6.0 Backyard Wetland Design

6.1 Overview of Practice

A backyard wetland, also referred to as a “pocket wetland” or a “wetland garden,” is built in an area that is perennially moist. The wetland is designed such that it will usually be wet, even several days to several weeks after a rain event, and is constructed as an alternative to a rain garden. A typical backyard wetland will be a shallow, excavated bowl ranging from 3 to 12 inches deep. A variety of wetland vegetation is planted. It is essential that a variety of plants are grown in the wetland to avoid a monoculture, which provides good mosquito habitat. Wetland vegetation tends to grow densely. Pocket wetlands capture runoff from small watersheds such as an individual property. Figures 6.1 and 6.2 show a wet spot in a yard (an ideal location for a pocket wetland) and types of vegetation found in a backyard wetland, respectively.

6.2 Backyard Wetland Siting

Backyard wetlands should be located in a low area where stormwater naturally drains. The wetland should be sited near the current surface drainage system (the drop inlet or swale that currently drains the watershed). This will allow the designer to direct overflow offsite. There are a number of other siting concerns for backyard wetlands. To avoid contact between the infiltrated stormwater and any building foundations, a wetland should be located at least 10 feet away from building foundations. The wetland should be at least 25 feet away from a septic system drain field or a well head. Utility lines should be located and marked prior to any soil excavation. For the best plant growth, the stormwater wetland should be located in an area that receives partial to full sun exposure.

In general, backyard wetlands should be selected over other BMPs when site conditions involve poorly drained soils and/or high water tables. When an initial soil investigation is performed, if the seasonal high water table (Section 4.4.4) is within 2 feet of the soil surface, the site should be considered for a backyard wetland. Additionally, if the soil investigation shows the soils to be poorly drained (Section 4.4.3) the site will be more suitable for a backyard wetland than a rain garden. If a location on a property has standing water present for multiple days after a rain event, it is a strong candidate for a wetland. If the initial simplified soil infiltration test described in Section 5.3.1 results in the 1 foot deep test hole draining in more than 3 days, a backyard wetland should be constructed at the site.


Figure 6.1 A perennially wet spot in a yard is a good location for a pocket wetland.
Figure 6.2 This pocket wetland in Tarboro, NC, features vegetation such as lily pads, pickerelweed, and joe pye weed.

SWCD staff should evaluate sites with poorly drained soils extremely carefully.
The overwhelming majority of CCAP projects will be too small to impact jurisdictional wetlands; if wetland soils are detected on a large project (> ¼ acre), then the location should be evaluated by a member of the Army Corps of Engineers and/or the North Carolina Division of Water Quality – 401/404 Wetlands Unit for jurisdictional wetland status.

6.3 Backyard Wetland Design

Please note: If the impervious area draining to the BMP exceeds 2500 square feet, design approval is required by a PE and the design recommendations and BMP policies for a Stormwater Wetland are required.

6.3.1 Determining wetland watershed characteristics

In order to capture stormwater runoff from driveways and other associated parking areas, the drainage must naturally flow to the proposed location. Rooftops normally are drained via gutters which may or may not drain to the proposed location. To maximize drainage to the wetland, either a 4- to 6-inch plastic flexible pipe (see Section 5.3.2) or a diversion berm (Section 3.5) can be used to direct this water to the proposed backyard wetland location. After any modifications are considered (for example, routing rooftop drainage to the proposed area), the total area draining to the proposed location and the percentage of impervious area in the watershed should be calculated. Measurements taken with a tape measure can help determine the watershed area, as well as the area draining from driveways, patios, and parking areas. The rooftop area draining to the wetland can be measured manually or GIS maps may be used.

6.3.2 Backyard wetland sizing

Backyard wetlands should be sized such that the ponding depth of the captured runoff is no more than 9 inches. Sizing is completed in a similar fashion to rain gardens – the simple method can be used to calculate the volume of stormwater produced by the water quality event. The wetland surface area will simply be this volume divided by the ponding depth desired for the site.

In some cases, a property owner may desire a larger wetland; if so, the ponding depth can be as little as 3 to 6 inches. The shape of backyard wetlands will vary based upon topography, obstructions (e.g., trees and utilities), landowner needs, available space, and aesthetic appeal. In general, neither the length nor the width should be less than 3 feet. In general, a 6 inch ponding depth is preferred to the 3 inch, because this depth "guarantees" more contact time for water with the vegetation.

6.3.3 Backyard wetland inlet considerations

As stormwater enters the wetland from a pipe or swale, the energy of the stormwater can cause erosion. Placing a check dam in the path of the stormwater just before it enters the wetland will reduce the velocity of the water. This check dam can be constructed of rolled erosion control matting or with 6" – 8" nominal diameter rip-rap.

This may not be required in all situations; however, if the slope of the swale or pipe entering the backyard wetland is steep (>6%), erosion is likely to occur. Examples of check dams constructed of erosion control matting and rock are shown below in Figures 6.3 and 6.4.

Figure 6.3 Swale leading to BMP with check dams constructed of rolled erosion control matting.

Figure 6.4 Swale with check dam constructed of stone.
(Source – USDA – Natural Resource Conservation Service – Illinois)

6.3.4 Backyard wetland outlet considerations

Similar to rain gardens, the outlet structure controls the ponding depth in the backyard wetland and allows excess flows to exit in a controlled manner. The first step in designing an outlet structure is determining the peak flow of the desired design storm for the given watershed (typically the 10-year, 5 minute storm). Section 3.4 discusses the use of the Rational Method for calculating peak flow rate. A weir structure is commonly used for wetlands, with the weir length sized to safely pass the 10-year storm. During the peak flow of the 10-year storm, all higher velocity outflow should be in contact with the weir, not contacting soil composing the berm. Section 3.5.2 discusses weir sizing. Appendix B describes the layout and construction of a wooden weir structure. A compacted, soil weir may also be used, but needs to be well vegetated with grass or sod. See the rain garden chapter (Section 5.3.7) for more information on outlet weirs.

See the CCAP Backyard Wetland Design Worksheet for more information.

6.3.5 Backyard wetland plants

Wetland plants thrive in perennially wet environments. Most notably for backyard wetlands, water depth plays an important role in plant selection. For the purposes of the CCAP, these water depths will be divided into three groups: upland plants (not normally in contact with surface water – planted around rim of wetland where roots can access moist soil), shallow water plants (water depth between 0 and 4 inches), and deep water plants (depths greater than 4 inches).

A short list of plants which thrive in each environment is shown in Tables 6.1, 6.2, and 6.3. Additional plant choices are available, especially with regard to perennials. A local cooperative extension horticulture agent should be contacted for additional plant choices. In times of extreme drought, the land owner is encouraged to water the wetland as needed based on the condition of the plants. Most backyard wetlands will NOT retain water deep enough for a long

enough period to support deep water plants. However, if after the wetland has been constructed the property owner observes 6- to 9-inch deep water reliably in the spring, summer, and fall, the plants listed in table 6.1 could potentially be incorporated into the planting scheme.

Some rules-of-thumb for backyard wetland plant selection include:
(1) Choose native species. Nearly all the species provided in Tables 6.1 through 6.3 are native to most of North Carolina
(2) Include evergreen vegetation to provide some color in the backyard wetland during the winter months
(3) Select a few species of plants with showy flowers, which will attract butterflies and dragonflies. This will add aesthetic appeal and provide an important mosquito predator (dragonflies).

Table 6.1 Sample deep water wetland plants.

Common Name	Scientific Name	Comments
American Lotus	*Nelumbo lutea*	Bold plant with foliage and flower stems standing 4' - 6' above water's surface. Large, showy yellow flowers produced throughout summer.
Spadderdock - Cow Lily	*Nuphar luteum*	Heart shaped leaves float on water's surface, 1"-2" wide, globe shaped, yellow flowers are born throughout summer
Fragrant Water-Lily	*Nymphaea odorata*	Rounded, heart shaped leaves float on water's surface. Large, white, sweetly fragrant flowers open throughout summer

It should be noted that if the water level in the wetland is not consistent and normally drains in between rain events, the deep water plants should not be used.

Table 6.2 Sample shallow water wetland plants.

Common Name	Scientific Name	Comments
Arrow Arum	*Peltandra virginica*	Elegant arrowhead shaped leaves and interesting green flowers on a clump forming plant
Pickerelweed	*Pontederia cordata*	Upright plant producing numerous 3' tall spikes topped with blue flowers all summer. Tough and attractive.
Lizard's Tail	*Saururus cernuus*	Spreading perennial that will grow in shallow standing water and wet soils. Pendant spikes of white flowers in late spring and summer.
Duck Potato	*Sagittaria latifolia*	Tough emergent aquatic with arrowhead shaped leaves and spikes of white flowers produced throughout summer. Reproduces rapidly.
Soft Rush	*Juncus effusus*	Common rush found throughout NC. 2' - 3' tall with dark green spiky foliage. Green flowers are to brown seed pods throughout summer. Near evergreen.
Woolgrass	*Scirpus cyperinus*	Large, 3' - 4' tall and wide clump forming bulrush producing wooly green flower heads in summer that age to an attractive rusty brown as seed mature

Table 6.3 Sample upland wetland plants.

Common Name	Scientific Name	Comments
Swamp Milkweed	*Asclepias incarnata*	Pink flowers in early summer. Larval food of monarch butterflies.
Joe Pye Weed	*Eupatorium fistulosum*	Masses of rosy-mauve flowers in late summer-fall attract butterflies
Swamp Sunflower	*Helianthus angustifolius*	Towers of 3" wide golden sunflowers in fall - attracts butterflies
Red Star Hibiscus	*Hibiscus coccineus*	Tough, clump forming, sturdy plant with star shaped red flowers in summer
Rose Mallow	*Hibiscus moscheutos*	Tough, durable plants with huge white, pink or rose flowers in summer
Cardinal Flower	*Lobelia cardinalis*	Tall spikes of crimson red flowers in late summer and fall - attracts hummingbirds and butterflies
Soft Rush	*Juncus effusus*	Common rush found throughout NC. 2' - 3' tall with dark green spiky foliage. Green flowers are to brown seed pods throughout summer.

6.4 Backyard Wetland Construction

6.4.1 Laying out the wetland

Once the wetland surface area has been calculated and a location has been selected, marking paint, string and rope, or flags can be used to lay out the perimeter of the wetland (Figures 6.5). The wetland dimensions will vary based on site conditions and landscaping preferences. The layout should be measured multiple times before digging to ensure that the surface area of the wetland is properly sized.

Figure 6.5 Mark wetland area prior to excavating the area.

6.4.2 Digging the wetland

After the wetland area has been laid out, digging can commence. Topsoil should be removed and set aside for later use. If the BMP is built on a slope, the remaining soil removed from the wetland area should be placed around the wetland perimeter to create a berm that will retain the stormwater (Figures 6.6 and 6.7). If it is not built on a slope, the entire BMP can be cut into the ground and no berm is required (Figure 6.8).

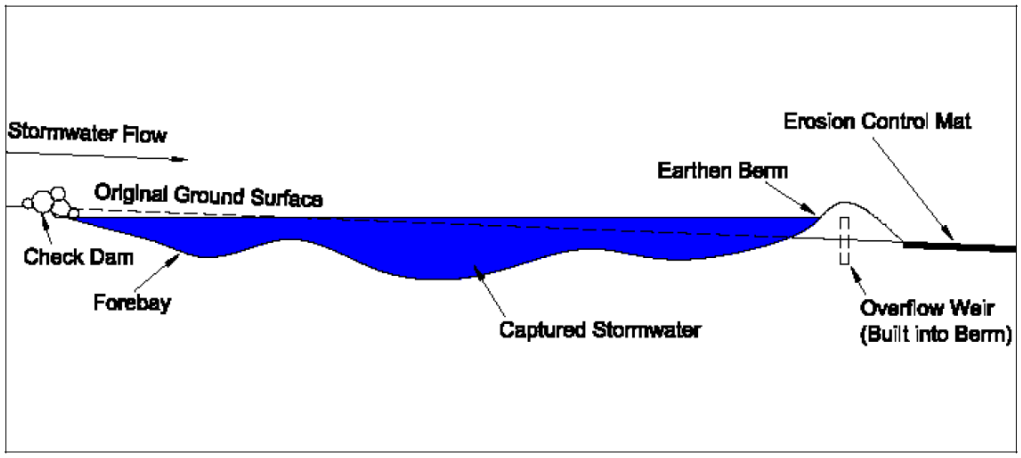

Figure 6.6 Illustration of backyard wetland constructed on 4% slope.

Figure 6.7 Berm construction at downslope edge of BMP.

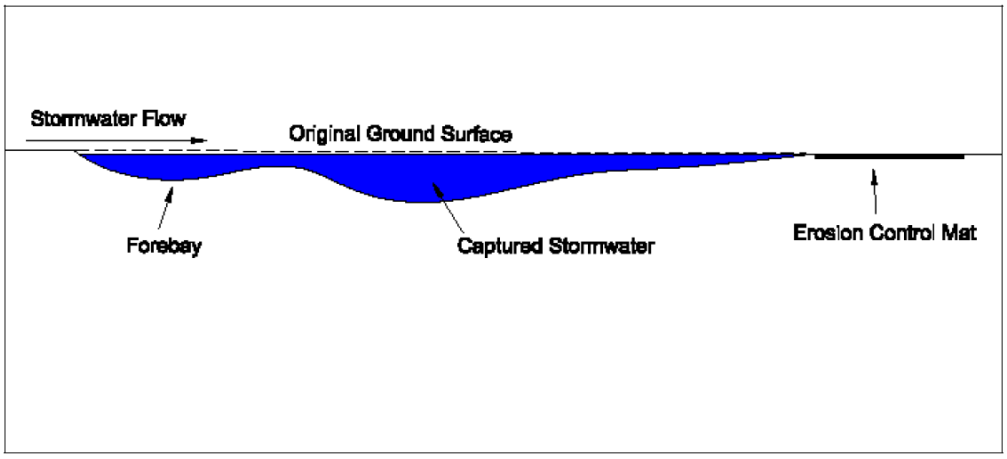

Figure 6.8 Illustration of backyard wetland constructed on 0.5% slope.

Since an average depth of 9 inches is desired, some areas in the wetland can be as deep as 1-foot, while other areas will be 3 inches or less. The depth is calculated by measuring from the top of the overflow weir (or lowest elevation along the wetland perimeter if no weir is used) to the excavated soil surface. Building variability into the wetland with respect to ponding depths encourages plant diversity. If the water table is encountered while digging the wetland, this is a good sign that wetland vegetation will survive in this location. The topsoil is then added back after digging; thus, the wetland may have to be a little deeper to account for the reapplication of the topsoil. A small, deeper section (forebay) can be included in the wetland design were the stormwater initially enters. This forebay will cause some sediment to fall out and will dissipate the energy of the stormwater, reducing erosion inside the BMP. Often, if the watershed is small (<0.5 acres) and stable, a forebay is not needed.

When a backyard wetland is constructed on a slope, the berm height will vary based on the severity of the slope. In general, the berm should not be more than 1 foot higher than the surrounding ground surface. This will minimize the erosive potential of any stormwater that

spills over the back side of the berm. The berm should be stabilized with grass seed and straw or sod after the construction is complete.

During the period before the grass has been established, the berm will be susceptible to erosion and should be checked after every rain event. If the property owner desires, sod strips can be used to stabilize the outlet berm. An outlet should be constructed as described in Section 5.3.7 to provide safe passage of stormwater overflow whenever a berm is necessary. Whether the BMP is constructed on a flat landscape or one that is sloped, a strip of erosion control fabric (the width of one roll of fabric, which is approximately 6 feet) should be added immediately downslope of the backyard wetland (Figures 6.6 and 6.8). After the berm and outlet structure have been constructed, the internal cavity, or bowl, of the wetland can be prepared. If the wetland is not sited where the water table will be readily accessed by plant roots (See sections 4.4.3-4.4.4), the wetland plants will rely on ponded stormwater remaining in the wetland due to poor infiltration. In locations where the water table is not encountered, a hand tamper or other mechanical compactor can be used to compact the underlying soils. This compaction will result in reduced soil infiltration, leading to improved water retention within the wetland.

After the underlying soils have been prepared, the topsoil that was removed should be reapplied on top of the underlying soils at a depth of 2 – 3 inches. This topsoil can be raked into the underlying soils to provide a suitable media for plant growth. One application of fertilizer may be applied to the area based on a soil test report to initiate plant growth. After initial fertilization, the wetland should not be fertilized again. In many cases, the wetland soil should also be limed. To verify pH, soil samples can be sent to the NCDA&CS laboratory in Raleigh for testing.

6.4.3 Planting the wetland

Some wetland plants can be purchased at home improvement stores, while others will only be available at specialty wetland plant nurseries. Plant nurseries can also provide valuable insight on plant selection. A trowel or shovel can be used to create a small hole for planting. Wetland plants should be placed in the ponding zone in which they are best suited (Section 6.3.5). The depth of zones is found by measuring from the top of the overflow weir (or lowest elevation along the wetland perimeter if no weir is used) to the underlying soil.

6.5 Backyard Wetland Maintenance

Backyard wetlands must be maintained to ensure their long term functionality. As mentioned earlier, the BMP should initially be checked frequently (every month) for signs of erosion around the containment berm (if one is present), the inlet of the wetland, and the outlet of the wetland. All three of these locations may be prone to erosion. If erosion is observed, the area can be graded with a rake and shovel and reseeded. Erosion control matting and check dams can be installed if additional protection is required. Once the vegetation has established and if there are no signs of erosion, inspection frequency can be decreased to only following storms exceeding 2 inches.

Invasive species can result in reduced plant diversity within the wetland. Cattails are one such species that often establishes in stormwater wetlands. Aquatic formulations of glyphosate should be wiped onto the cattail stalks, resulting in plant mortality. This should be performed the first time a cattail is identified in the wetland, typically in midspring. Care should be taken when using these chemicals. One way to apply the chemical is to wear a cloth glove over the chemical resistant glove and to let some of the chemical soak into the cloth glove. For a detailed description of this method of removing cattails, please see Stormwater Wetland and Wet Pond Maintenance (Hunt and Lord) available in Appendix G.

Additional maintenance activities include such things as cleaning out the sediment that has accumulated in the forebay of the BMP (using a shovel), and picking up any trash that has entered the wetland (Table 6.4).

Table 6.4 Maintenance activities for backyard wetlands.

Activity	Frequency
Monitor wetland for signs of erosion	Initially every month until stabilization and after any large storm (> 2 inches)
Remove sediment from forebay	As frequently as once per year, if ever.
Remove trash from wetland	As needed
Remove invasive species	As needed, typically mid-spring.
Remove debris from around overflow weir	As needed