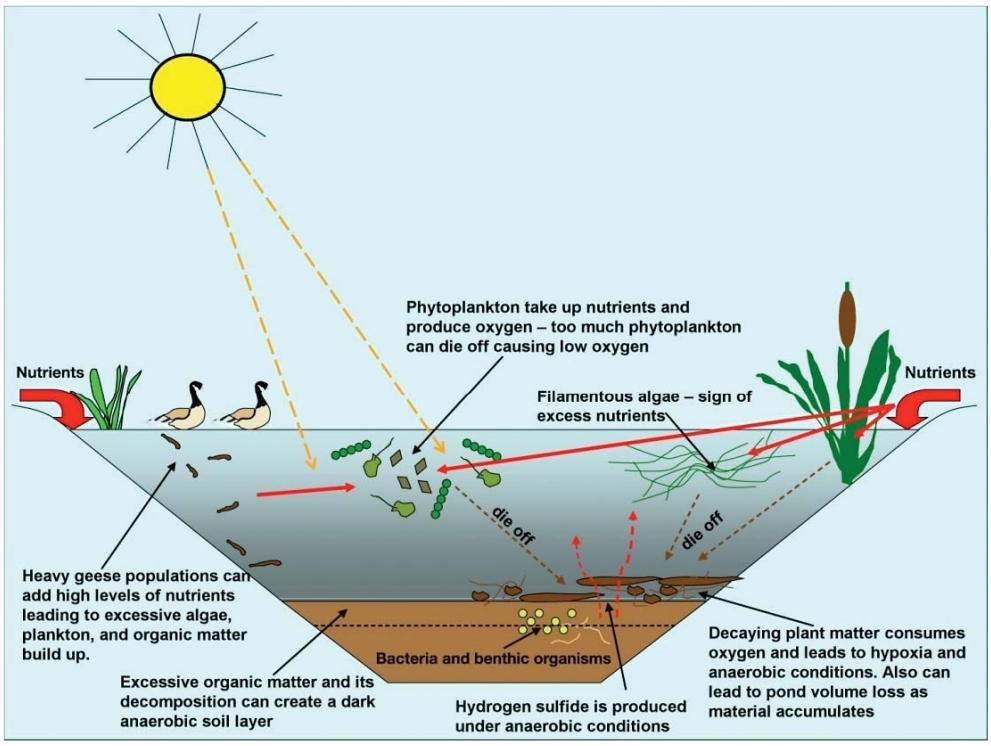
Maintaining Water Quality

In small aquatic ecosystems like stormwater ponds, a variety of interrelated biological and chemical processes work together to maintain a healthy environment for a diverse population of animals and plants. The surrounding soil type influences many characteristics of water quality such as pH, a measure of acidity and alkalinity. Concentrations of carbonate, for example, help to buffer acidity. Beneficial soil microbes and various worm-like organisms help breakdown organic matter and process nutrients. Each species contributes specific processes to drive and maintain the ecosystem. Aquatic plant life, including tiny phytoplankton and larger macrophytes or shallow water plants, helps to take up nutrients and, through photosynthesis, to absorb carbon dioxide and produce oxygen. Microscopic animals or zooplankton feed on phytoplankton and serve as important food for fish species, which provide forage to some birds and other wildlife species.

Although stormwater ponds are designed to trap sediments and nutrients from the adjacent watershed, a pond's natural processes have their limits. Overfertilization of lawns or a large waterfowl population, for example, can easily overload the ability of the plants and beneficial microbes to process nutrients. Such an imbalance can affect many aspects of water quality, causing problems such as wide fluctuations and reduction of dissolved oxygen, an increase in concentration of toxic nitrogen compounds such as ammonia, changes in pH, and production of hydrogen sulfide from decaying organic matter. Excess nutrients affect plant populations, encouraging the growth of algal mats or scums, filamentous algae, or unwanted invasive species. Following recommended turf grass management practices such as using organic sources and low phosphorus fertilizers will help reduce nutrient loading of ponds. Additionally, using beneficial plant species along the pond's edges or in floating settings may help take up nutrients and reduce the incidence of problem vegetation (see Table 1).

Plant Species for Stormwater Ponds

Aquatic plants are the foundation of a healthy ecosystem. They provide shade and cover for fish (especially fry),



Biological and chemical processes resulting from nutrient inputs to a stormwater pond.

food and cover for birds and animals, and a home for aquatic and non-aquatic inhabitants such as frogs, toads, tadpoles, salamanders, and insects (like water beetles, dragon and damselflies, butterflies, bees, and spiders). Many aquatic plants are well equipped to compete for nutrients in the pond environment. When nutrient levels are high and plants are absent, algae and toxins proliferate, contributing to poor water quality.

A good supply of native plants with favorable traits should be the goal when planning a stormwater pond. Plantings in rafts can improve nutrient uptake by increasing root exposure to the surrounding water body. Some plants provide bold flowers and foliage for increased aesthetic value. Non-flowering foliage plants should not be overlooked, however, simply because they don't produce colorful flowers. Some of the most dramatic landscapes are founded on foliage texture, color, form and shape. Large bodies of water are often viewed from a distance, and the gentle nuances that occur from a light breeze can be as captivating as flowers. To limit sediment runoff and reduce weed seed germination, same-plant species should be grouped together to help provide dense growth. Many species of wildlife prefer dense cover for nesting and as a food source, and dense plantings can be pleasing to the eye.

Turfgrass Management in Urban Watersheds

Sustainable turfgrass and landscape management play an important role in reducing nutrient runoff from lawns to stormwater ponds. Homeowners can make a difference in the health of their stormwater ponds, the Bay, and the environment by following conscientious practices related to fertilization, watering, controlling runoff, and general care and maintenance of the lawn and landscape.

Both turfgrass and ornamental plants are only as healthy as the soil they grow in. Regular soil testing is imperative. A soil test can provide information on levels of phosphorus, potassium, magnesium, pH, soil texture, organic matter, and recommendations for fertilizer applications. Turf fertilizers have traditionally contained the nutrients nitrogen, potassium, and phosphorus. Nitrogen gives turf its green color and promotes root and shoot growth. Phosphorus is used for root development and potassium is important for disease resistance and to build a tolerance to drought, foot traffic, and harsh winters. But too much phosphorus and nitrogen create problems associated with excess loading, including undesirable vegetation and the overgrowth of algae. Newer fertilizers are now available with low or no potassium and phosphorus, which aids in reducing phosphorus runoff. Organic fertilizers are often a better choice as they slowly release nitrogen and phosphorus as needed by turfgrass and can also add valuable organic matter to the soil.

The optimum soil pH for turf is 6.0 to 6.8, which is slightly acidic. Lime should only be applied when pH is lower than the optimum level and only according to the soil test recommendations. Grouping plants together that require similar fertility and pH, and light requirements facilitates care and maintenance. Soil tests should be taken for lawns and landscapes every 3 to 5 years for optimum results.

Fall is the best time to apply fertilizer to lawns. This timing promotes root growth, stores food for spring and helps plants recover from summer stress. No more than two

applications of nitrogen, in September and late October, should be applied at a rate of one pound of nitrogen per 1,000 square feet in each application. When choosing a turf fertilizer, a homeowner should look for slow-release products with low or no phosphorus, unless starting a new lawn. Slow-release fertilizers are also available for landscape plants. Slow-release fertilizers for lawns and gardens are available commercially in organic and synthetic forms. Organic fertilizers are a good choice for those who would like to add organic matter while fertilizing. These products tend to have lower nitrogen content and require a greater quantity to reach the desired rate of application, which makes them more costly.

Improved soil quality can lead to better air and water flow, resulting in a deeper root system, reduced erosion, and an overall healthier lawn and landscape. Unproductive soil, such as clay or sand, is one of the most difficult challenges faced by homeowners. Adding organic matter is the best way to improve soil structure by slowly releasing nutrients to the roots and increasing microbial activity. In clay soils, the addition of organic matter results in improved drainage and aeration to roots. In sandy soils, organic matter improves water and nutrient retention. Organic matter, such as compost, leaf mold, or grass clippings can be applied to lawns as topdressing of 1/4" to 1/2" or after core aeration, which in itself is helpful in improving air and water flow in the lawn. Landscape plants prefer soil high in organic matter at a rate of three percent or greater by weight in the topsoil. For the best results, incorporate up to 2 to 3 inches of organic matter annually into new and established beds as a soil amendment.

Proper mowing and irrigation can reduce weeds and stress on turfgrass. Cutting turfgrass lower that what is recommended for the species or mowing infrequently is one of the major causes of decline in most lawns. Turfgrass should be mowed at a height of approximately 3 inches (on turf-type tall fescue), and no more than 1/3 of the blade should be cut at one time. Clippings can be left on the lawn. This recycles nutrients and adds organic matter to the turf. Mowing should be avoided on heat or drought-stressed turf. Turf should only be irrigated when needed, when it develops a blue-gray or purplish color or when it lies down, leaving a footprint when walked upon. Slow and deep watering to 4 to 6 inches, applied in the early morning hours, works most effectively. Light and frequent watering can lead to shallow roots and increase disease and weed problems.

Use herbicides only as needed. Understanding how and why weeds grow is the first step in developing an effective control strategy. For example, spring and summer annual weeds, such as crabgrass, goosegrass, and yellow foxtail can be controlled with pre-emergent herbicides in the spring. Broadleaf weeds, such as clover and dandelions, can be treated with post-emergent herbicides during the growing season. It is important to follow label instructions and only apply what is necessary. Herbicides should not be applied to drought-stressed or dormant lawns.

All plantings in the lawn and landscape help absorb stormwater. While turfgrass does a nice job of absorbing stormwater, planting deep-rooted vegetation — such as woody plants, trees and shrubs, and certain grasses — along the property line helps to stop runoff and also recharges groundwater by allowing water to soak into the ground. Rain gardens are another option for controlling stormwater. A rain garden is a dish-shaped garden that is planted in native wetland vegetation, wet prairie wildflowers, grasses, trees, and shrubs that collects water and recharges the water table, preventing polluted runoff. Many of the plants species recommended for ponds (Table 1) can be used in rain gardens as well.

Table 1. Characteristics of recommended aquatic plants for ponds.

Botanical Name	Common Name	Photo	Description	Zone	Height	Depth	Flower	Wildlife Benefits	Habit	Comments
Acorus calamus	Sweet Flag		Glossy green blades are sweet-scented when broken. Leaves sway gracefully in the breeze.	4	2-3	0-15”	N/A	Food & cover – muskrat & wildfowl.	Upright, spreading.	Won’t spread into deep water.
Asclepias incarnata	Swamp Milkweed		Pink flowers attract butterflies. Seed pods are unique and unusual.	5	3-4	0-2”	August	Food & host – Monarch butterflies.	Upright, showy.	Seeds germinate in moist soil. Won’t spread into deep water.
Carex vulpinoidea	Fox Sedge		Narrow weeping green foliage forms dense uniform clumps.	5	2	0-2”	N/A	Food – various birds including songbirds	Clump forming.	Seeds germinate in moist soil. Won’t spread into deep water.
Cephalanthes occidentalis	Button Bush		Attractive glossy foliage on reddish-brown branches. White buttonlike flowers give way to interesting round seed heads.	4	6-8	0-6”	May, June	Food – various birds including songbirds and small mammals. Food & host for various butter-flies & moths.	Shrub.	Won’t spread into deep water.
Decodon verticillatus	Swamp Loosestrife		A woody perennial native to Eastern U.S. Arching branches hold purplish pink blooms. Brilliant Fall foliage.	3	3-4	0-6”	July, August		Mounding, shrublike.	Roots freely in the water.
Dulichium arundinaceum	Dwarf Bamboo		Compact bamboo-like foliage. Excellent for foreground or border planting. Not a true bamboo.	6	18”	0-4”	July, August	Food – muskrat & wildfowl.	Dense, spreading.	Won’t spread into deep water.
Hibiscus moschuetos	Swamp Hibiscus		Bold colorful flowers in pink, white or red add excellent late summer color.	6	4	0-4”	July, August	Food – humming-birds.	Upright, showy.	Woody perennial. Won’t spread into deep water.

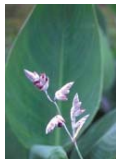
Table 1. Continued.

Botanical Name	Common Name	Photo	Description	Zone	Height	Depth	Flower	Wildlife Benefits	Habit	Comments
Iris versicolor	Blue Flag Iris		Delicate violet blossoms rise gracefully above swordlike foliage. Small stature.	4	2	0-6”	April, May	Food – birds, muskrat & wildfowl.	Clump forming.	Seeds germinate in moist soil. Won’t spread into deep water.
Justicia americana	Water Willow		White flowers are decorated with purple and resemble miniature orchid blossoms. Foliage resembles the narrow leaves of a willow.	4	12-18”	0-12”	July, August	Spawning area.	Low, spreading.	Won’t spread into deep water.
Kosteletzkya virginica	Seashore Mallow		Soft pink flowers are produced continually during the summer months. Leaves are velvety and downy.	5	6-9	0-6”	July, August, September		Upright, showy.	Woody perennial. Can handle brackish water. Won t spread into deep water.
Menyanthes trifolia	Bog Bean		Pink buds open to delicate fringed white flowers above soft green trifoliate leaves.	3	8”	0-8”	April	Spawning area.	Low, slow spreading.	Won’t spread into deep water.
Mimulus ringens	Lavender Musk		Lavender flowers nestled among soft green foliage. Long bloomer.	3	2	0-6”	July, August		Upright.	Seeds germinate in moist soil. Won t spread into deep water.
Nymphaea (cultivars)	Waterlily		Almost always the focal point of the pond with extraordinary blossoms. Foliage contrasts beautifully with the water s surface.	3	6”	18-24”	May, June, July, August, September	Food – mammals & wildfowl.	Clump forming.	Non-seeding cultivars are recommended.
Orontium aquaticum	Golden Club		Unique white and gold flowers held high above waxy-green foliage. Easy to grow, consistent and uniform.	6	1-2	0-10”	April, May		Clump forming.	Seeds germinate in moist soil. Won’t spread into deep water. Tolerates some shade.

Table 1. Continued.

Botanical Name	Common Name	Photo	Description	Zone	Height	Depth	Flower	Wildlife Benefits	Habit	Comments
Peltandra virginica	Arrow Arum		An attractive plant with dark green glossy arrowhead-shaped foliage. Easy to grow, consistent and uniform.	5	2-3	0-12”	N/A	Food – seeds, waterfowl & various birds.	Clump forming.	Seeds germinate in moist soil. Won’t spread into deep water. Tolerates some shade and anoxic conditions.
Phyla lanceolata	Frog Fruit		Delicate pink and white flowers float above deep green serrated-edged foliage.	5	2-6”	0-4”	July, August, September	Spawning area.	Dense, spreading.	Won’t spread into deep water.
Pontederia cordata	Pickerel Rush		Slick, broad dark green foliage. Bright lavender flowers. Easy to grow and long blooming.	3	2-3	0-8”	June, July, August, September	Food – muskrat & wildfowl.	Clump forming.	Seeds germinate in moist soil. Won t spread into deep water.
Sagittaria latifolia	Arrowhead		Strong, wide arrowhead-shaped foliage. Delicate white flowers with bright yellow centers.	4	2	0-6”	July, August	Food – muskrat & wildfowl.	Upright, spreading.	Seeds germinate in moist soil. Won’t spread into deep water. Tolerates anoxic conditions.
Saururus cernuus	Lizard Tail		Delicate cream-colored blossoms give way to an unusual seed formation hence the name Lizard Tail. Triangular green foliage.	4	1-3	0-6”	July	Food – wildfowl.	Upright, spreading.	Seeds germinate in moist soil. Won’t spread into deep water. Tolerates some shade and anoxic conditions.
Solidago sempervirens	Seaside Goldenrod		Bold golden yellow flowers stand atop rigid, lightly leaved stems. Foliage more dense at the base.	4	3-8	0”	August, September, October		Upright, showy.	Seeds germinate in moist soil. Won’t spread into deep water.

Table 1. Continued.

Botanical Name	Common Name	Photo	Description	Zone	Height	Depth	Flower	Wildlife Benefits	Habit	Comments
Taxodium distichum	Bald Cypress		Deciduous needle tree known to grow "knees" when planted below water level. Accepts severe pruning for limited area.	4	80-100	0-10"	N/A	Food & nesting – various birds.	Tree.	Won't spread into deep water.
Thalia dealbata	Water Canna		Bold dramatic foliage. Rich purple flowers on tall narrow spikes are held high above the foliage and sway gracefully in the breeze.	7	6-8	0-12"	July, August, September		Upright, clump forming.	Won't spread into deep water.

Summary

Ponds can serve as important mechanisms for reducing nutrients, while providing attractive settings and valuable community assets in the form of wildlife habitat, places for recreation, and ultimately increased property values. The degree to which a pond can serve these roles depends on the following factors: pond design, load of nutrients from the watershed, number and types of aquatic plants, and general pond management practices. Aquatic plants function as natural biofilters that use nitrogen and phosphorus for growth, and they add beauty and additional habitat for a host of wildlife species. Encouraging desirable plant species both in the pond and in the surrounding landscape — including healthy turf grass — and ensuring proper use of fertilizers will help maintain good pond quality. Proper management will help avoid some of the problems that can otherwise occur in ponds that are poorly maintained.

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