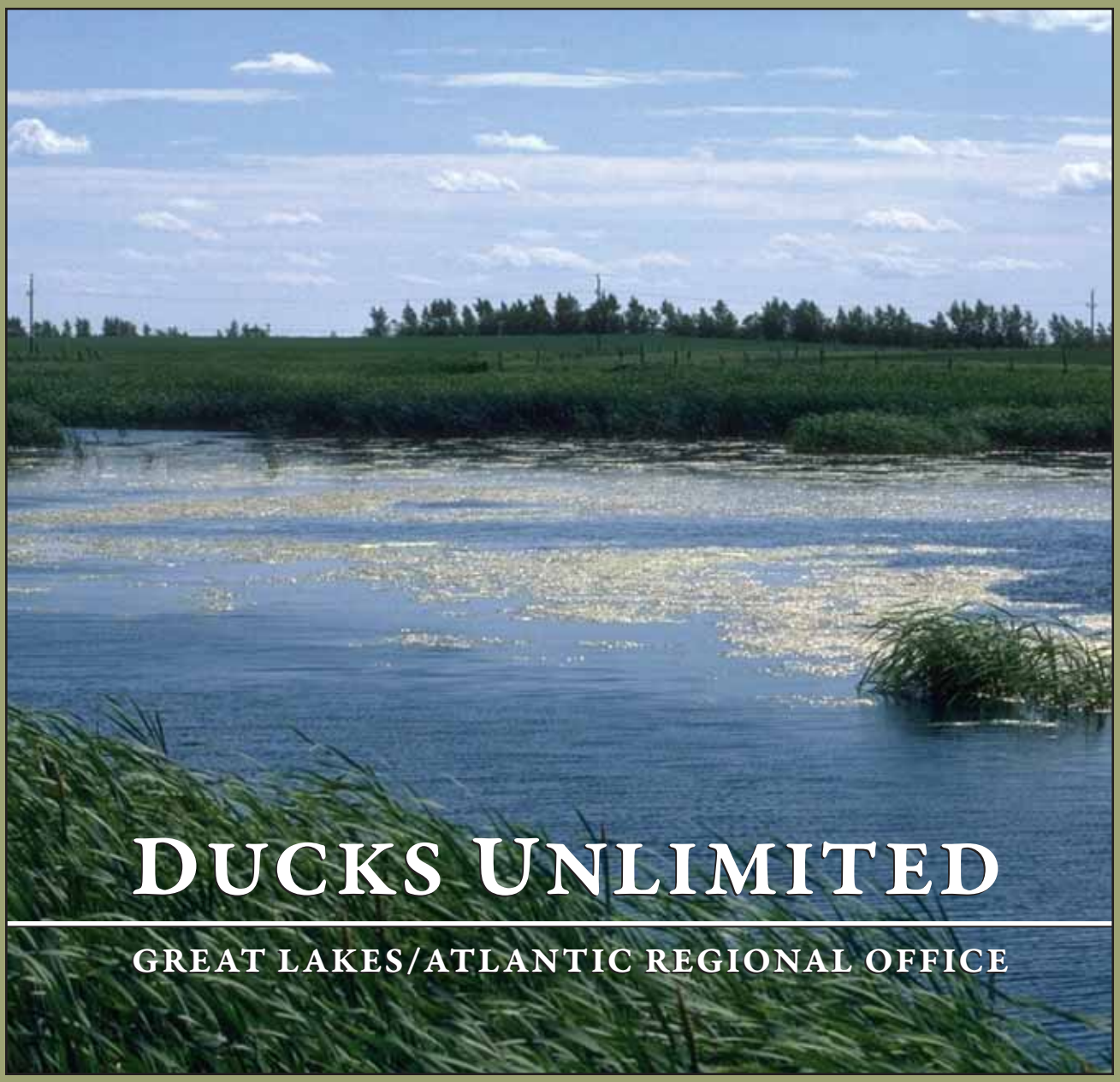
WETLAND HABITAT MANAGEMENT:

-A Guide for Landowners-

Updated Mar 3, 2005



DUCKS UNLIMITED

GREAT LAKES/ATLANTIC REGIONAL OFFICE

DUCKS UNLIMITED | Great Lakes/Atlantic Regional Office | 1220 Eisenhower Place | Ann Arbor, Michigan 48108 | ph: 734.623.2000 | www.ducks.org

WETLAND HABITAT MANAGEMENT:

-A Guide for Landowners-

TABLE OF CONTENTS

INTRODUCTION

The purpose of this handbook is to provide you, the landowner, with a reference of practical and successful wetland restoration, enhancement and management techniques for your property. Most landowners value the countless natural resources and recreational opportunities their lands provide. However, landowners also view their property as an economic investment and value its potential for income. Therefore, this publication was designed to furnish landowners with an economically sound, yet practical approach to wetland restoration, protection and management. Throughout this handbook landowners will find general guidelines that supplement specific recommendations received through a local natural resource professional. The goal of this publication is to equip landowners with a basic, yet necessary understanding of wetland restoration and management. Most importantly, the informed landowner will be able to experience the process of a successful wetland project with an appreciation and understanding of the many benefits their wetland will provide.

More than 75% of the wetlands in the Great Lakes region are in private ownership. In the past, urban development pressures and conversion to agriculture have contributed greatly to wetland loss, and to this day, they remain a continued threat. As a result, the future of private wetlands hinges on stewardship-minded individuals, such as yourself, who understand the importance of practicing natural resource conservation on their lands. Furthermore, most natural resource agencies and conservation organizations are eager to work with private landowners to implement wetland restoration projects that provide far-reaching benefits to wildlife, water quality and society as a whole. A number of programs are offered by federal, state and non-profit agencies that provide economic incentives as well as hands-on assistance regarding private land wetland restoration and management. However, you, the landowner, are the critical first step in the process of restoring and protecting the future of the valuable resource we call wetlands.

HOW CAN DUCKS UNLIMITED HELP?

A wetland restoration or enhancement project may seem like a difficult task to undertake. Fortunately, government agencies and private organizations such as Ducks Unlimited (DU) are available for technical and financial assistance. For example, DU contributes to numerous private land restorations by handling project costs, offering wetland protection in perpetuity through conservation easement contracts, providing consultation with biologists and supplying engineering design and construction services. Our conservation efforts extend well beyond the realm of waterfowl to benefit over 900 species of wildlife (including numerous species listed as threatened and endangered), improve water quality and promote ecosystem health across the continent.

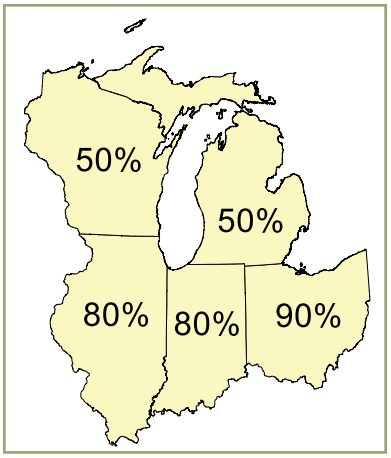
The mission of DUCKS UNLIMITED is to fulfill the annual life cycle needs of North American waterfowl by protecting, enhancing, restoring and managing important wetlands and associated uplands.

DUCKS UNLIMITED
GREAT LAKES/ATLANTIC REGIONAL OFFICE
1220 EISENHOWER PLACE | ANN ARBOR, MI 48108
PHONE: 734.623.2000 | FAX: 734.623.2035 | http://www.ducks.org

UNDERSTANDING WETLANDS

WETLAND HISTORY AND STATUS

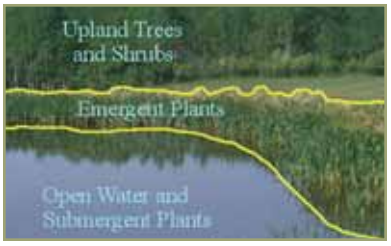
Throughout the history of North America, wetlands have been regarded as nonproductive wastelands having little or no economic value. Federal incentives such as the Swamp Lands Act of 1850 encouraged the drainage of wetlands for conversion to farmland. The result was a staggering amount of wetland loss. Over the last 200 years, more than 50% of the wetlands in the conterminous United States have been lost to farmland and commercial and residential development. Since pre-settlement times, wetland loss in the Great Lakes states has ranged from approximately 50% in Michigan and Wisconsin to more than 80% in Illinois, Indiana and Ohio. With increasing awareness of wetland values and the onset of federal wetland protection laws, the rate of wetland loss has substantially slowed in recent decades. However, wetland loss continues at the astounding rate of over 170,000 acres annually in North America, reinforcing the need for wetland restoration and enhancement projects throughout the region.



Loss of wetland in the Great Lakes region since European settlement. Midwestern states account for over 36 million acres of wetland lost in the United States (Dahl 1990).

WHAT IS A WETLAND?

Wetlands are generally defined as areas that are periodically flooded and under normal conditions are characterized by plants that require saturated soils for growth and reproduction. The Great Lakes region contains numerous wetland types ranging from shallow and deep water marshes to forested wetlands and wet meadows. Wetlands across the region have been defined on a relatively fine scale for purposes of classification, but are commonly characterized in a broad context using terminology such as marsh, swamp, bog and fen. Regardless of wetland type, all wetlands must contain three critical components: inundated or saturated conditions during some part of the growing season, plants adapted to wet conditions and hydric soils that have developed under saturation.



FUNCTIONS AND VALUES

Wetlands provide a multitude of important functions valued by society. Although difficult to quantify, wetlands are valued for their ecological, recreational, educational and aesthetic properties. One of the most important functions is the diverse array of habitat wetlands provide to a variety of fish and wildlife, including threatened and endangered species. Wetlands also act as filters, removing pollutants and sediments from surface and ground water inputs. Wetlands catch and slow excess water from storm events, thus reducing erosion, providing flood control and recharging ground water supplies. These are only a few examples of the unique set of functions and values associated with the variety of wetland types found on private lands throughout the region.

FUNCTIONS

- **IMPROVED WATER QUALITY** (filter excess nutrients, chemicals and sediments)
- **REDUCED SOIL EROSION** (prevent streambank and shoreline erosion)
- **REPLENISHED GROUND WATER SUPPLIES**
- **RETENTION OF FLOOD WATER**
- **HABITAT FOR FISH AND WILDLIFE** (fish nursery and spawning habitat; threatened and endangered species)

VALUES

- Nature photography/ wildlife viewing
- Boating/canoeing
- Hunting, fishing and trapping
- Clean water supply and storage
- Increased property values
- Flood protection
- Timber and food resource
- Education and research

THE WET AND DRY CYCLE

Wetlands, contrary to their name, do not always contain water. Many seasonal and temporary wetlands experience periods of drought at some point in time. Such wetlands tend to flood or recharge during winter months and will hold water into spring or early summer. In most instances this flooded stage will slowly dry out during the hot months of summer or early fall. This wet/dry cycle is essential to the continued productivity, function and longevity of many wetlands.

During dry periods, wetland de-watering (or drawdown) provides optimal conditions for a diverse array of wetland plants. Emergent plants supply food in the form of seeds and tubers to both brood-rearing and migrating waterfowl. When wetlands begin to recharge and hold water, the production of algae and invertebrates also increases, providing an abundant food source important to many wetland dependent species, including waterfowl. So, the next time you see a dry wetland, remember that wetlands undergo a natural wet-dry cycle that helps maintain a viable and productive ecosystem.

Above: (top to bottom) Dry, Drawdown, Wet

WHAT IS WETLAND RESTORATION?

In the past, many wetlands were drained for conversion to various types of land use such as agriculture, industry and urban development. This was accomplished by altering the hydrology of a wetland through tiling, ditching, filling and stream channelization. One of the most effective ways to offset wetland loss is through restoration. Wetland restoration is the process of returning a destroyed, disturbed or altered wetland to its previously existing natural condition. Degraded wetlands are often difficult to identify and in many instances may resemble a low saturated area of a farm field. Most converted wetlands will retain wetland qualities such as hydric soils and maintain a viable seed bank for long periods of time. In many instances, wetland restoration can be accomplished by simply breaking field tiles or plugging drainage ditches to restore wetland hydrology. It is often amazing how quickly a restored wetland reverts to its former character and productivity.

Wetlands restoration before…

…and after.

THE BENEFITS OF WETLAND RESTORATION AND MANAGEMENT

Some of the most notable benefits of wetland restoration and management are those experienced by wildlife. Many types of wildlife ranging from birds, mammals and fish, to invertebrates, amphibians and reptiles depend on wetlands at some point in their lifecycle. By restoring and managing wetland and/or adjacent upland habitats, one can attract an array of wildlife. For instance, migratory birds such as waterfowl, wading birds, shorebirds and songbirds rely heavily on wetlands for food resources and cover throughout the year.

Wetlands provide many functions that are not only crucial to wildlife and ecosystem health but are also a great benefit to landowners and society as a whole. Many landowners realize and understand the economic and recreational benefits associated with conservation and wise management of wetlands. Wetland habitats provide recreational opportunities in the form of bird watching, hiking, canoeing, hunting, trapping and fishing. Landowners often market these activities for a substantial economic return. Wetlands also provide flood control, improved water quality and reduced soil erosion. All of which are benefits landowners may receive through wetland restoration and management on their property.

CRITERIA FOR SELECTING A SITE

OBJECTIVES AND PROJECT PLANNING

Proper planning plays a crucial role in the success of any wetland restoration project. Landowners must determine the feasibility of wetland restoration on their property and take into account the planning process involved in implementing such a project. One must first identify project goals and objectives—"What do you want?" as well as the resources needed to complete the project—"What will it take?" Project goals and objectives are best discussed with trained natural resource professionals. Their ability and experience will help determine the most suitable areas and wetland types for restoration on your property. They can help determine the feasibility of restoration based on your objectives. For instance, you may prefer to utilize your wetland for recreational purposes such as waterfowl hunting or bird watching. Other objectives might include waterfowl and non-game species production, or improved water quality.

Landowners must understand that project objectives may not be met based on the type of wetlands found on their property. Adjustments will have to be made accordingly. Unaltered wetlands are usually best left alone for their contribution to the wetland resources within a region.

Landowners may be working closely with contractors, engineers and adjacent landowners. Following project plans and emphasizing goals and objectives during the construction stages of the project will make operations and working with outside parties much easier. Your ability to stay organized and remain fully aware of your limitations will make for a successful restoration. The following are a few general guidelines to consider when developing a wetland restoration and management strategy.

TOPOGRAPHY AND EXISTING HYDROLOGY

When evaluating the potential of your property for wetland restoration, it is important to first determine the topography of the land. Topographical maps and site surveys are an easy way to identify the drainage patterns of your land. Flat areas with low, shallow depressions that may have been previously tiled or ditched are ideal sites for restoration. Areas that are poorly drained and subject to shallow flooding also have potential. Deeply flooded areas such as man-made farm ponds are not ideal habitat for waterfowl and should not be a priority for management or restoration. Topography will also help indicate how a restored wetland will tie into the watershed and what function it will have in the landscape. Will adjacent landowners be impacted by restored wetland hydrology? Will you have enough upland area to provide a buffer for your wetland against disturbance and predation? To understand the topography and drainage of your land will help answer such questions that will likely need to be addressed when determining a viable restoration site on your property.

SOIL TYPES

Wetland restoration or enhancement projects often require earthwork to plug ditches or create low berms to capture more water. When looking for a suitable location for a restoration project, areas containing hydric or clay soils work best. Dikes or ditch plugs constructed of clay provide a watertight barrier resistant to leakage. Soils types such as loam, clay-loam and clay-sand are also sufficient for the construction of dikes. If hydric soils are used, dikes need to be designed 33% taller and wider to allow for shrinkage. A map of the soil types found on your property can be obtained free of charge from your local USDA Natural Resource Conservation Service Office. Soil survey maps list hydric soils that may reveal previously drained wetlands that may be most suitable for restoration efforts. Landowners should also visit a proposed wetland site and dig several holes to make sure there is a suitable layer of hydric or clay-based soils at least 2-3 feet in depth. Sandy or gravely soils drain quickly and their presence will compromise any efforts to control and maintain water levels.

© USDA-NRCS

WATER SOURCES AND WATER QUALITY

Buffer zones reduce soil erosion and pollutants that may enter a waterway.

Available sources of water for a wetland project must coincide with landowner goals and objectives. Depending on the type of wetland that is being developed, a number of questions may arise concerning water supply. For instance, what time of year will the water be needed and will there be a sufficient supply at that point in time? How much water is needed to maintain desired water levels? Who has the legal rights to the water source? What is the quality of the water source?

Natural springs, groundwater wells, high groundwater tables, precipitation runoff and surface waters are all sources of water that may be available for wetland restoration. The most desirable restoration projects are those that restore existing hydrology by breaking tiles and plugging ditches. These types of restorations do not require any long-term maintenance by means of pump stations and pipelines. However, in some instances, installing a pump station may be the landowner's only option to maintain a desirable water level. Pumps do provide a reliable source of water but one must consider initial and long-term costs, maintenance and aesthetics.

The quality of water both at the source and following wetland establishment are equally important. Well-designed wetland restoration plans are only as effective as the quality of water they contain. Adjacent land use may affect the amount of pollutants, sediments and excess nutrients entering a wetland. Buffer zones may remedy this problem but alterations in wetland design and management actions are often needed. Best described as areas of permanent vegetation, buffers help reduce sediments, fertilizers, pesticides and heavy metals from entering wetlands and waterways. They also slow water runoff, reduce soil erosion and provide wildlife habitat. Landowners who install buffers will be satisfied in knowing that they have taken the common sense approach to protecting and drastically improving the quality of their wetland project.

ADJACENT LAND USE

When planning a wetland restoration, landowners must avoid flooding the properties of adjacent landowners.

Good planning and a site survey should prevent this from happening. Alternatively, it may be possible to acquire flood easements if adjacent landowners are willing. Consequently, the land use patterns of your neighbors are also critical to the success of your restoration. Do adjacent landowners have wetlands on their property? Often projects can be connected to existing wetland habitats and allow for better overall function on a watershed scale. The types of crops planted in neighboring fields are also important. Fertilizers in runoff may enter your wetland causing excessive plant growth and algal blooms. Excess pesticides and herbicides entering a wetland may also prove harmful to plants and wildlife. Are there busy roads or industry close by that may disturb or pose health threats to wildlife? These types of questions are paramount and need to be addressed during the planning stages of your project.

ACCESSIBILITY

Access routes to proposed wetland sites need to be determined since many restorations require heavy equipment for initial construction and maintenance. Farm equipment access to wetlands and adjacent uplands is a must when planting wildlife food plots and nesting cover. If levees and/or water control structures are to be installed, access will be needed for long-term maintenance and repairs.

REGULATIONS AND PERMITS

Wetlands provide valuable functions that benefit both individuals and society alike. In order to protect these functions in the best interest of the public, regulations have been developed to control and guide activities within wetlands. Specifically, Section 404 of the Clean Water Act, administered by the Corps of Engineers and the U.S. Environmental Protection Agency (Department of Environmental Quality in Michigan), establishes federal protection of wetlands in the United States. This program regulates the discharge or fill of material into waters of the United States, including wetlands. Permits are required for most wetland related activities, including: modifications (such as dams or levees), development (buildings or roads) and conversion to upland for farming.

It is imperative that landowners be fully aware of their legal rights and responsibilities regarding wetland regulations. Thus, before initiating wetland restoration activities, landowners must contact the appropriate regulatory agency to ensure compliance with federal, state and local laws. This is a crucial step in the planning process of a restoration project and if overlooked, costly violations and delays may occur. Biologists can help landowners determine correct contacts.

AGENCIES INVOLVED IN WETLAND PROTECTION AND PERMITTING

U.S. Army Corps of Engineers
Great Lakes and Ohio River Division
P.O. Box 1159
Cincinnati, OH 45202-1159
513.684.3002

U.S. Environmental Protection Agency
Region 5
Watershed and Nonpoint Source Programs
77 West Jackson Boulevard
Chicago, IL 60604
312.886.6115 | Wetlands Hotline: 1.800.832.7828

Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271
217.783.6302

Indiana Department of Environmental Management
Office of Water Quality
100 North Senate Avenue
Indianapolis, IN 46204
317.232.8603 | 1.800.451.6027 within Indiana

Michigan Department of Environmental Quality
Land and Water Management Division
116 W. Allegan Street
P.O. Box 30458
Lansing, MI 48909-7958
517.373.1170

State of Ohio Environmental Protection Agency
Lazarus Government Center
P.O. Box 1049
Columbus, OH 43216-1049
614.644.3469

State of Wisconsin
Department of Natural Resources
P.O.Box 7921
Madison, WI 53707-7921
608.266.2621

WETLAND DESIGN AND CONSTRUCTION

SITE SURVEY

A site-specific survey is often needed to establish a base map of the restorable wetlands on your property. To help define the amount of surface water, rate and/or type of flow and desired water depths of a potential restoration site, landowners typically need to map changes in topography on 1-foot contours. Such data also help guide decisions on the need for constructing impoundments and installing water control structures. These structures are often important factors in overcoming changes that have occurred to the surrounding landscape such as adjacent development and altered drainage patterns.

Survey data subsequently help engineers develop site plans that specify the design (both size and location) of impoundments and water control structures (if needed). Contractors are then able to reference these plans or blueprints during construction phases of the project. For this reason, property boundaries, restricted areas, construction zones and access points should all be defined on a base-map. Assistance with site surveys is available through local conservation organizations, state agencies and the NRCS.

TYPE AND DESIGN OF RESTORED WETLANDS

Selecting the appropriate method of wetland restoration depends on project characteristics, objectives, budget and available equipment. A restoration project may require the construction of extensive impoundments and borrow areas, whereas others may only require breaking drainage tiles to restore existing wetland conditions. The following will explain the most common elements of delivering a wetland project and provide guidelines for proper construction and maintenance.

DIKES AND LEVEES

Low-level embankments or earthen dikes are generally used on low flat areas where shallow water depths are to be maintained. Size and placement of dikes is dictated by topography, desired wetland size and water depth. Landowners should consult qualified engineers for design and construction assistance.

Prior to dike construction, soils should be inspected to ensure they have enough clay content to prevent leakage. Dikes should have a gradual side slope of at least 4:1 with a height based on the maximum flooding depth. Generally, the top of a dike should be at least 8 feet wide to allow for easy access of maintenance equipment such as tractors and mowers. A freeboard (the distance from the highest expected water level to the top of the dike) of 2 to 3 feet should be incorporated into the design to account for wave action, dike settling and storm surges. An emergency spillway needs to be constructed for alternate water drainage during flood events. The bottom of a spillway should be placed at the desired high water mark to allow for optimal water level management. Spillway design and size will depend on the surrounding watershed and the total acreage of impounded wetland.

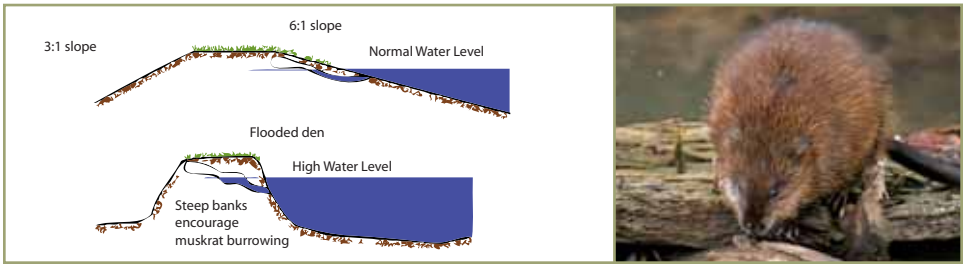
Dike construction involves the movement of large amounts of soil, thus heavy equipment such as excavators, terrace-building machines, bulldozers and draglines may be necessary. Always remember to install a silt-fence prior to construction when adjacent to existing wetlands or watercourses. The base (footprint) of the dike will need to be cleared of any organic matter or non-clay soils prior to construction. This allows for effective soil compaction and helps prevent leakage or washouts. Once organic material is removed, clay or clay-loam soils should be placed in 6 to 8 inch layers followed by thorough compaction using heavy equipment or a sheepsfoot roller. Soil can be taken from a borrow area (away from the toe of the dike within the wetland basin), other development sites, or cleared from higher elevations on site. Once construction is complete, dikes should be seeded with grasses and other non-woody vegetation to prevent soil erosion. Applied at a rate of 2 pounds per 1000 square feet, the following mixture will establish quickly and provide suitable cover for a variety of wildlife.

DIKE SEEDING MIXTURE

- **60% Brome grass** *(Bromas inermis)*
- **18% Red clover** *(Trifolium pratense)*
- **22% Perennial Ryegrass** *(Lolium perenne)*

MUSKRATS

Muskrat damage is an important factor to consider when designing and constructing impoundments. Muskrats often burrow into steep, narrow embankments, causing leakage and possibly failure. Therefore, dikes should be designed with gradual side-slopes and top widths of at least 8 feet. Borrow-soil used for dike construction should not be taken from areas directly adjacent to the dike. In addition, dikes can be covered with gravel or 'rat-wire' fencing to help prevent burrowing. However, this may be a costly option.



Proper dike construction will prevent damage from muskrat burrows.

TILE BREAKS

An inexpensive way to restore wetland hydrology is to break, plug or remove drainage tiles. Drainage tiles are usually made of clay or plastic and are buried in low areas to sufficiently drain lands for conversion to farmland. Often times, tiles broken in natural depressions are the only requirement needed to successfully restore wetland conditions. For precise water level control, risers or uprights containing debris guards can be attached to functioning drainage tiles. This method requires minimal effort and is effective in restoring a variety of naturally existing wetland types.

DITCH PLUGS

Similar to a tile break, surface-water ditches allowing drainage of low areas can be plugged or filled to restore wetland conditions. This interrupts existing drainage patterns, allowing water to flood an impoundment or natural depression. Water levels may need to be managed by installing water control structures or emergency spillways in order to prevent extensive flooding of adjacent lands.

WATER DEPTHS

When considering wetland design and maintenance of appropriate water depths, it is important to recognize the existing topography of the land. Although initial construction costs may be high, contour levees or dikes that follow elevation gradients will better manage and efficiently maintain the appropriate water levels needed to attract and sustain wildlife. This will allow for a variety of areas differing in water depth that can and should be included in your plan. Incorporating moist-soil areas and exposed mudflats will benefit a number of shorebirds and waterfowl. Shallow areas with depths below 18 inches favor many emergent plants and provide an abundant food source for waterfowl and wading birds. Areas with water depths greater than 18 inches harbor a number of submerged and floating aquatic plants that are utilized by waterfowl, fish and aquatic mammals. However, to maintain wetland productivity, wetlands need to experience periodic water level fluctuations and should generally not exceed 3 to 4 feet in depth. Keeping an ongoing record of water level changes will help assess the response of vegetation communities to the rate and timing of flooding and discharge. A monitoring program will allow for fine-tuning of water depths in order to create optimal use by wildlife.

WATER CONTROL STRUCTURES

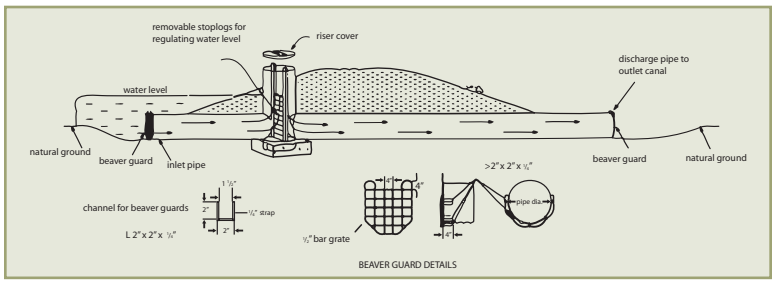
Water control structures are commonly installed in wetlands to allow for precise water level management. There are many advantages to using water control structures. For instance, they help control undesirable plants and permit the manipulation of plant community composition. Control structures can be used for water inlet as well as discharge but require some degree of time and effort by the landowner to monitor and maintain. Initial purchase and installation costs may be high but most control structures are long lasting and cost effective. It may be unnecessary to install control structures in small restorations, but structures remain very effective for managing water levels within large wetland units. Similarly, if a wetland is not to be actively managed and left in a natural state, water control structures are unnecessary.

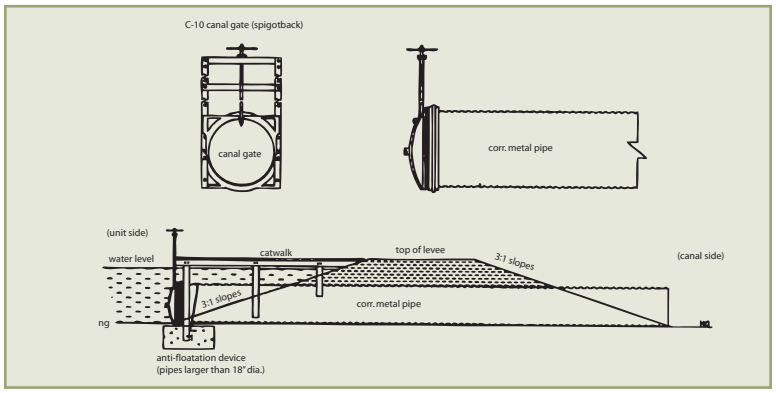
TYPES OF WATER CONTROL STRUCTURES

Flashboard and Full-Round risers are the most commonly used structures and remain one of the least expensive options for water level management. Depending on the number of boards inserted in the structure, fine adjustments in water level are made possible. Full-Round risers have advantages over Flashboard risers in that they provide some level of beaver control; they do not require a catwalk or boat to access and manipulate stoplogs; and they deter vandalism or tampering with stoplogs. However, initial costs may be slightly higher for Full-Round risers. Screwgate structures are also a relatively inexpensive water control option, but require a substantial amount of monitoring by the landowner. This type of structure is ideal for complete drawdowns or flooding of an impoundment, but precise water level manipulations are cumbersome and time consuming.

SIZE AND SHAPE

When planning your project, you should also consider the size and shape of the wetland that will be restored. Overall wetland size is dependent on a number of factors including topography, existing hydrology and parcel size. More importantly, wetlands should be composed of irregular shorelines and gradual or soft side slopes to insure wildlife use, peripheral vegetation establishment and to provide a natural appeal. For instance, wetlands with irregular shorelines and natural shapes improve waterfowl pair isolation during the breeding season and provide an interspersion of emergent vegetation and open water.





Pictures: Full Round Riser (above); Screwgate Structure (below)

PLACEMENT AND SIZE

Essential to water level management is choosing the correct placement of a water control structure. Control structures should be positioned at the lowest elevation in a wetland to allow for complete drainage or drawdown if needed. When managing more than one adjacent wetland impoundments, individual water delivery and discharge structures should be used. Every wetland restoration is unique in its own way; consequently, landowners must identify the appropriate water control system that best suits their project needs and budget. The appropriate size and number of control structures required will often depend on topography, overall size of the wetland and size of the surrounding watershed. Many types and sizes are available. Consult a qualified engineer for help in determining the proper selection for your wetland.

WILDLIFE HABITAT MANAGEMENT

Waterfowl and wetland-dependent wildlife rely on nesting, feeding and resting habitat that wetlands provide. These wetland habitats are often manipulated or improved for the benefit of both wildlife and humans, alike. Landowners can acquire such benefits through wetland management activities tailored to specific wetlands that exists on their property. The following sections provide a reference of general concepts and techniques to guide your habitat management decisions.

SHALLOW WATER MARSH MANAGEMENT

Shallow water marsh management mimics or enhances natural water level fluctuation within a wetland to increase productivity. By lowering water levels and exposing mudflats during various stages of the year, landowners are able to effectively attract a variety of wildlife. Waterfowl and other migratory birds such as shorebirds feed on the abundant supply of annual seeds and protein-rich invertebrates that shallow water marshes provide.

A prerequisite to shallow water marsh management is the ability to effectively manipulate water levels. Wetlands equipped with water control structures and contour levees give managers and landowners the advantage of being able to fine-tune the amount, rate and time of wetland flooding. The following sections will help you ensure efficient and productive management of shallow water marsh areas equipped with water control structures.

TIMING OF DRAWDOWN

Early spring drawdown

Drainage or drawdown of marsh management units should be scheduled to coincide with regional growing season lengths. The Great Lakes region has a growing season that ranges from 160 to 280 days in length. Consult your local NRCS Office for growing season dates in your area.

Drawdowns can be categorized into early, mid and late season. Generally, early season drawdowns are the most productive, providing optimal conditions for seed germination, root development and enhanced plant survival during mid-summer droughts. Mid season drawdowns also result in high quality seed production but plants experience poor root development and increased mortality. However, mid to late season drawdowns help reduce seed establishment and adult vigor of unwanted exotic plant species. Drawdown dates are an important factor determining the composition and production of responding vegetation. It is desirable to note and record plant composition resulting from your management actions. This will ensure that proper water level manipulations have been implemented and will aid in future management decisions.

DRAWDOWN RATES

The period of time at which drawdowns occur helps determine soil moisture, vegetative response and overall wetland productivity. Generally, rapid drawdowns scheduled for a 1 to 3 day period should be avoided. Slower drawdowns, extending from 2 to 3 weeks in length are more desired for plant production, invertebrate response and wildlife use. Extended periods of drawdown increase plant and invertebrate food availability resulting in longer foraging times for a diverse group of wildlife. Optimal wildlife use will occur where water levels encompass the proper foraging depth of specific species. For this reason, it is best to manage adjacent management units or basins at different phases of drawdown in order to provide a diversity of habitats and food resources.

Mid-summer vegetation growth

FREQUENCY OF DRAWDOWNS

Over time, the frequency at which a wetland is drawn down also plays a determining role in vegetation community response and ultimately use by wildlife. Drawdowns are typically scheduled on an annual basis or preferably on a 3 to 5 year schedule. During the first year, a wetland drawdown can provide a good response by annual emergent vegetation. These plants are a highly sought after food source of migrating waterfowl during the fall and winter months. Annual drawdowns also provide excellent shorebird and wading bird habitat. However, annual drawdowns should not be done for more than 3 years in a row in order to deter noxious weeds. On the other hand, periodic drawdowns every 3 to 5 years create a more diverse and productive wetland ecosystem that is much easier for landowners to accomplish. In this scenario, long term flooding can provide open water that benefits migratory bird species and other wildlife throughout the year. A drawdown schedule should be based on what best suits your individual wetland or project objectives.

Fall flooding

FLOODING

Moist-soil units should be inundated in the early fall (late August to early October) to coincide with peak migratory bird activity. Impoundments should be gradually flooded to a shallow depth that is optimal for waterfowl or shorebird foraging. Proper planning of spring drawdown dates will maximize annual plant growth and substantially increase waterfowl and other wildlife use during fall migration.

SMALL WETLAND BASINS

The region encompassing the Great Lakes is comprised of a landscape dotted with numerous shallow wetlands ranging from a tenth of an acre on up to five acres or more. These wetlands, often called potholes or depressions, are a dominant wetland type found on privately owned lands. They provide extremely important nesting habitat for waterfowl.

Under natural conditions, small wetland basins will experience drought conditions and undergo a period of drawdown. These dry conditions experienced during the hot months of summer are important to the continued productivity of the wetland. Dry conditions expose mudflats and allow for the germination of wetland vegetation, providing a food source for a variety of wildlife, especially waterfowl. If a wetland of this type exists on your land, hands-on management is often unnecessary. However, altered drainage patterns and changes in adjacent land use may have inhibited the natural hydrology or wet/dry cycle of your wetland. If this has occurred, active wetland management will be needed to restore wetland productivity. Maintaining a natural wetland disturbance regime will increase productivity, reduce the chance of establishing dense monotypic stands and diminish the threat of invasive plants. This process may involve the installation of a water control structure.

Farm ponds and small lakes are generally not well suited for successful marsh management because pin-point control of water levels is not typically available. When drainage of these areas is possible, a slow one to two foot drawdown in early June will usually stimulate the growth of beneficial plants on the exposed mud flats. Fall and early winter rains will usually refill these ponds and lakes, making food and cover available to marsh dwellers until the next drawdown. However, if refilling does not occur, you risk having perennial emergents like cattails colonizing the exposed areas. Establish food and cover strips around the water's edge and sow Japanese Millet on mudflats if production of natural plants is limited. Protecting the shoreline from livestock is essential if ponds are to be valuable to waterfowl.

HEMI-MARSH MANAGEMENT

Installation of a low-level berm and water control structure will allow for improved hydrology and wetland function through precise manipulation of water levels. Adjustments in the timing and amount of drawdown in a wetland will allow for the establishment of a hemi-marsh stage (diverse stands of emergent vegetation intermixed with equal areas of open water). The hemi-marsh is a 1:1 ratio of open water to wetland vegetation. The hemi-marsh stage provides a viable food source, diverse cover types and vegetative structure that are utilized by a variety of wetland-dependent wildlife. During spring and fall migration, hemi-marshes provide resting and stopover sites for large flocks of waterfowl. In addition, these wetlands are almost always utilized by breeding hens as brood rearing ponds. The high biodiversity experienced on these wetlands provide valuable invertebrate food for developing ducklings, while the emergent vegetation provides good cover from predators and bad weather. Additional activities such as fire management and manipulation of muskrat populations also aid in achieving hemi-marsh conditions. From a management perspective, the hemi-marsh can be difficult to maintain for long periods. Over time, this wetland can become completely dominated by continuous stands of cattails, with little or no value to wildlife. On the other hand, if water levels are too deep the wetland can become devoid of emergent vegetation. In nature, hemi-marshes experience periodic drying or drawdown cycles, which regulate vegetation growth. Muskrats and other wildlife can help to manage vegetation growth, but these also have to be kept in check. By utilizing control structures, scheduled drawdowns can be an effective means to regulate a hemi-marsh and increase their productivity.

AGRICULTURE AND WATERFOWL MIGRATION

Most aspects of agriculture, mainly the widespread drainage of wetlands and conversion of upland nesting habitats to cropland have been detrimental to North American waterfowl. However, many species of migrating waterfowl have adapted to the availability of waste grain in fields and rely heavily on it for winter survival. In some cases, migration routes and typical wintering grounds have shifted to more northern climes such as the Upper Great Lakes Basin.

If project objectives incorporate hunting and providing migration habitat, landowners may consider planting crops on adjacent uplands to attract migrant birds. Row crops and small grains such as corn, soybeans, winter wheat and millet provide excellent wildlife food sources. However, when compared to native wetland food sources, planted crops do not provide a high protein, nutritionally balanced diet. Agriculture should always be considered a supplement to the food sources and habitat that natural and restored wetlands provide.

A substantial amount of waste grain is lost per acre during agricultural harvest. For this reason, fields should not be tilled or disked after harvest in order to maintain maximum food availability. If possible, row crops and small grain fields should be flooded after harvest in early fall to a depth of 6 to 10 inches. Fields should remain flooded until early spring of the following year. Planting and harvest dates will vary depending on climate and length of the growing season.

MAINTENANCE

Proper maintenance of dikes, pumps and water control structures is critical when considering the initial time, effort and cost invested in a restoration project. Dikes need to be mowed on a yearly basis to prevent woody plant growth. This should be done during August

GREEN TREE RESERVOIRS

Green-tree reservoirs are an uncommon yet effective management strategy used to attract an array wildlife. Forested areas dominated by mast producing trees such as red, pin and swamp-white oak produce quality acorn crops as well as a protein-rich source of invertebrates for migrating waterfowl. However, management of green-tree reservoirs is difficult and labor intensive. Landowners are urged to seek technical advice before attempting this type of project.

In order to precisely control water levels and mimic natural flooding, an impoundment and water control structure will need to be installed. Generally, green-tree reservoirs should not to be flooded until leaves have changed color in the fall. Gradual inundation to a depth of 6 to 18 inches is recommended. Drainage should be complete prior to the growing season or the swelling of tree buds in late winter. This will reduce the chance of tree mortality and aid regeneration of important mast producing species. Consistent annual flooding will stress and eventually kill trees. Annual variability in your water management, including years without flooding, is necessary to maintain the long-term viability of a stand.

to avoid destroying nests during the breeding season. Any leaks or breaches in a dike must be quickly repaired to avoid washouts.

Muskrats also significantly increase the amount of required project maintenance. Muskrats may burrow in dikes, resulting in leaks that require immediate attention. Woody debris deposited by beaver near water control structures and emergency spillways will also need to be removed to reduce extensive flooding. Preventative maintenance and initial planning need to be considered when faced with the threat of potential wildlife damage.

Pumps and power units need to be monitored to make sure they are safe and in good working order. Water control structures, spillways and associated pipelines need to be checked for proper function on a regular basis. Normal maintenance of wetland structures and improvements will ensure a suitable return on project investments.

MONITORING

Evaluation and monitoring is a valuable and rewarding component of any wetland management plan. Standard census techniques should be incorporated in order to monitor wildlife and invertebrate response to changes in vegetation, hydrology and soil conditions. The productivity and water cycles of each wetland are unique, thus records need to be kept for individual management units or wetland basins. Mapping or taking note of the initial conditions of a wetland restoration will help determine changes in condition over time. Monitoring during the early stages of management also determines the success or failure of certain management recommendations and whether project objectives have been met. Detailed records of the following will allow for improved management practices in the future: water depth, duration and time of flooding, rates of flooding and discharge, vegetation composition, wildlife use, harvest of game species, seed and/or crop yields and weather conditions. You will also have a rewarding record of the success of your wetland through time.

ASSOCIATED UPLAND HABITAT MANAGEMENT

A diverse mixture of native grasses in upland areas adjacent to wetland habitats provides food, cover and nesting habitat for waterfowl, upland game birds and a variety of nongame species. Upland cover also creates an essential wetland buffer against predation, disturbance, contaminants and soil erosion. An optimal ratio of 1 acre of wetland to 3 or 4 acres of upland buffer is recommended. If this is not feasible, a minimum buffer of 100 feet should surround a wetland.

Following spring migration, most waterfowl begin nesting in mid to late April with re-nesting attempts extending into mid summer. Native upland grass and small grain plantings provide optimal cover (at least 12 inches in height, either overhead or lateral) for successful waterfowl nest sites during this time period. The following are recommendations for establishing and maintaining this type of nesting cover for the benefit of waterfowl.

PLANNING A PRAIRIE GRASS RESTORATION

Prairies are an excellent habitat to restore on your property. A number of topics regarding prairie grass establishment should be researched and discussed prior to restoring and managing native grassland habitat. Are the location and/or size of the upland area suitable for effective restoration and will it provide an essential wetland buffer? How will existing soil and vegetation cover types effect restoration success? What types of equipment and management practices are required and are they available? The following are general guidelines and techniques that will help answer these questions and help promote a successful prairie grass restoration on your land. Biologists are also available and willing to help you with these questions.

TYPES OF UPLAND COVER

Many vegetation types including native grasses, forbs, alfalfa and small grains provide suitable upland habitat for a variety of waterfowl. Cool season grasses (CSG), as their name implies, experience growth during the cool months of early spring and late fall. These mixtures provide good food resources, are relatively easy to establish and require maintenance every 3-5 years. Warm season grasses (WSG), on the other hand, experience extensive growth during warm summer months. They provide good residual cover throughout the winter and also provides cover for waterfowl nesting in early spring. Compared to CSG's, the establishment of WSG's may be more difficult but require less long-term maintenance. Overall, WSG's provide a more desirable nesting habitat for waterfowl when compared to CSG's.

The appropriate mixture to plant depends on project objectives and the amount of maintenance landowners are willing to provide. Many commercial plant mixes containing species native to the region are available for purchase. Valuable crops such as alfalfa and small grains also provide attractive upland nesting cover, however farming techniques and harvest dates must coincide with waterfowl nesting periods.

Upland cover is crucial for nest success

PLANTING AND MANAGEMENT

A variety of techniques can be used to plant native prairie grass mixes on croplands, old fields, or existing sod. Potential sites should be treated with herbicide such as Roundup and Plateau or in combination with cultivation prior to seeding. If available, mechanical seeders or no-till drills are an effective means to planting native WSG's. No-till drills are convenient to use. They do not require fields to be conventionally tilled and can be used on small or large tracts of land. For areas smaller than an acre, seeds can be hand-broadcast over a well-tilled seedbed followed by a roller to firmly pack seeds approximately 1/8 to 1/2 inch into the soil. Proper seed to soil contact is critical for both warm and cool season mixes. Fertilizer application is usually not warranted but proper application will generally benefit cool season grasses.

Prairie grasses require minimal long-term maintenance for viable stands to persist. Periodic burning is a management practice that stimulates plant growth, eliminates dead plant material, controls unwanted weeds or shrubs and is essential to the longevity of a stand of native grassland. Prescribed burning can be implemented in early spring during the second year of plant growth and continued on a rotation every 3 to 5 years for the life of the stand. Check state and local laws prior to implementing a controlled burning program.

UPLAND NESTING COVER

Warm Season Grasses	Cool Season Grasses		Companion Crops
Little Bluestem	Red fesue	Alfalfa	Oats
Poverty Grass	Brome grass	Red clover	Barley
Big Bluestem	Timothy	Sweet clover	Winter Wheat
Broom-sedge	Orchard Grass	White clover	Rye
Switchgrass	Redtop	Alsike clover	
Indian Grass	Blue-joint grass	Landino clover	
Side-oats gramma	Panicum		
Blue gramma	Rice-cut grass		
Hairy Gramma	June grass		

ADJUSTING FARM PRACTICES FOR NESTING WATERFOWL

In addition to native grasslands, many species of waterfowl select hayfields and croplands for nest sites. Therefore, first cutting of hay and alfalfa should be delayed until mid July in order to provide ample time for nest hatching. Early season cutting often exposes nests and causes hen mortality. The use of flushing bars attached to farming equipment will help flush sitting hens, preventing unnecessary adult mortality. The use of conservation tillage techniques and delayed cultivation for small grains such as winter wheat and rye, allow for increased nesting possibilities and improved soil conservation. These practices are becoming widely used and are easily incorporated into farming regimes without experiencing dramatic reductions in yield or profit.

Flushing bars

INVASIVE SPECIES OF CONCERN

PURPLE LOOSESTRIFE

Purple loosestrife is an aggressive exotic plant species that commonly invades North American wetlands. Under certain moist soil conditions, purple loosestrife may outcompete native vegetation reducing the availability of important waterfowl food sources and cover types. Eradication is difficult but if detected early, the spread and impact of purple loosestrife can be minimized. Extended flooding during late spring may exterminate loosestrife plants but seeds often remain viable in the soil for long periods of time. However, reducing native plant species composition may result from extended periods of flooding. EPA approved herbicides such as Roundup (Reg. No. 524-343) are most effective against purple loosestrife, however annual application is needed to ensure eradication. Plants should be sprayed when flowering, but before setting seed. Check local, state and federal regulations prior to applying any herbicides within a body of water. Biological control programs, notably the introduction of two leaf-eating beetles and a root boring weevil from Europe, have gained popularity in recent years and appear to be an effective measure of control.

This wetland vegetation community was dominated by Purple Loosestrife within a period of ten years (pictures: USGS-NPWRC).

REED-CANARY GRASS AND COMMON REED

Reed-canary grass and common reed are perennial grasses that aggressively invade moist soil vegetation zones. Both species can be effectively controlled using approved chemical herbicides such as Amitrol, Dalapon and Rodeo-EPA. Mechanical removal (hand-pulling and heavy equipment) is an effective control measure but has experienced limited results due to the extensive root systems produced by these species. Fire has been found to substantially reduce dense stands of reed-canary grass in areas that are dry enough to burn, especially followed by flooding of at least 18 inches. Extensive flooding of areas recently invaded by common reed to water levels > 30 cm can successfully reduce expansion.

Canary Reed (left); Common Reed (right)

CATTAIL

In desirable amounts, cattails are an important plant in a wetland. Cattail marshes with open water interspersion (hemi-marsh) create optimal habitat and provide important invertebrate food sources and cover for wildlife. However, cattails can quickly proliferate into dense stands, dominating and subsequently reducing wetland plant diversity. Drowning (cutting or burning stems followed by flooding at least 2 to 3 inches above the stems) of cattails provide the best overall results. However, water levels must remain stable throughout the growing season to be effective. Herbicides such as Rodeo-EPA applied in conjunction with Cidekick® have been proven an effective agent in controlling cattails. Caution should be used when applying herbicide treatments, as they are indiscriminant in the plant species they kill. Contact your local fire department for information regarding local ordinances prior to burning.

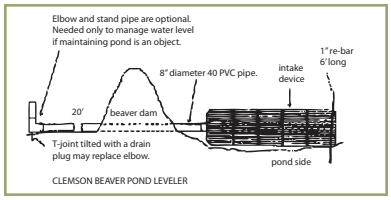
WOODY VEGETATION

Woody species such as willow and cottonwood are considered a nuisance when trying to manage wetlands for herbaceous plants. Willow and cottonwood are highly invasive and difficult to eradicate once they become established. Early detection and preventative maintenance is the key to keeping eradication cost low. Discing young saplings up to 3 times a year works best and is fairly economical. A fall mowing regime, followed by extensive flooding may effectively control newly established stands. In certain situations, application of herbicides is an option, but will be most effective when used in combination with other control measures.

Black willow *Cottonwood*

BEAVER

Beaver are responsible for creating large amounts of productive breeding waterfowl habitat. They are also an effective way to manage wetlands and alter successional patterns. However, without water level control, blockage of streams or drainage ditches can cause flooding of roads, farmland and commercial or residential buildings. Beaver are commonly controlled by trapping and relocation, but once dams are built and a population becomes established, the use of water control structures may need to be considered. Installing a pond leveler may be necessary because destroying a beaver dam recreates the sound of flowing water and is a welcome invitation for renewed beaver activity. Clemson beaver dam levelers and three-log drains can be used to help control water levels and are relatively inexpensive to build. Contact your state wildlife or animal control personnel to obtain the appropriate permits prior to implementing control procedures.



MUSKRAT

A moderate population of muskrats can play a key role in managing or maintaining an interspersion of open water and emergent vegetation within a wetland. However, muskrats have the potential to quickly overpopulate wetlands and exploit food resources that often results in a complete clearing of emergent vegetation. Muskrat trapping is one of the most effective control methods in wetlands experiencing overpopulation. Check your local trapping regulations prior to initiating control measures. In wetlands equipped with water control structures, lowering water levels during winter months increases the amount of winter-kill and keeps populations at a manageable level.

CARP

Often considered a nuisance in wetland habitats, the common carp has the ability to increase water turbidity and uproot valuable submerged aquatic plants. These activities are detrimental to waterfowl food sources and to a variety of native fish species that depend on wetlands for spawning. Where applicable, carp can be excluded from wetlands by installing screens with 1- inch slats at all inlets and outlets. If populations of carp become established, early spring drawdowns are effective in concentrating carp into small pools for their removal. Small pools may also be treated with rotenone to kill remaining fish. A private-pesticide-applicator certificate is needed to purchase rotenone and can be obtained through your local county extension agent. Winter drawdowns also control carp populations by creating anoxic conditions in wetlands, leading to an increased occurrence of winterkill.

NEST STRUCTURES

The use of artificial nest structures is an effective management tool for increasing local wood duck, mallard and Canada goose productivity, especially in areas where natural nesting habitat is lacking. Where adequate brood rearing requirements (permanent open-water wetlands) are met, artificial nest structures can provide supplemental nest sites that experience high success. However, artificial nesting structures require routine maintenance, including annual replacement of nesting materials. Disregard for such maintenance often leads to failure of artificial nest sites. Initial building costs, installation and aesthetic issues should also be considered when implementing a nest structure project.

WOOD DUCK

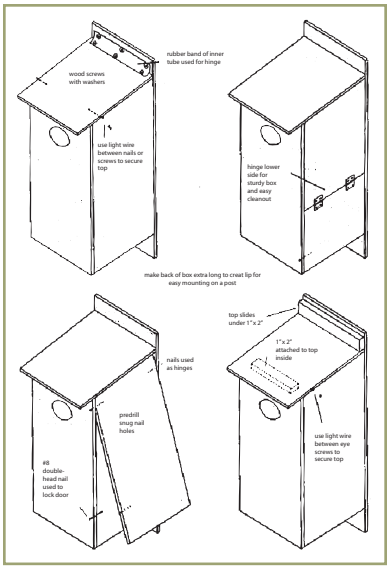
Wood ducks nest in natural tree cavities located in or adjacent to wetland habitats. Therefore, many factors need to be considered when choosing an appropriate site for nest box placement. Nest boxes should be installed as close to a wetland or watercourse as possible. If a nest box is placed over water, a minimum height of 3 feet above high water is recommended. When positioned above dry ground, nest boxes should be approximately 8 to 12 feet high to avoid ground predators and vandalism.

Proper spacing of nest boxes will help minimize competition, dump nesting and poor nest success. In open areas, nest boxes should be placed 100 to 150 yards apart, however in densely vegetated areas, nest boxes can be placed within 30 yards of one another. Nest boxes can be positioned close to one another until a breeding population becomes established. At that time boxes need to be spread out to reduce the chance of competition. Nest boxes are often anchored to living trees, metal poles, or wooden posts. Predator shields made of sheet metal must be installed on support posts or trees. Conical shields placed at least 3 feet off the ground provide optimal protection from raccoons, feral cats, snakes and other predators. Installing nest boxes without excluding predators will drastically reduce nest success and may induce hen mortality. A number of wildlife species including hooded mergansers, buffleheads, goldeneyes, owls, kestrels, swallows, starlings, woodpeckers, squirrels and opossums may compete with wood duck hens for nest box use.

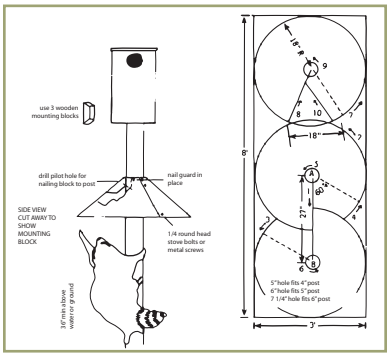
A variety of nest box designs and building materials have been tested and are currently used. However, wood ducks are noted to prefer the typical wooden box type structures. Rough-cut lumber such as cedar and redwood are durable construction materials, economical and maintain cool inside temperatures. Metal and plastic are cheaper materials, but when temperatures inside nest structures exceed 100 degrees, developing embryos may perish in the extreme heat. It is unnecessary and not recommended to paint nest boxes. A hardware-cloth ladder extending from nesting material to the exit hole should be included to allow for ducklings to exit the box.

Coarse wood shavings (purchased at animal feed shops and pet stores) provide the best nesting material for nest boxes. Four to 6 inches of shavings should be placed at the bottom of each nest box. Other materials such as leaves, grasses and twigs can be used but decay quickly. Nest materials should be checked and replaced each winter or early spring prior to waterfowl migration in early March.

Shurtleff & Savage



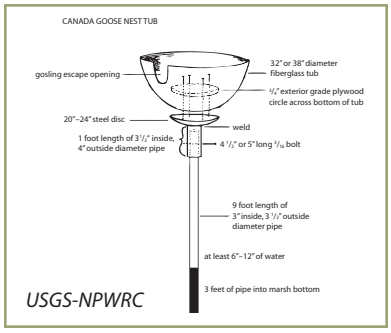
Nest Structures For Ducks & Geese



USDA-NRCS Wildlife Habitat Management Institute

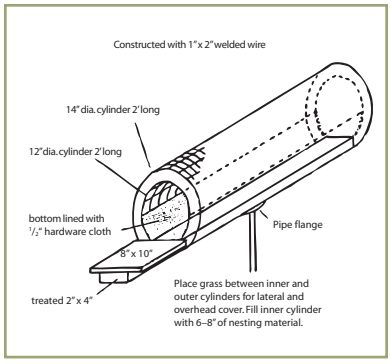
CANADA GOOSE

Generally, geese prefer over-water nest sites that are easily defended from predators. A variety of artificial nest structures such as open-topped cones and tubs are available that meet the nesting requirements of Canada geese. Choosing the appropriate nest structure is dependent on landowner budget, wetland size, aesthetics and ease of maintenance.



MALLARD

Mallards will often use the same nesting structures as those preferred by Canada geese. However, hen mallards prefer lateral and over-head cover. With slight modifications to improve lateral cover, nesting islands, round hay bales and post structures can be effective in attracting breeding mallards. Horizontal cylinders, open-topped cones and tubs (partitioned to discourage use by Canada geese) are the most commonly used nest structures by mallards. Post or over-water structures come in a variety of designs, are easy to build and are relatively inexpensive. Post structures are usually placed at least 50 feet from the shoreline and positioned 150 to 300 feet apart. Nest materials suitable for mallards include soft grasses, straw and hay. Similar to wood duck nest structures, predator guards must be installed.



NESTING ISLANDS

Constructed islands provide nesting, feeding and loafing sites that are relatively safe from predators. If constructed properly, islands provide habitat for a variety of wildlife, are easily maintained and will last for a long period of time. However, the initial cost of nest-island construction may be quite high.

Islands with an area ranging from 0.1 to 1 acre placed at least 150 feet from the shoreline work best at deterring predators. The height of the island must be at least 3 feet above the anticipated high water level, with a minimum water depth of 3 feet surrounding the island. Wetland size will determine the number of islands that can be constructed. Long distances (a minimum of 150 feet) between individual nesting islands render this technique ineffective for small wetland restoration projects.

A feasible alternative to nesting islands is to place round hay bales in the wetland. Tuned on end, Round hay bales made of coarse grass or grain straw create attractive nest sites available to both Canada geese and mallards. Bales are cost effective and can be installed during winter months where a thick layer of ice allows for safe and easy access to wetlands. Sites with water depths 18 to 30 inches that do not experience excessive water level fluctuations are preferred.

APPENDICES

COMMERCIAL SUPPLIERS OF NATIVE PLANT SPECIES

ILLINOIS

Bluestem Prairie Nursery

13197 E. 13th Road
Hillsboro, IL 62049
Ph: 217.532.6344 | Fax: 217.532.6344
bluestem@cillnet.com

Products include prairie, woodland and wetland plants; native grasses.

Enders Greenhouse

104 Enders Drive
Cherry Valley, IL 61016
Ph: 815.332.5255 | Fax: 815.968.2941
endrsnatvs@aol.com

Wholesale/retail nursery; products include prairie, woodland, wetland plants; native grasses; container-grown Midwest natives are nursery propagated; mail order catalog available.

INDIANA

Edge of the Prairie Wildflowers

1861 Oak Hill Road
Crawfordsville, IN 47933
Ph: 765.362.0915

Products include prairie, woodland and wetland plants; native grasses; plugs and gallon containers of prairie plants and grasses; local genotypes.

Berg—Warner Nursery, Inc.

P.O. Box 259
Lizton, IN 46149
Ph: 317.994.5487 | Fax: 317.994.5494
http://www.berg-warner.com | bwrm@netusa1.net

Wholesale tree nursery; forestry consulting services including tree plantings, appraisals, management plans; mail order catalog available.

Heartland Restoration Services, Inc.

349 Airport North Office Park
Fort Wayne, IN 46825
Ph: 219.489.8511 | Fax: 219.489.8607
hlandrest@aol.com

Wholesale nursery; products include prairie, woodland, wetland plants; native grasses; trees & shrubs; suppliers of local genotype seed and custom grown plants; offers range of environmental consulting services including installation and management of native landscapes including prescribed burns and limited herbicide applications/exotic species control of those ecosystems.

Spence Restoration Nursery

2220 E. Fuson Road
P.O. Box 546
Muncie IN 47308
Ph: 765.286.7154 | Fax: 765.286.0264
http://www.spencenursery.com | native@iquest.net

Wholesale/retail nursery; products include prairie, woodland, wetland plants; native grasses; floral inventories; retention basin/pond planting and design.

MICHIGAN

Wildtype Native Plants

900 N. Every Road
Mason, MI 48854
Ph: 517.224.1140
http://www.msu.edu/~wildtype | wildtype@msu.edu

Products include prairie, woodland, wetland plants; native grasses; trees & shrubs; bare root stock only, Michigan-area genotypes; species inventory and site assessment; design and planning; establishment and management of native landscapes.

The Michigan Wildflower Farm

11770 Cutler Road
Portland, MI 48875
Ph: 517.647.1914 | Fax: 517.647.6072
mwf@mrcc.com

Mail-order nursery; a seed producer of Michigan-area genotypes; mail-order catalog available.

Wetlands Nursery, Inc.

P.O. Box 14553
Saginaw , MI 48601
Ph: 517.752.3492
jewelr@aol.com

Wholesale/retail nursery; products include native wetland plants of Michigan-area genotypes & rescued plants; wetland plant database in CD format featuring information, photographs and drawings of native wetland plants; mail order catalog available.

Cold Stream Farm

2030 Free Soil Road
Free Soil, MI 49411
Ph: 616.464.5809
cfs@jackpine.com

Wholesale/retail nursery; products include prairie, woodland and wetland plants; trees & shrubs; specializing in wildlife habitat; mail order catalog available.

Nesta Prairie Perennials / Van Bochove's Greenhouse Direct

1019 Miller Road
Kalamazoo, MI 49001
Ph: 616.343.1669/800.233.5025 | Fax: 616.343.0768

Wholesale/retail nursery; products include wetland plants and native grasses; plugs, quart and gallon containers of prairie plants; custom propagation of customer seed; lectures, slide presentations, tours.

MINNESOTA

Prairie Moon Nursery

Route 3, Box 163
Winona, MN 55987-9515
Ph: 507.452.1362 | Fax: 507.454.5238
http://www.prairiemoonnursery.com | pmnrsy@luminet.net

Prairie Moon Nursery has provided seeds, plants and information to people interested in restoring the native plants of the Upper Midwest.

Prairie Wild Enterprises, Inc.

275 E. 4th Street South
Cottonwood, MN 56229
Ph: 507.423.5575 | Fax: 507.423.6683
http://www.prairiewild.com | info@prairiewild.com

Native grasses and wildflower seeds; live native plants; wildlife products; pond kits.

OHIO

Mary's Plant Farm

2410 Lanes Mill Road
Hamilton, OH 45013-9181
Ph: 513.894.0022 | Fax: 513.892.2053
http://www.Marysplantfarm.com | sales@Marysplantfarm.com

Retail nursery; products include prairie, woodland, wetland plants; native grasses; trees & shrubs; mail order catalog available.

WISCONSIN

Prairie Future Seed Company

P.O. Box 644
Menomonee, WI 53052-0644
Ph: 414.820.0211 | Fax: 414.325.1228 | pfsco@execpc.com

Wholesale/retail nursery; products include prairie and woodland plants; native grasses; seeds and container plant materials; S.E. Wisconsin and N.E. Illinois genotypes; consultant services; educational seminars; technical support for "do it yourself" programs; installation and management.

J&J Transplant Aquatic Nursery LLC

W 4980 County Road W.
P.O. Box 227
Wild Rose, WI 54984
Ph: 715.256.0059 | Fax: 715.256. 0039
http://www.tranzplant.com | jmalchow@tranzplant.com

Wholesale/retail nursery; products include prairie, woodland, wetland plants; native grasses; trees & shrubs; services include wetland restoration; mail order catalog available.

Marshland Transplant Aquatic Nursery

P.O. Box 1
Berlin, WI 54923
Ph: 920.361.4200 | Fax: 920.361.4200

Wholesale nursery; products include prairie, woodland, wetland plants; native grasses; trees & shrubs; nursery-grown potted material and bareroot plants; services include landscape design, habitat restoration, consulting, contract growing, drill and plug installation; plants and seeds for restoration, waste water treatment and water gardening.

Agrecol Corporation

2918 Agriculture Drive
Madison, WI 53589
Ph: 608.226.2544 | Fax: 608.223.3575
http://www.agrecol.com | ecosolutions@agrecol.com

Products include 200+ prairie, woodland and wetland plants; native grasses; wholesale nursery; seed and plant stock; restoration planning and assistance.

Great Lakes Nursery Company

1002 Hamilton St.
Wausau, WI 54403
Ph: 1.888.733.3564 | Fax: 1.715.848.9436
http://www.greatlakesnursery.com | info@greatlakesnursery.com

Great Lakes Nursery Company is a native seedling and transplant grower located in North-central Wisconsin. They specialize in hard-to-find plants that are native to Wisconsin, Michigan and Minnesota.

Taylor Creek Restoration Nurseries/Applied Ecological Services

17921 Smith Rd
PO Box 256
Brodhead, WI 53520
Ph: 608.897.8641 | Fax: 608.897.8486
http://www.appliedeco.com | info@appliedeco.com

Wholesale/retail nursery; products include prairie, woodland, wetland plants; native grasses; plants and seeds of wildflowers, grasses and sedges; contract growing; habitat restoration; planting design and installation.

Wildlife Nurseries, Inc.

P.O. Box 2724-LW
Oshkosh, WI 54903
Ph: 920.231.3780 | Fax: 920.231.3554

Wetland and aquatic plants and seeds; wetland creation and restoration; wildlife habitat enhancement.

Hild & Associates

326 South Glover Road
River Falls, WI 54022
Ph: 800.790.9495 | Fax: 715.426.9887
http://www.hildnatives.com | ghild@hildnatives.com

Growers of native prairie & wetland plant materials.

Kester's Wild Game Food Nurseries, Inc.

P.O. Box 516
Omro, WI 54963
Ph: 920.685.2929 | Fax: 920.685.6727
www.kestersnursery.com | kester@vbe.com

Consultations for recommendations on planting wetland sites; native and non-native weltand and prairie plants; wildlife food plot mixes.

OTHER SOURCES

Toadshade Wildflower Farm

53 Everittstown Rd.
Frenchtown, NJ 08825

Fax: 908.996.7500
http://www.toadshade.com | toadshad@toadshade.com

Toadshade Wildflower Farm makes native wildflowers, particularly perennials, more easily available. They provide native, perennial, propagated wildflower plants.

Tripple Brook Farm

37 Middle Road, Southampton, MA 01073
Ph: 413.527.4626 | Fax: 413.527.9853
http://www.tripplebrookfarm.com | catalog-request@tripplebrookfarm.com (catalog requests)

The Tripple Brook Farm is a mail-order plant nursery web site. They offer Eastern native plants, under-used cold-hardy exotics and over 300 species to meet a wide variety of gardening and landscaping needs.

Fiddley Fron's Nursery

P.O. Box 252, 7 Main St.
Norridgewock, Maine 04957
Ph/Fax: 207.634.4918
http://www.angelfire.com/biz/fiddleyfrondsnsy/index.html

Specializing in native perennial plants; wildflowers, ferns, wetland and woodland plants; ground covers, woody perennials and shrubs and trees. Over two hundred varieties; including many hard-to-find plants for landscape architects. Plants for shade and woodland gardens, ornamental ponds and water gardens, naturalizing landscapes, marshes, prairies and waste areas, wildlife food and cover, wetlands mitigation reclamation projects.

Ion Exchange

1878 Old Mission Drive
Harpers Ferry, Iowa 52146-7533
Ph: 800.291.2143 or 319.535.7231 | Fax: 319.535.7362
http://www.ionxchange.com/

Offers native Midwest seeds and plants.

Wetland Supply Company

194 Goodview Drive
Apollo, PA 15613
Ph: 724.727.3772 | Fax: 724.727.3778

Wetland plants for mitigation and restoration, custom wetland seed mixes.

Wetland Supply Company

194 Goodview Drive
Apollo, PA 15613
Ph: 724.727.3772 | Fax: 724.727.3778

Wetland plants for mitigation and restoration, custom wetland seed mixes.

Ernst Conservation Plants & Seeds

9006 Mercer Pike
Meadville, PA 16335
Ph: 800.873.3321 | Fax: 814.336.5191
www.ernstseed.com | ernst@ernstseed.com

Over 300 native and naturalized plant species, wetland plants, conservation species, wildlife habitat, wildflower and grass custom mixes.

APPENDICES

IMPORTANT WETLAND PLANTS FOR WATERFOWL

The following is a list of common wetland plants that provide food and cover for waterfowl. Although the seeds of most of these plants exist in the seed bed and will generally establish themselves naturally, they can be introduced artificially. Ducks Unlimited discourages the practice of seeding wetland vegetation because it is expensive and generally unnecessary. Caution should be taken though when artificially introducing these or any other plants into an ecosystem so that undesirable species such as purple loosestrife and other exotics are not accidentally introduced.

BEGGAR TICKS - *Bidens frondosa*

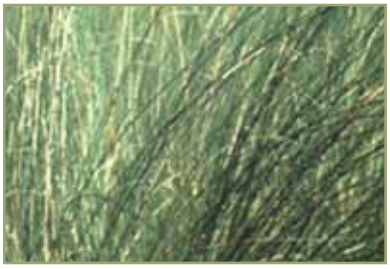
Beggar ticks, or bur-marigold, is a moist soil annual. In moist soil management, beggar ticks can be an important fall food source for migrating waterfowl. Seeds can be obtained commercially or harvested in the fall. Distribute seeds on exposed mudflats or along open areas of shoreline between early June and early August. Broadcast seeding works fine. Plant approximately 5lbs of seed per acre. This is an annual plant that may have to be re-planted each year.

BURHEAD SEDGE - *Scirpus cybensis*

Burhead sedge seeds are an important element of waterfowl diet. Found in the wet zone of swamps and marshes throughout North America, it grows from 3' to 5' in height. The plant also provides excellent wetland cover. Seeds or roots can be obtained commercially, or harvested from existing plants. Roots should be planted in early spring, while seeds should be planted in the late fall. Plant in shallow water up to 12" in depth, either 1200 roots per acre or 4lbs of seed. Once established this plant re-seeds itself.

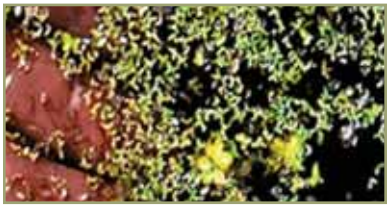
COONTAIL - *Ceratophyllum spp.*

Coontail is a submergent, floating wetland plant found throughout North America. Both the plant and seeds are consumed by waterfowl. This plant is easily recognized and obtained from existing wetlands. It floats in any water depth. It can be introduced from late March to early August. Introduce approximately 10 bu. of plants per acre of wetland. This is a perennial plant that does well once established.



CORD GRASSES - *Spartina spp.*

Cord grasses are very successful wetland grasses highly prized by waterfowl as a food source. These grasses grow quite tall and thrive in both fresh and salt water marshes, in either moist soil or shallow water. The seeds or roots can be obtained either commercially or in the wild. Seeds can be broadcast seeded during late fall, or roots can be planted in the early spring. Plant in shallow water up to 12" deep. Use approximately 5 lbs of seed per acre, or 1200 roots. These are annual plants that are quite successful once established.



DUCKWEED - *Lemna spp.*

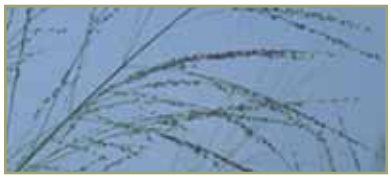
Duckweed is an important wetland food plant for most species of waterfowl. It is a tiny, floating plant that often forms a carpet-like cover on the water's surface. The plants reproduce by budding and can spread quite rapidly over a wetland surface. Duckweed can be introduced to a wetland from early spring to late fall, with plants readily available from commercial suppliers or other wetlands. Usually one bu. per acre should suffice.

DUCK POTATO - *Sagittaria lancifolia*

The duck potato is an emergent perennial plant that grows in shallow waters. It produces roots and corms which provide excellent waterfowl food. Seeds and roots can be obtained commercially or from other wetlands. Seeds should be planted in the late fall in shallow water or mud flats and roots should be transplanted during early spring. Use apprx. 10 lbs of seed per acre or 1200 plants.

FLAT SEDGES - *Cyperus spp.*

Flat sedges, otherwise known as nutsedges, are considered a prolific weed species to agriculture but can be a valuable food source to waterfowl. This plant grows well on saturated soils along wetlands. Seeds or tuber can be planted along wetland edges or on exposed mudflats from early April to mid-June. Seeds and tubers can be obtained commercially, or harvested from existing plants. Flat sedges are easy to establish and grow well.



PANIC GRASSES - *Panicum spp.*

Panic grasses are warm season annual grasses, such as switchgrass, which do well on saturated soils. These grasses grow tall while providing good residual nesting cover and a food source for waterfowl. Seeds can be planted in early spring on exposed mud flats or in the saturated zone of the wetland margin. Plant apprx 5 lbs per acre of seed from a commercial seed supplier.

PIN OAK - *Quercus palustris*

Pin oak is a tree species that grows well in saturated soils. It can grow to 90' tall under proper conditions. The acorns can be a good food source for migrating waterfowl and local wood ducks. This tree species is hardy and easily transplanted because of its fibrous root system. Although acorns can be used to establish trees, better success occurs from transplanting seedlings. Seedlings and larger containerized trees can be obtained from commercial suppliers. This species is an important component of bottomland hardwood forests.

PONDWEED - *Potamogeton spp.*

Pondweeds are an emergent perennial species of aquatic plant that grow well in calm or flowing water. The seeds are consumed by waterfowl, eaten throughout the late summer and early fall. The seeds, plant or tubers can be established from early April to mid-October. Plant in shallow water up to 18" deep. Use apprx 1200 plants per acre or 40 lbs of seed, which can be obtained commercially or from existing wetlands.

RIVER BULRUSH - *Scirpus fluviatilis*

This is another species of sedge utilized as an important waterfowl food. It is an emergent wetland plant that grows in shallow waters up to 18" deep. The seeds are readily consumed by waterfowl. Seeds and roots can be obtained commercially, or harvested from existing plants. Plant the roots in early spring, but seeds should be planted in the late fall. Plant in shallow water up to 12" in depth, either 1200 roots per acre or 4lbs of seed.

SMART WEED - *Polygonum spp.*

This wetland annual grows well on mudflats or in shallow water. The seeds and plants are consumed by waterfowl. Either the seeds or plants can be used to establish this species. Plant the seeds during late fall in moist soil or shallow water during late fall, and the plants in early spring. Use apprx 40 lbs of seed or 1200 plants per acre, obtained from a commercial supplier or existing wetland.

SWAMP WHITE OAK - *Quercus bicolor*

The swamp white oak is commonly found on saturated soils around rivers and wetlands. The acorns provide a good food source to migrating waterfowl and local wood ducks. This tree establishes quite well and is easy to transplant. Although it will grow from acorns it is easier to establish from seedlings. Seedlings and larger containerized trees can be obtained from commercial suppliers. This species is an important component of bottomland hardwood forests.

WILD CELERY - *Vallisneria Americana*

Wild celery is a common submergent wetland plant of the eastern US. It grows in shallow waters 1' to 5' in depth. The leaves, roots and seeds are all consumed by waterfowl throughout the year, and are especially important to migrating canvasbacks. Seeds can be planted in early spring by mixing with heavy clay mud and depositing in apprx 3' of water. Winter buds can be obtained in the fall, but should be planted in the early spring. The buds would have to be stored at 10oC until spring. Use apprx 1000 buds or 5 lbs of seed per acre. The buds and seeds should be commercially available.

WILD RICE - *Zizania aquatica*

Wild rice is an annual grass that grows in shallow, gently flowing water. The seeds, along with their young shoots, are highly prized and consumed by waterfowl. This plant is somewhat difficult to establish and requires specific conditions to grow. Plant seeds in soft, sticky mud in shallow (6" to 18"), slow flowing water. Water level fluctuations should be minimal. Approx. 10 lbs of seed per acre should suffice. Wild rice seed is readily available from commercial suppliers.

APPENDICES

IMPORTANT UPLAND GRASSES FOR WATERFOWL

BIG BLUESTEM - *Andropogan gerardii*

Big bluestem is a 3 to 6 foot tall perennial warm season grass. It grows best on well-drained upland sites of loamy-sand to sandy soils. It will however grow on wet soils of wetland margins. This is a tall grass species which provides excellent wildlife cover and works well in wetland buffer zones. This species is readily available from commercial suppliers. Depending on site conditions, plant 5 to 8 lbs of seed per acre.

INDIAN GRASS - *Sorghastrum nutans*

Indian grass is a perennial warm season grass growing 3 to 5 feet in height. It grows in similar conditions as big bluestem and works well as a companion grass in wet areas with that species, especially in buffer zones. It provides excellent food and cover for wildlife. This species is readily available from commercial suppliers. Depending on site conditions, plant 5 to 8 lbs of seed per acre.

LITTLE BLUESTEM - *Schizachyrium scoparium*

Little bluestem is a perennial warm-season grass which grows 2 to 3 feet in height. It does quite well in dry conditions on most soil types but tends to dominate stands on moist sites. It is an excellent forage grass consumed by cattle and wildlife while providing excellent wildlife cover. This species is readily available from commercial suppliers. Depending on site conditions, plant 4 to 8 lbs of seed per acre.

SWITCHGRASS - *Panicum virgatum*

Switchgrass is one of the tallest native prairie grasses, growing from 4 to 8 feet in height. It is a warm-season perennial adapted to a wide range of soil conditions. Switch grass can be planted in saturated soils and has a high value as a forage food. It is quite sturdy and provides excellent winter cover for wildlife. Seed is readily available from commercial suppliers. Generally, 4 to 10 lbs of seed per acre should be planted depending on site and individual requirements.

APPENDICES

GLOSSARY OF TERMS

Buffer zones: areas of permanent vegetation adjacent to a wetland that help prevent sediments and contaminants from entering wetlands and waterways

Degraded wetlands: areas where humans have altered the hydrology of a wetland to convert it for another type of land use

Dike: low-level embankments used to maintain shallow water depths of a restored wetland

Ditch plug: soil or other materials placed in a drainage ditch to disrupt existing drainage patterns and restore wetland conditions

Ditching: process of digging ditches in a wetland area to allow for drainage

Drawdown: drainage of a wetland that corresponds to regional growing season lengths

Green-tree reservoirs: flooded forested areas dominated by mast producing trees

Hemi-marsh: diverse stands of emergent vegetation intermixed with equal areas of open water

Hydric soils: soils characterized by high moisture content

Hydrology: properties, distribution and movement of water on or below the earth's surface

Invasive species: a non-native species (plant or animal) that disrupts a natural area

Loam soil: soil containing clay, silt and sand

Nesting islands: small, constructed patches of land within a wetland that provide nesting, feeding and loafing areas for wildlife

Pothole wetland: shallow depressions in the landscape that undergo an annual wet/dry cycle

Saturated conditions: full of water or flooded

Seasonal wetlands: wetland areas that experience drought at some point in time during the year, usually during late summer or early fall

Stream channelization: the straightening of a stream to allow for increased drainage

Tile break: the destruction or removal of a drainage tile to restore wetland hydrology

Tiling: underground placement of clay or plastic tiles that sufficiently drain land for conversion to farmland

Topography: description of a landscape's features and elevation

Wetland: periodically flooded areas characterized by plants that require saturated soils for growth and reproduction

WETLAND HABITAT MANAGEMENT:

-A Guide for Landowners-

DUCKS UNLIMITED

GREAT LAKES/ATLANTIC REGIONAL OFFICE
1220 EISENHOWER PLACE | ANN ARBOR, MI 48108
PHONE: 734.623.2000 | FAX: 734.623.2035 | http://www.ducks.org