URBAN Waterways

# Maintenance of Stormwater Wetlands and Wet Ponds

*Stormwater management practices must be kept in proper working order to maintain their intended functions and aesthetic appeal.*

This publication presents maintenance guidelines for stormwater wetlands and wet ponds, two stormwater practices that are being constructed across North Carolina.

## OVERVIEW

As its name implies, a *stormwater wetland* is a wetland system designed to treat stormwater runoff. Wetlands typically have shallow water (except for intermittent deep pools) and dense vegetation. A well-functioning stormwater wetland will be a diverse ecosystem that includes many plant and animal species. It will also do an excellent job of removing pollution from stormwater runoff—its intended function. Stormwater wetlands are very efficient at nutrient removal. Recent studies conducted by North Carolina State University researchers indicate that a stormwater wetland removes 40 to 80 percent of all nitrogen and 50 to 70 percent of all phosphorus entering the wetland. Figure 1 depicts some wetlands located across North Carolina. (For more information on stormwater wetlands, see *Designing Stormwater Wetlands for Small Watersheds*, AG-588-02, in the Urban Waterways fact sheet series.)

*Wet ponds* are typically much deeper than stormwater wetlands—their average depth ranges from 4 to 8 feet. They are designed so that most of the pond is open water. Wet ponds are the most common stormwater management practice in North Carolina and have been constructed since the 1970s in some parts of the state. More recent pond configurations incorporate wetland features, such as an aquatic shelf (or wetland bench) and a forebay.

An *aquatic shelf* is a shallow-water zone of a pond, usually along the bank edges, planted with wetland vegetation. These shelves flood during storms. A *forebay* is a pool where inflow first enters the pond, and heavier pollutants, such as sediment, initially settle there. Research conducted across the United States shows that wet ponds effectively remove sediment and the pollutants associated with it from stormwater. Both wet ponds and stormwater wetlands can



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**Figure 1. Stormwater wetlands across North Carolina: (A) Brevard College in the mountains; (B) Hillandale Golf Course in Durham; (C) Carteret-Craven Electric Cooperative near Morehead City; and (D) Smithfield-Selma Senior High School in Johnston County.**

be used for flood control as well. For more information on stormwater practices, see *Urban Stormwater Structural Best Management Practices (BMPs)* in the Urban Waterways series (AG-588-01).

## MAINTENANCE GOALS

Maintenance of stormwater wetlands and wet ponds is performed to achieve four goals: efficient hydraulic flow and pollutant removal, aesthetic appeal, safety, and mosquito control. Most of the maintenance activities associated with wetlands and wet ponds pertain to two or more of these goals. The following activities should be performed regularly to maintain stormwater wetland and wet pond efficiency:

- Remove sediment and gross solids from forebays.
- Keep the orifice (the drawdown hole) free-flowing.
- Clean away floating trash and debris.
- Remove vegetation along the dam face.
- Remove invasive plant species.
- Mow the perimeter of wet ponds.
- Control pests, such as muskrats and beavers.

## REMOVE SEDIMENT AND GROSS SOLIDS FROM FOREBAYS

Forebays are located at the inlets to stormwater wetlands and wet ponds. They are designed to slow incoming water, dissipating the water's energy, and to provide a location for sediment and other gross solids (such as leaves, other tree debris, cigarette butts, and trash) to settle and accumulate.

A forebay is typically 2 feet deep in a stormwater wetland and sometimes deeper in a wet pond. If the forebay fills with sediment and gross solids, these materials will bypass the forebay and begin to accumulate in other portions of the wetland or wet pond that may be more ecologically sensitive.

To check sediment levels inside the forebay, record the depth of the forebay at the same time each year. Depending on the size of the forebay, a fish finder can be used from a small boat or someone can survey the depth along a grid of the forebay with a rod (Figure 2). If the forebay water is clear, the depth can often be determined visually.

Once the forebay is half full of sediment or the average sediment level is within 1 foot of the water



**Figure 2. Inspection (A) of sediment depth and cleaning or "dipping" (B) of forebays. A long boom on the excavator is sometimes essential to access sediment collected in the middle of the forebay.**

surface, remove the sediment and gross solids. This task is typically accomplished by a track hoe or backhoe (Figure 2). The water level inside the wet pond or stormwater wetland can be lowered, if needed, to aid excavation of the forebay. Depending upon the size of the forebay, cleaning it can require anywhere from a day to a week.

Once the excavated soil (or *spoils*) from the dredging has begun to dry, either spread it in the watershed away from the banks of the wetland or wet pond and seed it, or take it to a landfill. Consider the location when disposing of the soil. Spoils from wet ponds downstream of industrial facilities may contain pollutants that need to be disposed of in a landfill, while those from a residential wetland or wet pond may not. If there is any concern as to proper disposal, samples of the excavated soil should be sent to a laboratory for chemical analysis. This can be costly.

A recent study by N.C. State researchers indicates that sediment and gross solids from forebays typically need to be removed (also known as *dipped* or *dredged*) once every 5 to 10 years. If wet ponds and stormwater wetlands are located in watersheds with active construction, however, spoils may need to be removed as often as once a year.

Like the forebay, the final *deep pool* of the pond or wetland near the outlet also must be inspected and maintained. The major difference between the two is that the final deep pool takes longer to fill with soil. The drawdown hole (located at the outlet and described in the next section) is where captured stormwater slowly drains from the wetland or wet pond. It must be free of accumulated debris and sediment to work properly. Remove sediment and gross solids from the deep pool near the outlet whenever the material is within 1 vertical foot of the drawdown hole.

## What Designers Can Do To Make Forebay Cleanout Easier

Access to older wet ponds and stormwater wetlands is often a problem. New design recommendations can make forebay cleanout easier by improving accessibility:

- Include reinforced paths that give heavy equipment easy access to the forebay (Figure 3). Sometimes the path doubles as a separation between the forebay and the remainder of the pond.
- Make forebays relatively long and narrow. A narrow forebay makes it easier for a trackhoe or backhoe arm to reach at least to the middle of the forebay from either side.

**Figure 3. A wide path is provided for heavy equipment to access the forebay (located to the right of the path).**

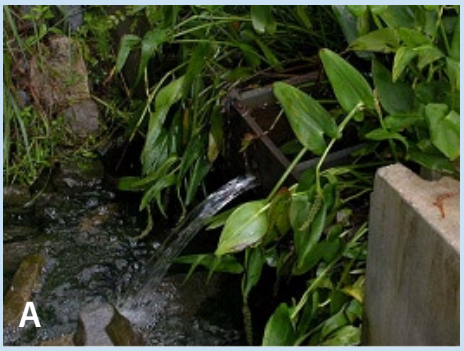



**Figure 4. A small orifice allows slow release of captured stormwater (A), but can easily clog due to its size. A clogged orifice can affect plant communities inside the wetland or wet pond (B).**

## KEEP THE ORIFICE (DRAWDOWN HOLE) FREE FLOWING

Wetlands and wet ponds are designed to capture and detain stormwater from 2 to 5 days. On smaller ponds and wetlands, a relatively small hole or *orifice* is used to detain water for this period. The diameter of the orifice can be as small as 2 inches, which makes it susceptible to clogging (Figure 4). Because many ponds and all wetlands contain vegetation, dead plants can float to and clog the orifice. Moreover, floating trash and debris (see the next section) will potentially clog the orifice.

A clogged drawdown hole poses several problems, including the loss of storage to capture later storms and flooding of desirable plant species. When water levels remain too deep for the desirable plants to survive, stronger, usually invasive, plant species take over. The aesthetics and performance of the practice can suffer when the plant community changes.

The wetland or wet pond needs to store water between storms to perform its intended function. It cannot store water from the next storm effectively if the orifice is clogged and the wetland is continually full.

Unclogging the orifice is relatively simple. Clean the hole with a stick, a piece of wire, a pole, or your hand. Inspect it regularly—the drawdown hole can clog at any time. Visit the site once a month to make sure water is flowing freely through the orifice, and inspect the outlet after every rainfall event exceeding 2 inches.

### WHY SUCH A SMALL HOLE?

A large opening would release the water too quickly and not provide adequate time for treatment. Stormwater wetlands and wet ponds are designed to capture the first flush (or water quality volume) from their upstream drainage areas. The first flush is runoff generated by a 1 to 1.5 inch storm. The total volume of water can range up to several acre-feet. Once the first flush is captured in the wetland or wet pond, it must be slowly released to allow time for sediment and other gross solids to settle. Design standards require that the first-flush volume be kept for at least 2 days, with a recommended 3- to 4-day retention time. To release this water slowly, a small hole is often necessary. When the hole is only 2, 3, or 4 inches in diameter, clogging is a significant concern.

## CLEAN AWAY FLOATING DEBRIS AND TRASH

Stormwater wetlands and wet ponds are located in low elevations of the landscape. All water from several acres drains to wetlands and wet ponds. With this water comes trash and other debris, called *floatage*. It must be removed from wetlands and wet ponds for several reasons:

- It is unsightly, particularly when the wetland or wet pond is designed to be an attractive amenity.
- Floating trash, such as cups or plastic bags, often store small amounts of water in a sheltered environment. Studies have shown that mosquito larvae are more likely to be protected inside floating trash than in the exposed pond.
- Trash and other floating debris can clog the drawdown hole (the orifice), which is often used to slowly release captured runoff (Figure 5).

Inspect wet ponds and wetlands for trash regularly and frequently—typically once a month but occasionally once a week. On smaller wetlands and wet ponds, collect trash by simply wading along the edges. With

**Figure 5. Trash floats to the drawdown hole, where it can clog the small hole, restricting flow. Removing the trash is often very simple, but essential.**

larger facilities, a small boat or vac truck may be required. Because most trash follows the movement of water, it tends to collect near the outlet of the wetland or wet pond. This makes trash easier to collect, but it increases the risk of clogging the drawdown orifice.

## REMOVE VEGETATION ALONG THE DAM FACE

Dam inspection officials require earthen dams to be free of large shrubs and trees. Roots can conduct water through the dam from the open pond to the downstream side of the embankment. The movement of water along the roots is called *piping*, which can eventually lead to soil erosion and, if unchecked, dam failure. Piping tends to be a problem for large ponds and wetlands that have a large dam face. Some small wetlands and wet ponds and those with concrete dams do not have this problem. If a dam face is vegetated, it should be grassed exclusively.

Inspect the dam once a year, and remove all shrubs and trees from the dam top and both faces. If the wetland or wet pond has been regularly maintained and any shrubs and trees growing are juvenile, simply mowing the bank is sufficient. Otherwise, a weed wiper, which applies herbicides to plants more than 12 inches tall, can be used along the bank. The weed wiper will kill any plant it touches or scrapes.

If a bank is severely overgrown, trees and shrubs should be cut down and removed. A systemic herbicide can be applied to the freshly cut stumps, which will kill the root systems. This is a laborious process. If the dam face is heavily overgrown, a contractor who specializes in removal should be consulted. Because dams of larger ponds and wetlands are responsible for retaining large volumes of water, dam failure can be catastrophic if homes, businesses, or roads are downstream.

## REMOVE INVASIVE PLANT SPECIES

Stormwater wetlands and wet ponds with aquatic shelves can become overgrown with invasive plants. The most common invasive plant is the cattail (*Typha* species, Figure 6). Cattails, while native to North Carolina, crowd out other, more desirable plants. Cattails tolerate a variety of conditions and do a good job of pollutant removal. From this functional standpoint, cattails can be considered good plants to have in a wetland. *However,* cattail monocultures fail to meet two very important design goals: aesthetics and mosquito control.

A wetland or wet pond that is overgrown with cattails is not a diverse ecosystem. Ecosystem diversity is critical for mosquito control. Cattails provide a safe environment for mosquito larvae to mature to adulthood. When cattails go dormant in the fall, some of the fronds will form a protective thicket for mosquitoes. For more information on mosquito control in wetlands and wet ponds, see *Mosquito Control for Stormwater Practice Designers and Managers* (AGW-588-04) in the Urban Waterways series.



**Figure 6. (A) Cattails (*Typha* sp.) and (B) common reeds (*Phragmites* sp.) are very aggressive invasive species. Once established, each plant will crowd out more desirable plant species.**


**Figure 7. Aquatic glyphosate (herbicide) can be applied via direct contact (a protected hand) or via a small weed-wipe pole (A). Stroking individual cattail fronds sends the herbicide down the shoot and reaches tubers located in the soil (B). Once the herbicide reaches the tubers, the cattails will die within 2-3 days (C). The herbicide can also be applied with a small brush.** *(Franklin County Cooperative Extension Center)*

Removing cattails can be challenging. It is almost impossible to remove a mass of cattails by hand. Cattails grow from tubers that spread, and they also spread by seed. If a piece of cattail is left in the wetland or wet pond after removal, the stand will probably re-establish. Use a backhoe for mass cattail removal when a wet pond or wetland is completely overgrown by cattails.

If a wetland or wet pond has a variety of vegetation but cattails are beginning to colonize it, use an alternative form of cattail removal, such as applying an aquatic formulation of the herbicide glyphosate (one trade name for this is Rodeo). Wear a chemical-resistant glove underneath a cloth glove. Soak the cloth glove in 2 percent glyphosate, and stroke the cattail leaves. Or brush the herbicide onto the leaves with a small weed wiper. Not every leaf needs to be touched by the herbicide because many of the cattails are connected by tubers. Within 10 to 12 days, the cattails fronds will wither and die (Figure 7).

The herbicide must be applied by hand rather than by broadcast spray because it will kill every herbaceous plant it touches. Use only aquatic formulations of glyphosate because they do not harm fish and other aquatic species.

The frequency of cattail removal can vary. Several factors influence the need to apply herbicide to cattails: the density at which the wetland is planted with desirable species, the time of year the wetland is planted, and the maturity of the wetland. During the first year or two after wetland construction, remove cattails twice a year. As the wetland matures and desirable species begin to dominate, reduce the maintenance frequency to once a year. The amount of time needed to remove unwanted vegetation (via the glyphosate wipe) varies, but a well-maintained, mature wetland requires visits of about 2 hours per acre of wetland.

Other unwanted plant species include common reed (*Phragmites* species, Figure 6), various noxious floating aquatics (such as parrot feather, *Myriophyllum aquaticum,* and giant salvinia, *Salvina* spp.), and Asiatic dayflower (*Murdannia keisak*). *Phragmites* species can be removed in a manner similar to that described for cattails. Noxious floating aquatics may require careful chemical or physical removal. If you observe these exotic invasive species, contact your county Extension center.

## MOW THE PERIMETER OF WET PONDS

Stormwater wetlands are not mowed to the water's edge and tend to be surrounded by mature grasses. As a result, mowing the perimeter of wetlands is not a typical stormwater wetland maintenance activity. Many wet ponds, however, do have a grassed perimeter that needs to be maintained. Mowing maintenance is almost purely aesthetic. The type of grass used, its growing season, and pond aesthetics dictate the height and frequency of mowing:

- Mow cool-season grasses to a recommended height of 4 inches and no lower than 2.5 inches. Cool-season grasses, such as fescue, tend to be used west of Interstate 95 in North Carolina.
- Mow warm-season grasses to a recommended

height of 2.5 inches and no lower than 1.5 inches. Warm season grasses include centipede, Bermuda, and zoysia, and are principally found in eastern North Carolina.

- Mow every one to three weeks during the growing season when the wet pond is part of an accessible landscape or treated as an amenity.
- Mow wet ponds that are located out-of-sight once or twice a year.

The size and severity of slopes along the wet pond determine the type of mower to use. For small ponds, a standard push mower is often adequate. Larger ponds or ponds with steep banks will probably require a specialized pond mower.

Grass clippings can be left adjacent to the pond to provide organic matter that encourages grass to grow. Do not discharge grass clippings into the water, as this will encourage the growth of algae and could potentially clog the drawdown hole.

## CONTROL PESTS

Rodents such as muskrats and beavers are attracted to stormwater wetlands and wet ponds (Figure 8). Once there, they can damage the stormwater management practice.


**Figure 8. (A) Muskrat *(Ondatra zibethicus).* (B) Beaver *(Castor canadensis).*** *(U.S. Fish and Wildlife Service)*

**Figure 9. Muskrat holes along the perimeter of the wetland or wet pond are a sign of infestation. Destroying the holes is a simple way of forcing muskrats to move, if the population is limited.**

Muskrats eat aquatic vegetation and burrow holes in the deeper pools. When muskrats actively burrow near the outlet of a wetland or wet pond, they will add sediment and increase turbidity to the outflow, increasing the release of pollutants from the wetland or wet pond. Moreover, muskrats will sometimes burrow holes around and through dams. These muskrat holes artificially lower the water level inside the pond or wetland, causing some plant species to die. At worst, the holes can lead to dam failure.

Beavers are attracted to the sound of running water. Once a beaver colonizes a wet pond or stormwater wetland, it will remove trees and shrubs surrounding the stormwater practice to build its lodge and dam. Beaver activity will clog or block the drawdown structure, thus raising the height of water inside the pond or wetland. This change in the depth of water inside wet ponds with aquatic shelves and stormwater wetlands will alter the types of vegetation that survive in the practice. Usually this change is undesirable.

Muskrat infestation is a difficult maintenance problem that usually must be addressed only when a pond or wetland has suffered from neglect. If the practice is infested, muskrats can be trapped under water, where they drown. Muskrats frequently escape traps, however, which makes live trapping difficult. Hire a licensed, experienced trapper who takes care to place traps where pets cannot be trapped by mistake. Once muskrats have been removed from the pond, their dwelling holes should be destroyed.

## Keep Geese Away from Wet Ponds and Stormwater Wetlands

Canada geese are attracted to an open body of water with good visibility around the perimeter, and they enjoy eating grass. This describes many "old-design" wet ponds that are mowed to the edge, allowing geese easy access in and out of the pond. Designers can include features in a wet pond to prevent Canada geese from taking up residence:

- Build a visual barrier along the pond perimeter—the aquatic shelf. By taking away good visibility, geese will not feel as safe. Most newly designed ponds include some aquatic shelf.
- Place shiny objects, such as silver tape, around the perimeter of the pond if building an aquatic shelf is not feasible.
- Place a grid of string across the wet pond to prevent easy waterfowl water landing. This string can also have shiny tape attached to it (Figure 10).

You can also bring a dog to the pond regularly to scare the geese. Geese do not like certain species of dogs, particularly border collies. If they often encounter a frightening dog, the Canada geese will eventually move elsewhere.

**Figure 10. A grid of fishing line adorned with silver tape has been strung across this wet pond to prevent geese from making it their home. The string grid makes water landing more difficult, and geese do not like shiny or flashy objects like windblown silver tape.**

If the stormwater practice has been regularly maintained, muskrat populations can more easily be controlled. Encourage muskrats to move away from the wetland or wet pond by making it an uncomfortable place to live. If muskrat holes are observed around the perimeter of a wet pond or stormwater wetland, destroy them or fill them with soil (Figure 9). Identify and destroy muskrat holes during any regular maintenance activity: whenever the wetland or pond is being inspected to verify that the drawdown is freely flowing and during mowing and trash removal.

Removing beavers is more difficult that removing muskrats. If a beaver is observed living in or around a stormwater wetland or wet pond, contact a professional trapper who specializes in beaver removal.

## SUMMARY

Well-designed stormwater wetlands and wet ponds remove pollutants and mitigate floods. To accomplish these goals and remain safe, aesthetically pleasing, and free of mosquitoes, they must be maintained properly to meet their design goals. Most stormwater wetland and wet pond maintenance activities are simple and inexpensive. But without them, the effectiveness of these stormwater management practices will decline.

**TABLE 1. STORMWATER WETLAND AND WET POND MAINTENANCE TASKS AND FREQUENCIES**

| Task | Frequency | Notes |
|---|---|---|
| Remove sediment from forebay and deep pool (dredging/ dipping). | Varies. In stable watersheds, once every 5 to10 years is typical. | In unstable watersheds (those with active construction), the frequency increases to once a year, assuming the forebay is correctly sized. |
| Monitor sediment depth in forebay and deep pools. | Once a year. | In a large pond or wetland, a small boat may be needed. |
| Maintaining free-flowing orifice (drawdown hole). | Once per month and after every storm exceeding 2 inches. | Perform inspection regularly. Unclogging the hole when needed is simple. |
| Remove floating trash and debris. | Depends on design aesthetics: once a week to once a month. | Remove trash whenever the drawdown hole is being inspected. Inspect for trash more often if necessary, and remove as needed. |
| Remove vegetation from dam top and faces. | Once a year. | Dam top and faces should consist of mowed grass, if vegetated. |
| Remove invasive species (particularly cattails). | In years 1 and 2, twice a year (spring and fall). From year 2 onward, once a year (spring). | If spread of cattails is somewhat limited, use the glyphosate-wipe method. |
| Mow the wet pond perimeter. | Depends on design aesthetics. Ranges from every 1 to 3 weeks to once a year. | Wet ponds that are a design amenity will require more frequent mowing (every 1 to 3 weeks). |
| Remove muskrats and beavers. | Muskrat hole inspection and destruction should occur every time the wetland or wet pond is visited (at least once a month). | Contact a professional beaver trapper to remove beavers. Use muskrat traps to remove muskrats, or contact a professional trapper. |

## RESOURCES

**Fact sheets in the Urban Waterways series,** North Carolina Cooperative Extension, N.C. State University:

Hunt, W. F. *Urban Stormwater Structural Best Management Practices (BMPs*). AG-588-01.
Online: http://www.bae.ncsu.edu/stormwater/PublicationFiles/UrbanBMPs1999.pdf

Hunt, W. F., and B. A. Doll. *Design of Stormwater Wetlands for Small Watersheds.* AG-588-02.
Online:http://www.bae.ncsu.edu/stormwater/PublicationFiles/SWwetlands2000.pdf

Hunt, W. F., C. A. Apperson, and W G. Lord. *Mosquito Control for Stormwater Facilities*. AG-588-04.
Online: http://www.bae.ncsu.edu/stormwater/PublicationFiles/Mosquitoes2005.pdf

Hunt, W. F., and W.G. Lord. *Bioretention Performance, Design, Construction, and Maintenance*. AGW-588-05.
Online: http://www.bae.ncsu.edu/stormwater/PublicationFiles/Bioretention2006.pdf

Rodewald, A. D. *Nuisance Canada Geese: How to Deal with the Problem*. Ohio State University Extension publication no. W-3-2001.
Online: http://ohioline.osu.edu/w-fact/003.html

**BAE Stormwater Group Web site:**
**www.bae.ncsu.edu/stormwater**
Obtain information on upcoming workshops (including BMP Inspection and Maintenance Certification Courses), publications, PowerPoint presentations, images to download, and design and construction specifications.

**State of North Carolina Stormwater Web site:**
**www.ncstormwater.org**

## ACKNOWLEDGEMENTS

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Recommendations for the use of agricultural chemicals are included in this publication as a convenience to the reader. The use of brand names and any mention or listing of commercial products or services in this publication does not imply endorsement by North Carolina Cooperative Extension nor discrimination against similar products or services not mentioned. Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Be sure to obtain current information about usage reulations and examine a current product label before applying any chemical. For assistance, contact your county Cooperative Extension agent.

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